Technical Memorandum Task 3.1: Identification of Water Quality Areas of Concern North Santa Monica Bay Watersheds Regional Watershed Implementation Plan and Malibu Creek Bacterial TMDL

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1.0 Introduction

This technical memorandum provides an overview of existing water quality conditions, characterization of potential point and non-point pollution sources, and prioritization of area of concern in the North Santa Monica Bay Watersheds (NSMBW). These tasks required review of existing water quality reports, Total Maximum Daily Loads (TMDLs), recent monitoring data, and newly developing methodologies for prioritizing water quality areas of concern. This technical memorandum will be used to develop pollutant specific and spatially targeted best management practices (BMPs) for the Regional Watershed Implementation Plan (RWIP) and the Malibu Creek Bacteria TMDL Implementation Plan.

Sections 1 and 2 of this technical memorandum provide an introduction to the NSMBW, critical regulatory issues, and current water quality monitoring. Sections 3 and 4 of this report review existing water quality conditions and potential sources for all pollutants or conditions of concern. Section 5 introduces the method used for prioritizing water quality areas of concern and presents the results of the prioritization for 35 NSMBW subwatersheds for multiple pollutants of concern as well as a subset prioritization of subwatersheds only for the Malibu Creek Bacteria TMDL. Section 6 provides a discussion of data gaps that were discovered during this review of water quality conditions.

1.1 North Santa Monica Bay Watersheds

The NSMBW area is approximately 200 square mile (mi^2) and includes Malibu Creek, Topanga Creek, and other coastal watersheds in the Santa Monica Mountains.

The Topanga Creek and other coastal watersheds comprise most of the NSMBW coastline, and are primarily undeveloped except along the coastal boundary, where there are residential and commercial land uses within the City of Malibu. Many of these developments are unsewered and the impacts of on-site wastewater treatment systems

(OWTS) from both single family residences and commercial facilities have been investigated by many stakeholders. Urban development in close proximity to the coast is a significant factor in high bacteria counts at NSMBW beaches.

The Malibu Creek watershed extends further inland than the Topanga Creek watershed and other coastal watersheds. Many of the headwaters of the Malibu Creek watershed are drained by municipal stormwater systems (MS4s) in the cities of Thousand Oaks, Agoura Hills, Calabasas, and Westlake Village. Runoff from these cities is discharged into upper Malibu Creek, other tributaries, and four inland lakes. In the middle of the watershed, streams route urban runoff through the Santa Monica Mountains, which is comprised primarily of state park land and other open space. These tributaries ultimately combine with lower Malibu Creek upstream of the Tapia Water Reclamation Facility (WRF). The Tapia WRF treats wastewater from the Las Virgenes Municipal Water District (LVMWD) service area, and its National Pollution Discharge Elimination System (NPDES) permit prohibits any effluent discharge during the summer months (April 15 through November 15). A large portion of the effluent is reused and the remainder is eliminated via irrigation of other open spaces in the watershed. The remaining low flow (without effluent) in lower Malibu Creek during the summer is contained in the Malibu Lagoon. Lower Malibu Creek also captures additional urban runoff from a commercial portion of the City of Malibu prior to reaching the lagoon. The lagoon is breached during high flow events in the wet season. This hydrologic scenario results in water quality conditions throughout the watershed that vary greatly spatially and seasonally.

1.2 Regulatory Background

In response to high priority 303d listed water quality impairments, the Santa Monica Bay Beaches Bacteria Total Maximum Daily Load (SMBBB TMDL) was developed and approved by the United States Environmental Protection Agency (EPA) in 2003. The Topanga Creek and other Santa Monica Mountain watersheds make up Jurisdiction 1 and 4 (J1/4) of this TMDL. Water quality impairments for several waterbodies within the Malibu Creek watershed triggered subsequent TMDLs to be developed for bacteria and nutrients. The EPA adopted TMDLs for bacteria and nutrients in 2003 to meet a schedule developed as part of a consent decree. A modified Bacteria TMDL was developed and adopted by the Los Angeles Regional Water Quality Control Board (LA RWQCB) in 2004 and is currently under review by the EPA. The LA RWQCB is also developing a modified TMDL for nutrients. This TMDL is not yet adopted and therefore this technical memorandum addresses the TMDL that was adopted by the EPA in 2003.

The Malibu Creek watershed bacteria and nutrient TMDLs will require an implementation plan that describes detailed measures that can be incorporated into existing water quality control programs, such as NPDES permitted stormwater programs of Los Angeles and

Ventura Counties, to achieve water quality objectives. The implementation plans must be submitted to the LA RWQCB for review.

The inland and beach bacteria TMDLs use different water quality objectives to set numeric targets based on the number of days of allowable exceedences of water quality objectives for full body contact (REC-1) beneficial use, as specified in the Los Angeles Regional Water Quality Control Plan (Basin Plan). This is because different indicator organisms are used to set water quality objectives for bacteria conditions in ocean versus freshwater (Table 1.1). Allowable exceedences were developed for wet-weather, winter dry, and summer dry weather conditions. The number of allowable exceedence days was determined by observing the number of exceedences from a reference watershed, the Arroyo Sequit, during the 1993 water year. This year was selected because it represents the 90th percentile year based on the number of wet days (with rainfall equal to or greater than 0.1 in,) when related to historical weather data. Based on this reference year, the SMBBB TMDL and the Malibu Creek Bacteria TMDL allow 17 exceedence days during wet weather, 3 exceedence days during winter dry weather, and zero exceedence days during summer dry weather.

Table 1.1
Bacteria Objectives for REC-1 Waterbodies in the NSMBW Area

	Parameter	30-Day Geometric Mean	Single Sample
Freshwater	Fecal	200	400
	E.coli	126	235
Marine Water	Total	1,000	10,000 or 1,000 if FC/TC > 0.1
	Fecal	200	400
	Enterococcus	35	104

2.0 Existing Water Quality Data

Water quality monitoring in the NSMBW is conducted by several municipalities and by volunteers through non-profit organizations. These agencies analyze for bacteria indicators to assess compliance with ocean and freshwater water quality objectives and, more specifically for TMDL compliance once compliance dates become effective. Nutrients are also monitored at inland sites due to the 303d listing and impending TMDL. Other constituents are also monitored as well to determine general water quality conditions or evaluate conditions related to other existing impairments.

2.1 Overview of Water Quality Monitoring Programs

The water quality monitoring programs referred to in developing this technical memorandum are described below.

Los Angeles County Department of Public Works Mass Emission and Other Monitoring
Mass emission monitoring has been conducted by the Los Angeles County Department of Public Works (LACoDPW) as part of its NPDES monitoring requirements since 1994. One mass emission monitoring location is within the Malibu Creek WMA and is located on Malibu Creek downstream of the confluence with Cold Creek.

LACoDPW has monitored 39 storm drain sites since February 2004 at or near their point of discharge to beaches in North Santa Monica Bay. These storm drains have been monitored for bacteria, nutrients, and other analytes.

During 2005, the LACoDPW contracted with Weston Solutions to monitor wet and dry weather water quality in seven Malibu Creek tributaries that capture urban stormwater runoff from inland Municipal Separate Storm Sewer System (MS4) outfalls in the Malibu Creek Watershed. Thus far, three storm events and three dry weather days were sampled during the wet season and nine dry weather days were sampled during the dry season. The samples were analyzed for metals, bacteria, nutrients, sediment, organics, oil and grease, and field measured parameters. Stream flow at the time of water quality sampling was estimated by applying the Manning's equation and field surveys of channel characteristics. During dry weather sampling, a portable flow velocity meter was used to estimate flow by measuring depth and velocity at multiple points along the channel cross section.

Ventura County Stormwater Quality Management Program
The Ventura County Stormwater Quality Management Program (VCSQMP) was developed to comply with stormwater NPDES requirements. NPDES requirements include monitoring of water quality in receiving waterbodies. Three tributaries in the upper Malibu Creek watershed were used as monitoring locations for the VCSQMP between 1996 and 1998.

NSMBW J1/4 Wet-Weather Bacteria TMDL Implementation Plan
Two storm events were monitored to aid in the development of the Wet-Weather Bacteria TMDL Implementation Plan for J1/4. The sampling was performed at six sites that included Topanga Creek, Solstice Creek, Trancas Creek, Marie Canyon, and Sweetwater Creek

Coordinated Shoreline Monitoring Program
The Coordinated Shoreline Monitoring Program (CSMP) is a re-organization of historic water quality monitoring along the beaches in Santa Monica Bay as a result of the adoption of the Santa Monica Bay Beaches Bacteria (SMBBB) Wet and Dry Weather TMDLs. The program combines existing beach monitoring by the LA County Department of Health Services (DHS), City of Los Angeles Environmental Monitoring Division of the Bureau of Sanitation (EMD), and the County Sanitation Districts.

Historic monitoring by the Ocean Water Monitoring Program was managed by the Recreational Health Department of the DHS. This program was developed to protect swimmers from harmful water quality conditions at commonly utilized beaches. This program includes 10 beaches in North Santa Monica Bay that have recently been integrated into the CSMP. Additionally, the EMD was required to monitor water quality at beaches near its Hyperion treatment plant ocean outfall under a NPDES wastewater discharge permit. Following years of compliance with effluent standards, the monitoring requirements were shifted to the stormwater NPDES monitoring program, and now these locations are included in the CSMP. There are no monitoring locations in the NSMBW portion of the CSMP that are managed by the County Sanitation Districts.

Malibu Creek Watershed Monitoring Program
The Malibu Creek Watershed Monitoring Program (MCWMP) program was developed under a Prop 50 grant administered by the LA RWQCB to assess water quality conditions as they relate to beneficial uses within the Malibu Creek watershed. The City of Calabasas is acting as the program manager. Water quality samples were collected at 13 sites between February and June 2005 and the results were summarized in a "Malibu Creek Watershed Monitoring Program Baseline Report". The MCWMP will continue to collect samples at these 13 sites to characterize water quality conditions during all seasons.

Heal the Bay/Stream Team
Heal the Bay is a non-profit organization committed to protection of water quality throughout California. They have been active in monitoring water quality in the Santa Monica Bay and its contributing watersheds through a volunteer group called the "Stream Team". The Stream Team has collected samples since 1998 from 17 locations in the Malibu Creek watershed and 3 locations in the J1/4 subwatersheds.

Las Virgenes MWD NPDES Monitoring
The Tapia WRP discharges to Malibu Creek above the confluence with the Las Virgenes River. The Las Virgenes MWD NPDES permit requires water quality monitoring at 7 sites along Malibu Creek upstream and downstream of the discharge. The monitoring program has included samples for fecal coliform since 1997. This monitoring program has been reduced to include only one site above the plant, and two sites below.

Surface Water Ambient Monitoring Program (SWAMP)
SWAMP is a statewide water quality monitoring program that is coordinated by the State Water Resources Control Board (SWRCB) through the RWQCBs. In the NSMBW area, samples were collected in March of 2003 and March of 2004 from 43 sites and analyzed for a bacteria, nutrients, metals, and inorganic contaminants. These two series of grab samples account for the only inland water quality monitoring in most of the J1/4 watersheds.

Southern ***California Coastal Water Research Project (SCCWRP)***
SCCWRP is a joint powers commission that conducts environmental monitoring throughout southern California. In the NSMBW area, SCCWRP has monitored bacteria, nutrients,

metals, and algae as part of a study investigating water quality from primarily natural watersheds. Dry weather samples were collected from Cold Creek, Cheseboro Creek, and the Arroyo Sequit during the spring of 2005. Wet weather samples were collected twice from the Arroyo Sequit and once from Cheseboro Creek between December 2004 and January 2005.

2.2 Water Quality Monitoring Locations

Water quality data has been collected and recorded in the NSMBW area since early bacteria sampling at several beaches by the LA County DHS Ocean Water Monitoring Program and the Heal-the-Bay Beach Report Card program. NPDES regulated dischargers and non-profit groups began to monitor inland sites, primarily within the Malibu Creek watershed, during the mid-1990s. Lake monitoring programs also arose in response to homeowners concerns in the villages of Lake Sherwood and Westlake. Recent water quality monitoring programs, beginning in the wet season 2004-2005, have dramatically increased monitoring locations for inland waterbodies within the Malibu Creek watershed (Figure 2-1).

An inventory of all the sampling locations from the multitude of monitoring programs is presented in Table 2.1. The inventory documents the station name, period of record, lead agency, and the subwatershed.

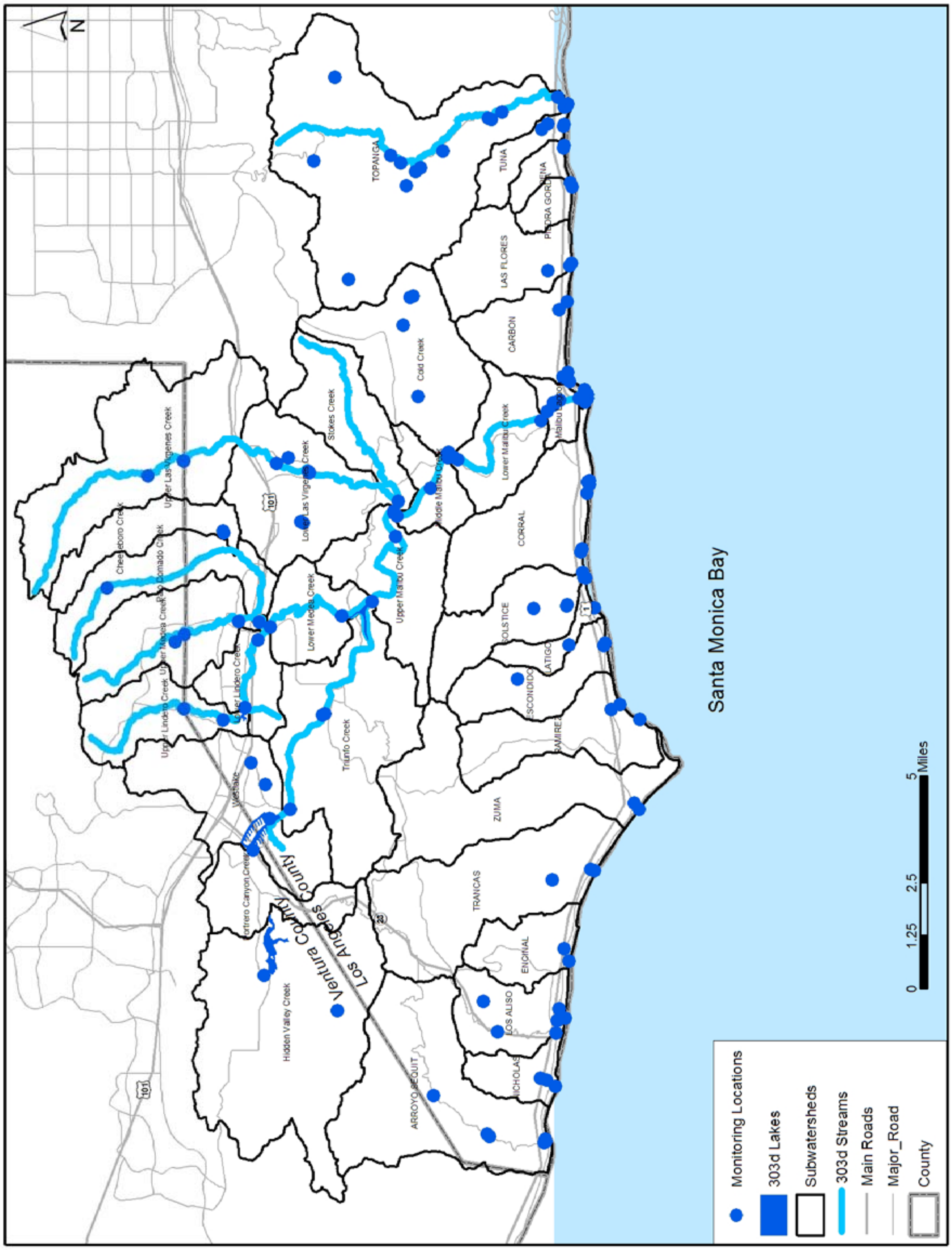

Figure 2.1
Water Quality Monitoring Locations in the NSMBW Area

Table 2.1
Water Quality Monitoring Locations

Site	Description	Agency/Program	Data Collected		Subwatershed
SMB-1-10	Solstice Creek at Dan Blocker County Beach	City of LA Environmental Monitoring	11/1/2004	10/25/2005	Corral
SMB-1-12	Marie Canyon storm drain at Puerco Beach	City of LA Environmental Monitoring	11/1/2004	10/29/2005	Corral
SMB-1-3	El Matador State Beach	City of LA Environmental Monitoring	11/1/2004	10/25/2005	Encinal
SMB-1-8	Escondido Creek, just east of Escondido State Beach	City of LA Environmental Monitoring	11/1/2004	10/29/2005	Escondido
SMB-1-14	Las Flores Creek at Las Flores State Beach	City of LA Environmental Monitoring	11/1/2004	10/25/2005	Las Flores
SMB-1-2	El Pescador State Beach	City of LA Environmental Monitoring	11/1/2004	10/25/2005	Los Aliso
SMB-1-17	Tuna Canyon	City of LA Environmental Monitoring	11/3/2004	9/27/2005	Tuna
SMB-1-16	Pena Creek at Las Tunas County	City of LA Environmental Monitoring	11/1/2004	10/25/2005	Pena
SMB-1-18	Topanga Canyon at Topanga State Beach (S2)	City of LA Environmental Monitoring	11/1/2004	10/29/2005	Topanga
SMB-1-6	"Walnut Creek" in Paradise Cove	City of LA Environmental Monitoring	11/1/2004	10/25/2005	Ramirez
SMB-1-13	Sweetwater Canyon on Carbon Beach	City of LA Environmental Monitoring	11/1/2004	10/25/2005	Carbon
SMB-MC-2	Breach point of Malibu Lagoon (S1)	City of LA Environmental Monitoring	11/1/2004	10/29/2005	Malibu Lagoon
HtB-6	Cheseboro Creek	Heat the Bay - Stream Team	11/7/1998	10/5/2003	Cheseboro Creek
HtB-2	Cold Creek	Heat the Bay - Stream Team	11/7/1998	10/16/2005	Cold Creek
HtB-3	Cold Creek	Heat the Bay - Stream Team	11/7/1998	10/16/2005	Cold Creek
HtB-11	Cold Creek Middle	Heat the Bay - Stream Team	4/7/2002	10/5/2003	Cold Creek
HtB-10	West Carlysle Creek	Heat the Bay - Stream Team	5/5/2001	10/5/2003	Hidden Valley Creek
HtB-13	Las Virgenes Creek Middle	Heat the Bay - Stream Team	4/7/2002	10/16/2005	Lower Las Virgenes
HtB-15	Tapia R-13 Stream Gauge	Heat the Bay - Stream Team	11/10/1998	10/6/2004	Lower Malibu Creek
HtB-7	Agoura Hills	Heat the Bay - Stream Team	11/7/1998	10/16/2005	Lower Medea Creek

Table 2.1 (Continued)
Water Quality Monitoring Locations

Site	Description	Agency/Program	Data Collected		Subwatershed
HtB-1	Malibu Creek	Heat the Bay - Stream Team	11/7/1998	10/16/2005	Malibu Lagoon
HtB-20	Tapia R-11 Malibu Lagoon	Heat the Bay - Stream Team	11/10/1998	10/6/2004	Malibu Lagoon
HtB-8	Palo Comado Creek	Heat the Bay - Stream Team	5/5/2001	9/12/2004	Palo Comado Creek
HtB-5	Las Virgenes Creek	Heat the Bay - Stream Team	11/7/1998	10/16/2005	Stokes Creek
HtB-16	Stokes Creek	Heat the Bay - Stream Team	4/8/2002	10/5/2003	Stokes Creek
HtB-17	Triunfo Creek	Heat the Bay - Stream Team	4/8/2002	10/16/2005	Triunfo Creek
HtB-9	Las Virgenes Creek	Heat the Bay - Stream Team	5/5/2001	10/5/2003	Upper Las Virgenes
HtB-4	Malibou Lake	Heat the Bay - Stream Team	11/7/1998	10/5/2003	Upper Malibu Creek
HtB-12	Rock Pool above Tapia	Heat the Bay - Stream Team	4/8/2002	10/16/2005	Upper Malibu Creek
HtB-19	Arroyo Sequit	Heat the Bay - Stream Team	4/8/2002	10/7/2003	Arroyo Sequit
HtB-18	Lachusa Creek	Heat the Bay - Stream Team	4/8/2002	10/16/2005	Los Aliso
HtB-14	Solstice Creek	Heat the Bay - Stream Team	4/8/2002	10/16/2005	Solstice
SMB-1-1	Arroyo Sequit Creek at Leo Carrillo State Beach (DHS010)	LA County DHS	11/1/2004	9/26/2005	Arroyo Sequit
SMB-MC-3	Malibu Pier on Carbon Beach (DH002)	LA County DHS	11/1/2004	9/26/2005	Carbon
SMB-1-11	Un-named creek at Puerco Beach (DHS004)	LA County DHS	11/1/2004	9/26/2005	Corral
SMB-MC-1	Malibu Point on Malibu State Beach (DHS003)	LA County DHS	11/1/2004	9/30/2005	Corral
SMB-4-1	Nicholas Canyon Creek at (DHS009)	LA County DHS	11/1/2004	9/26/2005	Nicholas
SMB-1-15	Big Rock Beach (DHS001)	LA County DHS	11/1/2004	9/28/2005	Piedra Gorda
SMB-1-4	Trancas Creek at Broad Beach (DHS008)	LA County DHS	11/1/2004	9/26/2005	Trancas
SMB-1-5	Zuma Creek at Zuma Beach	LA County DHS	11/1/2004	9/26/2005	Zuma
SMB-1-7	Ramirez Canyon at Paradise Cove Pier (DHS006)	LA County DHS	11/1/2004	9/26/2005	Ramirez

Table 2.1 (Continued)
Water Quality Monitoring Locations

Site	Description	Agency/Program	Data Collected		Subwatershed
SMB-1-9	Latigo Canyon, adjacent the Tivoli Bay Villa Treatment Plant (DHS00	LA County DHS	11/1/2004	9/26/2005	Latigo
MS4_1	Las Virgenes Creek	LA County Public Works	1/20/2005	8/1/2005	Lower Las Virgenes Creek
MS4_2	Liberty Canyon Channel	LA County Public Works	1/20/2005	8/1/2005	Lower Las Virgenes Creek
MS4_5	Lindero Canyon Channel	LA County Public Works	1/20/2005	8/1/2005	Lower Lindero Creek
S02	Mass Emission Site	LA County Public Works	10/28/2000	1/13/2004	Lower Malibu Creek
MS4_3	Cheseboro Creek	LA County Public Works	1/20/2005	8/1/2005	Upper Medea Creek
MS4_4	Medea Creek	LA County Public Works	1/20/2005	8/1/2005	Upper Medea Creek
MS4_6	Triunfo Channel	LA County Public Works	1/20/2005	8/1/2005	Westlake
MS4_7	Westlake	LA County Public Works	1/20/2005	8/1/2005	Westlake
Sweet	Sweetwater Creek	LA County Public Works	10/17/2004	10/17/2004	Carbon
MCC	Marie Canyon Channel	LA County Public Works	10/17/2004	10/17/2004	Corral
TC-PCH	Topanga Creek at PCH	LA County Public Works	8/28/2004	10/17/2004	Topanga
TC-2409	Topanga Creek #2409 Elect Poll	LA County Public Works	8/28/2004	10/17/2004	Topanga
Tran	Trancas Creek	LA County Public Works	10/17/2004	10/17/2004	Trancas
SCC	Solstice Canyon Creek	LA County Public Works	10/17/2004	10/17/2004	Solstice
R-7	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Lower Las Virgenes Creek
R-13	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Lower Malibu Creek
R-3	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Malibu Lagoon
R-4	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Malibu Lagoon
R-1	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Middle Malibu Creek
R-2	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Middle Malibu Creek
R-9	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Middle Malibu Creek
R-11	Malibu Creek	Las Virgenes MWD	1/5/2000	12/14/2005	Malibu Lagoon

Table 2.1 (Continued)
Water Quality Monitoring Locations

Site	Description	Agency/Program	Data Collected		Subwatershed
CC	Cold Creek	MCW Monitoring Program	3/3/2005	5/3/2005	Cold Creek
HV	Hidden Valley Creek	MCW Monitoring Program	3/3/2005	4/21/2005	Hidden Valley Creek
LC	Liberty Canyon	MCW Monitoring Program	3/3/2005	5/3/2005	Lower Las Virgenes
LV2	Las Virgenes Creek 2	MCW Monitoring Program	2/24/2005	5/3/2005	Lower Las Virgenes
Lin2	Lindero Creek 2	MCW Monitoring Program	2/24/2005	4/21/2005	Lower Lindero Creek
Mal	Malibu Creek	MCW Monitoring Program	3/3/2005	5/3/2005	Lower Malibu Creek
Tri	Triunfo Creek	MCW Monitoring Program	3/3/2005	4/21/2005	Triunfo Creek
LV1	Las Virgenes Creek 1	MCW Monitoring Program	2/24/2005	5/3/2005	Upper Las Virgenes
Lin1	Lindero Creek 1	MCW Monitoring Program	2/24/2005	4/21/2005	Upper Lindero Creek
Med1	Medea Creek 1	MCW Monitoring Program	3/3/2005	4/21/2005	Upper Medea Creek
Rus	Russell Creek	MCW Monitoring Program	3/3/2005	4/21/2005	Westlake
TC1	Paradise Lane	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC2	Cheney Bridge	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC3	Backbone Trail	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC4	Behind Topanga Market	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC5	Falls Drive	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC6	Topanga Canyon Blvd Bridge	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC7	Fernwood Dix Creek	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC8	Old Topanga Road	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC9	Greenleaf Road	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
TC10	Highvale Road	RCD of Santa Monica Mountains	10/14/2003	10/19/2004	Topanga
LV-1	Las Virgenes Creek at County Line -	Ventura County Watershed Protection	10/29/1996	5/5/1998	Upper Las Virgenes
LC-1	Lindero Creek at County Line	Ventura County Watershed Protection	9/10/1996	8/4/1998	Upper Lindero Creek
MC-1	Medea Creek at County Line	Ventura County Watershed Protection	9/10/1996	8/4/1998	Upper Medea Creek

Table 2.1 (Continued)
Water Quality Monitoring Locations

Site	Description	Agency/Program	Data Collected		Subwatershed
404SMB000	Arroyo Sequit at Fork	SWAMP	Mar-03	Mar-04	Arroyo Sequit
404SMB001	Arroyo Sequit Upper	SWAMP	Mar-03	Mar-04	Arroyo Sequit
404SMB002	Arroyo Sequit Lower	SWAMP	Mar-03	Mar-04	Arroyo Sequit
404SMB003	San Nicholas Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Nicholas
404SMB004	San Nicholas Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Nicholas
404SMB005	Los Aliso Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Los Aliso
404SMB006	Los Aliso Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Los Aliso
404SMB007	Lachusa Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Los Aliso
404SMB008	Lachusa Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Los Aliso
404SMB010	Encinal Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Encinal
404SMB011	Trancas Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Trancas
404SMB012	Trancas Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Trancas
404SMB014	Dume Creek/Zuma Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Zuma
404SMB016	Ramirez Canyon Lower	SWAMP	Mar-03	Mar-04	Ramirez
404SMB017	Escondido Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Escondido
404SMB018	Escondido Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Escondido
404SMB020	Latigo Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Latigo
404SMB021	Solstice Canyon Creek Middle	SWAMP	Mar-03	Mar-04	Solstice
404SMB022	Solstice Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Solstice
404SMB024	Corral Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Corral
404SMB026	Puerco Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Corral
404SMB028	Marie Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Corral
404SMB029	Malibu Lagoon	SWAMP	Mar-03	Mar-04	Corral
404SMB031	Sweetwater Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Carbon

Table 2.1 (Continued)
Water Quality Monitoring Locations

Site	Description	Agency/Program	Data Collected		Subwatershed
404SMB032	Carbon Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Carbon
404SMB033	Carbon Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Carbon
404SMB034	Las Flores Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Las Flores
404SMB035	Las Flores Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Las Flores
404SMB037	Piedra Gorda Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Piedra Gorda
404SMB038	Pena Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Malibu Lagoon
404SMB039	Pena Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Pena
404SMB040	Tuna Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Tuna
404SMB041	Tuna Canyon Creek Lower	SWAMP	Mar-03	Mar-04	Tuna
404SMB042	Topanga Canyon Creek Upper	SWAMP	Mar-03	Mar-04	Topanga
404SMB043	Topanga Canyon Creek Middle	SWAMP	Mar-03	Mar-04	Topanga
404SMB044	Topanga Lagoon	SWAMP	Mar-03	Mar-04	Topanga
404SMB061	Malibu Creek	SWAMP	Mar-03	Mar-04	Malibu Lagoon
404SMB062	Cold Creek	SWAMP	Mar-03	Mar-04	Cold Creek
404SMB063	Las Virgenes Canyon Creek	SWAMP	Mar-03	Mar-04	Stokes Creek
404SMB065	Triunfo Creek	SWAMP	Mar-03	Mar-04	Triunfo Creek
404SMB075	Topanga Canyon Creek at Greenleaf	SWAMP	Mar-03	Mar-04	Topanga
404SMB21A	Solstice Canyon Creek Upper at waterfall	SWAMP	Mar-03	Mar-04	Solstice
404SMB41A	Tuna Canyon Creek Eucalyptus Tree Stand	SWAMP	Mar-03	Mar-04	Tuna
Cheseboro Creek	Above Lost Hills landfill	SCCWRP	1/7/05	5/18/05	Cheseboro Creek
Cold Creek	Cold Creek Canyon Preserve	SCCWRP	6/9/2005	6/9/2005	Cold Creek
Arroyo Sequit	Arroyo Sequit at PCH	SCCWRP	12/28/04	1/7/05	Arroyo Sequit

3.0 Regional Water Quality Conditions of Concern

Several pollutants have been measured at levels that would impair the attainability of beneficial uses in waterbodies of the NSMBW area, based on Basin Plan objectives. These conditions are documented for each constituent and waterbody in the Clean Water Act 303d list (**Table 3.1**). **Figure 3.1** shows impaired waterbodies, which includes the ocean, beaches, inland streams, and lakes.

Table 3.1
Water Quality Impairments on the 303d list in the NSMBW Area

NSMB Waterbodies	Coliform	Nutrients	Trash	Scum/Foam	Sediment	Fish Barriers	Algae	Enrichment / Low DO	Selenium	Mercury	Lead	Odors	Chloride	Specific Conductivity	Ammonia	Eutrophic	DDT	Beach Closures	Sediment Toxicity	PCBs	Fish Consumption	Debris	PAHs (Sediment)
Malibu Creek	X	X	X	X	X	X																	
Stokes Creek	X																						
Lindero Creek Reach 1	X		X	X			X		X														
Lindero Creek Reach 2	X		X	X			X		X														
Palo Comado Creek	X																						
Medea Creek Reach 1	X		X		X		X		X														
Medea Creek Reach 2	X		X		X		X		X														
Las Virgenes Creek	X	X	X	X	X			X	X														
Triunfo Creek Reach 1					X					X	X												
Triunfo Creek Reach 2					X					X	X												
Topanga Canyon Creek																							
Malibou Lake							X	X								X							
Westlake Lake							X	X			X				X	X							
Sherwood Lake							X	X		X					X	X							
Lake Lindero			X				X					X	X	X		X							
NSMB Beaches	X																X	X		X			
Santa Monica Bay Offshore/Nearshore	X																X		X	X	X	X	X

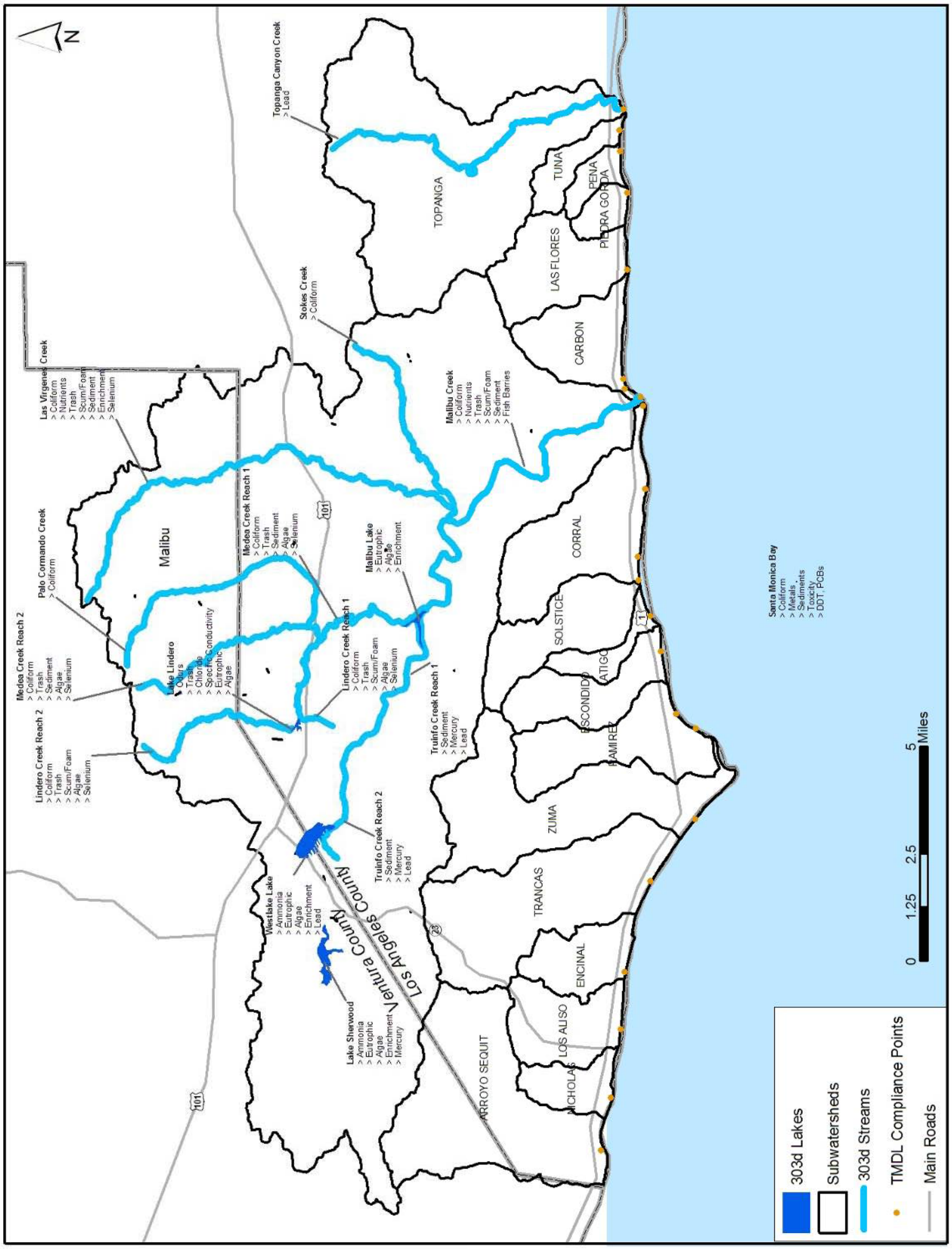

Figure 3.1
Water Quality Impairments on the 303d list in the NSMBW Area

The following section summarizes conditions of concern for various pollutants/stressors within the NSMBW area, except for bacteria in the Malibu Creek watershed. Water quality conditions and potential sources related to bacteria in the Malibu Creek watershed as well as additional analyses undertaken for the Malibu Creek Bacteria TMDL Implementation Plan are included in Section 4 of this memorandum, "Malibu Creek Bacteria TMDL Areas of Concern".

3.1 Bacteria

3.1.1 Existing Conditions

Additional bacteria data analysis

Bacteria conditions throughout the NSMBW area have been monitored by many groups. A different combination of bacterial indicators (Fecal coliform, E.coli) is used to establish and assess water quality in fresh water than are used for ocean water (Total Coliform, Fecal Coliform, Enterococcus). The water quality data that is described in Section 2 of this technical memorandum was analyzed to assess probability of exceedence of ocean water bacteria objectives along the coast and freshwater bacteria objectives for inland reaches within the J1/4 watersheds (see Table 1.1).

Following the collection and quality assurance checking of NSMBW bacteria data, a complete point layer of sampling locations was developed. MS Access was used to develop queries of the dataset to assess compliance by comparing actual data with the established REC-1 use water quality objectives. The maximum bacteria count from each calendar month was used to assess compliance, rather than evaluating every individual sample. This approach follows more closely the intent of the Basin Plan objective (10% of samples within a 30-day period). New fields in the point attribute table of the bacteria monitoring location GIS layer were created and results of the database queries were joined to this attribute table using a reference location identifier. The water quality monitoring locations were symbolized by two attributes, 1) percent of non-compliant calendar months and 2) number of non-compliant calendar months when sufficient data was present to determine compliance. These attributes are depicted as varying intervals of color and size of points, respectively.

Stratification of the data record at each bacteria station separated water quality during wet weather conditions. To extract wet weather samples from the long term bacteria database, rainfall data from the Monte Nido meteorological station was obtained. The historical rainfall record from this station was used to identify wet weather days at each of the bacteria monitoring stations; where daily rainfall exceeded 0.1 inches at the meteorological station. Queries were also developed to show frequencies of exceedences of water quality objectives for bacteria during dry weather conditions. Exceedences of objectives based on bacteria samples collected during dry weather days were compared between seasons. The rainy season was defined as November 1st through March 31st and the non-rainy season, April 1st though October 31st. No queries were developed to compare wet weather samples collected at different times of year, due to the limited number of samples.

The results of this analysis of bacteria data in the J1/4 watersheds are mapped to show existing impairments during summer dry (**Figure 3.2**), winter dry (**Figure 3.3**), and wet weather (**Figure 3.4**) flow conditions.

SMBBB J1/4 TMDL Implementation Plan Analysis
In work undertaken during the development of the SMBBB TMDL and the J1/4 Implementation Plan, available water quality conditions were reviewed and probabilities of exceedences of numeric targets assessed. Results of this evaluation for the NSMB beach monitoring locations are presented in **Table 3.2**.

Table 3.2
Probability of Exceeding Water Quality Objectives Near Coast in J1/4 Watersheds

Subwatershed	Summer Dry Weather	Winter Dry Weather	Wet Weather
Arroyo Sequit	1% (186)	6% (87)	27% (41)
Nicholas	2% (173)	4% (76)	26% (34)
Los Aliso	35% (23)	38% (8)	50% (2)
Encinal	0% (5)		
Trancas	1% (173)	5% (87)	31% (45)
Zuma	2% (173)	4% (85)	29% (42)
Ramirez	9% (178)	23% (82)	40% (40)
Escondido	56% (16)	80% (15)	100% (9)
Latigo	3% (173)	14% (84)	39% (41)
Solstice	19% (16)	0% (3)	0% (2)
Corral	11% (194)	25% (101)	62% (78)
Carbon	20% (5)		
Las Flores	0% (3)		
Piedra Gorda	17% (184)	24% (87)	43% (46)
Pena	0% (3)		
Tuna			
Topanga	3% (1215)	6% (659)	24% (274)

Note: Values in parenthesis represent the number of samples

One of the most significant conclusions of this water quality data evaluation is that bacteria conditions are greatly impacted by flow conditions. During wet weather, bacteria levels are high due to an increased volume of stormwater runoff reaching the beach. Another study reviewed recent coliform data at 20 southern California beach sites and showed that bacteria levels remained above water quality objectives between 3 to 5 days following rain events greater then 0.25 inches (Ackerman and Weisberg, 2003). Dry weather bacteria levels are significantly lower, and show less frequent probabilities of exceeding water quality standards. Nonetheless, dry weather exceedences were observed.

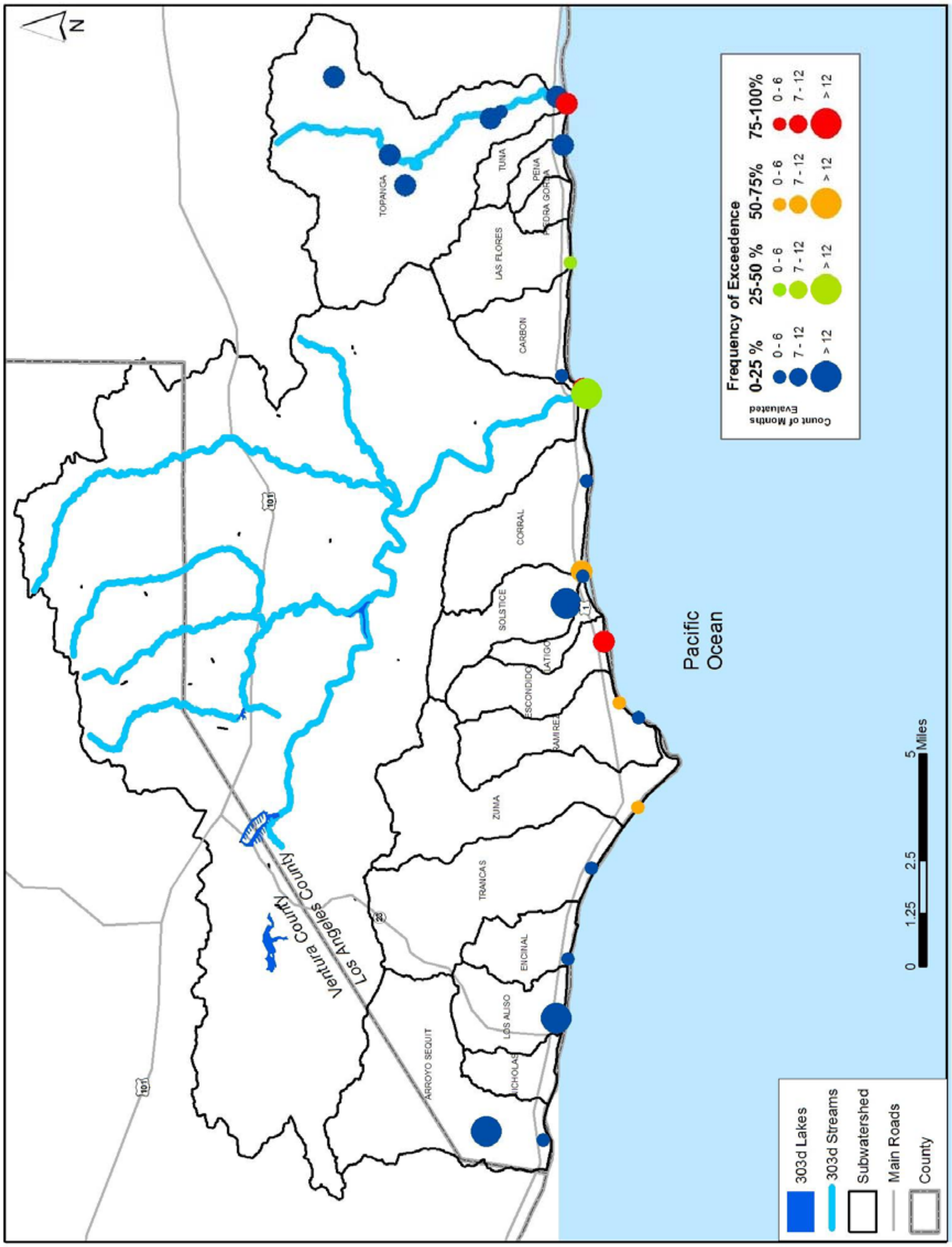

Figure 3.2
Frequency of Exceedences of Bacteria Water Quality Objectives in the J1/4 Watersheds during Dry Weather in the Summer

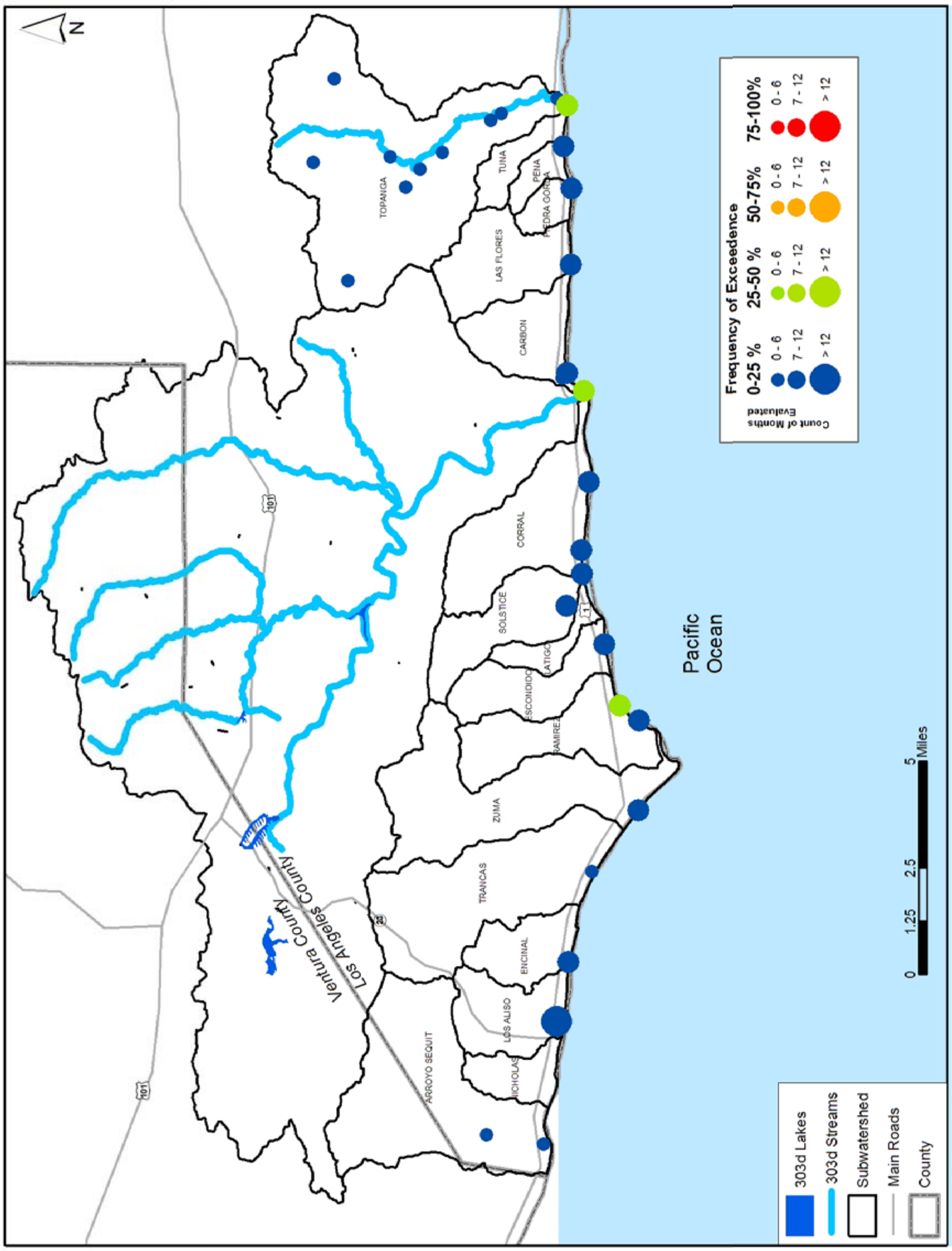

Figure 3.3
Frequency of Exceedences of Bacteria Water Quality Objectives in the J1/4 Watersheds during Dry Weather in the Winter

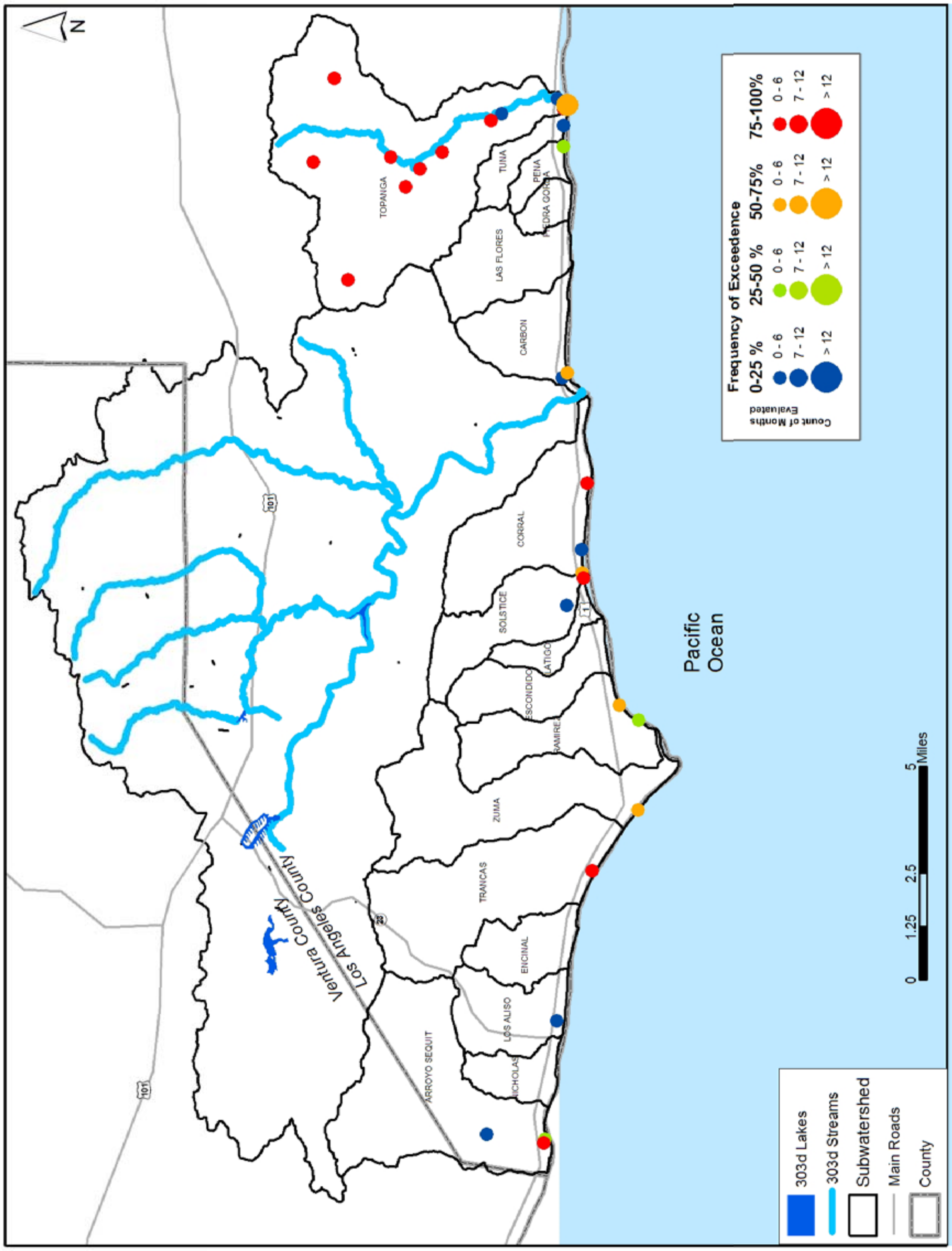

Figure 3.4
Frequency of Exceedences of Bacteria Water Quality Objectives in the J1/4 Watersheds during Wet Weather

3.1.2 Source Characterization

The J1/4 Implementation Plan investigated the relationship between bacteria conditions in 17 coastal watersheds and Southern California Area Government (SCAG) land use types. This effort revealed that the primary land use types responsible for generating bacteria at the beach were urban, and particularly commercial and residential areas in close proximity to the coast.

The J1/4 Implementation Plan and other studies have also evaluated specific sources of bacteria along NSMB beaches. Sources of bacteria in the J1/4 subwatersheds of the NSMBW area described below.

<u>Wildlife</u> – Several studies have shown that wildlife in the Topanga and Malibu Creek Lagoons are a significant source of bacteria (Warshall et al, 1992). Recent monitoring of water quality at undeveloped reference beaches in southern California, including 2 NSMB beaches, showed that during wet-weather, 20% of samples exceeded Basin Plan objectives (Schiff et al., 2005).

<u>Portable Toilets, Public Restrooms, and Refuse Facilities</u> – While the Arroyo Sequit watershed is primarily undeveloped and bacteria counts are generally low, counts along the coast near the watershed have been found that were higher than several other Santa Monica Mountain watersheds with substantially more urban development. The J1/4 bacteria TMDL Implementation Plan hypothesized that such facilities could be a potential source of bacteria, though the extent of this potential source could not be defensively quantified.

<u>Horse and Livestock</u> – The presence of horse ranches and other equestrian areas in some watersheds did correlate to high probabilities of bacteria standard exceedences; however this was not the case in all watersheds and therefore no general relationship could be established.

<u>Onsite Wastewater Treatment Systems</u> – Residential developments along the coast are primarily unsewered. The impact of aging, failing or bypassed Onsite Wastewater Treatment Systems (OWTS) or septic systems on bacteria conditions along the coast is difficult to discern. No statistically defensible correlation was identified in the J1/4 Implementation Plan or the TMDL; however it is known that many septic systems in these watersheds have been poorly designed or maintained (Septic System Management Task Force, 2001).

<u>Urban runoff</u> – The dry and wet weather SMBBB TMDLs both identified urban runoff as the principle source of bacteria along the coast. The J1/4 Implementation Plan found a moderate correlation between development and bacteria exceedences, especially when the development was in close proximity to the coast. Analysis of recent bacteria data also showed that proximity to urbanization is a strong predictor of exceedences of numeric

targets for bacteria. Build up of bacteria on impervious surfaces in residential and commercial areas is washed off during rain events or by irrigation overflow and car/driveway washing during dry weather. Sources of bacteria in urbanized areas include;

- Lawn and landscape fertilization
- Organic debris from gardens, landscaping, and parks
- Trash
- Domestic animal waste
- Human waste

High-use Recreational Areas - Bacteria loading impacts can result from activities associated with high recreational usage or where additional recreational facilities may be needed. For example, heavy use of beaches and open space areas where public restrooms are not readily available or wading in natural or constructed pools or in stream courses where no public restrooms are available may result in bacteria loading. Bacteria loading is possible from horse manure in high use equestrian areas such as staging areas, trail heads, parking areas, and on trails or from pet waste left on trails. Another additional potential source of bacteria is the use of the riparian area as a "camp" by homeless inhabitants.

3.2 Nutrients

3.2.1 Existing Conditions

Certain water quality impairments in the Malibu Creek WMA are related to elevated levels of nitrogen and phosphorous found in many of the inland watersheds. Particularly, inland lakes (Lake Sherwood, Westlake Lake, Lake Lindero, and Malibou Lake) and some streams (Malibu Creek, Malibu Lagoon, Las Virgenes Creek, Lower Medea Creek, Upper Medea Creek, and Lindero Creek) have 303d listed impairments for algae, eutrophic conditions, scum/odors, ammonia, organic enrichment, and low dissolved oxygen. These impairments stem from increased in-stream concentrations of nutrients and thus they are addressed by the EPA adopted Nutrient TMDL for the Malibu Creek watershed. The Topanga Creek and other Santa Monica Mountains watersheds do not have any significant impairment of water quality due to nutrients.

The water quality data that is described in Section 2 of this technical memorandum was analyzed to asses water quality conditions related to nutrients in the NSMBW area. This analysis validated the findings reported in the EPA Nutrient TMDL Staff Report (LA RWQCB is currently developing a nutrient TMDL for the Malibu Creek watershed that may supersede this TMDL). Mean concentrations were determined for all samples collected during winter and summer months. The results of this analysis were mapped to show relative nutrient concentrations during the summer (**Figure 3.5**) and winter (**Figure 3.6**) and report data from newly monitored waterbodies.

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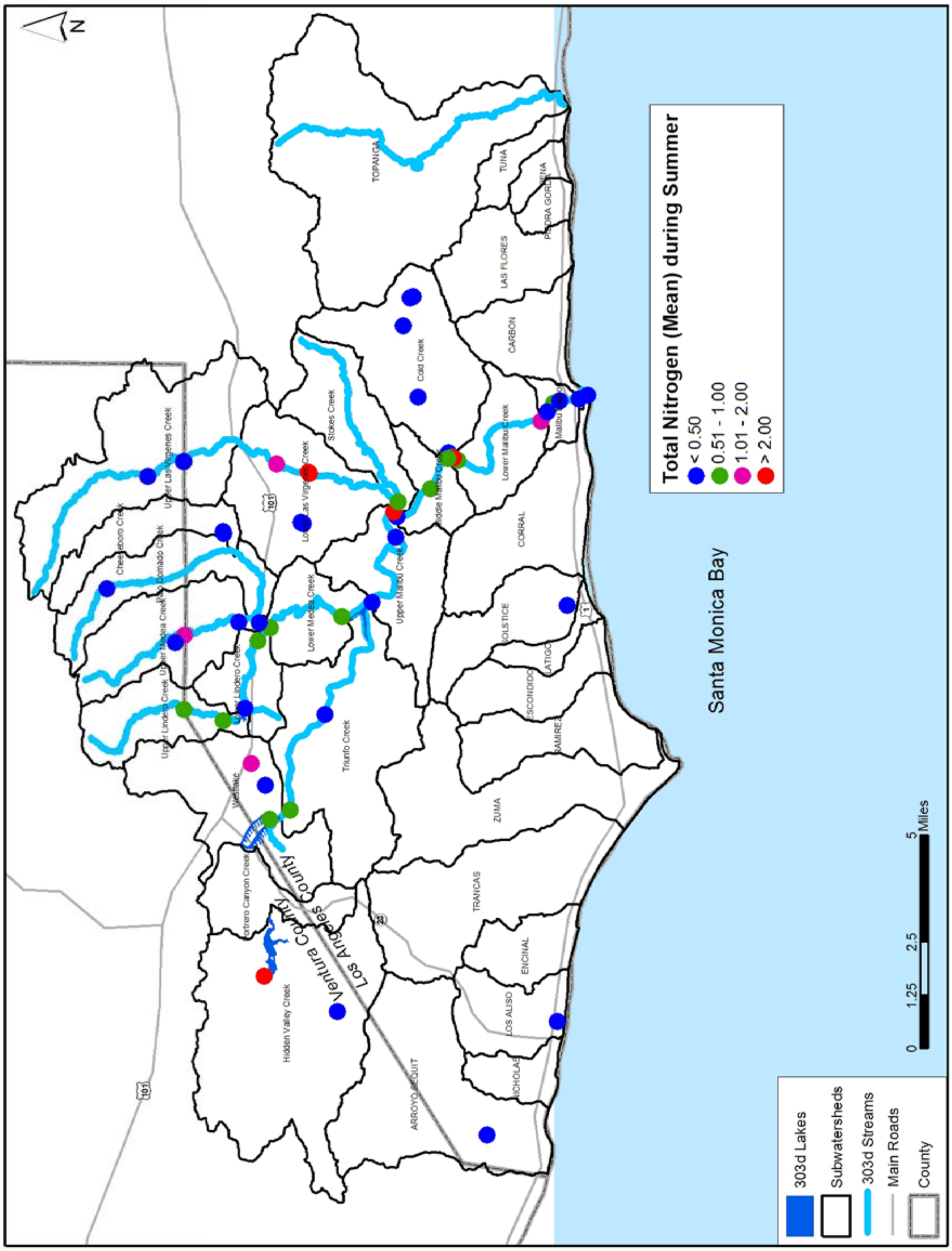

Figure 3.5
Maximum Nitrogen Concentration during the Summer (April 15 – November 15)

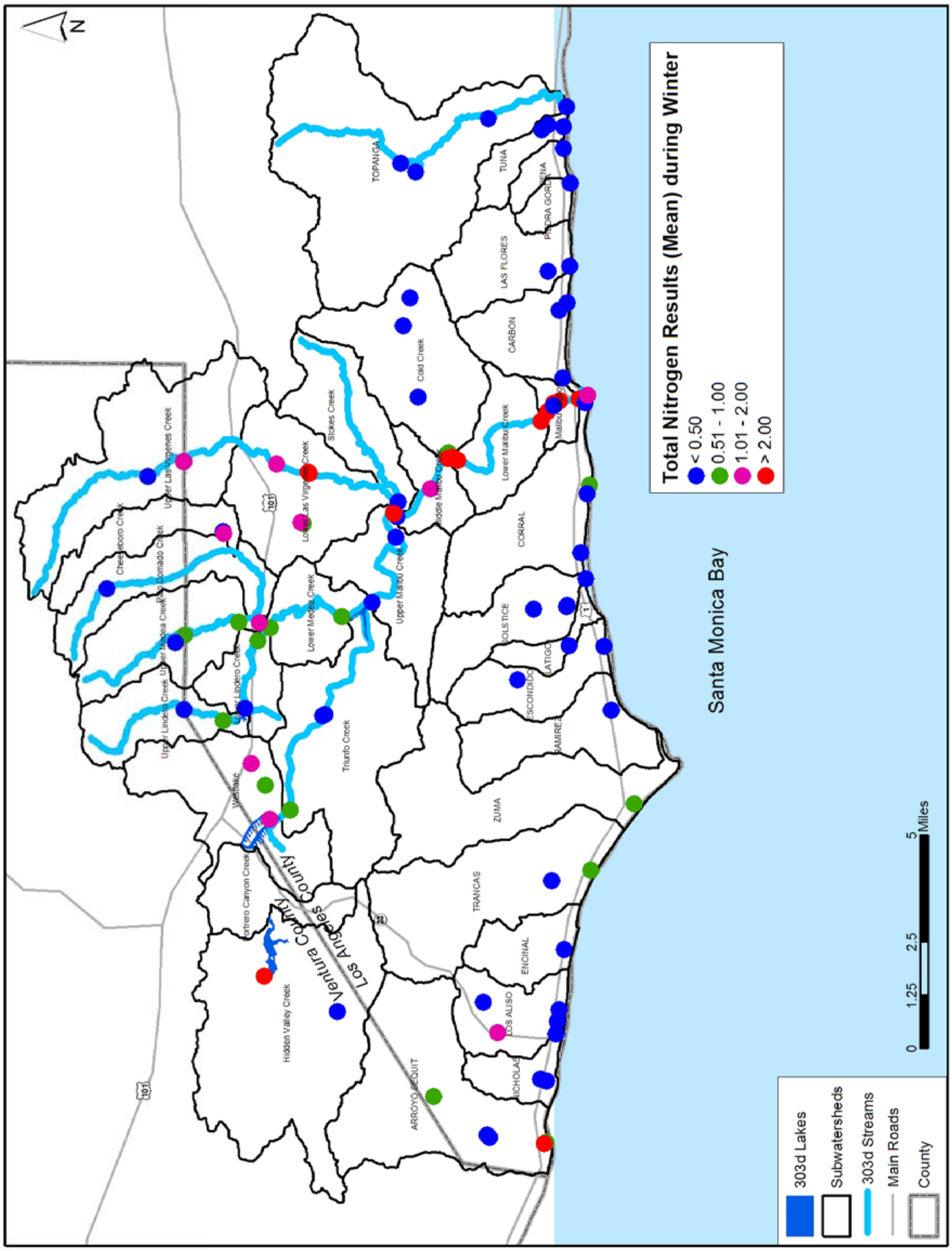

Figure 3.6
Maximum Nitrogen Concentration during the Winter (November 16 – April 14)

Total nitrogen concentration of all monitoring locations within each subwatershed is aggregated in **Table 3.3**. The data shown reflects nitrogen maximums in 17 subwatersheds in the Malibu Creek watershed during the summer and winter. There has been limited nutrient data recorded for the J1/4 watersheds. During March of 2003 and 2004, SWAMP collected data from many sites within the J1/4 watersheds. These results are included in Table 3.3 and are the reason that there are 17 winter nitrogen maximums and only three values during the summer in the J1/4 watersheds.

Table 3.3
Mean and Range of Summer and Winter Total Nitrogen Concentrations Recorded within NSMB Subwatersheds

Subwatershed	Summer Total Nitrogen (ppm)	Winter Total Nitrogen (ppm)
Arroyo Sequit	0.74 (0.01 - 4.64)	0.02 (0.01 - 0.08)
Carbon	0.21 (0.03 - 0.75)	No Data
Cheseboro Creek	0.08 (0.01 - 1.65)	0.01 (0.01 - 0.06)
Cold Creek	0.37 (0.01 - 2.51)	0.22 (0.01 - 1.69)
Corral	0.26 (0.02 - 1.08)	No Data
Encinal	0.05 (0.03 - 0.06)	No Data
Escondido	0.27 (0.04 - 0.6)	No Data
Hidden Valley Creek	2.32 (0.01 - 12)	1.05 (0.01 - 13.55)
Las Flores	0.04 (0.02 - 0.05)	No Data
Latigo	0.08 (0.02 - 0.11)	No Data
Los Aliso	0.3 (0.01 - 4.43)	0.03 (0.01 - 0.26)
Lower Las Virgenes Creek	1.57 (0.01 - 4.54)	1.35 (0.01 - 3.53)
Lower Lindero Creek	0.59 (0.01 - 1.78)	0.45 (0.02 - 1.36)
Lower Malibu Creek	4.97 (0.01 - 12)	0.91 (0.01 - 7.93)
Lower Medea Creek	0.86 (0.01 - 1.41)	0.72 (0.01 - 1.33)
Malibu Lagoon	3.23 (0.01 - 13.05)	0.42 (0.01 - 7.7)
Middle Malibu Creek	2.21 (0.01 - 12)	0.57 (0.01 - 8.4)
Nicholas	0.04 (0.04 - 0.05)	No Data
Palo Comado Creek	0.01 (0.01 - 0.05)	0.01 (0.01 - 0.01)
Pena	0.16 (0.01 - 0.3)	No Data
Piedra Gorda	0.01 (0.01 - 0.01)	No Data
Portrero Canyon Creek	No Data	No Data
Ramirez	0.36 (0.27 - 0.44)	No Data
Solstice	0.21 (0.01 - 1.58)	0.39 (0.01 - 2.7)
Stokes Creek	4.51 (0.17 - 9.1)	3.35 (0.17 - 6.4)
Topanga	0.21 (0.01 - 0.52)	No Data
Trancas	0.54 (0.03 - 2.43)	No Data
Triunfo Creek	0.38 (0.02 - 0.87)	0.18 (0.01 - 1.18)
Tuna	0.03 (0.01 - 0.04)	No Data
Upper Las Virgenes Creek	0.5 (0.01 - 2.71)	0.1 (0.01 - 1)
Upper Lindero Creek	0.5 (0.01 - 1.09)	0.78 (0.01 - 2.46)
Upper Malibu Creek	0.13 (0.01 - 1.4)	0.02 (0.01 - 0.31)
Upper Medea Creek	0.93 (0.01 - 3.82)	0.38 (0.01 - 3.92)
Westlake	1.17 (0.28 - 1.96)	0.68 (0.03 - 1.61)
Zuma	0.72 (0.34 - 1.24)	No Data

Note: Total Nitrogen as NO_3 + NO_2

Nutrient-related impairments were not well correlated to either nitrogen or phosphorous, based on several studies that attempted to identify the limiting factors for algal growth (Kamer et al, 2002; CH2MHILL, 2000; Ambrose et al, 2000). Consequently, EPA Region 9 developed a TMDL and set numeric targets based on the reference waterbody approach. Since nutrient impairments are amplified during the summertime when water temperatures rise, flushing of algal growth is reduced, and daytime length increases, the TMDL includes numeric targets for nitrate-nitrite nitrogen (1 mg/l) and total phosphorous (0.1 mg/l) during the summer and nitrate-nitrite nitrogen (8 mg/l) during the winter. Based on these targets, the final proposed nitrogen and phosphorous Nutrient TMDLs were developed by EPA and are presented in **Table 3.4**. These will be updated upon completion of the TMDL being developed the Regional Board.

Table 3.4
TMDLs for Total Nitrogen and Total Phosphorous

Season	Total Nitrogen	Total Phosphorous
Summer (April 15 – November 15)	27 lbs/day	2.7 lbs/day
Winter (November 16 – April 14)	8 mg/l (NO_2 + NO_3)	N/A

3.2.2 Source Characterization

The EPA adopted Nutrient TMDL and other Malibu Creek watershed studies have assessed specific sources of nutrients in the Malibu Creek WMA, which are in some cases different than those identified for bacteria. The final load allocations and waste load allocations from the linkage model show an estimated proportion of total nutrient transport from each of the sources that were identified. These sources, shown in **Table 3.5**, are further described below.

Table 3.5
Relative Contribution from Potential Source Categories based on Calibrated TMDL Linkage Model

Source Category	% of Total Nitrogen Load During Winter	% of Total Nitrogen Load During Summer	% of Total Phosphorous Load During Summer
Waste Load Allocations			
Tapia Direct Discharge	34	5	8
Load Allocations			
Septic Systems	9	22	21
Effluent irrigation/sludge	8	15	13
Runoff from developed areas	11	6	6
Golf Course Fertilization	5	9	16
Agriculture/Livestock	5	8	4
Dry Weather Urban Runoff	2	13	11
Runoff from undeveloped land	22	9	11
Other	5	14	10
Total	100	100	100

Direct and indirect wastewater effluent – The Tapia WRF has a capacity of 16 mgd and is located at the confluence of Las Virgenes and Malibu Creeks. Tapia WRF effluent typically has nitrate-nitrite nitrogen concentrations around 14 mg/l, which is above the proposed wintertime numeric target of 8 mg/l in the EPA adopted Nutrient TMDL Staff Report. Las Virgenes MWD, the owner and operator of the Tapia WRF, is playing an active role in the TMDL process to develop new numeric targets that are more feasible to implement and that will protect water quality in receiving waterbodies. The EPA staff report estimates that the Tapia WRF is the largest single source of nitrogen load in the Malibu Creek WMA during the winter months. Direct discharges from Tapia WRF to Malibu Creek are prohibited during the summer season (between April 15th and November 15th) by Regional Board Order No. 97-135. This prohibition reduces the concentration of nutrients in Lower Malibu Creek during the summer months, yet nutrient-related impairments are still observed in the lagoon (Ambrose et al., 1995). During the summer months, Tapia sells its effluent to a number of agencies for irrigation use, and the remainder is sprayed in the natural areas surrounding the WRF.

Nutrient-related impairments are listed for all of the inland lakes in the Malibu Creek watershed as well as for Las Virgenes, Medea, and Lindero Creeks (Upper and Lower reaches). These impairments are upstream of the Tapia WRF and therefore wastewater effluent is not a potential source of nutrients for these waterbodies.

On-site Wastewater Treatment Systems (OWTS) – The EPA TMDL identifies OWTSs as a significant source of nitrogen in Malibu Creek WMA waterbodies. Percolation of OWTS effluent into shallow groundwater occurs in areas with high or perched water tables. Shallow groundwater can be discharged to surface waterbodies, especially in areas where OWTS are in close proximity to streams or other conveyance features. Whereas many pollutants are removed by binding to soil particles, nitrogen is more difficult to control in a leachfield (Bedessem et al., 2005). The EPA adopted Nutrient TMDL linkage model estimated that 22% of summertime nitrogen loads and 21% of summertime phosphorous loads are generated by OWTS in the Malibu Creek watershed alone.

Runoff from residential and commercial areas – Urban runoff is estimated to be a limited source of nutrients to Malibu Creek watershed during dry weather conditions (approximately 11%). During wet weather nitrogen concentrations are typically below the water quality objectives for the beneficial uses in Malibu Creek and the other NSMBW. The EPA adopted Malibu Creek Nutrient TMDL Staff Report identified the following potential sources of nutrients from dry weather runoff in urbanized areas:

- Lawn and landscape fertilization
- Organic debris from gardens, landscaping, and parks
- Phosphorous is car washing/other detergents

- Trash
- Domestic animal waste
- Human waste

Runoff and erosion from undeveloped areas - Open space makes up approximately 75 percent of the land within the Malibu Creek watershed. Nutrients are introduced to area waterways through the erosion of soils that contain organic litter from the local vegetation. Various studies of watersheds suggest that water body impacts can be seen when development reaches 10% imperviousness, and in the west this threshold may be as low as 5% (Santa Clara Valley Urban Runoff Management Program studies). Soluble nutrients from the decomposition of organic materials can potentially reach area streams through surface runoff or through groundwater transport. Additionally, wastes from wildlife and waterfowl may contribute to watershed nutrient loads. According to the National Resource Conservation Service (NRCS), up to 50 species of mammals and 380 species of birds reside in or pass through the watershed. Waterfowl are a component of the Malibu lagoon ecosystem and are believed to be a potentially important source of nutrients in the lagoon (Warshall et al, 1992).

The EPA adopted Nutrient TMDL estimated that runoff from undeveloped land contributes 20 percent of the nitrogen and 17 percent of the phosphorus loads to the watershed annually.

Runoff associated with agriculture/livestock - Agricultural activities within the Malibu Creek watershed consist primarily of pastures and grazing with limited areas of orchards and vineyards. The bulk of this agricultural land is located in the Hidden Valley area but smaller agricultural plots can be found in the Stokes Creek, Lower Las Virgenes Creek, Lower Malibu Creek, Malibu Lagoon, and Triunfo Creek subwatersheds. Nutrients sources on agricultural lands include fertilizers applied during cultivation and decomposed litter from vegetation. The soluble nutrients are introduced to area waterways through surface runoff and groundwater transport.

Livestock facilities throughout the watershed are also a potential source of nutrient loading. Manure from animals may contribute nutrients directly to surface waters (i.e. waterfowl or cattle watering in streams) or through non-point source overland storm runoff. Horses are the most widely domesticated animals throughout the watershed and it is estimated in the TMDL that approximately 250 cattle and 200 sheep reside within the watershed boundary.

Golf course irrigation and fertilization - Nutrient loading from golf courses can be significant due to the high fertilization and watering rates generally associated with these areas. There are a number of golf courses within the watershed, the majority of which are located adjacent to waterways. Excess nutrients accumulate in golf course soils which can be washed into streams and lakes during storm events.

Groundwater - As discussed in many source summarizations above, groundwater has the potential to convey nutrients from many different land uses. The nutrient concentration in groundwater is dependent on the nature of the area soils, geology, vegetation type and coverage, and other nutrient sources such as septic systems and fertilizer use (Flowers, 1972). Shallow groundwater provides the baseflow for watershed streams and is, therefore, a major source of water in the summer. Groundwater monitoring has been conducted through the Rancho Las Virgenes Farm and the Calabasas Landfill. Background groundwater nitrogen loads were estimated through modeling of the monitoring datasets. The EPA adopted Nutrient TMDL estimated that groundwater loadings contribute 6% of the nitrogen and phosphorus to the Malibu Creek watershed annually.

Atmospheric Deposition, Sediments and Tidal Inflows - Less significant sources of nutrient loading within the Malibu Creek watershed include atmospheric deposition, sediments, and tidal inflows. It is estimated that each of these sources contributes less than 5% of nutrient loads over then entire watershed.

SCCWRP along with Ambrose et al., (2000) modeled recent atmospheric deposition rates for nitrogen in the Malibu Creek watershed. Although nutrient loads from atmospheric deposition can be significant over an entire basin, much of the nutrients are cycled through plants in the largely vegetated portions of the watershed and, therefore, it is unlikely that atmospheric deposition is contributing a significant nutrient load. Loading from atmospheric deposition is higher during summer months.

Some nutrient loading can be traced to sediment releases within watershed lagoons and lakes. Ambrose et al., (1995 and 2000) estimated that nutrient and phosphorus loads from Malibu Lagoon sediments can have a major effect on concentrations within the actual lagoon, even though nutrient loading from sediment is minor on a watershed-wide scale.

Nutrient loads from tidal inflows, which affect only the lagoon, were calculated from estimated inflow rates from the aforementioned UCLA study. The EPA TMDL estimated that tidal inflow accounts for 4 percent of annual nitrogen and 2 percent of annual phosphorus loadings for the entire watershed.

3.3 Metals

3.3.1 Existing Conditions

There are various impairments within the NSMBW resulting from elevated metal concentrations. Specifically, Westlake Lake and Sherwood Lake is 303d listed for lead and mercury, respectively, and segments of Triunfo Creek, Lindero Creek, Medea Creek, and Las Virgenes Creek are listed for metal impairments including lead, mercury, and selenium. To date, no TMDL has been developed for the metal impairments found within the watershed. However, many organizations within the Malibu Creek Watershed Advisory Council are continually monitoring metal levels throughout the basin. The City of Calabasas includes metals (selenium, in particular) as part of its baseline data collection that has been in progress since 2000 along Las Virgenes Creek. The LACoDPW monitors metals in Malibu Creek as part of its NPDES stormwater mass emissions monitoring program. The LA RWQCB conducted a one-time sampling event in 2003 that assessed metals throughout the watershed as part of the SWAMP.

3.3.2 Source Characterization

Limited studies have been conducted to identify watershed-specific sources of high metal concentrations. Studies have been conducted on the trace metal levels found in fish and invertebrates in the coastal wetlands of this area. Reports have mainly linked metals to storm runoff from developed areas. This urban runoff can include metals from landscape irrigation, street cleaning, and accidental sewer overflows, as well as illegal industrial and commercial discharges. Metals can also be traced to natural background and atmospheric deposition.

Selenium - Selenium can occur naturally in the environment. It is released through both natural processes and human activities. Selenium is discussed in limited detail in the Malibu Creek Natural Resource Plan where sources of trace metals are identified as domestic and industrial discharges, urban runoff, and direct atmospheric deposition. Naturally occurring selenium can be mobilized to waterways when soils are disturbed through storm events, construction, and/or agricultural activities, particularly irrigated agriculture where selenium can be easily transported through ditches. During this refining and purification, there can be some loss of selenium into the environment. In addition, industries concerned with the production of glass, electronic equipment, or certain metals may emit selenium into the environment in the immediate vicinity of the factories involved.

Lead - Lead is a naturally occurring element in the earth's crust. Elevated lead levels have been measured in Westlake Lake and segments of Triunfo Creek. According to the EPA, lead in the environment can be traced to the following sources: past lead additives in gasoline, paint, household dust and soil around homes, lead piping, and industrial emissions. Sources of lead in surface water include deposits of lead-containing dust from the atmosphere, waste water from industries that handle lead (iron and steel and lead producers), and urban runoff from roadways and residential areas.

Mercury - Mercury is found naturally in soils and elevated levels have been documented in Nevada and California. The ultimate source of mercury to most aquatic ecosystems is deposition from the atmosphere, primarily associated with rainfall. In addition, particles attach to soils and are washed into streams and lakes through storm runoff. Mercury can be associated with industry, particularly in the manufacturing of electrical equipment (batteries, lamps, switches, and rectifiers). It may enter the environment through mining, smelting (not found in this watershed), and fossil fuel combustion. Fungicides used in agricultural practices can contain mercury. Mercury can also be reintroduced through sediment releases where anoxic bottom conditions exist in lakes and reservoirs.

3.4 Hydromodification

3.4.1 Existing Conditions

Hydromodification is defined by EPA as the "alteration of the hydrologic characteristics of surface waters, which in turn could cause degradation of water resources." In the NSMBW area, there is a potential for hydromodification of natural streams downstream of urbanizing areas. Urbanization can cause hydromodification when downstream waterbodies do not have the capacity to convey increasing flow volumes and durations that are associated with increasing imperviousness in the watershed. This can be a major concern in a watershed such as Malibu Creek with upstream development levels greater than 10%. It can also be tied to mitigation if there is ongoing degradation that contributes to pollutant loading.

3.4.2 Impacts of Hydromodification

Hydromodification activities can have beneficial purposes such as creating drinking water supplies, reducing flood impacts, expanding road networks, increasing drainage, preventing erosion, and reducing sediment loss. However, many hydromodification activities also lead directly or indirectly to adverse impacts on aquatic ecosystems. Hydromodification activities can negatively affect streams in numerous ways.

Stream channelization can cause streambed scouring and hardening, streambank erosion, altered waterways, and altered hydrochemistry. As a result, there is a potential to adversely affect water quality by altering pH, water temperature, metals concentration, dissolved oxygen, sediment loads, and nutrient levels. The hardening of banks along waterways also increases surface water flows and the transport of pollutants from the upper reaches of watersheds into coastal waters. According to EPA, a frequent result of channelization is also a diminished suitability of instream and streamside habitat for fish and wildlife. In unchannelized waterbodies, increasing streambank erosion can lead to excessively high sediment loads that can contribute to increased levels of turbidity that eventually settle causing problems for submerged vegetation, shellfish beds, natural stream pools, and tidal flats.

3.5 Pesticides

3.5.1 Existing Conditions

EPA defines a pesticide as "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest." Substances found in pesticides, such as chlordane and dieldrin, are on the 303d list due to elevated levels found in fish tissue within the Santa Monica Bay area. The LACoDPW monitors pesticides in Malibu Creek as part of its NPDES stormwater mass emissions monitoring program. Various other organizations also list pesticides as monitored parameters as well.

In order to assist the LA RWQCB's TMDL development for the Malibu Creek watershed, SCCWRP produced a technical report regarding a study of organophosphorus pesticides within the basin. Three streams were assessed for contamination by pesticides. Monthly samples were collected between June 2002 and March 2003 from Malibu Creek, Las Virgenes Creek, and Medea Creek. Two storm events in February 2003 were also sampled on Malibu Creek. The study found that water quality was most impaired in Medea and Las Virgenes Creeks, indicated by the survival of C. dubia (Brown and Bay, 2003).

3.5.2 Sources and Impacts of Pesticide Use

As discussed above, chemicals associated with pesticides are on the 303d list for areas within the Santa Monica Bay region. Many of the persistent pesticides such as dieldrin, chlordane, and DDT are no longer produced in the United States, yet they remain in the ecosystem. Many pesticides are persistent in the environment and bioaccumulate in aquatic species.

Pesticides are introduced to the environment through industrial, commercial, agricultural, and household use. Many pesticides cause adverse enzymatic and hormonal changes in fish that lead to impaired reproductive ability.

Chemicals associated with pesticides can enter and contaminate water through direct application, runoff, wind transport, and atmospheric deposition. Generally, runoff from agricultural areas produces locally high concentrations of pesticides, while atmospheric deposition causes low-level but widespread contamination. Atmospheric deposition occurs through the processes of wet and dry deposition. Wet deposition happens when chemicals in the gas phase bond to particles in the air that are then washed out by rainfall. On the other hand, dry deposition is a constantly occurring process when chemically bonded particles settle to the land or water surface.

4.0 Malibu Creek Bacteria TMDL Implementation Plan

In response to the LA RWQCB adoption of a TMDL for bacteria in the Malibu Creek watershed, an implementation plan is being prepared to meet the requirement of developing a detailed implementation plan for review within one year following EPA approval of the TMDL. The bacteria TMDL is expected to be approved in January 2006 and therefore the bacteria TMDL Implementation Plan will be completed prior to December 2006.

This implementation plan will describe detailed measures that will be incorporated into existing water quality control programs, such as the NPDES permitted stormwater programs of Los Angeles and Ventura Counties, to achieve the TMDL water quality objectives. The implementation plan will be submitted to the LA RWQCB for review within one year following EPA approval of the TMDL. The numeric target for the bacteria TMDL is a number of allowable days when water quality objectives for REC-1 use can be exceeded. The number of allowable wet-weather exceedence days was determined by observing the number of exceedences during wet weather from a reference watershed, the Arroyo Sequit, during the 1993 water year. This year was selected because it represents the 90th percentile year based on the number of wet days when related to historical weather data. The TMDL for wet weather was set at 17 allowable exceedence days based on this reference condition. For dry weather conditions, zero exceedence days are allowed during the summer months (April1 – October 31) and three exceedence day are allowed during the winter months (November 1 – March 31).

Review of water quality data aids the development of an effective TMDL Implementation Plan, by identifying and prioritizing areas where different measures will be most effective at reducing bacteria related to runoff. The elements of the Implementation Plan will include both non-structural and structural BMPs. Structural facilities are costly and therefore are best located where pollution reduction benefits are maximized, for instance, downstream of potential non-point pollution source areas.

In this section, current bacteria data from the Malibu Creek watershed are analyzed in relation to water quality objectives for REC-1 use established in the Los Angeles Water Quality Control Plan (Basin Plan) to assess potential hot spots. Following this review, sources of bacteria in the Malibu Creek watershed, was identified in the TMDL Staff Report and other watershed studies, are summarized. The spatial distribution of existing water quality hot spots is combined with a land use based source characterization to prioritize water quality areas of concern for subwatersheds within Malibu Creek. It is assumed that structural BMPs will be most beneficial for achieving regional water quality improvements when they are located in the highest priority areas.

4.1 Existing Conditions

4.1.1 Malibu Creek Bacteria TMDL Staff Report

In the Malibu Creek Bacteria TMDL water quality data recorded from 1998 to 2002 in Malibu Creek, Malibu Lagoon, and Las Virgenes Creek was utilized to assess compliance with the dry weather exceedence day standards (Table 4.1) (additional data from other years is presented in Section 3.0). One caveat is that daily monitoring was not used to count exceedence days, and therefore the number of annual exceedences days would likely be higher than reported.

Table 4.1
Exceedence Days for Malibu Creek, Malibu Lagoon, and Las Virgenes Creek as Reported in the Malibu Creek Bacteria TMDL Staff Report

Waterbody	Season (Allowable Exceedence Days)	1998	1999	2000	2001	2002
Malibu Creek	Summer (0 days)	1	1	2	2	4
	Winter (3 days)	3	0	3	12	1
Malibu Lagoon (above PCH)	Summer (0 days)			0	0	2
	Winter (3 days)			1	2	0
Malibu Lagoon (below PCH)	Summer (0 days)			2	6	3
	Winter (3 days)			8	3	1
Las Virgenes Creek	Summer (0 days)		2	26	16	15
	Winter (3 days)		1	14	25	3

Wet-weather bacteria data from the LACoDPW mass emission station S02 in relation to the Basin Plan water quality objective for fecal coliform of 400 MPN/100ml was evaluated and reported in the Malibu Creek Bacteria TMDL. The Staff Report summarized that 86.5% of 52 samples collected between 1995 and 2002 exceeded the fecal coliform objective. This technical memorandum reviewed recently published (post TMDL adoption) LACoDPW wet-weather bacteria data recorded at this station, and revealed that 73% of 11 samples exceeded the Basin Plan objective for fecal coliform. These findings show that exceedences of bacteria objectives have a high probability in Malibu Creek during wet-weather conditions.

4.1.2 Additional bacteria data analysis

Recent water quality monitoring programs, beginning in the wet season 2004-2005, have increased the distribution of bacteria monitoring locations within the Malibu Creek watershed. Previous plans or reports had identified bacteria data for these inland Malibu Creek waterbodies as a data gap (Malibu Creek Watershed Advisory Council Monitoring and Modeling Subcommittee, 1999). This data has been combined with longer term monitoring data to develop a watershed wide common database of bacteria records (see Section 2 of this technical memorandum for a more complete description of the data sources).

In order to assess water quality areas of concern, this bacteria database was analyzed in relation to the Basin Plan's single sample E. coli objective of 235 MPN/100ml for REC-1 use. The maximum bacteria count from each calendar month was extracted for the database and used to assess compliance, rather than evaluating every individual sample. This approach reduces weighting of months with more samples collected and follows more closely the intent of the Basin Plan objective (10% of samples within a 30-day period).

Following the collection and quality assurance checking of NSMBW bacteria data, a complete point layer of sampling locations was developed. MS Access was used to develop queries of the dataset to assess compliance by comparing actual data with the established REC-1 use water quality objectives. Fields in the point attribute table of the bacteria monitoring location GIS layer were created to show the results of the database queries. Results from queries of the database were joined to the attribute table using a reference location identifier. These fields were used to symbolize sampling locations in the GIS model. The points on these maps are symbolized by two attributes, 1) percent of non-compliant calendar months and 2) number of non-compliant calendar months when sufficient data was present to determine compliance. These attributes are depicted as varying intervals of color and size of points, respectively.

Stratification of the data record at each bacteria station separated water quality conditions during wet weather. To extract wet weather samples from the long term bacteria database, rainfall data from the Monte Nido meteorological station was obtained. The historical rainfall record from this station was used to identify wet weather days at each of the bacteria monitoring stations; where daily rainfall exceeded 0.1 inches at the meteorological station. Queries were also developed to show frequencies of exceedences of water quality objectives for bacteria during dry weather conditions. Exceedences of objectives based on bacteria samples collected during dry weather days were compared between seasons. The rainy season was defined as November 1st through March 31st and the non-rainy season, April 1st though October 31st. Wet weather data was excluded from this seasonal analysis to assess differences in bacteria water quality in dry weather flow between the rainy and non-rainy seasons. No queries were developed to compare wet weather samples collected at different times of year, due to the limited number of samples.

The results of this analysis are mapped to show the spatial distribution of bacteria exceedences during dry weather summer (Figure 4.1), dry weather winter (Figure 4.2), and wet weather (Figure 4.3) flow conditions.

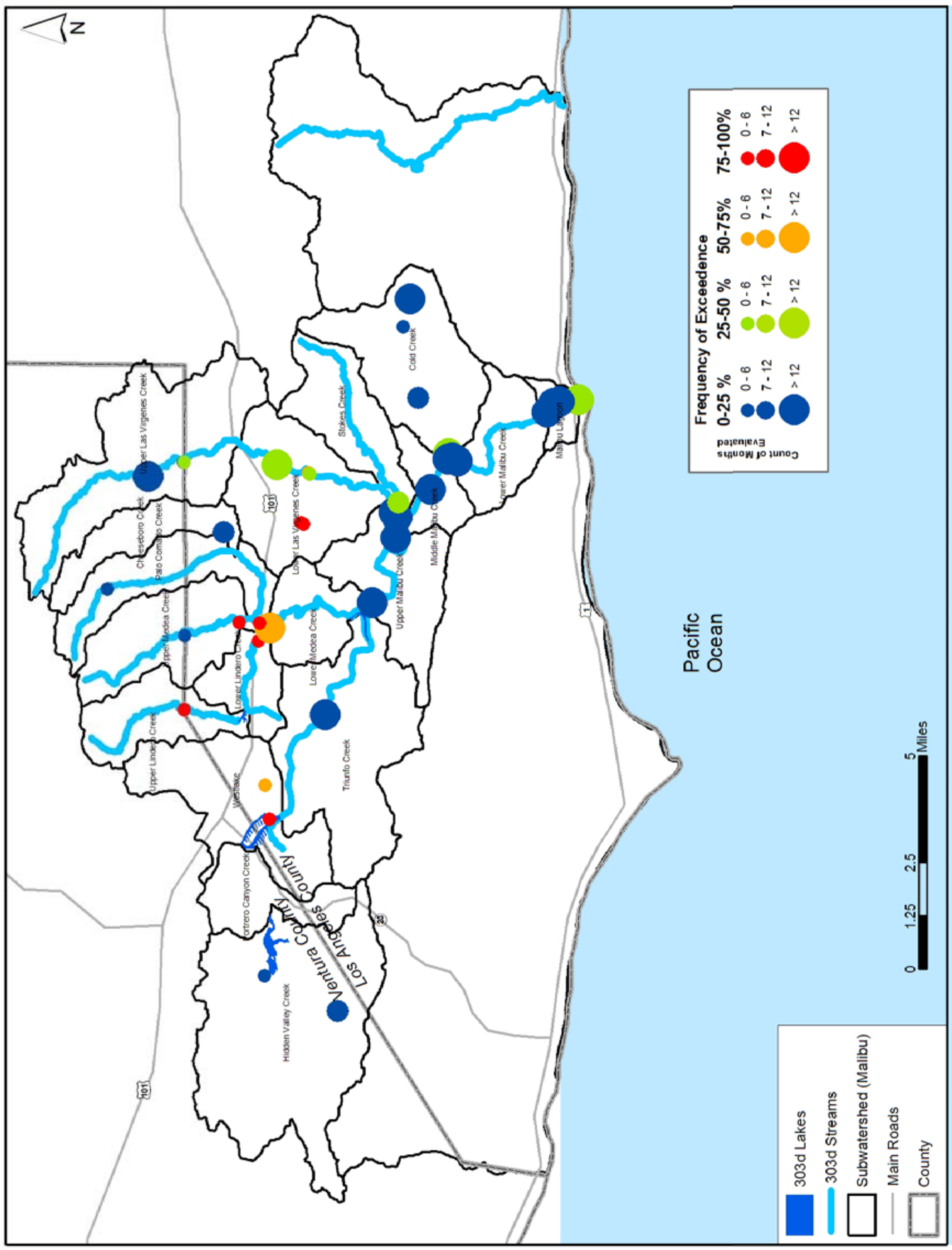

Figure 4.1
Frequency of Exceedence of E. coli Water Quality Objectives in the Malibu Creek Watershed during Dry Weather between April 1 and October 31

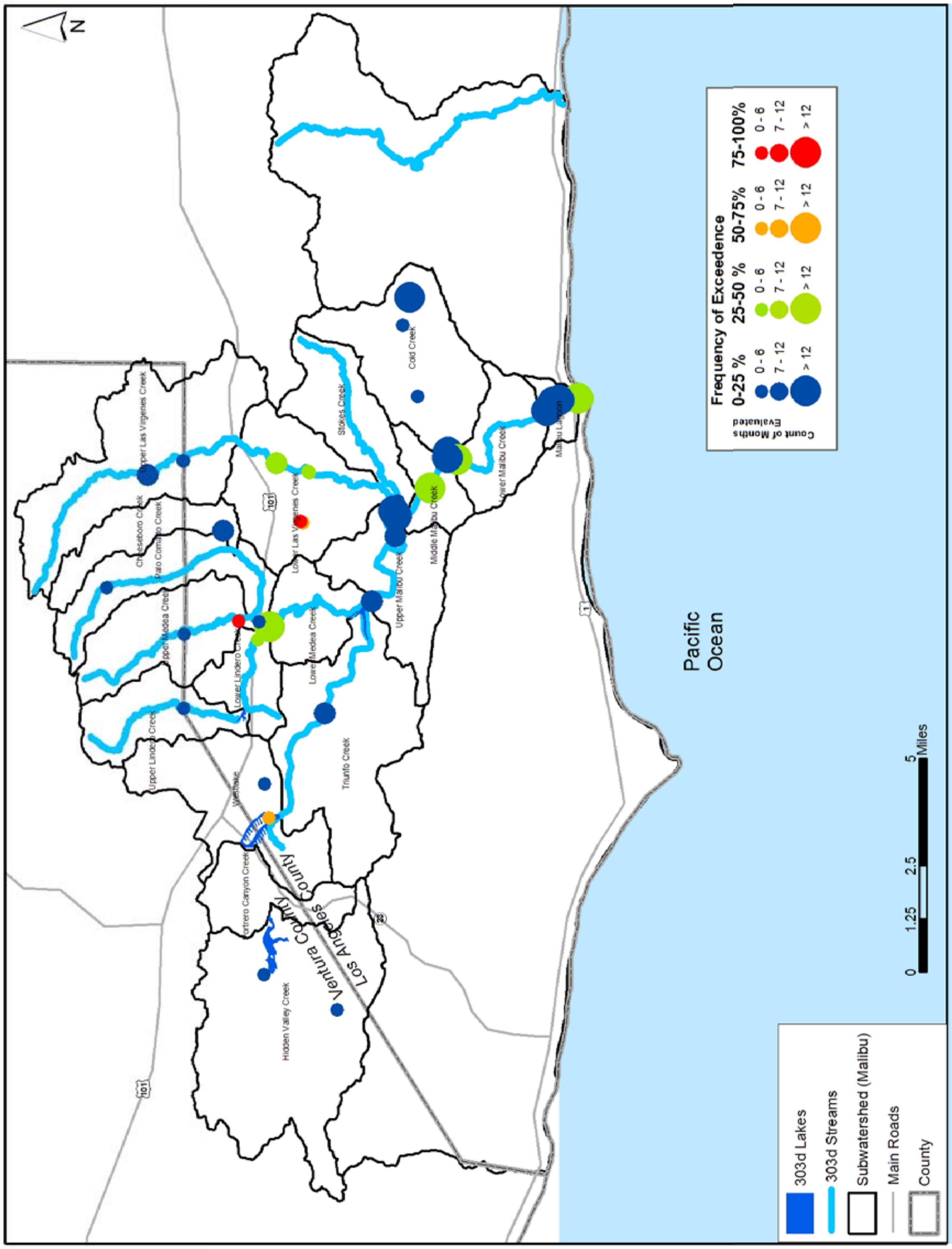

Figure 4.2
Frequency of Exceedance of E. coli Water Quality Objectives in the Malibu Creek Watershed during Dry Weather between November 1 and March 31

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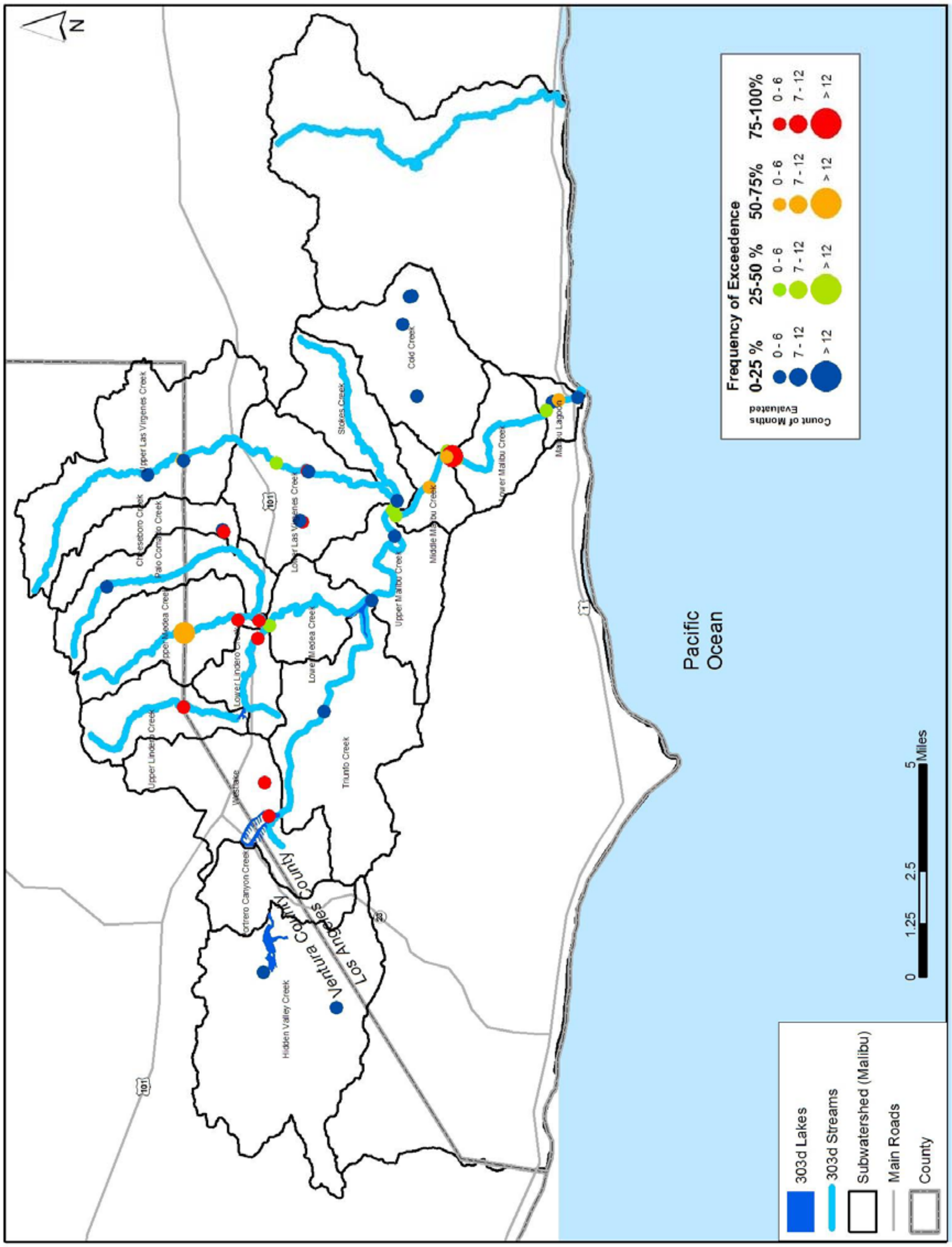

Figure 4.3
Frequency of Exceedence of E. coli Water Quality Objectives in the Malibu Creek Watershed during Wet-Weather

4.2 Source Characterization

The Malibu Creek Bacteria TMDL Staff Report identified potential point and non-point sources of bacteria in the watershed. Bacteria loads expected from each of these potential sources were input into a pollutant transport model (Hydrologic Simulation Program – FORTRAN). The model was developed to simulate water quantity and quality from the 18 subwatersheds shown in the preceding maps, including major tributaries and lakes within each subwatershed. Historical receiving water quality data was compared to model simulations results at five locations within the watershed (LVMWD monitoring site R2, R3, R4, R9, and R11). Relative loading from watershed sources was then adjusted to calibrate the model to actual water quality data at these locations. The results of this model calibration provide a relative contribution of bacteria to the Malibu Creek watershed from each source category, which was used to set load reduction targets, in the form of waste load allocations (WLA) for point sources and load allocations (LA) for non-point sources (**Table 4.2**).

The Implementation Plan will need to address each of these source categories and develop an approach to achieve the WLAs and LAs. Pollutant loads from these sources vary significantly depending upon the season. The model was not validated due to data limitations; therefore the relative source allocation should be considered an estimate. Each of the sources is further described below.

Table 4.2
Relative Contribution from Potential Source Categories based on Calibrated TMDL Linkage Model

Source Category	Estimated Annual Bacteria Load	% of Existing Bacteria Load
Tapia Discharge	59	0%
Storm Water Runoff		
Commercial/Industrial	2,550,000	39%
High/Med. Density Residential	2,700,000	42%
Low Density Residential	344,000	5%
Rural Residential	97,500	2%
Agriculture/Livestock	32,100	0%
Onsite Wastewater Treatment Systems	247,000	4%
Effluent Irrigation	12	0%
Dry Weather Runoff		
Entire Watershed (except lagoon)	5,210	0%
Malibu Lagoon	18	0%
Birds	450,000	7%
Tidal Inflow	16,100	0%
Natural Sources Other than Birds		
Vacant	1,950	0%
Chaparral/Sage Scrub	37,700	1%
Grasslands	2,690	0%
Woodlands	809	0%
TOTAL	6,485,148	100%

Direct and indirect wastewater effluent – The Tapia WRF has a capacity of 16 mgd and is located at the confluence of Las Virgenes and Malibu Creeks. Due to Title 22 wastewater NPDES requirements, the effluent from the Tapia WRF is chlorinated so that fecal coliform counts do not exceed 2.2 MPN/100ml. As a result, this discharge is not a concern for bacteria loading, but rather serves to dilute bacteria in Lower Malibu Creek. However, direct discharges from Tapia WRF to Malibu Creek are prohibited during the summer season (between April 15th and November 15th) by Regional Board Order No. 97-135. This prohibition during the summer months eliminates the dilution effect that the effluent discharge has on bacteria in lower Malibu Creek. For this reason, bacteria conditions in Malibu Creek are a greater concern during summer dry weather than winter dry weather flow conditions. Conversely, during the period that the lagoon is not breached, there is no direct flow from the Creek to the downstream beach.

On-site Wastewater Treatment Systems (OWTS) – Properly designed and maintained OWTSs should not be a potential source of bacteria. Bacteria in effluent from these systems is removed as it percolates through the soil matrix in a leachfield. Conversely, OWTSs that are located in high groundwater areas, not regularly maintained, or are short-circuited can be a significant source of bacteria in the Malibu Creek watershed.

Residential areas in the upper Malibu Creek watershed are mostly sewered; however outside the cities of Calabasas, Agoura Hills, Thousand Oaks, and Westlake Village rural residential homes utilize OWTSs. Additionally, the residential areas in the City of Malibu in lower Malibu Creek watershed are completely unsewered. There are also 20 commercial OWTS, which are designed to treat wastewater from shopping areas and some multi-family developments in the City of Malibu. The total number of septic systems watershed wide was estimated at 2,420 in 2001 (Tetra Tech, 2002). The distribution of OWTS is provided in **Table 4.3**.

LA RWQCB found high fecal coliform counts in shallow groundwater in the vicinity of OWTSs in the Malibu Colony and Cross Creek shopping area. These areas are characterized by typically high groundwater and they are close to Malibu Lagoon, therefore failed systems may contribute effluent directly to the lagoon.

The TMDL calibrated linkage model assumed that 8% of residential OWTS were failing and that 40% of this bacteria load could reach a surface waterbody. For the commercial OWTS, the model assumed a 20% failure rate and 100% transport of the loads to Malibu Lagoon due to the high groundwater in the Malibu Lagoon subwatershed. These assumptions use information from various prior studies cited in the TMDL document, but are not based on actual data.

Runoff from residential and commercial areas – Runoff from urbanized areas is estimated to be the greatest source of bacteria in the Malibu Creek watershed, especially during wet-weather flow conditions. Build up of bacteria on impervious surfaces in residential and commercial areas is washed off during rain events or by irrigation overflow and car/driveway washing during dry weather. Sources of bacteria in urbanized areas include the following:

- Lawn and landscape fertilization
- Organic debris from gardens, landscaping, and parks
- Trash
- Domestic animal waste
- Human waste

Table 4.3
Number of OWTS in Malibu Creek Subwatersheds

Subwatershed	Number of OWTS
Hidden Valley Creek	625
Portrero Canyon Creek	0
Westlake	60
Upper Lindero Creek	0
Lower Lindero Creek	0
Upper Medea Creek	0
Palo Comado Creek	0
Cheseboro Creek	0
Lower Medea Creek	110
Triunfo Creek	820
Upper Malibu Creek	95
Upper Las Virgenes Creek	0
Lower Las Virgenes Creek	50
Stokes Creek	85
Middle Malibu Creek	50
Cold Creek	300
Lower Malibu Creek	5
Malibu Lagoon	0
Above Lagoon	170
Adjacent to Lagoon	30
Commercial near lagoon	20
Total	**2,420**

Horse and Livestock – Bacteria in horse and livestock manure is a potential source in the Malibu Creek watershed. The Malibu Creek Bacteria TMDL Staff Report inventoried the number of horses, cattle, and sheep or goats in each subwatershed and applied a per animal fecal production load. This was then reduced because of manure collection programs for horse stables, except in the Hidden Valley Creek subwatersheds where there are open pastures. According to the Staff Report, the relative contribution of this source category was not significant.

Wildlife – A large portion (~75%) of the Malibu Creek watershed is open space and provides habitat for 50 species of mammals and 380 species of birds. The Malibu Creek Bacteria TMDL used reference values that LACoDPW developed for chaparral/sage scrublands, grasslands, and woodlands as a means to estimate contributions from wildlife. Recent monitoring of water quality at undeveloped reference beaches in southern California, including two NSMB beaches, showed that during wet weather, 20% of samples exceeded Basin Plan objectives (Schiff et al., 2005) which may suggest contribution from natural sources including wildlife.

Waterfowl are a component of the Malibu lagoon ecosystem and are believed to be a potentially important source of nutrients in the lagoon (Warshall et al, 1992). For this reason, the TMDL independently considered waterfowl loading to Malibu Lagoon. The linkage model estimated that waterfowl in Malibu Lagoon alone contribute as much as 7% of the total bacteria load from the Malibu Creek watershed.

High-use Recreational Areas - Bacteria loading impacts can result from activities associated with high recreational usage or where additional recreational facilities may be needed. For example, heavy use of beaches and open space areas where public restrooms are not readily available or wading in natural or constructed pools or in stream courses where no public restrooms are available may result in bacteria loading. Bacteria loading is possible from horse manure in high use equestrian areas such as staging areas, trail heads, parking areas, and on trails or from pet waste left on trails. Another additional potential source of bacteria is the use of the riparian area as a "camp" by homeless inhabitants.

5.0 Prioritization of Regional Water Quality Areas of Concern

The RWIP and the Malibu Creek Bacteria TMDL Implementation Plans will incorporate non-structural and structural BMPs into existing water quality control programs to achieve pollution reduction goals. For the bacteria TMDL, these goals are measured by a maximum number of days when exceedences of Basin Plan REC-1 use objectives are allowed to occur. For the RWIP, goals are included in the bacteria TMDLs for Malibu Creek and the J1/4 watersheds, the Malibu Creek Nutrient TMDL, existing NPDES Permit requirements for Los Angeles and Ventura Counties, AB 885, and will also be included in future TMDLs for other 303d impairments, NPDES Permit modifications, and other water quality management plans.

Implementation plans strategize watershed management efforts to reduce pollutants of concern and meet regional water quality goals. One way this is accomplished in a watershed implementation plan is to identify and prioritize water quality areas of concern (AOC), where BMPs would provide the greatest benefits.

The NSMBW area is broken into 35 subwatersheds, 18 within Malibu Creek watershed and 17 in the Topanga Creek and other coastal watersheds. The prioritization method addresses AOCs for these 35 subwatersheds. Elements considered in prioritizing water quality AOC include the following:

- Pollutant event mean concentrations (EMCs)
- Runoff potential estimated by watershed imperviousness
- Presence of an existing 303d impairment or completion of a TMDL
- Existing monitoring data documented in Section 2 of this technical memorandum. These data were evaluated for bacteria indicators and nutrient constituents.

The approach used was an enhancement of the approach used to prioritize subwatersheds for the SMBBB TMDL J1/4 Implementation Plan and draws concepts from a Catchment Prioritization Index approach that has been under development for use in the Ballona Creek Watershed and potentially to other watersheds. The methodology and results of the prioritization for the RWIP are presented in Section 5.1 and for the Bacteria TMDL in Section 5.2.

5.1 Prioritization of AOC for the RWIP

5.1.1 Catchment Prioritization Index

The catchment prioritization index (CPI) approach used for the RWIP provides an indication of the likelihood of a subwatershed to be a source of pollution relative to other subwatersheds in the region. This value is based on land uses and presence of waterbodies with existing 303d impairments or TMDLs, and also takes into account actual data for both bacteria and nutrients (constituents for which there are substantial quantity of available data). Section 5.2 presents the existing water quality conditions that were incorporated into the CPI to prioritize the 35 NSMB subwatersheds.

The Prioritization Methodology computes a CPI by considering seven potential pollutants representing five pollutant groups:

- Fecal coliform
- Nitrate
- Trash
- Total Metals (Copper, Lead, Zinc)
- Total Suspended Solids

The CPI for a subwatershed is a function of the pollutant load score (PLS) of each of the pollutants that are assessed and available water quality data. The PLSs are the product of the area-weighted runoff coefficient and the area-weighted EMCs for each pollutant in each subwatershed with adjustments for the relative importance of specific pollutants and actual monitoring data. The calculation of the CPI for each NSMB subwatershed is presented as a series of steps below.

Step 1 - The SCAG 2000 GIS database was modified to generalize its 231 land use categories into six land use types including single family residential, other urban (including multiple family residential), open space, agricultural, commercial, and industrial. Generalized land use distributions for each of the 35 NSMB subwatersheds were computed using these land use categories from the SCAG 2000 land use GIS database.

Step 2 - Area-weighted runoff coefficients for each of the aggregated land use categories were calculated for each of the 35 NSMB subwatersheds based on the values in **Table 5.1**. Runoff coefficients were included in the prioritization methodology because the likelihood of surface runoff generation is closely related to the watershed imperviousness. If a certain land use is a potential source of pollution, the role of the routing mechanism by which the pollutant reaches the waterbody of concern must be considered.

Step 3 - Area-weighted EMCs for each of the generalized land use categories were calculated for each of the 35 Malibu Creek WMA subwatersheds based on the values in Table 5.2. EMCs are used in the prioritization methodology to weight areas of greater pollutant generating potential. Inherent errors in estimation of EMCs are understood. This method uses area-weighted EMCs to compute an index of pollution potential, rather than an actual loading estimate. Therefore, the actual concentration is not used to assess compliance with existing or potential numeric targets.

Table 5.1
Runoff Coefficients Used in Water Quality Area of Concern Prioritization (from Ackerman and Schiff, 2003)

Land Use Category	Runoff Coefficient
Agricultural	0.10
Commercial	0.61
Industrial	0.64
Open space	0.06
Single family residential	0.39
Other urban	0.41

Table 5.2
Geometric Mean EMCs Used in Water Quality Area of Concern Prioritization (from "Draft Structural BMP Prioritization Methodology")

Land Use Category	Trash cf/ac	Total Nitrogen (ppm)	Total Copper (ppb)	Total Lead (ppb)	Total Zinc (ppb)	Fecal Coliform MPN/100ml	TSS ppm
Agricultural	0	11.3	84.1	20.4	246.6	6,842	699
Commercial	1	0.5	18.8	2.1	127.5	72,035	58
Industrial	1	0.5	31.6	4.3	289.5	32,679	81
Open space	0	1.0	3.8	0.0	2.1	255	28
Other urban	1	0.3	14.7	5.0	52.6	98,272	65
Single family residential	1	0.6	12.3	2.5	116.3	98,272	33

* Values were computed from LACoDPW flow-weighted composite-sampled land use runoff monitoring data and Ventura County data.
** These EMCs are not yet finalized for the "Draft Structural BMP Prioritization Methodology"

Step 4 - Using the area-weighted runoff coefficients and EMCs a normalized PLS was computed for each pollutant in each subwatershed. PLSs are scaled based on the pollutant group. Metals (Lead, Zinc, and Copper) are scaled by a factor of 15 (5 for each metal), bacteria (fecal coliform), trash, and nutrients (nitrate) are scaled by a factor of 10, and sediment (total suspended solids) is scaled by a factor of 5. For example, a PLS of 0.34 for fecal coliform would be scaled to 3.4 and a PLS of 0.76 for TSS would be scaled to 3.8.

$$PLS_{(Fecal\ Coliform, Total\ Nitrogen, Trash)} = 10 \times \frac{(Area\ weighted\ R_c \times Area\ weighted\ EMC)}{PLS_{(Maximum\ Subwatershed)}}$$

$$PLS_{(Total\ Copper, Total\ Lead, Total\ Zinc, TSS)} = 5 \times \frac{(Area\ weighted\ R_c \times Area\ weighted\ EMC)}{PLS_{(Maximum\ Subwatershed)}}$$

This scaling approach was developed because total copper, total lead and total zinc EMCs are total concentrations, including dissolved and particulate fractions. To weight the dissolved fraction of these metals more closely to the other pollutant groups, the particulate fraction of the total metals pollutant group is taken from the total suspended solids pollutant group, whereby the weight of suspended sediment is reduced by 50%, and the total metals pollutant group is increased by 50% (5 for each metal).

<u>Step 5</u> - To provide additional emphasis on impaired waterbodies, the PLSs are multiplied by a factor of 2 if there is a listed 303d impairment and by a factor of 3 if there is a TMDL in the process of being developed or already adopted for the pollutant.

<u>Step 6</u> – An additional score was added to each subwatershed based on actual bacteria and nutrient conditions during dry and wet weather. The water quality database presented in Section 2 of this technical memorandum was evaluated in relation to the Basin Plan objectives for REC-1 uses of freshwater and ocean waterbodies.

Table 5.3 shows the maximum bacteria exceedence probability from all monitoring locations within each subwatershed based on an evaluation of recent data from the J1/4 watersheds and the entire period of record collected throughout the Malibu Creek watershed. There was no water quality monitoring locations in the Portrero Creek subwatershed; however the MCWMP will be monitoring Portrero Creek this year.

Nutrient data, as summarized for each subwatershed in Table 3.3 was also utilized to develop a nutrient rating for each subwatershed for the summer and winter seasons. PLSs for the bacteria and nutrient pollutant groups are increased by a value of 5 for every "moderate" rating and 10 for every "high" rating. Ratings were developed for the summer and winter for nutrients and for wet and dry conditions for bacteria. The rating criteria are summarized below:

- Summer Nutrient Rating
  - High: Mean Total Nitrogen Concentration > or = 1 mg/L
  - Moderate: Mean Total Nitrogen Concentration < 1 mg/L and > or = 0.5 mg/L
  - Low: Mean Total Nitrogen Concentration < or = 0.5 mg/L

- Winter Nutrient Rating
  - High: Mean Total Nitrogen Concentration > or = 2 mg/L
  - Moderate: Mean Total Nitrogen Concentration < 2 mg/L and > or = 1 mg/L
  - Low: Mean Total Nitrogen Concentration < or = 1 mg/L
- Wet and Dry Weather Bacteria Rating
  - High: Single Sample Criteria Exceedence in > or = 67% of Calendar Months
  - Moderate: Single Sample Criteria Exceedence in > 33% and < 67% of Calendar Months
  - High: Single Sample Criteria Exceedence in < 33% of Calendar Months

These values were selected because they result in a potential increase in PLS for the bacteria and nutrient pollutant groups equal to 2/3 of the highest possible score from the preceding steps (e.g. Two "High" ratings will add 20 additional points to maximum score of 30). Similarly, a subwatershed with two moderate ratings for bacteria or nutrients would increase it's PLS by 1/3 of the maximum possible score.

Step 7 - The summation of all seven adjusted PLSs for each subwatershed is normalized to the NSMB subwatershed with the highest sum to calculate the final CPIs. The CPI is multiplied by a factor of 100 to show them as "equivalent percentile" ranks and highlight the relative differences between subwatersheds, especially in subwatersheds with relatively low pollutant loading potential.

$$CPI = 100 \times \frac{\sum_{Pollutant\ i}^{Pollutant\ j} PLS}{CPI_{(Maximum\ Subwatershed)}}$$

5.1.2 Results

The calculated CPIs that are used to assign priorities to each subwatershed are summarized in **Table 5.4** and mapped in **Figure 5.1**. Subwatersheds were categorized into priority categories based on CPI, where:

- Priority 1 (40-100)
- Priority 2 (30-39)
- Priority 3 (20-29)
- Priority 4 (10-19)
- Priority 5 (0-9)

The result of incorporating nutrient and bacteria ratings into the CPI calculation resulted in a 40% increase in the maximum CPI score. The remaining subwatersheds are normalized to this higher CPI score. Some subwatersheds increased in priority as a result of moderate or high ratings. Conversely, the CPI of some subwatersheds with low ratings or missing data was reduced due to normalization to a higher maximum CPI.

Table 5.3
Maximum Bacteria Exceedance Probability from All Monitoring Locations within NSMB Subwatersheds

Subwatershed	Summer Dry Weather	Winter Dry Weather	Wet Weather
Arroyo Sequit	11 % (19, 42)	7 % (15, 24)	67 % (6, 7)
Carbon	18 % (11, 53)	14 % (21, 46)	44 % (9, 10)
Cheseboro Creek	13 % (8, 19)	0 % (7, 17)	100 % (1, 2)
Cold Creek	14 % (64, 91)	6 % (34, 56)	25 % (4, 6)
Corral	59 % (17, 103)	9 % (32, 62)	47 % (15, 18)
Encinal	0 % (6, 24)	0 % (11, 18)	20 % (5, 6)
Escondido	100 % (7, 62)	25 % (12, 24)	80 % (5, 8)
Hidden Valley Creek	0 % (9, 13)	0 % (7, 11)	No Data
Las Flores	50 % (6, 30)	0 % (10, 13)	80 % (5, 8)
Latigo	40 % (5, 28)	10 % (10, 20)	25 % (4, 6)
Los Aliso	6 % (34, 52)	4 % (24, 32)	17 % (6, 7)
Lower Las Virgenes Creek	55 % (42, 52)	48 % (21, 24)	83 % (6, 8)
Lower Lindero Creek	83 % (6, 11)	60 % (5, 7)	100 % (2, 3)
Lower Malibu Creek	7 % (85, 137)	23 % (60, 95)	73 % (15, 25)
Lower Medea Creek	57 % (30, 44)	47 % (17, 28)	50 % (2, 3)
Malibu Lagoon	23 % (189, 474)	26 % (147, 326)	67 % (27, 46)
Middle Malibu Creek	11 % (111, 240)	19 % (74, 181)	50 % (16, 18)
Nicholas	20 % (5, 22)	10 % (10, 17)	25 % (4, 4)
Palo Comado Creek	0 % (3, 7)	0 % (5, 7)	No Data
Pena	14 % (7, 31)	0 % (12, 19)	40 % (5, 9)
Piedra Gorda	40 % (5, 25)	0 % (10, 15)	25 % (4, 4)
Portrero Canyon Creek	No Data	No Data	No Data
Ramirez	27 % (11, 55)	29 % (21, 40)	63 % (8, 12)
Solstice	14 % (35, 65)	0 % (24, 29)	56 % (9, 10)
Stokes Creek	23 % (40, 53)	17 % (18, 28)	50 % (2, 3)
Topanga	26 % (87, 239)	18 % (62, 154)	73 % (22, 40)
Trancas	20 % (5, 23)	30 % (10, 25)	40 % (5, 6)
Triunfo Creek	12 % (25, 26)	25 % (12, 15)	0 % (2, 2)
Tuna	20 % (5, 20)	10 % (10, 19)	0 % (1, 1)
Upper Las Virgenes Creek	13 % (15, 23)	20 % (10, 13)	75 % (4, 4)
Upper Lindero Creek	67 % (3, 4)	100 % (2, 4)	100 % (6, 6)
Upper Malibu Creek	5 % (42, 54)	5 % (20, 30)	0 % (2, 3)
Upper Medea Creek	73 % (11, 20)	57 % (7, 10)	85 % (13, 14)
Westlake	73 % (11, 20)	29 % (7, 10)	100 % (4, 6)
ZUMA	60 % (5, 29)	20 % (10, 23)	75 % (4, 5)

Note: Values in parenthesis represent the total number of calendar months, followed by the total number of samples for all monitoring locations within the subwatershed where bacteria data was evaluated

Table 5.4
Prioritization Results from Water Quality AOC Analysis in the NSMBW Area for the RWIP

Subwatershed	CPI Ranking	Priority
Westlake	100	1
Lower Lindero Creek	85	1
Malibu Lagoon	83	1
Upper Lindero Creek	82	1
Upper Medea Creek	78	1
Lower Las Virgenes Creek	57	1
Portrero Canyon Creek	52	1
Hidden Valley Creek	49	1
Stokes Creek	36	2
Lower Medea Creek	32	2
Escondido	29	3
Middle Malibu Creek	29	3
Lower Malibu Creek	27	3
Ramirez	26	3
Zuma	25	3
Upper Las Virgenes Creek	25	3
Palo Comado Creek	23	3
Cheseboro Creek	20	3
Las Flores	20	3
Piedra Gorda	19	4
Triunfo Creek	18	4
Corral	18	4
Topanga	17	4
Cold Creek	17	4
Carbon	16	4
Trancas	14	4
Arroyo Sequit	12	4
Latigo	12	4
Los Aliso	9	5
Encinal	9	5
Solstice	9	5
Pena	8	5
Upper Malibu Creek	8	5
Nicholas	7	5
Tuna	5	5

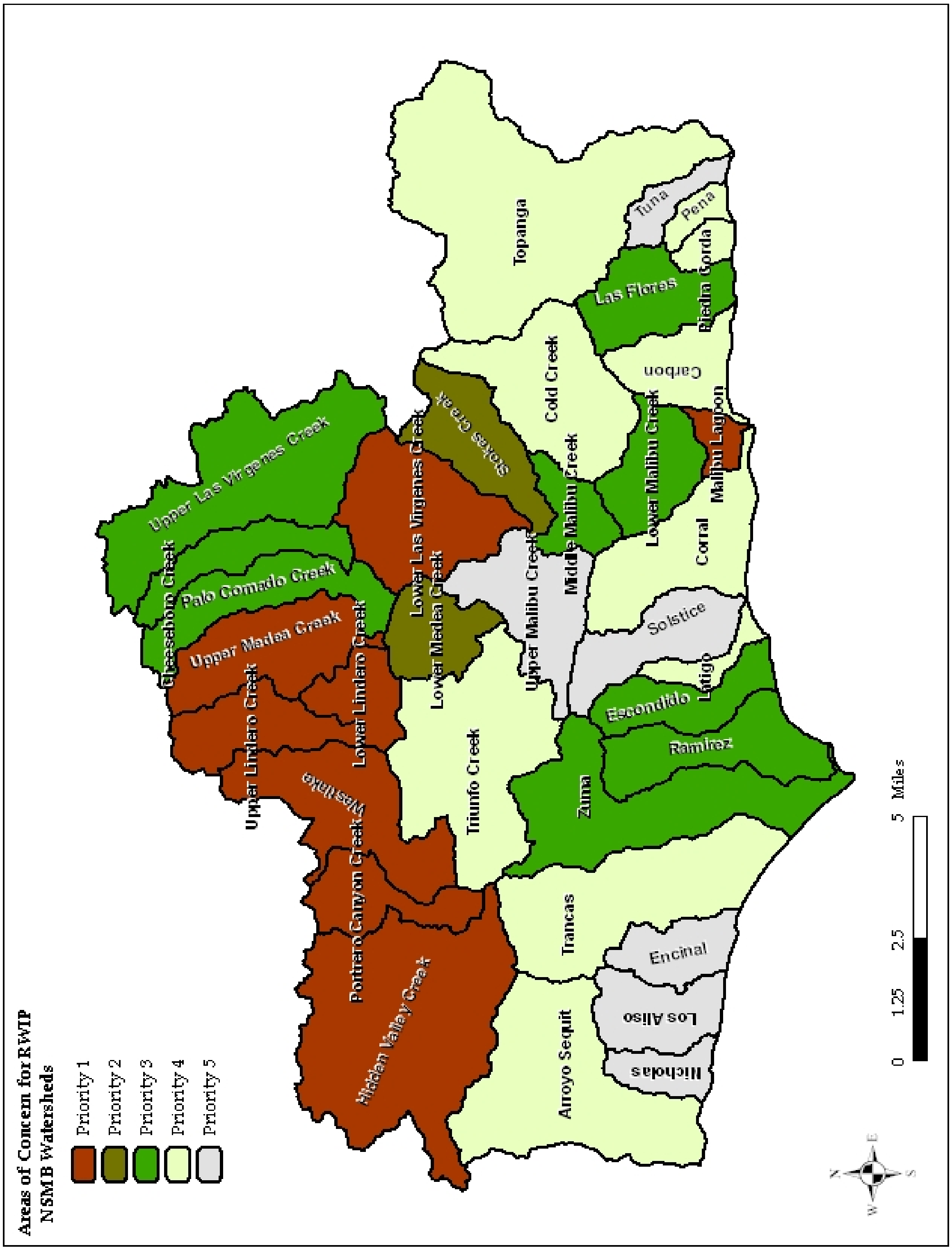

Figure 5.1
Prioritization of Water Quality AOC for the RWIP

5.2 Prioritization of AOC for the Bacteria TMDL IP

5.2.1 Bacteria Pollutant Load Score

To prioritize water quality AOC for the Malibu Creek Bacteria TMDL Implementation Plan, only bacteria in the 18 Malibu Creek subwatersheds was considered. This prioritization used a similar approach to the RWIP prioritization considering loading potential related to different land uses and actual bacteria conditions in the watershed. A modification of the method presented in Section 5.1 of this technical memorandum was used to estimate the likelihood of a subwatershed to be a source of bacteria relative to other subwatersheds in Malibu Creek.

The single constituent based PLS for bacteria, computed in Step 6, for the 18 Malibu Creek subwatersheds was used in the prioritization of water quality AOC, instead of the multi-constituent based CPI that was computed for the RWIP in Step 7. The bacteria PLSs are normalized to the subwatershed with the maximum bacteria PLS and then multiplied by a factor of 100 to express the score as a percentile rank. These final adjusted PLS are used to assign priorities to each subwatershed for the Malibu Creek Bacteria TMDL IP, where:

- Priority 1 (40-100)
- Priority 2 (30-39)
- Priority 3 (20-29)
- Priority 4 (10-19)
- Priority 5 (0-9)

5.1.2 Results

The final prioritization results are summarized in **Table 5.5** and mapped in **Figure 5.2.** The Portrero Canyon Creek subwatershed PLS score did not include any value for bacteria results because water quality sampling has not occurred. Also, during wet weather, the Hidden Valley Creek and Palo Comado Creek subwatersheds were not given any value due to a lack of wet weather event sampling.

In most case, the relative priorities between subwatersheds within the Malibu Creek Watershed based only on a PLS score for bacteria are not substantially different compared to the relative priorities developed for the RWIP based on a multiple pollutant analysis. The one exception is the Hidden Valley Creek subwatershed which is ranked much higher for the RWIP due primarily to relatively high nutrient levels observed from that subwatershed.

Table 5.5
Results of Water Quality Area of Concern Prioritization for the Malibu Creek Bacteria TMDL

Subwatershed	Final Bacteria PLS	Priority
Westlake	100	1
Upper Medea Creek	94	1
Lower Lindero Creek	92	1
Upper Lindero Creek	92	1
Malibu Lagoon	57	1
Lower Las Virgenes Creek	43	1
Portrero Canyon Creek	33	2
Lower Medea Creek	29	3
Upper Las Virgenes Creek	26	3
Cheseboro Creek	22	3
Lower Malibu Creek	21	3
Middle Malibu Creek	13	4
Stokes Creek	13	4
Palo Comado Creek	10	4
Cold Creek	7	5
Triunfo Creek	6	5
Hidden Valley Creek	4	5
Upper Malibu Creek	1	5

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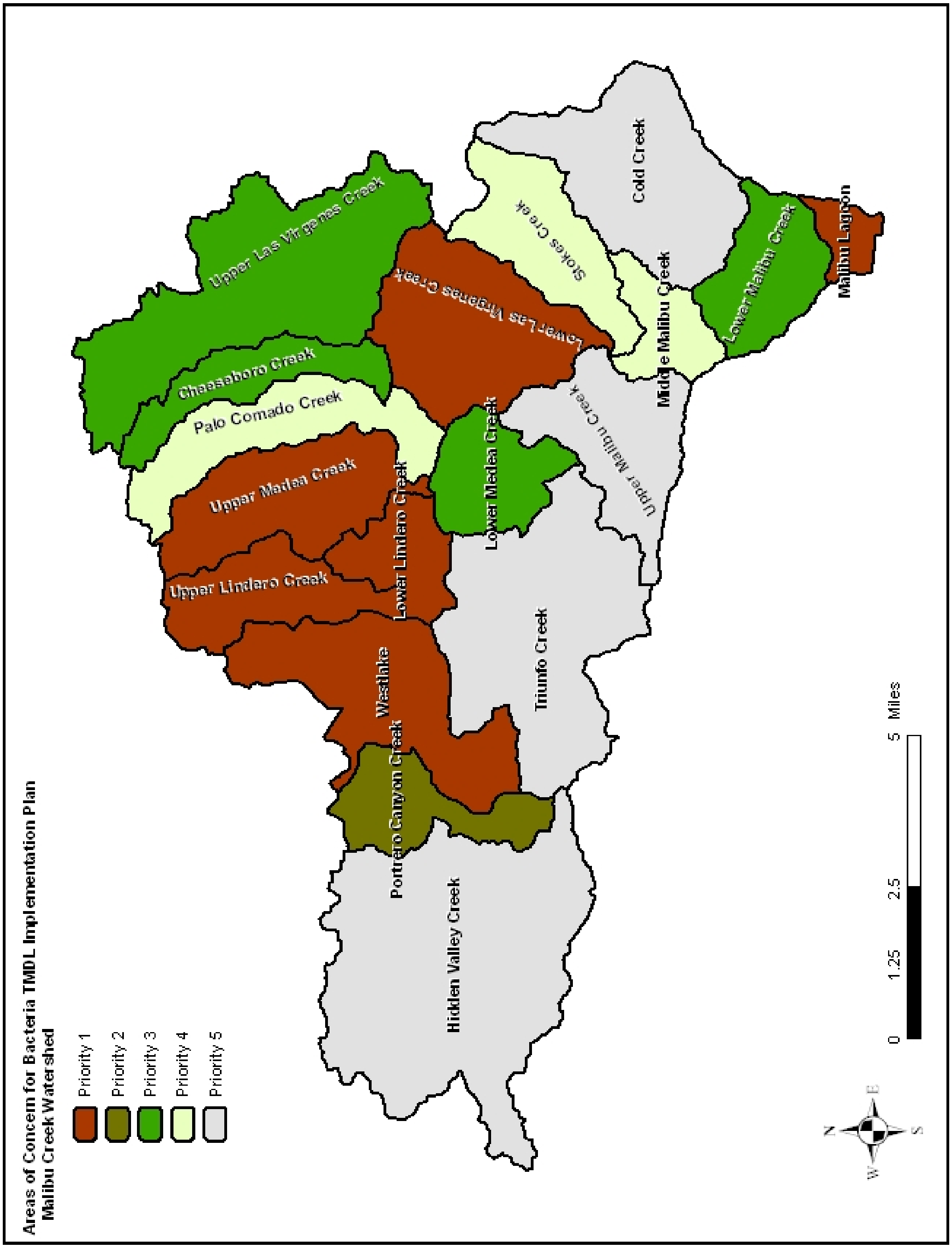

Figure 5.2
Prioritization of Water Quality AOC for the Malibu Creek Bacteria TMDL Implementation Plan and the SMBBB TMDL Implementation Plan

6.0 Data Gaps

Aside from Heal the Bay's Stream Team program (1998-2005), the single LACDPW mass emissions monitoring station in Malibu Creek below the confluence with Cold Creek for the NPDES Permit (1995-2005) and permit monitoring by LVMWD in lower Malibu Creek, more extensive water quality monitoring throughout the Malibu Creek watershed has only begun recently (2004-2005). These data sets are valuable and their continued monitoring will improve the validity of findings presented in this report. Current water quality data gaps and or limitations for the NSMB RWIP and the Malibu Creek Bacteria TMDL IP include:

- There are no bacteria monitoring data recorded in the Potrero Canyon Creek subwatershed. This subwatershed is located in the northwestern part of the NSMBW area, between the Westlake and Hidden Valley Creek subwatersheds. Due to the CPI for this subwatershed, it was assigned to the Priority 2 group; however monitoring data may suggest that it be upgraded to a Priority 1 subwatershed. The MCWMP has a site on Potrero Canyon Creek that is located on private property and site permissions are still being developed.
- Most of the water quality data available for the J1/4 watersheds are beach sites, and therefore only bacteria indicators are monitored. There are inland stations monitored by Heal the Bay for bacteria and nutrients in the Arroyo Sequit, Solstice, and Los Aliso subwatersheds. The RCDSMM monitors bacteria in 10 inland streams in the Topanga Creek watersheds. There are no inland monitoring locations in the Nicholas, Encinal, Trancas, Zuma, Ramirez, Escondido, Latigo, Corral, Carbon, Las Flores, Piedra Gorda, Pena, and Tuna subwatersheds aside from the two (March 2003, March 2004) dry weather sampling events completed by the LA RWQCB as part of the SWAMP.
- The monitoring conducted by the MCWMP and Heal the Bay encompasses a large portion of water quality data from tributaries to Malibu Creek. These programs analyze water samples for bacteria, nutrients, and physical parameters, but do not analyze metals. Mass emission monitoring in Malibu Creek at site S02 and recent wet and dry weather monitoring (2005) by LACoDPW as well as 18 months of a LVMWD California Toxics Rule (CTR) review at site R-1 (Malibu Creek downstream of Tapia WRF) do include metals in the suite of analytes.
- Aside from the detailed investigation of OWTS impacts in a small study area, conducted by Stone Environmental, there have been no programs to monitor short-circuited or failing OWTSs throughout the NSMBW area.
- More extensive water quality monitoring data is available compared to stream or tributary flow monitoring. The mass emission flow gage is the only long term continuous record of flow in the NSMBW. Different methods of assessing stream flow at the time of water quality sampling have been used by some sampling entities.

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