# Newport Bay Fecal Coliform Source Management Plan

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# PREFACE AND ACKNOWLEDGEMENTS

The *Newport Bay Fecal Coliform Source Management Plan (SMP)* was developed through and agreement between the County of Orange and the State Water Resources Control Board (California) established through the Proposition 13 Coastal Nonpoint Source Pollution Control Grant Program. The SMP should be considered a living/working document intended to inform the implementation of Best Management Practices (BMPs) designed reduce exceedances of Water Quality Standards in Newport Bay (Bay). Recommendations presented in the SMP are based on assumptions established through the initial review of readily available water quality data and information regarding the contribution of Fecal Indicator Bacteria (FIB) from sources, FIB transport processes to and within the Bay, and knowledge of BMP effectiveness in reducing FIB in water bodies. If assumptions contained within the SMP are revised based on information gained through technical studies, water quality monitoring, or BMP implementation, revisions are recommended.

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# EXECUTIVE SUMMARY

Located in Orange County, Newport Bay (Bay) is the second largest estuarine embayment in southern California. The Bay is made up of two water bodies: 1) the Upper Bay, currently a high value estuary that contains a State Ecological Reserve; and 2) the Lower Bay (commonly referred to as Newport Harbor), a regionally important recreational area where thousands of people visit every year and take part in various recreational activities, including swimming and boating. In1986, the Santa Ana Regional Water Quality Control Board (Regional Board) identified and listed Newport Bay (Lower and Upper) as a water quality limited receiving water body for pathogens in accordance with Section 303(d) of the Federal Clean Water Act. This listing (and associated policies developed as a result of this listing), began a series of technical studies and initial implementation actions that form our current understanding of FIB sources, pathways and effective control options for the Bay. In April 1999, the Regional Board amended the Santa Ana Region Water Quality Control Plan (Basin Plan) by adopting the *Total Maximum Daily Load (TMDL) for Fecal Coliform in Newport Bay* (Fecal Coliform TMDL).

Building upon technical studies conducted and management programs implemented since 1986, the County of Orange (County) received grant funding in 2005 from the State Water Resources Control Board (State Board) to: 1) conduct studies in Newport Bay to better identify and quantify the contribution of urban and natural sources of FIB impairment in the Bay; and, 2) prepare the *Newport Bay Fecal Coliform Source Management Plan (SMP)*. The goals of the SMP are to evaluate and prioritize sources and pathways of FIB, document best management practices (BMPs) currently implemented in the Bay watershed, and recommend BMPs to reduce exceedances of Water Quality Standards associated with FIB.

## Water Quality Standards

The Upper and Lower Bays are designated as Water Contact Recreation (REC-1) and Shellfish Harvesting (SHELL) water bodies. Previous assessments have shown that the level of REC-1 and SHELL uses varies spatially and temporally in the Bay. For example, results of the recreational use assessment conducted in 2001 indicate that substantial variability exists in the average number of recreators at different sites/areas in the Bay and between seasons. Furthermore, the population potentially exposed to pathogens is far greater at some sites (e.g., Newport Dunes), and increases dramatically during the high use (May-September) season, and more specifically during summer holidays (Figure ES.1).

Collectively with designated beneficial uses, water quality objectives/criteria based on fecal indicator bacteria (FIB), such as total coliforms, fecal coliforms, *E. coli*, fecal streptococci, and *Enterococcus,* make water quality standards. These indicators generally do not cause illness themselves, but they do have characteristics that make them good indicators of fecal material in water and based on epidemiological studies suggest that harmful pathogens may be present. Two types of FIB, fecal coliforms and *Enterococcus,* are currently used to assess water quality conditions in Newport Bay. Water quality criteria/objectives based on single sample maximums and geometric/log means of these types of FIB have been adopted by the Regional Board to protect the REC-1 and SHELL beneficial uses.

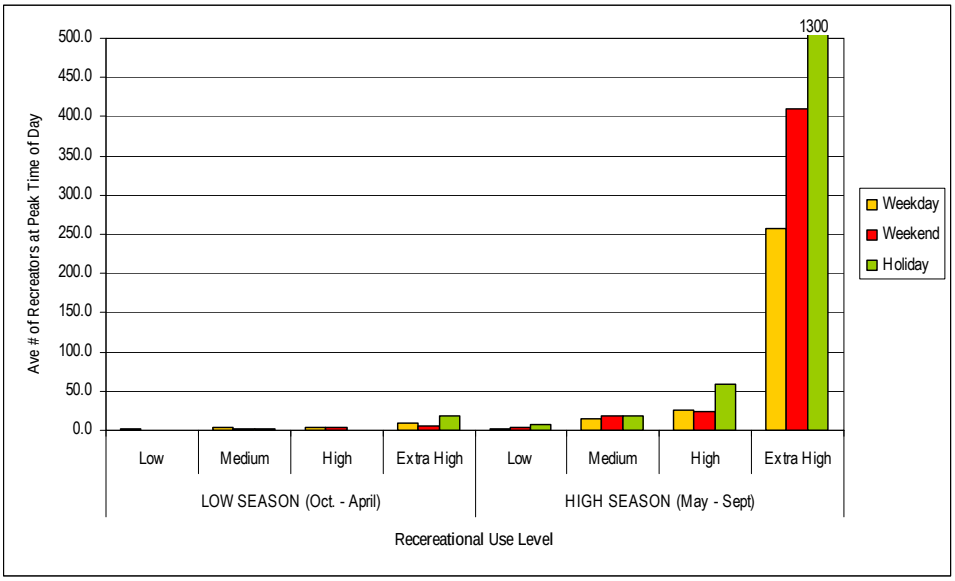



Figure ES.1. Average number of recreators at Newport Bay beaches with various levels of recreational use during high and low seasons at the peak time of day (11:00am to 3:00pm) on weekdays, weekends and holidays (EOA 2001).

## Long-Term Trends in Newport Bay Water Quality

Over the last three decades, a variety of FIB monitoring has occurred in the Bay. The most comprehensive and long-term FIB dataset was collected by the Orange County Health Care Agency (OCHCA), which began collecting data in 1986 and continues today at 31 beach and Bay margin sites. Evaluation of the long-term dataset (1987-2007) suggests that fecal coliform concentrations have decreased substantially over time on a Bay-wide scale (Figure ES.2). Trends in *Enterococcus* concentrations are less evident, possibly due to the shorter historical data collection period (1999-2007). Although the implementation of significant best management practices (BMPs) took place in roughly the same time frame, the causes of observed decreases in FIB concentrations in the Bay remain unclear.

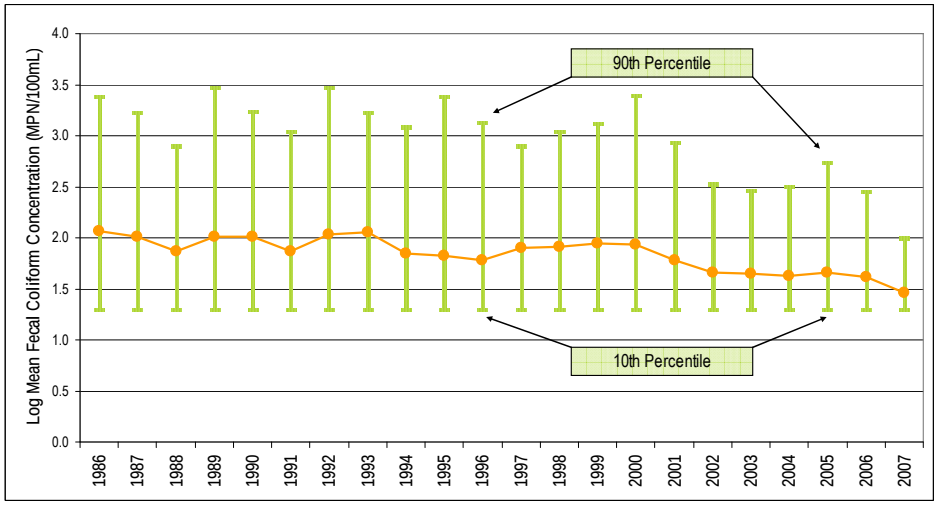



Figure ES.2. Average annual log concentrations of fecal coliform bacteria at all sites sampled by OCHCA in Newport Bay (1986-2007).

## Differences in Water Quality during Wet and Dry Weather

Statistical evaluations of OCHCA fecal coliform and *Enterococcus* datasets were conducted to examine whether rain/runoff events appear to affect Bay water quality. Results indicate that significant differences ($p < 0.05$) exist between FIB concentrations in the Bay during wet and dry weather.[1] Additionally, variability in FIB concentrations is far less in dry weather, compared to wet weather (Figure ES.3). Similar results were found in the FIB dataset collected during the Source Identification Project. Based on these observed differences, FIB data were stratified between "wet" and "dry" datasets to identify priority areas for management consideration.

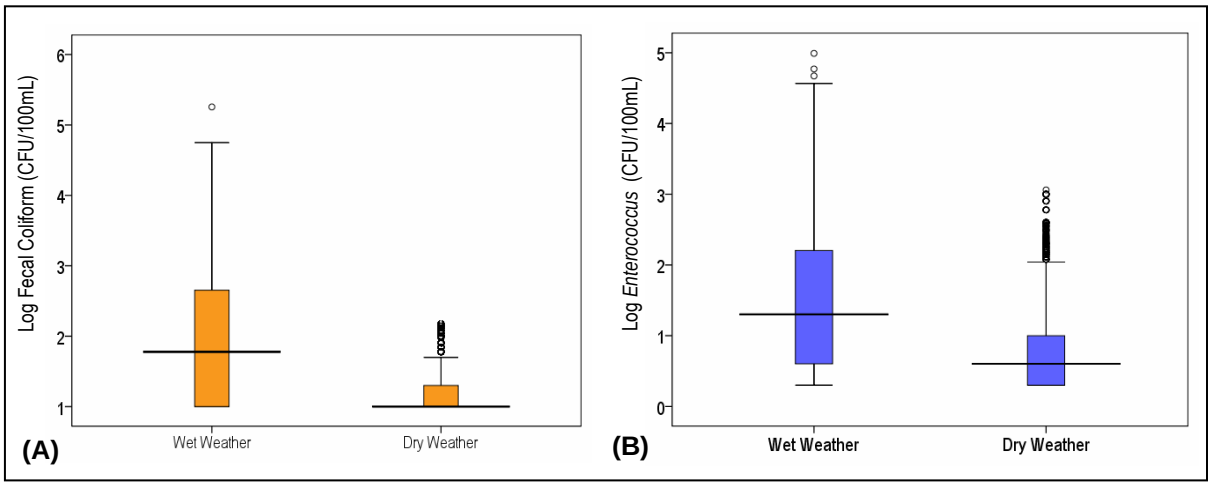



Figure ES.3. Box-whisker plots illustrating differences in median (horizontal line) (A) fecal coliform and (B) *Enterococcus* concentrations and variability (box height) between dry and wet weather datasets.

## FIB Sources and Transport Pathways

Sources are defined as activities or processes leading to the release FIB into the environment. Based upon a review of existing information on sources of FIB to the Bay, there are a variety of sources that may contribute to exceedances of water quality objectives/criteria (Figure ES.4). These sources can deposit FIB: 1) onto the surface of the watershed draining to the Bay (e.g., wildlife and pet waste); or 2) directly into the Bay and tributaries/conveyances draining to the Bay (e.g., water birds and vessel waste). For sources that deposit FIB onto the surface of the watershed, a pathway (e.g., tributary or urban runoff conveyance system) is needed to transport the deposited FIB to the Bay during dry or wet weather.

For land-based sources of FIB, pet waste is estimated to contribute the largest load, approximately two orders-of-magnitude greater than the next largest sources (i.e., terrestrial wildlife and biosolid/fertilizer applications), of fecal coliforms to the surface of the Newport Bay watershed. For sources that directly input FIB into the Bay, water bird droppings and tidal washing of sediment appear to contribute the largest load of FIB to the Bay.

[1] Wet weather is defined as those days that the OCHCA issues a "rain advisory" for Newport Bay, which occurs on those days with and for 72 hours after, $\geq$ 0.2 inches of rain. Dry weather includes those days that do not meet the wet weather definition.

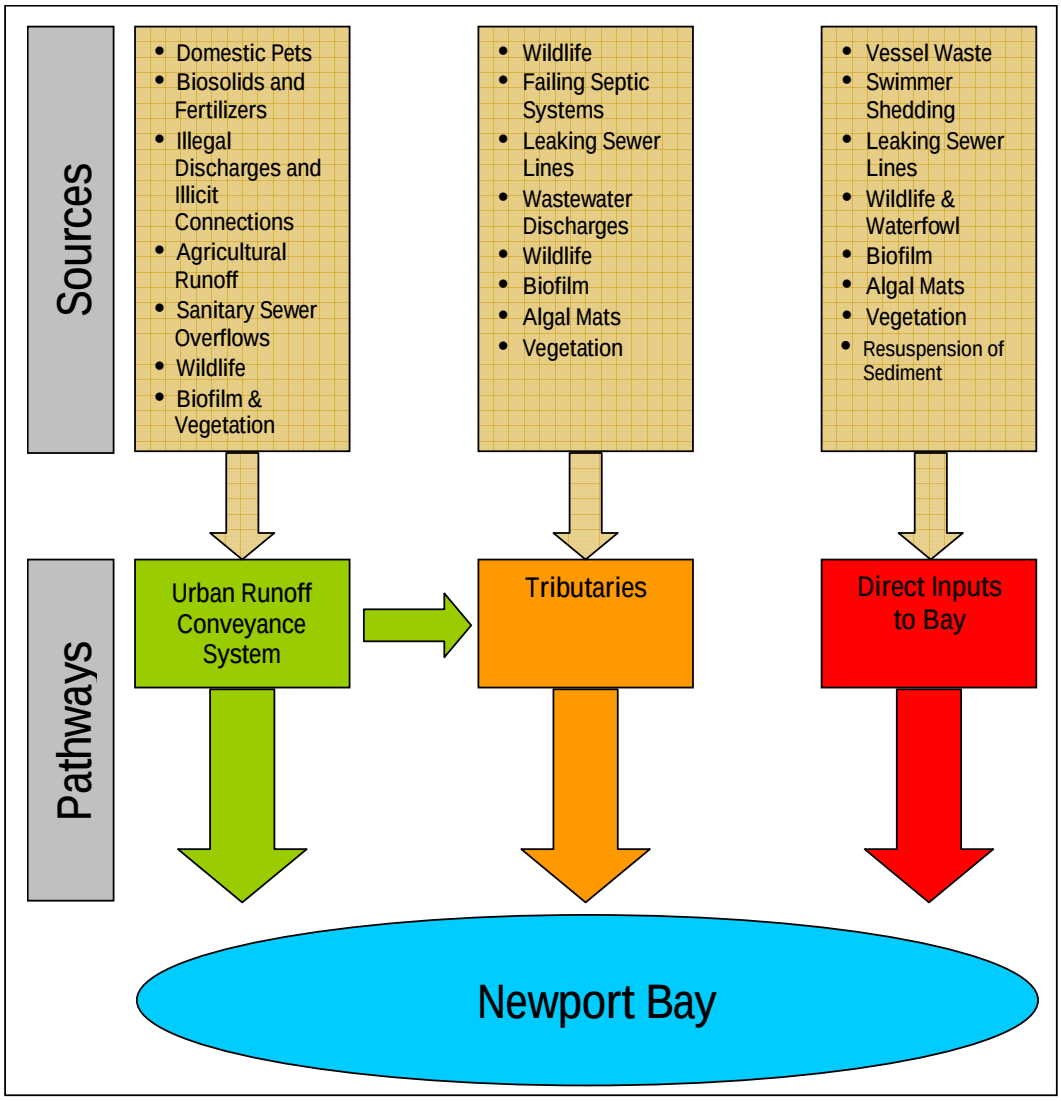



Figure ES.4 Potential fecal indicator bacteria (FIB) sources and pathways to Newport Bay.

Bacteria deposited onto the surface of the watershed are transported to the Bay via tributaries and urban runoff conveyance systems, or "pathways" during dry or wet weather runoff events. Additionally, FIB can be directly discharged to the Bay via a pathway termed "direct inputs", which is applicable to sources such as vessel waste and water bird droppings.

Table ES.1 provides a comparison of average fecal coliform concentrations and loading estimates from urban runoff conveyances and tributaries during dry and wet weather. Based on these estimates, median fecal coliform concentrations in samples collected from drains are substantially (2 to 20x) higher than those from tributaries. Additionally, dry weather fecal coliform loads are similar between the three transport pathways (i.e., urban runoff conveyance, tributaries and direct inputs). During wet weather, however, the FIB load from all tributaries combined (particularly the load from San Diego Creek) is greater than the load from either urban runoff conveyances or direct inputs.

Table ES.1. Estimated average fecal coliform concentrations and loading rates of transport pathways (urban runoff conveyance, tributaries and direct inputs) during dry and wet weather.

| Pathway | Dry Weather | | Wet Weather | |
|---|---|---|---|---|
| | Concentration (organisms/100mL) | Load (organisms/day) | Concentration (organisms/100mL) | Load (organisms/day) |
| Tributaries | | | | |
| San Diego Creek | 130 | $2.5 \times 10^{10}$ | 2,100 | $1.3 \times 10^{12}$ |
| Santa Ana Delhi | 390 | $2.4 \times 10^{10}$ | 2,000 | $3.2 \times 10^{11}$ |
| Big Canyon Wash | 130 | $1.1 \times 10^{9}$ | 300 | $2.2 \times 10^{10}$ |
| Total | NA | $5.0 \times 10^{10}$ | | $1.3 \times 10^{12}$ |
| Urban Runoff Conveyance (Large and Small Drains) | 6,500 | $7.3 \times 10^{10}$ | 5,091 | $6.8 \times 10^{11}$ |
| Direct Inputs (Water Birds & Vessel Waste) | NA | $4.7 \times 10^{10}$ | NA | $8.0 \times 10^{9}$ |
| Totals | | $1.7 \times 10^{11}$ | | $2.4 \times 10^{12}$ |

## Identification of Priority Areas in Newport Bay

Priority areas in Newport Bay recommended for considered of additional or enhanced BMPs were identified using datasets representing "current" (2004-2007) FIB concentrations in both the channels and margins of the Upper and Lower Bays. Data were evaluated using water quality assessment metrics shown in Table ES.2 and associated scoring/weighting factors. Areas were then prioritized on a scale of 1 to 4 (1 being the greatest concern) separately for dry and wet weather, based on the level of recreational use and the magnitude of WQO/criteria exceedances at a site/area.

ES.2. Water quality assessment metrics used to identify sites for source management consideration during wet and/or dry weather.

| Water Quality Assessment Metrics | | Dry Weather | | Wet Weather | |
|---|---|---|---|---|---|
| | | Fecal Coliform | *Enterococcus* | Fecal Coliform | *Enterococcus* |
| Log/Geometric Mean | Long-Term log mean/geomean compared to log mean/geomean Water Quality Objective/Criteria | X | X | X | X |
| | % of rolling log means/geomeans (based on 5 samples over a maximum of 30 days) that exceeded the log mean/geomean Water Quality Objective/Criteria | X | X | | |
| Upper Percentile Value or Single Sample Maximum | % of samples that exceeded the SSM for fecal coliform or the *Enterococcus* UPV for designated bathing beaches | X | X | X | X |

Based on the water quality assessment metric results for dry weather, no sites met the Level 1 or 2 criteria. However, three priority level-3 and seven priority level-4 areas/sites in Newport Bay were identified for consideration of additional or enhanced dry weather BMP implementation (Figure ES.5). The remaining 29 monitoring sites not listed above (i.e., those scoring zero) are assumed to be within an acceptable water quality range for the purposes of this SMP.

During wet weather, all sites with the exception of BTO 9 and BTO 10, met the priority area definition. Four sites ranked as priority level-1, six sites ranked as priority level-2, twenty-eight sites ranked as priority level-3, and two sites ranked as priority level-4 for source management consideration (ES.6). For the purpose of the SMP, sites identified on the wet weather priority list are considered to be a lower priority than those on the dry weather priority list due to: 1) the significant decrease in recreational use that occurs during wet weather at Bay sites; and 2) the limited ability of traditional stormwater best management practices (source controls or treatment devices) to effectively reduce FIB in storm-driven flows.

## Priority FIB Sources and Pathways

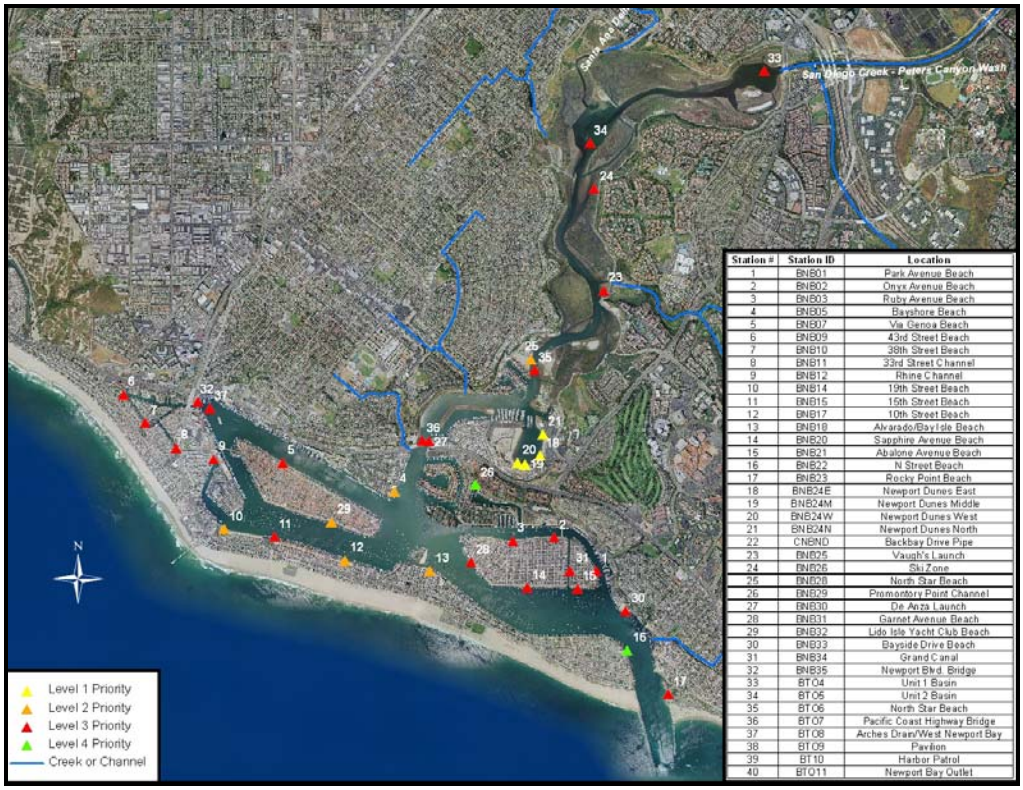
Over the past twenty years, a series hydrologic and water quality modeling exercises were conducted to better understand the loading and movement of salinity, water, sediment and pollutants (including FIB) in the Bay. In addition, numerous source identification and characterization studies specific to the Bay have also been conducted. To assist watershed managers in identifying which sources and pathways deserve additional attention, FIB sources and pathways were prioritized based on the results of these studies, and source contribution estimates developed in the SMP.

With regard to transport pathways, studies and modeling have shown that FIB can affect Bay water quality at three distinct scales of interest: 1) Bay-scale; 2) Beach-scale; and 3) Drain-scale. Additionally, modeling suggests that dry weather discharges from San Diego Creek and Santa Ana Delhi channel are confined to the Upper Bay. During wet weather, only FIB loadings from San Diego Creek during large discharge events ($\geq$90 percentile) appear to have Bay-scale (including the main channels in the Lower Bay) water quality impacts. Wet weather FIB loadings from Santa Ana Delhi channel during large discharge events, however, are predicted to only impact the Upper Bay. Loadings from either tributary during small discharge events do not appear to impact water quality in the Upper or Lower Bay.

In addition to potential impacts from tributaries, wet and dry weather (i.e., non-stormwater) discharges from urban runoff conveyance systems can also affect Bay water quality at the Bay-scale. Specifically, based on the results of previous studies it is likely that dry and wet weather discharges from the five large drains impact water quality at the Bay-scale. As for the numerous small drains (~200) in Newport Bay, data evaluated via the SMP suggest that these drains can impact water quality at the beach and/or drain scales.

| Station # | Station ID | Location |
|---|---|---|
| 7 | BNB10 | 38th Street Beach |
| 8 | BNB11 | 33rd Street Channel |
| 12 | BNB17 | 10th Street Beach |
| 23 | BNB25 | Vaugh's Launch |
| 24 | BNB26 | Ski Zone |
| 30 | BNB33 | Bayside Drive Beach |
| 32 | BNB35 | Newport Blvd. Bridge |
| 33 | BTO4 | Unit 1 Basin |
| 34 | BTO5 | Unit 2 Basin |
| 37 | BTO8 | Arches Drain/West Newport Bay |

Figure ES.5. Newport Bay dry weather priority areas (No areas have been identified as level-1 or level-2 priorities).




| Station # | Station ID | Location |
|---|---|---|
| 1 | BNB01 | Park Avenue Beach |
| 2 | BNB02 | Onyx Avenue Beach |
| 3 | BNB03 | Ruby Avenue Beach |
| 4 | BNB05 | Bayshore Beach |
| 5 | BNB07 | Via Genoa Beach |
| 6 | BNB09 | 43rd Street Beach |
| 7 | BNB10 | 38th Street Beach |
| 8 | BNB11 | 33rd Street Channel |
| 9 | BNB12 | Rhine Channel |
| 10 | BNB14 | 19th Street Beach |
| 11 | BNB15 | 16th Street Beach |
| 12 | BNB17 | 10th Street Beach |
| 13 | BNB18 | Alvarado/Bayside Beach |
| 14 | BNB20 | Sapphire Avenue Beach |
| 15 | BNB21 | Abalone Avenue Beach |
| 16 | BNB22 | N Street Beach |
| 17 | BNB23 | Rocky Point Beach |
| 18 | BNB24E | Newport Dunes East |
| 19 | BNB24M | Newport Dunes Middle |
| 20 | BNB24W | Newport Dunes West |
| 21 | BNB24N | Newport Dunes North |
| 22 | CNBND | Backbay Drive Pipe |
| 23 | BNB25 | Vaugh's Launch |
| 24 | BNB26 | Ski Zone |
| 25 | BNB28 | North Star Beach |
| 26 | BNB29 | Promontory Point Channel |
| 27 | BNB30 | De Anza Launch |
| 28 | BNB31 | Garnet Avenue Beach |
| 29 | BNB32 | Lido Isle Yacht Club Beach |
| 30 | BNB33 | Bayside Drive Beach |
| 31 | BNB34 | Grand Canal |
| 32 | BNB35 | Newport Blvd. Bridge |
| 33 | BTO4 | Unit 1 Basin |
| 34 | BTO5 | Unit 2 Basin |
| 35 | BTO6 | North Star Beach |
| 36 | BTO7 | Pacific Coast Highway Bridge |
| 37 | BTO8 | Arches Drain/West Newport Bay |
| 38 | BTO9 | Pavilion |
| 39 | BT10 | Harbor Patrol |
| 40 | BTO11 | Newport Bay Outlet |

Figure ES.6. Newport Bay wet weather priority areas.

Similar to FIB transport pathways discussed above, sources that contribute FIB directly to the Bay may impact water quality, depending on site specific characteristics, hydrology, FIB concentrations, and a variety of other factors. Based on the results of recent field studies and modeling conducted in the Bay, the following preliminary conclusions have been established regarding the likelihood of direct inputs to impact water quality at the beach/shoreline-scale:

- Source identification studies suggest that vessel waste and swimmer shedding have a negligible impact on Bay water quality.
- Older sewer lines in specific areas around the Bay could be sources of FIB, although the extent and magnitude of contributions to exceedances of water quality criteria/objectives is currently unknown.
- The presence of even a modest number of water birds at beach/shoreline sites can cause exceedances of water quality criteria.
- FIB concentrations in sediments collected from the sub-tidal and intertidal areas of Newport Bay are well within the range to cause exceedances of water quality criteria at shoreline/beach sites in Newport Bay.

Based on estimates of FIB contributions to the surface of the watershed, a number of land-based sources also contribute to exceedances of water quality criteria/objectives in the Bay. Although the importance of a specific land-based FIB source is dependent on a variety of factors (e.g., transport processes and the location of the discharge point), domestic pet and terrestrial wildlife waste, fertilizers, and vegetation/biofilms appear to be the greatest sources of FIB to the watershed.

## Summary of Current BMPs and Recommended Next Steps

Based on the review of available information, it is clear that a variety of pollution prevention, source control and treatment control BMPs have been implemented by public agencies in the Newport Bay watershed. In most cases, these BMPs are specifically intended to reduce or prevent water quality impacts associated with FIB. In summary:

- Urban Runoff BMPs - Significant efforts have been taken by local municipalities to reduce the impacts of urban runoff on Newport Bay, including: 1) the adoption of local ordinances to prevent pet waste impacts; 2) reducing fertilizer impacts by promoting Integrated Pest Management; 3) reducing excess irrigation and promoting water conservation; 4) preventing and responding to illegal discharge and illicit connections; 5) diverting nuisance dry weather flows away from the storm drain system; and, 6) implementing effective street sweeping, solid waste collection and drainage maintenance programs.
- Agricultural Runoff BMPs - The Regional Board has issued Waste Discharge Requirements (WDR) to each nursery in the watershed greater than 5 acres in size, which require BMPs to be implemented. Additionally, BMP handbooks have been developed to protect water quality from nurseries and equestrian-related activities.
- Vessel Waste BMPs - Significant improvements to vessel waste pumpout accessibility have been made in recent years. Currently, there are 16 pumpout stations in Newport Bay. Orders developed by the Regional Board require these stations to be inspected on a frequent basis (e.g., multiple times per week), and report and remedy issues observed in a timely manner.

- Other Urban Sources:
    - Septic System BMPs - Septic systems are present in the northeastern portion of the San Diego Creek subwatershed. To help insure that these systems do not impact water quality in Newport Bay, the Orange County Stormwater Program published a public education brochure which was sent to septic system owners and is currently available on their website.
    - Sewer Line BMPs - Many of the cities in the Newport Bay watershed have adopted ordinances requiring maintenance of sewer service laterals. Additionally, the City of Newport Beach consistently repairs or replaces local sewer lines, laterals and cleanouts within their jurisdiction. Presently, the City of Newport Beach is on a one-year program of sewer cleaning, and areas needing more frequent cleaning are cleaned as frequently as monthly and quarterly. The City of Newport Beach is also in the process of a conducting a multi-year video inspection of the all local sewer lines in their jurisdiction. Additionally, OCSD is planning a variety of rehabilitation projects on their regional sewer lines and pump stations in the Lower Newport Bay subwatershed.
    - Sanitary Sewer Overflow BMPs - Sewer In response to the beach closures, the Santa Ana Regional Board adopted WDRs for the operation of sewage collection systems, which apply to the cities within the Newport Bay Watershed. One of the requirements of the WDR is preparation and implementation of a Sewer System Management Plan (SSMP). Additionally, cities within the watershed also have extensive FOG inspection programs, and in coordination with some cities in the watershed, the County has implemented a spill control program for SSOs.
    - Swimmer Shedding BMPs - Based on the review of information provided, no BMPs associated with swimmer shedding are currently implemented in the watershed.
- BMPs for Natural Sources - Managing natural source (i.e., wildlife and waterfowl) impacts to water quality are neither straightforward nor successful. Only one existing BMP intended to reduce the impacts of FIB from water birds was identified during this review (i.e., the relocation of a large number of Mallard Ducks conducted by the City of Newport Beach).
- BMPs for Dunes Recreational Area – Water quality at the Dunes Recreational Area has improved substantially over the last decade, to a point that FIB concentrations appear to no longer be of concern during dry weather periods. Therefore, recommended BMPs specific to this area include continued implementation of BMPs. These include, diversion of the Back Bay Drain to the Orange County Sanitation District (OCSD) treatment facility during dry weather months (April-September), and continued plugging during dry weather of small drains that receive runoff from the parking lots and landscaped areas adjacent to the Dunes.

Based on information compiled, reviewed and analyzed as part of the SMP development, recommended next step are provided on: 1) New and/or enhanced BMPs for all sources and pathways that appear to contribute to FIB to specific areas of potential concern in the Bay; 2) Technical studies intended to assist watershed managers in developing a better understanding of FIB contributions to the Bay from specific sources and pathways; and, 3)

Revisions to selected portions of the Santa Ana Basin Water Quality Control Plan (Basin Plan) applicable to FIB in the Bay.

Recommended BMPs to improve water quality conditions during dry weather dry weather priority areas are summarized in Table ES.3. For ease of presentation, dry weather priority areas were grouped into four geographical areas (i.e., Western Newport Bay, Bayside Drive Beach, 10th St. Beach, and Upper Bay). Recommended BMPs for wet weather include: 1) High Priority - BMPs that address contributions of FIB and pathogens from human-associated sources; 2) Medium Priority - BMPs that reduce the contributions of FIB onto the surface of the watershed from sources during dry weather; and 3) Lower Priority - BMPs that attempt to treat wet weather urban runoff (i.e., diversions or on-site disinfection) at large costs and significant engineering limitations.

In addition to BMPs, technical studies that reduce uncertainties in our understanding of FIB contributions from specific sources and pathways to priority areas are recommended. These include: 1) characterizing contributions of FIB from biofilms; 2) investigation of Santa Ana Delhi Channel FIB sources and relative impacts to Bay water quality; 3) enhanced source identification studies at dry weather priority areas; and 4) quantification of FIB contributions from natural sources. Recommended modifications to existing water quality standards, the Newport Bay Fecal Coliform TMDL, and FIB monitoring in the Newport Bay are also recommended.

Table ES.3. Recommended Best Management Practices (BMPs) to reduce FIB at dry weather priority areas in Newport Bay.

| Source/BMP Category | Recommended BMP | Dry Weather Priority Area | | | |
|---|---|---|---|---|---|
| | | Western Newport Bay | Bayside Drive Beach | 10th St. Beach | Upper Bay |
| Urban Runoff | | | | | |
| Domestic Pet Waste | City/County Ordinance Enforcement | High | High | High | High |
| | Public Education and Outreach to Residents and Dog-walkers | High | High | High | High |
| | Bag Dispenser Program at Parks/Waterfront Areas | High | High | High | High |
| Fertilizers, Biosolids & Over-Irrigation | Model IPM Program Implementation | High | High | High | High |
| | Identifying Com. and Res. Property-owners Over-Irrigating and Promotion of Smart Controllers | High | High | High | High |
| | Adoption of Water Conservation in Landscaping Ordinance Pertaining to Res. and Com. Props. | High | High | High | High |
| | Public Education and Outreach | High | High | High | High |
| Illegal Discharges & Illicit Connections | Implementation of ID/IC Programs | Medium | Medium | Medium | High |
| | Source Characterization via Sanitary Surveys | Medium | Low | Medium | Medium |
| Municipal Maint. | Implementation of Model Municipal Maintenance Program | High | High | High | High |
| Urban Runoff Treatment | Natural Treatment Systems in the San Diego Creek Watershed | NA | NA | Low | NA |
| | Advanced Treatment (on-site disinfection or diversion) | Low | Low | Low | Low |
| Vessel Waste (Including Pumpout Stations) | | | | | |
| Vessel Discharges | Enforcement of No Discharge Zone and Local Ordinances | High | High | High | NA |
| Pumpout Stations | Implementation of Pumpout Station Operation, Maintenance and Inspection Programs | High | High | High | NA |
| Other Urban Sources | | | | | |
| Septic Tank Systems | Public Education and Outreach | NA | NA | NA | Low |
| Sewer Lines | Inspection and Possible Replacement of Sewer Lines at Current Level of Effort | Low | Low | High | Low |
| SSOs & Spills | BMPs for Reducing SSOs and Sewage Spills | Low | Low | NA | NA |
| Swimmer Shedding | Public Education and Required Showering Prior to Swimming | Low | Low | Low | Low |
| Agricultural Runoff | | | | | |
| Nurseries | Implementation of Runoff Reduction Measures | Low | Medium | NA | Medium |
| | Periodic Site Inspections of Nurseries | Low | Low | NA | Low |
| Equestrian Activities | Implementation of Equestrian-Related BMPs to Protect Water Quality | Low | Low | Low | Low |
| Natural Sources | | | | | |
| Wildlife | Relocating or Hazing Birds from Lower Bay Beaches | Low | Low | Medium | NA |
| Veg/Biofilm/Sediment | Implementation of Municipal Maintenance & Vegetation Waste Management Programs | High | High | High | High |

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# LIST OF ACRONYMS

| | |
|---|---|
| AVMA | American Veterinary Medical Association |
| BBLM | Beach Boundary Layer Mathematical Model |
| BEACH Act | Beaches Environmental Assessment and Coastal Health Act |
| BMP | Best Management Practice |
| BTO | Bay to Ocean |
| BYB | Balboa Yacht Basin |
| CCR | California Code of Regulations |
| CFU | Colony Forming Units |
| COMM | Commercial and Sport Fishing Beneficial Use |
| CWA | Clean Water Act |
| DFG | California Department of Fish and Game |
| DWR | California Department of Water Resources |
| EOA | Eisenberg, Olivieri & Associates |
| EPA | US Environmental Protection Agency |
| FIB | Fecal Indicator Bacteria |
| FOG | Fats, Oils and Grease |
| GPD | Gallons per Day |
| HCP | Habitat Conservation Plan |
| HOA | Home Owners Association |
| ID/IC | Illegal Discharges and Illicit Connections |
| IPM | Integrated Pest Management |
| IRWD | Irvine Ranch Water District |
| KLI | Kinnetic Laboratories, Inc. |
| LA | Load Allocation |
| MAR | Marine Habitat Beneficial Use |
| MEP | Maximum Extent Possible |
| MGD | Million Gallons per Day |
| MPN | Most Probable Number |
| MS4 | Municipal Separate Storm Sewer System |
| MSD | Marine Sanitation Devices |
| NCCP | Natural Community Conservation Planning |
| NDZ | No Discharge Zone |
| NPDES | National Pollution Discharge Elimination System |
| NPS | State of California Non-point Source Program |
| NTAC | National Technical Advisory Committee |
| NWR | National Wildlife Refuge |
| OAL | Office of Administrative Law |
| OCCK | Orange County Coastkeeper |
| OCHCA | Orange County Health Care Agency |
| OCPFRD | Orange County Public Facilities and Resource Department |
| OCSD | Orange County Sanitation District |
| OCWP | Orange County Watersheds Program |
| PFGE | Pulsed Field Gel Electrophoresis |
| RARE | Preservation of Rare and Endangered Species Beneficial Use |
| REC-1 | Water Contact Recreation Beneficial Use |
| REC-2 | Non-contact Water Recreation Beneficial Use |
| ROI | Region of Impact |

| | |
|---|---|
| SAD | Santa Ana Delhi |
| SDC | San Diego Creek |
| SHEL | Shellfish Harvesting Beneficial Use |
| SMP | Source Management Plan |
| SPON | Stop Polluting our Newport |
| SPWN | Fish Spawning |
| SSM | Single Sample Maximum |
| SSMP | Sewer System Management Plan |
| SSO | Sanitary Sewer Overflow |
| TAC | Technical Advisory Committee |
| TASC | Tustin Area Spill Control |
| TMDL | Total Maximum Daily Load |
| UCCE | University of California Cooperative Extension |
| UPV | Upper Percentile Value |
| USACE | US Army Corps of Engineers |
| WDR | Waste Discharge Requirements |
| WILD | Wildlife Habitat Beneficial Use |
| WLA | Waste Load Allocation |
| WNB | West Newport Bay |
| WQA | Water Quality Act |
| WQO | Water Quality Objective |

# 1.0 INTRODUCTION

Newport Bay (Bay) is located in southern Orange County, approximately 40 miles south of Los Angeles and 70 miles north of San Diego. The Bay is the second largest estuarine embayment in southern California and is made up of two water bodies, the Upper Bay and the Lower Bay, which is commonly referred to as Newport Harbor. The Upper Bay was carved out by the prehistoric flow of the Santa Ana River and is currently a high value estuary that contains a State Ecological Reserve. The Upper Bay feeds and eventually joins Newport Harbor, which was created through sand deposition and then modified through dredging and filling. The Harbor includes Balboa Island, Bay Island, Harbor Island, Lido Isle and Linda Isle. Newport Bay is a regionally important recreational area where thousands of people visit every year and take part in various recreational activities, including swimming and boating. Newport Harbor is one of the largest pleasure craft harbors in the United States.

Figure 1.1 Newport Bay and surrounding area.

Due to the presence of swimming[2] and other full contact recreational activities within the Bay and the level of recreational uses at some sites, the Orange County Health Care Agency (formerly the Health Department) began monitoring fecal indicator bacteria (FIB) in 1972. These early data raised some concerns regarding the potential for illness in those individuals recreating in the Bay. This concern continued through the next 14 years, during which beach closures and warnings occurred consistently at some sites in the Bay. In 1986, the Santa Ana Regional Water Quality Control Board (Regional Board) identified and listed Newport Bay (Lower and Upper) as a water quality limited receiving water body for

[2] In 1975 the California Department of Fish and Game adopted the following prohibition on swimming in the upper bay "Swimming is permitted only in that area bayward from North Star Beach to mid-channel." (Section 14.630.117 (B) CCR). Further, The City of Newport prohibits swimming in the main channel or entrance to the Newport Harbor (Newport Beach Municipal Code 11.12.130).

pathogens in accordance with Section 303(d) of the Federal Clean Water Act. This listing (and associated policies developed as a result of this listing), began a series of technical studies and initial implementation actions that form our current understanding of FIB sources, pathways and effective control options for the Bay.

## 1.1 Water Quality Impairment and Fecal Coliform TMDL Requirements

In April 1999, the Regional Board amended the Santa Ana Region Water Quality Control Plan (Basin Plan) by adopting the *Total Maximum Daily Load (TMDL) for Fecal Coliform in Newport Bay* (Fecal Coliform TMDL). The Fecal Coliform TMDL includes Waste Load Allocations (WLAs) for point sources and Load Allocations (LAs) for non-point sources (Table 1.1). Waste Load Allocations (WLAs) are specified for vessel waste and urban runoff, including stormwater. Municipal stormwater (i.e., urban runoff) quality is regulated under a Countywide NPDES permit issued by the Regional Board. Urban runoff is thus regulated as a point source, even though it is diffuse in origin. Load Allocations (LAs) are specified for fecal coliform inputs from agricultural runoff, including dry weather and stormwater runoff, and natural sources.

Table 1.1. Total Maximum Daily Load (TMDL), Waste Load Allocations (WLAs), and Load Allocations (LAs) for Fecal Coliform in Newport Bay (Regional Board1999).

| TMDL/Schedule for REC-1 and SHELL Uses | WLAs for Urban Runoff | LAs for Agricultural Runoff | LAs for Natural Sources | WLAs for Vessel Waste |
|---|---|---|---|---|
| REC-1 Beneficial Use | | | | |
| TMDL: 30-day/5-sample Geometric Mean less than 200 organisms/100mL, and not more than 10% of the samples exceed 400 organisms/100mL for any 30-day period. | Same as TMDL | | | No Discharges (0 Organisms/100mL) |
| Schedule | 14 years after Approval | | In Effect | In Effect |
| SHELL Beneficial Use | | | | |
| TMDL: Monthly Median less than 14 MPN/100mL, and not more than 10% of the samples exceed 43 organisms/100 mL. | Same as TMDL | | | No Discharges (0 Organisms/100mL) |
| Schedule | 20 years after Approval | | | In Effect |

The TMDL and all allocations were established at concentrations equivalent to the Water Quality Objectives (WQOs) for recreational waters that are currently in the Basin Plan. Therefore, a substantial margin of safety is implicitly incorporated in the TMDL due to the fact that the TMDL does not incorporate considerations of pathogen sources, dilution, natural die-off or tidal flushing within the Bay. Compliance dates for meeting interim allocations (i.e., REC-1 fecal coliform WQO) is December 30, 2014. Shellfish WQOs are to be achieved by no later than December 30, 2019.

Recognizing the complexity of the bacterial water quality problem, the paucity of relevant data on bacterial sources, and the expected difficulties in identifying and implementing appropriate control measures, the TMDL included a prioritized, phased approach to achieving load allocations. This phased TMDL approach called for further data collection and analyses concerning the sources and impacts of fecal coliform inputs to the Bay. Descriptions, compliance dates and summaries of these studies are included in Table 1.2.

## 1.2 Proposition 13 Grant (Source Identification and Management Plan)

Building upon studies conducted since 1986, the County of Orange (County) received grant[3] funding in 2005 from the State Water Resources Control Board (State Board) to: 1) conduct studies in Newport Bay to better identify and quantify the contribution of urban and natural sources of FIB impairment in the Bay; and, 2) prepare a Fecal Coliform Source Management Plan (SMP). The first task was intended to assist the Regional Board and local agencies in better defining the relative contribution of natural and urban sources, which will allow watershed managers to make cost effective and scientifically justifiable decisions regarding which sources to target for management. This task was named the *Proposition 13 Newport Bay Fecal Coliform Source Identification Project* (Source ID Project), and was comprised of the following four subtasks:

1. Field sampling studies to characterize the loading of FIB from urban and natural sources in and around the perimeter of the Upper Bay (Grant Task 2.1.1);
2. Field sampling, microcosm, and reconnaissance studies to assess potential urban sources of FIB to Lower Bay from subsurface sewage leaks, pump-out stations, docks and wharves, wash-down activities, and storm drains (Grant Task 2.1.2);
3. Microcosm and field studies to characterize the rate and magnitude of natural sources and within-Bay processes that affect the concentration of FIB in the Bay water column (Grant Task 2.1.3); and,
4. Advanced molecular and biochemical studies on enterococci and *Escherichia coli* cultures isolated from the Bay to assess their likely origin (i.e., human fecal, non-human fecal, not fecal) (Grant Task 2.1.4).

Information gained through the Source ID Project is currently being finalized and is included in the Source ID Project Report (Grant et al. 2009).

This document serves as the deliverable for the second task of the Proposition 13 Grant (i.e., Source Prioritization and Management Plan Development). Much of the information gained through the Source ID Project is further utilized in this document to identify and prioritize FIB sources for management consideration.

[3] Proposition 13 Coastal Nonpoint Source Pollution Control Grant Program

Table 1.2. Tasks to be addressed through the Newport Bay Fecal Coliform TMDL (Regional Board 1999).

| Task | Description | Compliance Date | Deliverable | Current Status |
|---|---|---|---|---|
| Task 1 | Routine Monitoring Program (Section 3.a.ii.a) | | | |
| | a) Submit Proposed Routine Monitoring Plan(s) | a) January 30, 2000 | TMDL Technical Report | Approved 11/17/00 (Resolution 00-100) |
| | b) Implement Routine Monitoring Plan(s) | b) Upon Regional Board Approval of Plan(s) | Orange County Health Care Agency Plan | On-going |
| | c) Submit Monthly and Annual Reports (Reporting Period: April 1-March 31) | c) Monthly within 30 days, Annual Report by September 1 | Monthly and Annual Reports | On-going |
| Task 2 | Water Quality Model for Bacterial Indicators (Section 3.a.ii.b) | | | |
| | a) Submit Proposed Model Development Plan | a) January 30, 2000 | TMDL Technical Report | Approved 11/17/00 (Resolution 00-100) |
| | b) Submit Calibrated Model and Model Documentation | b) 13 months after Regional Board approval of plan(s) | Technical Report | Completed |
| Task 3 | Beneficial Use Assessment Plan (Section 3.a.ii.c) Submit Proposed Assessment Plan for: | | | |
| | a) REC-1 | a) January 30, 2000 | TMDL Technical Report | Approved 11/17/00 (Resolution 00-100) |
| | b) SHEL | b) March 1, 2001 | *Work plan for the Beneficial Use Assessment for Shellfish Harvesting in Newport Bay (KLI and EOA 2001)* | Approved 6/1/01 (Resolution 01-59) |
| Task 4 | Beneficial Use Assessment Report (3.a.ii.c) Submit Beneficial Use Assessment Report for: | | | |
| | a) REC-1 | a) 13 months after Regional Board approval of plan(s) | *Public Health Risk Assessment for the Newport Bay Watershed: Recreational Contact and Microbiological Risk (EOA 2001, Soller et al. 2006)* | Completed 9/01 |
| | b) SHEL | b) 13 months after Regional Board approval of plan(s) | *Newport Bay Shellfish Harvesting Assessment Final Report (KLI and EOA 2004); Newport Bay Shellfish Beneficial Use Assessment Validation (KLI and Soller Env. 2007)* | Completed 8/04; 9/07 |

| Task | Description | Compliance Date | Deliverable | Current Status |
|---|---|---|---|---|
| Task 5 | Source Identification and Characterization Plan(s) (Section 3.a.ii.d) Submit Proposed Source Identification Plans for: | | | |
| | a) The Dunes Resort | a) March 1, 2000 | TMDL Technical Report | Approved 11/17/00 (Resolution 00-100) |
| | b) Urban Runoff (including stormwater) | b) March 1, 2000 | *Prop 13 Project Plan (Grant et al. 2005)* | Rejected 11/17/00; Prop. 13 grant awarded 2/05 |
| | c) Agriculture (including stormwater) | c) April 1, 2000 | TMDL Technical Report | Approved 11/17/00 (Resolution 00-100) |
| | d) Natural Sources | d) April 1, 2000 | *Prop 13 Project Plan (Grant et al. 2005)* | Rejected 11/17/00; Prop. 13 grant awarded 2/05 |
| Task 6 | Source Identification and Characterization Reports (Section 3.a.ii.d) Submit Source Identification and Characterization Reports for: | | | |
| | a) The Dunes Resort | a) 7 months after Regional Board approval of plan(s) | *Swimmer Shedding Study in Newport Dunes, California (Jiang et al. 2005)* | Completed |
| | b) Urban Runoff (including stormwater) | b) 13 months after Regional Board approval of plan(s) | *Prop 13 Newport Bay Fecal Coliform Source Identification Project* | On-going under Prop. 13 Project |
| | c) Agriculture (including stormwater) | c) 16 months after Regional Board approval of plan(s) | *UC Cooperative Extension Agricultural Runoff Study (Kabashima and Haver 2003)* | Completed |
| | d) Natural Sources | d) 16 months after Regional Board approval of plan(s) | *Prop 13 Newport Bay Fecal Coliform Source Identification Project* | On-going under Prop. 13 Project |
| Task 7 | Evaluation of Vessel Waste Program (Section 3.a.ii.e) | | | |
| | a) Submit Proposed Plan for Evaluating the Current Vessel Waste Program | a) April 1, 2000 | TMDL Technical Report | Approved 11/17/00 (Resolution 00-100) |
| | b) Submit Report on the Evaluation of the Vessel Waste Program | b) 12 months after Regional Board approval of plan | Public Health Risk Assessment for the Newport Bay Watershed: Recreational Contact and Microbiological Risk (EOA 2001); The Contribution of Marinas to Fecal Indicator Bacteria Impairment in Lower Newport Bay, Southern California (Grant et al. 2004) | Completed 9/01; Completed 9/04 |

| Task | Description | Compliance Date | Deliverable | Current Status |
|---|---|---|---|---|
| Task 8 | TMDL, WLA, and LA Evaluation and Source Monitoring Program (Section 3.a.ii.f) | | | |
| | a) Submit Proposed Evaluation and Source Monitoring Program Plan(s) | a) 3 months after completion of Tasks 2, 4a, and 6 | To be completed | |
| | b) Implement Evaluation and Source Monitoring Plan(s) | b) Upon Regional Board approval of plan(s) | | |
| | c) Submit Monthly and Annual Reports (Reporting Period: April 1-March 31) | c) Monthly within 30 days, Annual Report by September 1 | | |
| Task 9 | Updated TMDL Report; Submit updated TMDL report for: | | | |
| | a) REC-1 | a) 6 months after completion of Tasks 2, 4a, 6, and 7 | To be completed | |
| | b) SHEL | b) 6 months after completion of Tasks 2, 4b, 6, and 7 | | |
| Task 10 | Adjust TMDL, if necessary; adopt interim WLAs, LAs, and Compliance Dates (Section 3.a.ii.h) | | | |
| | a) REC-1 | a) 12 months after completion of Updated TMDL Report for REC-1 (Task 9.a) | To be completed | |
| | b) SHEL | b) 12 months after completion of Updated TMDL Report for SHEL (Task 9.b) | | |

## 1.3 Purpose of Source Management Plan

The goals of the *Newport Bay Fecal Coliform Source Management Plan* (SMP) are to evaluate and prioritize sources of FIB, assess existing best management practices (BMPs) currently implemented in the Bay watershed, and recommend BMPs for site-specific and bay-wide sources of FIB, including planning-level costs associated with site specific and programmatic efforts. Sources are prioritized based on the nature and magnitude of loading, water quality impacts and control feasibility. The SMP recommends pollution prevention, source controls and treatment controls for the Bay, including localized implementation measures for specific sources where possible. These recommendations are tied to the goals and timeframes of the Fecal Coliform TMDL.

The SMP builds upon the information gained through studies conducted over the last decade, including the Source ID Project. The SMP is intended to provide a focused road map for local agencies and the Regional Board in their efforts to further reduce FIB in Newport Bay, with the ultimate goal of protecting human health and applicable beneficial uses.

The SMP development was guided by the following primary management questions:

- *Have water quality conditions associated with FIB in the Bay gotten better or worse over time (Section 4.0)?*
- *What are the current frequencies and magnitudes of water quality standard exceedances under wet and dry weather conditions in the Bay (Sections 4.0 & 6.0)?*
- *What are the most important sources, pathways and factors affecting FIB concentrations in the Bay and which of these contribute to current exceedances of water quality standards (Sections 5.0 and 7.0)?*
- *To what degree are existing Best Management Practices (BMPs) implemented to reduce FIB sources and transport to the Bay (Section 8.0)?*
- *What are the relative costs, feasibilities and predicted successes of implementing additional or enhanced BMPs (Section 9.0)?*
- *Which BMPs are recommended for implementation in the future and where should they be implemented (Sections 8.0 & 9.0)?*

It is important to note that although the Fecal Coliform SMP was initially focused on fecal coliform bacteria, the Bay is listed as impaired by the broader category of “pathogens”, and therefore the SMP also addresses enterrococci[4] bacteria. Also, as additional knowledge is gained regarding the extent of water quality impairment in Newport Bay, contributions to impairment from particular sources, and the effectiveness of management actions, this SMP may be revised to incorporate this information. Therefore, this SMP should be considered a living/working document.

[4] Enterococci bacteria are currently the fecal indicator bacteria (FIB) for which the U.S. EPA has based its water quality criteria that apply to marine recreational waters in the State of California (USEPA 2000).

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# 2.0 NEWPORT BAY WATERSHED AND STAKEHOLDERS

The Newport Bay watershed is approximately 152 square miles ($mi^2$) and drains land from eastern Orange County to the Pacific Ocean (Figure 2.1). Two-thirds of the watershed is urbanized and includes all or portions of the cities of Costa Mesa, Irvine, Laguna Hills, Laguna Woods, Lake Forest, Newport Beach, Orange, Santa Ana and Tustin; and the unincorporated County of Orange and the Orange County Flood Control District (OCWP 2006). Of the remaining land, one-half is un-developable due to mountainous slopes or protected habitat. About 27$mi^2$ of open space within the watershed is set aside, and includes the Natural Community Conservation Plan & Habitat Conservation Plan (NCCP/HCP), the Laguna Coast Wilderness Park, Mason Regional Park, Peters Canyon Regional Park, Upper Newport Bay Ecological Reserve, and the University of California Irvine Reserve. Additional habitat areas include the Siphon Reservoir Coastal Sage Scrub Restoration Site, San Joaquin Marsh, the proposed El Toro National Wildlife Refuge (NWR)[5], and the 17 mitigation sites identified for the Clean Water Act Section 404 by the U.S. Army Corps of Engineers (USACE) Regulatory Branch (OCWP 2006).

## 2.1 Subwatersheds and Tributaries

The Newport Bay watershed can be divided into four subwatersheds: 1) Lower Bay; 2) Upper Bay; 3) Santa Ana Delhi Channel; and, 4) San Diego Creek/Peters Wash (Figure 2.1). The Lower Bay subwatershed is roughly 7 $mi^2$ in size. It is almost entirely urban, receives drainage primarily from stormwater conveyance systems, and includes the cities of Newport Beach and Costa Mesa.

The Upper Bay subwatershed begins at the Hwy-1 Bridge and ends at confluence of the two main tributaries draining to the Bay - San Diego Creek and the Santa Ana-Delhi Channel. The Upper Bay subwatershed is roughly 9 $mi^2$ and includes land area within the cities of Newport Beach and Costa Mesa (Table 2.1). Big Canyon Creek and Costa Mesa Channel are the major tributaries in this subwatershed.

The Santa Ana Delhi Channel subwatershed is 17 $mi^2$ and empties into the far northwestern end of Upper Newport Bay. This subwatershed includes the cities of Costa Mesa, Santa Ana, Irvine and Newport Beach, along with the Unincorporated County (Table 2.1).

Lastly, the San Diego Creek/Peters Canyon Wash (San Diego Creek) subwatershed makes up about 119 $mi^2$ (77%) of the entire Newport Bay watershed and includes portions of the cities of Costa Mesa, Irvine, Tustin, Lake Forest, Laguna Hills, Laguna Woods, Orange and Santa Ana, along with the Unincorporated County (Table 2.1). San Diego Creek is the main tributary in this subwatershed and drains into the northeastern Upper Newport Bay. Historically only about 15 square miles of land drained into the bay via San Diego Creek. However, the drainage area was increased to about 119 square miles by the channelization of San Diego Creek as part of a major flood control project completed in 1968.

[5] The proposed El Toro NWR was a part of the El Toro Marine Corps Air Station and encompasses approximately 890 acres. The Federal Aviation Authority (FAA) currently has ownership of the property.

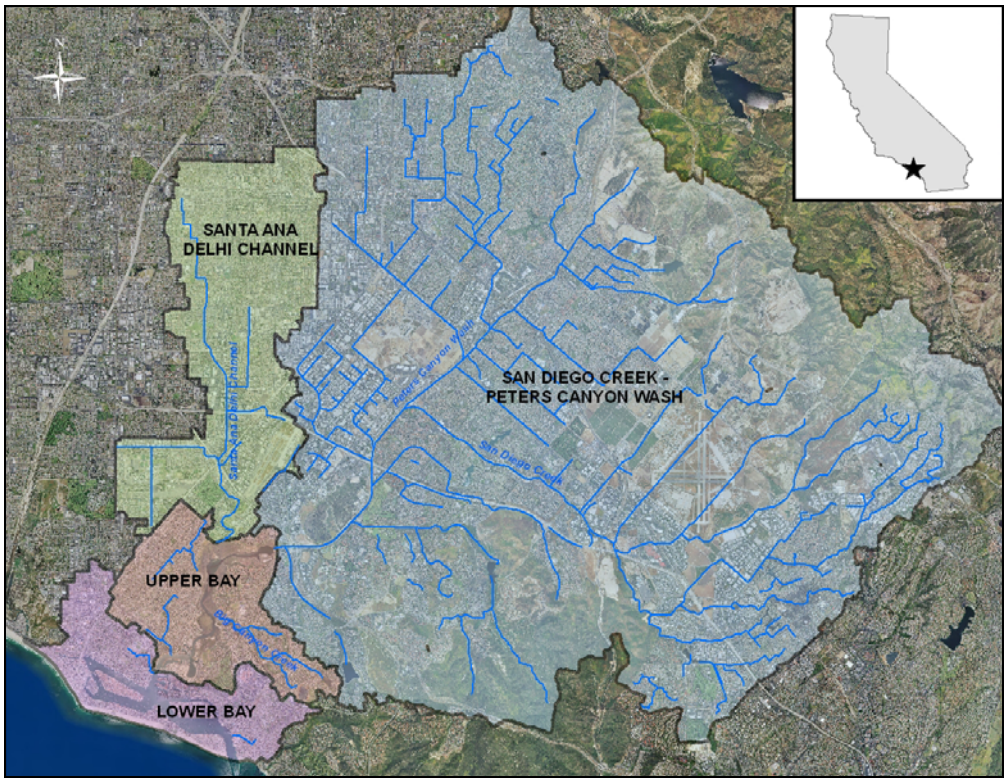


Figure 2.1 Newport Bay subwatersheds and tributaries.

Table 2.1. Percentage of land area in the Newport Bay watershed and subwatersheds within the boundaries of municipalities in Orange County.

| Municipality | Total Area (mi²) | Subwatershed | | | |
|---|---|---|---|---|---|
| | | Lower Bay (%) | Upper Bay (%) | Santa Ana Delhi Channel (%) | San Diego Creek (%) |
| City of Irvine | 65.8 | - | - | 1.5 | 38.8 |
| County of Orange | 15.0 | - | 3.5 | 7.8 | 34.0 |
| City of Santa Ana | 16.4 | - | - | 62.3 | 4.8 |
| City of Newport Beach | 17.1 | 87.5 | 73.0 | 1.3 | 2.1 |
| City of Tustin | 11.1 | - | - | - | 9.2 |
| City of Lake Forest | 11.6 | - | - | - | 7.0 |
| City of Costa Mesa | 7.7 | 12.2 | 23.5 | 27.0 | - |
| City of Laguna Woods | 1.9 | - | - | - | 1.5 |
| City of Orange | 1.9 | - | - | - | 1.5 |
| City of Laguna Hills | 1.2 | 0.3 | - | - | 1.0 |
| Total Area | 152 | 7.4 | 8.6 | 17.1 | 119.1 |

## 2.2 Land Uses and Geographical Features

There are numerous land uses in the Newport Bay watershed including residential, commercial, industrial, agricultural, infrastructure, mixed, and recreational/open space (Figure 2.2). Residential, commercial and recreational/open space land uses form the greatest portion of the Newport Bay watershed, although land uses vary between subwatersheds (Table 2.2).

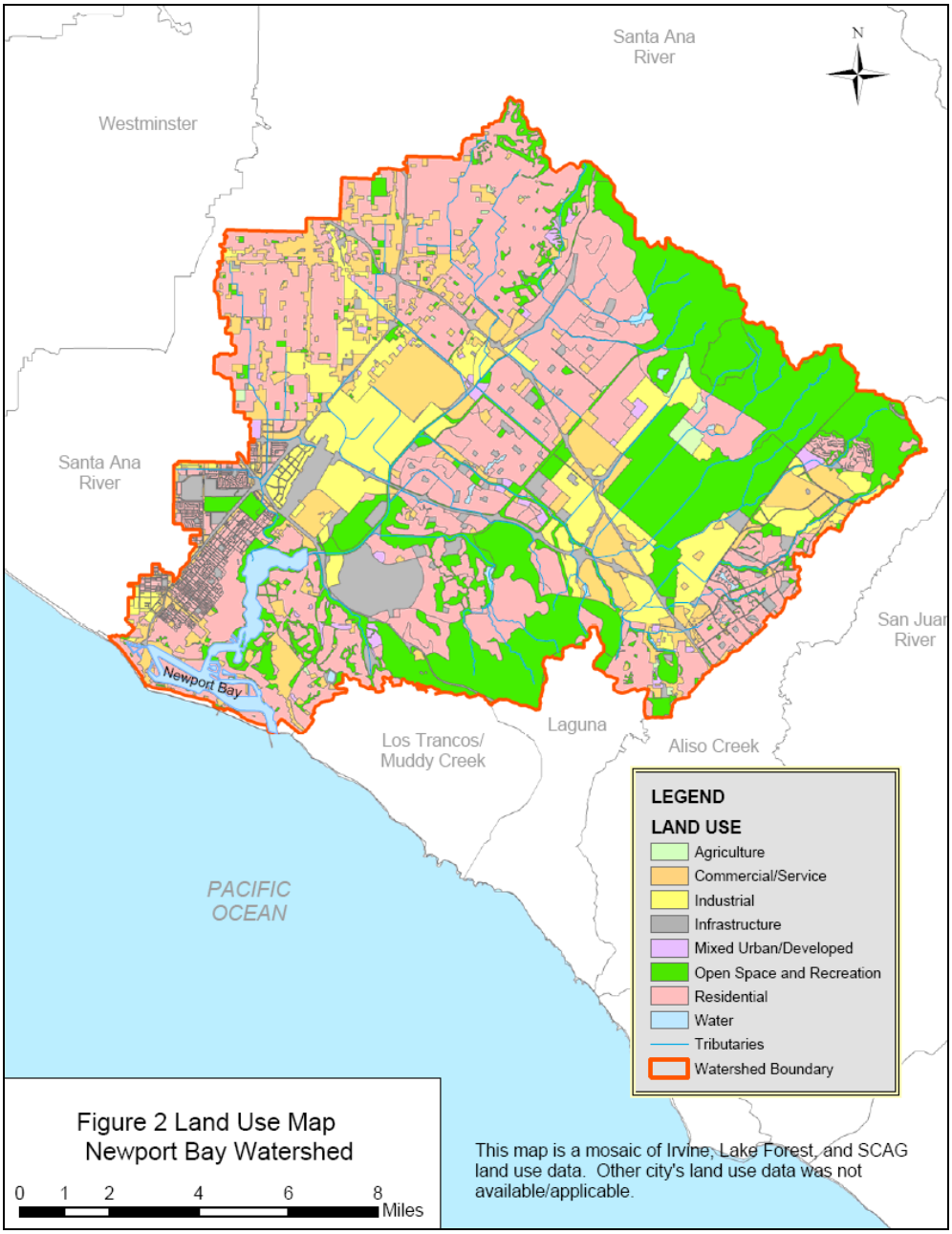


Figure 2.2. Land uses within the Newport Bay watershed.

Table 2.2. Percentage of different land uses in Newport Bay watershed and subwatersheds.

| Land Use | Upper and Lower Bay | Santa Ana Delhi Channel | San Diego Creek | Newport Bay |
|---|---|---|---|---|
| Agriculture Use | 0.9% | 0.0% | 6.5% | 5.2% |
| Commercial | 14.1% | 16.6% | 8.2% | 9.8% |
| Education and Religion | 0.7% | 1.1% | 0.3% | 0.4% |
| Industrial | 3.2% | 7.6% | 5.1% | 5.4% |
| Recreational/Open Space | 9.9% | 8.6% | 28.5% | 24.4% |
| Residential | 40.4% | 36.6% | 15.0% | 19.7% |
| Transportation, Communication & Utility | 0.8% | 0.7% | 1.5% | 1.3% |
| Vacant Land | 12.4% | 5.7% | 20.3% | 17.7% |
| Roads | 17.5% | 23.1% | 14.6% | 16.0% |

In addition to land uses, there are at least two large-scale water resource features in the Newport Bay watershed that should be discussed. These are the Upper Newport Bay Ecological Preserve and the Newport Harbor.

The Upper Newport Bay Ecological Reserve was created in 1975 as a result of the purchase of 527 acres of land in and around the Bay from the Irvine Company and the transfer of 214 acres of tidal wetlands from the County of Orange to the State. An additional 11 acres of land in Big Canyon was added in 1982 bringing the total acreage of the Ecological Reserve to 752 acres. The preserve is managed by the California Department of Fish and Game (DFG).

The Lower Bay was historically a coastal lagoon formed between 1824 and 1862 because of sand deposition from the Santa Ana River. In the early 1920's, U.S. Army Corps of Engineers diverted the Santa Ana River from the Lower Bay, dredged channels and constructed a short west jetty entrance to the Pacific Ocean. In 1936, the final major jetty extension, dredging, and landfill projects were completed, creating what is known today as the Newport Harbor. The Newport Harbor is roughly four miles long is a regionally important recreational area where thousands of people visit every year and take part in various recreational activities.

## 2.3 Newport Bay Stakeholders

Two stakeholder groups were formed to review scientific and programmatic issues related to the Newport Bay Fecal Coliform TMDL and the Newport Bay/San Diego Creek watershed. The Regional Board formed a Technical Advisory Committee (TAC) to review and provide input on the scientific studies, data and results related to the Newport Bay Fecal Coliform TMDL. The TAC includes members from the Regional Board, the County of Orange Health Care Agency, the University of California at Irvine, the County of Orange Public Works Department, City of Newport Beach, Orange County Sanitation District, Orange County Coastkeeper and Stop Polluting Our Newport (SPON).

Additionally, the Newport Bay Watershed Management Committee was formed to advise the Newport Bay Watershed Executive Committee which, in turn, was formed by agreement between the County of Orange, the cities of Newport Beach, Irvine, Lake Forest and Tustin, the Irvine Company, California Department of Fish and Game, the Regional Board and

Irvine Ranch Water District (IRWD). Members of the Management Committee were appointed by the Executive Committee and include staff from the County of Orange, local municipalities in the Newport Bay watershed, the Army Corps of Engineers, U.S. Environmental Protection Agency, Department of Fish and Game, the Coastal Conservancy, the University of California Cooperative Extension and an environmental representative. Meetings of the Management Committee are held quarterly and are open to the public.

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# 3.0 APPLICABLE WATER QUALITY STANDARDS

A water quality standard is comprised of a beneficial use and the water quality criteria[6] necessary to protect that use or uses (U.S. EPA 1983). Water quality criteria for bacteria may be defined as concentrations of indicator organisms (e.g., fecal coliform) that should not be exceeded to protect human health from pathogen-caused illness (U.S. EPA 2004b). This section provides background information on beneficial uses designated for the Newport Bay by the Santa Ana Regional Water Quality Control Board (Regional Board), State and local prohibitions relevant to these uses, and the results of previous beneficial use assessments designed to evaluate the level of recreational uses in Newport Bay. Additionally, pertinent water quality criteria and objectives are discussed.

## 3.1 Relevant Beneficial Uses

Under California law, beneficial uses establish how a body of water can be used for the benefit of people or wildlife. Examples include drinking, swimming, industrial and agricultural water supply, and the support of fresh and saline aquatic habitats. As required by Section 303 of the Federal Clean Water Act (33 USC §1313), uses in California are designated and adopted into a Water Quality Control Plan (Basin Plan) by Regional Water Quality Control Boards. These designations are not final until approved by the State Water Resources Control Board, the Office of Administrative Law (OAL) and the U.S. EPA (EPA).

The first complete Basin Plan for the Santa Ana region was adopted by the Regional Board in 1975. Beneficial Uses were tabulated in Chapters 1 and 2. Since that time, the Basin Plan was amended by the Regional Board in 1983, 1989, 1995 and 2008. Uses associated with recreation (REC-1 and REC-2), commercial and sport fishing (COMM), aquatic habitat (WILD, RARE, SPWN and MAR) and shellfish harvesting (SHEL) have been designated by the Regional Board for Lower and Upper Newport Bay (Table 3.1).

Table 3.1. Beneficial uses designated in the *Water Quality Control Plan for the Santa Ana Region* for Upper and Lower Newport Bay (Regional Board 2008).

| WATER BODY | COMM | MAR | EST | NAV | RARE | BIOL | REC-1 | REC-2 | SPWN | SHEL | WILD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lower Newport Bay | X | X | | X | X | | X | X | X | X | X |
| Upper Newport Bay | X | X | X | | X | X | X | X | X | X | X |

MAR = Marine Habitat; NAV =Navigation; RARE= Preservation of Rare and Endangered Species; REC-1 = Water Contact Recreation; REC-2 = Non-contact Recreation; SPWN = Fish Spawning; WILD = Wildlife Habitat; COMM= Commercial and Sport Fishing; EST= Estuarine Habitat; BIOL= Preservation of Biological Habitats of Special significance; SHEL= Shellfish Harvesting

Although recreational uses have been designated by the Regional Board for Newport Bay, the level of recreational use (e.g., swimming or surfing) in the Bay varies greatly by site and time of year (e.g., increases on summer holiday weekends and decreases during storm events), as described in the REC-1 Beneficial Use Assessment conducted by EOA (2001). Furthermore, as discussed later in this section, certain types of designated uses (i.e., SHEL and REC-1) are currently prohibited in the Upper Bay and the main channel in the Lower

[6] Water Quality Criteria are promulgated by the U.S. EPA, while the term Water Quality Objectives which are typically similar to Criteria are adopted by the State of California.

Bay (i.e., REC-1). To better define the extent of the Water Contact Recreation (REC-1) and Shellfish Harvesting (SHEL) Uses in Upper and Lower Newport Bays, Use surveys were recently conducted in coordination with Regional Board staff. The following sections briefly summarize the findings of these surveys and present information on State and Municipal Codes that prohibit certain types of recreational uses in the Bay.

### 3.1.1 Water Contact Recreation (REC-1)

***Designated Uses***

Waters designated for Water Contact Recreation (REC-1)[7] are those used for recreational activities involving body contact with water where ingestion of water is reasonably possible (Regional Board 2008). These uses may include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, and use of natural hot springs. Both Upper and Lower Newport Bays are designated as REC-1 waters in the Basin Plan. These designations were originally made in 1983 (Regional Board 2008).

***Newport Bay Swimming Prohibitions***

Because a large majority of the Upper Bay is an Ecological Reserve (as declared by the State of California's Fish and Game Commission) that provides habitat to species of special concern, certain recreational activities are prohibited by the State of California. As described in the §14.630.117(B) (1975) of the California Code of Regulations that pertains specifically to the Upper Newport Bay Ecological Reserve:

> *"Swimming is permitted <u>only</u> in that area bayward from North Star Beach to mid-channel."*

For the Lower Bay, the City of Newport Beach Municipal Code §11.12.130 prohibits swimming in the main channel and entrance to the Newport Harbor. Specifically, the code states that:

> *"It shall be unlawful for any person in the act of swimming to be in any portion of the main channel or entrance channel of Newport Harbor from the harbor entrance to the turning basin, as the same are shown on the U.S. Harbor Line Map File No. 958, Los Angeles District U.S. Army Engineers and as shown on U.S. Coast & Geodetic Survey Chart No. 5108 on file in the district office. (1949 Code § 10721 as amended by Ord. 1090; August 24, 1964)".*

Figure 3.1 illustrates the approximate locations of where State and local codes prohibit swimming in the Bay.

[7] As described in the Basin Plan, the REC-1 beneficial use designations assigned to surface water bodies in this Region should not be construed as encouraging recreational activities. In some cases, access to the water bodies is prohibited because of potentially hazardous conditions and/or because of the need to protect other uses, such as municipal supply or sensitive wildlife habitat. Where REC-1 is indicated as a beneficial use, the designations are intended to indicate that the uses exist or that the water quality of the water body could support recreational uses.

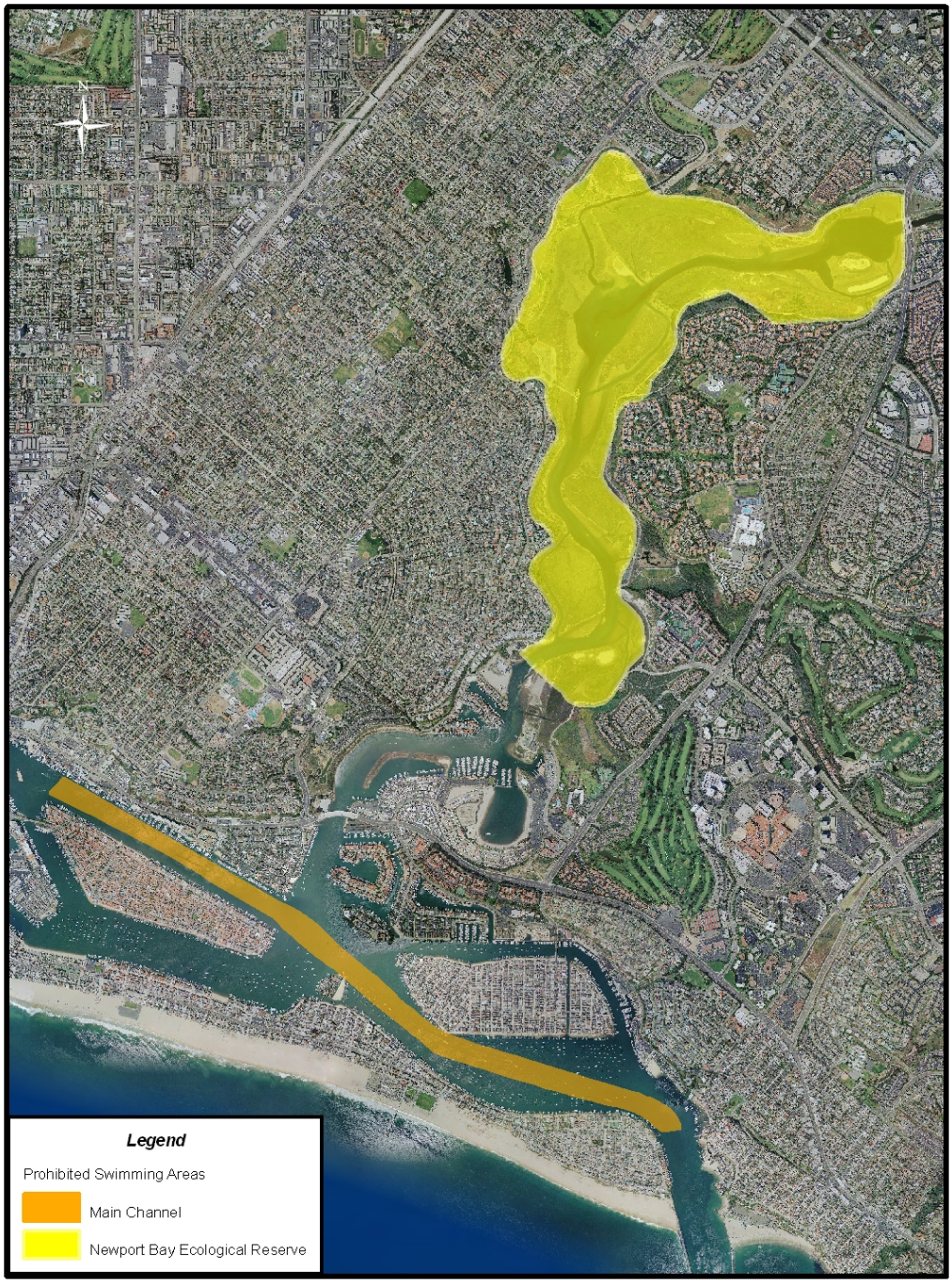



Figure 3.1. Approximate areas of Newport Bay where swimming is prohibited by the State of California (Newport Bay Ecological Preserve) and the City of Newport Beach (Main Channel).

### *Recreational Use Assessment*

To assist the Regional Board in further evaluating the reasonable protection of the REC-1 Beneficial Use in Newport Bay, EOA Inc. (EOA) was contracted to conduct a public health risk assessment investigation in 1998. As part of this investigation, EOA conducted a REC-1 Beneficial Use Assessment (REC-1 Assessment) to qualitatively and quantitatively describe the population that may be exposed to pathogenic microorganisms through body contact recreation in the Bay. The REC-1 Assessment was conducted between June 1999 and May 2000 and designed to gather data on the levels and patterns of recreational use in Newport Bay to estimate:

1) The frequency and duration of recreational exposure in Newport Bay; and,
2) The size of the population most likely to recreate in Newport Bay.

The REC-1 Assessment was composed of two parts: monitoring use patterns (counting number of recreators) and surveying recreators (asking recreators a series of questions). The assessment was based on a focused sampling design in which recreational use in the Bay was monitored during 36 days (representing approximately 10% of the year). Monitoring design was based on a randomized sampling plan, which was stratified by season and type of day (weekday, weekend and holiday). Further, the monitoring program was purposely weighted to emphasize data collection during the summer (high use) period. The numbers of recreators at representative recreational sites were documented during the summer, fall, winter, and spring seasons.

In addition to counting recreators at selected recreational sites, a portion of recreators who were present at those sites were surveyed to determine where they reside, how often they recreate in Newport Bay, and how much swimming occurs during those times of recreation. The overall goal of the survey effort was to interview a representative sample of recreators at each of the recreational sites on each survey day. Surveys were conducted on approximately 20% of the days monitored, and recreators were selected at random. A total of 150 interviews were conducted during the course of the assessment.

A total of seven recreational sites were selected based on those sites currently monitored by the Orange County Health Care Agency (OCHCA) and on discussions with stakeholders[8]. Each of the sites was categorized preliminarily by level of Use (low, medium, high). It was assumed that each of the sites categorized as a particular Use level received similar recreational activity. Representative sites for each Use level were selected for beneficial use monitoring and surveying (Table 3.2).

[8] Larry Honeybourne (OCHCA), Ken Theisen (Water Board) and Dr. Jack Skinnner (SPON).

Table 3.2. Level of Recreational Use during High Season (May-Sept) at OCHCA monitoring sites.[9]

| Low Use | Medium Use | High Use | Extra-High Use |
|---|---|---|---|
| 43rd Street<br>38th Street<br>33rd Street<br>Rhine Channel<br>Sapphire Avenue<br>N Street Beach<br>Promontory Point<br>**De Anza Pier**<br>Grand Canal | Park Avenue<br>**Onyx Avenue**<br>Ruby Avenue<br>Via Genoa<br>15th Street<br>**10th Street**<br>**Bayshore Beach**<br>Alvarado/Bay Island<br>Abalone Avenue<br>Garnet Avenue<br>Harbor Patrol Beach | **19th Street**<br>Rocky Point<br>Dunes North<br>North Star Beach<br>**Lido Island Yacht Club**<br>**Bayshore Beach** (during holidays) | **Newport Dunes** (Middle, East, West and North) |

Bolded sites indicate those that were evaluated during the Recreational Use Assessment. (EOA 2001).

The REC-1 Assessment yielded the following general observations:

- Substantially more recreation occurs at the Newport Dunes than any other recreational site in Newport Bay (Table 3.2; Figure 3.2). During high season at any given time it is estimated that the Dunes has more than 100 times as many recreators as low use beaches and more than 10 times as many recreators as high use beaches.
- About 30% of recreators surveyed reported that they do not swim when they visit Newport Bay beaches. An additional 10% reported that they swim for less than 15 minutes. Responses were fairly evenly distributed among the survey ranges (i.e., 15 min to 1 hr, 1-2 hrs, and greater than 2 hrs), with about 20% of the responses falling in each range.
- Anecdotally, it is estimated that the majority of those recreating in Newport Bay were children. One surveyor estimated that of those observed recreating in water approximately two-thirds were children.
- The most frequent recreators at Newport Bay beaches live in the City of Newport Beach or otherwise live nearby Newport Bay. The further away people live from Newport Bay, the less likely they are to visit Newport Bay beaches.
- Substantial seasonal differences exist in the average number of recreators at Newport Bay beaches, suggesting that the population that is potentially exposed to pathogens increases dramatically during the high use (May-September) season, and more specifically during holidays (Figure 3.2).

[9] The use classifications identified during the 1998 use assessment appear to be consistent with the definitions contained in the 2004 CFR promulgating national bacteriological standards (CFR 131.41, U.S. EPA 2004).

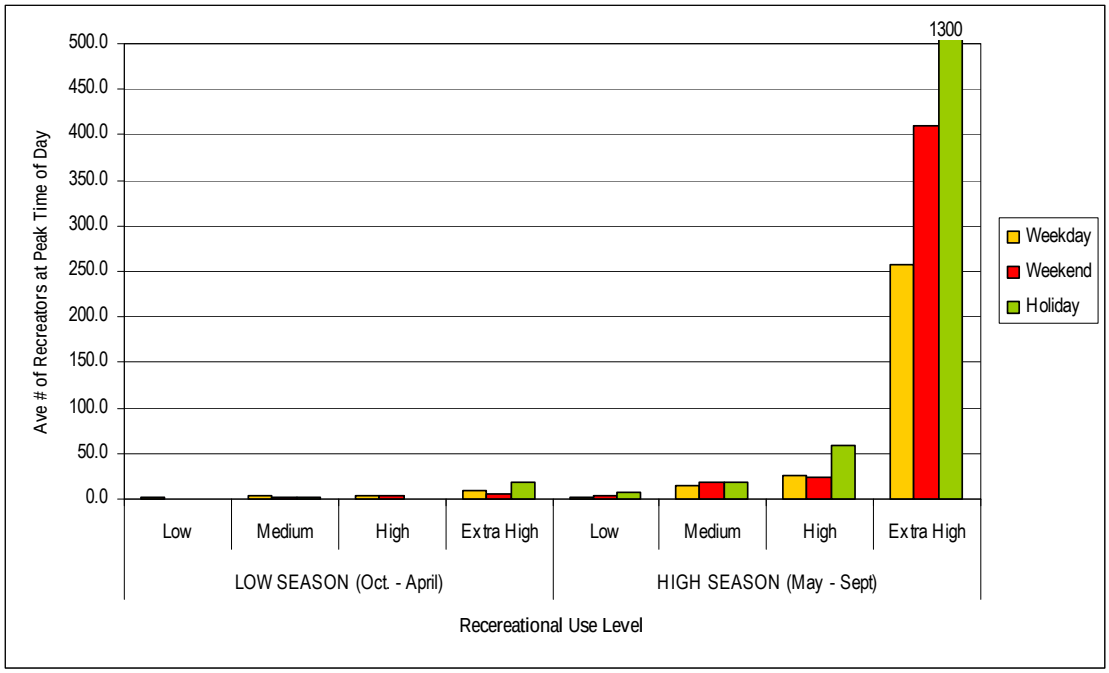



Figure 3.2. Average number of recreators at Newport Bay beaches with various levels of recreational use during high and low seasons at the peak time of day (11:00am to 3:00pm) on weekdays, weekends and holidays (EOA 2001).

As described above, the results of the recreational use assessment were only applied to sites monitored by the Orange County Heath Care Agency (OCHCA) (see Table 3.4) to illustrate recreational use levels. For the purposes of this SMP, the OCHCA monitoring sites are assumed to be geographically representative of all recreational areas in the Bay, excluding areas where swimming is prohibited, which include the Upper Bay above North Star Beach and the main channel in the Lower Bay. These areas where swimming is prohibited are assumed to have a low recreational use level during both the high (May to September) and Low (October to April) seasons. The application of use levels to sites within the Bay in the SMP is for illustrative purposes only and is not a formal regulatory designation.

### 3.1.2 Shellfish Harvesting (SHEL)

#### *Designated Uses*

Waters designated for Shellfish Harvesting (SHEL) are intended to support habitats necessary for shellfish (e.g., clams, oysters, limpets, abalone, shrimp, crab, lobster, sea urchins and mussels) collected for human consumption, commercial or sport purposes (Regional Board 2008). Both Upper and Lower Newport Bays are designated as SHEL waters in the Basin Plan. These designations were originally made in 1983 (Regional Board 2008).

#### *Newport Bay Shellfishing Prohibitions*

Due to consistently high levels of total coliform bacteria, the upper portion of Upper Newport Bay (Upper Bay) has been closed to these uses since 1974 (Regional Board 1999). In 1978, the shellfish harvesting prohibition area was expanded to include all of the Upper Bay. This prohibition is described in §14.630.117(A) of the California Code of Regulations that pertains

specifically to the Upper Newport Bay Ecological Reserve, and states that "…clamming or wading is not permitted [in the Ecological Reserve]". In addition to the prohibition, OCHCA generally advises against the consumption of shellfish harvested anywhere in Newport Bay.

### *Shellfish Harvesting Use Assessment*

In response to TMDL requirements, the County of Orange, on behalf of the watershed cities, submitted a work plan for completion of the Shellfish Harvesting Beneficial Use Assessment on March 1, 2001. The work plan was subsequently amended and approved by the Regional Board on June 1, 2001. The primary objectives of the assessment were to:

1) Identify historic areas of bivalve mollusk shell harvesting (shellfishing) in the Bay;
2) Establish the existing level of the shellfishing resource in Newport Bay;
3) Characterize current levels of shellfish collection (for consumption and bait) as a beneficial use in Newport Bay;
4) Investigate impediments to, and the possibility of enhancing the potential for, increased levels of shellfish collection in Newport Bay, and;
5) Document the results of the investigation in a manner that will be useful to the Regional Board for decision-making purposes.

Qualitative and quantitative sampling was conducted by Kinnetic Laboratories, Inc. (KLI) to determine the existing level of the shellfish resource in Newport Bay. Qualitative sampling was performed over a three-day period in January 2003 around the low tides. A total of 91 sites[10] were sampled at locations throughout Upper and Lower Newport Bay (Figure 3.3) to provide information on the general composition, distribution and relative abundance of intertidal bivalve resources. Information gained from this survey served as the basis for selecting the appropriate sites to conduct the quantitative resource surveys.

As a follow up to the qualitative sampling, six sites (Figure 3.3b) were selected for the quantitative surveys based upon 1) the results of the qualitative survey, 2) historical shellfish harvesting activity and 3) locations influenced by major stormwater discharge points. Quantitative sampling for bivalves was conducted over a three day period in February 2003.

[10] Thirty-one sites were sampled in Upper Newport Bay from the Pacific Coast Highway (PCH) Bridge to the Jamboree Road Bridge, and sixty sites were sampled in Lower Newport Bay from the PCH Bridge to the Entrance Channel.

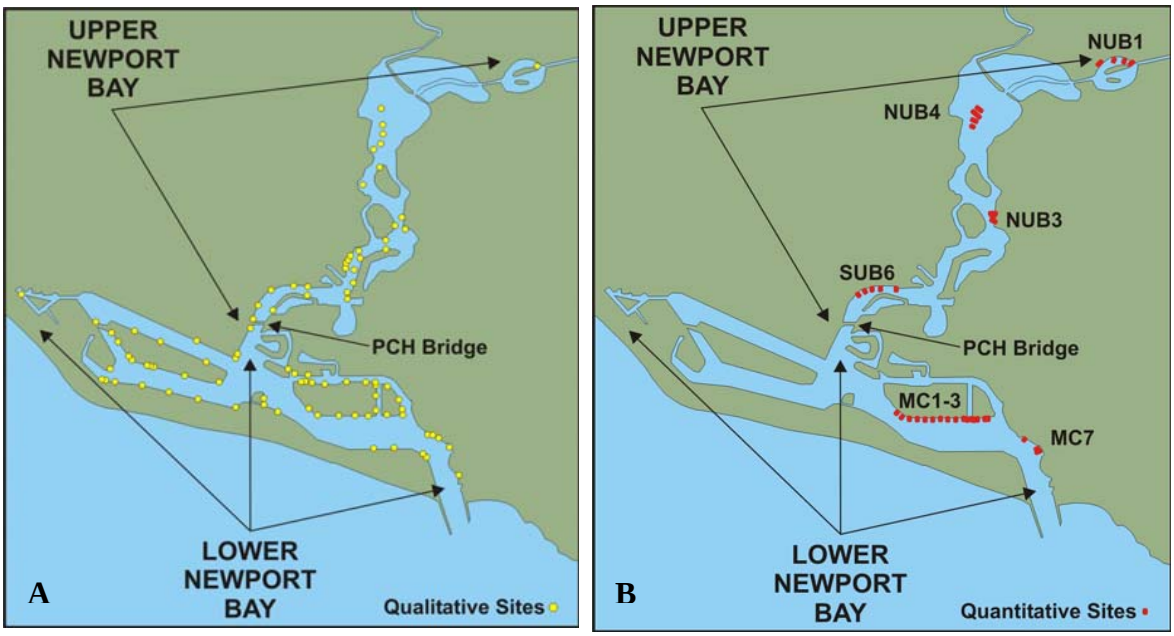



Figure 3.3. Sites sampled during qualitative surveys (A); and quantitative surveys (B) during the Shellfish Harvesting Use Assessment (KLI and EOA 2004).

The results of both the qualitative and quantitative surveys showed that the five most abundant species in Newport Bay included *Protothaca staminea* (Common Littleneck Clam), *Tagelus affinis* (Neighbor Tagelus), *Tagelus subteres* (Lesser Tagelus), *Chione undatella* (Frilled Venus), and *Macoma nasuta* (Bent-Nosed Clam). These five species accounted for over 86% of all shellfish collected (KLI and EOA 2004). The number of shellfish species was highest at sites in Lower Newport Bay at MC7 and progressively declined at sites located further into the northern reach of Upper Newport Bay at NUB1 (Figure 3.4).

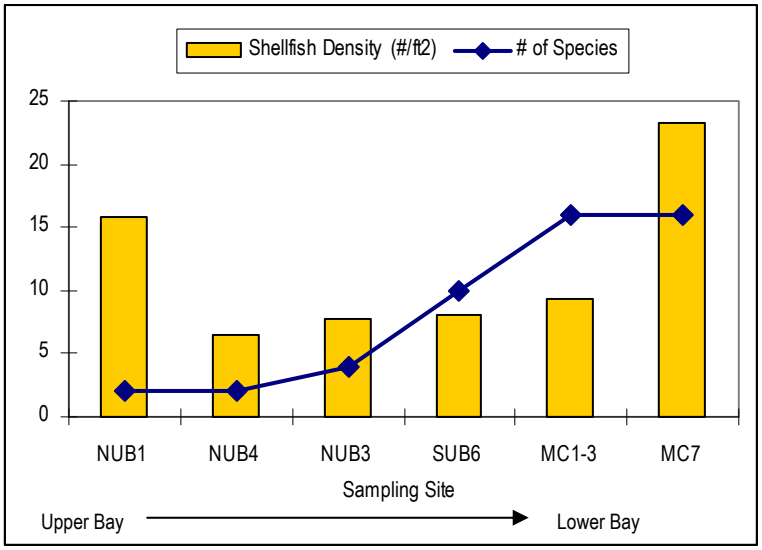



Figure 3.4. Shellfish density and species richness by survey site (KLI and EOA 2004).

To determine the extent to which shellfish harvesting actually occur at historical or probable current shellfishing areas, KLI and EOA (2004) conducted an intensive two-week site validation program at sites identified in the literature and reconnaissance surveys. The site validation program surveyed 226 people and identified the most likely shellfishing areas within the Bay.

A data collection plan was then developed to characterize the intensity of existing shellfish activities in the Bay. This brief questionnaire survey was designed to identify how shellfish collected in Newport Bay are likely to be used and to identify any possible relationships between the consumption of the harvested shellfish and subsequent illness. A total of 1,100 individuals were surveyed.

The following observations were made as a result of these sampling programs (KLI and EOA, 2004):

- The majority (90%) of the respondents surveyed lived within a one hour drive of Newport Bay. Two-thirds were Caucasians, 45% were fishing and an additional 45% were engaged in “other activities” such as dog walking, sunbathing, or reading.
- Roughly 10% of those surveyed collected or collect shellfish from Newport Bay with half of those harvesting shellfish once or more per week. The vast majority of those who harvest shellfish do so for the purpose of bait collection, and the collection of shellfish for consumption is rare.
- Shellfish harvesting occurs at least as frequently during the summer as during the winter with the most commonly reported locations being the Lower Bay fishing locations, the Pacific Coast Highway Beach, and Balboa Island.

At the request of the Regional Board in 2005, an additional data collection plan (KLI and Soller Environmental 2007) was developed to validate the data described in KLI and EOA (2004) and further assess what happens with shellfish after collection. Methods used during the validation study were very similar to those used by EOA and KLI. Based on this methodology, the validation monitoring plan encompassed a total of 11 days over both wet and dry seasons between July 2006 and April 2007. During the Use validation study, a total of 97 surveys were administered to 215 individuals. Comparison of the results between the 2003/2004 and 2006/2007 data collection programs clearly indicates that no substantive changes occurred during this time (Table 3.3).

Table 3.3. Comparison of Sampling Efforts for 2003/2004 and 2006/2007 Shellfish Harvesting Beneficial Use Data Collection Programs.

| Program | # Days Surveyed | # People Surveyed | % Children | # Surveyed Who Eat Newport Bay Shellfish | # Who Eat Shellfish Uncooked |
|---|---|---|---|---|---|
| 2003/2004 Beneficial Use Data Collection | 54 | 1062 | 23% | 2 (0.2%) | 0 |
| 2006/2007 Beneficial Use Validation | 11 | 215 | 20% | 1(0.5%) | 0 |

## 3.2 Fecal Indicator Bacteria

Most disease-causing microbes (e.g., viruses) exist in very small amounts and are difficult and expensive to enumerate in water samples. Fecal indicator bacteria (FIB) have been used for more than a century to help identify where fecal contamination has occurred and, therefore, where disease-causing microbes (i.e., pathogens) may be present. Bacteria that have typically been used for this purpose include total coliforms, fecal coliforms, *E. coli*, fecal streptococci, and *Enterococcus*. These indicators generally do not cause illness themselves, but they do have characteristics that make them good indicators of fecal material in water and based on epidemiological studies suggest that harmful pathogens may be present. Depending on the region of California, different types and concentrations of FIB may be used as water quality objectives.

## 3.3 Water Quality Objectives and Criteria

With respect to the protection of the SHEL and REC-1 beneficial uses, there are several relevant sources of water quality objectives and criteria applicable to Newport Bay (Table 3.4). The following paragraphs briefly describe the derivation of these objectives or criteria. A more complete summary of the history of water quality objectives and criteria is provided in Appendix B.

Table 3.4. Summary of Applicable REC-1 and SHEL Water Quality Objectives for Newport Bay and Relevant Criteria (U.S. EPA 1986, U.S. EPA 2004b, Regional Board 2008).

| Relevant Beneficial Use | Source | Organism | Criteria | Value | Units |
|---|---|---|---|---|---|
| SHEL | Basin Plan (Fresh and Salt) | Fecal Coliform | median | 14 | MPN/100mL |
| | | | Not more than 10% | 43 | MPN/100mL |
| REC-1 | Basin Plan (Fresh and Salt) | Fecal Coliform | log mean | 200[1] | MPN/100mL |
| | | | Not more than 10% | 400 | MPN/100mL |
| REC-1 | EPA Salt Water Criteria | *Enterococcus* | geometric mean | 35[1] | colonies/100mL |
| | | | designated beach – UPV | 104 | colonies/100mL |
| | | | Moderately used site – UPV | 158 | colonies/100mL |
| | | | Lightly used site – UPV | 276 | colonies/100mL |
| | | | Infrequently used site - UPV | 500 | colonies/100mL |

1. Based on a minimum of 5 equally spaced samples in any 30 day period
UPV – Upper Percentile Value

### 3.3.1 1976 U.S. EPA Criterion and Basin Plan Objectives

Federal water quality criteria recommendations were first proposed in 1968 by the National Technical Advisory Committee (NTAC) of the Department of the Interior (U.S. EPA 1986). The NTAC committee suggested that fecal coliforms[11] are the recommended indicator because they are more fecal-specific and less subject to variation than total coliforms. The NTAC went on to find that about 18% of the total coliforms were found to be fecal coliforms and this proportion was used to determine that the equivalent of 2300 total coliforms/ 100 mL (i.e., the density at which a statistically significant swimming-associated gastrointestinal

[11] Fecal coliform bacteria have been used for decades as indicators of fecal contamination in water. Fecal coliforms are a group of bacteria that include organisms that originate in feces (*Escherichia*), as well as those that are not of fecal origin (*Enterobacter, Klebsiella, and Citrobacter*).

illness is observed) was about 400 fecal coliforms/100 mL. The NTAC suggested that a detectable risk was undesirable and, therefore, one-half of the density at which a health risk occurred (i.e., 200 fecal coliform/100 mL) was proposed as the water quality criteria to protect human health of recreators. The NTAC also suggested that the use of the water should not cause a detectable health effect more than 10% of the time. Thus, the recommended criterion for recreational waters was as follows:

> *"Fecal coliforms should be used as the indicator organism for evaluating the microbiological suitability of recreation waters. As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content of primary contact recreation waters shall not exceed a log mean of 200/100 mL, nor shall more than 10 percent of total samples during any 30-day period exceed 400/100 ml."*

This recommended criterion was published by the U.S. EPA (EPA) for marine and freshwater recreational waters in 1976, even though it had been criticized on a number of issues (U.S. EPA 1986). The Santa Ana Regional Board incorporated the following fecal coliform WQO into the Basin Plan in 1983:

> *"REC-1 – Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period."*

This WQO is similar to the USEPA Criterion although differences exist. Quoted above from the most current Basin Plan, the WQO is still present in the Basin Plan today.

### 3.3.2 1986 U.S. EPA Criteria and 2000 BEACH Act

In 1972, the USEPA initiated a series of studies at marine and fresh water bathing beaches, designed to correct the perceived deficiencies of the studies that informed the 1968 NTAC recommended criterion (ultimately the EPA 1976 criterion). One goal of the USEPA studies was to determine if swimming in sewage-contaminated water carries a health risk for bathers; and, if so, to what type of illness. If a quantitative relationship between water quality and health risk was obtained, two additional goals were to determine which bacterial indicator is best correlated to swimming-associated health effects and if the relationship is strong enough to provide a criterion (U.S. EPA 1986).

The marine studies were conducted at bathing beaches in New York City, New York, Boston, Massachusetts, and at Lake Pontchartrain, near New Orleans, Louisiana. Two beaches were selected at each site; one that received very little or no contamination and the other whose water quality was barely acceptable with respect to local recreational water quality standards. In the New York City and Boston Harbor studies, the “barely acceptable” beaches were contaminated with pollution from multiple sources, usually treated effluents that had been disinfected (U.S. EPA 1986). Results indicated that *Enterococcus* showed the strongest relationship to health effects (i.e., gastroenteritis). *E. coli* was a very poor second and all of the other indicators, including total coliforms and fecal coliforms showed very weak correlations to gastroenteritis.

Based on the results of these studies, the USEPA published new criteria for recreational waters in 1986. The criteria were developed based on log-linear relations between indicator densities and levels of accepted illness rates[12]. The equations were used to calculate the geometric mean indicator densities corresponding to the accepted gastrointestinal illness rates for steady state dry weather conditions (U.S. EPA 1986). Upper Percentile Values (UPVs) were also identified based on the relative level of use expected to occur at recreational sites. These salt water criteria are presented in Table 3.4.

Although the EPA published revised criteria in 1986, the Regional Board did not immediately update the Basin Plan WQOs based on this information. Subsequently, in 2000, the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) was signed into law, amending the Federal Clean Water Act (CWA) with two significant provisions. First, the BEACH Act amended the CWA by adding section 303(i), which requires states and tribes that have coastal recreation waters (e.g., California) to adopt new or revised water quality standards by April 10, 2004, that are "as protective of human health as" the USEPA's 1986 criteria. For those states that fail to establish standards by this date, the BEACH Act also directs USEPA to promulgate standards for states. Secondly, sections 104(v) and 304(a) were also added to the CWA, which together require EPA to conduct studies associated with pathogens and human health and to publish new or revised CWA section 304(a) criteria for pathogens and pathogen indicators based on those studies.

Based on review of bacteria standards adopted by the states, in 2000 the USEPA concluded that some regions in the State of California had not adopted standards as protective as the nationally recommended criteria for some of their coastal recreation waters. Consequently, the USEPA promulgated revised standards that apply, with few exceptions, to California coastal recreation waters (U.S. EPA 2004b, 40 CFR 131.41). These standards are identical to the USEPA criteria published in 1986 (Table 3.4).

Although the 1986 EPA criteria were just recently incorporated into the State of California regulatory structure, pursuant to the Beach Act additional efforts by USEPA are underway to review and potentially revise water quality criteria for recreational waters. Specifically, the USEPA is currently in the process of collecting input from the broad scientific and technical community on research and science needs to develop up-to-date, scientifically defensible criteria to protect people from exposure to contaminated recreational waters. Near-term needs were defined as specific research and scientific activities that could be accomplished in 2 to 3 years to support development of new or revised criteria by 2012 (U.S. EPA 2007). Depending on nature of the new or revised criteria, USEPA may again require states to update their water quality standards for water contact recreation.

[12] U.S. EPA acceptable illness rates are 8 illnesses per 1,000 swimmers at fresh water beaches and 19 illnesses per 1,000 swimmers at marine beaches.

# 4.0 FECAL INDICATOR BACTERIA IN NEWPORT BAY

The following sections provide a brief summary of data collected in Newport Bay during the monitoring efforts introduced above. Specifically, temporal trends in Bay water quality are examined, in addition to the "current" concentrations of FIB in Newport Bay. Relationships between rainfall and FIB concentrations and recent exceedances of water quality criteria/objectives are described.

Over the last three decades, a variety of FIB monitoring has occurred in Newport Bay. The majority of these data applicable to current water quality standards were collected by the Orange County Health Care Agency (OCHCA) beginning in 1986 at beach sites and locations on the Bay margins. This OCHCA sampling program has generated the most consistent FIB dataset available for the Bay. Additionally, the routine monitoring program is also required by the Water Board to determine compliance with TMDL targets. At a minimum, routine monitoring includes the collection of five samples per 30-day period at a total of 35 stations, as identified in Figure 4.1. Currently, the monitoring program coordinated by OCHCA analyzes Bay water samples for total coliform, fecal coliform, and *Enterococcus* indicator bacteria.

As part of the *Newport Bay Source Identification Study*, a large FIB dataset was also collected by Grant et al. (2009) in 2006 and 2007 at nine Bay-to-Ocean Transect (BTO) sites (BTO4 to BTO11) located along the Bay channel. Three additional creek sites (BTO1 – BTO3) and one ocean control site (BTO12) were also sampled during this study and are further described in Section 5.0 (FIB Sources, Pathways and Fate). At most BTO sites, water samples were collected approximately weekly from five locations in the channel cross-section: three at the channel thalweg (surface, bottom, and depth integrated), and two at the channel's edges[13]. Dry season data were collected from July through October 2006, and wet season from March through April 2006. Samples were analyzed for *Enterococcus* and *E. coli*.

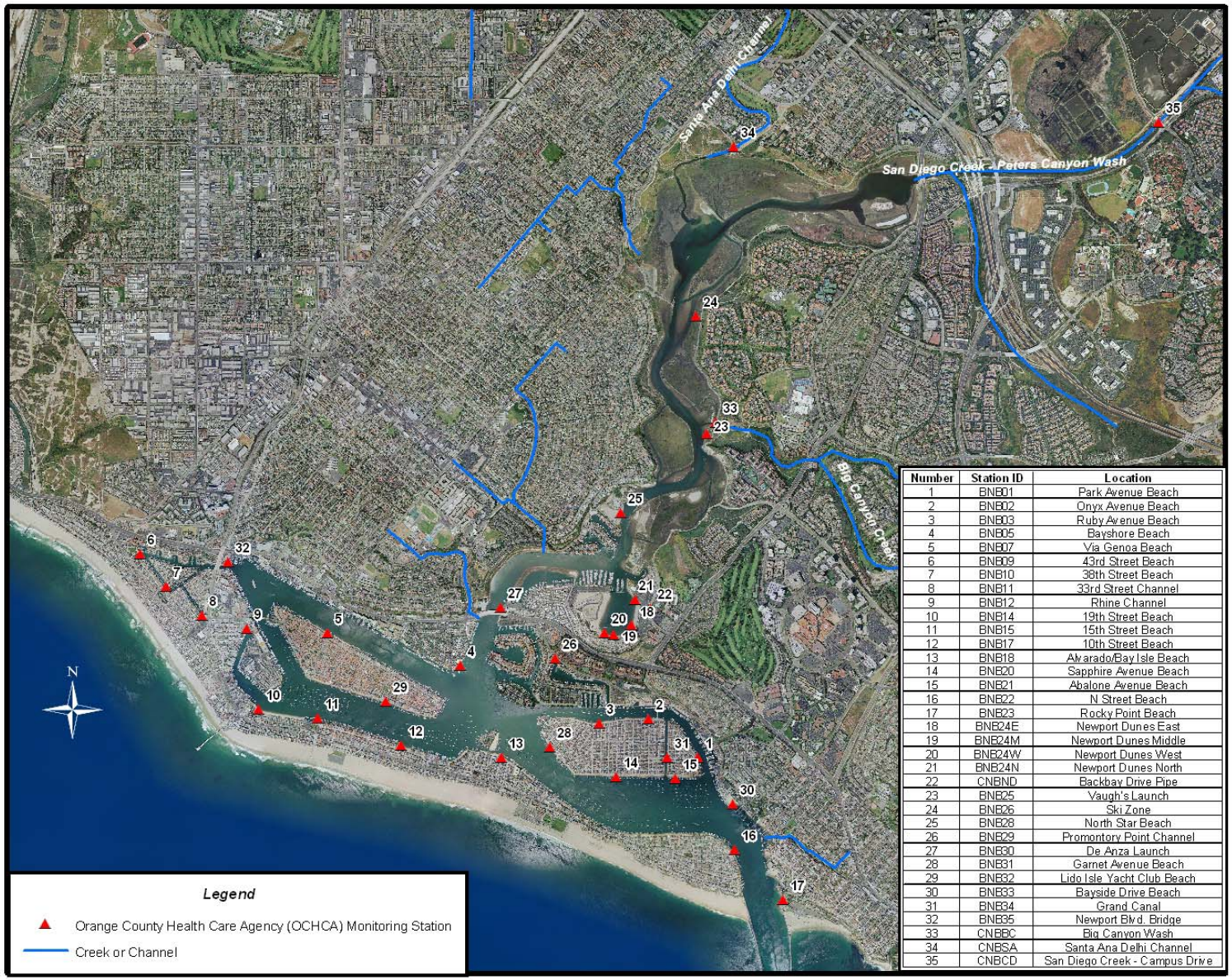
In addition to the two studies briefly described in the paragraphs above, a variety of short-term studies also generated FIB data from the Bay (Grant et al. 2004, Everest International 2004; Jiang 2005). These studies were generally focused on developing a better understanding of the contribution of FIB to the Bay from specific sources and pathways. As applicable, the data from each study is discussed in this section or within Section 5.0.

## 4.1 Temporal Trends and Variability in Bay-wide FIB Concentrations

### 4.1.1 Long-term Trends in FIB Concentrations

From January 1986 through December 2007, over 25,000 samples collected from sites within Newport Bay and its tributaries were analyzed for fecal coliform bacteria by OCHCA. Additionally, OCHCA collected over 14,000 samples between January 1999 and December 2007 from sites within Newport Bay and analyzed each for enterococci bacteria. To evaluate potential long-term changes in FIB concentrations on a Bay-wide scale, an annual log mean concentration was calculated for all OCHCA sites combined.

[13] These sites were located in the main channel of the Bay, and therefore may not fully represent the concentration of FIB at sites where full body contact recreation is probable (i.e., beach sites).




| Number | Station ID | Location |
|---|---|---|
| 1 | BNB01 | Park Avenue Beach |
| 2 | BNB02 | Onyx Avenue Beach |
| 3 | BNB03 | Ruby Avenue Beach |
| 4 | BNB05 | Bayshore Beach |
| 5 | BNB07 | Via Genoa Beach |
| 6 | BNB09 | 43rd Street Beach |
| 7 | BNB10 | 38th Street Beach |
| 8 | BNB11 | 33rd Street Channel |
| 9 | BNB12 | Rhine Channel |
| 10 | BNB14 | 19th Street Beach |
| 11 | BNB15 | 15th Street Beach |
| 12 | BNB17 | 10th Street Beach |
| 13 | BNB18 | Alvarado/Bay Isle Beach |
| 14 | BNB20 | Sapphire Avenue Beach |
| 15 | BNB21 | Abalone Avenue Beach |
| 16 | BNB22 | N Street Beach |
| 17 | BNB23 | Rocky Point Beach |
| 18 | BNB24E | Newport Dunes East |
| 19 | BNB24M | Newport Dunes Middle |
| 20 | BNB24W | Newport Dunes West |
| 21 | BNB24N | Newport Dunes North |
| 22 | CNBND | Backbay Drive Pipe |
| 23 | BNB25 | Vaugh's Launch |
| 24 | BNB26 | Ski Zone |
| 25 | BNB28 | North Star Beach |
| 26 | BNB29 | Promontory Point Channel |
| 27 | BNB30 | De Anza Launch |
| 28 | BNB31 | Garnet Avenue Beach |
| 29 | BNB32 | Lido Isle Yacht Club Beach |
| 30 | BNB33 | Bayside Drive Beach |
| 31 | BNB34 | Grand Canal |
| 32 | BNB35 | Newport Blvd. Bridge |
| 33 | CNBBC | Big Canyon Wash |
| 34 | CNBSA | Santa Ana Delhi Channel |
| 35 | CNBCD | San Diego Creek - Campus Drive |

Figure 4.1. Long-term sites monitored in Newport Bay by the Orange County Health Care Agency (OCHCA) for Fecal Indicator Bacteria (FIB).

Annual log mean FIB concentrations for the Bay are presented in Figures 4.2 and 4.3. Descriptive statistics for OCHCA data collected during each sampling year are provided in Appendix C. Trends for specific sites are further discussed in later sections of this SMP.

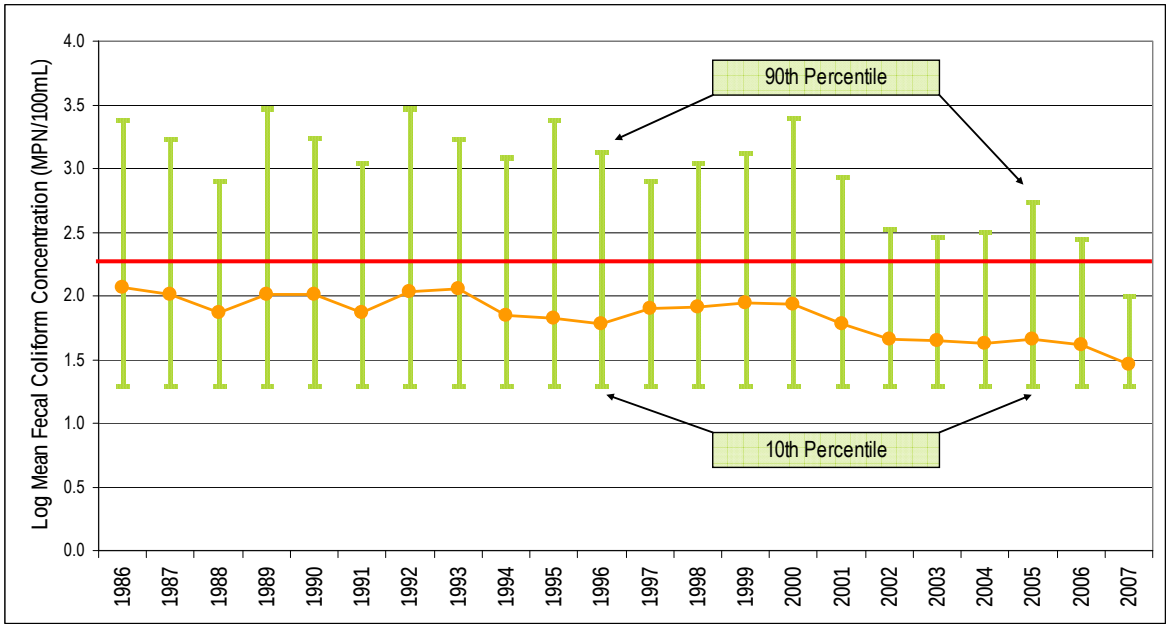



Figure 4.2. Average annual log concentrations of fecal coliform (1986-2007) bacteria at all sites sampled by OCHCA in Newport Bay (please note that reporting limits have been standardized[14] for all data presented). Red line indicates the log mean water quality objective.

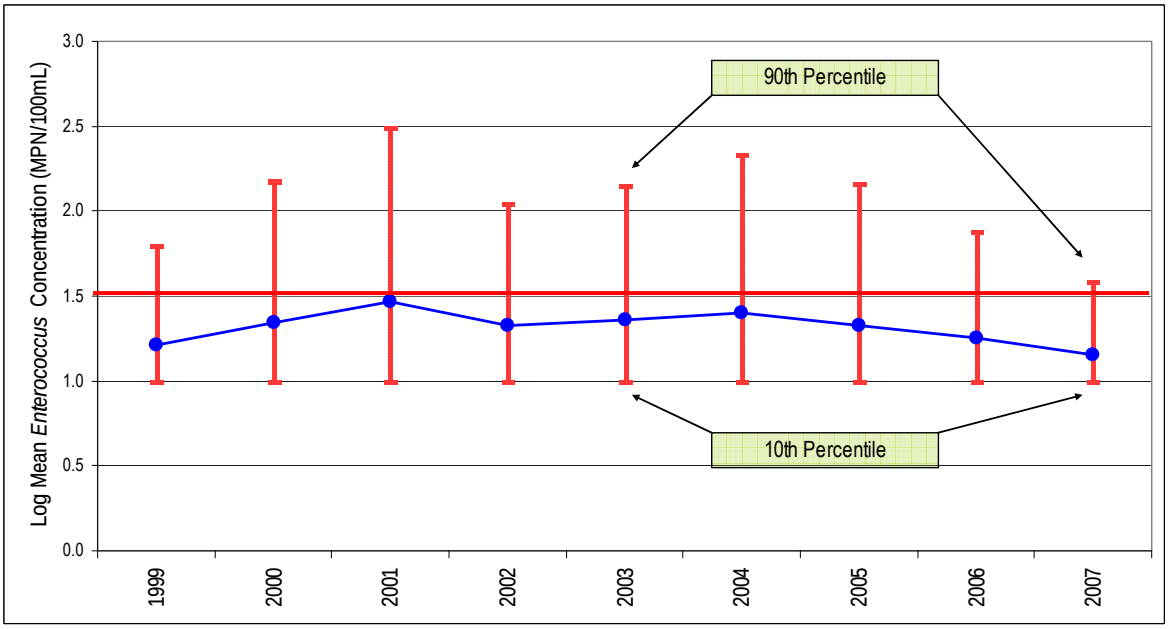



Figure 4.3. Average annual log concentrations of *Enterococcus* (1999-2007) bacteria at all sites sampled by OCHCA in Newport Bay (please note that reporting limits have been standardized[15] for all data presented). Red line indicates the log mean water quality objective.

[14] Fecal coliform reporting limits standardized to 20 MPN/100mL for all years reported.
[15] *Enterococcus* reporting limits standardized to 10 MPN/100mL for all years reported.

Based on the visual evaluation of long-term data from Newport Bay sites, it appears that both fecal coliform concentrations have decreased substantially over time on a Bay-wide scale. The average log concentrations of fecal coliforms for all Bay sites combined have decreased from over 2.0 (logs) in 1986 (n=740) to less than 1.3 (logs) in 2007 (n=1,519). Based on the fecal coliform data presented in Figure 4.2, the reduction appears to have begun in 2000. Because the OCHCA dataset for *Enterococcus* spans a much shorter timeframe (1999 – 2007), it is unclear as to whether concentrations of this indicator have also declined (Figure 4.3).

There are at least three potential explanations for the observed decreases in annual average FIB concentrations in Newport Bay. First, an evaluation to identify if OCHCA made significant changes in sampling and/or laboratory methodologies at some point during the record of data collection was performed. However, through discussions with OCHCA staff no significant changes have been made in sampling or laboratory procedures during the period of record that could have caused the observed decreases in FIB concentrations. Additionally, if a change in procedure did occur, the effect would not be a gradual decrease in FIB overtime, rather a sharp decline in a single year.

A second plausible explanation to the observed decrease would be that sampling which occurred in the 1980's and 90's was somehow not comparable to more recent sampling. Specifically, if the number or location of monitoring sites, or if the sampling frequency significantly changed over the period of data collection, then one could argue that the entire OCHCA dataset may not be conducive to trends analyses (i.e., apples versus oranges comparison). Based on an evaluation of the entire dataset, annual sampling frequencies have fluctuated (see Appendix A). However, samples have been consistently collected during both: a) times when low concentrations are generally expected (i.e., dry weather) and, b) times when higher concentrations are expected (i.e., wet weather) over the entire data collection period. Additionally, sites have generally remained the same overtime. Therefore, based on a limited review of the data, it appears that the OCHCA dataset is generally consistent over time in both its representation of Bay conditions when FIB concentrations would be expected to vary, and in the number and location of sites sampled. Thus, it is assumed that the design of the OCHCA monitoring program is not the primary reason for observable decreases in FIB concentrations over time.

A third possible explanation for the decrease in FIB concentrations in Newport Bay is the implementation of effective management actions. Section 8.0 provides a summary of all readily available information on actions implemented by public agencies and stakeholders in the Newport Bay watershed. Through this review, two large-scale implementation actions appear to coincide with the observable decreases in FIB concentrations. Specifically, the San Joaquin Marsh natural treatment system began receiving San Diego Creek water in the late 1990's and the Back Bay drain diversion project began eliminating dry weather flows into the Dunes recreational area in 2001. Based on information presented later in this SMP, it appears that these and other management actions could be responsible, at least in part for observed reduction in FIB concentrations in Newport Bay.

### 4.1.2 Variability in FIB Concentrations

In addition to evaluating long-term trends in FIB concentrations in Newport Bay, annual variability in concentrations was also examined to determine if the frequency of "high" (>400 MPN or CFU/ 100mL) and "very high" (> 4,000 MPN or CFU/ 100mL) FIB concentrations have also decreased over time. These values are of significant concern from a human

health perspective, as they are more likely to cause impacts to recreational uses and beach postings or closures.

Figures 4.4 and 4.5 illustrate the changes in annual fecal coliform variability over the term of the OCHCA monitoring program (1986-2008). The temporal trends in bay-wide fecal coliform variability are illustrated as Box-whisker[16] plots in Figure 4.4. Inspection of the data presented in Figure 4.4 indicates that there has been a consistent decrease in variability in fecal coliform concentrations since 2000. Those data also indicate that the median bay-wide fecal coliform values have decreased to the reporting limit (10 MPN/100 mL) since 2004.

The temporal trend of bay-wide fecal coliform observations above a threshold of 4,000 MPN or CFU/ 100mL is presented in Figure 4.5. Inspection of these data illustrate that the occurrence of fecal coliform concentrations >4,000 has decreased substantially over the course of the monitoring program and is currently relatively stable at less than 5%.

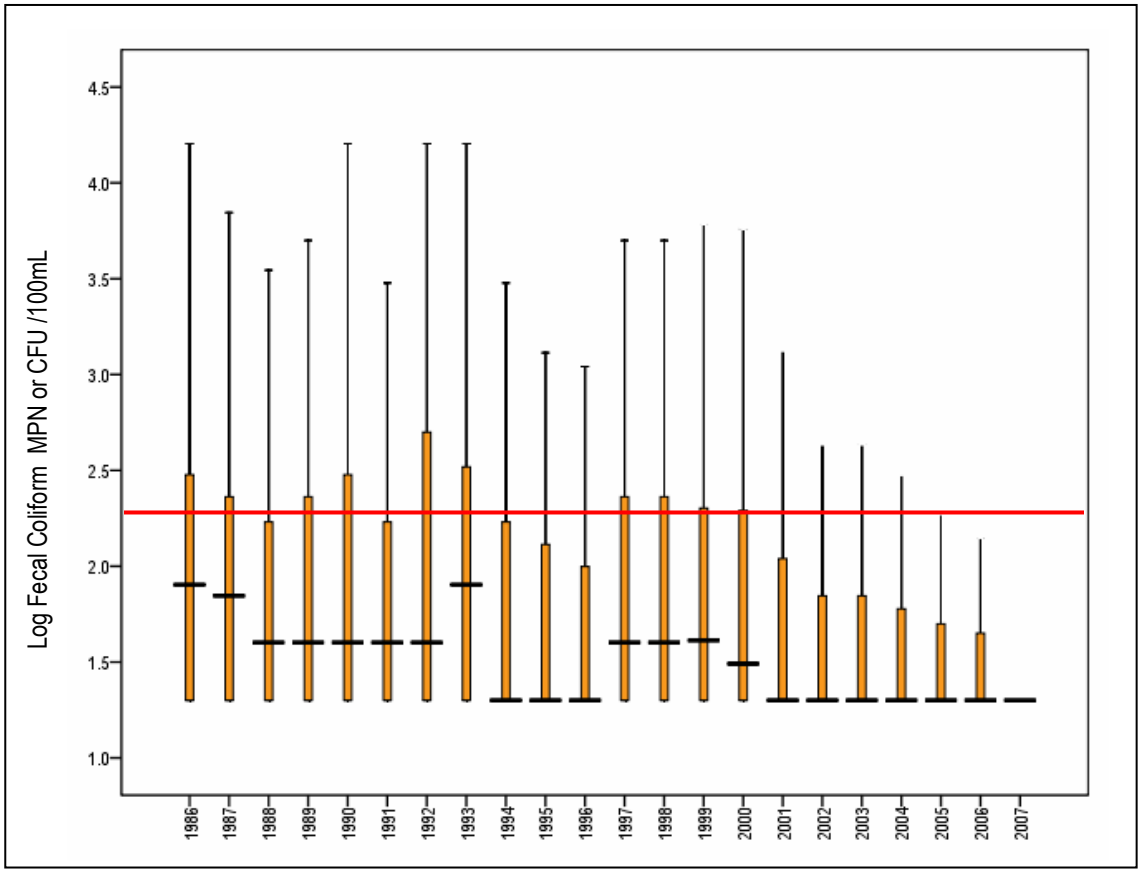



Figure 4.4. Box-whisker plot of fecal coliform concentrations (1986-2007). Box whisker plots illustrate the median as horizontal line at the midpoint of the box, interquartiles (25th and 75th percentiles) as the length of the box, and the range of non-outlier data (those within 1.5 times the interquartiles) as the whiskers. Red line indicates the log mean water quality objective.

[16] Box whisker plots illustrate the median as horizontal line at the midpoint of the box, interquartiles (25th and 75th percentiles) as the length of the box, and the range of non-outlier data (those within 1.5 times the interquartiles) as the whiskers.

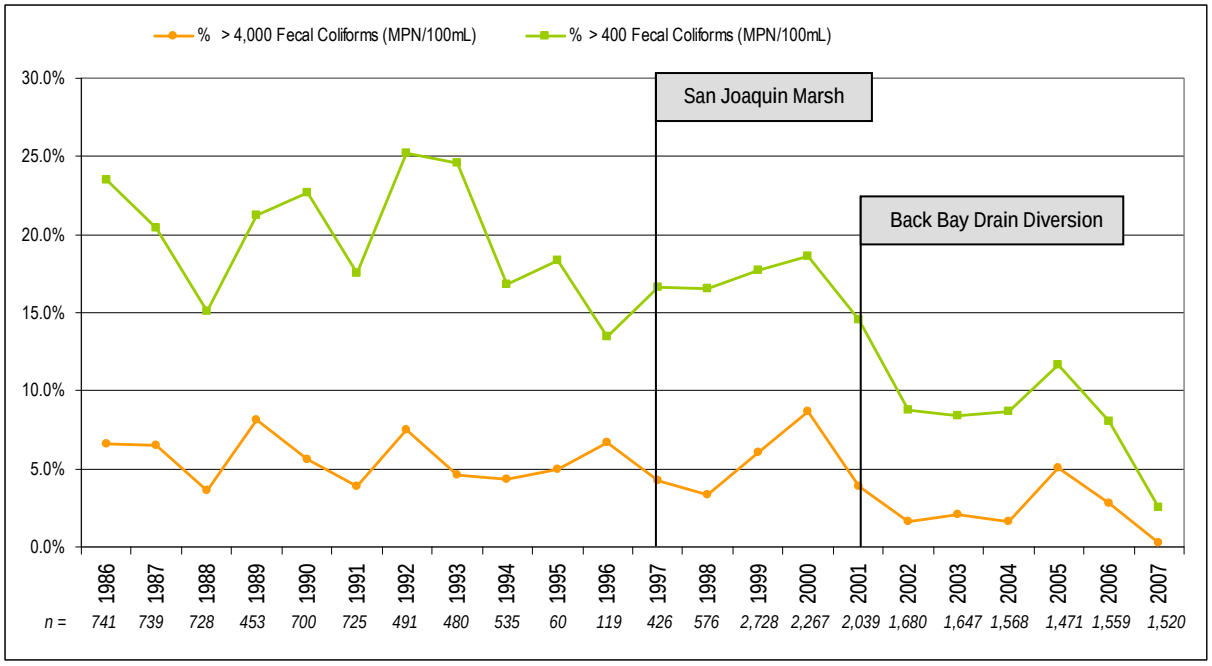



Figure 4.5. Temporal trend (1986-2007) of fecal coliform concentrations > 400 MPN or CFU/ 100 mL or > 4,000 MPN or CFU/100 mL at all OCHCA monitoring stations in Newport Bay.

## 4.2 Current FIB Concentrations in Newport Bay

As described in Section 2.0, the Bay is made up of two water bodies, the Upper Bay and the Lower Bay (i.e., Newport Harbor). The Upper Bay contains a high quality State Ecological Reserve that is relatively shallow, while the Newport Harbor contains both deeper channels and shallow beach and littoral areas around its periphery.

In an effort to characterize the "current" FIB concentrations in both the channels and littoral regions throughout the Upper Bay and Newport Harbor, two data sets described in the following sections were compiled and evaluated. It is important to note that due to the large number of sites in the Bay (i.e., 39) represented by these datasets and their relatively uniform spatial distribution, it is assumed that sites currently sampled by OCHCA (beach and margin sites) and those sampled during the *Source Identification Study* (channel sites) are generally representative of the Upper Bay and Newport Harbor (Lower Bay).

### 4.2.1 OCHCA Fecal Coliform and *Enterococcus* Dataset (2004-2007)

As described above, OCHCA has collected FIB data in the Bay since 1986. During that time period the number of sites sampled has changed, as well as the sampling frequency and analytical methods used by OCHCA (see Appendix D). Additionally, management actions designed to reduce FIB concentrations in the Bay having continued to be employed (see Section 8.0) and appear to have improved water quality. Therefore, these factors must be considered when attempting to characterize the "current" water quality condition at OCHCA sites.

Readily available OCHCA data were assessed and the most recent dataset was selected to depict current FIB concentrations in the littoral regions of the Bay, based on the following criteria:

1. Data must have been collected after the implementation of known management actions that appear to have at least partially caused the observed reduction in FIB concentrations in Newport Bay (i.e., post-2001);
2. FIB data should have been collected using consistent analytical methods to avoid the issues of standardizing different method detection limits;
3. Data should have been collected during years representing both high and low rainfall/runoff events, which could effect variations in FIB concentrations; and,
4. Only data collected from entire calendar years would be considered to remain consistent throughout the timeframe selected.

Based on these criteria, OCHCA fecal coliform and *Enterococcus* data collected from January 2004 through December 2007 were selected to represent current FIB concentrations in the Bay.

As a next step, statistical tests (i.e., T-tests, Mann-Whitney U test, Levene test for homogeneity and Bonferroni test) were explored. These tests are typically used to determine if multiple datasets (e.g., years of data) can be pooled in a statistically sound manner. However, after further examination of data collection frequency and the objectives of developing a “current” FIB dataset, these tests were not employed because of the following:

- Binning data into calendar years for statistical comparisons is arbitrary and inconsistent with the objectives of the proposed statistical tests; and,
- The variability observed in the 2004 to 2007 dataset is welcome, as it assists in better understanding the range of FIB concentrations at a particular site and ensures that the greatest range of possible conditions is represented in the dataset.

Fecal coliform and *Enterococcus* concentrations in the pooled 2004 to 2007 dataset for each OCHCA monitoring site are presented as box-whisker plots in Figures 4.6 and 4.7, respectively.

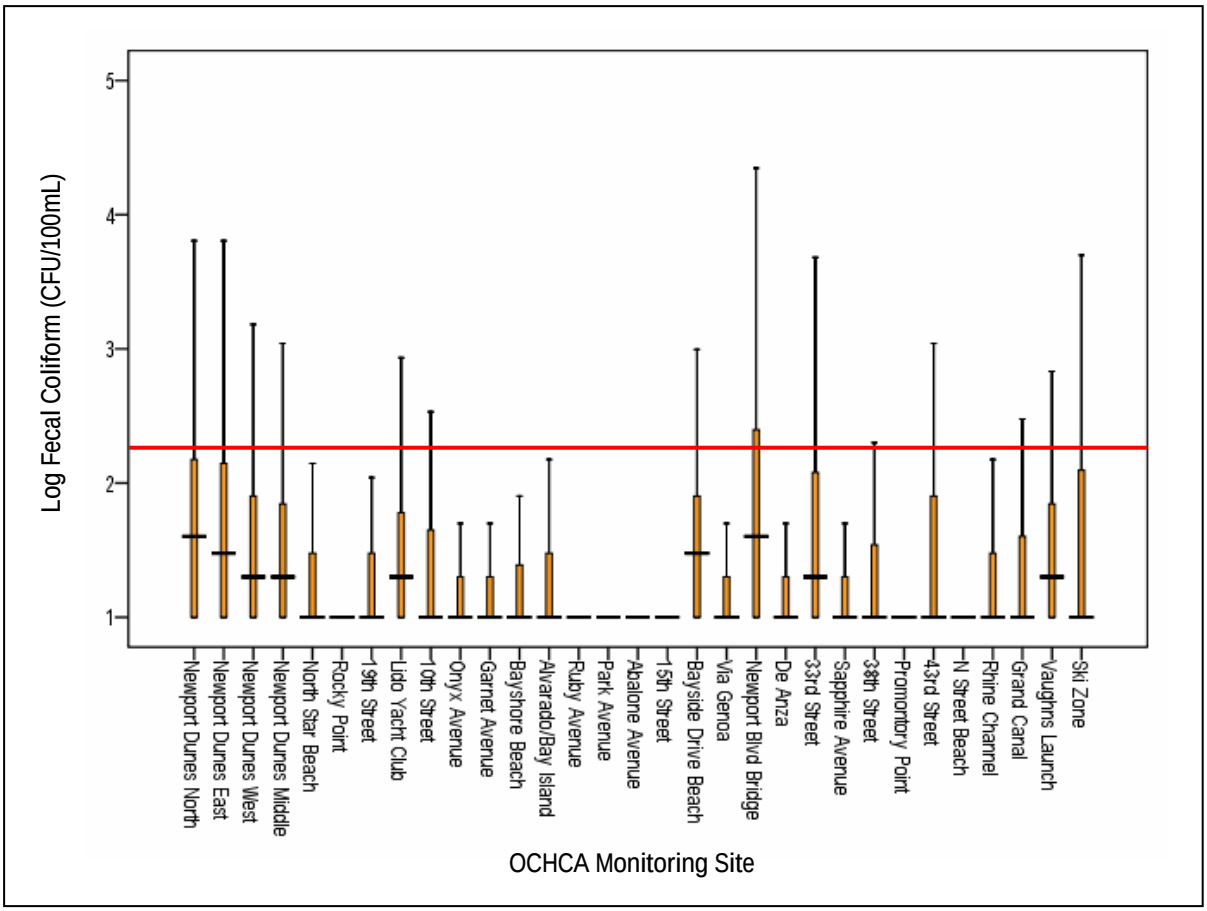



Figure 4.6. Box-whisker plot of fecal coliform concentrations (2004-2007) at the 31 OCHCA monitoring sites in the Bay compared to the log mean water quality objective (red line). Box whisker plots illustrate the median as horizontal line at roughly the midpoint of the box, interquartiles (25th and 75th percentiles) as the length of the box, and the range of non-outlier data (those within 1.5 times the interquartiles) as the whiskers.

Inspection of Figure 4.6 reveals several interesting observations with respect to fecal coliform concentrations in Newport Bay over the "current" time period of 2004 to 2007:

- The median fecal coliform concentration at most (22 of 31) sites throughout the Bay is 10 MPN /100mL (i.e., the method detection limit).
- The sites that have median values higher than 10 MPN/100mL are located either in Newport Dunes, Upper Bay (Vaughn's Launch), West Newport Bay (Newport Blvd Bridge and 33rd St.), Lido Yacht Club or near Bayside Drive.
- All sites have median concentrations substantially less than 200 CFU/100mL, the log mean water quality objective for fecal coliforms.
- Most of the sites that exhibit the greatest variability in fecal coliform concentrations are the sites that also have median values higher than 10 MPN/100mL (i.e., Newport Dunes sites, Lido Yacht Club, Bayside Drive Beach, Newport Blvd. Bridge, 33rd St. and Vaughns Launch). Other sites that also exhibit substantial variability include 43rd St. and Ski Zone.

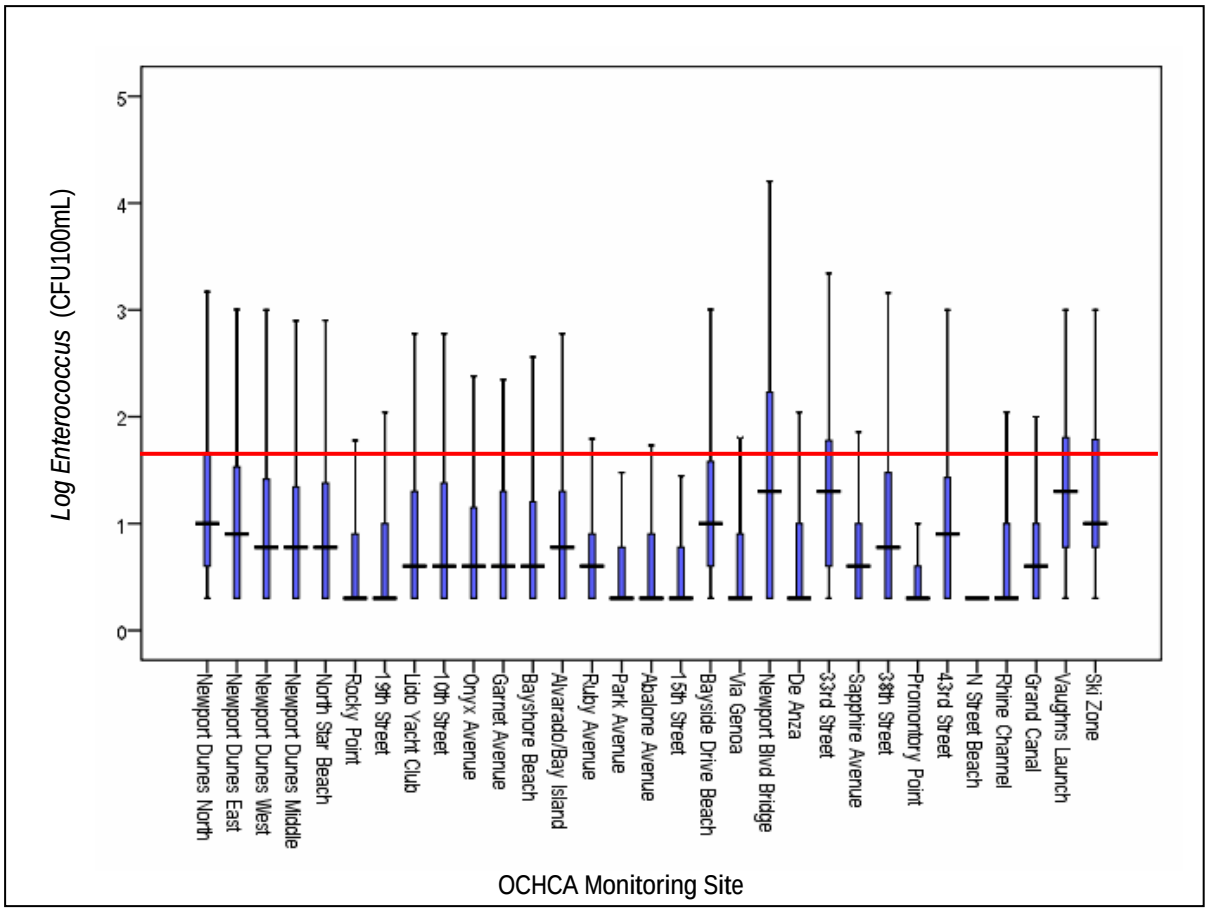



Figure 4.7. Box-whisker plot of *Enterococcus* concentrations (2004-2007) at the 31 OCHCA monitoring sites in the Bay compared to the geomean water quality objective (red line). Box whisker plots illustrate the median as horizontal line at roughly the midpoint of the box, interquartiles (25th and 75th percentiles) as the length of the box, and the range of non-outlier data (those within 1.5 times the interquartiles) as the whiskers.

Similar to fecal coliforms, inspection of Figure 4.6 reveals several interesting observations with respect to *Enterococcus* concentrations in Newport Bay over the time period of 2004 to 2007:

- The median *Enterococcus* concentration at nearly all (28 of 31) sites throughout the Bay is 10 MPN /100mL or less (method detection limit 2 CFU/100mL), substantially lower than the geometric mean water quality criteria of 35 MPN /100mL.
- The sites that have median values higher than 10 MPN/100mL also have median fecal coliform values greater than 10 MPN / 100mL. These sites include Vaughn's Launch, Newport Blvd Bridge, and 33rd St.
- Variability in *Enterococcus* concentrations (in general) is higher than fecal coliforms. The sites that exhibit the greatest variability in *Enterococcus* concentrations are 33rd St. and Newport Blvd Bridge.

### 4.2.2 Source Identification Study *Enterococcus* Dataset (2006-2007)

In addition to the OCHCA long-term dataset, water samples were also collected at nine Bay-to-Ocean (BTO) transect sites in the Upper and Lower Newport Bay as part of the Newport Bay Source Identification Project[17] (Figure 4.8). These sites are numbered BTO4 to BTO11 and are intended to represent areas within the channel of the Bay. Site BTO 12 is an ocean control site, and BTO1, BTO2 and BTO3 are tributary sites, which are further discussed in Section 5.0.

At most BTO sites, water samples were collected approximately weekly from five locations in the channel cross-section: three at the channel thalweg (surface, bottom, and depth integrated), and two at the channel's edges[18]. Dry season data were collected from July through October 2006, wet season from March through April 2006, and storm data were collected during February storm events in 2007. Samples were analyzed for *Enterococcus* and *E. coli*.

In summary, ranges and median concentrations of *Enterococcus* in water appear to decline the closer the proximity to the ocean, suggesting that dilution or die-off plays a role in the Lower Bay (Figure 4.8). Interestingly, as described in Section 5.0, *Enterococcus* concentrations in bedded sediments had higher concentrations in the Lower Bay, compared to the Upper Bay. Explanations for this phenomenon are explored in Section 5.0.

## 4.3 Relationship Between FIB and Precipitation

During and after a significant rain event, storm drains, creeks and rivers carry floodwaters combined with urban runoff to the Bay and ocean. Many studies have shown and it is generally accepted in the scientific community that FIB concentrations in water bodies increase following rain events that generate urban runoff. To ensure that public health and safety is protected, OCHCA advises against the use of ocean or Bay waters during and directly after substantial rain events ($\geq$ 0.2 inches). The elevated bacterial levels in the Bay may continue for a period of at least three days depending on the intensity of the rain and the volume of runoff (OCHCA 2009).

[17] With respect to application of the Proposition 13 Project, results should be considered preliminary as they have not yet been peer reviewed or otherwise externally validated.

[18] These sites were located in the main channel of the Bay, and therefore may not fully represent the concentration of FIB at recreation areas.

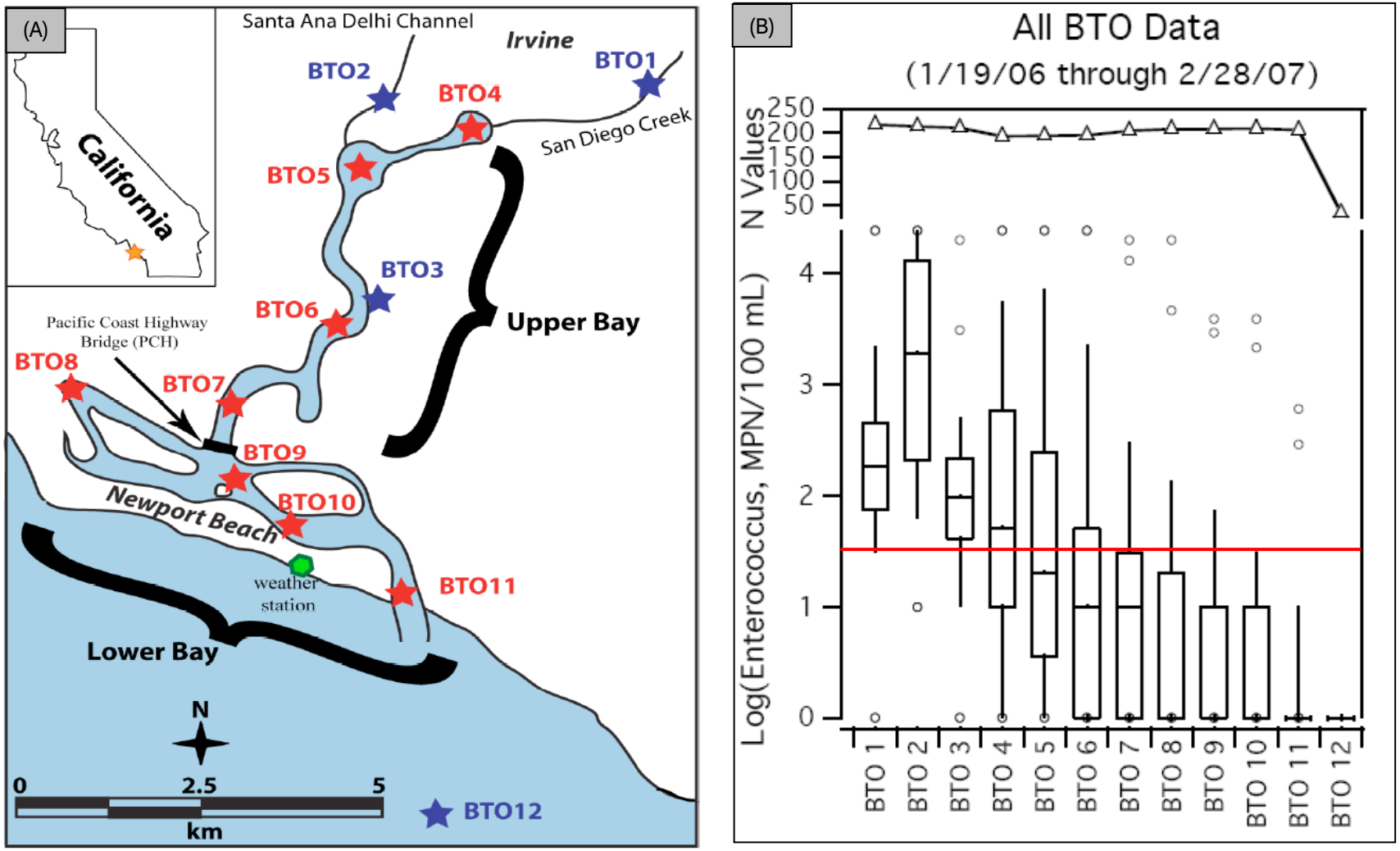



Figure 4.8. (A) Newport Bay to Ocean (BTO) transect monitoring sites sampled in 2006 and 2007 (Grant et al. 2009); and, (B) Box whisker plots for log *Enterococcus* concentrations at BTO transect sites compared to the geomean water quality objective (red line). Please note BTO sites 1, 2 and 3 are not within the Bay, rather in tributaries (BTO1 – San Diego Creek; BTO2 – Santa Ana Delhi Channel; BTO3 – Big Canyon Wash) draining to the Bay.

Given that it is generally accepted that runoff-generating rain events increase FIB concentrations in the Bay and ocean, OCHCA data representing "current" conditions were stratified into two datasets (wet weather and dry weather) to test if there are statistically significant differences. If results suggest that differences are apparent, this information would provide strong support to stratifying datasets for further analyses in the SMP. The wet weather dataset includes data collected on any sampling day with ≥ 0.2 inches of precipitation or within three days following the rain event. This definition is synonymous with OCHCA's rain advisory (Table 4.1). The dry weather dataset includes any data collected on days not meeting the wet weather definition.

Table 4.1. Wet weather and dry weather definitions.

| Dataset | Definition |
|---|---|
| Wet Weather | Days with ≥ 0.2 inches of precipitation plus 3 days following the rain event. Synonymous with OCHCA rain advisory: During or after a rainstorm event of ≥0.2" of rain, unless multiple events occur during the 72-hour window of the previous rainstorm. In those cases the existing rain advisory continues for an additional 72 hours. |
| Dry Weather | Any day not included in a rain advisory (above). |

To assess if statistically significant differences exist between OCHCA wet and dry weather datasets, all FIB data were first log-transformed to establish normally distributed populations. For fecal coliform and *Enterococcus* datasets, T-tests were then performed to determine whether the means of the wet and dry weather datasets were equal. Results indicate that significant differences ($p < 0.05$) exist between wet and dry weather datasets for both fecal coliform and *Enterococcus*. Based on the differences between wet and dry weather, OCHCA data will be discussed as "wet" and "dry" weather for the remainder of the SMP. Figure 4.9 illustrates the median and variability in both wet and dry weather datasets for OCHCA sites.

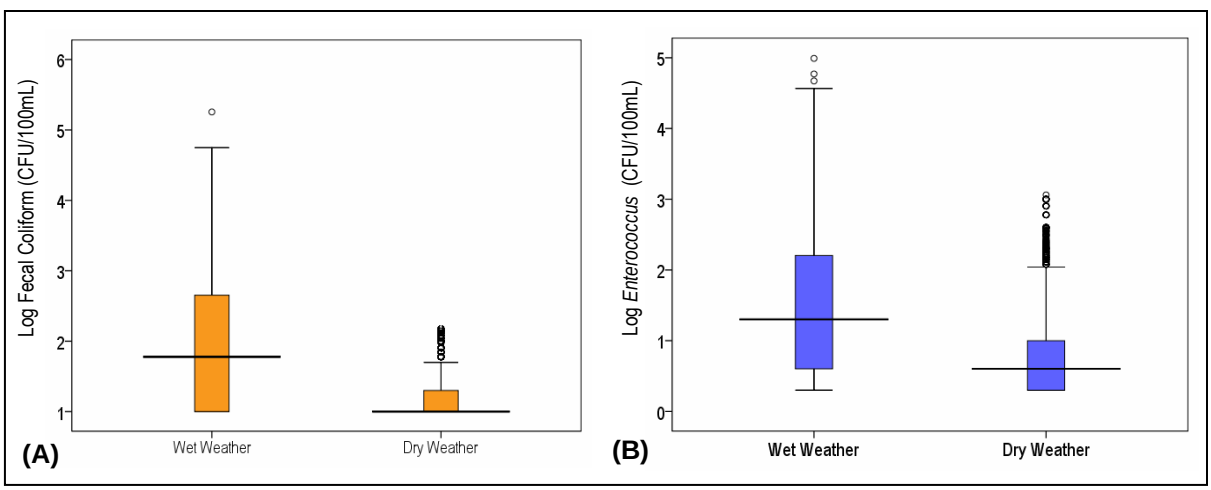



Figure 4.9. Box-whisker plots of fecal coliform (A) and Enterococcus (B) concentrations from 2004-2007 at the 31 OCHCA monitoring sites during dry and wet weather.

Table 4.2 presents the total annual rainfall from 2004 through 2007 and the number of days in each year that meet the wet weather definition described above (i.e., rain advisory days). As illustrated, 2004 through 2007 exhibited both above average and below average annual rainfall and a substantial range in the number of annual rain advisory days. Therefore, the dataset selected to represent the "current" water quality condition in the Bay (i.e., 2004 to 2007) includes data collected during both relatively wet and dry years. This information provides strong support that the timeframe selected to represent current water quality represents both high and low rainfall/runoff events that may affect water quality.

Table 4.2. Average rainfall and number wet weather days per year (2004-2007).

| | 2004 | 2005 | 2006 | 2007 | Average |
|---|---|---|---|---|---|
| Total Rainfall (Irvine Rainfall Station #75) | 17.2 | 20.1 | 8.8 | 4.1 | 13.9[a] |
| Number of Wet Weather Days (Ocean and Bay rain advisories-issued during or after a rainstorm event ≥0.2") | 65 | 73 | 75 | 48 | 59.8 |
| % of Wet Weather Days | 17.8% | 20.0% | 20.5% | 13.2% | 16.4% |

[a] Average of 1987 through 2007

Table 4.3 (fecal coliform) and Table 4.4 (*Enterococcus*) provide a comparison of current OCHCA dry weather datasets to applicable water quality objectives and criteria for each Bay monitoring site. Table 4.5 and 4.6 present and compare wet weather data to applicable water quality objectives and criteria for fecal coliforms and *Enterococcus*, respectively. Recreational use levels presented in these tables are based on the recreational use assessment conducted by EOA (2001) and presented in Section 3.0.

Examination of dry and wet weather data presented in Tables 4.3 to 4.6 illustrates many salient points. Specifically, the OCHCA 2004 to 2007 dry and wet weather fecal coliform and *Enterococcus* datasets reveal that:

- At all sites, the percentage of wet weather samples that are equal to, or greater than the Upper Percentile Value water quality objective or criteria for designated bathing beaches is substantially higher than dry weather samples;
- At nearly all sites, wet weather samples exceeded the fecal coliform or *Enterococcus* Upper Percentile Value water quality objective or criteria for designated bathing beaches between 20 and 60% of the time;
- During dry weather sampling events, only 1 of 31 (3%) OCHCA monitoring sites (33rd St.) exceeded the fecal coliform log-mean water quality objective more than 10% of the time (based on the 30-day running geomean), however, 6 of 31 (19%) of sites (Vaughns Launch, Newport Blvd Bridge, 38th Street, Bayside Drive Beach, 33rd Street and10th Street) exceeded the *Enterococcus* geomean water quality criteria more than 10% of the time (based on the 30-day running geomean);
- Sites that exceeded the fecal coliform SSM greater than 10% of the time during dry and wet weather, also had the highest rates of *Enterococcus* SSM exceedances among all sites.

Table 4.3. Comparison of 2004 to 2007 OCHCA dry weather fecal coliform data at the 31 Newport Bay sites to applicable water quality objectives and criteria.

| Station ID | Station Location | Rec Use Level | Fecal Coliform | | | |
|---|---|---|---|---|---|---|
| | | | # Sampling Events | Geomean[a] | % 30-day Running Log-mean[b] ≥ 200 (CFU/100mL)[c] | % Samples ≥ 400 (CFU/100mL)[d] |
| BNB24N | Newport Dunes North | Extra High | 166 | 36 | 2.6% | 3.6% |
| BNB24E | Newport Dunes East | Extra High | 173 | 30 | 3.3% | 6.4% |
| BNB24W | Newport Dunes West | Extra High | 164 | 21 | 0.0% | 2.4% |
| BNB24M | Newport Dunes Middle | Extra High | 163 | 20 | 0.0% | 1.2% |
| BNB28 | North Star Beach | High | 165 | 15 | 0.0% | 2.4% |
| BNB23 | Rocky Point | High | 164 | 13 | 0.0% | 1.2% |
| BNB14 | 19th Street | High | 166 | 16 | 0.0% | 2.4% |
| BNB32 | Lido Yacht Club | High | 165 | 23 | 3.9% | 4.8% |
| BNB17 | 10th Street | Medium | 168 | 19 | 2.4% | 4.2% |
| BNB02 | Onyx Avenue | Medium | 165 | 15 | 0.0% | 1.2% |
| BNB31 | Garnet Avenue | Medium | 159 | 14 | 0.0% | 1.3% |
| BNB05 | Bayshore Beach | Medium | 165 | 15 | 0.0% | 1.8% |
| BNB18 | Alvarado/Bay Island | Medium | 163 | 16 | 0.0% | 1.2% |
| BNB03 | Ruby Avenue | Medium | 162 | 14 | 0.0% | 2.5% |
| BNB01 | Park Avenue | Medium | 158 | 12 | 0.0% | 0.0% |
| BNB21 | Abalone Avenue | Medium | 167 | 13 | 0.0% | 7.5% |
| BNB15 | 15th Street | Medium | 163 | 12 | 0.0% | 1.8% |
| BNB33 | Bayside Drive Beach | Medium | 180 | 32 | 5.6% | 6.7% |
| BNB07 | Via Genoa | Medium | 159 | 14 | 0.0% | 0.6% |
| BNB35 | Newport Blvd Bridge | Low | 158 | 44 | 7.8% | 12.0% |
| BNB30 | De Anza | Low | 161 | 14 | 0.0% | 3.1% |
| BNB11 | 33rd Street | Low | 156 | 44 | 18.5% | 14.1% |
| BNB20 | Sapphire Avenue | Low | 159 | 13 | 0.0% | 0.0% |
| BNB10 | 38th Street | Low | 173 | 22 | 3.3% | 5.8% |
| BNB29 | Promontory Point | Low | 157 | 11 | 0.0% | 0.0% |
| BNB09 | 43rd Street | Low | 163 | 23 | 2.6% | 3.7% |
| BNB22 | N Street Beach | Low | 161 | 12 | 0.0% | 1.9% |
| BNB12 | Rhine Channel | Low | 165 | 17 | 0.0% | 0.6% |
| BNB34 | Grand Canal | Low | 162 | 20 | 0.0% | 3.1% |
| BNB25 | Vaughns Launch | Low | 96 | 22 | 0.0% | 2.1% |
| BNB26 | Ski Zone | Low | 57 | 25 | 0.0% | 5.3% |

[a] Geometric mean of all dry weather samples.
[b] Based on a minimum of 5 samples collected during a 30-day period.
[c] Fecal coliform log-mean water quality objective (Water Board 2008).
[d] Fecal coliform upper percentile value water quality objective (Water Board 2008).

Table 4.4. Comparison of 2004 to 2007 OCHCA dry weather *Enterococcus* data at the 31 Newport Bay sites to applicable water quality objectives and criteria.

| Station ID | Station Location | Rec Use Level | *Enterococcus* | | | | |
|---|---|---|---|---|---|---|---|
| | | | # Sampling Events | Geomean[a] | % 30-day Running Geomean[b] ≥ 35 (CFU/100mL)[c] | % Samples ≥ 104 (CFU/100mL)[d] | % Samples ≥ Rec Use Level-based Upper Percentile Value[e] |
| BNB24N | Newport Dunes North | Extra High | 167 | 11 | 3.9% | 4.8% | 4.8% |
| BNB24E | Newport Dunes East | Extra High | 174 | 8 | 5.6% | 6.3% | 6.3% |
| BNB24W | Newport Dunes West | Extra High | 165 | 6 | 2.6% | 4.2% | 4.2% |
| BNB24M | Newport Dunes Middle | Extra High | 165 | 6 | 0.0% | 3.0% | 3.0% |
| BNB28 | North Star Beach | High | 167 | 7 | 2.6% | 3.6% | 2.4% |
| BNB23 | Rocky Point | High | 165 | 4 | 4.4% | 3.6% | 1.8% |
| BNB14 | 19th Street | High | 166 | 5 | 2.5% | 3.6% | 3.6% |
| BNB32 | Lido Yacht Club | High | 165 | 6 | 1.3% | 4.2% | 3.0% |
| BNB17 | 10th Street | Medium | 169 | 6 | 11.0% | 6.5% | 3.6% |
| BNB02 | Onyx Avenue | Medium | 165 | 5 | 0.0% | 3.6% | 1.2% |
| BNB31 | Garnet Avenue | Medium | 159 | 5 | 0.0% | 1.3% | 0.6% |
| BNB05 | Bayshore Beach | Medium | 165 | 5 | 0.0% | 3.6% | 1.8% |
| BNB18 | Alvarado/Bay Island | Medium | 163 | 7 | 2.6% | 4.3% | 1.8% |
| BNB03 | Ruby Avenue | Medium | 162 | 4 | 0.0% | 1.2% | 0.6% |
| BNB01 | Park Avenue | Medium | 158 | 3 | 0.0% | 0.6% | 0.0% |
| BNB21 | Abalone Avenue | Medium | 167 | 4 | 1.2% | 4.8% | 1.2% |
| BNB15 | 15th Street | Medium | 163 | 3 | 0.0% | 1.2% | 1.2% |
| BNB33 | Bayside Drive Beach | Medium | 180 | 12 | 15.6% | 6.1% | 2.2% |
| BNB07 | Via Genoa | Medium | 159 | 4 | 2.9% | 1.3% | 0.6% |
| BNB35 | Newport Blvd Bridge | Low | 158 | 17 | 26.6% | 26.6% | 8.9% |
| BNB30 | De Anza | Low | 162 | 4 | 4.3% | 4.3% | 1.2% |
| BNB11 | 33rd Street | Low | 156 | 15 | 13.8% | 12.8% | 1.9% |
| BNB20 | Sapphire Avenue | Low | 159 | 5 | 1.4% | 2.5% | 0.6% |
| BNB10 | 38th Street | Low | 173 | 9 | 18.9% | 8.1% | 1.7% |
| BNB29 | Promontory Point | Low | 157 | 3 | 0.0% | 0.6% | 0.6% |
| BNB09 | 43rd Street | Low | 163 | 8 | 6.6% | 6.7% | 2.5% |
| BNB22 | N Street Beach | Low | 161 | 3 | 0.0% | 0.0% | 0.0% |
| BNB12 | Rhine Channel | Low | 165 | 5 | 2.6% | 4.2% | 0.6% |
| BNB34 | Grand Canal | Low | 162 | 5 | 0.0% | 0.6% | 0.0% |
| BNB25 | Vaughns Launch | Low | 96 | 15 | 42.9% | 8.3% | 1.0% |
| BNB26 | Ski Zone | Low | 57 | 15 | 0.0% | 14.0% | 3.5% |

[a] Geometric mean of all dry weather samples.
[b] Based on a minimum of 5 samples collected during a 30-day period.
[c] *Enterococcus* geomean water quality criteria (US EPA 2004b).
[d] *Enterococcus* upper percentile value water quality objective for designated bathing beaches (US EPA 2004b).
[e] *Enterococcus* recreational use-based upper percentile value water quality objectives (CFU/100mL) include: designated beaches/extra high use (104), moderately used sites/high use (158), lightly used sites/medium use (276) and infrequently used sites/low use (500) (US EPA 2004b).

Table 4.5. Comparison of 2004 to 2007 OCHCA wet weather fecal coliform data at the 31 Newport Bay sites to applicable water quality objectives and criteria.

| Station ID | Station Location | Rec Use Level | Fecal Coliform | | |
|---|---|---|---|---|---|
| | | | # Sampling Events | Geomean [a] | % Samples ≥ 400 (CFU/100mL)[b] |
| BNB24N | Newport Dunes North | Extra High | 57 | 530 | 44.7% |
| BNB24E | Newport Dunes East | Extra High | 57 | 493 | 39.0% |
| BNB24W | Newport Dunes West | Extra High | 56 | 388 | 48.7% |
| BNB24M | Newport Dunes Middle | Extra High | 56 | 344 | 46.2% |
| BNB28 | North Star Beach | High | 52 | 278 | 47.1% |
| BNB23 | Rocky Point | High | 56 | 37 | 10.5% |
| BNB14 | 19th Street | High | 59 | 88 | 27.5% |
| BNB32 | Lido Yacht Club | High | 59 | 106 | 28.6% |
| BNB17 | 10th Street | Medium | 64 | 102 | 25.6% |
| BNB02 | Onyx Avenue | Medium | 59 | 67 | 30.8% |
| BNB31 | Garnet Avenue | Medium | 60 | 74 | 23.8% |
| BNB05 | Bayshore Beach | Medium | 58 | 100 | 20.5% |
| BNB18 | Alvarado/Bay Island | Medium | 59 | 98 | 29.3% |
| BNB03 | Ruby Avenue | Medium | 62 | 53 | 18.6% |
| BNB01 | Park Avenue | Medium | 60 | 48 | 21.4% |
| BNB21 | Abalone Avenue | Medium | 58 | 44 | 15.0% |
| BNB15 | 15th Street | Medium | 58 | 66 | 29.3% |
| BNB33 | Bayside Drive Beach | Medium | 61 | 75 | 22.0% |
| BNB07 | Via Genoa | Medium | 60 | 71 | 21.4% |
| BNB35 | Newport Blvd Bridge | Low | 58 | 269 | 37.5% |
| BNB30 | De Anza | Low | 58 | 125 | 30.8% |
| BNB11 | 33rd Street | Low | 59 | 134 | 19.5% |
| BNB20 | Sapphire Avenue | Low | 61 | 48 | 19.0% |
| BNB10 | 38th Street | Low | 63 | 78 | 16.3% |
| BNB29 | Promontory Point | Low | 61 | 31 | 14.3% |
| BNB09 | 43rd Street | Low | 57 | 115 | 26.8% |
| BNB22 | N Street Beach | Low | 58 | 34 | 12.5% |
| BNB12 | Rhine Channel | Low | 60 | 64 | 21.4% |
| BNB34 | Grand Canal | Low | 60 | 50 | 17.1% |
| BNB25 | Vaughns Launch | Low | 31 | 190 | 34.8% |
| BNB26 | Ski Zone | Low | 22 | 144 | 42.9% |

[a] Geometric mean of all wet weather samples.
[b] Fecal coliform upper percentile value water quality objective (Water Board 2008).

Table 4.6. Comparison of 2004 to 2007 OCHCA wet weather *Enterococcus* data at the 31 Newport Bay sites to applicable water quality objectives and criteria.

| Station ID | Station Location | Rec Use Level | *Enterococcus* | | | |
|---|---|---|---|---|---|---|
| | | | # Sampling Events | Geomean[a] | % Samples ≥ 104 (CFU/100mL)[b] | % Samples ≥ Rec Use Level-based Upper Percentile Value[c] |
| BNB24N | Newport Dunes North | Extra High | 62 | 152 | 46.3% | 46.3% |
| BNB24E | Newport Dunes East | Extra High | 61 | 118 | 41.9% | 41.9% |
| BNB24W | Newport Dunes West | Extra High | 59 | 102 | 32.5% | 32.5% |
| BNB24M | Newport Dunes Middle | Extra High | 61 | 118 | 42.9% | 42.9% |
| BNB28 | North Star Beach | High | 57 | 120 | 44.7% | 36.8% |
| BNB23 | Rocky Point | High | 56 | 17 | 13.2% | 7.9% |
| BNB14 | 19th Street | High | 60 | 29 | 28.6% | 26.2% |
| BNB32 | Lido Yacht Club | High | 60 | 22 | 18.6% | 18.6% |
| BNB17 | 10th Street | Medium | 65 | 43 | 25.0% | 15.9% |
| BNB02 | Onyx Avenue | Medium | 59 | 28 | 25.6% | 20.5% |
| BNB31 | Garnet Avenue | Medium | 61 | 33 | 25.6% | 16.3% |
| BNB05 | Bayshore Beach | Medium | 60 | 39 | 29.3% | 22.0% |
| BNB18 | Alvarado/Bay Island | Medium | 60 | 40 | 26.2% | 14.3% |
| BNB03 | Ruby Avenue | Medium | 63 | 21 | 18.2% | 18.2% |
| BNB01 | Park Avenue | Medium | 61 | 19 | 20.9% | 16.3% |
| BNB21 | Abalone Avenue | Medium | 59 | 20 | 19.5% | 14.6% |
| BNB15 | 15th Street | Medium | 59 | 26 | 26.2% | 19.0% |
| BNB33 | Bayside Drive Beach | Medium | 62 | 43 | 31.0% | 14.3% |
| BNB07 | Via Genoa | Medium | 61 | 26 | 25.6% | 18.6% |
| BNB35 | Newport Blvd Bridge | Low | 59 | 128 | 56.1% | 34.1% |
| BNB30 | De Anza | Low | 60 | 50 | 31.7% | 22.0% |
| BNB11 | 33rd Street | Low | 61 | 82 | 32.6% | 20.9% |
| BNB20 | Sapphire Avenue | Low | 62 | 22 | 20.9% | 14.0% |
| BNB10 | 38th Street | Low | 65 | 41 | 22.2% | 15.6% |
| BNB29 | Promontory Point | Low | 62 | 12 | 20.9% | 16.3% |
| BNB09 | 43rd Street | Low | 57 | 44 | 26.8% | 19.5% |
| BNB22 | N Street Beach | Low | 59 | 14 | 19.5% | 12.2% |
| BNB12 | Rhine Channel | Low | 61 | 23 | 25.6% | 20.9% |
| BNB34 | Grand Canal | Low | 61 | 24 | 21.4% | 14.3% |
| BNB25 | Vaughns Launch | Low | 32 | 143 | 50.0% | 20.8% |
| BNB26 | Ski Zone | Low | 22 | 81 | 42.9% | 14.3% |

[a] Geometric mean of all wet weather samples.
[b] *Enterococcus* upper percentile value water quality objective for designated bathing beaches (US EPA 2004b).
[c] *Enterococcus* recreational use-based upper percentile value water quality objectives (CFU/100mL) include: designated beaches/extra high use (104), moderately used sites/high use (158), lightly used sites/medium use (276) and infrequently used sites/low use (500) (US EPA 2004b).

In addition to the OCHCA dataset, data generated through the Source Identification Project were also evaluated to assess the effects of both season and rainfall on FIB concentrations in the Bay. Unlike OCHCA monitoring sites that are located at beaches and on the margins of the Bay, FIB samples were collected from the channel of the Bay during the Source ID Project. Therefore, channel sites may provide additional information on seasonal and storm-driven FIB transport patterns from sources.

Investigation of Figure 4.10 reveals several interesting observations with respect to *Enterococcus* concentrations in samples collected daily or weekly from Newport Bay (BTO4 to BTO11) during: A) four months of dry weather in 2006; B) two months during the wet season in 2006; and, C) storm event during three weeks in 2007:

- For all Bay sites, the median and 75$^{th}$ percentile for *Enterococcus* are below the Upper Percentile Value water quality criterion (104 CFU/100mL) for *Enterococcus* during dry season;
- Median *Enterococcus* concentrations in samples collected during storm events are greater than those collected during the wet (season, which are greater than dry season samples; and,
- At nearly all Bay sites, variability in *Enterococcus* concentrations was less during the dry season, compared to storm events or the wet season.

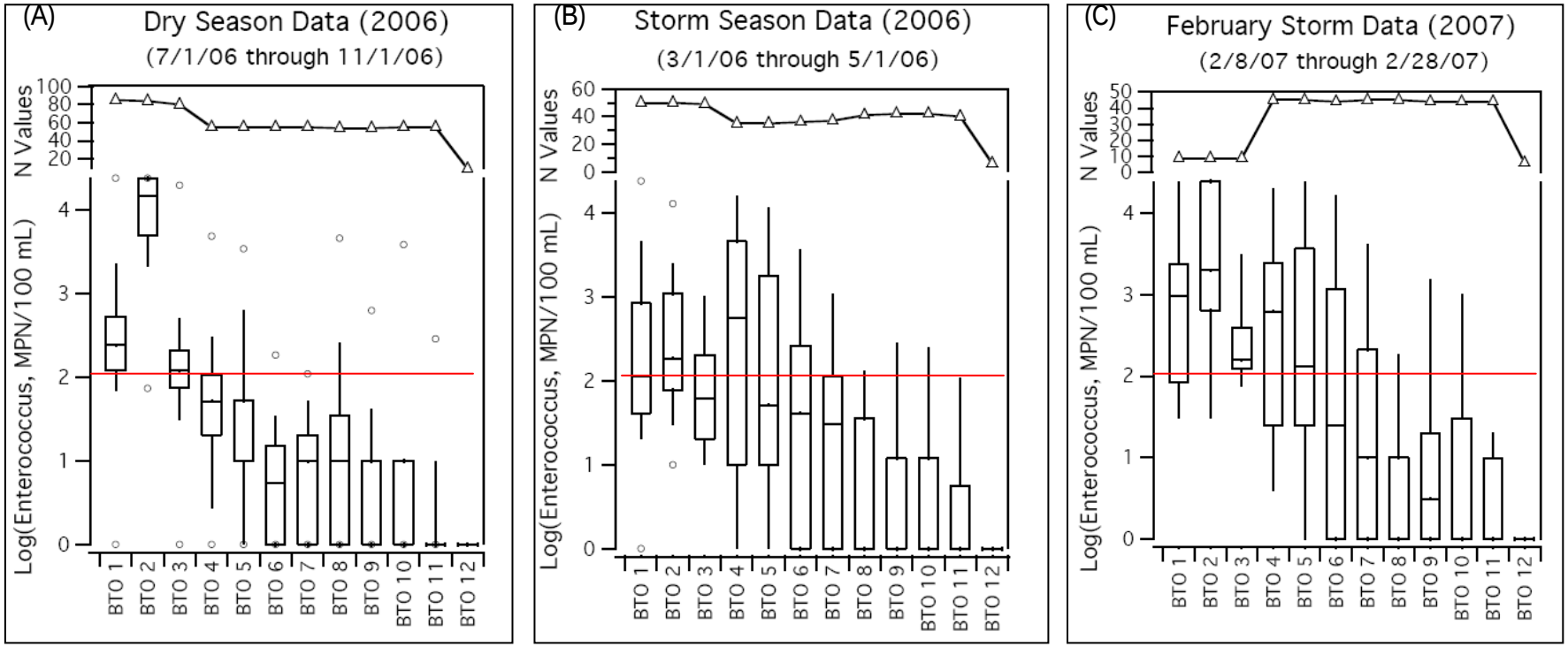



Figure 4.10. *Enterococcus* concentrations in samples collected at Bay to Ocean Transect (BTO) sites during the dry season (A); storm season (B); and storm events (C) during 2006 and 2007 (Grant et al. 2009). (Note: the red line denotes the U.S. EPA Upper Percentile Value (UPV) water quality criteria for as a point of reference and is not assumed to be applicable to all BTO sites).

## 4.4 Additional Pertinent Technical Studies

A number of additional studies and investigations have been completed in recent years, or are presently ongoing, to identify the sources, magnitude, and impacts of FIB (and microbial pathogens) in the Bay. Many of these studies were conducted to meet TMDL requirements (see Table 1.2). The following paragraphs briefly summarize the most pertinent studies applicable to this Management Plan.

(1) Water Quality Monitoring, Identification of Problematic Areas, and Analysis of Historical Trends Using OCHCA Data (Pednekar et al. 2005): In this study, historical coliform measurements in Newport Bay, were compiled and analyzed. The results indicated that coliform concentrations in Newport Bay decrease along an inland-to-ocean gradient, consistent with the hypothesis that this tidal embayment attenuates fecal pollution from inland sources. Nearly 70% of the variability in the coliform record can be attributed to seasonal and inter-annual variability in local rainfall, implying that stormwater runoff from the surrounding watershed is a primary source of coliform in Newport Bay. The storm loading rate of coliform from the San Diego Creek watershed appears to be unaffected by the dramatic shift away from agricultural land-use that occurred in the watershed over the study period. Further, the peak loading of coliform during storms is larger than can be reasonably attributed to sources of human sewage, suggesting that nonhuman fecal pollution and/or bacterial regrowth contribute to the coliform load. Overall, the results suggest that efforts to improve water quality in Newport Bay will likely have greater efficacy during dry weather summer periods. Water quality during winter storms, on the other hand, appears to be dominated by factors outside of local management control; namely, virtually unlimited nonhuman sources of coliform in the watershed and global climate patterns, such as the El Nino Southern Oscillation, that modulate rainfall and stormwater runoff in southern California.

(2) Evaluation of Illicit Boat Discharges as a Source of FIB in Newport Bay (Jeong et al. 2005): This study investigated the contribution of marinas to fecal indicator bacteria impairment in Newport Bay. Three different fecal indicator bacteria groups were assayed, including total coliform, *Escherichia coli*, and enterococci bacteria. To document temporal variability in the fecal indicator bacteria signal, water column samples ($n$ = 4132) were collected from two marinas over time scales ranging from hours to months. To document spatial variability of the fecal indicator bacteria signal, water column and sediment samples were collected from a number of sites ($n$ = 11 to 36, depending on the study) in and around the two marinas, over spatial scales ranging from meters to kilometers. To identify the dominant temporal and spatial patterns in these data a statistical approach was utilized. Finally, to clarify the transport pathways responsible for the observed temporal and spatial patterns, fecal indicator bacteria data were compared to simultaneous measurements of tidal flow, temperature, and salinity. The results of this field effort collectively implicate dry and wet weather runoff at all sites as a primary source of fecal indicator bacteria in the water column and subtidal sediments.

(3) Public Health Risk Assessment for Recreational Contact from Exposure to FIB Concentrations in Newport Bay (EOA 2001, Soller et al. 2006): In this investigation, a comprehensive health based investigation was designed and implemented. Bacterial indicator data indicate that exceedances of the water quality objectives are temporally sporadic, geographically limited and most commonly occur during the

time of the year and/or in areas of the Bay where the REC-1 use is low or non-existent. A disease transmission model produced simulated risk estimates for recreation in the Bay that were below levels considered tolerable by the U.S. EPA (median estimate 0.9 illnesses per 1,000 recreation events). Control measures to reduce pathogen loading to Newport Bay are predicted to reduce risk by an additional 16% to 50%.

(4) Swimmer Shedding Study at the Dunes Beach (Jiang et al. 2005): The swimmer shedding study in Newport Dunes was conducted to examine the contribution of bathers to FIB in the Newport Bay water column at the Newport Dunes and to investigate if sediment resuspension could be an alternative source of fecal contamination. The working hypotheses for this study were: a) Fecal bacterial are shed during bathing/swimming activities; b) The current fecal bacterial assay method is sufficiently sensitive to detect bacteria shedding during bathing/swimming; c) The water column fecal bacteria concentration increases with increasing number of bathers; and 4) Both direct shedding from the body of swimmers and stirring of sediment that harbors high concentration of bacteria during water activities contribute to the elevated level of fecal indicator bacteria in the water column. The results of the study indicate that bathing activities do not appear to be the cause of observed increases of indicator bacteria in Newport Dunes swimming areas; however, the number of bathers at the high use area was 20 or less. Thus, the impacts of shedding may have been undetected.

(5) Hydrodynamic modeling of flow in Newport Bay (Everest International 2004): A hydrodynamic model of Upper Newport Bay was initially configured in 1997 and 1998 for hydrodynamics, sediment transport, and salinity simulation in support of the U.S. Army Corp of Engineers Feasibility Study. The model was then extended in 1999 and 2000 for simulation of basic water quality parameters such as temperature, dissolved oxygen, nutrients, phytoplankton and macrophytes. The RMA model uses a finite element numerical model that permits explicit representation of the complex shape of Newport Bay and is well suited to simulation of shallow estuaries where large areas of mudflats are exposed at low tides. In 2001 a new hydrodynamic modeling effort occurred to extend the existing numerical modeling capability for Newport Bay to include simulation of fecal coliform and coliphage in support of the fecal coliform TMDL for the Newport Bay watershed. The numerical model provides temporally and spatially varying concentrations of fecal coliform and coliphage for use by the public health risk assessment model described above.

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# 5.0 FIB SOURCES, PATHWAYS AND ENVIRONMENTAL FATES

Developing an understanding of fecal indicator bacteria (FIB) sources, transport pathways and environmental fates assists managers in developing a solid foundation to base source management decisions. Sources are defined as activities or processes leading to the release of pollutants into the environment. Transport pathways are routes through which pollutants from sources enter a water body. Environmental fates are processes that can affect pollutant concentrations, including physicochemical removal from and mobilization into the water column, die-off and growth.

This section provides an overview of current information regarding the importance of potential FIB sources, pathways and fates in the Newport Bay watershed. Additionally, preliminary estimates of FIB deposits onto the surface of the watershed from sources and loadings from pathways are provided. Figure 5.1 provides an illustration of potential FIB sources and pathways in the watershed.

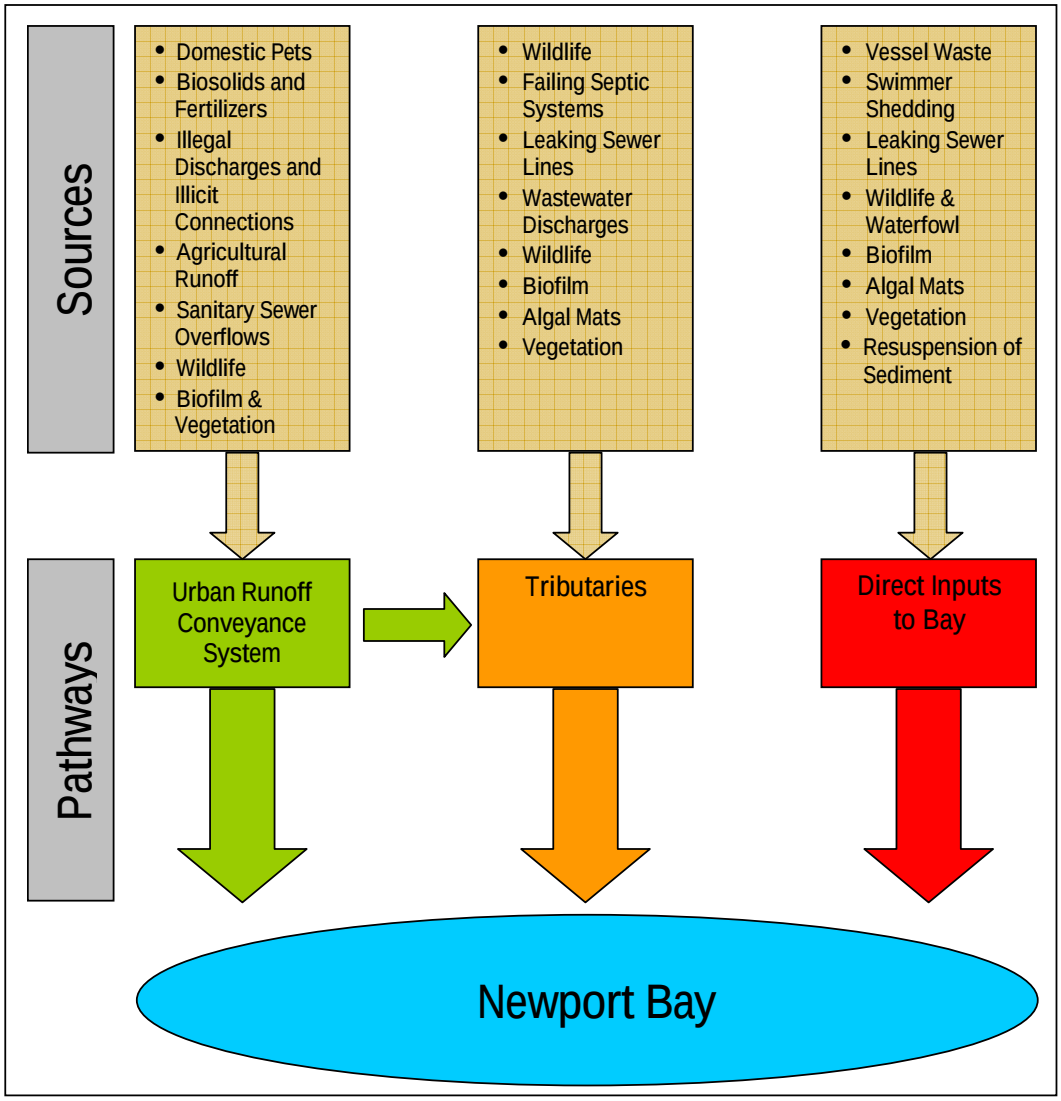


Figure 5.1 Potential fecal indicator bacteria (FIB) sources and pathways to Newport Bay.

## 5.1 Sources of FIB

There are a variety of sources that can contribute FIB to Newport Bay (Table 5.1, Figure 5.2). These sources can deposit FIB: 1) onto the surface of the watershed draining to the Bay (e.g., wildlife and pet waste); or 2) directly into the Bay and tributaries/conveyances draining to the Bay (e.g., water birds and vessel waste). For sources that deposit FIB onto the surface of the watershed, a pathway (e.g., tributary or urban runoff conveyance system) is then needed to transport FIB to the Bay during dry or wet weather. Transport pathways are further discussed in Section 5.2.

The *Total Maximum Daily Load for Fecal Coliform in Newport Bay* (Fecal Coliform TMDL) recognizes four "source categories" presented in Table 5.1 that comprise a large majority of FIB sources to the Bay. An additional source category was also added to include "Other Urban Sources" not included in four existing TMDL source categories. Information on the extent and magnitude of specific sources within each category are described in this section based on the results of technical studies conducted during the development and implementation of the Fecal Coliform TMDL (e.g., Jeong et al. 2005, Jiang et al. 2005, Everest International 2004, Pednaker et al. 2007, Grant et al. 2009).

Table 5.1. TMDL source categories and sources contributing FIB to Newport Bay (W = deposits FIB onto surface of watershed; B = direct inputs to the Bay).

| TMDL Source Category | Fecal Indicator Bacteria (FIB) Sources | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Domestic Pet Waste | Biosolid & Fertilizer Applications | Illegal Discharges and Illicit Connections | Nurseries and Row Crops | Boat Waste & Pump Out Facilities | Failing Septic Systems & Leaking Sewer Lines | Sanitary Sewer Overflows | Wastewater Discharges | Swimmer Shedding | Watershed and Bay Wildlife | Vegetation, Resuspended Sediment, Biofilms and Algal Mats |
| 1) Urban Runoff | W | W | W | | | | | | | | |
| 2) Other Urban Sources[19] | | | | | | B | W/B | B | B | | |
| 3) Vessel Waste | | | | | B | | | | | | |
| 4) Agriculture Runoff | | W | | W | | | | | | | |
| 5) Natural Sources | | | | | | | | | | W/B | W/B |

[19] The "Other Urban Sources" category is not currently included in the TMDL, but includes those urban sources not part of urban runoff.

Figure 5.2. Potential fecal indicator bacteria (FIB) sources and pathways to the Upper and Lower Newport Bay, Orange County, California.

### 5.1.1 Natural versus Anthropogenic Sources

Both natural and anthropogenic sources can release FIB into the environment. The *Fecal Coliform TMDL for the Newport Bay* (TMDL) specifically identifies natural sources as a source category. For the purposes of this SMP, natural sources are defined as:

> *"Fecal indicator bacteria (FIB) that are released into the environment from wildlife or plant species, or through growth and replication".*

For the purposes of this SMP, the following FIB sources are within the natural source category: 1) waste from wildlife present in the watershed or within the Bay; 2) vegetation, biofilms, and algal mats either within the watershed, Bay or urban runoff conveyance system; and, 3) growth or replication of FIB.

### 5.1.2 Watershed versus Bay Sources

When developing a conceptual model of FIB releases from sources, it is important to distinguish the geographical area where sources deposit FIB into the environment. Sources can deposit FIB either onto the surface of the watershed or directly into the Bay. With the exception of sanitary sewer overflows (SSOs) and those "natural" sources described above, sources that deposit FIB onto the watershed surface are include in the TMDL "urban runoff" source category (see Table 5.1). Those sources that release FIB directly into the Bay are included in the appropriate TMDL categories other than urban runoff. This nuance becomes more important as estimates of FIB from sources are compared to calculated loads from transport pathways in Section 5.4.

### 5.1.3 Development of Preliminary FIB Loading Estimates from Sources

Where feasible, a preliminary estimate of the rate of FIB deposits (i.e., organisms/day) from each FIB source and source category is provided in this section. Formulas used to calculate deposits from sources and technical support documents referenced are included in Appendix E. These estimates are partially based on results from recent studies and data collection efforts that have attempted to quantify the contribution of FIB to the Bay from sources. Additionally, peer-reviewed literature was utilized to develop preliminary estimates for sources that have not been previously quantified for Newport Bay. Estimates of FIB deposits from sources are summarized and compared at the end of this section. Please note that estimates described in this section are intended to be illustrative of the relative contributions of FIB (i.e., order-of-magnitude estimates) from potential sources in the watershed. Additional information regarding watershed transport processes and environmental fates is needed to reduce the inherent uncertainty within the estimates presented.

### 5.1.4 Urban Runoff Sources

For the purposes of this SMP, the term urban runoff includes all water and FIB from urban anthropogenic sources that are discharged during dry and wet weather from urban runoff conveyance systems. Urban runoff sources include activities and processes that deposit FIB onto the surface of the watershed and within the urban runoff conveyance system. The following paragraphs briefly describe and present preliminary rates of FIB releases for each urban runoff source.

## Domestic Pets

Local ordinances throughout the Newport Bay have established requirements for the proper disposal of pet solid waste. However, it is highly likely that a portion of the waste is left on lawns, sidewalks, or paved surfaces, and can be transported by urban runoff to local water bodies. Therefore, pet waste is considered a source to urban runoff. Estimates of the rate of FIB deposits to the surface of the watershed from domestic pets are described below. Methods and information used to derive these estimates are fully documented in a separate technical support document (i.e., Technical Memorandum #1) and included in Appendix E.

Population estimates for domestic pets were developed using a method recommended by the American Veterinary Medical Association (AVMA) and the following assumptions:

- Approximately 40,000 households in the Newport Bay watershed (U.S. Census 2000);
- Roughly 37% and 32% of households have dogs and cats, respectively (AVMA 2009);
- On average, each pet-owning household has 1.6 dogs or 2.1 cats (AVMA 2000);
- Approximately 44% of cats (Dabritz et al. 2006) and 100% dogs defecate outdoors;
- Each dog and cat excretes approximately $1 \times 10^9$ fecal coliforms per day (USEPA 2004a; Weiskel et al. 1996); and,
- Existing management actions by dog owners (i.e., picking up dog waste) reduces fecal coliform deposits by dogs by 80%.

Using these assumptions, the total contributions of fecal coliforms from domestic (non-feral) cats and dogs to the surface of the Newport Bay watershed are presented in Table 5.2.

Table 5.2. Estimated rates of fecal coliform deposits to the surface of the Newport Bay watershed from domestic pets.

| Type of Pet | Estimated Population in Watershed[a] | % Defecating Outside | Fecal Coliform Production Rate[c] (day/animal) | % Reduction of due to Management Actions[d] | Loading Estimate to Surface of Newport Bay Watershed (Fecal Coliforms/day) |
|---|---|---|---|---|---|
| Dogs | 23,808 | 100% | $1 \times 10^9$ | 80% | $4.8 \times 10^{12}$ |
| Cats | 27,216 | 44%[b] | $1 \times 10^9$ | 0% | $1.2 \times 10^{13}$ |
| | | | | Total | $1.7 \times 10^{13}$ |

[a] Based on American Veterinarian Medical Association (AVMA) formula
[b] Dabritz et al. (2006)
[c] Weiskel et al. (1996)
[d] Based on review of BMPs described in Section 8.0

Other types of domestic animals (e.g., horses and livestock) are also present in the watershed and likely contribute FIB to the watershed. For example, in a recent query of the number of horse stables located in the Newport Bay watershed, more than 10 horse boarding facilities were identified. Additionally, horses are frequently seen on trails near the Upper Bay. Limited information is available on the population of horses and other livestock (e.g., cows and pigs) in the watershed, however, and therefore contributions of FIB from these animals were not calculated.

## Biosolid and Fertilizer Applications

Runoff from lawns and landscaped areas that are maintained with fertilizers containing animal manures have been shown to have greater concentrations of FIB than runoff from unfertilized areas (Edwards and Daniel 1993). Additionally, biosolid applications have been shown to contribute FIB to runoff (Kirchhoff 2004). Ackerman and Stein (2005) also demonstrated that runoff generated from Southern California non-urbanized areas during dry weather periods can contain relatively high concentrations of FIB and other pollutants. Furthermore, although dry weather runoff is typically considered to be an amalgamation of diffuse inputs (e.g., car and sidewalk washing and landscape irrigation), the over-irrigation of urban landscaping areas (i.e., lawns) is believed to be the predominant contributor of dry weather urban runoff in Newport Bay (Everest International 2004).

In an effort to quantify the contribution of FIB from biosolids and fertilizers to urban runoff in the Newport Bay watershed, a literature review was conducted to find specific rates of application and average concentrations of FIB in runoff attributable to these sources. Of the studies reviewed, one isolated FIB concentrations from landscape irrigation in street curbs during dry weather (Grant et al. 2009). Sampling was conducted in the early morning hours to coincide with a peak in landscape irrigation from the surrounding drainage area, and therefore it can be reasonably assumed that a relatively large portion of the FIB in samples collected during this study are likely attributable to landscaping and fertilizers. Although fecal coliforms were not analyzed, median *E. coli* concentrations[20] in samples collected from street curbs were 794 organisms/100mL (Grant et al 2009). Because *E. coli* make up only a fraction of species enumerated in a fecal coliform analysis, this concentration should be considered a lower-bound estimate.

Although discharge estimates from dry weather runoff have not been estimated for the Newport Bay watershed, dry weather discharge rates from urban runoff conveyance systems (i.e., drains)[21] have. Total estimated dry weather discharge from residential land uses in the Newport Bay watershed is 951,682 gallons per day (52.7 gallons/day/acre). These discharge rates, in combination with median dry weather *E. coli* concentrations observed by Grant et al. (2009), were used to develop rates of FIB deposits onto the surface of the watershed for fertilizers. For a full description of methods and information used to calculate FIB contributions from this source see Appendix E.

Based on the information described above, the estimated rate of *E. coli* deposited to the residential land use portion of the Newport Bay watershed from fertilizer and biosolid applications is $3.9 \times 10^{10}$ organisms per day.

## Illegal Discharges and Illicit Connections

Illegal discharges are defined as any non-permitted disposal into the urban runoff conveyance system. With regard to FIB, illegal discharges may originate from a variety of activities that are typically acute in nature. Examples of activities that may illegally contribute FIB to urban runoff include, direct dumping of fecal material (e.g., diapers) onto the watershed, wastes from food service facilities (e.g., restaurants), and discharges from portable toilets. Illicit connections are defined as un-permitted connections to the urban

[20] *Enterococcus* concentrations were also enumerated from dry weather collected in street curbs. A summary of this information is included in the technical support document, "Technical Memorandum #2: Sources, Pathways and Loadings" (EOA 2009).
[21] Dry weather discharge rates from urban runoff conveyance systems (drains) include a mixture of dry weather runoff and groundwater that infiltrates into the system, and therefore may not be fully attributable to over-irrigation.

runoff conveyance system that may result in illegal discharges. Illicit connections, for example, may include cross-connections with a sanitary sewer system or interior floor drains at businesses that have been illegally connected to the urban runoff conveyance system or discharge to the watershed.

Although municipalities have extensive programs to eliminate illegal discharges and illicit connections (see Section 8.0), it is impossible to know exactly how many illegal discharges occur on an annual basis. Discharges occur sporadically and are likely only reported when identified by citizens or public agency staff. Santa Ana Regional Board's NPDES municipal urban runoff Permittees are required to implement an Illegal Discharge and Illicit Connection Control Program that identifies and responds to non-urban runoff and non-exempt discharges. These discharges are not specifically targeted to sources of fecal material, but there are occasions when fecal wastes are discharged onto the watershed or into an urban runoff conveyance system. For example, between 1996 and 2003 three incidents were reported to the County's spill response database where portable toilets were referenced in a complaint. Additionally, very few illegal connections involving sewage have been identified by the Newport Bay municipalities over the last decade.

Due to the limited number sewage-associated illegal discharges and illicit connections identified by citizens or municipalities, loadings from these sources do not appear to be a significant source of FIB in the Newport Bay watershed. Reported incidents are so infrequent (<10) that very limited information is available about this potential source, and therefore loadings were not estimated.

### 5.1.5 Other Urban Sources

**Failing Septic Systems and Leaking Sewer Lines**

***Septic Systems***

Septic systems have proven to be a relatively inexpensive and effective method of wastewater treatment in low-density areas if they are correctly designed and responsibly maintained. A typical septic system includes inlet piping, a septic tank that traps solids and provides storage for peak inflows, and a drain field or leach field that purifies and disperses liquid effluent at a rate governed by the permeability of the surrounding soils. If septic systems fail, poorly treated effluent may surface and drain to nearby storm drain systems and receiving waters. Some possible reasons for septic system failure include:

- Inadequate design – Systems must be sized appropriately (storage), and constructed in soils with adequate permeability to leach the effluent. Systems may become overburdened if additional square footage is added to the residence without expansion of the septic system.
- Inadequate maintenance – Systems must be periodically maintained by pumping the tank to remove accumulated solids, and keeping the inlet, tank, and effluent field clear of roots and other obstructions.

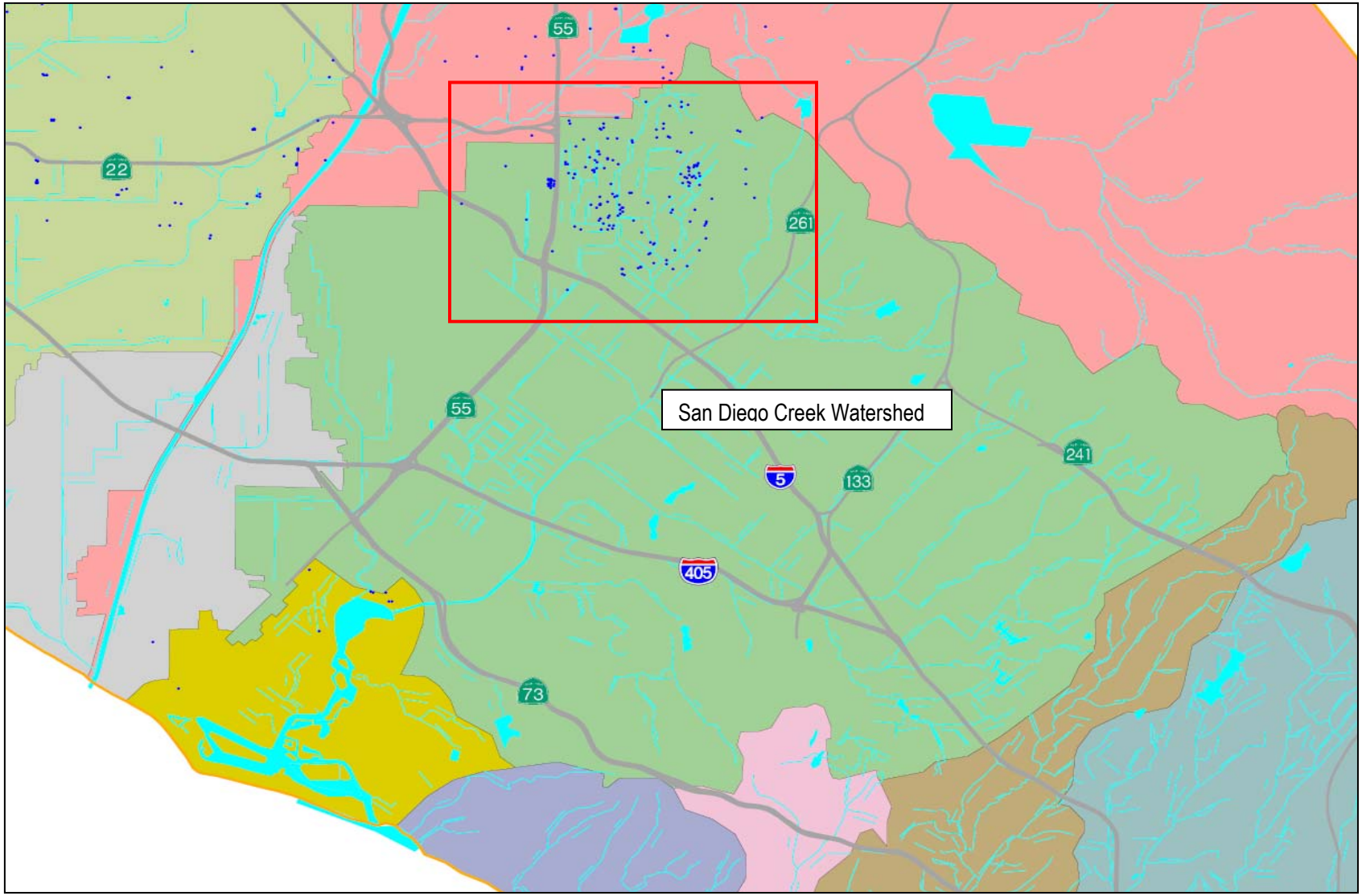


Figure 5.3. Location of septic tanks (blue dots) in the San Diego Creek subwatershed (red box), Orange County, CA (RBF 2004).

There are a total of 292 known septic systems in the Newport Bay watershed (RBF 2003), all of which are located in the northeastern portion of the San Diego Creek sub-watershed (Figure 5.3). Septic system failure rates and fecal coliform loading estimates were developed by RBF in 2003. The failure rate for Orange County septic systems was developed through surveys in 2002 and calculated to be 2% in any one year[22], or 5.8 per year in the Newport Bay watershed. The average daily discharge from a failed septic system was assumed to be one-half of the estimated daily per-capita water consumption of the dwelling (112.5 gallons/day), assuming three persons per dwelling and excluding consumption for landscape. Based on these calculations, average daily loading of fecal coliform from failing septic systems in the Newport Bay watershed to the San Diego Creek is estimated to be $5.8 \times 10^8$ organisms per day. Formulas, information and assumptions used in this calculation are provided by RBF (2003).

### *Leaking Sewer Lines*

Sewers are the pipes that form a sewerage system that convey sewage or wastewater. They can be made from a variety of materials such as concrete, cast iron, plastic or, especially for older sewers, brick or vitrified clay. Sewer pipes are laid in a trench as shown in Figure 5.4. The trench is filled with a granular material that allows for movement, settling and drainage. Pipes are typically manufactured in short lengths to make it easier for transport and construction, although it does mean they have to be joined.

Infiltration and exfiltration can occur via a variety of routes as shown in Figure 5.5. Loose joints (1), displaced joints (2), and cracks in the structure of the pipe (3) all allow water into and sewage out of the pipe. Other routes include poor junctions between pipe branches (4), leaking manholes (6) and at the points where pipes enter structures (7) or as inflow, directly along pipes (for example pipes leading to abandoned or future connections) (5). Physical damage is typically caused when pipes settle relative to other pipes or structures.

From an extensive survey, Bishop *et al*. (1998) showed a steady rise in the rate of failure as sewers age, and pointed out that the most common cause of sewer failure was joint fracturing related to using rigid joints. Deterioration of pipe material did not appear to play an important role in failure. Battersby and Pond (1997) added that tree root ingress, rodent activity and damage from subsurface work on other utilities may also cause leaks.

Sewer lines are located throughout the Newport Bay watershed and vary in age. Studies conducted as part of the Source Identification Project (Grant et al. 2009) provided information regarding the potential for sanitary sewer lines to contribute FIB to the Bay. Although the City of Newport Beach is implementing programs to replace the older sewer lines as new development and/or significant remodeling occurs, older sewer lines (circa 1920s) composed primarily of vitrified clay pipe with cement joints could conceivably be sources of FIB to the Bay. Grant et al. (2009) did find that *Enterococcus* concentrations in subsurface water were somewhat elevated at one site (near 10th Street) and significantly elevated at another site (Alvarado Place), suggesting that some sewer lines may be failing or leaking in these vicinities

[22] Calculated as the average of the computed 95% confidence interval from the results of this study.

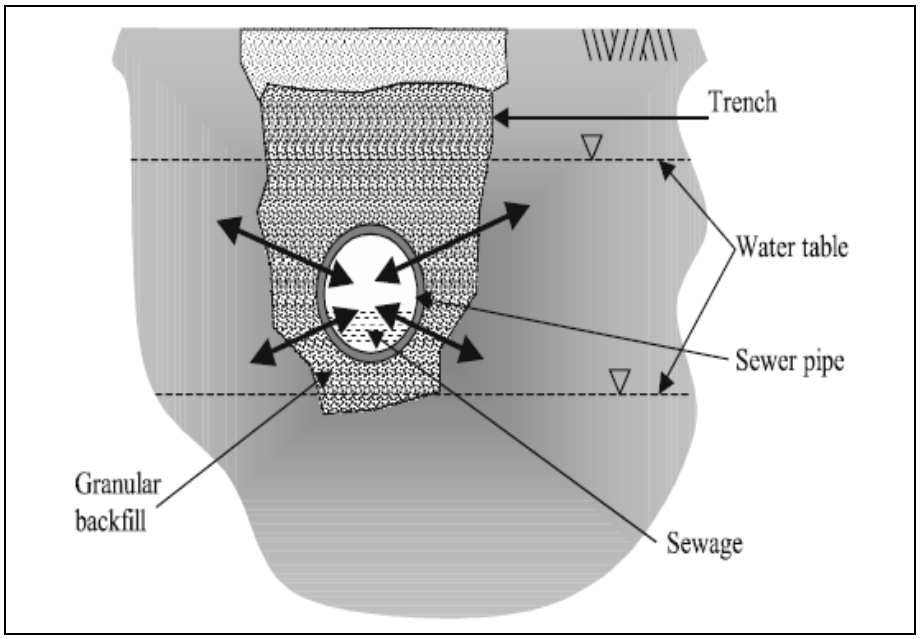


Figure 5.4. Sewer line and surrounding area cross-section.

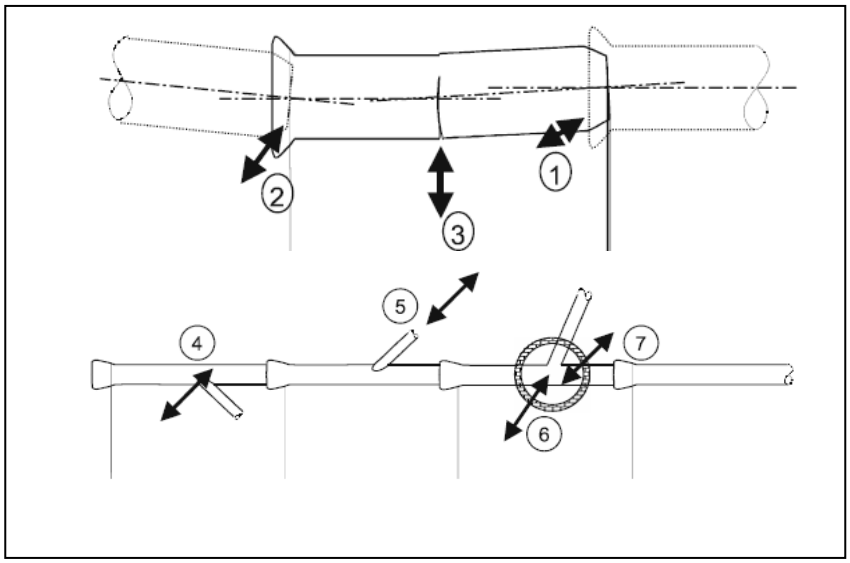


Figure 5.5. Common sewer infiltration and exfiltration routes.

Although FIB leaking from sewer lines could reach the Bay, bacteria (and pathogens) transported from this source would likely be confounded by a variety of barriers. First, FIB would need to be transported underground through natural soils or granular material used below sewer lines. Transport through soils is highly unlikely considering the types of soils present in the Newport Bay watershed (i.e., sand or sand-loam) can be highly effective in removing FIB from water (Olivieri et al. 2006). Alternatively, FIB could possibly travel below sanitary sewer lines via coarser granular material and make its way to the Bay. Regardless of the likelihood of these transport processes occurring in the Newport Bay watershed, it is not possible at this time to quantify contributions of FIB to the Bay from leaking sanitary sewers.

## Wastewater Discharges and Sanitary Sewer Overflows

### *Wastewater Discharges*

There are no direct planned discharges of municipal wastewater into Newport Bay or its tributaries. However, municipal wastewater reclaimed by the Irvine Ranch Water District (IRWD) through its Michelson Water Reclamation Plant (Reclamation Plant) in the San Diego Creek watershed is used throughout the watershed for irrigation of crops, golf courses, parks, school grounds, greenbelts, street medians, and freeway landscaping. The Reclamation Plant has a capacity is 15 million gallons per day (MGD) and the average flow is approximately 11 MGD. The Reclamation Plant produces high quality water that has gone through a tertiary treatment process and disinfection. During high demand periods the water flows directly from the plant and into 250 miles of reclaimed water pipelines for reuse. During cooler months when demand is lower, reclaimed water is sent to storage reservoirs such as Rattlesnake Reservoir, Sand Canyon Reservoir or several constructed tank-type reservoirs throughout the community. During winter months, some reclaimed water is also sent to the Orange County Water District's Green Acres Project which provides reclaimed water to areas outside IRWD boundaries. Because the Reclamation Plant incorporates tertiary treatment and disinfection, reclaimed water used throughout the Newport Bay watershed is not considered to be an important source of FIB to the Newport Bay watershed. Therefore, contributions of FIB from the Reclamation Plant were not calculated and are considered “deminimus”.

### *Sanitary Sewer Overflows*

Sanitary sewer overflows (SSOs) are conditions when untreated sewage is discharged into the environment prior to reaching a wastewater treatment facility. When caused by rainfall SSOs are also known as wet weather overflows. Sanitary sewer overflows (SSOs) can occur from privately (i.e., sewer laterals) or publicly owned (i.e., collection/main) sewer lines. The main causes of SSOs are:

- Infiltration of excessive urban runoff into sewer lines during heavy rainfall;
- Rupture or blockage of sewerage lines;
- Malfunction of pumping station lifts or electrical power failure; and,
- Human operator error at treatment plant facilities.

For all of Orange County, Dudek, Inc. (2008) estimated that approximately 311 SSOs occurred annually, between 2002 and 2006, with roughly half of these occurring on private property. Of these SSOs, only 8% reached surface waters, contributing on average 21,000 gallons of a combination of untreated sewage and urban runoff to local water bodies in Orange County per year between 2002 and 2006.

To calculate the potential contribution of SSOs to Newport Bay, the average annual SSO volume for all of Orange County (presented above) was normalized to the Newport Bay watershed (16.3% of Orange County). This resulted in an estimated 3,423 gallons of SSO wastewater reaching Newport Bay water bodies per year, or 9.4 gallons per day. This estimated daily volume of water from SSO events was then multiplied by the U.S. EPA (2004b) estimated average fecal coliform concentration (500,000 MPN/100mL) in wet weather SSOs to obtain the estimated daily fecal coliform load to Newport Bay from SSOs, or $1.8 \times 10^7$ organisms per day.

**Swimmer Shedding**

Research over the last decade indicates that FIB in recreational waters can originate from swimmers (Gerba 2000; Elmir et al. 2007), and crowded beach waters usually have the high FIB levels (Kay et al. 1994; Elmir et al. 2007). Additionally, recent studies indicate that such relationships exist for waterborne pathogens as well (Graczyk et al. 2007; Sunderland et al. 2007). Swimmers shed between $10^5$ and $10^6$ *Enterococcus* per person in the first 15 minutes, with an approximately 50% reduction during subsequent immersions (Elmir et al. 2007). This shedding pattern is consistent with the results of a previous study by Gerba et al. (2000) that concluded most FIB released by swimmers is associated with fecal material.

Information on swimming behavior was used by EOA (2001) to develop an estimate of fecal coliform loading to the Bay from swimmers. Loading to the Bay was estimated based on the percentage of recreators swimming during a given time interval, the expected number of recreators at a given time, the expected duration distribution for swim events, and values for fecal coliform loading per time swimming. Loading values were originally calculated for all beaches. However, based on the results of the water quality modeling presented by DeGeorge et al. (2003), it was found that the impact of loading from beaches was negligible, except from the Dunes beach sites where more recreational activities occur than at any other site in the Bay. Fecal coliform loading estimates were therefore only developed for the Dunes sites ($1.6 \times 10^7$ to $1.1 \times 10^8$ organisms per day, average $6.3 \times 10^7$ per day). For additional information on the methods and assumptions used to develop estimates, see EOA (2001).

To further investigate the contribution of swimmers to FIB in the water column at the Dunes beach, Jiang et al. (2004) conducted a study designed to evaluate the following hypotheses:

1) Fecal bacteria are shed during bathing/swimming activity;
2) The current fecal bacterial assay method is sensitive to detect bacteria shedding during bathing/swimming;
3) The water column fecal bacteria concentration increases with increasing number of swimmers; and,
4) Both direct shedding from the body of swimmers and stirring of sediment that harbors high concentration of bacteria during water activities contribute to the elevated level of fecal indicator bacteria in water column.

Based on the results of the study, swimmers and swimmer-induced sediment resuspension do not appear to be the cause of observed increases of FIB in Newport Dunes swimming areas. However, the impacts of shedding may have been undetected during this study due to the minimal number (20 or less) of bathers at the high use area. Therefore, uncertainties remain as to the loading of FIB from swimmers at the Dunes beach sites and the fecal coliform loading estimates presented above should be considered both preliminary and an upper-bound estimate at this time.

### 5.1.6 Vessel Waste (Including Pump-Out Facilities)

Thousands of people regularly enjoy recreational boating in Newport Bay. Although the Bay has been designated as a No-Discharge harbor for vessel sanitary wastes since 1976, it has been suggested in the Newport Bay Fecal Coliform TMDL and by EOA (2001) that some discharge of fecal waste from vessels likely occurs either through illegal discharges or

leaking pumpout stations. Because these wastes are of human origin, they may be a potential source of pathogens (and FIB) to the Bay, and thus they may pose a potential public health threat.

Loading estimates from marinas/boats were developed by Soller et al. (2006). Based on a fecal coliform loading rate of $1.95 \times 10^9$ organisms per day per capita (Geldreich 1962; Hilton and Stotzky 1973; Feachem et al. 1983; Gerba 2000), the estimated fecal coliform loadings to Newport Bay from vessel waste was $9.9 \times 10^{10}$ organisms per day for weekdays and $4.0 \times 10^{11}$ organisms per day for holidays and weekends (Soller 2006). Assuming there is an average of 114 holiday and weekend days in a given year, the average daily fecal coliform loading to Newport Bay from vessel waste was estimated to be $1.9 \times 10^{11}$ per day.

Since these estimates were developed, two significant actions regarding vessel waste have occurred. First, to investigate the contribution of marinas to fecal indicator bacteria impairment in the Lower Newport Bay, field studies were conducted by Grant et al. (2004) at the Balboa Yacht Basin (BYB), which is owned and operated by the City of Newport Beach; and the County of Orange owned and privately operated Dunes Marina (Dunes). Based on the results of this study, the authors concluded that discharges from boats at marinas do not appear to be the primary source of FIB at the Dunes and BYB marinas. Secondly, a number of best management practices (BMPs) have recently been implemented due to Regional Board Orders requiring the installation of additional pumpouts, consistent inspections and operation/maintenance procedures (see Section 8.0). It is believed that these actions have likely reduced the risk of FIB entering the Bay from vessels due to illegal dumping of leaking pumpouts.

Based on the results of Grant et al. (2004) and recently implemented BMPs, the original estimates by Soller et al. (2006) are assumed to be upper-bound loadings that are not likely representative of average loadings to the Bay. Therefore, estimates of daily contributions of fecal coliforms from vessels in Newport Bay were reduced by 80 percent, equating to $3.9 \times 10^{10}$ organisms/day. Information used to develop these estimates is provided in Appendix E.

### 5.1.7 Agricultural Runoff Sources

Agriculture land uses comprise only a small portion (< 7%) of the Newport Bay watershed. Production of agricultural crops includes strawberries, organic fruits/vegetables and ornamental plants at container nurseries. In a study designed to better characterize the contribution of FIB to Newport Bay from agricultural runoff, the University Cooperative Extension implemented a sampling and analysis study to monitor runoff from various nurseries and agricultural lands in the watershed during dry weather. The study was conducted in 2002 and 2003. Results were not well documented, but appear to indicate that fecal coliform concentrations were high (>10,000 MPN/100mL) in some samples, although concentrations were highly variable over the course of the study. However, as described by Kabashima and Haver (2003), the agricultural runoff study was challenging due to the infrequency of significant dry weather flows from agricultural production, which is mostly attributable to the transition of the container nurseries to complete recycling systems.

Due to the limited quantity of available water quality and runoff data, it was not possible to calculate FIB loading estimates from agricultural runoff at this time. Furthermore, there are very minimal agricultural land use activities within the Newport Bay watershed and dry weather runoff from the few row crop, container nursery and organic fruit locations has been

significantly reduced due to the implementation of runoff reduction measures (further described in Section 8.0). Both of these factors suggest that agricultural runoff is not a major contributor of FIB to Newport Bay.

### 5.1.8 Natural Sources

**Terrestrial and Aquatic Wildlife**

Wildlife, including water birds (e.g., gulls, geese, ducks) small land mammals (e.g., skunks, raccoons and coyotes), marine mammals (e.g., seals) and rodents (e.g., rats) are likely sources of FIB to the Bay. Previous studies (Griffith *et al.* 2006, Ahn et al. 2005, Alderisio et al. 1999, Geldreich and Kenner 1969, Hussong et al. 1979, Ricca and Cooney 1998, Stanridge et al. 1979) have shown that water birds and other bird species (e.g., pigeons) can be important sources of FIB to water bodies. Additionally, in some cases, wildlife alone can provide enough FIB to exceed water quality criteria in recreational water bodies (Noble et al. 2004, Tiefenthaler et al. 2008).

Although population and average fecal coilform production rates were not available for all types of terrestrial and aquatic wildlife[23] in the Newport Bay watershed, data were available for some resident species. Loading estimates presented in the following paragraphs are therefore only provided for those species that have available data and known to reside in the Newport Bay watershed, and should be only be considered illustrative at this time.

Based on published literature values from a more rural area than the Newport Bay watershed, raccoon densities in urbanized areas range from 14 to 129 per square mile, with an average of 71 raccoons per square mile (Broadfoot et al. 2001, Riley et al. 1998). Additionally, skunk densities range from 2.5 to 4.9 per square mile, with an average of 3.7 skunks per square mile (Broadfoot et al. 2001). Because a large majority of the Newport Bay watershed is urbanized (~75%) compared to the area where the original estimates were developed, the estimated density of skunks and raccoons in the Newport Bay was reduced by 50% (see Table 5.3). Fecal coliform production rates for skunks and raccoons (U.S. EPA 2004a) are presented in Table 5.3. Multiplying the estimated number of raccoons and skunks in the Newport Bay watershed by their respective fecal coliform production rates results in an estimated $4.1 \times 10^{11}$ and $2.1 \times 10^{10}$ fecal coliforms per day, respectively. Additional information on the formula and assumptions used to calculate loading rates from skunks and raccoons are provided in Appendix E.

Table 5.3. Estimated daily contributions of fecal coliform from skunks and raccoons to the surface of the Newport Bay watershed.

| Type of Wildlife | Average Population | Production Rate [c] (organisms/day/animal) | Estimated Loading to the Surface of the Watershed (organisms/day) |
|---|---|---|---|
| Raccoons | 4,125 [a,b] | $1 \times 10^8$ | $4.1 \times 10^{11}$ |
| Skunks | 212 [a] | $1 \times 10^8$ | $2.1 \times 10^{10}$ |
| | | Total | $4.3 \times 10^{11}$ |

[a] Broadfoot et al. 2001; [b] Riley et al. 1998; [c] USEPA 2004a

[23] Seal, pigeon, squirrel, coyote, rat and other terrestrial and aquatic wildlife population estimates for urban areas similar to those in the Newport Bay watershed were not available through peer-reviewed literature.

In addition to terrestrial wildlife contributions to the watershed, water birds also provide FIB inputs directly into the Bay and may impact water quality. Monthly water birds censuses are conducted in Upper Newport Bay by the Orange County Chapter of the Audubon Society. Additionally, observations of Grant et al. (2009) during water and sediment sampling conducted as part of the FIB Source Identification Study also estimated the water birds population for Newport Bay.

Newport Bay Naturalists and Friends (2008) estimate that on any given day, up to 30,000 birds can be seen in Upper Newport Bay. To estimate the contribution of FIB from water birds directly to the Upper Newport Bay, the average number of shorebirds, geese, ducks, loons and grebes in the Bay at any one time were multiplied by daily fecal coliform production rates available in the literature (Hussong et al. 1979, Koppelman and Tanenbaum 1982). Bird censuses data collected by Sea and Sage Audubon Society from September 2000 to August 2002 were used to estimate the population of ducks, geese, gulls and terns in Upper Newport Bay. Ducks, gulls geese and shorebirds have been shown to produce between $10^4$ to$10^9$ organisms per day (Aldersisio and DeLuca 1999, Hussong et al. 1979, Levesque et al. 1993, Ricca and Cooney 1998). Estimated contributions of fecal coliforms from these types of water birds to the Bay are presented in Table 5.4. These estimates are similar (within two orders-of-magnitude) to those developed by Grant et al. (2009).

Table 5.4. Estimated daily fecal coliform deposit rates directly to Newport Bay from water birds.

| Water Birds | Average Daily Population [a] | Average Production Rate (organisms/day/animal) | Estimated Contribution to the Surface of the Watershed (organisms/day) |
|---|---|---|---|
| Ducks and Geese | 635.8 | $1 \times 10^7$ | $6.4 \times 10^9$ |
| Gulls and Terns | 159.0 | $1 \times 10^7$ | $1.6 \times 10^9$ |
| Loons and Grebes | 38.4 | $1 \times 10^6$ | $3.8 \times 10^7$ |
| Shorebirds | 1,939.4 | $1 \times 10^4$ | $1.9 \times 10^7$ |
| | | Total | $8.0 \times 10^9$ |

[a] Sea and Sage Audubon Society from September 2000 to August 2002
[b] Aldersisio and DeLuca (1999), Hussong et al. (1979), Levesque et al. (1993), Ricca and Cooney (1998)

## Vegetation, Biofilms, Algal Mats and Sediments

There are twenty-seven different species of *Enterococcus* that have been enumerated from human or animal feces, or environmental samples. Eight of the twenty-seven are known to be fecal-associated (Schleifer et al. 1984). Furthermore, studies have shown that roughly 97% of the *Enterococcus* isolated from humans (Ruoff 1990, Stern 1994, Pinto 1999) and 96% of those isolated from animals (Devriese 1994, Stern 1994, Mac 2003, Poeta 2005) are fecal-associated species. However, when *Enterococcus* have historically been identified from water samples in Newport Bay, it is unclear whether these bacteria are plant or fecal-associated.

As an initial assessment of the degree to which *Enterococcus* in Newport Bay and tributaries are plant- or fecal-associated, water samples were analyzed by Grant et al. (2009) at three creek and nine Bay sites between February 2006 and July 2007. Up to five *Enterococcus* colonies in each sample were selected, purified, and speciated through biochemical and growth tests. Results were then verified by using Pulsed Field Gel Electrophoresis (PFGE), which is used extensively for tracking public health outbreaks by the U.S. Center for Disease Control.

In summary, preliminary results suggest that approximately 50% of *Enterococcus* isolated from Newport Bay and its tributaries were plant-associated species (*E. casseliflavus* and *E. mundtii*). The remaining percent of isolates were fecal-associated (38%) species and other species than *Enterococcus* (11%). The distribution of species was similar for tributaries and the Bay, suggesting that non-fecal related sources may be significant contributors to *Enterococcus* enumerated in Newport Bay, which could effect source management decisions. However, the representativeness of this limited dataset and methodologies have been questioned by local microbiologists and water quality specialist. Additional studies are needed to provide a more robust understanding of proportion of fecal- and plant-associated species of *Enterococcus* in Newport Bay.

One possible non-fecal source of FIB to Newport Bay may be biofilms. A biofilm is a slime layer which naturally develops when bacteria attach to vegetation, stone, metal, or wood. In nature, nonfilament-forming microorganisms (i.e., coliform bacteria) can stick to the surface of the biofilm in a location that provides an optimal growth environment (i.e., pH, dissolved oxygen, nutrients). Since nutrients tend to concentrate on solid surfaces, a microorganism saves energy through cell adhesion to a solid surface rather than by growing unattached and obtaining nutrients randomly. Additionally, the biofilm provides a safe environment for bacterial replication and protection against microbial predators, sunlight, drying and disinfectants. From a water quality perspective, biofilms are of interest because bacteria may detach from the surface of the biofilm, enter the water column, and contribute to exceedances of water quality standards.

Although only a few studies have been conducted on the occurrence of FIB in biofilms in the environment (Ksoll et al. 2007), one was recently conducted in Newport Bay. In 2006, the Orange County Health Care Agency (OCHCA) conducted a study to assess whether FIB can survive and grow in biofilm collected from within an urban runoff conveyance system. Preliminary results indicated that *Enterococcus* can grow within urban runoff biofilm, and up to 4.6 million *Enterococcus* can be enumerated from 100g of biofilm. These findings are consistent with other researchers results, which conclude that FIB can colonize on macro-algae (Weiskel et al. 1996, Byappanahalli et al. 2003, Whitman et al. 2003) and periphyton

(Ksoll et al. 2007), and suggest that algal and debris mats observed by Grant et al. (2009) in 2006 and 2007 may also be important sources of FIB to the Bay.

Although the information presented suggests that a portion of *Enterococcus* enumerated in the Bay and tributaries to the Bay is associated with non-fecal (i.e. plant) sources, it is currently unclear what the particular source(s) of non-fecal FIB may be. Plant-associated sources contributing FIB may be located within the watershed (e.g., leaf litter or lawn clippings) or within the Bay (e.g., algal mats or aquatic macrophytes) and conveyance systems (e.g., biofilms). Grant et al. (2009) demonstrated that algal mats are consistently present in the Upper Bay and the FIB concentrations appear to be significantly correlated with phytoplankton concentrations, leading one to believe that plant-associated sources in the Bay are contributing some level of FIB to Bay water. Additionally, recent research (Ott et al. 2001) has found that *Enterococcus* can be a common part of the epiphytic microflora of grasses, suggesting that vegetation and “green waste” in urban areas may contribute to the pool of FIB in Newport Bay.

Due to the limited information on the contribution of FIB from plant-based sources in Newport Bay or its watershed, FIB loading estimates were not developed for these sources. However, based on the research discussed in this section, studies designed to better identify what proportion of FIB enumerated in Bay water is of fecal origin should be considered (see Section 9.3.4). Findings from these studies could be critically important in determining whether water quality is protective of public health at Newport Bay recreational areas.

In addition to vegetation, biofilms and algal mats, bedded sediments can be resuspended into the water column and contribute to exceedances of water quality objectives/criteria. Sediments may therefore be considered a source of FIB to Newport Bay. For ease of discussion, however, sediments are discussed in Section 5.4 (Potential Environmental Fates).

## 5.2 FIB Transport Pathways

Pollutant transport pathways can include urban runoff conveyance systems, creeks and rivers, deposition from the atmosphere, and wastewater discharges. In the Newport Bay watershed, there are three main pathways that transport FIB from sources to the Bay – tributaries, urban runoff conveyance systems and direct inputs (see Figure 5.1). The location, extent and magnitude of each source transport pathway are described in this section, along with preliminary FIB pathway loading estimates. Daily FIB loading estimates from transport pathways are provided for both dry and wet weather.

Information introduced is intended to assist managers in understanding the relative importance of different pathways, which may inform decisions about where management actions should be explored. Information is summarized from both literature sources and data collected from pathways to the Newport Bay. Formulas and assumptions used in the development of preliminary loading estimates from pathways to Newport Bay are more fully described in technical support documentation (i.e., Technical Memorandum #3).

### 5.2.1 Direct Inputs

As discussed in the previous section, FIB can be released or deposited into the Bay directly by sources and therefore have no specific transport pathway. For the purposes of this SMP, these sources are grouped under the general transport pathway “direct inputs”. Direct inputs

of FIB to the Bay include wildlife waste, swimmer shedding and vessel waste. These sources and loading estimates are described in Section 5.1 and are therefore not discussed in this section regarding transport pathways. Comparisons among transport pathways are made, however, in Section 5.3.

### 5.2.2 Urban Runoff Conveyance Systems

Dry and wet weather runoff that does not evaporate or infiltrate, flows through a network of gutters, curbs, and underground pipes (collectively referred to as the urban runoff conveyance system) to the Bay. As described by Grant et al. (2009), a total of 214 urban runoff conveyance system outfalls (i.e., drains) discharge directly to Newport Bay (Figure 5.6). These drains are distributed around the perimeter of the Bay, and vary in diameter (4 to 146 inches, median 18 inches) and drainage area (<1 to 805 acres, median 10 acres).

An additional number of drains flow to tributaries, which in turn flow to the Bay. The contributions of FIB from these drains are not described in this section. Rather, drains discharging to tributaries are included in the discussion in Section 5.2.2 (tributaries).

**Dry and Wet Weather FIB Concentrations**

Fecal indicator bacteria (FIB) have been enumerated during dry weather from urban runoff conveyance system outfalls in the Newport Bay watershed during a variety of monitoring studies. Everest International (2004) enumerated FIB from the five largest outfalls during a *Storm Drain Diversion Feasibility Study*. The Orange County Stormwater Program also enumerates FIB in water samples collected during their dry weather reconnaissance monitoring of urban runoff drains. Lastly, Pednekar et al. (2007) collected samples from the urban runoff conveyance system discharging to West Newport Bay (WNB). These studies together form the dataset used to estimate the high (90$^{th}$ percentile), low (10$^{th}$ percentile) and average (median) concentrations of FIB discharged to Newport Bay via drains during dry (i.e., non-storm) weather (Table 5.5).

*Enterococcus* data collected from urban runoff conveyance systems in WNB by Pednekar et al. (2007) and by Grant et al. (2009) at various drains around the Bay were used to estimate high (90$^{th}$ percentile), low (10$^{th}$ percentile) and median concentrations discharged to Newport Bay via drains during wet weather (Table 5.5). Wet weather fecal coliform concentrations are not available for drains discharging to Newport Bay. Therefore, median wet weather concentrations of fecal coliform were estimated from those published in the National Urban Runoff Quality Database (Maestre and Pitt 2005). The 90$^{th}$ and 10$^{th}$ percentile concentrations for this dataset were not available.

Table 5.5. Median, 10$^{th}$ percentile and 90$^{th}$ percentile fecal coliform concentrations used to develop wet and dry weather loading estimates from storm drains discharging to Newport Bay.

| Estimate | FIB Concentrations (organisms/100mL) | | | |
|---|---|---|---|---|
| | Fecal Coliform | | *Enterococcus* | |
| | *Dry Weather* | *Wet Weather* | *Dry Weather* | *Wet Weather* |
| High (90th Percentile) | 18,300 | NA | 8,405 | 535,446 |
| Average (Median) | 6,500 | 5,091 | 3,161 | 6,360 |
| Low (10th Percentile) | 1,449 | NA | 148 | 124 |

NA = Not available

Figure 5.6. Urban runoff drains (outfalls) that discharge directly to Newport Bay, as identified by Grant et al. (2009).

## Dry and Wet Weather Discharge Rates

Estimated average dry and wet weather discharge rates for the 214 storm drains are presented in Table 5.6. Dry weather discharge rates for drains flowing to Newport Bay were estimated using two different calculations – one for the five largest drains and one for the remaining 209 smaller drains. First, descriptive statistics were calculated for the five largest drains studied by Everest International (2004) to establish an average discharge rate of 97 gallons/day/acre. Secondly, a linear regression between dry weather flow and sub-drainage area (i.e., 11 gallons/day/acre) established by Grant et al. (2009) was utilized to estimate dry weather discharge from the additional 209 drains. Based on these estimates, total estimated average dry weather discharge for the 5 largest drains and the 209 smaller drains were calculated to be 253,364 gallons/day and 43,051 gallons per day, respectively.

Table 5.6. Estimated average dry and wet weather discharge rates for the 214 storm drains flowing to Newport Bay.

| | Dry Weather | | | Wet Weather |
|---|---|---|---|---|
| | *5 Largest Drains* | *209 Smaller Drains* | *All Drains* | *All Drains* |
| Average Discharge (GPD) | 219,296 | 43,051 | 296,415 | 10,255,102 |

Wet weather discharge data for large and small drains were not readily available during the development of this SMP. Therefore, flow estimates were developed using a simple runoff calculation model developed by Schueler (1987). This model provides general estimates of annual urban runoff using runoff coefficients derived for land use types.

Annual urban runoff (R) from the portion of the Newport Bay watershed that drains to the 214 storm drains (6,526 acres) was calculated as:

$$R=[(P*Pj*Rv)12*]A$$

*where:*

| | | |
|---|---|---|
| R | = | Annual Runoff (Acre feet) |
| P | = | Annual Rainfall (inches) |
| Pj | = | Fraction of annual rainfall events that produce runoff |
| Rv | = | Runoff coefficient for major land uses |
| 12 | = | Conversion of inches to feet |
| A | = | Area (Acres) |

Runoff coefficients (Rv) presented in Table 5.7 were utilized for each major land use category in the Newport Bay watershed. Average annual rainfall (P) is 13.9 inches as obtained from the long-term rainfall dataset presented in Section 4.3. The fraction of annual rainfall that is expected to produce runoff (Pj) was calculated at 60% (0.6)[24] using rainfall data from 1987 to 2007[25].

[24] Days with greater than 0.09 inches of rainfall were assumed to produce runoff, which calculates into roughly 60% of the days that have detectable rainfall.
[25] Irvine Rainfall Station #75

Table 5.7. Runoff coefficients for each major land use category.

| | Residential | Commercial | Industrial | Mixed[26] | Agriculture | Open |
|---|---|---|---|---|---|---|
| Runoff Coefficient (Rv) | 0.60 | 0.91 | 0.89 | 0.80 | 0.07 | 0.06 |

Using the model described above, the estimated wet weather discharge for the area that drains to the 214 drains is 598 acre feet per year. On average, this runoff occurs on 55 "wet weather" days (5.2%) of the year[27]. Dividing the estimated volume of annual wet weather discharge by the average number of wet weather days, produces an estimated wet weather discharge of 31.5 acre feet per day, or 10.3 million gallons per day (MGD) from the 214 drains. It is important to note that this is a first order estimate that is based on runoff coefficients and runoff-producing rainfall amounts that have not been validated in the Newport Bay watershed. Based on the lack of watershed-specific data, the uncertainty of this estimate is high.

## FIB Loading from Urban Runoff Conveyance Systems

Daily loading estimates of FIB entering the Bay from urban runoff drains were developed by multiplying the estimated dry or wet weather discharge rates by FIB concentrations measured at the drains or within the urban runoff conveyance system. High, low and average FIB loading estimates for dry and wet weather are presented in Tables 5.8 and 5.9, respectively. As data were available, high and low FIB loading rates were developed using 90$^{th}$ and 10$^{th}$ percentile FIB concentrations and average discharge rates, respectively. Average FIB loading estimates were developed using median FIB concentrations and average discharge rates.

Table 5.8. High, average and low FIB loading rates from storm drains discharging to Newport Bay during dry weather.

| Estimate | FIB Loading Rates (organisms/day) | | | | | |
|---|---|---|---|---|---|---|
| | Fecal Coliform | | | *Enterococcus* | | |
| | *5 Largest Drains* | *209 Smaller Drains* | *All Drains* | *5 Largest Drains* | *209 Smaller Drains* | *All Drains* |
| High[a] | $1.8 \times 10^{11}$ | $3.0 \times 10^{10}$ | $2.1 \times 10^{11}$ | $8.1 \times 10^{10}$ | $1.4 \times 10^{10}$ | $9.5 \times 10^{10}$ |
| Average[b] | $6.2 \times 10^{10}$ | $1.1 \times 10^{10}$ | $7.3 \times 10^{10}$ | $3.0 \times 10^{10}$ | $5.2 \times 10^{9}$ | $3.6 \times 10^{10}$ |
| Low[c] | $1.4 \times 10^{10}$ | $2.4 \times 10^{9}$ | $1.6 \times 10^{10}$ | $1.4 \times 10^{9}$ | $2.4 \times 10^{8}$ | $1.7 \times 10^{9}$ |

NA = Not available
[a] High FIB Loading = 90th percentile FIB Concentration x Average Flow
[b] Average FIB Loading = Median FIB Concentration x Average Flow
[c] Low FIB Loading = 10th percentile FIB Concentration x Average Flow

[26] Runoff coefficient for the mixed land use category was calculated by averaging the runoff coefficient for residential, commercial and industrial land use categories.
[27] The number of wet weather day was calculated based on the definition of wet (>85$^{th}$ percentile of annual discharge) and dry (<85$^{th}$ percentile of annual discharge) weather discharge for San Diego Creek and Santa Ana Delhi described in Section 5.2.3 (Figure 5.13).

Table 5.9. High, average and low FIB loading rates from all storm drains discharging to Newport Bay during wet weather.

| Estimate | FIB Loading Rates (organisms/day) | |
|---|---|---|
| | Fecal Coliform | *Enterococcus* |
| High[a] | NA | $2.1 \times 10^{14}$ |
| Average[b] | $6.8 \times 10^{11}$ | $8.5 \times 10^{11}$ |
| Low[c] | NA | $4.8 \times 10^{10}$ |

NA = Not available
[a] High FIB Loading = 90th percentile FIB Concentration x Average Flow
[b] Average FIB Loading = Median FIB Concentration x Average Flow
[c] Low FIB Loading = 10th percentile FIB Concentration x Average Flow

### 5.2.3 Tributaries

Tributaries transport FIB to Newport Bay from watershed sources described in Section 5.0 and storm drains discharging to these water bodies. San Diego Creek, Santa Ana-Delhi Channel and Big Canyon Wash are the major tributaries discharging to Newport Bay. Indicator bacteria have been enumerated in tributaries during a variety of studies and monitoring activities. The OCHCA has sampled FIB near the mouths of San Diego Creek consistently since 1997 and Santa Ana Delhi Channel since 1986. The OCHCA sampling site on Big Canyon Wash has also been sampled for a number of years.

Based on data collected by the OCHCA, the median, 90$^{th}$ percentile and 10$^{th}$ percentile fecal coliform bacteria and *Enterococcus* concentrations during dry and wet weather were calculated for each tributary site. *Enterococcus* estimates were compared to those developed by Grant et al. (2009), who sampled tributary sites during the 2006 Newport Bay FIB Source Identification Project. Both FIB concentrations and loading estimates for each tributary are described in the following sections.

**Dry and Wet Weather FIB Concentrations in Tributaries**

***San Diego Creek***

San Diego Creek is the largest tributary to Newport Bay, draining roughly 77% of the Newport Bay watershed. High (90$^{th}$ percentile), average (median) and low (10$^{th}$ percentile) FIB concentrations during dry (< 0.2 inches of rainfall in 3-days prior to sampling event) and wet ($\geq$ 0.2 inches of rainfall in 3-days prior to sampling event) weather conditions in San Diego Creek are presented in Table 5.10. Additionally, dry and wet weather annual fecal coliform concentrations for San Diego Creek (at Campus Drive) are presented in Figures 5.7 and 5.8, respectively (OCHCA 2008).

During dry weather, median FIB concentrations have generally remained the same during this timeframe, with the exception of 2004 when concentrations were roughly 0.5 log units higher than other years. Dry weather median fecal coliform and *Enterococcus* concentrations for data collected between 2004 and 2007 were 130 and 38 organisms/100mL, respectively. Annual wet weather median FIB concentrations are consistently higher than dry weather by roughly 1.5 log units. During wet weather, median

fecal coliform and *Enteroroccus* concentrations observed by OCHCA from 2004 through 2007 were 2,100 and 800 organisms/100mL, respectively.

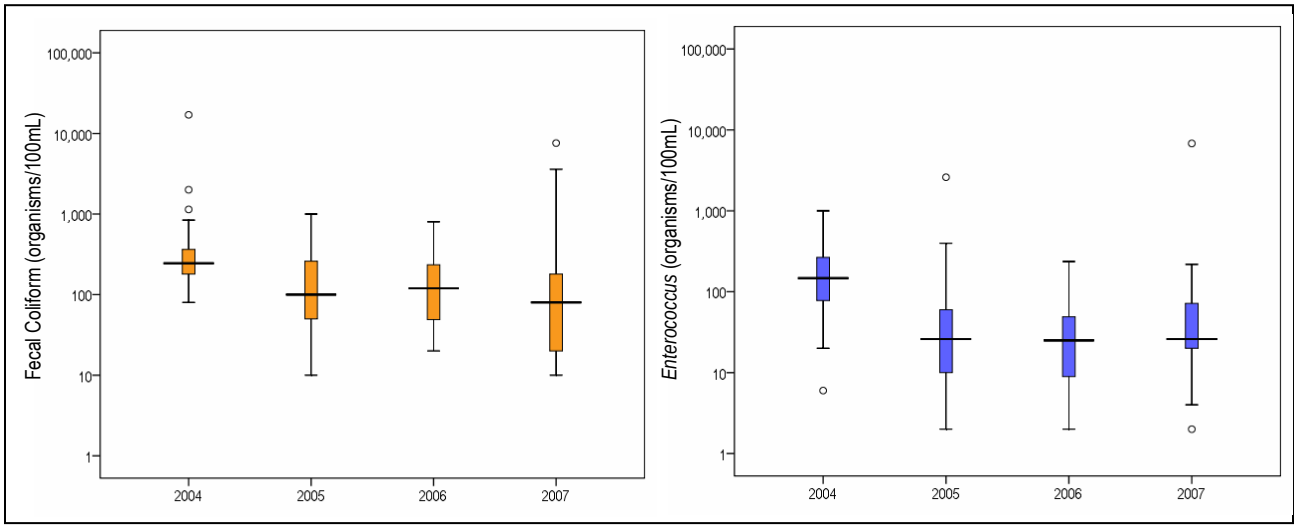


Figure 5.7. Median (horizontal line), 25th and 75th percentiles (top and bottom of box), and maximum and minimum (whiskers) dry weather fecal coliform (a) and *Enterococcus* (b) concentrations in the San Diego Creek water column (Campus Drive) from January 2004 to December 2007 (OCHCA 2008).

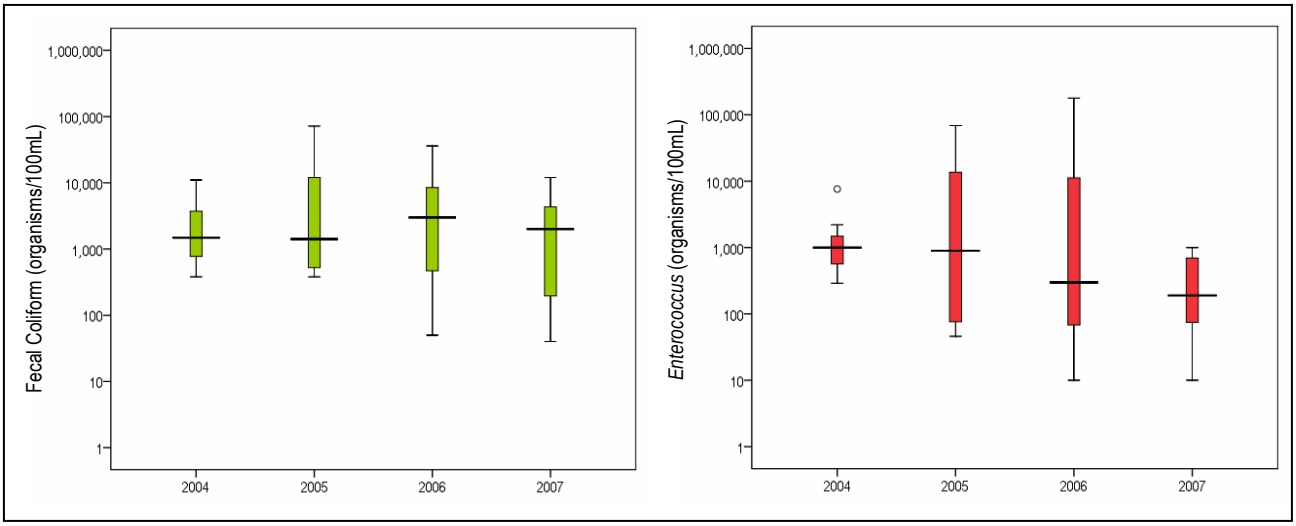


Figure 5.8. Median (horizontal line), 25th and 75th percentiles (top and bottom of box), and maximum and minimum (whiskers) wet weather fecal coliform and *Enterococcus* concentrations in the San Diego Creek water column (Campus Drive) from January 2004 to December 2007 (OCHCA 2008).

Table 5.10. High (90th percentile), median and low (10th percentile) fecal coliforms and *Enterococcus* concentrations measured in the three Newport Bay tributaries during dry and wet weather from 2004 through 2007 (OCHCA 2008).

| Tributary Monitoring Station | Dry Weather[1] Concentration (organisms/100mL) | | Wet Weather[2] Concentration (organisms/100mL) | |
|---|---|---|---|---|
| | Fecal Coliform | *Enterococcus* | Fecal Coliform | *Enterococcus* |
| San Diego Creek | | | | |
| High (90th percentile) | 518 | 247 | 12,000 | 20,800 |
| Average (Median) | 130 | 38 | 2,100 | 800 |
| Low (10th percentile) | 20 | 8 | 202 | 48 |
| *Number of Samples (n)* | *153* | *154* | *38* | *39* |
| Santa Ana Delhi Channel | | | | |
| High (90th percentile) | 3,800 | 1,000 | 15,400 | 10,400 |
| Average (Median) | 390 | 224 | 2,000 | 600 |
| Low (10th percentile) | 140 | 78 | 312 | 105 |
| *Number of Samples (n)* | *151* | *152* | *37* | *39* |
| Big Canyon Creek | | | | |
| High (90th percentile) | 390 | 208 | 3,960 | 2,840 |
| Average (Median) | 130 | 72 | 300 | 180 |
| Low (10th percentile) | 30 | 32 | 100 | 50 |
| *Number of Samples (n)* | *141* | *141* | *29* | *29* |

[1] Any sampling event that does not occur during a OCHCA rain advisory (see below).
[2] Sampling events that occur within 3 days after a rain event of ≥0.2" (synonymous with OCHCA rain advisory).

### *Santa Ana Delhi Channel*

The Santa Ana Delhi Channel is the second largest tributary to the Bay, draining a 17 $mi^2$ watershed that is comprised of primarily urban land uses. Annual dry and wet weather FIB concentrations from 2004 through 2007 are presented in Figures 5.9 and 5.10, respectively. Similar to San Diego Creek, FIB concentrations appear to increase dramatically during wet weather. Median dry and wet weather fecal coliform concentrations were 390 and 2,000 organisms/100mL, respectively (Table 5.10). During dry weather, however, FIB concentrations are markedly higher than the other tributaries. Dry weather concentrations from Santa Ana Delhi suggest that dry weather sources of FIB to this tributary may be important from a Bay water quality perspective (see further discussion in Section 7.0).

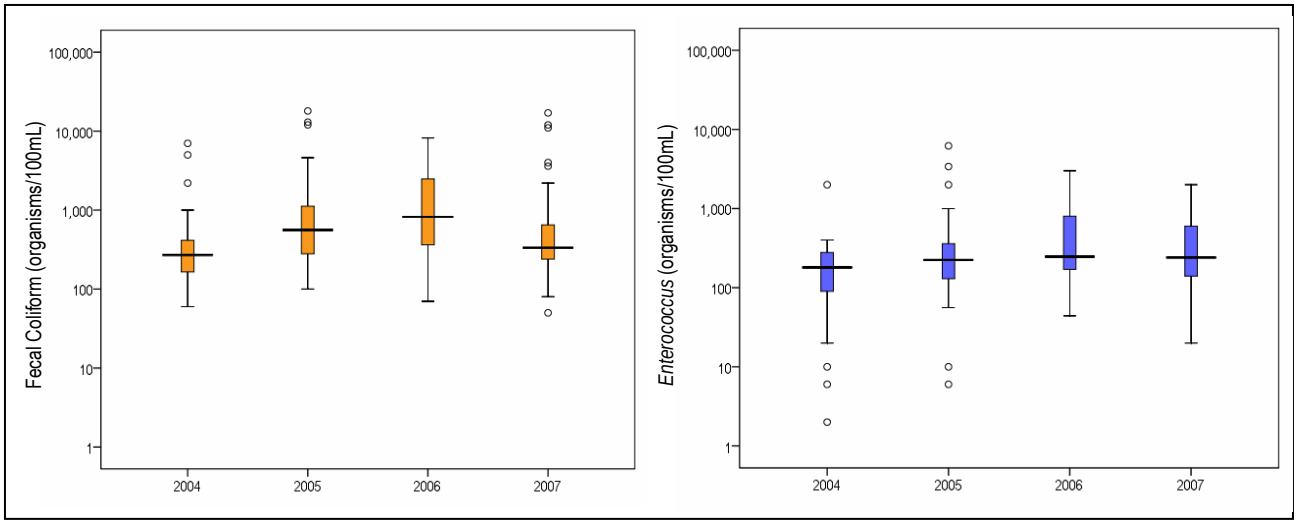


Figure 5.9. Median (horizontal line), 25th and 75th percentiles (top and bottom of box), and maximum and minimum (whiskers) dry weather fecal coliform and *Enterococcus* concentrations in the Santa Ana Delhi Channel from January 2004 to December 2007 (OCHCA 2008).

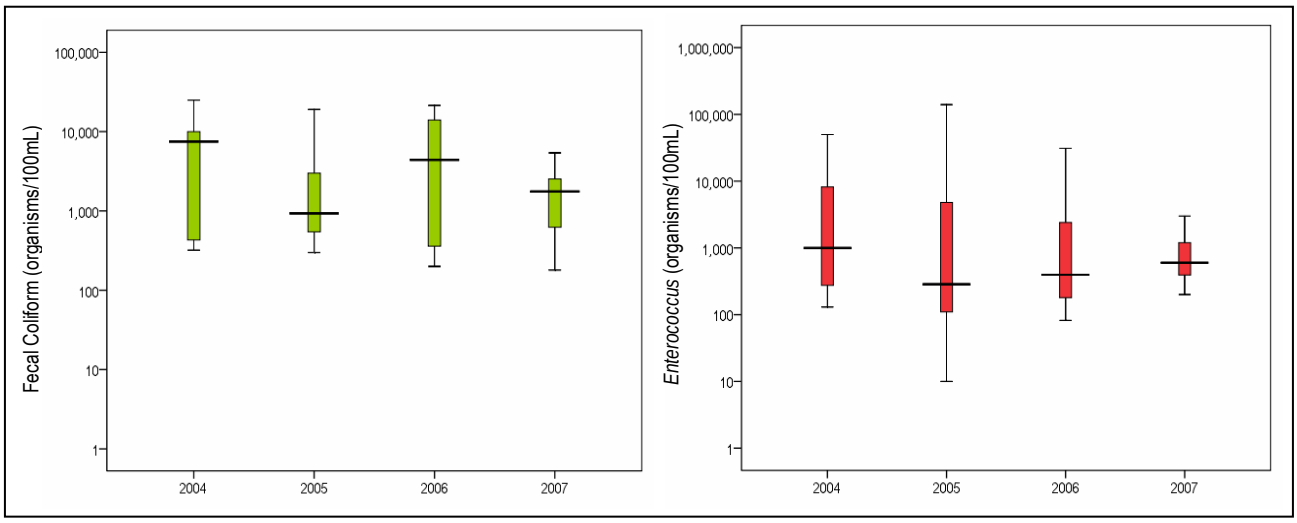


Figure 5.10. Median (horizontal line), 25th and 75th percentiles (top and bottom of box), and maximum and minimum (whiskers) wet weather fecal coliform and Enterococcus concentrations in the Santa Ana Delhi Channel from January 2004 to December 2007 (OCHCA 2008).

### *Big Canyon Wash*

Big Canyon Wash is the third largest tributary to Upper Newport Bay. It drains a 2mi$^2$ urbanized watershed on the southeast side of the Bay in the City of Newport Beach. Annual dry and wet weather FIB concentrations from 2004 through 2007 are presented in Figures 5.11 and 5.12. Similar to other tributaries, FIB concentrations increase substantially under wet weather conditions.

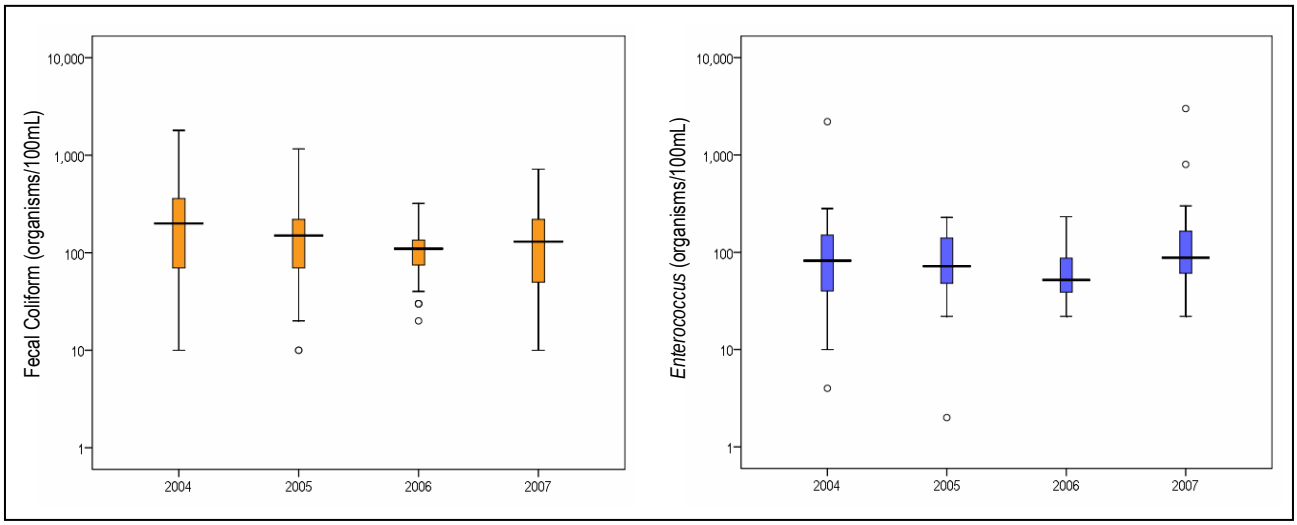


Figure 5.11. Median (horizontal line), 25th and 75th percentiles (top and bottom of box), and maximum and minimum (whiskers) dry weather fecal coliform and *Enterococcus* concentrations in the Santa Ana Delhi Channel from January 2004 to December 2007 (OCHCA 2008).

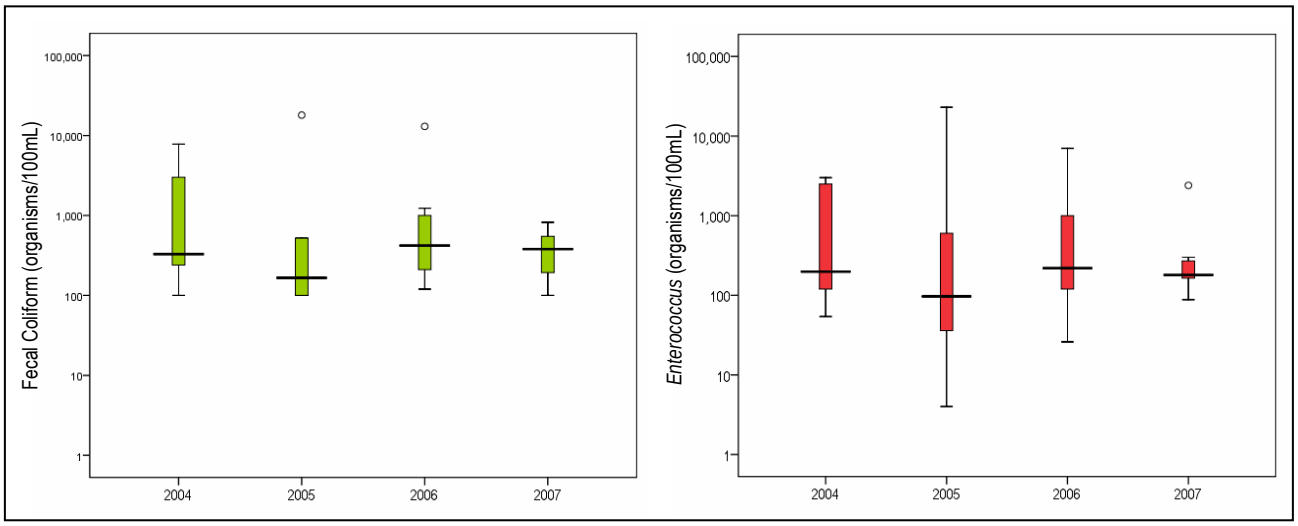


Figure 5.12. Median (horizontal line), 25th and 75th percentiles (top and bottom of box), and maximum and minimum (whiskers) wet weather fecal coliform and *Enterococcus* concentrations in the Santa Ana Delhi Channel from January 2004 to December 2007 (OCHCA 2008).

In addition to the FIB data collected by the OCHCA presented above, water samples were also collected from sites near the mouths of the three major tributaries to the Bay from March 2006 through February 2007 by Grant et al. (2009) as part of the Newport Bay FIB Source Identification Project. Among other parameters, water samples were analyzed for *Enterococcus* and *E. coli* bacteria. Fecal coliforms were not measured during this study. Similar to OCHCA data, results from Grant et al. (2009) indicate that on average the Santa Ana Delhi Channel has substantially higher *Enterococcus* concentrations than San Diego Creek and Big Canyon Wash during dry weather. Median *Enterococcus* concentrations observed by Grant et al. (2009) in the Santa Ana Delhi Channel during the summer/fall of 2006 were >10,000 organisms/100mL, compared to the other two tributaries where median concentrations were less than 500 organisms/100mL (see Figure 4.10). Additional discussion regarding high concentrations of FIB in Santa Ana Delhi Channel is provided in Sections 6.0 and 7.0.

**Dry and Wet Weather Discharge from Tributaries**

Data obtained from the Newport Bay Source Identification Project (Grant et al. 2009) were used to develop high, median and low wet and dry weather discharge rates for each of the three tributaries to the Bay. Based on these data, median annual discharge rates were 3 to 5 times higher in San Diego Creek (11 cfs) than Santa Ana Delhi channel (2.7 cfs). Further, peak flow in San Diego Creek (1000 cfs) was nearly ten times larger than in Santa Ana Delhi channel (100 cfs).

To develop average daily discharge rates for wet and dry periods probability distributions of discharge that were generated from daily-averaged discharge measured in the San Diego Creek and Santa Ana Delhi channel (Figure 5.13) by Grant et al. (2009) for 2006 were utilized. The near vertical slope of these probability curves around their respective medians indicates that for the majority of the year, there is a near-constant discharge of dry weather runoff. The long tails at high discharge rates indicates that, during rain events, discharge rapidly increases over many orders of magnitude. Median discharge during dry weather (base flow) was estimated by visually identifying the “knee” in the curve and selecting the midpoint (median) discharge rate for the area below the knee. The average wet weather discharge rate was estimated using the same method described above, but for the area above the knee of the curve. Maximum and minimum flow rates were also established for each tributary using historical data from the Orange County Public Facilities and Resources Department (OCPFRD).

Daily maximum, average and minimum discharge rates for the three tributaries are presented in Table 5.11. Daily discharge records for San Diego Creek range between 0.35 and 43,500 cfs, while Santa Ana Delhi channel daily flow rates range between 0.8 and 6,450 cfs. Maximum discharges presented were measured during an El Nino year (1997). Only average dry season discharge estimates were available for Big Canyon Wash (DeGeorge et al. 2003). Wet season average discharge rates for Big Canyon Wash were developed using methods described in 5.2.2.

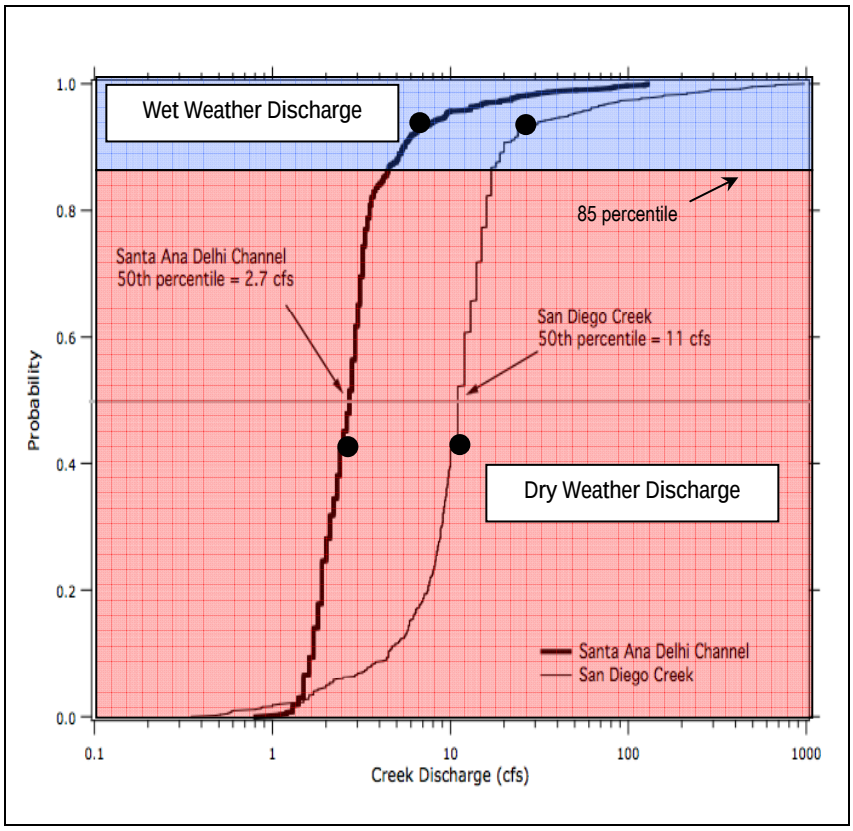


Figure 5.13. Probability plots of daily-averaged flow (cubic feet per second, cfs) measured in San Diego Creek and Santa Ana Delhi Channel from January through December 2006 (Grant et al. 2009). (Note: Black dots represent median flows for dry and wet weather periods).

Table 5.11. Maximum, median and minimum discharge rates from the three Newport Bay tributaries during dry and wet weather from 2004 through 2007 (OCHCA 2008).

| Tributary | Discharge (cfs) | |
|---|---|---|
| | Dry Weather | Wet Weather |
| San Diego Creek | | |
| Maximum | 10 | 43,500 |
| Average (Median) | 8 | 26 |
| Minimum | 0.35 | 10 |
| Santa Ana Delhi Channel | | |
| Maximum | 4 | 6,450 |
| Average (Median) | 2.5 | 6.5 |
| Minimum | 0.8 | 2.5 |
| Big Canyon Wash | | |
| Maximum | NA | NA |
| Average (Median) | 0.35 | 3.0 |
| Minimum | NA | NA |

## Annual FIB Loading from Tributaries

Using FIB concentration and discharge data presented in the previous section, FIB loading rates from tributaries were developed (Table 5.11). To depict the range of FIB loading rates possible during dry and wet weather, high, average and low rates were calculated for each tributary. High FIB loadings were calculated by multiplying the maximum daily discharge volume by the 90$^{th}$ percentile FIB concentration. Low FIB loading rates were calculated by multiplying the minimum daily discharge volume by the 10$^{th}$ percentile FIB concentration. Average FIB loading rates were calculated by multiplying the median daily discharge volume by the median FIB concentration.

Table 5.11. Estimated high, average and low fecal coliform and *Enterococcus* loading rates to Newport Bay from the three tributaries during dry and wet weather.

| Tributary | Fecal Coliforms to Newport Bay (organisms/day) | | | *Enterococcus* to Newport Bay (organisms/day) | | |
|---|---|---|---|---|---|---|
| | High | Average | Low | High | Average | Low |
| Dry Weather | | | | | | |
| San Diego Creek | $1.3 \times 10^{11}$ | $2.5 \times 10^{10}$ | $1.7 \times 10^{8}$ | $6.0 \times 10^{10}$ | $7.4 \times 10^{9}$ | $6.9 \times 10^{7}$ |
| Santa Ana Delhi Channel | $3.7 \times 10^{11}$ | $2.4 \times 10^{10}$ | $2.7 \times 10^{9}$ | $9.8 \times 10^{10}$ | $1.4 \times 10^{10}$ | $1.5 \times 10^{9}$ |
| Big Canyon Wash | NA | $1.1 \times 10^{9}$ | NA | NA | $6.2 \times 10^{8}$ | NA |
| Wet Weather | | | | | | |
| San Diego Creek | $1.3 \times 10^{16}$ | $1.3 \times 10^{12}$ | $4.9 \times 10^{10}$ | $2.2 \times 10^{16}$ | $5.1 \times 10^{11}$ | $1.2 \times 10^{10}$ |
| Santa Ana Delhi Channel | $2.4 \times 10^{15}$ | $3.2 \times 10^{11}$ | $1.9 \times 10^{10}$ | $1.6 \times 10^{15}$ | $9.5 \times 10^{10}$ | $6.4 \times 10^{9}$ |
| Big Canyon Wash | NA | $2.2 \times 10^{10}$ | NA | NA | $1.3 \times 10^{10}$ | NA |

Based on the estimated daily loadings of fecal coliform and *Enterococcus* from tributaries presented in Table 6.4, the following salient points were identified:

- For all tributaries, dry and wet weather loading rates for fecal coliforms are greater or nearly equal to those for *Enterococcus;*
- During dry weather, Santa Ana Delhi Channel *Enterococcus* loading rates are greater than those for San Diego Creek and fecal coliform rates are approximately equal, even though average discharge rates for San Diego Creek are three times greater[28];
- FIB loading from Big Canyon Wash during dry weather is one to two orders-of-magnitude less than San Diego Creek and Santa Ana Delhi; and,
- During wet weather, San Diego Creek has a higher average FIB loading rate than Santa Ana Delhi, which has higher loading than Big Canyon Wash.

[28] Results from Grant et al (2009) were similar.

### 5.2.4 Comparison of Pathway Loading Estimates

Table 5.12 provides a comparison of average fecal coliform concentrations and loading estimates from storm drains and tributaries described earlier in Section 5.2, and sources described in the Section 5.1 that directly input FIB into Newport Bay (i.e., wildlife and vessel waste).

Table 5.12. Comparison of estimated average fecal coliform concentrations and loading rates for transport pathways (urban runoff conveyance, tributaries and direct inputs) during dry and wet weather.

| Pathway | Dry Weather | | Wet Weather | |
|---|---|---|---|---|
| | Concentration (organisms/100mL) | Load (organisms/day) | Concentration (organisms/100mL) | Load (organisms/day) |
| Tributaries | | | | |
| San Diego Creek | 130 | $2.5 \times 10^{10}$ | 2,100 | $1.3 \times 10^{12}$ |
| Santa Ana Delhi | 390 | $2.4 \times 10^{10}$ | 2,000 | $3.2 \times 10^{11}$ |
| Big Canyon Wash | 130 | $1.1 \times 10^{9}$ | 300 | $2.2 \times 10^{10}$ |
| Total | NA | $5.0 \times 10^{10}$ | | $1.3 \times 10^{12}$ |
| Urban Runoff Conveyance (Large and Small Drains) | 6,500 | $7.3 \times 10^{10}$ | 5,091 | $6.8 \times 10^{11}$ |
| Direct Inputs (Water Birds & Vessel Waste) | NA | $4.7 \times 10^{10}$ | NA | $8.0 \times 10^{9}$ |
| Totals | | $1.7 \times 10^{11}$ | | $2.4 \times 10^{12}$ |

The comparison of average (median) fecal coliform concentrations and estimated average loads presented in Table 5.12 above illustrates the following interesting points relevant to source management:

- Median fecal coliform concentrations in samples collected from drains are substantially (2 to 20x) higher than those from tributaries;
- Dry weather fecal coliform loads are similar for the three types of pathways – urban runoff conveyance, tributaries and direct inputs;
- Daily wet weather loads from urban runoff conveyances and tributaries are one to two orders-of magnitude greater than dry weather loads; and,
- During wet weather, tributary loads (particularly those from San Diego Creek) are greater than either storm drains or direct inputs.

## 5.3 Comparison Between Sources and Pathways

In the previous two sections, deposits of FIB from sources onto the surface of the watershed and loadings from transport pathways were presented. In this section, contributions of fecal coliforms[29] to the surface of the watershed from sources are separated by sub-watershed to compare against loadings from pathways. Comparisons between sources and pathways will provide additional information on the relative contributions from different sources for each sub-watershed, which in turn may assist with source management decisions.

### 5.3.1 Source Contributions per Sub-watershed

Estimated contributions of fecal coliforms to the surface of the entire Newport Bay watershed from sources were broken down by sub-watershed and then compared to the major transport pathways draining each land area. These sub-watersheds are:

1) Lower Bay Sub-watershed (7 $mi^2$) – drains to the engineered urban runoff conveyance system that ultimately discharges to the Bay via urban runoff drains (i.e., four of the five large drains (excluding Polaris) and 130 small drains);
2) Upper Bay Sub-watershed (9 $mi^2$) – drains to the engineered urban runoff conveyance system that ultimately discharges to the Bay via urban runoff drains (i.e., Polaris drain, 79 small drains and Big Canyon Wash);
3) Santa Ana Delhi Sub-watershed (17 $mi^2$) – drains to Santa Ana Delhi Channel; and,
4) San Diego Creek Sub-watershed (119 $mi^2$) – drains to San Diego Creek.

Contributions of FIB to each sub-watershed listed above were developed based on information regarding the location of each source and the land use characteristics of the sub-watershed. Table 5.13 presents estimated contributions from sources to each sub-watershed draining to the Bay.

Preliminary estimates of fecal coliform contributions to the surface of each sub-watershed sources reveal the following interesting points:

- Although the San Diego Creek has the lowest percentage of urban land use area of the four sub-watersheds (i.e., 45%), it still has the greatest number of fecal coliforms released onto its surface by an order-of-magnitude, due to its size. Additionally, due to the large percentages of urban land area, the other sub-watersheds (i.e., Lower and Upper Bays, and Santa Ana Delhi) have a larger proportional release of fecal coliforms than the San Diego Creek sub-watershed.
- Of those sources that had available data, domestic pet waste is estimated to contribute the most fecal coliforms to the surface of the watershed (one to three orders-of magnitude greater than fertilizers and wildlife) even though.

[29] *Enterococcus* are not described in this section due to the limited information to quantify contributions from sources.

Table 5.13. Estimated daily fecal coliform loading rates to the surface of Newport Bay sub-watersheds from natural and anthropogenic watershed sources.

| FIB Source (Applicable Land Use) | Estimated Contribution of Fecal Coliform to the Surface of Newport Bay Sub-watersheds (organisms/day) | | | | Total Contribution of Fecal Coliforms to the Surface of the Newport Bay Watershed[b] (organisms/day) |
|---|---|---|---|---|---|
| | Lower Newport Bay | Upper Newport Bay | Santa Ana Delhi Channel | San Diego Creek | |
| Pet Waste (Urban[a]) | $1.0 \times 10^{12}$ | $1.5 \times 10^{12}$ | $3.1 \times 10^{12}$ | $1.1 \times 10^{13}$ | $1.7 \times 10^{13}$ |
| Terrestrial Wildlife Waste | $1.8 \times 10^{10}$ | $2.6 \times 10^{10}$ | $4.8 \times 10^{10}$ | $3.4 \times 10^{11}$ | $4.3 \times 10^{11}$ |
| Biosolid & Fertilizer Applications (Residential Land Use)[c] | $3.3 \times 10^{9}$ | $4.7 \times 10^{9}$ | $8.0 \times 10^{9}$ | $2.3 \times 10^{10}$ | $3.9 \times 10^{10}$ |
| Total Estimated Load to the Surface of Sub-watershed/Watershed | $1.1 \times 10^{12}$ | $1.5 \times 10^{12}$ | $3.2 \times 10^{12}$ | $1.2 \times 10^{13}$ | $1.8 \times 10^{13}$ |
| % of Total Estimated Load to Surface of the Entire Newport Bay Watershed | 6.1 % | 8.6 % | 18.1 % | 67.1 % | |
| % of Newport Bay Watershed | 4.8 % | 5.6 % | 11.1 % | 77.3 % | |
| % of Urban[a] Land Use | 76.7 % | 76.7 % | 85.7 % | 44.7 % | |

[a] Urban area includes the following land uses: commercial, industrial, residential and transportation.
[b] Not all potential watershed sources of fecal coliforms have data available to estimate loadings and therefore in the future as additional information becomes available, contributions to the watershed should be revised.
[c] Based *E. coli*, as fecal coliform data were unavailable.

### 5.3.2 Pathway Loadings per Sub-watershed

As described in Section 5.2, sources of FIB to surface of the watershed can be discharged to Newport Bay via multiple transport pathways (i.e., urban runoff drains or tributaries). Bacteria in the San Diego Creek and Santa Ana Delhi Channel sub-watersheds are discharged via a single pathway - their respective tributaries. In the Lower and Upper Newport Bay sub-watersheds, however, FIB are discharged from large and small urban runoff drains. In addition, in the Upper Newport Bay sub-watershed FIB are transported to the Bay via Big Canyon Wash. The following paragraphs briefly describe the assumptions used to calculate loads for the Upper and Lower Bay sub-watersheds.

The Lower Bay sub-watershed is 7.4 $mi^2$. Through visual observation, it is obvious that four of the five large drains discharge to the Lower Bay, and the fifth drain (Polaris) discharges to the Upper Bay. Therefore, the FIB load from the four drains (El Paseo, Carnation, Arches and Dover) drains is attributable to sources within the Lower Bay sub-watershed. These four drains receive drainage from a 3.5 $mi^2$ area, leaving the remaining 3.9 $mi^2$ drainage area within the Lower Bay sub-watershed to drain to small urban runoff drains (see Section 5.2.2). To calculate the dry and wet weather discharge and FIB load from this 3.9 $mi^2$ drainage area, the average drainage area for small outfalls was first calculated (i.e., 0.03 $mi^2$

per small outfall) along with the estimated number of small drains in this 3.9 $mi^2$ drainage area (i.e. 130 small drains). This drainage area and number of small drains was then used to calculate wet and dry weather discharge per methods described Section 5.2.2.

Estimates of daily average fecal coliform loading from each sub-watershed are presented in Table 5.14. To estimate fecal coliform loading rates during dry weather from the Upper Bay sub-watershed, the following information was used:

- Estimated average Big Canyon FIB loading rates (see Table 5.11);
- Discharge measurements taken by Everest International (2004) at the Polaris drain;
- Average discharge estimates developed by Grant et al. (2009) for small drains; and,
- Average FIB concentrations described in Section 5.1 and 5.2.

To estimate average wet weather fecal coliform loading rates from each sub-watershed, the following information was used:

- Average fecal coliform concentrations previous described in Section 5.2.1;
- For San Diego Creek and Santa Ana Delhi channel, median discharge measurements for wet weather; and,
- For Big Canyon Wash and storm drains (large and small), discharge estimates developed using methods described in Section 5.2.2.

Table 5.14. Estimated average dry and wet weather fecal coliform loading rate from sub-watersheds via storm drains and tributaries.

| Estimate | Fecal Coliform (organisms/day) per Sub-watershed | | | | | | Newport Bay Watershed Load (organisms/day) |
|---|---|---|---|---|---|---|---|
| | Lower Newport Bay[a] | Upper Newport Bay | | | Santa Ana Delhi Channel | San Diego Creek | |
| | | Storm Drains[b] | Big Canyon Wash | Total | | | |
| Dry Weather [c] | $6.0 \times 10^{10}$ | $1.3 \times 10^{10}$ | $1.1 \times 10^{9}$ | $1.4 \times 10^{10}$ | $2.4 \times 10^{10}$ | $2.5 \times 10^{10}$ | $1.2 \times 10^{11}$ |
| Wet Weather [d] | $4.9 \times 10^{11}$ | $2.0 \times 10^{11}$ | $2.2 \times 10^{10}$ | $2.2 \times 10^{11}$ | $3.2 \times 10^{11}$ | $1.3 \times 10^{12}$ | $2.3 \times 10^{12}$ |

[a] Includes loading from 4 large (El Paseo, Carnation, Arches and Dover) and 130 small storm drains.
[b] Includes loading from 1 large (Polaris) and 79 small storm drains.
[c] Days below the 85th percentile discharge rate in San Diego Creek and Santa Ana Delhi channel.
[d] Days above the 85th percentile discharge rate in San Diego Creek and Santa Ana Delhi channel.

Although there were a number of assumptions used to develop loading estimates presented in Table 5.13, the comparison between sub-watersheds and pathways provides the following salient points with regard to FIB source management:

- During dry weather, fecal coliform loads from storm drains and tributaries are within the same order-of-magnitude ($10^{10}$), however during wet weather, tributaries (in particular San Diego Creek) are contributing the largest proportion of fecal coliforms to the Bay from watershed-based sources; and,
- During dry weather, fecal coliform loadings are similar (within and order-of-magnitude) between the four sub-watersheds.

### 5.3.3 Comparison Between Sources and Pathways

Both contributions of FIB from sources and pathways were developed using independent datasets, information and assumptions. Source contributions represent the rate which FIB are deposited onto the surface of the watershed or directly into the Bay from specific sources (e.g., water birds). In contrast, pathway[30] loading estimates represent the average loading of FIB to the Bay from drains or tributaries during dry or wet weather. Table 5.15 provides a summary of annual source contributions to and pathway loadings from, each Newport Bay sub-watershed. Annual wet and dry weather loadings (from pathways) are based on the average number of wet (60 days) and dry (305) weather days (see Table 4.2).

Although estimates of FIB contributions from sources and pathways have an inherent level of uncertainty, a few salient points are apparent:

- Annual contributions of FIB to the surface of the Newport Bay watershed are two orders-of-magnitude greater than annual dry or wet weather loadings to the Bay. Suggesting that there are consistently large inputs of FIB available for transport to the Bay via dry or wet weather runoff events, although only a small portion of FIB are transported to the Bay. Explanations for this lack of transport include: 1) a large proportion of FIB dieoff while in the watershed; and/or, 2) FIB are accumulated and "stored" within the watershed, and are unavailable for transport to the Bay during dry and/or wet weather events.
- Although there are five times as many dry weather days as wet weather days in an average year, dry and wet weather annual loadings of fecal coliforms to the Bay are similar (within an order-of-magnitude).

Table 5.15. A comparison of the estimated average annual contributions of fecal coliforms from sources to the surface of the watershed and loadings from pathways during the dry and wet weather.

| Source Contribution or Pathway Loading | Estimated Average Annual Fecal Coliform Contribution/Load (organisms/year) by Sub-watershed | | | | Total |
|---|---|---|---|---|---|
| | Lower Newport Bay | Upper Newport Bay | Santa Ana Delhi Channel | San Diego Creek | |
| Contributions from Sources to Sub-watershed Surface | $4.0 \times 10^{14}$ | $5.5 \times 10^{14}$ | $1.2 \times 10^{15}$ | $4.4 \times 10^{15}$ | $6.5 \times 10^{15}$ |
| Dry Weather Pathway Loading to the Bay | $1.8 \times 10^{13}$ | $4.3 \times 10^{12}$ | $7.3 \times 10^{12}$ | $7.6 \times 10^{12}$ | $3.8 \times 10^{13}$ |
| Wet Weather Pathway Loading to the Bay | $2.9 \times 10^{13}$ | $1.3 \times 10^{13}$ | $1.9 \times 10^{13}$ | $7.8 \times 10^{13}$ | $1.4 \times 10^{14}$ |

[30] Although direct inputs (e.g., waste from water birds) are also identified as pathway in Section 5.1, for comparison purposes in this section the direct input pathway has been removed and is not discussed.

## 5.4 Potential Environmental Fates of FIB

In addition to the five FIB source categories (Section 5.1) and transport pathways (Section 5.2), there are a number of processes that can affect FIB concentrations in Newport Bay. These include physicochemical removal of FIB from the water column (adsorption, sedimentation, filtration) and mobilization into the water column from substrates (sediment resuspension, tidal washing off of mudflats); die-off (exposure to sunlight, salinity, pH); predation (zooplankton); and growth (Figure 5.14). Because these processes may effect the prioritization and evaluation of source management control feasibility, it is important to understand the role that these processes have on FIB concentrations in Newport Bay. Therefore, the following paragraphs briefly describe these processes and summarize information regarding the environmental fate of FIB in the Bay.

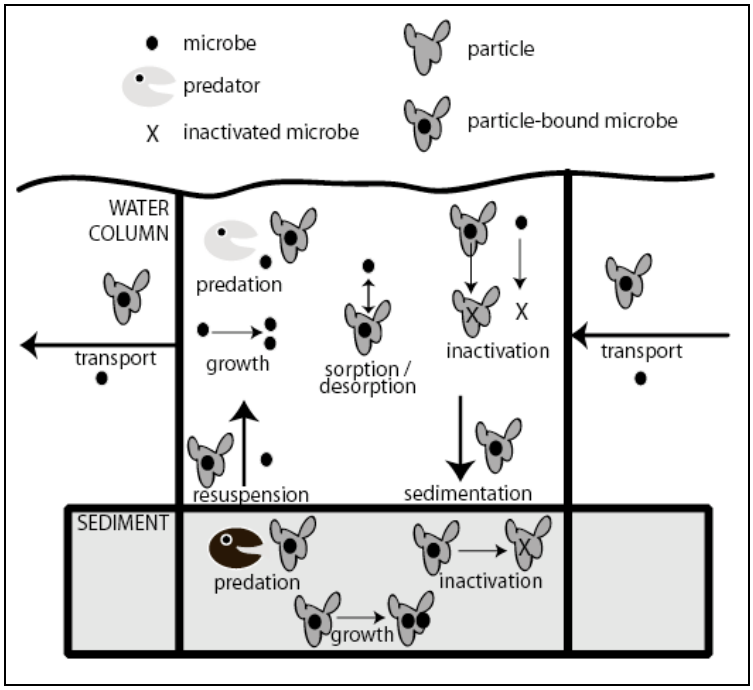


Figure 5.14. Possible environmental fates of FIB (microbes) in water bodies (Olivieri et al. 2006).

### 5.4.1 Die-off and Predation

For decades, researchers have documented the effect of sunlight on the viability of FIB. During the dark hours of the night and early morning, fecal indicator bacteria are typically two to ten times higher than when the sun is out (Gauthier et al. 1989). The exact mechanism whereby FIB become non-viable after sunlight exposure is not entirely clear. When FIB are exposed to sunlight, they lose culturability, however it is less obvious whether they can regain their culturability via intracellular repair mechanisms. Photons can damage DNA or other cellular components directly or cause damage indirectly by promoting the production of free radicals in the presence of dissolved oxygen and organics.

Temperature has also been shown to affect FIB in water bodies. In cooler waters, FIB can persist in a culturable state for longer periods than in warm waters. Solic and Krstulovic (1992) showed that the time required for a 90% reduction in fecal coliforms decreased 55%

for each 10°C increase in water temperature. Field research as well as laboratory experiments supported these results. However, based on the coefficient of correlation and light and dark experiments, solar radiation is a more significant effect than temperature. Noble et al. (2004) obtained similar results, finding higher inactivation at higher temperatures (20°C rather than 14°C) for total coliforms, E. coli, *Enterococcus* and F+ specific coliphage.

Salinity may affect pathogen inactivation in coastal receiving waters such as estuaries or the coastal ocean. Solic and Krstulovic (1992) found an inverse relationship between fecal coliform survival and salinity concentrations. Specifically, the researchers found an approximate 55% reduction for each 5% salinity increment in the 7-15 ppt range, and a decrease of about 15-40% for each 15% salinity increment in the 15-40 ppt range. They also noted that higher salinity and high levels of solar radiation combined to produce a synergistic effect, resulting in higher mortality rates of fecal coliforms. In Newport Bay, Grant et al. (2009) also found that FIB concentrations appear to increase in response to a decrease in salinity, particularly at Upper Bay sites and during low tides at sites receiving primarily dry weather runoff.

To our knowledge, no studies on predation of FIB in Newport Bay or tributaries to the Bay have been conducted. However, a variety of research has suggests that predation puts pressure on both FIB and indigenous microbes in water bodies, and is an important biological process that should be considered when assessing water quality impacts. Specifically, protozoa, nanoflagellates, microflagellates, ciliates, amoeba, and bacteria may prey upon viruses as well as other protozoa and bacteria. Barcina et al. (1997) asserted that grazing by protozoa is one of the main biological processes that control allochthonous bacterial density. Fujioka et al. (1980) documented anti-viral microorganisms in natural waters. Enzinger and Cooper (1976) showed that estuarine waters from San Francisco Bay contained both protozoa (including ciliates and amoeba) and bacteria (including *Bdellovibrio bacteriovorus*) that cause declines in *Enterococcus*. In a similar study, McCambridge and McMeekin (1980) showed that protozoa and bacteria reduced *Enterococcus* levels from 108 to 10 CFU/mL over 10 days, a much greater reduction than previously thought possible via this mechanism.

The presence of sunlight exacerbates predation pressure on *Enterococcus* (McCambridge and McMeekin, 1981; Rhodes and Kator, 1990) even though sunlight has no effect on the numbers of predators present in the waters. Chamberlain and Mitchell (1978) suggest that solar radiation causes injury to *Enterococcus* that makes them susceptible to predation. Rhodes and Kator (1988) reported first-order decay constants between 0.43–0.92/day for *Enterococcus* in estuarine water.

### 5.4.2 Sediment Deposition, Retention and Mobilization

Fecal indicator bacteria may enter a water body in the free phase or adsorbed to suspended particles. Once in a water body, FIB attached to particles and free in aqueous solution may settle to the base of the water column and be incorporated into the sediments (Jamieson et al., 2002; Steets and Holden, 2003). This process is also termed deposition. Over the last 40 years, numerous studies, including the Newport Bay Source Identification Study (Grant et al. 2009), have reported high concentrations of FIB in the sediments of water bodies (Gerba and McLeod 1976, Goyal et al. 1977, Van Donsel et al. 1967, Smith et al. 2001).

Researchers have acknowledged since at least the 1960s that sediments can be reservoirs of FIB. While some researchers view sediments to be a “dead end” in the FIB life cycle (Winfield and Groisman, 2003), others have found that some have lifecycles within sediment (Byappanahalli et al., 2006). Some investigations have found that water quality violations only occur when a sediment reservoir of FIB is present (Crabill et al. 1999). Additionally, sediments also provide increased nutrients that FIB may use to reproduce (Gerba and McLeod 1976).

A variety of physical processes, including tidal cycles, currents, and human activity, can affect the shear stress at the bed of a water body, which may cause FIB to mobilize into the water column (Bai and Lung 2005). Pitt and Field (1990) found that if a FIB settles to the base of the water column, it can be incorporated into the sediments where it may remain indefinitely, or until the sediment is scoured (i.e., mobilized in the water column) by shear force at the bed. Solo-Gabriele et al. (2000) also found that high tides can wash FIB from creek sediments to the water column. Plummer et al. (1987) showed that tidal currents in an estuary periodically resuspended particle-associated FIB. Consequently, the occurrence of scouring suggests that the concentration of microorganisms in water may not necessarily reflect the true degree of microbial contamination in a water body.

In Newport Bay, Grant et al. (2009) found that in Lower Bay sediments have high concentrations of *Enterococcus*, and relatively low concentrations of *E. coli*. Observed *Enterococcus* concentrations in Bay sediment were between 40 MPN/10 grams and 4000 MPN/10 grams. Additionally, *Enterococcus* concentrations had considerable temporal variability in sediments, but appeared to increase with closer proximity to the ocean. Grant et al. (2007) concluded that within-Bay sediments have higher concentrations of *Enterococcus* than tributary sediments, suggesting that Bay sediments provide a large reservoir of FIB that may be resuspended over time. Based on these results, the authors concluded that *Enterococcus* is maintaining, and perhaps growing, in the sub-tidal sediments of Newport Bay.

To further evaluate if *Enterococcus* in the sub-tidal sediments of Newport Bay a significant source of FIB to overlying water column, Grant et al. (2009) calculated Spearman rank correlation coefficients between concentrations measured in the sediments an simultaneously measured FIB concentrations in the overlying water. The correlation analysis indicated that concentrations in the <u>sub-tidal</u> sediments were largely uncoupled from the concentrations in the overlying water. However, further investigations of the <u>intertidal</u> sediments by Grant and others indicate that FIB are consistently transported out of intertidal sediments into the water column during rising tides.

In summary, research has shown that FIB can be deposited, retained, grown and mobilized from sediments. Specifically, investigations conducted by Grant et al. (2009) as part of the Newport Bay FIB Source Identification Project suggest that *Enterococcus* deposited in the intertidal portions of the Bay may increase in concentration while in the sediments, and become mobilized during rising tides. In some instances, the mobilization of *Enterococcus* from sediments can trigger exceedances of water quality criteria. Therefore, it assumed for purposes of the SMP development that intertidal sediment can retain FIB that is delivered from Bay sources and transport pathways described in Sections 5.1 and 5.2. Additionally, under optimal environmental conditions, FIB concentrations may increase in sediment with time, providing another source of FIB to the Bay.

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# 6.0 PRIORITIZATION OF AREAS IN NEWPORT BAY

## 6.1 Summary of Identification Approach

This section describes the approach used to identify and prioritize areas of interest in Newport Bay with regard to FIB. The goal is to use the most scientifically defensible and regulatory acceptable approach to prioritize sites/areas in Newport Bay for source management action consideration. The approach uses the most recent and robust FIB datasets available and is consistent with current regulatory guidance (USEPA 1986, 2001, 2004b) and epidemiological study results (Cabelli et al. 1979, Cabelli et al. 1982) used to develop current Water Quality Criteria. The approach incorporates a rationale for selecting monitoring or averaging periods, stratification of dry and wet weather data, and the use of Upper Percentile Values (UPVs) and REC-1 Use Assessment results.

### 6.1.1 Monitoring Datasets Utilized

As described in Sections 1.0 and 2.0, Newport Bay is the second largest estuarine embayment in southern California, roughly 2.3mi$^2$ in size. The Upper Bay is currently a high value shallow estuary that lies mostly within the boundaries of a State Ecological Reserve. The Lower Bay is an active harbor that has a complex shape that includes a number of relatively small embayments and channels. Recreational (water and non-water contact) activities, including swimming at small and moderately-sized public and private beaches (mostly in the Lower Bay), kayaking, and boating/sailing, are currently carried out at a variety of locations in the Upper and Lower Bays.

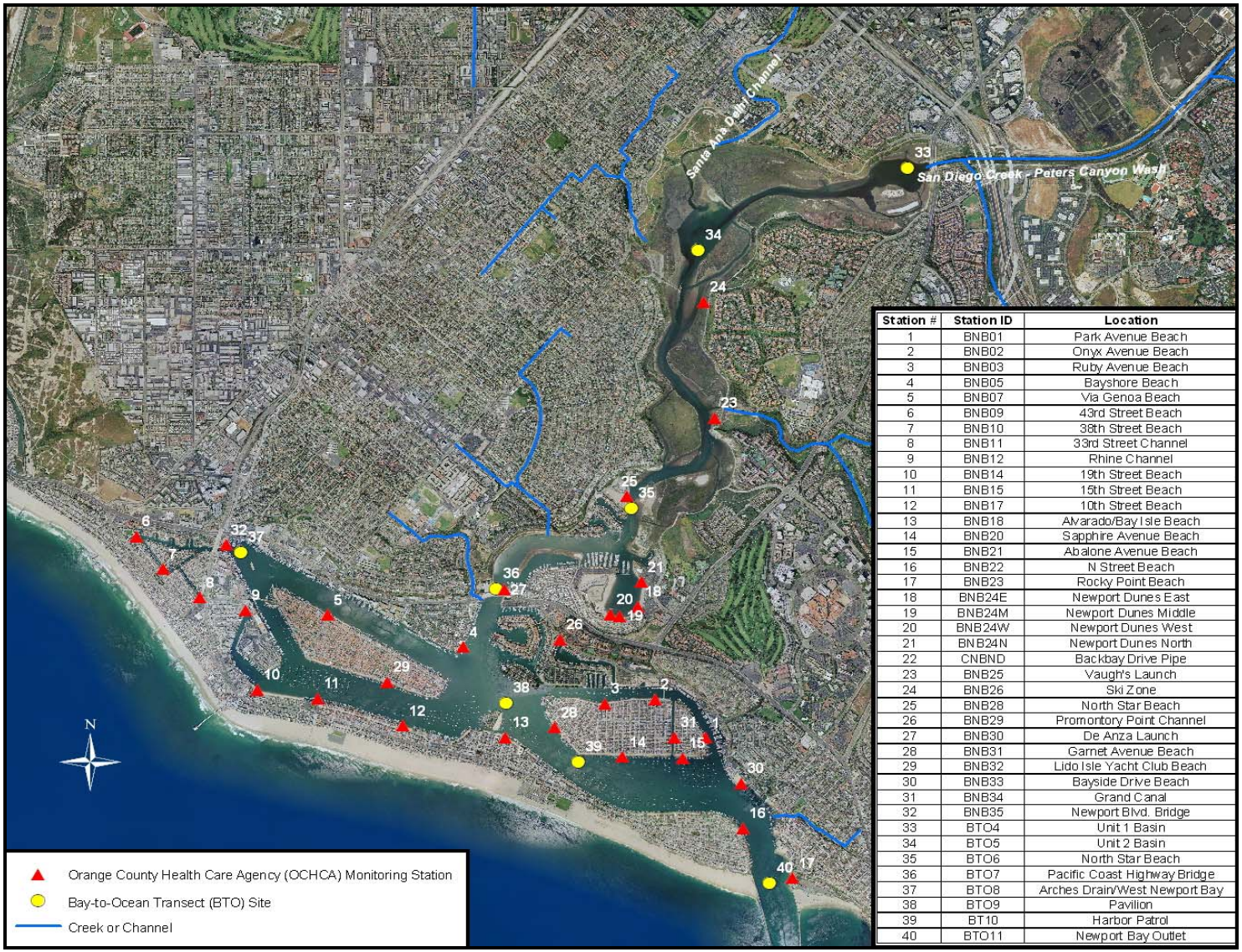
Combined, the datasets described below represent 40 locations in both the Lower and Upper Bays where recreational activities occur. Specifically, data used to identification areas of interest were collected from 23 beaches and 17 channel locations geographically distributed throughout the Bay (Figure 6.1). Due to the large number of monitoring sites, FIB data collected from these locations are assumed to be representative of the water quality condition in Newport Bay.

#### *OCHCA Dataset (2004-2007)*

The Orange County Health Care Agency (OCHCA) has collected the most spatially and temporally robust FIB dataset from Newport Bay to-date. Initial OCHCA data collection efforts began in 1987 and currently 31 Bay sites are sampled at least weekly for fecal coliform and *Enterococcus*. Site locations are along the margins of the Bay and are intended to represent areas where: 1) full body contact recreation has the highest likelihood to occur; and/or 2) are in close proximity to sources and/or pathways of interest. As described in Section 4.0, OCHCA data collected from January 2004 through December 2007 were selected to represent current FIB concentrations at areas in Newport Bay where full body contact recreation has the highest likelihood to occur (i.e., the margins and of the Bay).

#### *FIB Source Identification Study Dataset (2006-2007)*

In addition to the OCHCA long-term dataset, water samples were also collected at nine Bay-to-Ocean (BTO) transect sites in the Upper and Lower Newport Bay as part of the Newport Bay FIB Source Identification Project. Dry season data were collected approximately weekly from July through October 2006, and wet season from March through April 2006 and during




| Station # | Station ID | Location |
|---|---|---|
| 1 | BNB01 | Park Avenue Beach |
| 2 | BNB02 | Onyx Avenue Beach |
| 3 | BNB03 | Ruby Avenue Beach |
| 4 | BNB05 | Bayshore Beach |
| 5 | BNB07 | Via Genoa Beach |
| 6 | BNB09 | 43rd Street Beach |
| 7 | BNB10 | 38th Street Beach |
| 8 | BNB11 | 33rd Street Channel |
| 9 | BNB12 | Rhine Channel |
| 10 | BNB14 | 19th Street Beach |
| 11 | BNB15 | 15th Street Beach |
| 12 | BNB17 | 10th Street Beach |
| 13 | BNB18 | Alvarado/Bay Isle Beach |
| 14 | BNB20 | Sapphire Avenue Beach |
| 15 | BNB21 | Abalone Avenue Beach |
| 16 | BNB22 | N Street Beach |
| 17 | BNB23 | Rocky Point Beach |
| 18 | BNB24E | Newport Dunes East |
| 19 | BNB24M | Newport Dunes Middle |
| 20 | BNB24W | Newport Dunes West |
| 21 | BNB24N | Newport Dunes North |
| 22 | CNBND | Backbay Drive Pipe |
| 23 | BNB25 | Vaugh's Launch |
| 24 | BNB26 | Ski Zone |
| 25 | BNB28 | North Star Beach |
| 26 | BNB29 | Promontory Point Channel |
| 27 | BNB30 | De Anza Launch |
| 28 | BNB31 | Garnet Avenue Beach |
| 29 | BNB32 | Lido Isle Yacht Club Beach |
| 30 | BNB33 | Bayside Drive Beach |
| 31 | BNB34 | Grand Canal |
| 32 | BNB35 | Newport Blvd. Bridge |
| 33 | BTO4 | Unit 1 Basin |
| 34 | BTO5 | Unit 2 Basin |
| 35 | BTO6 | North Star Beach |
| 36 | BTO7 | Pacific Coast Highway Bridge |
| 37 | BTO8 | Arches Drain/West Newport Bay |
| 38 | BTO9 | Pavilion |
| 39 | BT10 | Harbor Patrol |
| 40 | BTO11 | Newport Bay Outlet |

Figure 6.1. Sites monitored for FIB by OCHCA and Bay-to-Ocean (BTO) transect sites monitored during the Source Identification Project.

storm events in February 2007. Samples were collected at the water surface and at depth at each BTO site, and analyzed for both *Enterococcus* and *E. coli*.

For the purpose of identifying areas of interest in Newport Bay, FIB data collected via the Source Identification Project were utilized to represent current FIB concentrations within the channels of the Bay, which complements the OCHCA data collected on the margins. Consistent with Regional Board staff evaluation of FIB data during the development of the 2008 recommended 303(d) list of impaired water bodies in the Santa Ana region, only water samples collected at the surface were used to identify areas of interest. Additionally, because there are currently no regulatory standards for *E. coli* in marine water bodies, only *Enterococcus* data collected at BTO sites were utilized.[31]

### 6.1.2 Selection of Water Quality Assessment Metrics

Microbial Water Quality Criteria (Criteria) and Water Quality Objectives (WQOs) are based on relationships between the concentrations of specific types of FIB and human health endpoints with an acceptable level of risk. Current Criteria for *Enterococcus* (U.S. EPA 2004b) and Fecal Coliform WQOs (Regional Board 2008) applicable to Newport Bay are presented below and fully described in Section 3.0.

- *Fecal Coliform WQO: log mean less than 200 organisms/100 mL based on five or more samples/30 day period,* ***and*** *not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.*

- *Enterococcus Criteria: Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the enterococci densities should not exceed 35 per 100 ml; no sample should exceed a one sided confidence limit (CL) using the following (Upper Percentile Values) as guidance:*
    - *Designated bathing beach (75% CL) - 104/100mL*
    - *Moderate use for bathing (82% CL) - 159/100mL*
    - *Light use for bathing (90% CL) - 276/100mL*
    - *Infrequent use for bathing (95% CL) - 501/100mL*

Because there are multiple approaches that can be used to apply these WQOs and Criteria, guidance was sought from the USEPA documents and the Newport Bay Technical Advisory Committee (TAC) on the selection of the most scientifically sound and regulatory acceptable approaches and water quality assessment metrics (metrics) to employ. These approaches and metrics are intended to assist in interpreting water quality data for the purposes of prioritizing sites/areas in Newport Bay for management action consideration. Each metric is described below with a rationale of why it was selected.

#### *Log/Geometric Mean Metrics*

For long-term datasets with a log-normal distribution, the geometric (log) mean provides the best representation of central tendency. According to the USEPA (2004b), the geometric

[31] Due to the lack of Fecal Coliform data available for BTO sites sampled during the Source Identification Study, only *Enterococcus* data were used to identify and prioritize BTO sites. Based on the evaluation of FIB data presented in Section 4.0, using only *Enterococcus* data to prioritize BTO sites provides an additional level of conservativeness and possibly overestimates the level of priority of a BTO site. Therefore, it is recommended that prior to management actions being implemented to address a specific BTO site, additional analysis should be conducted to better estimate the level of concern at the site.

mean is generally more relevant (than the Upper Percentile Values) because it is usually a more reliable measure of long term water quality, being less subject to random variation, and more directly linked to the underlying studies upon which the 1986 *Enterococcus* criteria and 2004 standards were based.

Averaging periods used to calculate a FIB log/geometric mean can range from 30 days to multiple years. Additionally, FIB log/geometric means can be calculated using a rolling/running or a static (non-rolling) averaging approach. Based on a review of the *Implementation Guidance for Ambient Water Quality Criteria for Bacteria* (USEPA 2004a), USEPA indicates that the log/geometric mean should be calculated based on the total number of samples collected over the specified monitoring period. However, USEPA guidance does not specify the duration over which the geometric mean should be calculated. Rather, the USEPA recognizes that States have discretion on selecting monitoring periods (USEPA 2004a).

Averaging periods and approaches were also presented and discussed with the Newport Bay TAC in April 2009. Based on the review of USEPA guidance, the results of the TAC discussion and additional feedback from Regional Board staff, the log/geometric mean averaging periods and approaches presented in Table 6.1 were selected to assist in prioritizing sites/areas in Newport Bay for management action consideration.

Table 6.1. Log/geometric mean water quality assessment metrics used to prioritize sites/areas in Newport Bay for source management consideration.

| Water Quality Assessment Metrics (Log/Geometric Mean) | Rationale/Justification |
|---|---|
| Long-Term log mean/geomean compared to log mean/geomean Water Quality Objective/Criteria | • Incorporates the largest FIB dataset available<br>• Reliable measure of long term water quality<br>• Less subject to random variation<br>• More directly linked to the underlying epidemiological studies |
| % of rolling log means/geomeans (based on 5 samples over a maximum of 30 days) that exceed the log mean/geomean Water Quality Objective/Criteria[a] | • Compared to UPVs, less subject to random variation<br>• Currently used by OCHCA to determine beach postings and closures in Newport Bay |

[a] Not calculated for the *Enterococcus* dataset collected via the Newport Bay FIB Source Identification Study (Prop 13) due to the limited timeframe data were collected.

### *Upper Percentile Value Metrics*

Upper Percentile Values (UPVs)[32] are based on the standard deviation of values around a log/geometric mean (USEPA 2004a). Four UPVs are currently included in the Criteria for *Enterococcus*. Each *Enterococcus* UPV has a qualitative descriptors of beach usage (e.g., Designated Beach Area, Moderate Full Body Contact) associated with different confidence levels (USEPA 1986, 2001). The WQO for fecal coliform also includes a maximum value similar to a UPV (i.e., 400 organisms/100mL), but called a Single Sample Maximum (SSM).

[33]Upper Percentile Values are also known as Single Sample Maximums (SSMs).

In practice, USEPA (2004a) suggests that the choice of a *Enterococcus* UPV depends on several considerations, including the degree of confidence that the variability associated with the standard deviation accurately reflects the variability at the site. For example, if the site exhibits enormous variability in bacteria levels, then a UPV at a lower confidence level (e.g., 75%) may be more appropriate than a UPV for a designated bathing beach (USEPA 2004a). That said, the OCHCA uses the UPV for designated bathing beaches (i.e., 104 organisms/100mL) in combination with a log/geometric mean, for making beach posting and closure decisions in Newport Bay.

One UPV metric for *Enterococcus* and the SSM metric for fecal coliform were used to assist in prioritizing sites/areas in Newport Bay for source management consideration (Table 6.2). The *Enterococcus* UPV metric used was the percentage of samples at each site that exceeded the designated bathing beach UPV (i.e., 104 organisms/100mL). This metric was applied to both sites sampled by OCHCA and during the Newport Bay FIB Source Identification Project (i.e., BTO sites) and is intended to be very conservative, as not all monitoring sites in Newport Bay are beaches. The fecal coliform metric used was the percentage of samples at each site that exceeded the fecal coliform SSM (i.e., 400 organisms/100mL).

Table 6.2. Upper Percentile Value (UPV) water quality assessment metric used to prioritize sites/areas in Newport Bay for source management consideration.

| Water Quality Assessment Metrics (Upper Percentile Values) | Rationale/Justification |
|---|---|
| % of samples that exceeded the SSM for fecal coliform (400 organisms/100mL) or the *Enterococcus* Upper Percentile Value for designated bathing beaches (104 organisms/100mL) | • Generally more stringent than water quality assessment metrics based on log/geometric means<br>• Currently used by OCHCA to determine beach postings and closures in Newport Bay |

### *Summary of Metrics Utilized and Considerations of Wet and Dry Weather*

Table 6.3 provides a summary of water quality assessment metrics used to identify priority areas in Newport Bay during wet and dry weather. Data collected during wet and dry weather were stratified based on rationale provided in Section 4.0. Upon examination, it is clear that not all water quality assessment metrics selected, can or should be used to evaluate the fecal coliform and *Enterococcus* wet and dry weather datasets. Specifically, rolling/running geometric means cannot be calculated for the wet weather dataset due to the sporadic nature of wet weather events, as depicted in Figure 6.2.

Table 6.3. Water quality assessment metrics used to identify sites for source management consideration during wet and/or dry weather.

| Water Quality Assessment Metrics | | Dry Weather | | Wet Weather | |
|---|---|---|---|---|---|
| | | Fecal Coliform | *Enterococcus* | Fecal Coliform | *Enterococcus* |
| Log/Geometric Mean | Long-Term log mean/geomean compared to log mean/geomean Water Quality Objective/Criteria | X | X | X | X |
| | % of rolling log means/geomeans (based on 5 samples over a maximum of 30 days) that exceeded the log mean/geomean Water Quality Objective/Criteria | X | X | | |
| Upper Percentile Value or Single Sample Maximum | % of samples that exceeded the SSM for fecal coliform or the *Enterococcus* UPV for designated bathing beaches | X | X | X | X |

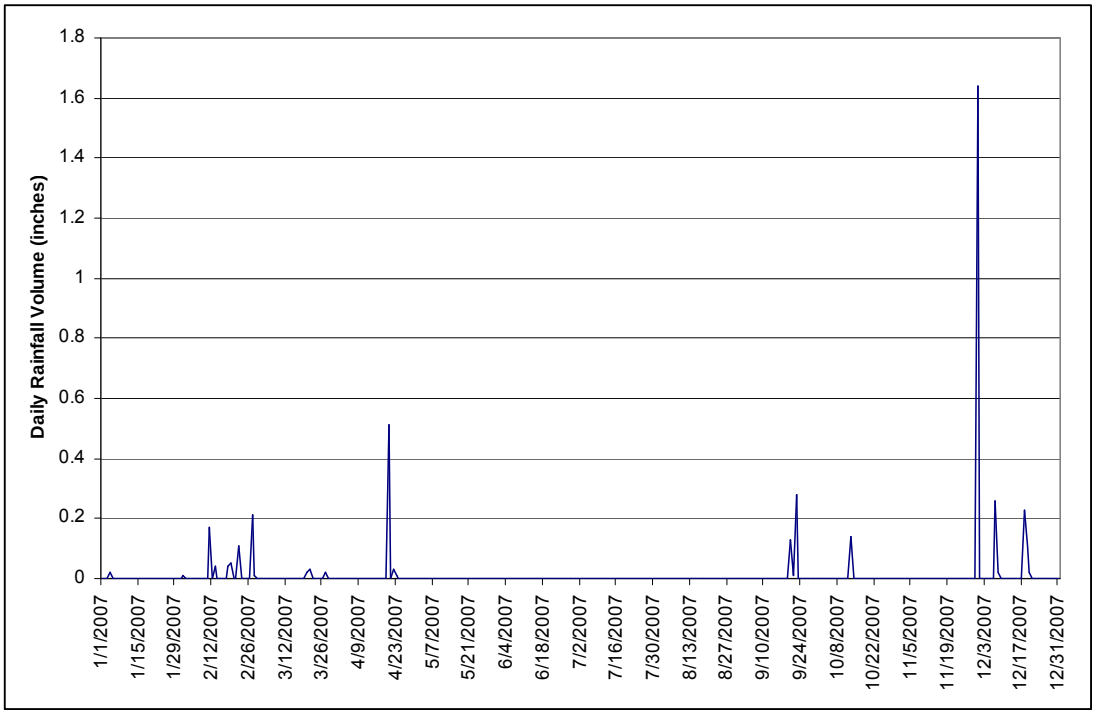



Figure 6.2. Daily rainfall volumes recorded at Irvine Rainfall Station #75 during 2007.

### 6.1.3 Water Quality Assessment Metric Scoring and Weighting

Following the selection of the water quality assessment metrics used to evaluate wet and dry weather FIB datasets, a site/area ranking approach was developed to assist in prioritizing locations in Newport Bay for source management consideration. Metric results for each Newport Bay monitoring location were scored (i.e., High = 100; Medium = 50; Low = 0) using the ranges presented in Table 6.4. Metric scoring ranges established were based on two principals:

- For the long-term log/geometric mean metric, a high score (100) was assigned to a site that was at or above the water quality objective/criteria. A medium score (50) was given to a site that was between the water quality objective/criteria and half of the water quality objective/criteria. Sites with a result of below half of the water quality objective/criteria were scored low (0) for this metric.
- For the remaining metrics (% exceedance of geomean and UPV/SSM), a site received a high score if it had a >15% exceedance frequency. A medium score was assigned to sites with exceedance frequencies between 15% and 10%, and a low score was given to those sites with <10%. (Exceedance frequencies that correspond to medium and low scores are similar to what is required to delist a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria).

Following scoring, a weighting factor (see Table 6.4) was applied to each metric based on recommendations provide by Regional Board staff (*personal communication with Linda Candelaria*). For each type of FIB during either wet or dry weather there was a total possible weighted metric score of 100. For both dry and wet weather, total *Enterococcus* and fecal coliform metric scores were then combined to create a total ranking score for each monitoring site (possible score of 200). Dry and wet weather results for each monitoring site are discussed in the following sections.

Table 6.4. Water quality assessment metric scoring ranges used to prioritize areas in Newport Bay for source management consideration (note: points awarded for each scoring range are in parentheses).

| Water Quality Assessment Metric | Fecal Coliform Scoring Ranges[a] | | | *Portion of Fecal Coliform Metric Score (Weighting)* | *Enterococcus* Scoring Ranges[a] | | | *Portion of Enterococcus Metric Score (Weighting)* |
|---|---|---|---|---|---|---|---|---|
| | High Range (100) | Medium Range (50) | Low Range (0) | | High Range (100) | Medium Range (50) | Low Range (0) | |
| *Dry Weather* | | | | | | | | |
| Long-Term Log Mean/Geomean (organisms/100mL) | >200 | 200-100 | <100 | *30%* | >34 | 34-17 | <17 | *30%* |
| % of Rolling Log Means/Geomeans > Log/Geomean Criteria/Objective | >15% | 15-10% | <10% | *40%* | >15% | 15-10% | <10% | *40%* |
| % of samples > the Water Quality Objective or UPV for designated bathing beaches | >15% | 15-10% | <10% | *30%* | >15% | 15-10% | <10% | *30%* |
| *Wet Weather* | | | | | | | | |
| Long-Term Log Mean/Geomean (organisms/100mL) | >200 | 200-100 | <100 | *40%* | >34 | 34-17 | <17 | *40%* |
| % of Rolling Log Means/Geomeans > Log/Geomean Criteria/Objective | NA | | | | NA | | | |
| % of samples > the Water Quality Objective or UPV for designated bathing beaches | >15% | 15-10% | <10% | *60%* | >15% | 15-10% | <10% | *60%* |

[a] Exceedance frequencies that correspond to medium and low scores are similar to what is required to delist a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria.

## 6.2 Dry Weather Priority Areas

Metric scoring results for OCHCA fecal coliform and *Enterococcus* dry weather datasets are presented in Tables 6.5 and 6.6, respectively. Results for BTO sites sampled during the Source Identification Project are presented in Table 6.7.

Examination of the ranking approach results brings the following salient points for dry weather:

- No OCHCA or BTO sites received all high metric scores.
- Ten of forty sites had a combined *Enterococcus* and fecal coliform metric score of greater than zero.
- Two OCHCA sites (33rd St. Channel and Newport Blvd. Bridge) received a fecal coliform metric score greater than zero.
- Seven OCHCA sites (33rd St. Channel, Newport Blvd. Bridge, Bayside Dr. Beach, Vaughns Launch, 38th St. Beach, Ski Zone and 10th St. Beach), and three BTO sites (BTO4, BTO5 and BTO8) had an *Enterococcus* metric score greater than zero.

Based on the dry weather metric results presented in Tables 6.5, 6.6 and 6.7, the following 10 Newport Bay sites (i.e., those sites with combined fecal coliform and *Enterococcus* metric scores >0) are potential areas of interest and will be considered for dry weather source management actions in this SMP:

- 33rd Street Channel
- Newport Blvd. Bridge
- Bayside Drive Beach
- Vaughns Launch
- 38th Street Beach
- Ski Zone
- 10th Street Beach
- BTO4
- BTO5
- BTO8

All other sites not listed above (i.e., those scoring zero) are assumed to be within an acceptable water quality range for the purposes of this SMP. Prioritization of the sites listed above is described in Section 6.4.

Table 6.5. Dry weather fecal coliform metric scores for OCHCA sites based on data collected weekly from 2004 to 2007 (note: metric results are in parenthesis and monitoring stations with a total fecal coliform metric score >0 are highlighted in blue).

| OCHCA Station ID | OCHCA Station Name | Fecal Coliform Metric Scores | | | Total Fecal Coliform Metric Score (100 possible) |
|---|---|---|---|---|---|
| | | Long-Term Log Mean (30 possible) | Rolling Log Means (40 possible) | Upper Percentile Value (30 possible) | |
| BNB11[a] | 33rd Street | 0 (44) | 40 (18.5%) | 15 (14.1%) | 55 |
| BNB35 | Newport Blvd Bridge | 0 (44) | 0 (7.8%) | 15 (12.0%) | 15 |
| BNB33[a] | Bayside Drive Beach | 0 (32) | 0 (5.6%) | 0 (6.7%) | 0 |
| BNB25[a] | Vaughns Launch | 0 (22) | 0 (0.0%) | 0 (2.1%) | 0 |
| BNB10[a] | 38th Street | 0 (22) | 0 (3.3%) | 0 (5.8%) | 0 |
| BNB26[a] | Ski Zone | 0 (25) | 0 (0.0%) | 0 (5.3%) | 0 |
| BNB17[a] | 10th Street | 0 (19) | 0 (2.4%) | 0 (4.2%) | 0 |
| BNB34[a] | Grand Canal | 0 (20) | 0 (0.0%) | 0 (3.1%) | 0 |
| BNB32[a] | Lido Yacht Club | 0 (23) | 0 (3.9%) | 0 (4.8%) | 0 |
| BNB31[a] | Garnet Avenue | 0 ( 14) | 0 (0.0%) | 0 (1.3%) | 0 |
| BNB30[a] | De Anza | 0 (14) | 0 (0.0%) | 0 (3.1%) | 0 |
| BNB29[a] | Promontory Point | 0 (11) | 0 (0.0%) | 0 (0.0%) | 0 |
| BNB28[a] | North Star Beach | 0 (15) | 0 (0.0%) | 0 (2.4%) | 0 |
| BNB24W[a] | Newport Dunes West | 0 (21) | 0 (0.0%) | 0 (2.4%) | 0 |
| BNB24N[a] | Newport Dunes North | 0 (36) | 0 (2.6%) | 0 (3.6%) | 0 |
| BNB24M[a] | Newport Dunes Middle | 0 (20) | 0 (0.0%) | 0 (1.2%) | 0 |
| BNB24E[a] | Newport Dunes East | 0 (30) | 0 (3.3%) | 0 (6.4%) | 0 |
| BNB23[a] | Rocky Point | 0 (13) | 0 (0.0%) | 0 (1.2%) | 0 |
| BNB22[a] | N Street Beach | 0 (12) | 0 (0.0%) | 0 (1.9%) | 0 |
| BNB21[a] | Abalone Avenue | 0 (13) | 0 (0.0%) | 0 (7.5%) | 0 |
| BNB20[a] | Sapphire Avenue | 0 (13) | 0 (0.0%) | 0 (0.0%) | 0 |
| BNB18[a] | Alvarado/Bay Island | 0 (16) | 0 (0.0%) | 0 (1.2%) | 0 |
| BNB15[a] | 15th Street | 0 (12) | 0 (0.0%) | 0 (1.8%) | 0 |
| BNB14[a] | 19th Street | 0 (16) | 0 (0.0%) | 0 (2.4% ) | 0 |
| BNB12[a] | Rhine Channel | 0 (17) | 0 (0.0%) | 0 (0.6%) | 0 |
| BNB09[a] | 43rd Street | 0 (23) | 0 (2.6%) | 0 (3.7%) | 0 |
| BNB07[a] | Via Genoa | 0 (14) | 0 (0.0%) | 0 (0.6%) | 0 |
| BNB05[a] | Bayshore Beach | 0 (15) | 0 (0.0%) | 0 (1.8%) | 0 |
| BNB03[a] | Ruby Avenue | 0 (14) | 0 (0.0%) | 0 (2.5%) | 0 |
| BNB02[a] | Onyx Avenue | 0 (15) | 0 (0.0%) | 0 (1.2%) | 0 |
| BNB01[a] | Park Avenue | 0 (12) | 0 (0.0%) | 0 (0.0%) | 0 |

[a] Based on a comparison of both dry and wet weather data to the fecal coliform SSM, site partially meets the criteria for delisting a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria.

Table 6.6. Dry weather *Enterococcus* metric scores for OCHCA sites based on data collected weekly from 2004 to 2007 (note: metric results are in parenthesis and monitoring stations with a total *Enterococcus* metric score >0 are highlighted in blue).

| OCHCA Station ID | OCHCA Station Name | *Enterococcus* Metric Scores | | | Total *Enterococcus* Metric Score [a] (100 possible) |
|---|---|---|---|---|---|
| | | Geomean (30 possible) | Rolling Geomeans (40 possible) | Upper Percentile Value for Designated Bathing Beaches (30 possible) | |
| BNB35 | Newport Blvd Bridge | 15 (17) | 40 (26.6%) | 30 (26.6%) | 85 |
| BNB33[a] | Bayside Drive Beach | 0 (12) | 40 (15.6%) | 0 (6.1%) | 40 |
| BNB25 | Vaughns Launch | 0 (15) | 40 (42.9%) | 0 (8.3%) | 40 |
| BNB10[a] | 38th Street | 0 (9) | 40 (18.9%) | 0 (8.1%) | 40 |
| BNB11 | 33rd Street | 0 (15) | 20 (13.8%) | 15 (12.8%) | 35 |
| BNB17[a] | 10th Street | 0 (6) | 20 (11.0%) | 0 (6.5%) | 20 |
| BNB26 | Ski Zone | 0 (15) | 0 (0.0%) | 15 (14.0%) | 15 |
| BNB34[a] | Grand Canal | 0 (5) | 0 (0.0%) | 0 (0.6%) | 0 |
| BNB32[a] | Lido Yacht Club | 0 (6) | 0 (1.3%) | 0 (4.2%) | 0 |
| BNB31[a] | Garnet Avenue | 0 (5) | 0 (0.0%) | 0 (1.3%) | 0 |
| BNB30[a] | De Anza | 0 (4) | 0 (4.3%) | 0 (4.3%) | 0 |
| BNB29[a] | Promontory Point | 0 (3) | 0 (0.0%) | 0 (0.6%) | 0 |
| BNB28[a] | North Star Beach | 0 (7) | 0 (2.6%) | 0 (3.6%) | 0 |
| BNB24W[a] | Newport Dunes West | 0 (6) | 0 (2.6%) | 0 (4.2%) | 0 |
| BNB24N[a] | Newport Dunes North | 0 (11) | 0 (3.9%) | 0 (4.8%) | 0 |
| BNB24M[a] | Newport Dunes Middle | 0 (6) | 0 (0.0%) | 0 (3.0%) | 0 |
| BNB24E[a] | Newport Dunes East | 0 (8) | 0 (5.6%) | 0 (6.3%) | 0 |
| BNB23[a] | Rocky Point | 0 (4) | 0 (4.4%) | 0 (3.6%) | 0 |
| BNB22[a] | N Street Beach | 0 (3) | 0 (0.0%) | 0 (0.0%) | 0 |
| BNB21[a] | Abalone Avenue | 0 (4) | 0 (1.2%) | 0 (4.8%) | 0 |
| BNB20[a] | Sapphire Avenue | 0 (5) | 0 (1.4%) | 0 (2.5%) | 0 |
| BNB18[a] | Alvarado/Bay Island | 0 (7) | 0 (2.6%) | 0 (4.3%) | 0 |
| BNB15[a] | 15th Street | 0 (3) | 0 (0.0%) | 0 (1.2%) | 0 |
| BNB14[a] | 19th Street | 0 (5) | 0 (2.5%) | 0 (3.6%) | 0 |
| BNB12[a] | Rhine Channel | 0 (5) | 0 (2.6%) | 0 (4.2%) | 0 |
| BNB09[a] | 43rd Street | 0 (8) | 0 (6.6%) | 0 (6.7%) | 0 |
| BNB07[a] | Via Genoa | 0 (4) | 0 (2.9%) | 0 (1.3%) | 0 |
| BNB05[a] | Bayshore Beach | 0 (5) | 0 (0.0%) | 0 (3.6%) | 0 |
| BNB03[a] | Ruby Avenue | 0 (4) | 0 (0.0%) | 0 (1.2%) | 0 |
| BNB02[a] | Onyx Avenue | 0 (5) | 0 (0.0%) | 0 (3.6%) | 0 |
| BNB01[a] | Park Avenue | 0 (3) | 0 (0.0%) | 0 (0.6%) | 0 |

[a] Based on a comparison of both dry and wet weather data to the UPV for designated bathing beaches, site partially meets the criteria for delisting a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria.

Table 6.7. Dry weather *Enterococcus* metric scores for BTO sites sampled during the Newport Bay FIB Source Identification Project (note: possible metric scores are in parenthesis and monitoring stations with a total *Enterococcus* metric score >0 are highlighted in blue).

| Bay-to-Ocean (BTO) Transect Station ID | # Sampling Events | Long-Term Geomean (organisms/100mL) | *Geomean Metric Score (40 possible)* | % of samples > Designated Bathing Beach UPV | *Designated Bathing Beach UPV Metric Score (60 possible)* | Total *Enterococcus* Metric Score [a] (100 possible) |
|---|---|---|---|---|---|---|
| BTO 4 | 33 | 56 | *40* | 24% | *60* | 100 |
| BTO 5 | 33 | 23 | *20* | 22% | *60* | 80 |
| BTO 8 | 32 | 14 | *0* | 22% | *60* | 60 |
| BTO 6 | 32 | 7 | *0* | 9% | *0* | 0 |
| BTO 7 | 32 | 8 | *0* | 6% | *0* | 0 |
| BTO 9 [a] | 31 | 5 | *0* | 6% | *0* | 0 |
| BTO 10 [a] | 31 | 4 | *0* | 6% | *0* | 0 |
| BTO 11 [a] | 31 | 3 | *0* | 6% | *0* | 0 |

[a]Based on a comparison of both dry and wet weather data to the UPV for designated bathing beaches, site partially meets the criteria for delisting a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria.

## 6.3 Wet Weather Priority Areas

Metric scoring results for OCHCA fecal coliform and *Enterococcus* wet weather datasets are presented in Tables 6.8 and 6.9, respectively. Results for BTO sites sampled during the Source Identification Project are presented in Table 6.10.

Examination of the ranking approach results reveals the following salient points for wet weather:

- In contrast to dry weather, no OCHCA sites had a total metric score equal to zero, and nearly all sites had at least one metric that received a high score.
- Six OCHCA sites (i.e., Newport Blvd Bridge**,** North Star Beach and the four Newport Dunes Beach sites) received the highest possible fecal coliform metric score (i.e., 100 score).
- Twelve OCHCA sites (i.e., Newport Blvd Bridge, North Star Beach, four Newport Dunes Beach sites, De Anza Launch, Vaughns Launch, 10th St. Beach, 33rd St. Channel, Bayshore Beach and 38th St. Beach), and three BTO sites (BTO4, BTO5 and BTO8) had the highest possible *Enterococcus* metric scores (i.e., 100 score).

Based on the wet weather metric results summarized above, all Newport Bay sites (i.e., those sites with combined fecal coliform and *Enterococcus* metric scores >0) with the exception of BTO9, BTO10 and BTO11 are potential areas of interest and will be considered for wet weather source management in this SMP. Prioritization of the OCHCA and BTO sites is described in the next section.

Table 6.8. Wet weather fecal coliform metric scores for OCHCA sites based on data collected weekly from 2004 to 2007 (note: metric results are in parenthesis and monitoring stations with a total fecal coliform metric score >0 are highlighted in blue).

| OCHCA Station ID | OCHCA Station Name | Fecal Coliform Metric Scores | | Total Fecal Coliform Metric Score[a] (100 possible) |
|---|---|---|---|---|
| | | Long-Term Log Mean (40 possible) | Upper Percentile Value (60 possible) | |
| BNB28 [a] | North Star Beach | 40 (278) | 60 (47.1%) | 100 |
| BNB24W [a] | Newport Dunes West | 40 (388) | 60 (48.7%) | 100 |
| BNB24N [a] | Newport Dunes North | 40 (530) | 60 (44.7%) | 100 |
| BNB24M [a] | Newport Dunes Middle | 40 (344) | 60 (46.2%) | 100 |
| BNB24E [a] | Newport Dunes East | 40 (493) | 60 (39.0%) | 100 |
| BNB35 | Newport Blvd Bridge | 40 (269) | 60 (37.5%) | 100 |
| BNB25 [a] | Vaughns Launch | 20 (190) | 60 (34.8%) | 80 |
| BNB26 [a] | Ski Zone | 20 (144) | 60 (42.9%) | 80 |
| BNB32 [a] | Lido Yacht Club | 20 (106) | 60 (28.6%) | 80 |
| BNB30 [a] | De Anza | 20 (125) | 60 (30.8%) | 80 |
| BNB05 [a] | Bayshore Beach | 20 (100) | 60 (30.5%) | 80 |
| BNB09 [a] | 43rd Street | 20 (115) | 60 (26.8%) | 80 |
| BNB11 [a] | 33rd Street | 20 (134) | 60 (19.5%) | 80 |
| BNB17 [a] | 10th Street | 20 (102) | 60 (30.6%) | 80 |
| BNB07 [a] | Via Genoa | 0 (71) | 60 (21.4%) | 60 |
| BNB20 [a] | Sapphire Avenue | 0 (48) | 60 (19.0%) | 60 |
| BNB03 [a] | Ruby Avenue | 0 (53) | 60 (18.6%) | 60 |
| BNB12 [a] | Rhine Channel | 0 (64) | 60 (21.4%) | 60 |
| BNB01 [a] | Park Avenue | 0 (48) | 60 (21.4%) | 60 |
| BNB02 [a] | Onyx Avenue | 0 (67) | 60 (30.8%) | 60 |
| BNB34 [a] | Grand Canal | 0 (50) | 60 (17.1%) | 60 |
| BNB31 [a] | Garnet Avenue | 0 (74) | 60 (23.8%) | 60 |
| BNB33 [a] | Bayside Drive Beach | 0 (75) | 60 (22.0%) | 60 |
| BNB18 [a] | Alvarado/Bay Island | 0 (98) | 60 (29.3%) | 60 |
| BNB10 [a] | 38th Street | 0 (78) | 60 (16.3%) | 60 |
| BNB14 [a] | 19th Street | 0 (88) | 60 (27.5%) | 60 |
| BNB15 [a] | 15th Street | 0 (66) | 60 (29.3%) | 60 |
| BNB23 [a] | Rocky Point | 0 (37) | 30 (10.5%) | 30 |
| BNB29 [a] | Promontory Point | 0 (31) | 30 (14.3%) | 30 |
| BNB22 [a] | N Street Beach | 0 (34) | 30 (12.5%) | 30 |
| BNB21 [a] | Abalone Avenue | 0 (44) | 30 (15.0%) | 30 |

[a]Based on a comparison of both dry and wet weather data to the fecal coliform SSM, site partially meets the criteria for delisting a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria.

Table 6.9. Wet weather *Enterococcus* metric scores for OCHCA sites based on data collected weekly from 2004 to 2007 (note: metric results are in parenthesis and monitoring stations with a total *Enterococcus* metric score >0 are highlighted).

| OCHCA Station ID | OCHCA Station Name | *Enterococcus* Metric Scores | | Total *Enterococcus* Metric Score[a] (100 possible) |
|---|---|---|---|---|
| | | Long-Term Geomean (40 possible) | Upper Percentile Value for Designated Bathing Beaches (60 possible) | |
| BNB25 | Vaughns Launch | 40 (143) | 60 (50.0%) | 100 |
| BNB26 | Ski Zone | 40 (81) | 60 (42.9%) | 100 |
| BNB28[a] | North Star Beach | 40 (120) | 60 (44.7%) | 100 |
| BNB24W[a] | Newport Dunes West | 40 (102) | 60 (32.5%) | 100 |
| BNB24N[a] | Newport Dunes North | 40 (152) | 60 (46.3%) | 100 |
| BNB24M[a] | Newport Dunes Middle | 40 (118) | 60 (42.9%) | 100 |
| BNB24E[a] | Newport Dunes East | 40 (118) | 60 (41.9%) | 100 |
| BNB35 | Newport Blvd Bridge | 40 (128) | 60 (56.1%) | 100 |
| BNB30[a] | De Anza | 40 (50) | 60 (31.7%) | 100 |
| BNB33[a] | Bayside Drive Beach | 40 (43) | 60 (31.0%) | 100 |
| BNB05[a] | Bayshore Beach | 40 (39) | 60 (29.3%) | 100 |
| BNB18[a] | Alvarado/Bay Island | 40 (40) | 60 (26.2%) | 100 |
| BNB10 | 38th Street | 40 (41) | 60 (22.2%) | 100 |
| BNB11[a] | 33rd Street | 40 (82) | 60 (32.6%) | 100 |
| BNB17[a] | 10th Street | 40 (43) | 60 (25.0%) | 100 |
| BNB07[a] | Via Genoa | 20 (26) | 60 (25.6%) | 80 |
| BNB20[a] | Sapphire Avenue | 20 (22) | 60 (20.9%) | 80 |
| BNB03[a] | Ruby Avenue | 20 (21) | 60 (18.2%) | 80 |
| BNB12[a] | Rhine Channel | 20 (23) | 60 (25.6%) | 80 |
| BNB01[a] | Park Avenue | 20 (19) | 60 (20.9%) | 80 |
| BNB02[a] | Onyx Avenue | 20 (28) | 60 (25.6%) | 80 |
| BNB32[a] | Lido Yacht Club | 20 (22) | 60 (18.6%) | 80 |
| BNB34[a] | Grand Canal | 20 (24) | 60 (21.4%) | 80 |
| BNB31[a] | Garnet Avenue | 20 (40) | 60 (25.6%) | 80 |
| BNB21[a] | Abalone Avenue | 20 (20) | 60 (19.5%) | 80 |
| BNB09[a] | 43rd Street | 20 (44) | 60 (26.8%) | 80 |
| BNB14[a] | 19th Street | 20 (29) | 60 (28.6%) | 80 |
| BNB15[a] | 15th Street | 20 (26) | 60 (26.2%) | 80 |
| BNB29[a] | Promontory Point | 0 (12) | 60 (20.9%) | 60 |
| BNB22[a] | N Street Beach | 0 (14) | 60 (19.5%) | 60 |
| BNB23[a] | Rocky Point | 20 (20) | 30 (13.2%) | 50 |

[a] Based on a comparison of both dry and wet weather data to the UPV for designated bathing beaches, site partially meets the criteria for delisting a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria.

Table 6.10. Wet weather *Enterococcus* metric scores for BTO sites sampled during the Newport Bay FIB Source Identification Project (note: possible metric scores are in parenthesis and monitoring stations with a total fecal coliform metric score >0 are highlighted in blue).

| Bay-to-Ocean (BTO) Transect Station ID | # Sampling Events | Long-Term Geomean (organisms/100mL) | *Geomean Metric Score (40 possible)* | % of samples > Designated Bathing Beach UPV | *Designated Bathing Beach UPV Metric Score (60 possible)* | Total *Enterococcus* Metric Score[a] (100 possible) |
|---|---|---|---|---|---|---|
| BTO 4 | 10 | 756 | *40* | 70% | *60* | 100 |
| BTO 5 | 11 | 654 | *40* | 64% | *60* | 100 |
| BTO 6 | 12 | 102 | *40* | 42% | *60* | 100 |
| BTO 7 | 28 | 48 | *40* | 39% | *60* | 100 |
| BTO 8 | 13 | 18 | *20* | 25% | *60* | 80 |
| BTO 9[a] | 14 | 8 | *0* | 7% | *0* | 0 |
| BTO 10[a] | 14 | 6 | *0* | 7% | *0* | 0 |
| BTO 11[a] | 14 | 3 | *0* | 0% | *0* | 0 |

[a]Based on a comparison of both dry and wet weather data to the UPV for designated bathing beaches, site partially meets the criteria for delisting a water body segment from the Federal Clean Water Act section 303(d) list of impaired water bodies for bacteria.

## 6.4 Further Prioritization of Newport Bay Priority Areas

In the previous sections, areas/sites of interest in Newport Bay were identified for source management consideration. One dry weather list and one wet weather list of sites/areas of interest were developed. This section prioritizes those areas/sites based on two factors: 1) the level of recreational use at the site/area, and 2) the magnitude of WQO/criteria exceedance. The following paragraphs briefly describe the use of each factor in the prioritization process.

### 6.4.1 Prioritization Factors

***Level of Recreational Use***

From a public health perspective, the level of recreational use at a particular site is an important factor that should be considered when prioritizing source management actions in a water body as diverse as Newport Bay. For example, sites that have a relative high recreational use levels and high total metric scores should be considered a high priority for source management. Alternatively, those sites with low recreational use levels and relatively low metric scores should be held at a lower priority.

The recreational use level for each OCHCA and Newport Bay FIB Source Identification Project monitoring sites are presented in Table 6.11. A recreational use levels (extra high, high, medium or low) was calculated for each OCHCA site based on the *Recreational Use Assessment* conducted by EOA (Soller et al. 2006, EOA 2001), which qualitatively and quantitatively described the population that may be exposed to pathogenic microorganisms through full body contact recreation in Newport Bay. For the purposes of the SMP, all sites monitored during the Newport bay FIB Source Identification Project were assigned a low recreational use level due to the swimming prohibitions currently present in the Upper Bay and Lowe Bay channels.

Table 6.11. Recreational use levels at OCHCA monitoring sites identified by EOA (2001) and assigned to Newport Bay FIB Source Identification Project monitoring stations.

| Monitoring Program/Project | Relative Level of Recreational Use at OCHCA and Newport Bay FIB Source Identification Project Monitoring Stations (EOA 2001) | | | |
|---|---|---|---|---|
| | Extra High | High | Medium | Low |
| OCHCA Monitoring Stations | Newport Dunes Beach (Middle, East, West and North) | 19th Street Beach<br>Rocky Point Beach<br>North Star Beach<br>Lido Yacht Club<br>Bayshore Beach (during holidays) | Park Avenue<br>Onyx Avenue Beach<br>Ruby Avenue Beach<br>Via Genoa Beach<br>15th Street Beach<br>10th Street Beach<br>Bayshore Beach<br>Alvarado/Bay Island Beach<br>Abalone Avenue Beach<br>Garnet Avenue Beach<br>Bayside Drive Beach | 43rd Street Beach<br>38th Street Beach<br>33rd Street Channel<br>Rhine Channel<br>Sapphire Avenue Beach<br>N Street Beach<br>Promontory Point Channel<br>De Anza Pier<br>Grand Canal<br>Ski Zone<br>Vaughns Launch |
| Newport Bay Source Identification Project Stations (BTO) | None | None | None | BTO4 BTO8<br>BTO5 BTO9<br>BTO6 BTO10<br>BTO7 BTO11 |

Based on recreational use levels established by EOA (2001) and calculated total combined metric scores (i.e., *Enterococcus* and fecal coliform metric scores), the ranking system presented in Table 6.12 was developed. The ranking system output is a relative level of priority for each Newport Bay monitoring site (i.e., Priority 1, 2, 3 or 4).

Table 6.12. Ranking system used to prioritize Newport Bay sites based on total ranking score ranges and the observed relative annual level of recreational use.

| Combined Total Metric Score[a] | Recreational Use Level | | | |
|---|---|---|---|---|
| | Low | Medium | High | Extra high |
| 200 - 151 | *Priority 3* | *Priority 2* | *Priority 1* | *Priority 1* |
| 150 - 101 | *Priority 3* | *Priority 3* | *Priority 2* | *Priority 1* |
| 100 - 51 | *Priority 4* | *Priority 3* | *Priority 2* | *Priority 1* |
| 50 - 1 | *Priority 4* | *Priority 4* | *Priority 3* | *Priority 2* |
| 0 | Within Acceptable Water Quality Ranges | | | |

[a] For OCHCA sites, the combined total metric scores are the sum of fecal coliform and *Enterococcus* metric scores. For sites monitored via the Newport Bay FIB Source Identification Project, *Enterococcus* metric scores were doubled for comparison purposes (i.e., total possible combined metric score for al sites is 200).

### *Frequency of Very High FIB Concentrations*

To further prioritize sites for source management consideration, the frequency at which a site exhibited “very high” FIB concentrations during dry or wet weather was also calculated. For the purposes of this SMP, concentrations an order-of-magnitude or greater than the SSM for fecal coliform (i.e., 4000 organisms/100mL) or the *Enterococcus* UPV for designated bathing beaches (i.e., 1040 organisms/100mL) were defined as very high. The percentage of samples that meet the very high definition for fecal coliform or *Enterococcus* were calculated for all sites of interest. Priority site rankings were based on the combined percentages of very high fecal coliform and *Enterococcus* concentrations and are denoted numerically (i.e., 1.1, 1.2, 1.3, etc.) in Tables 6.13 (dry weather) and 6.14 (wet weather).

## 6.4.2 Prioritized Areas - Dry and Wet Weather

Using the prioritization factors described in section 6.4.1, each dry or wet weather site/area of interest in Newport Bay was assigned a relative priority ranking. Results for potential areas of interest during dry weather are presented in Table 6.13 and Figure 6.3. Results for potential areas of interest during wet weather are presented in Table 6.14 and Figure 6.4.

Table 6.13. Priority areas of interest in Newport Bay identified for FIB source management consideration during dry weather.

| Station ID | Station Name | Area of Interest | Combined Total Metric Score[a] (200 possible) | Recreational Use Level | % of Samples w/ Very High Fecal Coliform Concentrations[b] | % of Samples w/ Very High *Enterococcus* Concentrations[b] | Combined % of Samples w/ Very High FIB Concentrations[b] | Relative Level of Priority |
|---|---|---|---|---|---|---|---|---|
| No stations were prioritized as a level 1 (extra high) or level 2 (high) based on metric scores and recreational use levels | | | | | | | | 1 or 2 |
| BTO 4 | BTO 4 | Upper Newport Bay | 200[a] | Low | NA | 12.4% | 12.4% | 3.1 |
| BTO 5 | BTO 5 | Upper Newport Bay | 160[a] | Low | NA | 9.4% | 9.4% | 3.2 |
| BTO 8 | BTO 8 | Western Newport Bay | 120[a] | Low | NA | 3.1% | 3.1% | 3.3 |
| BNB11 | 33rd Street | Bay | 90 | Low | 5.8% | 1.3% | 7.1% | 4.1 |
| BNB35 | Newport Blvd Bridge | Western Newport | 100 | Low | 3.2% | 3.8% | 7.0% | 4.2 |
| BNB26 | Ski Zone | Upper Newport Bay | 15 | Low | 1.8% | 1.8% | 3.5% | 4.3 |
| BNB10 | 38th Street | Western Newport | 40 | Low | 1.2% | 1.2% | 2.3% | 4.4 |
| BNB25 | Vaughns Launch | Upper Newport Bay | 40 | Low | 1.0% | 1.0% | 2.1% | 4.5 |
| BNB17 | 10th Street | Southern Bay | 20 | Medium | 0.6% | 1.2% | 1.8% | 4.6 |
| BNB33 | Bayside Drive Beach | Southeastern Bay | 40 | Medium | 0.0% | 0.6% | 0.6% | 4.7 |

[a]Due to the lack of Fecal Coliform data available, only *Enterococcus* data were used to identify and prioritize BTO sites. *Enterococcus* Ranking Scores were therefore doubled to create a Combined Total Metric Score for BTO sites. It is important to note however that using only *Enterococcus* data to prioritize BTO sites provides an additional level of conservativeness and possibly overestimates the level of priority of a BTO site (see Section 4.0). It is therefore recommended that prior to management actions being implemented to address a specific BTO site, additional analysis should be conducted to better estimate the level of concern at the site.
[b]Samples w/ Very High FIB Concentrations are those with concentrations an order-of-magnitude or greater than the SSM for fecal coliform (i.e., 4000 organisms/100mL) or the *Enterococcus* UPV for designated bathing beaches (i.e., 1040 organisms/100mL).

| Station # | Station ID | Location |
|---|---|---|
| 7 | BNB10 | 38th Street Beach |
| 8 | BNB11 | 33rd Street Channel |
| 12 | BNB17 | 10th Street Beach |
| 23 | BNB25 | Vaugh's Launch |
| 24 | BNB26 | Ski Zone |
| 30 | BNB33 | Bayside Drive Beach |
| 32 | BNB35 | Newport Blvd. Bridge |
| 33 | BTO4 | Unit 1 Basin |
| 34 | BTO5 | Unit 2 Basin |
| 37 | BTO8 | Arches Drain/West Newport Bay |

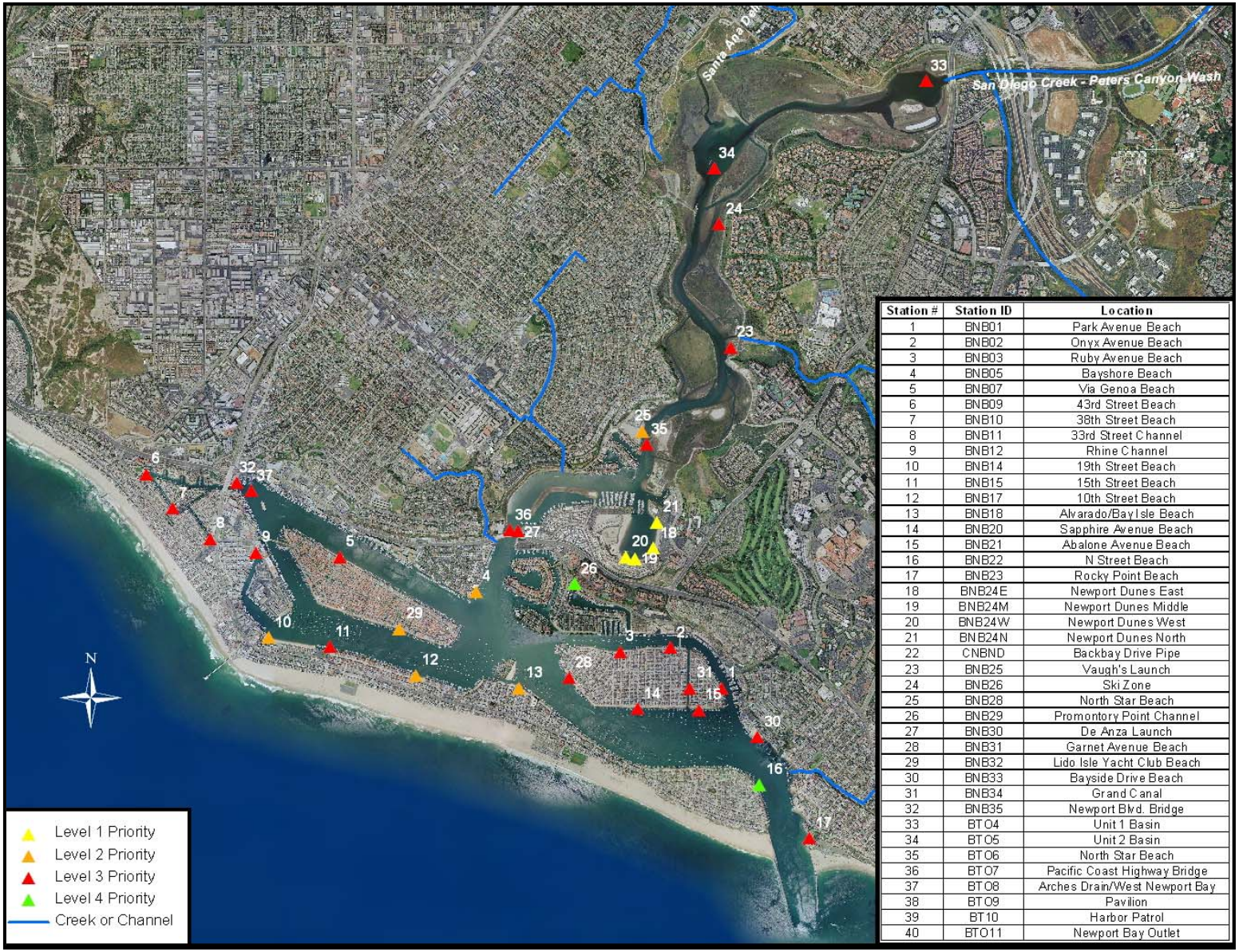
Figure 6.3. Newport Bay dry weather priority areas (No areas have been identified as level 1 or 2 priority).

Table 6.14. Priority areas of interest in Newport Bay identified for FIB source management consideration during wet weather.

| Station ID | Station Name | Combined Total Metric Score[a] (200 possible) | Recreational Use Level | % of Samples w/ Very High Fecal Coliform Concentrations[b] | % of Samples w/ Very High *Enterococcus* Concentrations[b] | Combined % of Samples w/ Very High FIB Concentrations[b] | Relative Level of Priority |
|---|---|---|---|---|---|---|---|
| BNB24N | Newport Dunes North | 200 | Extra High | 26.3% | 24.4% | 50.7% | 1.1 |
| BNB24E | Newport Dunes East | 200 | Extra High | 22.0% | 18.6% | 40.6% | 1.2 |
| BNB24W | Newport Dunes West | 200 | Extra High | 17.9% | 20.0% | 37.9% | 1.3 |
| BNB24M | Newport Dunes Middle | 200 | Extra High | 20.5% | 19.0% | 39.6% | 1.4 |
| BNB17 | 10th Street | 175 | Medium | 9.3% | 13.6% | 22.9% | 2.1 |
| BNB28 | North Star Beach | 200 | High | 8.8% | 21.1% | 29.9% | 2.2 |
| BNB32 | Lido Yacht Club | 158 | High | 14.3% | 14.0% | 28.2% | 2.3 |
| BNB05 | Bayshore Beach | 175 | Medium | 12.8% | 14.6% | 27.5% | 2.4 |
| BNB14 | 19th Street | 133 | High | 7.5% | 14.3% | 21.8% | 2.5 |
| BNB18 | Alvarado/Bay Island | 133 | Medium | 7.3% | 14.3% | 21.6% | 2.6 |
| BTO 4 | Upper Bay near SDC | 200 | Low | NA | 60.0% | 60.0% | 3.1 |
| BTO 5 | Upper Bay Channel near SAD | 200 | Low | NA | 63.6% | 63.6% | 3.2 |
| BNB35 | Newport Blvd Bridge | 200 | Low | 20.0% | 24.4% | 44.4% | 3.3 |
| BNB25 | Vaughns Launch | 175 | Low | 17.4% | 16.7% | 34.1% | 3.4 |
| BTO 6 | Upper Bay near North Star | 200 | Low | NA | 33.3% | 33.3% | 3.5 |
| BNB30 | De Anza Launch | 175 | Low | 15.4% | 17.1% | 32.5% | 3.6 |
| BNB11 | 33rd Street | 175 | Low | 12.2% | 16.3% | 28.5% | 3.7 |
| BTO 7 | Upper Bay near De Anza | 200 | Low | NA | 25.0% | 25.0% | 3.8 |
| BNB15 | 15th Street | 133 | Medium | 9.8% | 14.3% | 24.0% | 3.9 |
| BNB12 | Rhine Channel | 133 | Low | 9.5% | 14.0% | 23.5% | 3.10 |
| BNB09 | 43rd Street | 158 | Low | 14.6% | 7.3% | 22.0% | 3.11 |
| BNB26 | Ski Zone | 158 | Low | 14.3% | 7.1% | 21.4% | 3.12 |
| BNB07 | Via Genoa | 133 | Medium | 9.5% | 11.6% | 21.2% | 3.13 |
| BNB31 | Garnet Avenue | 133 | Medium | 7.1% | 14.0% | 21.1% | 3.14 |
| BNB02 | Onyx Avenue | 133 | Medium | 7.7% | 12.8% | 20.5% | 3.15 |
| BNB03 | Ruby Avenue | 133 | Medium | 7.0% | 11.4% | 18.3% | 3.16 |
| BNB10 | 38th Street | 150 | Low | 9.3% | 8.9% | 18.2% | 3.17 |
| BNB01 | Park Avenue | 133 | Medium | 7.1% | 9.3% | 16.4% | 3.18 |
| BNB20 | Sapphire Avenue | 117 | Low | 4.8% | 11.6% | 16.4% | 3.19 |
| BNB21 | Abalone Avenue | 92 | Medium | 5.0% | 9.8% | 14.8% | 3.20 |
| BNB33 | Bayside Drive Beach | 133 | Medium | 4.9% | 7.1% | 12.0% | 3.21 |
| BNB34 | Grand Canal | 117 | Low | 2.4% | 9.5% | 12.0% | 3.22 |
| BTO 8 | Lower Bay near WNB/Turning Basin | 134 | Low | NA | 0.0% | 0.0% | 3.23 |
| BNB23 | Rocky Point | 58 | High | 0.0% | 7.9% | 7.9% | 3.24 |
| BNB29 | Promontory Point | 92 | Low | 4.8% | 14.0% | 18.7% | 4.1 |
| BNB22 | N Street Beach | 75 | Low | 2.5% | 9.8% | 12.3% | 4.2 |

[a]Due to the lack of Fecal Coliform data available, only *Enterococcus* data were used to identify and prioritize BTO sites. *Enterococcus* Ranking Scores were therefore doubled to create a Combined Total Metric Score for BTO sites. It is important to note however that using only *Enterococcus* data to prioritize BTO sites provides an additional level of conservativeness and possibly overestimates the level of priority of a BTO site (see Section 4.0). It is therefore recommended that prior to management actions being implemented to address a specific BTO site, additional analysis should be conducted to better estimate the level of concern at the site.

[b]Samples w/ Very High FIB Concentrations are those with concentrations an order-of-magnitude or greater than the SSM for fecal coliform (i.e., 4000 organisms/100mL) or the *Enterococcus* UPV for designated bathing beaches (i.e., 1040 organisms/100mL).




| Station # | Station ID | Location |
|---|---|---|
| 1 | BNB01 | Park Avenue Beach |
| 2 | BNB02 | Onyx Avenue Beach |
| 3 | BNB03 | Ruby Avenue Beach |
| 4 | BNB05 | Bayshore Beach |
| 5 | BNB07 | Via Genoa Beach |
| 6 | BNB09 | 43rd Street Beach |
| 7 | BNB10 | 38th Street Beach |
| 8 | BNB11 | 33rd Street Channel |
| 9 | BNB12 | Rhine Channel |
| 10 | BNB14 | 19th Street Beach |
| 11 | BNB15 | 15th Street Beach |
| 12 | BNB17 | 10th Street Beach |
| 13 | BNB18 | Alvarado/Bay Isle Beach |
| 14 | BNB20 | Sapphire Avenue Beach |
| 15 | BNB21 | Abalone Avenue Beach |
| 16 | BNB22 | N Street Beach |
| 17 | BNB23 | Rocky Point Beach |
| 18 | BNB24E | Newport Dunes East |
| 19 | BNB24M | Newport Dunes Middle |
| 20 | BNB24W | Newport Dunes West |
| 21 | BNB24N | Newport Dunes North |
| 22 | CNBND | Backbay Drive Pipe |
| 23 | BNB25 | Vaugh's Launch |
| 24 | BNB26 | Ski Zone |
| 25 | BNB28 | North Star Beach |
| 26 | BNB29 | Promontory Point Channel |
| 27 | BNB30 | De Anza Launch |
| 28 | BNB31 | Garnet Avenue Beach |
| 29 | BNB32 | Lido Isle Yacht Club Beach |
| 30 | BNB33 | Bayside Drive Beach |
| 31 | BNB34 | Grand Canal |
| 32 | BNB35 | Newport Blvd. Bridge |
| 33 | BTO4 | Unit 1 Basin |
| 34 | BTO5 | Unit 2 Basin |
| 35 | BTO6 | North Star Beach |
| 36 | BTO7 | Pacific Coast Highway Bridge |
| 37 | BTO8 | Arches Drain/West Newport Bay |
| 38 | BTO9 | Pavilion |
| 39 | BT10 | Harbor Patrol |
| 40 | BTO11 | Newport Bay Outlet |

Figure 6.4. Newport Bay wet weather priority areas.

## 6.5 Summary

Water quality conditions in Newport Bay naturally vary geographically and temporally (see Section 4.0). Therefore, two geographically distributed and temporally robust datasets collected between 2004 and 2007 at 40 monitoring sites representing beaches and channels were utilized to identify and prioritize areas of interest in Newport Bay. Due to significant differences in sources, pathways and ranges of concentrations, dry and wet weather FIB datasets were handled separately.

For each site, three *Enterococcus* and three fecal coliform water quality assessment metrics were calculated for dry weather datasets. Two *Enterococcus* and two fecal coliform metrics were used for wet weather datasets. Metrics were scored and summed to identify which sites should be considered “priority areas” in Newport Bay where FIB source management should be considered. These priority areas were then prioritized on a scale of 1 to 4 (1 being the greatest concern) for dry and wet weather, based on metric scores, degree of recreational use, and the magnitude of water quality objective/criteria exceedances. This prioritization process yielded the following results:

- Substantial differences are apparent in the number of dry and wet weather sites meeting the priority area definition (i.e., >0 total metric score). Dry weather water quality assessment metric scores are far less than wet weather scores.
- During dry weather, no sites with extra high or high levels of recreational use had a total metric score that meets the priority area definition, and therefore no sites received a priority 1 or 2 ranking. Two sites ranked as priority 3, and eight ranked as priority 4.
- During wet weather, with the exception of BTO 9 and BTO 10, all sites met the priority area definition. Four sites ranked as priority 1, six sites ranked as priority 2, twenty-eight sites ranked as priority 3, and two sites ranked as priority 4 for source management consideration. Wet weather ranking was heavily dependent on the level of recreational use at sites.

Areas of interest identified in this section will form the basis for source identification and prioritization described in Section 7.0.

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# 7.0 CONTRIBUTIONS OF FIB SOURCES AND PATHWAYS TO PRIORITY AREAS IN NEWPORT BAY

## 7.1 Introduction

In Section 5.0, the estimated rates of FIB deposited onto the surface of the Newport Bay watershed from sources (e.g., pet waste, wildlife and fertilizers) and loadings of FIB from pathways (e.g., tributaries and storm drains) are described. Estimations of FIB contributions from both natural and anthropogenic sources are summarized. Section 6.0 describes the locations in the Bay (channels and shorelines) that are prioritized for source management consideration during dry and wet weather, based on the most robust FIB monitoring datasets available. Here, the relative contributions of FIB from sources and pathways specific to these prioritized locations are more fully examined. Specifically, the purpose of this section is to assist watershed managers in prioritizing FIB sources and pathways that appear to be impacting channel and shoreline locations in the Bay.

Over the past twenty years, a series hydrologic and water quality modeling exercises have been conducted to better understand the loading and movement of salinity, water, sediment and pollutants (including FIB) in the Bay (DeGeorge 2003, Everest International 2004, Grant 2009). In addition, numerous source identification and characterization studies specific to the Bay have also been conducted (RBF 2003, Grant et al. 2004, RBF 2004, Jeong et al. 2005, Jiang et al 2005, Pednekar 2007, Grant et al. 2009). The most pertinent major studies are listed in Table 7.1 and introduced in Sections 4.4 and 5.0. Lessons learned from these studies are further described throughout this section and used to identify sources and pathways impacting channel and shoreline locations prioritized in Section 6.0.

Table 7.1. A summary of major modeling and source identification studies conducted in Newport Bay pertinent to the geographical areas prioritized for source management.

| Project/Study Name | Summary Scope |
|---|---|
| Newport Bay Fecal Coliform Source Identification Study and Beach Boundary Model (Grant et al. 2009) | Conducted numerous FIB source identification studies and developed a beach boundary layer mathematical model (BBLM) for FIB in Newport Bay. |
| Assessing the Seasonal Impact of Storm Drains on Water Quality in Western Newport Bay (Pednekar et al. 2007) | Field studies conducted in summer and winter seasons to assess the role of storm drains in contributing FIB to Western Newport Bay. The possibility of biofilm also contributing to FIB in the Bay and to discharges from storm drains was also evaluated. |
| Swimmer Shedding Study in Newport Dunes, California (Jiang et al. 2005) | Assessed the potential impacts of swimmers on beach water quality at the Dunes recreational area. |
| City of Newport Bay Storm Drain Diversion Study (Everest International 2004) | Modeled the transport and dispersion of FIB loading from five storm drains. Model results were used to assess the relative impact of each drain on the 28 OCHCA monitoring stations in the Lower Bay. |
| The Contribution of Marinas to Fecal Indicator Bacteria impairment in Lower Newport Bay (Grant et al. 2004) | Investigated whether there were significant impacts at the Dunes and the Balboa Yacht Basin due to marinas/vessels. |
| Water Quality Model to Support the Newport Bay Fecal Coliform TMDL (DeGeorge et al. 2003) | Hydrodynamic model developed as part of the risk assessment conducted by EOA (2001). Model was used to evaluate alternative control strategies that may affect viral loading. |

As described in Section 6.0, and worth repeating here, there are two separate and distinct lists of locations in the Bay recommended for source management consideration. The first and highest priority list is based on water quality conditions during dry weather, which includes the timeframe when the largest numbers of recreators use the Bay (see Section 3.1.1). The dry weather priority list includes ten sites located in four geographical areas of the Bay (see Figure 6.3). The second and lower priority list of sites is associated with water quality during wet weather. For the purpose of this SMP, sites identified on the wet weather priority list are considered to be a lower priority than those on the dry weather priority list due to: 1) the significant decrease in recreational use that occurs during wet weather at Bay sites; and 2) the limited ability of traditional stormwater best management practices (source controls or treatment devices) to effectively reduce FIB in storm-driven flows.

Sources and pathways of FIB that appear to be impacting water quality at sites on either the dry or wet weather priority list are described in this section. It is important to note that although many studies have been conducted in the Bay to assist in source management, limited information is currently available for some pathways and sources. Therefore, best professional judgment was used to identify the estimated relative contribution of FIB from these sources and pathways. As additional pertinent information becomes available, it is recommended that this section of the SMP be updated accordingly.

## 7.2 Impacts of FIB Sources and Pathways at Different Geographic Scales

Prior to describing the lessons learned from pertinent source identification and modeling exercises, it is important to point out that FIB sources and pathways can impact water quality in the Bay at different geographical scales. As described by Grant et al. (2009), there are three distinct scales of interest:

1. Bay Scale: Bay-wide water quality impacts of FIB loading from tributaries.
2. Beach Scale: Local water quality impacts along shorelines caused by FIB loading from distributed sources along the shore (e.g. water birds droppings).
3. Drain Scale: Local water quality impacts along shorelines caused by FIB loading from individual storm drains.

Depending on the location of interest in the Bay, water quality along the shorelines and within channels can be affected by both Bay-scale (e.g., the impact of storm flow from the San Diego Creek on water quality over the entire Bay), and highly localized and transient beach-scale or drain-scale sources and pathways of FIB. Therefore, as each FIB source and pathway to a particular location in the Bay is discussed in this section, the applicable scale of interest will also be described.

## 7.3 Summaries of Lessons Learned from Previous Modeling and Source Identification Efforts

### 7.3.1 Bay-Scale Water Quality Impacts of Tributary Flows

Tributary flows during dry and wet weather may be an important dispersion mechanism (i.e., pathway) of FIB into the Newport Bay channel and shorelines of interest. Based on studies conducted as part of the Source Identification Project (Grant et al. 2009) and previous modeling of Newport Bay (DeGeorge et al. 2003), one of the main factors controlling FIB concentrations within the Bay channel during wet weather is discharge from tributaries. For

example, freshwater transit times modeled by Grant et al. (2009) suggest that FIB from the largest tributary (San Diego Creek) spend, four days on average in the Upper Bay during wet weather and another two days in Lower Bay before exiting to the ocean. Additionally, during wet weather the mass budget model developed by Grant et al. (2009) predicts that *Enterococcus* loading from San Diego Creek may affect water quality over a relatively large region of Newport Bay (Figure 7.1). However, the rate of FIB loading during wet weather appears to be an important factor in estimating the region of impact (ROI). For example, when the estimated 90$^{th}$ percentile *Enterococcus* loading rate from San Diego Creek is used as input to the model, the ROI extends from the outlet of San Diego Creek far into the Lower Bay. However, when using the 50$^{th}$ percentile or lower wet weather loading rates, the model predicts that no portion of the Upper or Lower Bay exceeds water quality criteria for *Enterococcus*. A similar pattern is evident for wet weather FIB loading from the Santa Ana Delhi channel (Figure 7.1).

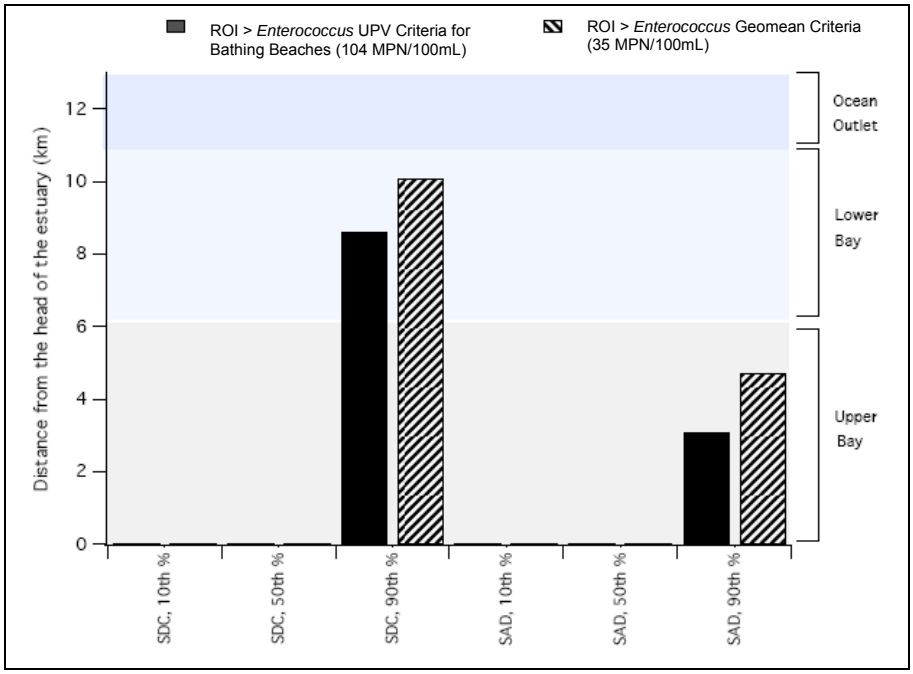


Figure 7.1. Model predicted regions of impact (ROI) under three different wet weather *Enterococcus* loading rates (10$^{th}$, 50$^{th}$, and 90$^{th}$ percentiles) from San Diego Creek (SDC) or Santa Ana Delhi (SAD) (Grant et al. 2009).

Compared to wet weather, the residence time of FIB in the Bay is expected to increase substantially during dry weather due to the lack of dispersion potential caused by reduced tributary flows. This is illustrated in modeling conducted by Grant et al. (2009), which predicts that during dry weather, the ROI associated with San Diego Creek *Enterococcus* loading is confined to the Upper Bay. The ROI model predicts dry weather *Enterococcus* loading from the Santa Ana Delhi channel, however, causes water quality impacts throughout the Bay. This prediction is inconsistent with empirical data collected the Bay-to-Ocean (BTO) transect site directly downstream of the Santa Ana Delhi channel confluence with the Bay (i.e., BTO5), which suggests that the ROI model over-predicts the impacts of dry weather loading from the Santa Ana Delhi channel.

Although not fully tested, one hypothesis is that measured FIB concentrations at BTO5 are lower than modeled values due to natural treatment (i.e., dilution, die-off, and filtration) that

occurs as dry weather discharge from Santa Ana Delhi flows through extensive intertidal mudflats before entering the Bay[33]. This process would result in lower proportional concentrations and loads of FIB from Santa Ana Delhi channel to the Upper Bay during dry weather, compared to those presented in Section 5.2.3.

In summary, based on modeling and field measurements conducted by Grant et al. (2009) during the Source Identification Project, water quality impacts (as measured by *Enterococcus* concentrations) associated with dry weather discharges from San Diego Creek and Santa Ana Delhi channel appear to be confined to the Upper Bay. During wet weather, only FIB loadings from San Diego Creek during large discharge events (i.e., large storms) appear to have Bay-scale (including the main channels in the Lower Bay) water quality impacts. Additionally, wet weather FIB loadings from Santa Ana Delhi channel during large discharge events are predicted to only impact the Upper Bay and possibly the uppermost portion of the Lower Bay. Loadings from either tributary during small discharge events do not appear to impact water quality in the Upper or Lower Bay. Due to only partial agreement between ROI model predictions and empirical data, the exact ROI associated with discharges from San Diego Creek and Santa Ana Delhi Channel during dry and wet weather are currently unknown. Loading of FIB from these major tributaries to the Bay is an important issue that deserves further investigation.

### 7.3.2 Bay-Scale and Beach-Scale Impacts from Large and Small Storm Drains

In addition to potential Bay-scale impacts from tributaries, wet and dry weather (i.e., non-stormwater) discharges from urban runoff conveyance systems can also affect Bay water quality (Everest International 2004, Pednekar et al. 2007, Grant et al 2009). As described in Section 5.0, there are five large stormwater outfalls or “drains” (i.e., Arches, El Paseo, Dover, Carnation and Polaris) and roughly 200 smaller drains, most of which discharge to the Lower Bay at varying rates during dry and wet weather. Modeling conducted by Everest International (2004) supports the notion that dry weather discharges of FIB from the five largest drains can impact water quality at both the Bay and beach scales.

Cumulative wet weather discharges and FIB loading rates from the five largest drains in Newport Bay are included in Section 5.0. Based on these analyses, wet weather FIB loading rates from all five largest drains combined are estimated to be similar (within an order of magnitude) to the cumulative loading rates from all small drains, and from San Diego Creek. Water quality modeling to assess impacts of these five large drains during wet weather, however, has not been completed. That said, based on our understanding of: 1) Bay hydrology; 2) the lack of tidal effects on water quality at OCHCA sites during wet weather (see below); 3) the ability of runoff-derived FIB to remain viable when mixed with high salinity water (Grant et al. 2009); and 4) the modeled near and far-field impacts of large drains during dry weather (Everest International 2004), it is hypothesized that wet weather discharges from the five large drains may impact water quality at both the Bay and beach scales.

As for the numerous small drains in Newport Bay, data presented in Section 5.0 suggests that small drains can impact water quality at the beach and/or drain scales. While the FIB loading rate from single drains is small in comparison to, for example, San Diego Creek, their large number and periodic spacing along the shore implies that these drains could, collectively, impact water quality at shoreline sites in Newport Bay. Grant et al. (2009)

[33] Further studies are currently being proposed to better understand the impacts of Santa Ana Delhi Channel on Bay water quality.

demonstrated that due to relatively small discharge rates, impacts from these drains during dry weather are likely localized, confined to the margins of the Bay, and heavily affected by tides. Specifically, researchers collected over 320 water samples from 86 locations during dry weather conditions in 2006 to better understand the localization of water quality impacts from small drains, and the effects of tides on water quality along shorelines in the Lower Bay. At each site, samples were collected at or near small drains and roughly 100 feet away from the shoreline during both flood and ebb tides (see discussion of tidal effects below). Results indicate that samples collected during dry weather at the small drains had higher concentrations of *Enterococcus* than to those collected 100 feet from the shoreline.

Although some evaluation of water quality impacts associated with wet weather discharges from small drains were conducted by Pednekar et al. (2007), impacts and sources have not been fully examined and are therefore remain largely unknown. Impacts of FIB loading from each small storm drain is likely dependent on a number of factors such as: 1) the time frame over which FIB from the drains mix into near-shore waters; 2) buoyancy associated with runoff as it mixes with brackish water from the Bay; 3) the degree of mixing by turbulent diffusion; and 4) the fate of FIB as it enters the die-off, predation, and growth (Grant et al. 2009).

### 7.3.3 Tidal Effects of Discharges from Storm Drains at Beach and Drain Scales

Based on the results of the data collection efforts by Grant et al. (2009) described above, tides appear to have a dramatic effect on the concentrations of *Enterococcus* both at, and approximately 100ft away from small drains during dry weather. Specifically, during this study *Enterococcus* concentrations were significantly higher at both near-drain sites and sites 100 feet away from the shoreline, compared to sites further away. To explain the effects of tides on water quality near storm drains, it was hypothesized by Grant et al. (2009) that during dry weather, the up-slope side of a drain receives relatively small and intermittent flows of runoff (Figure 7.2), while the down-slope side of the drain experiences relatively large periodic flows of Bay water into the drain during flood tides, and out of the drain during ebb tides. Therefore, water quality along the shoreline worsens during low (ebb) tides and improves during flood tides because during low tide, the flow from a drain mixes into a shallower water column on the Bay margin and undergoes minimal dilution.

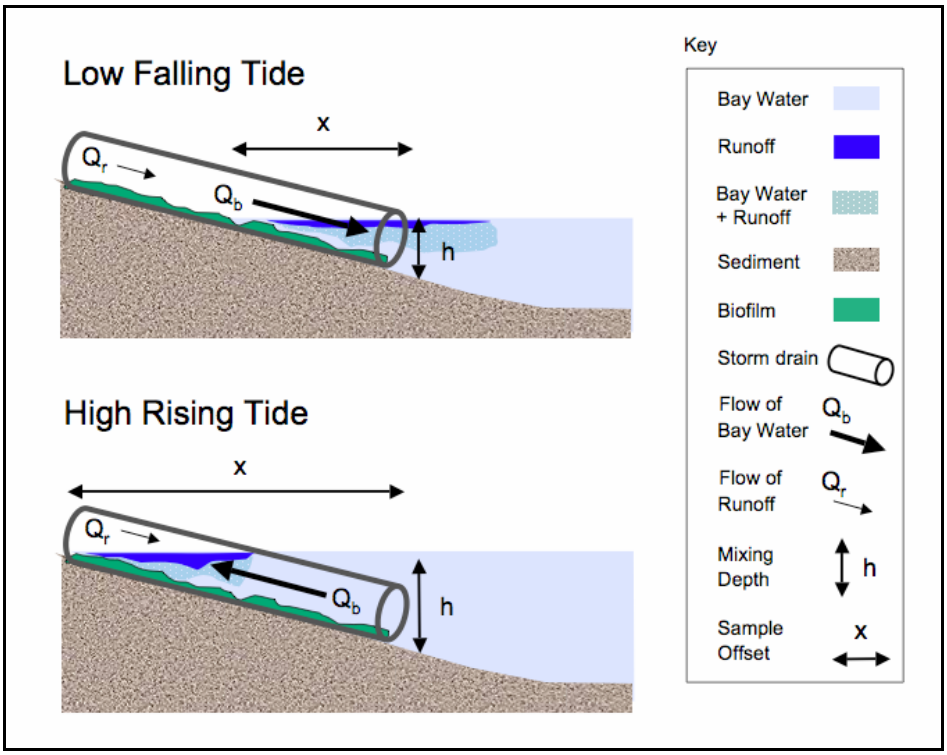


Figure 7.2. Conceptual model of how runoff in storm drains might impact water quality along the shoreline in the Lower Newport Bay during high and low tides (Grant et al. 2009).

To further test the hypothesis described above, Grant et al. (2009) compiled: 1) OCHCA water quality monitoring data (March 2001 to February 2005), 2) the date and time samples were collected, and 3) the tidal cycle at the time of sampling. This information was then evaluated for correlations between tides and FIB concentrations. Results indicate that during dry weather, significant ($p<0.05$) correlations exist between FIB concentrations and tides at many OCHCA sites. Specifically, these findings suggest that at low tide, discharges from drains may have the most detectable impacts at the drain and/or beach scales. In contrast to the correlations between dry weather runoff and tidal cycles, correlations between tides and FIB concentrations during wet weather were generally not significant, suggesting that OCHCA sites are less affected by tides during wet weather conditions (Grant et al. 2009).

### 7.3.4 Beach-Scale Impacts from Direct Inputs to the Bay

Waste from water birds inhabiting the Bay, inadequate vessel waste handling and storage, leaking sewer lines, sanitary sewer overflows, swimmer shedding, and tidal washing or resuspension of Bay sediments are sources of FIB that could be directly released into the Bay. Depending on site specific characteristics, hydrology, FIB concentrations, and a variety of other factors, each source has the potential to impact water quality in the Bay. Based on the results of recent field studies and modeling conducted in the Bay, the following preliminary conclusions have been established regarding the likelihood of direct inputs of FIB to cause or contribute to exceedances of water quality criteria/objectives at the beach/shoreline-scale:

- Based on vessel waste and swimmer shedding source identification studies conducted by Grant et al. (2004) and Jiang et al. (2005), respectively, these sources are predicted to have a negligible impact on Bay water quality.

- Based on shallow groundwater testing by conducted by Grant et al. (2009) at a limited number of sites (five) in the Lower Bay, older sewer lines in specific areas around the Bay could be sources of FIB, although the extent and magnitude of contributions to exceedances of water quality criteria/objectives is currently unknown.
- Based on analyses and modeling conducted by Grant et al. (2009), the presence of even a modest number of water birds at shoreline sites, such as in the Upper Bay, can cause exceedances of water quality criteria at beach/shoreline sites.
- Grant et al. (2009) concluded that FIB concentrations in sediments collected from the sub-tidal and intertidal areas of Newport Bay are well within the range to cause exceedances of water quality criteria at shoreline/beach sites in Newport Bay.

## 7.4 Prioritization of Dry Weather Sources and Pathways

Sources and pathways of FIB that may be contributing to current water quality conditions at priority areas in Newport Bay during dry weather are described in this section. Due to the limited information distinguishing specific sources of FIB contributing to sites prioritized in Section 6.0, sites are grouped by geographical area (e.g., Western Newport Bay). If site specific source information becomes available in the future, it is recommended that this section of the SMP be updated and adapted accordingly.

### 7.4.1 Western Newport Bay (38th St., 33rd St., Newport Blvd. Bridge & BTO8)

Western Newport Bay[34] (WNB) is the area located in the northwestern portion of the City of Newport Beach that includes the Newport Island Channels (Figure 7.3). The channels are home to a large number recreational boats (nearly all homes bordering the channel have boat slips) and provide a navigation route to the central portion of the Lower Bay. Due to their relatively small width (~30 to 60 ft) and configuration, these channels have poor tidal circulation and mixing, compared to the rest of the Lower Bay. The watershed area draining to WNB is almost entirely urbanized, comprised predominately of single family residential homes on and near Newport Island, with commercial and industrial land uses in the upper drainage area (i.e., North of the Pacific Coast Highway/101).

One small neighborhood beach site (38$^{th}$ St. Beach) and four channel sites (33rd St. Channel, Newport Blvd. Bridge and BTO8) were identified as locations recommended for source management consideration. As described in Section 5.0, three types of pathways can contribute FIB to the Bay: 1) tributaries (i.e., creeks); 2) storm drains; and 3) direct deposits into the Bay (e.g., water birds droppings). No tributaries drain into or near WNB, and modeling suggests that the three tributaries that discharge to the Upper Bay, are not significant pathways of FIB to WNB.[35] Rather, the WNB area is served entirely by stormwater drainage systems that convey urban runoff to roughly twenty storm drains that varying in size. Dry weather discharges to the Newport Island Channels from these drains is estimated to be roughly 35,000 gpd (Grant et al. 2009). One of the drains in WNB, a large V-ditch (i.e., Arches Drain) has been of particular interest in previous studies due to the relatively large volume of water discharged during dry weather conditions (i.e., ~30,000 gpd), and the relatively high concentrations of *Enterococcus* at its discharge point (i.e.,

[34] For the purposes this SMP, WNB includes four OCHCA monitoring sites (i.e., 38$^{th}$ St. Beach, 43$^{rd}$ St. Channel, 33$^{rd}$ St. Channel and Newport Blvd. Bridge) and one site (i.e., BTO8) monitored during the Source Identification Project.

[35] This statement is based on the results of all modeling studies/exercises reviewed as part of the SMP development. Comments on the Draft SMP were received from reviewers that indicated Santa Ana Delhi and San Diego Creek are sources of FIB to WNB during dry weather, based on modeling currently underway. If the results of new modeling are confirmed and indicate that tributaries are significant pathways, managers may chose to revisit the conclusions presented in this section of the SMP.

Newport Blvd Bridge) that have caused OCHCA to issue a long-term warning of impacted water quality at this site.

A variety of land-based sources may contribute FIB to the stormwater drainage system in WNB. The density of homes near the channels and previous observations that dry weather discharges to Newport Bay typically occur during morning hours when irrigation systems are activated (Everest International 2004), suggest that FIB sources associated with residential land uses may be important. Residential sources of FIB include pet waste, and the combination of over-irrigation of lawns and fertilizer usage. Other sources of FIB to the stormwater drainage system in WNB may possibly include wildlife in the watershed (e.g., skunks and raccoons), and illicit connections and illegal discharges to the stormwater conveyance system attributable to commercial land use areas.

With regard to sources providing FIB directly to the Bay, Pednekar et al. (2007) demonstrated that biofilms lining the inside of stormwater drainage systems may be a source of FIB to the overlying water column under dry weather conditions. Additionally, although Grant et al. (2004) demonstrated that vessel waste is not likely a contributor of FIB to the Lower Bay, the density of vessels consistently housed in the Newport Island channels creates a greater risk of sewage spills and leaks. Other possible sources including leaking sewer lines, pumpout stations, sanitary sewer overflows and bay wildlife are assumed to be minimal due to existing management actions currently implemented in this area (see Sections 5.0 and 8.0).

Based on the information summarized above, the estimated relative impacts of each possible FIB source and pathway on water quality in WNB during dry weather are presented in Table 7.2.

Figure 7.3. Monitoring sites in the West Newport Bay (WNB) area sampled by OCHCA or during the Source Identification Project (red dots), and small (small blue dots) and large (large green dot) storm drains in the vicinity.

Table 7.2. Relative importance of FIB sources and pathways to geographical areas in Newport Bay that are prioritized for source management consideration during dry weather.

| Geographical Area of Interest | Monitoring Station Name | Relative Level of Priority[a] (See Table 6.13) | FIB Transport Pathways | | | FIB Sources to the Watershed | | | | FIB Sources Directly to the Bay | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stormwater Conveyance Systems (Drains) | Tributaries (Creeks) | Direct Inputs to Bay | Pet Waste | Watershed Wildlife | Biosolid & Fertilizer Application | Illicit Connections and Illegal Discharges | Leaking Sewer Lines | Biofilm or Vegetation (Non-Fecal) | Bay Sediment/Sand | Sanitary Sewer Overflows | Wastewater Discharges | Swimmer Shedding | Boat Waste & Pump Out Facility Management | Bay Wildlife (Water birds) | Failing Septic Systems |
| Western Newport Bay | Newport Blvd Bridge | 4.2 | ● | | ● | ● | ● | ● | ● | • | ● | | • | NA | | • | • | NA |
| | 38th Street | 4.4 | | | | | | | | | | | | | | | | |
| | 33rd Street | 4.1 | | | | | | | | | | | | | | | | |
| | BTO8 | 3.3 | | | | | | | | | | | | | | | | |
| Harbor Entrance Channel | Bayside Drive Beach | 4.7 | ● | | • | ● | ● | ● | • | • | ● | | • | NA | | • | • | NA |
| West Lido Channel | 10th Street | 4.6 | ● | | • | ● | ● | ● | ● | ● | | | | NA | | ● | ● | |
| Upper Newport Bay | Vaughns Launch | 4.5 | • | ● | ● | ● | ● | ● | ● | | ● | ● | | | | NA | ● | • |
| | Ski Zone | 4.3 | | | | | | | | | | | | | | | | |
| | BTO4 | 3.1 | | | | | | | | | | | | | | | | |
| | BTO5 | 3.2 | | | | | | | | | | | | | | | | |

[a] Very High Priority = 1; High Priority = 2; Medium Priority = 3; Low Priority = 4.

### 7.4.2 Bayside Drive Beach

Bayside Drive Beach is a public beach maintained by the County of Orange and located on the southeastern waterfront area of Lower Newport Bay in the City of Newport Beach. The beach is only moderately used by swimmers, as recreators generally go to nearby beaches in Corona del Mar because of their unique geography, rocks to climb and vistas that Bayside Drive Beach lacks (*personal communication with Jack Skinner*). Based on its proximity to the Bay's outlet to the Pacific Ocean the water column at Bayside Beach is tidally influenced.

No tributaries drain into or near the vicinity of Bayside Drive Beach, and as described earlier in this section, tributaries discharging to the Upper Bay do not appear to impact water quality at Lower Bay sites during dry weather. Possible pathways of FIB in close proximity to Bayside Drive Beach include storm drains and direct inputs. The closest large storm drains to Bayside Drive Beach are the El Paseo and Carnation drains (Figure 7.4). Although modeling suggests that the Carnation storm drain has the least impact to Lower Newport Bay compared to the other five largest drains in the Bay (see Section 5.0), this large drain appears to affect water quality at Bayside Drive Beach during dry weather. Additionally, modeling indicates that the El Paseo storm drain also has a similar level of impact on this site. Figure 7.4 illustrates the location of these two large drains and other smaller drains in comparison to Bayside Drive Beach and other sites monitored either by OCHCA or during the Source Identification Project.

Figure 7.4. Monitoring sites in the Bayside Beach area sampled by OCHCA or during the Source Identification Project (red dots) and small (small blue dots) and large (large green dots) storm drains in the vicinity.

The drainage areas served by the Carnation and El Paseo drains are mostly comprised of residential and commercial land uses. Therefore, similar to WNB, a variety of land-based sources associated with these land uses may contribute FIB to these drains. The density of single family homes in these drainage areas and previous observations that dry weather discharges to Newport Bay typically occur during morning hours when irrigation systems are activated, suggest that FIB sources associated with residential land uses may be important. Residential sources of FIB include pet waste, over-irrigation of lawns and the use of fertilizers. Other land-based sources of FIB in these drainage areas may include wildlife (e.g., skunks and raccoons) in the watershed.

Aside from land-based sources of FIB, there are other possible sources that may impact water quality at Bayside Drive Beach. As previously described, biofilms lining the inside of stormwater drainage systems may be a source of FIB to the overlying water column under dry weather conditions. Additionally, leaking sewer lines in areas draining to the two major storm drains could be a source of FIB to the drains, although little is currently known. Based on the very limited number of sanitary sewer overflows (SSOs) that have been reported in the land area draining to Bayside Drive Beach, the lack of septic systems in the area, and the relatively minimal number of vessels present directly adjacent to the beach, these potential sources of FIB are not assumed to be significant. Furthermore, little is known about the contribution of FIB from beach sand/sediment and wildlife at this site.

Based on the information summarized above, the estimated relative impacts of each possible FIB source and pathway on water quality at Bayside Drive Beach during dry weather are presented in Table 7.2.

### 7.4.3 10th Street Beach

The public beach located on West Bay Avenue between 9$^{th}$ and 10$^{th}$ streets on the Balboa Peninsula in the City of Newport Beach (i.e., 10$^{th}$ St. Beach) is moderately used by recreators (EOA 2001). Based on its location, the water column at the 10$^{th}$ St. Beach is tidally influenced and water quality is likely impacted by both sources and pathways of FIB at the beach and drain scales during dry weather (Everest International 2004, Grant et al. 2009). Based on modeling results presented earlier in this section, tributaries are not likely contributors of water quality impacts to the 10$^{th}$ St. Beach during dry weather. Small storm drains and direct inputs nearby the beach, and large storm drains located in other parts of the Bay however, are FIB pathways that may impact dry weather water quality. For example, modeling conducted by Everest International (2004) suggests that the Polaris and Dover Drains located in the Upper Bay could impact water quality at 10$^{th}$ St. Beach during dry weather (Everest International 2004). Additionally, numerous small drains are present in the vicinity of the beach and could receive FIB from sources associated residential land uses (e.g., pet waste and fertilizers) via dry weather runoff (Figure 7.5).

Figure 7.5. Monitoring sites in the 10th Street Beach area sampled by OCHCA or during the Source Identification Project (red dots) and small (small blue dots) storm drains in the vicinity (note: Polaris and Dover Drains are located in the Upper Bay).

Other sources that may be contributing FIB directly to the Bay at or near the 10th St. Beach area include leaking sewer lines, biofilm (see discussion of other sites) and water birds. Water birds are periodically present along the Balboa Peninsula shoreline, and therefore may be important sources of FIB. Specific to leaking sewer lines, preliminary studies conducted by Grant et al. (2009) indicate that groundwater sampled near the 10th St. Beach (i.e., 9th Street) had relatively elevated *Enterococcus* concentrations (292 MPN/100mL). The sampling location was near a sewer main constructed (circa 1931) of vitrified clay pipe (VCP). Similar types of pipe are also present in other areas of the Balboa Peninsula. Little is known about the contribution of FIB directly to the 10th St. Beach area from other sources, including beach sand/sediment and wildlife.

Based on the information summarized above, the estimated relative impacts of each possible FIB source and pathway on water quality at 10th St. Beach during dry weather are presented in Table 7.2.

### 7.4.4 Upper Bay (Vaughns Launch, Ski Zone, BTO 5 & BTO 4)

Four monitoring sites in the Upper Newport Bay (i.e., Vaughns Launch, Ski Zone, BTO4 and BTO5) were prioritized for management action consideration. Because the Upper Bay is an Ecological Reserve and swimming is prohibited, these sites received a low priority ranking (see Section 6.0). That said, watershed managers may choose to implement management actions to reduce sources of FIB to the Upper Bay and therefore pertinent sources and pathways are identified in this section.

Due to the proximity of the San Diego Creek and Santa Ana Delhi channel to the four Upper Bay sites, it is natural to assume that these are important FIB pathways during dry weather.

However, data collected by Grant et al. (2009) during dry weather in the Upper Bay only partially supports this assumption. Measured concentrations of *Enterococcus* in the main tidal channel suggest that not all FIB measured in the Santa Ana Delhi channel are released to the Upper Bay during dry weather periods. As described earlier in this section, this is likely due to natural treatment that occurs as the dry weather runoff from this tributary is retained within in-channel basins before reaching the Upper Bay. While this tributary does not appear to contribute its entire FIB load to the Upper or Lower Bay during dry weather, consistently elevated concentrations of *Enterococcus* have been observed at the OCHCA monitoring site (see Section 5.0) and therefore, watershed managers may choose to implement source identification and/or management actions specific to the Santa Ana Delhi watershed.

With regard to other tributaries, modeling conducted by Grant et al. (2009) indicates that inputs from San Diego Creek during dry weather only partially explain the *Enterococcus* concentrations measured in the Upper Newport Bay channel (i.e., BTO4 and BTO5). Furthermore, modeling also suggests that OCHCA monitoring sites located down-bay from BTO4 and BTO5 (i.e., Vaughns Launch and Ski Zone) are likely not impacted by FIB discharged from San Diego Creek during dry weather. Modeling conducted by Grant et al. (2009) did not consider impacts from Big Canyon Wash. Field observations and monitoring conducted by OCHCA suggest that FIB loading from this tributary during dry weather is minimal and therefore for the purposes of this SMP, is not considered an important FIB pathway to Upper Newport Bay.

Other FIB pathways that may impact water quality at beach sites in the Upper Bay include direct inputs and storm drains. With regard to direct inputs, Grant et al. (2009) suggest that water birds droppings and tidal washing of Bay sediments are likely to cause exceedances of water quality objectives/criteria in the Upper Bay. Specifically, loading rates of FIB from water birds alone are sufficient enough to impact water quality. Sediment concentrations of FIB in the Upper Bay are also well within the range needed to exceed water quality criteria.

Lastly, activities associated with residential (e.g., landscape fertilizers) and equestrian-related (e.g., horse stables and trails) land uses are also considered to be potential sources to the Upper Bay. The land area directly surrounding the Upper Bay is comprised of mostly residential land uses and drains to numerous small drains (~50) that discharge to the Upper Bay shoreline. The location of each small drain is illustrated in Figure 7.6.

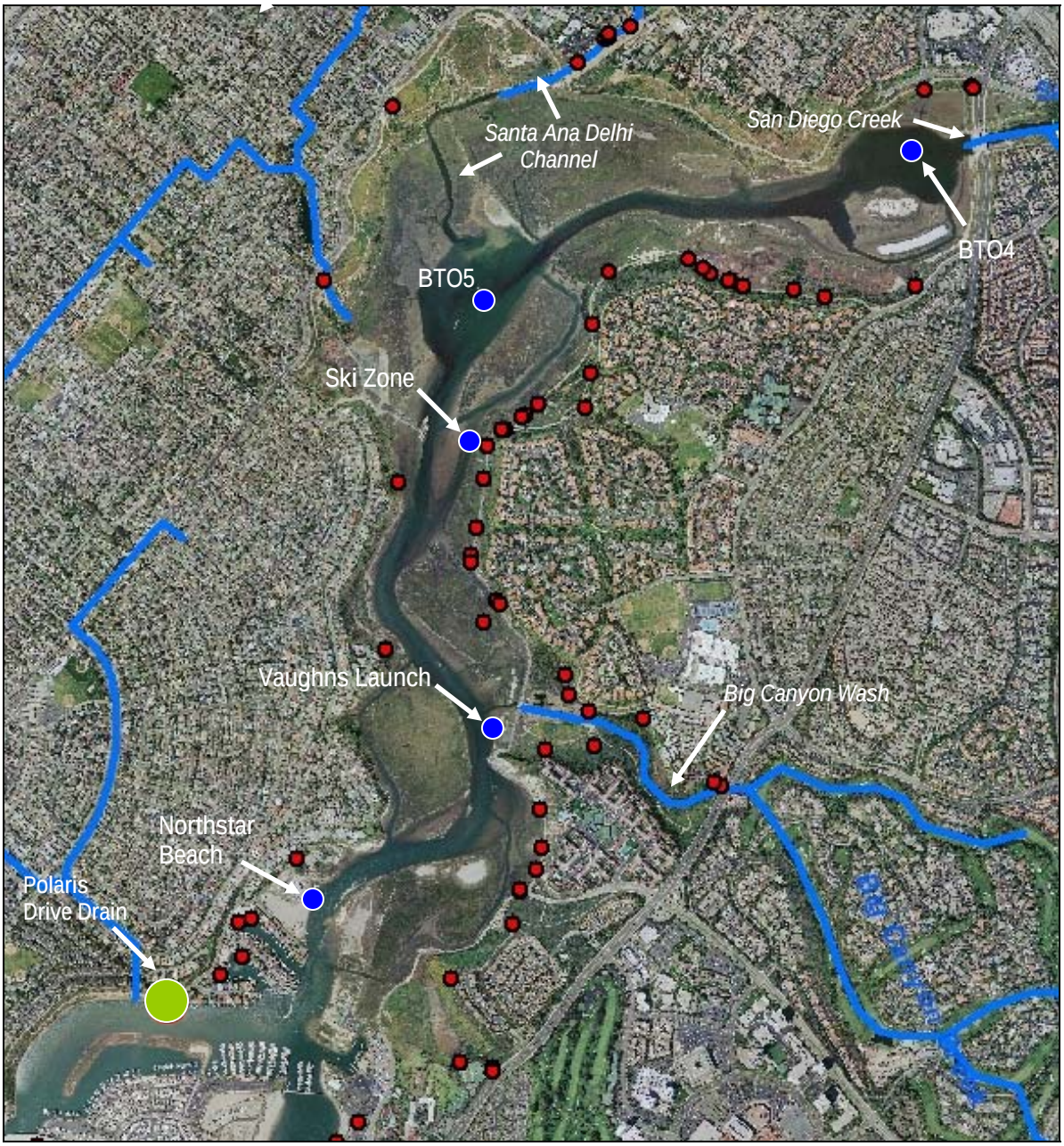


Figure 7.6. Monitoring sites in the Upper Bay sampled by OCHCA or during the Source Identification Project (blue dots) and small (red dots) and large (green dot) storm drains in the vicinity.

## 7.5 Prioritization of Wet Weather Sources and Pathways

This section attempts to identify sources and pathways contributing FIB to specific priority areas in Newport Bay during wet weather.[36] Based on the results of the prioritization process for wet weather sites described in Section 6.0, a total of 36 locations in the Bay (31 OCHCA and 5 BTO sites) were identified for source management consideration. Although the number of wet weather sites identified is much greater than those prioritized for dry weather, recreator exposure is highly reduced during wet weather (EOA 2001, Soller 2006). Therefore, for the purpose of this SMP, wet weather sources and pathways contributing FIB to priority areas in the Bay are considered to be a much lower priority than dry weather sources and pathways.

Similar to dry weather, information from existing source identification studies and modeling exercises were used to assist in identifying important wet weather sources and pathways of FIB. Based on this information, pathways contributing FIB to Newport Bay during wet weather include tributaries, stormwater conveyance systems, and direct inputs. As described earlier in this section, San Diego Creek appears to be an important FIB pathway to Bay channels (i.e., BTO sites) during wet weather events that exhibit large FIB loading rates (see Figure 7.1). Additionally, Grant et al. (2009) suggests that discharges from small and large drains can impact water quality along the shoreline during wet weather.

A few FIB sources that could directly discharge to the Bay do not appear to impact water quality in wet weather. These include, vessel waste and pumpout facilities (Grant et al. 2004), swimmer shedding (Jiang et al. 2005), and biofilms (Pednekar et al. 2007). For watershed-based sources of FIB, very limited information exists regarding the relative contributions of FIB to the Bay during wet weather conditions, making source/pathway prioritization challenging. To supplement this lack of information, estimated rates of FIB deposits onto the surface of the watershed from specific sources presented in Section 5.0 were utilized to assist in wet weather source prioritization.

### 7.5.1 Lower Newport Bay

Modeling conducted by Grant et al. (2009) suggests that wet weather discharges from San Diego Creek are causing water quality impacts to the Lower Bay. However, modeling results indicate that impacts to the Lower Bay only occur during large (90$^{th}$ percentile) FIB loading events (see Figure 7.1). Therefore, tributaries are assumed to be moderate to minimal contributors of FIB to the Lower Bay during the entire wet weather period. In contrast, numerous small and large storm drains discharge to shorelines throughout the Lower Bay, and Grant et al. (2009) demonstrated they can impact water quality at the beach and drain-scales.

Based on estimates presented in Section 5.0, potential land-based sources that may contribute to FIB in the stormwater drainage system in the Lower Bay include pet waste, fertilizers, wildlife, and illicit connections and illegal discharges. Possible sources directly discharging FIB to the Lower Bay include leaking sewer lines, sanitary sewer overflows, vessel waste, tidal washing of Bay sediment, and water birds droppings. Based on the limited information available for wet weather sources, estimated relative contributions of FIB to the Upper Bay from all sources and pathways are presented in Table 7.3.

[36] Wet weather defined as those days with ≥ 0.2 inches of precipitation plus 3 days following the rain event.

### 7.5.2 Upper Newport Bay

Based on modeling conducted by Grant et al. (2009) and loading estimates presented in Section 5.0, the Upper Bay appears to be impacted by all FIB pathways during wet weather. For tributaries, modeling indicates that San Diego Creek and Santa Ana Delhi Channel (discharges from Big Canyon Wash were not modeled) adversely impact water quality during large wet weather loading events ($90^{th}$ percentile). Additionally, the high density of storm drains draining to the Upper Bay also suggests that these are important pathways of FIB in wet weather. Contributions of water birds waste directly to the Upper Bay mudflats also appear to be important sources of FIB. Based on the limited information available for wet weather sources, estimated relative contributions of FIB to the Lower Bay from all sources and pathways are presented in Table 7.3.

Table 7.3. Relative importance of FIB sources and pathways to geographical areas in Newport Bay that are prioritized for source management consideration during wet weather.

| Geographical Area of Interest | Monitoring Station Name | FIB Transport Pathways | | | FIB Sources to the Watershed | | | | FIB Sources Directly to the Bay | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Stormwater Conveyance Systems (Drains) | Tributaries (Creeks) | Direct Inputs to Bay | Pet Waste | Watershed Wildlife | Biosolid & Fertilizer Application | Illicit Connections and Illegal Discharges | Leaking Sewer Lines | Biofilm or Vegetation (Non-Fecal) | Bay Sediment/Sand | Sanitary Sewer Overflows | Wastewater Discharges | Swimmer Shedding | Vessel Waste & Pump Out Facility Management | Bay Wildlife | Failing Septic Systems |
| Western Newport Bay | Newport Blvd Bridge, 38th St. 33rd St., 43rd St. & BTO8 | ● | • | • | ● | ● | ● | • | • | • | • | • | | | | • | |
| Lido Channel | Via Genoa & Bayshore Beach | ● | ● | • | ● | ● | ● | • | • | • | • | • | | | | • | |
| Lido Peninsula & West Lido Channel | Rhine Channel, 19th St. & 15th St., Lido Yacht Club, 10th St. & Alvarado/Bay Island | ● | ● | • | ● | ● | ● | • | • | • | • | • | | | | • | |
| Newport Dunes & De Anza | Newport Dunes West, Middle, East and North, and De Anza Boat Launch | ● | ● | • | ● | ● | ● | • | • | • | • | • | | | | • | |
| Balboa Island (North & South) | Park Ave., Onyx Ave., Ruby Ave. & Promontory Point, Garnet Ave., Sapphire Ave., Abalone Ave. & Grand Canal | ● | ● | • | ● | ● | ● | • | • | • | • | • | | | | • | |
| Harbor Entrance Channel | Bayside Dr. Beach, Rocky Point & N St. Beach | ● | ● | • | ● | ● | ● | • | • | • | • | • | | | | • | |
| Upper Bay | Vaughns Launch, Ski Zone, Northstar Beach, BTO4, BTO5, BTO6 & BTO7 | ● | ● | ● | ● | ● | ● | • | • | • | • | • | | | | ● | • |

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# 8.0 SUMMARY OF EXISTING BEST MANAGEMENT PRACTICES

This section provides an overview of best management practices (BMPs) currently employed by local public agencies and stakeholders in Newport Bay watershed to reduce the extent and magnitude of water quality impacts. Summaries of existing BMP programs and activities contained in this section are intended to provide a representation of actions design to address sources of Fecal Indicator Bacteria (FIB), and Waste Load Allocations and Load Allocations prescribed in the *Total Maximum Daily Load (TMDL) for Fecal Coliform in Newport Bay* (Regional Board 1999). Information was obtained from a variety of regulatory compliance documents and scientific reports, and through personal communications with public agency staff and local stakeholders. Thus, the accuracy of the information presented is commensurate with the information received from these information sources.

For the purposes of this SMP, a BMP is defined as a practice or combination of practices that are determined through problem assessment, examination of alternatives, and appropriate public participation to be the most effective and practicable (including technological, economic, and institutional considerations) means of preventing or reducing FIB-related impacts in Newport Bay. BMPs can be divided into three categories: pollution prevention, source controls and treatment controls. Pollution prevention activities consist of policies and practices to prevent the release of pollutants into the environment, including public education and outreach efforts, and integrated pest management (IPM). Source controls are designed to reduce the impacts of pollutants once the have entered the environment, and include such practices as street sweeping and responses to illegal discharges. Treatment controls are typically structural BMPs or low impact design features (i.e. landscape pervious materials) installed to reduce or slow pollutant inputs into a water body. Examples of treatment BMPs include stormwater treatment ponds and diversions of dry weather flows to wastewater treatment facilities. Pollution prevention, source control and treatment controls generally complement each other, although non-treatment BMPs are often seen as the first line of defense and are generally implemented before treatment controls. This process follows the saying: “An ounce of prevention is worth a pound of cure.”

Summaries of existing BMPs are organized by the TMDL source category they are intended to address (i.e., urban runoff, vessel waste, agriculture and natural sources). Additionally, BMPs designed to address other urban sources of FIB that do not fit into these categories (e.g., sanitary sewer overflows) are also described. Recommendations for new BMPs, or enhancements to existing BMPs to further address FIB sources impacting areas of interest included in Section 7.0 are described in Section 9.0.

## 8.1 Urban Runoff BMPs

The 1972 Federal Water Pollution Control Act (Clean Water Act) established prohibitions on the discharge of any pollutant to navigable waters from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 Water Quality Act (WQA) added section 402 (p) to the Clean Water Act, requiring that the U.S. EPA or a permitting authority (e.g., States) issue NPDES permits for the following categories of stormwater (i.e., urban runoff) discharges:

- Those discharges associated with industrial activity (including construction);

- Municipal Separate Storm Sewer Systems (MS4s) discharges from large (systems serving a population of 250,000 or more) and medium (systems serving a population of 100,000 or more, but less than 250,000) systems; and,
- Discharges judged by the permitting authority to be significant sources of pollutants or which contribute to a violation of a water quality standard.

NPDES permits are issued for a five-year term and have progressively included more stringent requirements. In California, NPDES permits are administered by the State Water Resources Control Board (State Board) and nine Regional Water Quality Control Boards (Regional Boards) that enforce regulations within their respective regions. Industrial and construction stormwater NPDES permits, and general municipal stormwater permits under Phase II of the program are issued by the State Board and enforced by Regional Boards. Individual municipal stormwater permits are issued to MS4s by Regional Boards. The Newport Bay watershed lies within the jurisdiction of the Santa Ana Regional Board.

Orange County MS4s (i.e. Permittees) are currently regulated under their fourth NPDES permit (Order # R8-2009-0030, NPDES #CAS618030), which requires the implementation of BMPs to reduce stormwater discharges that contain pollutants to the maximum extent practicable (MEP). BMPs are established through requirements in the NPDES that are focused on the following elements:

- Construction Site and Industrial/Commercial Business Inspections;
- New Development/Significant Redevelopment Activities;
- Municipal Government Activities;
- Public Education and Outreach; and,
- TMDL-related Activities.

The following sections provide a summary of BMPs currently implemented by local agencies and stakeholders to reduce FIB in urban runoff discharged to the Newport Bay. Management practices are organized by the applicable source of FIB to urban runoff that the action is intended to address. Those BMPs that address multiple sources of FIB to urban runoff are described at the end of the section.

### 8.1.1 Domestic Pet Waste Reduction

Regulations concerning pet waste have been established in every municipality in the Newport Bay watershed. Current regulations are generally similar to the City of Newport Beach's Municipal Code (§7.20.020), which states that it is unlawful for the owner or person having charge, custody or control of any animal to permit such animal to defecate and to allow the feces to thereafter remain on any public sidewalk, public beach or park or on any other public property or on any private property other than that of the owner or person who has custody or control of the animal. These regulations are enforced through the local police departments and code enforcement officers.

In addition to municipal codes and ordinances, local municipalities have extensive public education and outreach programs to increase awareness of pollution issues and change behaviors that may impact urban runoff quality. The Orange County Stormwater Program has published numerous educational materials on the sources and impacts of urban runoff

pollution, and specifically on pet waste. The brochure, *Tips for Pet Care* (Appendix F) for cats and dogs, is a good example of localized outreach materials. The brochure advises outdoor pet bathing methods that reduce runoff into storm drains and informs residents every city has an ordinance which requires picking up and properly disposing of pet waste to prevent it from entering into storm drains which flow directly to waterways and the ocean—untreated--where it can be harmful to human health, marine life and the environment. Furthermore, municipalities provide and stock doggy bag dispensers at selected parks throughout the Newport Bay watershed. Park signs explain the need for park users to “pick up their pet waste”.

In concert with public education and outreach, a pet waste dispenser program is administered by the City of Newport Beach Parks Department (Figure 8.1), and a number of Homeowners Associations (HOAs) contract with private companies (e.g., Entre-Manure, LLC) to remove pet waste from neighborhoods and communities (*personal communication, City of Newport Beach staff*).

Figure 8.1. Pet waste bag dispenser at 38th Street Beach (City of Newport Beach).

### 8.1.2 Biosolid and Fertilizer Controls

Fertilizer applications occur on urban land use areas owned by municipalities, HOAs, businesses and individual land owners. As discussed in Section 5.0, over use of fertilizers and over-irrigation of landscaped areas can cause nuisance dry weather urban runoff that contains high concentrations of FIB. Management actions to control the impacts of fertilizers and biosolids can target the reduction of fertilizer use, reducing over-irrigation, or a combination of both. Management actions currently implemented by municipalities and other public agencies in the Newport Bay watershed to reduce the impacts of fertilizers and biosolids on Newport Bay are briefly described below.

#### *Fertilizer Reduction Efforts*

In June 2001, the County (on behalf of the Orange County Stormwater Program) entered into a five-year agreement with the University of California Cooperative Extension (UCCE) to conduct water quality monitoring studies and implement water quality improvement

programs in areas where the University has special expertise, particularly related to fertilizer and pesticide applications. On May 10, 2005, the agreement was revised and extended for up to six additional years. In the first year of the agreement with the UCCE, Model IPM, Pesticide and Fertilizer Guidelines (IPM Guidelines) were completed in close cooperation with the UCCE. The Guidelines require the Permittees to conduct Integrated Pest Management (IPM) self-audits; implement a model IPM, pesticide and fertilizer Management Guidelines based on IPM principles; and, undertake training. With oversight and assistance from UCCE, the Permittees have successfully completed annual self-audits of the Model IPM program and the implementation of the Guidelines. Additionally, annual IPM trainings for municipal staff have also been conducted by the Orange County Stormwater Program. Since the IPM and management guidelines were implemented by Orange County municipalities, municipal fertilizer use has declined countywide (Figure 8.2).

In addition to the Model IPM Guidelines, the Orange County Stormwater Program has published the brochure, *Tips for Landscape and Gardening* that addresses general landscaping tips and garden/lawn maintenance. The brochure includes information on proper use, storage and disposal of fertilizers and pesticides as well as information on over-watering.

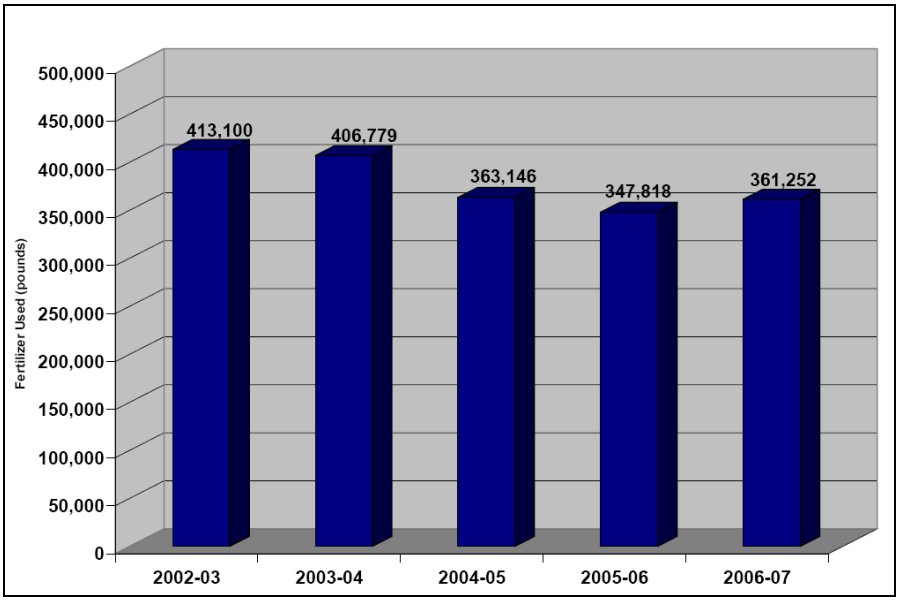


Figure 8.2. Reported fertilizer applications (pounds of active ingredient) by Orange County municipalities for Fiscal Years 2002-03 through 2006-07 (Orange County 2007).

### *Over-Irrigation Reduction and Water Conservation Efforts*

In addition to fertilizer reduction efforts encouraged and implemented by local municipalities, the Irvine Ranch Water District (IRWD) and the City of Newport Beach have spent significant resources in implementing programs designed to reduce excess landscape irrigation. Specifically, the City of Newport Beach has a full time water conservation coordinator who implements their public education program. Public education and outreach tasks includes: speaking at Home Owners Association (HOA) meetings about the impacts of over-irrigation; implementing runoff reduction measures via irrigation upgrades and free “smart” controller installations; and promoting drought tolerant landscape programs (personal communication, City of Newport Beach staff). Newport Beach is also currently drafting a water conservation

in landscaping ordinance based on a preliminary draft ordinance issued by the California Department of Water Resources (DWR) to meet the requirements of the Water Conservation in Landscaping Act of 2006 (AB1881). AB1881 enacts recommendations designed to improve the efficiency of water use in new and existing urban irrigated landscapes in California by (among other things) requiring local agencies, not later January 1, 2010, to adopt the DWR's updated Model Efficient Landscape Ordinance or equivalent (City of Newport Beach 2008).

In coordination with Orange County municipalities, the IRWD also has a variety of programs and activities designed to reduce dry weather runoff and conserve water in the Newport Bay watershed, including:

- Conservation rate structures – The IRWD uses a progressive water rate structure which promotes water efficiency.
- Monthly landscape watering schedule – A weekly suggested watering schedule (by month) is posted on IRWD's website for spray-head irrigation systems.
- Free water audits – In an effort to assist customers who have received penalties from high water use find ways to conserve water inside and outside their homes and businesses, the IRWD (for no cost) provides a trained water auditor to visit the site and check for leaks, evaluate the landscaping and irrigation system, and, teach the customer how and when to adjust their irrigation controller for maximum watering efficiency.
- Landscape workshops – residential landscape workshops are held twice per year for residents within IRWD's service area and focus on plant selection, proper irrigation and runoff reduction.

Additionally, IRWD has implemented an innovative rebate program for weather-based "smart" controllers for irrigation. A smart controller automatically reduces the watering times as the weather gets cooler and less water is needed. Then as the weather begins to warm up, the controller will add more watering time. The largest of the smart controllers are Central Computer Irrigation Controller Systems, which are designed for larger irrigated areas such as golf courses, parks, schools and large commercial complexes.

### 8.1.3 Illegal Discharge and Illicit Connection Control Programs

As described in Section 5.0, illegal discharges are defined as any non-exempt, non-permitted disposal into the storm drain system, and illicit connections are defined as un-permitted connections to the stormwater conveyance system that may result in illegal discharges.

The municipal stormwater NPDES permit for Orange County (Santa Ana Region) requires municipalities to implement a program to detect illegal discharges and illicit connections (ID/IC), facilitate public reporting, investigate and enforce compliance and violations, and undertake training (Orange County 2006). Telephone and web-based reporting systems have been established for reporting by the general public, and are advertised in the Stormwater Program's public education materials, Orange County "White Pages" telephone directories, and Permittee websites. In Fiscal Year 2006-07, a total of 4,012 complaints were received via these reporting mechanisms (Orange County 2006).

Response to complaints regarding ID/IC is a long established element of Permittee ID/IC programs. During 2006-07, the Permittees encountered and sought to mitigate a total of 4,052 incidents, of which 172 were associated with bacteria and 880 associated with wastewater. Enforcement actions were undertaken according to the adopted Water Quality Ordinances and accompanying Enforcement Consistency Guide. In instances of noncompliance, the Permittee may adopt one of four types of remedies, including educational letters, administrative remedies, criminal remedies, or other civil or criminal remedies, as appropriate. The Permittees reported a total of 4,490 enforcement actions, associated with ID/IC investigations during the FY 2006-07 reporting period.

In addition to the ID/IC response program described above, each Permittee in Orange County began implementing a Dry Weather Reconnaissance Program in May 2006. This program is based upon statistically derived benchmarks, was developed and implemented in both permit regions specifically to identify and respond to illegal discharges and illicit connections during the typically dry summer months of May through September using a suite of water quality analyses conducted in the field at designated random and targeted drains (Orange County 2006).

In concert with the ID/IC response and dry weather reconnaissance programs, Permittees also conduct stormwater inspections at commercial and industrial facilities to ensure adequate urban runoff BMPs are implemented. With regards to FIB, the Orange County Health Care Agency (OCHCA) conducts inspections at food service facilities on behalf of Permittees. During these inspections, OCHCA staff assess whether waste management areas (e.g., dumpsters) are adequately maintained to prevent FIB from food waste entering the urban runoff conveyance system. As issues are identified, referrals are forwarded to respective Permittee staff for follow up.

Permittees also ensure that municipal staff is adequately trained on ID/IC and Industrial/Commercial Facility Inspection procedures. To assist in this effort, the Orange County Stormwater Program has developed a number of training modules that are offered by the County throughout the year. The Orange County Stormwater Program also has a NPDES Inspection Sub-Committee that meets quarterly to provide training to municipal inspectors on issues related to spill response, inspection and enforcement. This Sub-Committee also serves as a forum for the coordination and discussion of ongoing difficult or new enforcement, investigation, or enforcement issues and to profile cases or incidents.

### 8.1.4 Urban Runoff BMPs Addressing Multiple Sources

In addition to control measures described above that focus on addressing specific sources of FIB to urban runoff, other management actions that address multiple urban runoff sources have also been implemented in the Newport Bay watershed. These management actions are briefly described below.

#### *Dry Weather Diversion of Back Bay Drain*

Prior to 2001, FIB levels at the Newport Dunes resort area were consistently elevated during the summer months when the resort area has a high number of recreators. To address this issue, the City of Newport Beach began implementing a dry weather diversion of the Back Bay Drain in March 2001. The diversion occurs by gravity flow controlled by a shallow dam along the storm drain, and diverts approximately 8,640 gallons per day (GPD) to the Orange County Sanitation District (OCSD) treatment facility between April and September. A manual shut off valve prevents flow from entering the sewer system during the wet season. FIB

measurements have shown a significant improvement since the diversion was put in place (OCHCA 2008). A location map of the Newport Dunes Diversion Project is shown in Figure 8.3.

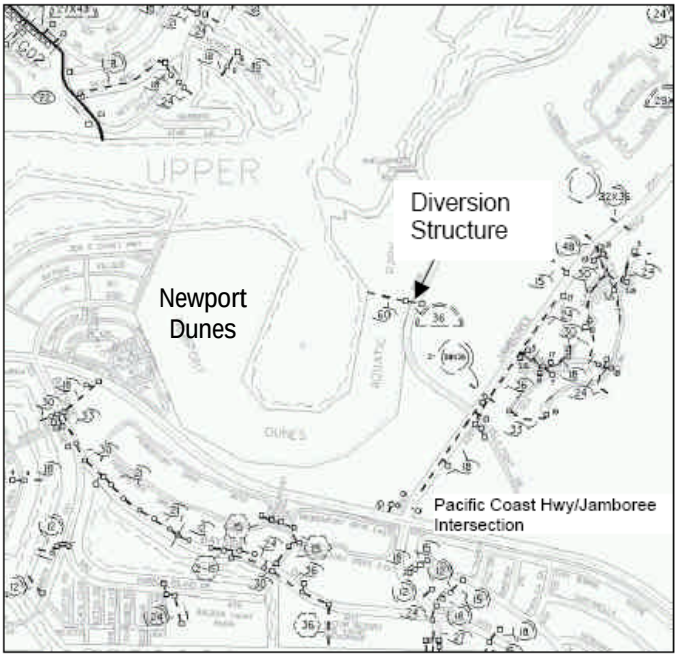


Figure 8.3. Location of the Back Bay dry weather diversion structure constructed by the City of Newport Beach in 2001 at the Newport Dunes recreational area.

### *Plugging Storm Drains at Dunes Recreational Area*

In addition to the dry weather diversion of the back bay drain, maintenance staff at the Dunes recreational area also plug four small drains during dry weather that have historically contributed FIB to the Dunes beaches (personal communication, City of Newport Beach staff). The drains receive runoff from the parking lots and landscaped areas adjacent to the beaches. In combination with the Back Bay diversion, plugging the small drains appears to have reduced FIB concentrations during dry weather at the Dunes (see section 4.0).

### *Arches Drain Bioswale*

As described in sections 4.0 and 6.0, relatively high concentrations of FIB during dry weather have been consistently observed in and around West Newport Bay (WNB), including the monitoring site at Newport Blvd. Bridge. Furthermore, studies have shown that dry weather discharges from the arches drain may impact WNB water quality (Everest International 2004, Pednekar 2007) during dry weather. Concerns for water quality impacts associated with the arches drain prompted the City of Newport Beach to construct an in-line bioswale treatment control structure in the arches drain in 2007 (personal communication, City of Newport Beach staff).

A bioswale is a broad, shallow channel with a dense stand of vegetation covering the side slopes and bottom (CASQA 2003). Swales can be natural or manmade, and are designed to trap particulate pollutants (e.g., FIB), promote infiltration, and reduce the flow velocity runoff. The arches drain bioswale was constructed in 2007 and is located along Newport Blvd

(Highway 55). The bioswale treats dry weather and stormwater runoff from a relatively large drainage area (>350 acres). City of Newport Beach staff suggests that the bioswale has been highly effective at reducing FIB concentrations at the Newport Blvd. Bridge monitoring site (personnel communication with John Kappler, City of Newport Beach). However, due to the limited timeframe since the bioswale has been in place, empirical monitoring data to verify this assertion is currently limited (see Section 9.0).

Figure 8.4. Location (a) and image (b) of the Arches Drain bioswale in Newport Beach.

### 8.1.5 Municipal Maintenance BMPs

Municipal maintenance activities include street sweeping, solid waste collection, drainage facility maintenance, and trash/debris control. These activities have been implemented for decades, prior to the adoption of the first NPDES permit for municipal stormwater in Orange County. Although municipal maintenance BMPs have not been shown to effectively reduce FIB in urban runoff (CASQA 2003), they do provide some level of source control including the removal of vegetation and sediments that may contain FIB and are therefore described in this section.

In FY 2002-03, the Orange County Stormwater Program developed a Model Municipal Activities Program (Model Program), which establishes a framework for conducting a systematic program of evaluation and BMP implementation that targets fixed facilities, field programs and drainage facilities. As described in the following paragraphs, all Permittees currently implement the Model Program.

#### *Street Sweeping*

All Permittees maintain street sweeping programs in residential, commercial and/or industrial areas. In FY 2006-07, a total of 88,567 tons of material was removed from the streets and gutters throughout the County, which represents a sustained increase in weight of material collected annually since FY 2002-03 (Figure 8.5). Pollutants removed from road surfaces by sweepers are typically those attached to sediments, including fertilizers and

bacteria. Walch (2006) estimated that on average, one kilogram of street dirt contains roughly three million colony forming units (CFU) of fecal coliform bacteria. Additionally, it has been suggested that bacteria incubate in puddles on street surfaces between storms and that dog feces accounts for only about 12 percent of the total bacteria at the storm-sewer outfall. (Zarriello et al. 2003).

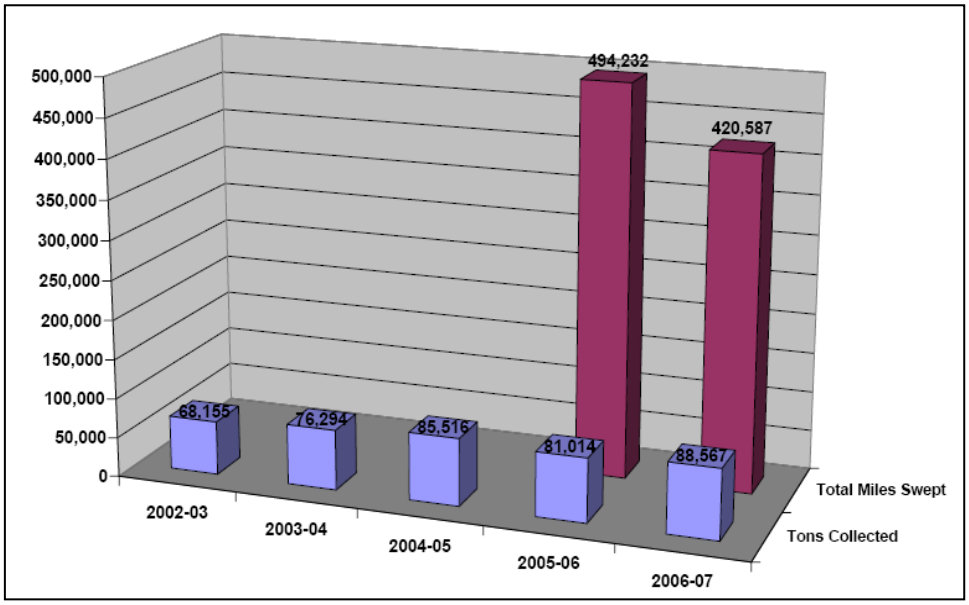


Figure 8.5. Reported mile swept and volume of material removed via street sweeping by Orange County municipalities for Fiscal Years 2002-03 through 2006-07 (Orange County 2007).

### *Solid Waste Collection*

Orange County Stormwater Program Permittees implement solid waste collection programs for public, residential, commercial and industrial areas. In FY 2006-07, a total of 3,319,233 tons of solid waste was collected. Regular solid waste collection can prevent trash being windblown into water bodies or catch basins and prevents rainwater runoff from trash, potentially containing pet or human waste, from reaching water bodies.

### *Drainage Facility Maintenance*

Debris left in catch basins or drainage lines contains FIB and can provide habitat for bacteria to replicate, which may degrade water quality in downstream waterways. Permittees inspect their drainage systems within their jurisdictions annually and remove accumulated debris on an as needed basis. By removing this material from the catch basin inlets and the stormwater conveyance system, Permittees make a significant contribution in preventing the passage of these materials into downstream receiving waters. In FY 2006-07, twenty-three (23) Permittees reported inspecting (and cleaning if necessary) 100% or more of their catch basin inlets. For the same fiscal year, a total of 36,294 catch basins were cleaned (Figure 8.6).

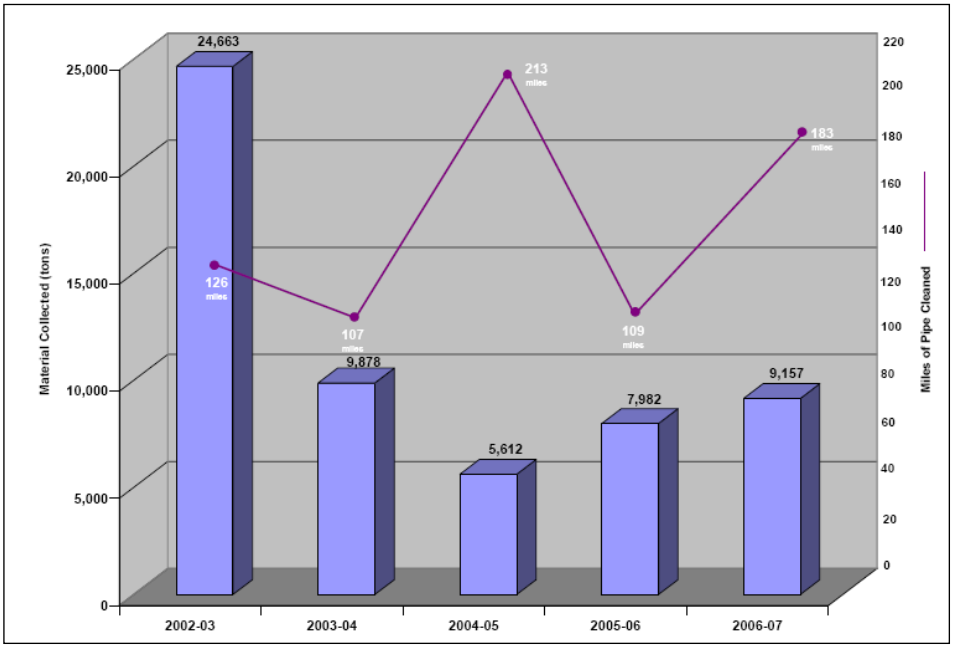


Figure 8.6. Reported miles of stormwater conveyance system pipe cleaned and the volume of material removed via drainage facility maintenance by Orange County municipalities for Fiscal Years 2002-03 through 2006-07 (Orange County 2007).

### *Trash & Debris Control*

Although most Permittees historically viewed litter control as a public service program (i.e., preventing visual blight, etc.), rather than as a pollution control problem, it is now considered important as a visual indicator of water quality. Trash and debris BMPs divert litter and other solid materials (which can introduce or increase growth of FIB) from the stormwater conveyance system. These include structural BMPs, such as catch basin inlet screens and other proprietary devices that prevent trash and debris entering the catch basin, as well as in-channel trash booms, which recover floatable material. There are three trash booms in the Newport Bay Watershed; Santa Ana Delhi Channel (at Mesa Drive in Newport Beach), El Modena-Irvine Channel (near the Eastern Transportation Corridor), and San Diego Creek (near IRWD treatment plant facility).

Additionally, the Inner-Coastal and Watershed Cleanup Day, which engages the public directly in the cleanup of trash and debris, has been heavily promoted by the Orange County Stormwater Program over the past few years. Since 2002, over 310,000 pounds of trash has been removed from Orange County's beaches, harbors and creeks on Cleanup days.

## 8.2 BMPs for Other Urban Sources

### 8.2.1 Septic System Management

There are a total of 292 known septic systems in the Newport Bay Watershed (RBF 2003), all of which are located in the northeastern portion of the San Diego Creek subwatershed. If not properly installed or maintained, septic tanks can fail, which may lead to impacts on receiving waters. As part of a study conducted by RBF in 2003, an information handout was developed for homeowners that describes operation and maintenance tips. These tips were subsequently incorporated on the Orange County Stormwater Program's website (www.ocwatersheds.com) as a public education BMP.

Additionally, the Orange County Stormwater Program published a brochure *Help Prevent Ocean Pollution: Tips for Maintaining a Septic Tank System* (Appendix G). The brochure includes tips on conserving water to decrease production of wastewater, protecting the system from harmful materials, runoff, damage from cars, advises keeping records and regular inspection of septic systems**.** A copy of this brochure with an informational letter was mailed to all residents in the County with septic systems on January 19, 2007.

### 8.2.2 Sewer Line Inspection, Maintenance and Rehabilitation

In general, there are three types of sewer lines that convey sewage from homes, businesses and public buildings in Orange County to regional wastewater treatment facilities. A property owner's sewer pipes are called service laterals and are connected to larger local main and regional trunk lines. Service laterals run from the connection at the home or business to the connection with the public sewer (including the area under the street). These laterals are the responsibility of the property owner and must be maintained by the property owner. Many of the cities in the Newport Bay Watershed have adopted ordinances requiring maintenance of service laterals.

Operation and maintenance of local main and regional trunk sewer lines are the responsibility of the city sewer/public works departments and public sanitation districts, respectively. In the Newport Bay Watershed, the OCSD is responsible for regional sewer line maintenance and rehabilitation. The OCSD is planning a variety of rehabilitation projects on their regional sewer lines and pump stations in the Lower Newport Bay subwatershed. A majority of these projects are currently in the design phase. Additional information is available at www.ocsd.com.

In addition to upgrades to the regional sewer lines in the Newport Bay Watershed, the City of Newport Beach (City) consistently installs, repairs or replaces local sewer lines and sewer laterals and cleanouts (the City of Newport Beach owns and maintains all sewer laterals) within their jurisdiction. The City has historically cleaned the sewer system on a regular basis and continues to do so today. Once a year is the industry standard for agencies with comprehensive sewer maintenance programs. Presently, the City is on a one-year program of sewer cleaning. Areas needing more frequent cleaning are cleaned as frequently as monthly and quarterly. Maintenance and inspections are also consistently conducted on the 20 City-owned pump stations. Lastly, the City is currently in the process of a conducting a multi-year video inspection of the all local sewer lines in their jurisdiction. The results of the video inspection will identify sources of infiltration into and exfiltration (sewage leaks) out of the lines. The responsibilities of other cities within the Watershed are described below.

### 8.2.3 Sanitary Sewer Overflow Prevention and Spill Response

As reported by RBF (2004), 46% of all sewage spills reported to the Santa Ana Regional Board between 2002 and 2006 were on private property and multi-family residential dwellings, which present the greatest threat to public health and water quality (average single-family residential sewage spill is 39 gallons as compared to the average multifamily residential spill of 972 gallons). Commercial property spills are believed to be less of a significant threat to the environmental because the vast majority of commercial spills involved food service establishments which are now under strict Fats, Oils and Grease (FOG) reduction programs as part of WDRs described below. Both commercial and multi-family residential sewage spills are predominately caused by grease buildup in the private lateral.

In response to the beach closures, the Santa Ana Regional Board adopted WDRs for the operation of sewage collection systems. The Sewer WDRs were adopted on April 26, 2002, and apply to all the sewer system owners in Orange County whose lines are tributary to the OCSD treatment plants. Therefore, these regulations apply directly to the cities within the Newport Bay Watershed. One of the requirements of the WDR is preparation and implementation of a Sewer System Management Plan (SSMP). In 2006, the State Board finalized their statewide approach to reducing Sanitary Sewer Overflows (SSOs). This approach is very similar to that of the Regional Board.

On a jurisdictional scale, SSMPs, have been developed by the City of Newport Beach and other municipalities within the Newport Bay Watershed. By preparing and practicing the procedures in the plan, SSOs are expected to decrease or be eliminated entirely. Cities also have ordinances requiring grease control devices for new restaurants and restaurants undertaking a major remodel. Additionally, cities within the watershed also have extensive FOG inspection programs.

During the most recent MS4 permit term, the County and OCSD developed and implemented a coordinated sewage spill prevention and response demonstration project in the Newport Bay Watershed (The “Tustin Area Spill Control (TASC) Demonstration Project”). The TASC included: 1) Development of SSO response procedures; 2) selection of primary and backup sewage spill response contractors for containment and recovery of SSOs; and 3) SSO hands-on field response training for Permittee staff and municipal sewer agency staff.

In 2007-08, TASC evolved from a demonstration project to a program (now designated CASC, or “Countywide Area Spill control”) with the area of implementation broadened to include the cities of Villa Park and Orange. One of the goals for TASC is to gradually phase the implementation of the project throughout the County so that the proactive interagency planning and coordination for sewage spill response can be implemented and/or improved in other watersheds.

### 8.2.4 Wastewater Treatment

There are no direct planned discharges of municipal wastewater into Newport Bay or its tributaries. Current management actions are limited to the operation and maintenance of the Michelson Water Reclamation Plant in the San Diego Creek watershed. Additional information on control measures associated with this Plant can be found at www.irwd.com.

### 8.2.5 Swimmer Shedding Pollution Prevention

A limited number of swimming beaches are located within the Lower Bay. Additionally, swimmer shedding is not believed to be a significant source of FIB to recreational areas (Jiang et al 2005). Based on our review of existing BMPs, no control measures specifically addressing FIB contribution from swimmers are currently being implemented in Newport Bay.

## 8.3 Vessel Waste BMPs

Proper waste management for commercial and recreational boats can prevent water quality impacts. Vessel sewage discharge is regulated under Clean Water Act Section 312. The USEPA, the Coast Guard and the State work together to protect human health and the

aquatic environment from disease-causing microorganisms which may be present in sewage discharged from boats. Section 312 provides standards for marine sanitation devices (MSD) and no-discharge zone (NDZ) designations for vessels. A NDZ is an area of a water body or an entire water body into which treated or untreated vessel sewage discharge is prohibited to protect environmentally sensitive areas, including shellfish beds, coral reefs, fish spawning areas, or drinking water sources. The Newport Bay has been designated as a NDZ by the USEPA.

California Code of Regulations (CCR) (Title 23, Chapters 20 and 20.1) contains procedures for the State Board and Regional Boards to follow in requiring any person lawfully vested with the possession, management, or control of a marine terminal to provide adequate vessel sewage retention device pumpout capability at locations which are convenient and accessible to vessel users. The regulations include standards establishing criteria for the design, construction, operation and maintenance of pumpout facilities, and specify administrative procedures to be followed to provide a standard method of determining which vessel terminals shall be required to install and operate these facilities.

In 1988, the Santa Ana Regional Board found that the vessel waste program in Newport Bay was inadequate and thus adopted Resolution No. 88-89 and Orders No. 88-83, 88-84, 88-85, 88-89, and 88-91. Resolution No. 88-89 approved a vessel pumpout program for Newport Bay while the orders more specifically required certain vessel terminals to install vessel pumpout facilities. The vessel pumpout program approved by the Santa Ana Regional Board required the installation of pumpout facilities and dump stations at specific locations.

As a follow up to the resolutions and orders passed by the Santa Ana Regional Board in 1988, vessel waste pumpout facility surveys in Orange County were conducted by the OCCK in October 2002, and by the Santa Ana Regional Board staff with OCCK in March 2003. The surveys revealed issues related to pumpout facilities, including: the inadequate number, inoperable status, poor housekeeping, improper use, and lack of public education. As a result of the surveys, the Santa Ana Regional Board staff prepared a *Pumpout Facilities Need Report* detailing the findings, and on August 22, 2003, the Santa Ana Regional Board approved Resolution No. R8-2003-0074 requesting that the State Board require the implementation of a proposed Vessel Sewage Disposal Program. This program mandates that specific vessel terminal owners/operators install, operate and/or maintain pumpout facilities and dump stations in Newport Bay and Huntington Harbor.

In 2004, the State Board adopted Order No. 2004-0017-DWQ, based on the Regional Board's resolution, requiring the installation of five pumpout stations and three dump stations in Newport Bay. Since the adoption of the 2004 Order, all required pump stations have been installed. Additionally, two marinas hired a pumpout service contractor to service boats on a monthly basis, as an equivalent to installing a pump station (*personal communication, City of Newport Beach staff*).

The Santa Ana Regional Board adopted Order No. R8-2005-011 in 2005 regarding vessel sewage disposal in Newport Bay. This Order contains specific requirements for education, access, operation and maintenance of pumpout stations. Specifically, a minimum number of annual inspections, regular collection of samples and review of bacterial data collected from the receiving waters in the vicinity of the pumpout facilities are required. The Santa Ana Regional Board must also review effectiveness of the vessel waste pumpout program at a

minimum of every two years to determine if revisions of the facility standards are necessary (Regional Board 2005).

Currently, there are 16 pumpout stations located in the City of Newport Beach (City). Four are public pumpouts on public docks that the City owns and operates, six are private pumpouts on private docks that are not publicly available, and the remaining six are public pumpouts on private docks that must be made available to the general public because the marinas accepted grant funding to install or upgrade their pumpout facilities. In recent years, the City retrofitted their older systems with new plumbing, resulting in improvement with operation and maintenance at these stations. As required by the Santa Ana Regional Board and discussed above, pump station owners must inspect pumpout stations five times per week during summer, and three times per week during the winter. City staff performs these inspections on the four pump stations owned and operated by the City. In addition, City staff inspect all of the pump stations, both public and private, once a week to make sure they are operational. The City has taken on these additional inspections out of concern for water quality. City staff will contact owners if they observe an issue with the pumpout stations (*personal communication, City of Newport Beach staff*).

Lastly, a statewide permit for marinas is currently being developed by the State Board through the Non-point Source Marina Program (*personal communication, Regional Board staff*). The permit will include requirements for bacteria as well as oil and grease and other pollutants. The permit is currently in administrative draft form and will likely go through a formal public review process in 2010.

## 8.4 Agricultural Runoff BMPs

As described in Section 5.0 (FIB Sources, Pathways and Environmental Fate), agricultural land uses comprise less than 7% of the Newport Bay watershed. Agricultural land uses are associated with privately-owned row crops (i.e., strawberries), ornamental container nurseries and small organic farms. Discharges from these land uses are regulated under the State of California's Non-point Source (NPS) program, administered by the Santa Ana Regional Board. Under the NPS program, the Regional Board has issued Waste Discharge Requirements (WDR) to each nursery in the watershed greater than 5 acres in size.
In 2007, the UCCE, Orange County Coastkeeper (OCCK), Orange County Farm Bureau and Southern California Edison developed a BMP guide for nurseries titled *Best Management Practices – A Water Quality Field Guide for Nurseries* (Appendix H). The goal of the project was to provide a simple BMP guide for nursery growers, land owners, employees and stormwater municipal personnel (within urban environments) to reduce pollutants from entering storm drains, creeks and water bodies, including Newport Bay (UCCE 2007). The guide emphasizes impacts of operations on the beneficial uses of local water bodies. It stresses nurseries must develop and implement the most efficient fertilization, irrigation and pest management programs in order to reduce possible water pollution. BMPs in the guide include:

- Locating composting, soil storage and mixing areas as far away from water conveyance systems and overland storm flow and cover to protect then from wind and rain;
- Storing bags or non-waterproof containers of fertilizers on pallets covered with plastic tarps or inside a storage area to protect from rain;

- Impermeable secondary containment system for fertilizer tanks, and mixing and loading fertilizers on an impermeable surface, such as concrete or tarp, to allow complete and easy spill clean up;
- Utilization of non-production landscape areas as buffers to collect stormwater and irrigation water;
- Regularly cleaning up spilled potting soil to prevent transport by rainwater;
- Watering plants in graveled areas so runoff containing fertilizers and pesticides can infiltrate and erosion can be prevented;
- Implementing a water recycling program to reduce dry weather runoff and water conservation; and,
- Shifting to controlled- and slow-release fertilizers.

In addition to the agricultural BMPs described above, control measures have also been developed to address potential water quality impacts from equestrian-related activities. In a cooperative effort among private and public entities in Orange and San Diego counties, a guidance document titled *Equestrian-Related Water Quality Best Management Practices* was completed in June 2004. The guidance document identifies and lists expectations of the equestrian community (e.g., commercial stables and horse owners) and describes specific BMPs to protect water quality, with a focus on pathogens. The document is publicly available on the County of Orange website (www.ocwatersheds.com) and included in Appendix I.

## 8.5 Management of Natural Sources

As described in Section 5.0, wildlife and water birds can contribute large amounts of FIB to water bodies. Although these sources are natural, some public agencies remain concerned about the potential health risk of swimming in waters that contain FIB from primarily wildlife. Managing these natural sources in attempts to reduce water quality impacts, however, has been shown in many cases to be neither straightforward nor successful. Water birds management programs are typically focused on Canada Geese and designed to reduce the number of geese and gulls roosting and defecating in or near receiving waters. This is typically done through hazing, shoreline management, egg addling, physical barriers or egg depredation. However, this type of water fowl management is not considered compatible with the designated ecological and endangered species habitat uses of Upper Newport Bay.

Additionally, populations can also be relocated similar to the relocation of a large number of Mallard Ducks conducted by the City of Newport Beach, which moved these water birds out of the watershed from the Grand Canal on Balboa Island (personal communication, City of Newport Bay staff).This is the only known current wildlife management action in the Newport Bay watershed that was identified in the development of the SMP.

## 8.6 Large-scale Restoration and Treatment Efforts

Based on a review of available information, a number of large-scale BMPs have been constructed in the Newport Bay watershed. Three of these BMPs are briefly discussed in the following sections. These BMPs have primarily been constructed to reduce the discharge of sediment and bacteria to the Bay in response to the 303(d) listing for this water body.

### 8.6.1 San Joaquin Marsh

The San Joaquin Marsh was constructed by the IRWD primarily to reduce nutrient concentrations in the San Diego Creek and the Bay. Dry weather flows in the creek are pumped through a series of ponds before most of the flow is returned to San Diego Creek. A portion of the treated water is used onsite for mitigation projects. A comparison of influent and effluent FIB concentrations shows roughly a 50% reduction in concentrations (Orange County 2003). Additionally, the marsh provides habitat for a variety of water fowl and wildlife species.

### 8.6.2 Sediment Trapping Basins

To implement the sediment TMDL for San Diego Creek, a Cooperative Agreement entitled "Newport Bay/San Diego Creek Watershed Sediment Control Monitoring and In-Channel Maintenance Program" was executed on April 20, 1999 (Orange County 2003). The Agreement between the County of Orange, the Irvine Company and the cities of Newport Beach, Irvine, Tustin and Lake Forest, provides a funding base for the implementing the various components of the sediment TMDL and in-channel basin maintenance programs. As part of the early action 208 Program, seven foothill water retarding/sediment trapping basins (Hicks Canyon, East Hicks Canyon, Round Canyon, Agua Chinon, Bee Canyon, Marshburn and Orchard Estates) have been completed in the upper San Diego Creek watershed and three in-channel sediment trapping basins in the lower reach of San Diego Creek just upstream of the Bay. Although the effectiveness of these sediment basins in reducing FIB concentrations in San Diego Creek and the Bay has not been evaluated, it is likely that some level of treatment and FIB reduction occurs as a result of these large-scale BMPs (CASQA 2003, Olivieri et al. 2006).

## 8.7 Existing BMP Summary

Based on the review of available information summarized in this section, it is clear that a variety of pollution prevention, source control and treatment control BMPs have been implemented by public agencies in the Newport Bay watershed (Table 8.1). In most cases, these BMPs are specifically intended to reduce or prevent impacts associated with FIB. In summary:

- **Urban Runoff** - Significant efforts have been taken by local municipalities to reduce the impacts of urban runoff on Newport Bay, including: 1) the adoption of local ordinances to prevent pet waste impacts; 2) reducing fertilizer impacts by promoting IPM; 3) reducing excess irrigation and promoting water conservation; 4) preventing and responding to illegal discharge and illicit connections; 5) diverting nuisance dry weather flows away from the storm drain system; and, 6) implementing effective street sweeping, solid waste collection and drainage maintenance programs.
- **Other Urban Sources:**
    - Septic systems are present in the northeastern portion of the San Diego Creek subwatershed. To help insure that these systems do not impact water quality in Newport Bay, the Orange County Stormwater Program published a public education brochure which was sent to septic system owners and is currently available on their website.
    - Many of the cities in the Newport Bay watershed have adopted ordinances requiring maintenance of sewer service laterals. Additionally, the City of Newport Beach (City) consistently installs, repairs or replaces local sewer

lines and sewer laterals and cleanouts within their jurisdiction. Presently, the City is on a one-year program of sewer cleaning. Areas needing more frequent cleaning are cleaned as frequently as monthly and quarterly. The City is also in the process of a conducting a multi-year video inspection of the all local sewer lines in their jurisdiction. Additionally, OCSD is planning a variety of rehabilitation projects on their regional sewer lines and pump stations in the Lower Newport Bay subwatershed.

- In response to the beach closures, the Santa Ana Regional Board adopted WDRs for the operation of sewage collection systems, which apply to the cities within the Newport Bay Watershed. One of the requirements of the WDR is preparation and implementation of a Sewer System Management Plan (SSMP). Additionally, cities within the watershed also have extensive FOG inspection programs, and in coordination with some cities in the watershed, the County has implemented a spill control program for SSOs.
- Based on the review of information provided, no BMPs associated with swimmer shedding are currently implemented in the watershed.

- **Vessel Waste** - Significant improvements to vessel waste pumpout accessibility have been made in recent years. Currently, there are 16 pumpout stations in Newport Bay. Orders developed by the Regional Board require these stations to be inspected on a frequent basis (e.g., multiple times per week), and report and remedy issues observed in a timely manner.

- **Agricultural Runoff** - Agricultural land uses (including nurseries) comprise less than 7% of the Newport Bay watershed, and consist of crop lands, container nurseries and equestrian facilities. The Regional Board has issued Waste Discharge Requirements (WDR) to nurseries in the watershed greater than 5 acres in size, which require BMPs to be implemented. Handbooks describing BMPs have been developed for nurseries and equestrian-related activities, with the goal of water quality protection.

- **Natural Sources** - Managing natural source (i.e., wildlife and water birds) impacts to water quality are typically neither straightforward nor successful. Only one existing BMP intended to reduce the impacts of FIB from water fowl was identified during this review (i.e., the relocation of a large number of Mallard Ducks conducted by the City of Newport Beach).
- **Newport Dunes Recreational Area** – In addition to the BMPs summarized above, two BMPs directly focused on improving water quality at the Newport Dunes Recreational Area have been implemented. Approximately 8,640 gallons per day are current diverted from the Back Bay Drain to the Orange County Sanitation District (OCSD) treatment facility during dry weather months (April-September). Also, four small drains that receive runoff from the parking lots and landscaped areas adjacent to the Dunes are plugged by maintenance staff during dry weather. Both BMPs appear to have significantly reduced FIB concentrations during dry weather at the Dunes (see section 4.0).

Table 8.1. Summary of existing Best Management Practices (BMPs) implemented in the Newport Bay watershed.

| BMP Category | Best Management Practice | BMP Program | Description of BMP Program | Applicable Public Agency(s) |
|---|---|---|---|---|
| Urban Runoff Controls | Domestic Pet Waste Controls | Municipal Codes and Ordinances | Enforcement of codes and ordinances | All municipalities in Newport Bay watershed |
| | | Public Education and Outreach | Publication and distribution of educational materials (e.g., Tips for Pet Care) | Orange County Stormwater Program |
| | | Pet Waste Dispenser Program | Dispensers located near beaches and on walking routes in Newport Beach | City of Newport Beach Parks Department |
| | Biosolid and Fertilizer Controls | Fertilizer Reduction Efforts | Implement water quality monitoring and improvement programs<br>Develop Pesticide and Fertilizer Guidelines | Orange County Stormwater Program and University Cooperative Extension |
| | | Over-Irrigation Reduction and Water Conservation Efforts | Public Education Program<br>Watering Landscape Ordinance | City of Newport Beach |
| | | | Reduce dry weather runoff and conserve water (e.g., establish rate structures and watering schedules, conduct water audits, workshops)<br>Develop rebate program for weather-based "smart" controllers for irrigation | Irvine Ranch Water District (IRWD) |
| | Illegal Discharge and Illicit Connection Control Programs | ID/IC Response Program | Reduction of illegal discharges and connections into the municipal stormwater systems through inspections and spill response programs. | Municipal Stormwater Programs in the Newport Bay watershed |
| | | Dry Weather Reconnaissance Program | Detection of dry weather discharges through routine screening of the municipal stormwater system. | |
| | Municipal Maintenance Activities | Street Sweeping | Collection of bacteria bound to sediment and vegetation through large municipal programs focused on drainage/flood control, waste management, and pollution control. | Municipal Stormwater Programs in the Newport Bay watershed |
| | | Solid Waste Collection | | |
| | | Drainage Facility Maintenance | | |
| | | Trash & Debris Control | | |

| BMP Category | Best Management Practice | BMP Program | Description of BMP Program | Applicable Public Agency(s) |
|---|---|---|---|---|
| | Controls Addressing Multiple Urban Runoff Sources | Dry Weather Diversion and Drain Plugging | Dry weather diversion of back bay drain to OCSD beginning in 2001. Plugging four small drains in the Newport Dunes parking lot during dry weather. | Dunes Maintenance Staff and City of Newport Beach |
| Controls for Other Urban Sources | Septic System and Sewer Line Management | Municipal sewer/public works departments and public sanitation districts | Sewer line maintenance and rehabilitation and pump stations in the Lower Newport Bay subwatershed. Installation, repair or replacement of local sewer lines, laterals and cleanouts | Orange County Sanitation District (OCSD) and municipalities in the Newport Bay watershed |
| | Wastewater and Sanitary Sewer Overflow Management | State of California's Non-point Source (NPS) program and TASC/CASC Programs | Waste Discharge Requirements (WDR) for the operation of sewage collection systems. Preparation and implementation of a Sewer System Management Plan (SSMP). Tustin Area Spill Control (TASC) and Countywide Area Spill Control (CASC) Programs enhance agency coordination for sewage spill response. | Santa Ana Regional Board; SSMP s developed by City of Newport Beach and other municipalities in the watershed; County coordination of TASC/CASC programs |
| | Wastewater Treatment | POTW Pollution Control Program (NPDES) | Operation and maintenance of the Michelson Water Reclamation Plant in the San Diego Creek watershed. | Irvine Ranch Water District (IRWD) |
| Vessel Waste Controls | Resolutions, Orders and Solid Waste Management | Clean Water Act Section 312. | Standards for marine sanitation devices (MSD) and no-discharge zone (NDZ) designations. | EPA, the Coast Guard and State of California |
| | | California Code of Regulations (CCR) | Standards establishing criteria for the design, construction, operation and maintenance of pumpout facilities. | SWRCB and Santa Ana Regional Board |
| | | Pumpout Facility Operation and Maintenance | Installation of pumpout facilities and dump stations at specific locations. Education, access, operation and maintenance of pumpout stations. | City of Newport Beach and Private Marinas |
| | | Statewide Marina Permit (In Development) | Unclear at this time. | Unknown |
| Agricultural Runoff Controls | Agriculture Pollution Prevention and Control Activities | State of California's Non-point Source (NPS) program | Waste Discharge Requirements (WDR) for nurseries greater than 5 acres in size. | Santa Ana Regional Board |

| BMP Category | Best Management Practice | BMP Program | Description of BMP Program | Applicable Public Agency(s) |
|---|---|---|---|---|
| | | Public Education and Outreach | BMP guide for nursery growers, land owners, employees and stormwater municipal staff. | University of California Cooperative Extension (Orange County), Orange County Coastkeeper, Orange County Farm Bureau and Southern California Edison |
| | | | Equestrian-Related Water Quality BMP Guide | Cooperative effort among Orange and San Diego County Public and Private Entities |
| Management of Natural Sources | Wildlife and Water birds Management | Water birds management programs | Relocation of mallard ducks out of the watershed from the Grand Canal on Balboa Island. | City of Newport Beach |
| Large-scale Restoration and Treatment Efforts | Bay and Tributary Stormwater Treatment Controls | San Joaquin Marsh | Construct marsh to reduce nutrient concentrations in the San Diego Creek and the Bay. | Irvine Ranch Water District (IRWD) |
| | | Sediment Trapping Basins | Construction of 7 foothill water retarding/sediment trapping basins in upper San Diego Creek watershed and 3 in-channel sediment trapping basins in the lower reach of San Diego Creek. | County of Orange, the Irvine Company and the cities of Newport Beach, Irvine, Tustin and Lake Forest |

# 9.0 RECOMMENDED BMPS AND TECHNICAL STUDIES

Sources and pathways of FIB to Newport Bay (Bay) priority areas were identified in Section 7.0. In Section 8.0, the extensive efforts taken to-date by local agencies to reduce FIB impacts on the Bay were summarized. Based on the information presented in these sections and our current understanding of the effectiveness of BMPs to reduce FIB in receiving water bodies, this section provides recommendations on:

1. New and/or enhanced BMPs for all sources and pathways that appear to contribute to FIB to specific priority areas in the Bay;
2. Technical studies intended to assist watershed managers in developing a better understanding of FIB contributions to the Bay from specific sources and pathways; and,
3. Revisions to selected portions of the Santa Ana Basin Water Quality Control Plan (Basin Plan) applicable to FIB in the Bay.

Preliminary planning-level cost estimates for recommended BMPs and technical studies are also presented in this section and Appendix J. Cost estimates are based on available information from Orange County or other similar geographical areas and are for planning purposes only.

With regard to water quality in the Bay, many of the public agencies are required by State and Federal policies and laws to implement BMPs designed to reduce the impacts of FIB and associated pathogens from their respective sources or pathways to the Bay. Table 9.1 provides a short list of these public agencies and the associated existing regulatory mechanism(s) by which FIB reductions may occur.

## 9.1 Recommended BMPs to Reduce FIB in Newport Bay

As described in Section 8.0, BMPs are defined as the most effective and practicable means of preventing or reducing FIB-related impacts in Newport Bay. As described by Olivieri et al. (2006) and Clary et al. (2008), however, relatively little high quality information is available on the effectiveness of individual BMPs to significantly reduce FIB from sources and pathways. That said, decreases in long-term average concentrations of FIB at monitoring stations in Newport Bay appear to coincide with the implementation of certain BMPs (see Figures 4.2 & 4.3), suggesting that improvements in Bay water quality are likely, in part, due to BMPs already in place. Therefore, based on this demonstrated success, recommendations presented in this section are intended to build upon existing efforts at specific areas of interest in Newport Bay.

Recommended BMPs are first listed in this section (and Table 9.2) by TMDL source category. Later in section, BMPs are prioritized for each dry or wet weather area of interest in Newport Bay based the site prioritization presented in Section 6.0 and on our current understanding of the contributions of FIB from specific sources and pathways to these sites (see Section 7.0). Furthermore, considerations of human health risk based on contributions from human and non-human sources of FIB (and enteric pathogens), are also incorporated into the BMP prioritization process, where applicable.

Table 9.1. Public agencies and stakeholders in the Newport Bay watershed, associated primary areas of interest, and potential regulatory mechanisms for control FIB in Newport Bay.

| Newport Bay Fecal Coliform TMDL Source Category | Primary Area of Interest | Implementing Public Agency or Stakeholder | Regulatory Mechanism for FIB Control |
|---|---|---|---|
| Urban Runoff | Municipal Stormwater | Cities within the Newport Bay Watershed and the County of Orange<br><br>Citizens/Visitors to Newport Bay | MS4 NPDES Permit<br><br>Local Ordinances |
| | Construction Site Runoff | Construction Site Operators | NPDES General Permit for Construction Site Stormwater |
| | Runoff from Industrial Facilities | Industrial Facility Owners and Operators | NPDES General Permit for Stormwater from Industrial Facilities |
| Other Urban Sources<br><br>(New Category not currently included in TMDL) | Septic Systems | County of Orange | Local Ordinances |
| | Sanitary Sewer Overflows | Orange County Sanitation District<br><br>Irvine Ranch Water District (IRWD)<br><br>Cities within the Newport Bay watershed | Waste Discharge Requirements for Sanitation Districts<br><br>Local Ordinances and Plans |
| | Swimmer Shedding | Beach Owners and Operators<br><br>Beach Visitors | None Applicable |
| Vessel Waste | Sewage Discharge from Boats<br><br>Spills and Leaks from Pumpout Stations | Vessel Owners and Operators<br><br>Marina Owners and Operators<br><br>City of Newport Beach | Federal Water Pollution Control Act<br><br>California Code of Regulations<br><br>State and Regional Board Orders<br><br>Local Ordinances |
| Agricultural Runoff | Nursery Runoff<br><br>Equestrian-Related Activities<br><br>Crop Lands and Livestock | Local Nurseries<br><br>Horse Stables and Private Owners<br><br>Row Crop Landowners and Livestock Owners | Waste Discharge Requirements for Nurseries<br><br>Waste Discharge Requirements for Concentrated Animal Facilities (CAFOs)<br><br>Non-Point Source (NPS) Program |
| Natural Sources | Wildlife<br><br>Sediments. Algal Mats and Biofilms | California Department of Fish and Game<br><br>None | None<br><br>None |

Table 9.2. Summary of recommended BMPs and Level of Effort (LOE) to reduce FIB in Newport Bay.

| Source/BMP Category | Recommended BMP | Recommended Implementation Level | |
|---|---|---|---|
| | | Current LOE | Enhanced LOE |
| *Urban Runoff* | | | |
| Domestic Pet Waste | City/County Ordinance Enforcement | ♠ | |
| | Public Education and Outreach to Residents and Dog-walkers | | ♠ |
| | Bag Dispenser Program at Parks/Waterfront Areas | | ♠ |
| Fertilizers, Biosolids & Over-Irrigation | Model IPM Program Implementation | ♠ | |
| | Identification of Commercial and Residential Property-owners Over-Irrigating and Promotion of Smart Controllers | | ♠ |
| | Adoption of Water Conservation in Landscaping Ordinance Applicable to Residential and Commercial Properties | | ♠ |
| | Public Education and Outreach | | ♠ |
| Illegal Discharges & Illicit Connections | Implementation of ID/IC Programs | ♠ | |
| | Source Characterization via Sanitary Surveys | | ♠ |
| Municipal Maint. | Implementation of Model Municipal Maintenance Program | ♠ | |
| Urban Runoff Treatment/Diversion | Natural Treatment Systems in the San Diego Creek Watershed | | ♠ |
| | Advanced Treatment (on-site disinfection or diversion) | ♠ | |
| *Vessel Waste* | | | |
| Vessel Discharges | Enforcement of No Discharge Zone and Local Ordinances | ♠ | |
| Pumpout Stations | Implementation of Pumpout Station Operation, Maintenance and Inspection Programs | ♠ | |
| *Other Urban Sources* | | | |
| Septic Tank Systems | Public Education and Outreach | ♠ | |
| Sewer Lines | Inspection and Possible Replacement of Sewer Lines at Current Level of Effort | ♠ | |
| SSOs & Spills | BMPs for Reducing SSOs and Sewage Spills | | ♠ |
| Swimmer Shedding | Public Education and Required Showering Prior to Swimming | | ♠ |
| *Agricultural Runoff* | | | |
| Nurseries | Implementation of Runoff Reduction Measures | ♠ | |
| | Periodic Site Inspections of Nurseries | | ♠ |
| Equestrian-Related Activities | Implementation of Equestrian-Related BMPs to Protect Water Quality | ♠ | |
| Croplands and Livestock | Implementation of BMPs to Protect Water Quality | ♠ | |
| *Natural Sources* | | | |
| Wildlife | Relocating or Hazing Birds from Lower Bay Beaches | ♠ | |
| Biofilms | Studies to determine the relative contributions of FIB from biofilms | | ♠ |
| Vegetation | Implementation of Municipal Maintenance & Vegetation Waste Management Progs. | ♠ | |
| Sediment | Implementation of Construction Site Inspection and Municipal Maintenance Progs. | ♠ | |

### 9.1.1 Urban Runoff BMPs

The urban runoff source category identified in the Newport Bay Fecal Coliform TMDL is comprised of multiple anthropogenic sources that deposit FIB onto the surface of the watershed. Discharges from municipal stormdrain systems to the Bay are regulated under NPDES permits issued by the Santa Ana Regional Water Quality Control Board (Regional

Board) for five-year terms. Additionally, stormwater NPDES permits for industrial and construction activities are issued by the State Board and enforced by the Regional Board.

Based on our current understanding of FIB transport processes from the Bay watershed to the Bay, dry and wet weather runoff flowing into municipal stormdrain systems appears to contribute to exceedances of water quality objectives in specific areas of interest in the Bay (see Section 7.0). The primary urban runoff sources contributing FIB to dry and wet weather runoff appear to be domestic pet waste, fertilizers and wildlife waste deposited onto the surface of the watershed. To a lesser extent, illicit discharges may contribute to sources to urban runoff.

Urban runoff BMPs are typically focused on pollution prevention, maintenance practices or treatment. Recommended new and/or enhanced urban runoff pollution prevention, maintenance practice and treatment BMPs are presented below with preliminary planning level cost estimates. The recommended level of effort of implementation (i.e., current or enhanced) for each recommended BMP is discussed below and included in Table 9.2. The BMPs recommended for implementation at specific locations in the watershed are presented in Section 9.2.

### *Pollution Prevention and Source Control BMPs*

Domestic Pet Waste

- Continue to effectively enforce municipal pet waste ordinances. If existing ordinances do not require individuals to appropriately dispose of waste from their domestic pets into the garbage or toilet, then ordinances should be updated.
- Enhance public education to residents on the water quality impacts of improper disposal of domestic pet waste and recommend appropriate pollution prevention BMPs, such as picking up and disposing of waste into the garbage or toilet.
- Evaluate the effectiveness of existing BMPs designed to promote proper pet waste disposal (e.g., bag dispensers for pet waste) and explore opportunities for improvements, which may include increasing the number of pet waste bag dispensers at public parks and areas frequented by dogs.
- Increase (where applicable) support and encouragement for Homeowners Associations (HOAs) to contract with private companies (e.g., Entre-Manure, LLC) to effectively remove domestic pet waste deposited in neighborhoods and communities.

Fertilizer/Biosolids Applications and Over-Irrigation

- Continue to implement Model IPM, Pesticide and Fertilizer Guidelines (IPM Guidelines), including self-audits and training for municipal staff.
- Water Districts in the watershed (e.g., IRWD), in coordination with municipalities, should continue promote the use of drought tolerant vegetation, identify properties where over-irrigation practices are observed, provide focused consultation with property owners to assist in implementing “smart” controllers or other water conversation practices, and conduct enforcement if necessary.
- Evaluate the need for adopting a water conservation in landscaping ordinance based on a preliminary draft ordinance issued by the California Department of Water Resources (DWR) to meet the requirements of the Water Conservation in Landscaping Act of 2006 (AB1881).
- Water Districts in the watershed (e.g., IRWD), in coordination with municipalities, should evaluate the need and potential effectiveness of expanding public education

and outreach on water conservation with a specific focus on reducing landscape over-irrigation.
- Although the use of biosolids for fertilizer applications in the watershed appears to be minimal, BMPs should be evaluated to insure water quality is protected.

Illegal Discharges and Illicit Connections (ID/IC)

- Continue to implement existing ID/IC programs and make any modifications to the program based on the latest municipal stormwater NPDES permit applicable to municipalities in the watershed.
- Continue to implement inspections at food service facilities (e.g., restaurants), identify issues associated with FIB (e.g., waste management) and require adequate BMP implementation.
- Conduct a focused source identification study on municipal stormdrains discharging directly to dry weather areas of interest in Newport Bay to further identify sources of FIB.
- If recommended technical studies suggest that Santa Ana Delhi Channel is a significant contributor of FIB to the Upper and/or Lower Newport Bay (see Section 9.3), conduct a sanitary survey in the channel watershed. Examples of effective sanitary survey protocols are provided in Appendix K.

Municipal Maintenance Activities

- Continue to implement the Orange County Stormwater Program's Model Municipal Activities Program (Model Program), which establishes a framework for conducting a systematic program of evaluation and BMP implementation that targets fixed facilities, field programs and drainage facilities.
- Evaluate the need to enhance flushing of municipal stormdrains identified as high contributors of FIB via biofilm to dry weather areas of interest in Newport Bay based on the findings of source identification studies and sanitary surveys.

***Urban Runoff Treatment***

Urban runoff treatment BMPs include on-site treatment systems (e.g., retention ponds, swales, media filters, bioretention) and diversions to treatment facilities. Studies that have documented the effectiveness of treatment BMPs (e.g., wet ponds, vegetated swales and proprietary devices) in reducing FIB in urban runoff are limited and have used inconsistent methodologies that make comparisons difficult (Olivieri et al. 2006). Furthermore, based on current information presented in the International Stormwater BMP Database, reductions in FIB concentrations have only been observed for a small set of on-site treatment BMPs (e.g., retention ponds and media filters). However, effluent concentrations for these BMPs typically remain above water quality objectives and criteria, suggesting that they may not be effective options for FIB. The following paragraphs briefly describe other urban runoff treatment options that should only be considered if the recommended enhanced pollution prevention and source control BMPs described above do not effectively reduce FIB at areas of concern in Newport Bay.

- Natural Treatment Systems - Within the next 5 to 10 years, the IRWD plans to construct about 37 small wetlands scattered throughout the San Diego Creek watershed. The project is modeled after the San Joaquin Marsh and is planned to divert dry-weather runoff from existing and new development through the network of ponds and marshes, where plants and microbes will absorb nitrogen and reduce

bacteria and other pollutants. Plans call for water to be returned to San Diego Creek with reduced concentrations of FIB. Due to the estimated reductions of FIB projected, the project is recommended for implementation. The IRWD estimates that this Natural Treatment System will cost $25 million to $30 million to build.

- Physical/Chemical Treatment - In addition to the planned natural treatment system described above, treatment (i.e., disinfection and diversions) is also a possible BMP for urban runoff. Possible on-site disinfection of urban runoff (in combination with pretreatment suspended sediment removal) and diversion of dry weather runoff to Publicly Owned Treatment Works (POTWs) have been successfully implemented in Southern California. However, both diversions and onsite disinfection have their limitations and should be approached cautiously. As described in Appendix J, on-site disinfection and diversion of dry weather runoff can be expensive to implement and therefore, it is recommended that sanitary surveys be conducted in municipal stormdrain systems of interest prior to considering these treatment options. If sanitary survey results are inconclusive, then a full cost-benefit analysis, which includes the consideration of risk to human health, is recommended as part of considering diversions to POTWs or onsite disinfection.

### 9.1.2 Other Urban Sources

#### *Septic Tank System Failures*

Due to the lack of proximity of rural properties to the Newport Bay that use septic tank systems, septic tank systems are not considered a high priority source of FIB to the Bay (see Section 7.0). Furthermore, as sanitary sewer system service reaches rural areas and as homeowners connect to the County's sanitary sewer system where service is available, the number of septic tank system failures is expected to decline. Therefore, the recommended BMPs for septic tank systems at this time are limited to continuing to develop and distribute public education materials describing proper septic tank system operation and maintenance to owners via either direct mail or the www.ocwatersheds.com website.

#### *Leaking Sanitary Sewer Lines and Laterals*

Little is currently known about the load of FIB to the Bay, tributaries or municipal stormdrain systems associated with leaking sewer lines. Although, the City of Newport Beach has developed a plan to update older sanitary sewer lines as redevelopment occurs, this potential source is currently identified as a high priority due the public health concern regarding potential inputs of human enteric pathogens. In particular, an evaluation[37] of the presence of leaking sanitary sewer lines and laterals in the vicinity of Western Newport Bay and 10th Street Beach is recommended[38].

Additionally, cities within the Newport Bay watershed should consider requiring property owners or management companies of multifamily residential dwellings and commercial buildings to provide a Closed Circuit Television (CCTV) inspection of their sewer lateral prior to selling a property. If the structural integrity of the sewer lateral is significantly reduced, owners could be required to replace the lateral prior to the transfer of ownership. For example, the City of Berkeley (California) recently adopted an ordinance requiring CCTV

[37] There are a variety of techniques which can be used to identify exfiltration (leaking) of sewage, including dye testing, water tests and manual surveys.

[38] It is our understanding that the City of Newport Beach has already conducted evaluations on many lines within these areas and will continue to conduct inspections over the next two years.

inspection and repair of sewer laterals prior to the transfer of ownership of any commercial, industrial, and residential property.[39]

### *Sanitary Sewer Overflows and Spills*

The vast majority of Sanitary Sewer Overflows (SSOs) occur at multi-family dwellings and food service establishments (Dudek 2008). Based on an SSO assessment conducted by Dudek, Inc.(2008) and the recommendations of the committee associated with this study, the following BMPs are recommended for reducing SSOs and sewage spills in the Newport Bay watershed.

- Inspection After An Overflow – Cities and sanitation districts should require an inspection of the sewer lateral within a specified number of days following a blockage or overflow of the sewer lateral. The inspection would provide current information on the condition of the sewer lateral, whether the cause of the blockage was mitigated and what additional work might be required to ensure the lateral would not experience additional overflows in the future.
- Educational Outreach Program – An enhanced educational outreach program focused on business should be developed in an effort to stress the proper use of the sewer system with instruction of what types of material may or may not be disposed of within the sewer system. Coordination with existing educational outreach efforts is recommended.
- Model Sewage Spill Response Procedures – Implementation of the County of Orange and OCSD Countywide Area Spill Control (CASC) Program should be continued, including the development of sanitary sewer overflow (SSO) response procedures; selection of primary and backup sewage spill response contractors for containment and recovery of SSOs; and, SSO hands-on field response training for Permittee staff and municipal sewering agency staff. Consider gradual phasing of CASC throughout the County so that the proactive interagency planning and coordination for sewage spill response can be implemented and/or improved in the entire Newport Bay watershed.
- Fats, Oils and Grease (FOG) Reduction Program – Public agencies in the Newport Bay watershed currently successfully implement FOG programs. Continued implementation and looking for ways to improve program effectiveness is recommended.
- Scheduled Reoccurring Lateral Inspections – Cities or local public sewering agencies should consider requiring that multifamily sewer laterals be routinely inspected based upon a predetermined frequency. Inspections would consist of at least a CCTV inspection by a licensed plumber and provide the local public sewering agency with proof that the sewer lateral has passed the inspection.
- Scheduled Lateral Inspections Based Upon Remodels – Cities or local public sewering agencies should consider requiring that sewer laterals be inspected before any home/business remodel of a specified dollar value or the addition of a specified number of square feet of habitable space is finalized, or when a specified number (or more) of new plumbing fixtures are attached to the existing sewer lateral.

[39] http://www.ci.berkeley.ca.us/ContentDisplay.aspx?id=8160

***Swimmer Shedding***

Research over the last decade indicates that FIB in recreational waters can originate from swimmers (Gerba 2000; Elmir et al. 2007), and crowded beach waters can have relatively high concentrations of FIB (Kay et al. 1994; Elmir et al. 2007). In Newport Bay, Jiang et al. (2004) concluded that swimmers and swimmer-induced sediment resuspension do not appear to be the cause of observed increases of FIB in Newport Dunes swimming areas. However, due to remaining uncertainties of the impacts of swimmers to water quality at Dunes swimming areas, it is recommended that the management company that currently owns and operates the water park at the Newport Dunes Waterfront Resort and Marina increase their level of public education to recreators and increase or begin signage asking swimmers to shower before they enter the water. Additionally, it is recommended that all owners and operators of beaches in Newport Bay require swim diapers for small children that are not potty-trained and swimming in these areas. The costs associated developing and posting signage to implement these public education BMPs is expected to be less than $1,000. Additional cost considerations for public education activities are also provide at the end of this section.

### 9.1.3 Vessel Waste BMPs

Vessel waste is a source of human sewage that very likely contains human enteric pathogens. Therefore, ensuring the proper waste management for commercial and recreational boats should be a high priority for all Newport Bay stakeholders. Vessel sewage discharge is specifically regulated under Clean Water Act Section 312 and Newport Bay is a no-discharge zone (NDZ) for vessels. Additionally, California Code of Regulations (CCR) (Title 23, Chapters 20 and 20.1) contains procedures for the SWRCB and Regional Boards to follow in requiring any person lawfully vested with the possession, management, or control of a marine terminal to provide adequate vessel sewage retention device pumpout capability at locations which are convenient and accessible to vessel users. The regulations include standards establishing criteria for the design, construction, operation and maintenance of pumpout facilities, and specify administrative procedures to be followed to provide a standard method of determining which vessel terminals shall be required to install and operate these facilities.

Currently, there are 16 pumpout stations located in the City of Newport Beach (City). As required by the Regional Board Orders, pump station owners must inspect pumpout stations five times per week during summer, and three times per week during the winter (See Section 8.4 for additional information). City staff performs these inspections on the four pump stations owned and operated by the City. In addition, City staff inspect all of the pump stations, both public and private, once a week to make sure they are operational. The Regional Board must also review the effectiveness of the vessel waste pumpout program at a minimum of every two years to determine if revisions of the facility standards are necessary (Regional Board 2005).

Based on the current level of BMP implementation required through Orders issued by the Regional Board, additional BMPs are not recommended at this time. However, as mentioned above, discharges from vessel waste activities (in particular during dry weather periods) should be considered a high priority and responded to quickly and effectively by the appropriate agencies to reduce potential exposure of waste to the public and eliminate the reoccurrence of discharges. Additionally, if the Statewide Marina Permit (see Section 8.3) requires additional BMPs, or if further assessments of water quality monitoring data indicate

that vessel waste is emerging as an important source of FIB to the Bay, it is recommended that an evaluation of whether the current pumpout operation and maintenance BMPs and the density of pumpouts are sufficient. Planning level cost estimates for improving current vessel waste management programs are provided in Appendix J.

### 9.1.4 Agricultural Runoff

Agricultural runoff includes discharges from farms, nurseries, confined animal facility operations (CAFOs) and golf courses. Runoff from agricultural land uses is hypothesized to be relatively minimal (particularly during dry weather) due to recently implemented BMPs, conversion of land to non-agricultural uses, and Waste Discharge Requirements (WDR) issued by the Regional Board to each nursery in the watershed greater than 5 acres in size. Efforts by the University of California Cooperative Extension, the Orange County Farm Bureau and other local stakeholders to a develop guidance on BMP implementation for nurseries is a positive step to ensuring that runoff from nurseries does not contribute to water quality impacts in Newport Bay. Additional implementation of runoff reduction measures such as using full recycled water systems for irrigation and low flow precipitation irrigation heads are also recommended for nurseries and small farms that exist in the watershed. Periodic site inspections by Regional Board staff combined with evaluations of water quality data, fertilizer usage and BMP implementation consistent with WDRs is also recommended.

### 9.1.5 BMPs for Natural Sources

Natural sources of FIB include Bay and watershed wildlife, vegetation, biofilm and algal mats. Compared to anthropogenic sources, there are limited options for controlling FIB from natural sources. For wildlife that reside in the watershed, no BMPs are recommended aside from those described in the urban runoff section. For birds within the Bay, focused efforts to relocate ducks from specific beach sites in the Lower Bay have been conducted by the City of Newport Beach. For those areas of interest identified in Lower Bay (Section 6.0) that are believed to have significant contributions of FIB from birds considerations should be given to potential relocation or hazing of birds to discourage their presence. No such controls are recommended for Upper Bay due to its designation as an ecological reserve.

With regard to biofilm in municipal stormdrain systems or tributary channels, and sediment resuspension in the Bay, it is recommended that as a first step attention be given to better characterizing the contribution of FIB from this source to areas of interest in the Bay. Specific characterization studies are more fully described in Section 9.3. Recommended BMPs associated with vegetation and sediment entering municipal stormdrain systems include those described for urban runoff municipal maintenance (Section 9.1.2). No BMPs for algal or debris mats are recommended at this time.

### 9.1.6 BMPs for Dunes Recreational Area

For nearly a decade, significant improvements in water quality have been observed at the Newport Dunes Recreational Area – an area where substantially more recreation occurs compared than any other recreational site in Newport Bay (see Table 3.2; Figure 3.2). These improvements are a result of the following BMPs that have been effectively implemented are therefore recommended for continued implementation into the future.

- Continued diversion of the Back Bay Drain to the Orange County Sanitation District (OCSD) treatment facility during dry weather months (April-September).; and,

- Continued plugging during dry weather of small drains that receive runoff from the parking lots and landscaped areas adjacent to the Dunes.

## 9.2 Prioritization of BMPs by Priority Area

Recommended BMPs were described by TMDL source category in the previous section. Here, recommended BMPs are prioritized by dry and/or wet weather areas of interest based on our current understanding of contributions of FIB from sources and pathways (see Section 7.0). Dry and wet weather areas of interest were identified based on FIB water quality data (see Section 6.0) and prioritized using four "levels of priority" (i.e., levels 1 to 4, 1 being the highest priority). As additional information becomes available on the contributions and impacts from specific FIB sources and pathways, watershed managers may choose to reprioritize or augment recommended BMPs.

### 9.2.1 Recommended BMPs for Dry Weather Priority Areas

***Western Newport Bay (38th St., 33rd St., Newport Blvd. Bridge & BTO 8)***

Based on the site prioritization process described in Section 6.0, no monitoring sites in Western Newport Bay (WNB) received the highest levels of priority (i.e., Levels 1 or 2) during dry weather. However, one site (BTO 8) was identified as Level 3 Priority, and three sites (38$^{th}$ St., 33$^{rd}$ St. and Newport Blvd Bridge) were identified as Level 4 Priority. Considerable efforts have been conduced to-date to characterize and reduce FIB in WNB, including BMP implementation by the City of Newport Beach to reduce domestic pet waste and over-irrigation. In addition, the bioswale recently constructed within the channel leading to Arches drain has likely assisted in reducing FIB in WNB, although water quality data have not yet been analyzed to confirm this assumption.

A prioritized list of recommended BMPs that build upon existing efforts to further reduce FIB in the WNB area of interest is presented in Table 9.3. Prior to the implementation of BMPs at an enhanced level of effort, it is recommended that FIB data from Arches drain first be analyzed to determine if the bioswale constructed in 2008 has significantly reduced FIB concentrations of FIB in WNB during dry weather. If FIB concentrations have remained elevated since the construction of the bioswale, it is recommended that future BMP implementation be primarily focused on identifying FIB sources through a sanitary survey and reducing contributions of FIB from watershed areas draining directly to WNB via municipal stormdrains.

Table 9.3. Recommended BMPs to reduce FIB in Western Newport Bay during dry weather.

| Source/BMP Category | Recommended BMP | Recommended Level of Priority |
|---|---|---|
| *Urban Runoff* | | |
| Domestic Pet Waste | Continued and Enhanced Ordinance Enforcement | High |
| | Enhanced Public Education and Outreach | High |
| | Enhancement of Bag Dispenser Program at Parks/Waterfront Areas | High |
| Fertilizers & Over-irrigation | Model IPM Implementation | High |
| | Enhanced Identification of Properties Over-Irrigating and Promotion of Smart Controllers | High |
| | Adoption of Water Conservation in Landscaping Ordinance | High |
| | Enhanced Public Education and Outreach | High |
| Illegal Discharges & Illicit Connections | Continued Implementation of ID/IC Programs | Medium |
| | Source Characterization via Sanitary Surveys | Medium |
| Muni. Maintenance | Continued Implementation of Model Municipal Maintenance Program | High |
| Urban Runoff Treatment | Implementation of Natural Treatment Systems in the San Diego Creek Watershed | NA |
| | Additional Advanced Treatment (on-site disinfection or diversion) | Low |
| *Other Urban Sources* | | |
| Septic Tank Systems | Continued Public Education and Outreach | NA |
| Sewer Lines | Continued Inspection and Possible Replacement of Sewer Lines at Current Level of Effort | Low |
| SSOs & Spills | Implement Recommended BMPs for Reducing SSOs and Sewage Spills | Low |
| Swimmer Shedding | Public Education and Require Showering Prior to Swimming | Low |
| *Vessel Waste* | | |
| Vessel Discharges | Continued Enforcement of No Discharge Zone and Local Ordinances | High |
| Pumpout Stations | Continued Implementation of Pumpout Station Operation, Maintenance & Inspection Programs | High |
| *Agricultural Runoff* | | |
| Nurseries | Continued Implementation of Runoff Reduction Measures | Low |
| | Periodic Site Inspections | Low |
| Equestrian-Related Activities | Implementation of Equestrian-Related BMPs to Protect Water Quality | Low |
| *Natural Sources* | | |
| Wildlife | Relocating or Hazing Birds from Lower Bay Beaches | Low |
| Veg/Biofilm/Sediment | Continued Implementation of Municipal Maintenance & Vegetation Waste Management Progs. | High |

### *Bayside Drive Beach*

Although Bayside Drive Beach received the lowest level of priority (Level 4) of all areas of interest identified in Newport Bay, minimal exceedances of water quality criteria (15.6% of samples exceeded geomean water quality criteria for *Enterococcus*) have occurred from 2004 through 2007. Based on the conclusions presented in Section 7.0 (Source and Pathway Prioritization), contributions from domestic pet waste, fertilizers via over-irrigation of landscaped areas, wildlife and biofilms appear to have the greatest affect on water quality at this area of interest. Therefore, BMPs to address these sources are recommended as high priority for implementation in areas draining directly to Bayside Drive Beach via municipal stormdrains. These and other BMPs of lesser priority are presented in Table 9.4.

Table 9.4. Recommended BMPs to reduce FIB at Bayside Drive Beach during dry weather.

| Source/BMP Category | Recommended BMP | Recommended Level of Priority |
|---|---|---|
| *Urban Runoff* | | |
| Domestic Pet Waste | Continued and Enhanced Ordinance Enforcement | High |
| | Enhanced Public Education and Outreach | High |
| | Enhancement of Bag Dispenser Program at Parks/Waterfront Areas | High |
| Fertilizers & Over-Irrigation | Model IPM Implementation | High |
| | Enhanced Identification of Properties Over-Irrigating and Promotion of Smart Controllers | High |
| | Adoption of Water Conservation in Landscaping Ordinance | High |
| | Enhanced Public Education and Outreach | High |
| Illegal Discharges & Illicit Connections | Continued Implementation of ID/IC Programs | Medium |
| | Source Characterization via Sanitary Surveys | Low |
| Municipal Maintenance | Continued Implementation of Model Municipal Maintenance Program | High |
| Urban Runoff Treatment | Implementation of Natural Treatment Systems in the San Diego Creek Watershed | NA |
| | Advanced Treatment (on-site disinfection or diversion) | Low |
| *Vessel Waste* | | |
| Vessel Discharges | Continued Enforcement of No Discharge Zone and Local Ordinances | High |
| Pumpout Stations | Continued Implementation of Pumpout Station Operation, Maintenance and Inspection Programs | High |
| *Other Urban Sources* | | |
| Septic Systems | Continued Public Education and Outreach | NA |
| Sewer Lines | Continued Inspection and Possible Replacement of Sewer Lines at Current Level of Effort | Low |
| SSOs & Spills | Implement Recommended BMPs for Reducing SSOs and Sewage Spills | Low |
| Swimmer Shedding | Public Education and Require Showering Prior to Swimming | Low |
| *Agricultural Runoff* | | |
| Nurseries | Continued Implementation of Runoff Reduction Measures | Medium |
| | Periodic Site Inspections | Low |
| Equestrian-Related Activities | Implementation of Equestrian-Related BMPs to Protect Water Quality | Low |
| *Natural Sources* | | |
| Wildlife | Relocating or Hazing Birds from Lower Bay Beaches | Low |
| Veg/Biofilm/Sediment | Continued Implementation of Municipal Maintenance and Vegetation Waste Management Programs | High |

### *10th Street Beach*

Similar to Bayside Drive Beach, 10th Street Beach received a Level 4 Priority due to minimal exceedances of water quality objectives/criteria (11.0% of samples exceeded geomean water quality criteria for *Enterococcus*) that occurred from 2004 through 2007. Based on the conclusions presented in Section 7.0 (Source and Pathway Prioritization), contributions from domestic pet waste, fertilizers via over-irrigation of landscaped areas and biofilms appear to have the greatest affect on water quality at this area of interest. Other sources that may be contributing FIB to 10th Street Beach include leaking sewer lines and water birds.

A prioritized list of recommended BMPs that build upon existing efforts to further reduce FIB in the 10th Street Beach area of interest is presented in Table 9.5. It is recommended that

these BMPs be primarily focused on sources within the watershed areas draining directly to, or near 10th Street Beach via municipal stormdrains.

Table 9.5. Recommended BMPs to reduce FIB at 10th Street Beach during dry weather.

| Source/BMP Category | Recommended BMP | Recommended Level of Priority |
|---|---|---|
| *Urban Runoff* | | |
| Domestic Pet Waste | Continued and Enhanced Ordinance Enforcement | High |
| | Enhanced Public Education and Outreach | High |
| | Enhancement of Bag Dispenser Program at Parks/Waterfront Areas | High |
| Fertilizers & Over-Irrigation | Model IPM Implementation | High |
| | Enhanced Identification of Properties Over-Irrigating and Promotion of Smart Controllers | High |
| | Adoption of Water Conservation in Landscaping Ordinance | High |
| | Enhanced Public Education and Outreach | High |
| Illegal Discharges & Illicit Connections | Continued Implementation of ID/IC Programs | Medium |
| | Source Characterization via Sanitary Surveys | Medium |
| Municipal Maintenance | Continued Implementation of Model Municipal Maintenance Program | High |
| Urban Runoff Treatment | Implementation of Natural Treatment Systems in the San Diego Creek Watershed | Low |
| | Advanced Treatment (on-site disinfection or diversion) | Low |
| *Vessel Waste* | | |
| Vessel Discharges | Continued Enforcement of No Discharge Zone and Local Ordinances | High |
| Pumpout Stations | Continued Implementation of Pumpout Station Operation, Maintenance and Inspection Programs | High |
| *Other Urban Sources* | | |
| Septic Systems | Continued Public Education and Outreach | NA |
| Sewer Lines | Continued Inspection and Possible Replacement of Sewer Lines at an Enhanced Level of Effort | High |
| SSOs & Spills | Implement Recommended BMPs for Reducing SSOs and Sewage Spills | NA |
| Swimmer Shedding | Public Education and Required Showering Prior to Swimming | Low |
| *Agricultural Runoff* | | |
| Nurseries | Continued Implementation of Runoff Reduction Measures | NA |
| | Periodic Site Inspections | NA |
| Equestrian Activities | Implementation of Equestrian-Related BMPs to Protect Water Quality | Low |
| *Natural Sources* | | |
| Wildlife | Relocating or Hazing Birds from Lower Bay Beaches | Medium |
| Veg/Biofilm/Sediment | Continued Implementation of Municipal Maintenance and Vegetation Waste Management Programs | High |

### *Upper Bay (Vaughns Launch, Ski Zone, BTO 5 & BTO 4)*

Although the Upper Bay area of interest is designated as a REC-1 water body, it is comprised entirely of an Ecological Reserve where swimming is prohibited. That said, two monitoring sites in the Upper Bay (i.e., BTO4 and BTO5) received a Level 3 Priority, and two sites (i.e., Vaughns Launch and Ski Zone) received a Level 4 Priority. No sites in the Upper Bay received a Level 1 or 2 Priority. Based on information presented in Section 7.0, sources contributing the largest proportion of FIB to the Upper Bay include bird and other wildlife waste onto and tidal washing of, Bay mudflats. Other important FIB sources may include

domestic pet waste, fertilizers via over-irrigation of landscaped areas and biofilms transported to the Upper Bay via Santa Ana Delhi channel and/or San Diego Creek.

A prioritized list of recommended BMPs that build upon existing efforts to further reduce FIB in the Upper Bay is presented in Table 9.6. Although bird and other wildlife waste deposited onto mudflats are believed to be a very important source of FIB in the Upper Bay, these are natural sources and therefore associated BMPs are low priority. As an alternative, it is suggested that existing BMPs continue to be implemented while efforts are made to further characterize and quantify the contribution of FIB from the Santa Ana Delhi channel to the Upper Bay under dry weather conditions (see Section 9.3).

Table 9.6. Recommended BMPs to reduce FIB at in the Upper Bay during dry weather.

| Source/BMP Category | Recommended BMP | Recommended Level of Priority |
|---|---|---|
| *Urban Runoff* | | |
| Domestic Pet Waste | Continued and Enhanced Ordinance Enforcement | High |
| | Enhanced Public Education and Outreach | High |
| | Enhancement of Bag Dispenser Program at Parks/Waterfront Areas | High |
| Fertilizers & Over-Irrigation | Model IPM Implementation | High |
| | Enhanced Identification of Properties Over-Irrigating and Promotion of Smart Controllers | High |
| | Adoption of Water Conservation in Landscaping Ordinance | High |
| | Enhanced Public Education and Outreach | High |
| Illegal Discharges & Illicit Connections | Continued Implementation of ID/IC Programs | High |
| | Source Characterization via Sanitary Surveys | Medium |
| Muni. Maintenance | Continued Implementation of Model Municipal Maintenance Program | High |
| Urban Runoff Treatment | Implementation of Natural Treatment Systems in the San Diego Creek Watershed | NA |
| | Advanced Treatment (on-site disinfection or diversion) | Low |
| *Vessel Waste* | | |
| Vessel Discharges | Continued Enforcement of No Discharge Zone and Local Ordinances | NA |
| Pumpout Stations | Continued Implementation of Pumpout Station Operation, Maintenance & Inspection Programs | NA |
| *Other Urban Sources* | | |
| Septic Systems | Continued Public Education and Outreach | Low |
| Sewer Lines | Continued Inspection and Possible Replacement of Sewer Lines at Current Level of Effort | Low |
| SSOs & Spills | Implement Recommended BMPs for Reducing SSOs and Sewage Spills | NA |
| Swimmer Shedding | Public Education and Required Showering Prior to Swimming | Low |
| *Agricultural Runoff* | | |
| Nurseries | Continued Implementation of Runoff Reduction Measures | Medium |
| | Periodic Site Inspections | Low |
| Equestrian Activities | Implementation of Equestrian-Related BMPs to Protect Water Quality | Low |
| *Natural Sources* | | |
| Wildlife | Relocating or Hazing Birds from Upper Bay Beaches | NA |
| Veg/Sed/Biofilm | Continued Implementation of Municipal Maintenance & Vegetation Waste Management Progs. | High |

### 9.2.2 Recommended BMPs for Wet Weather Priority Areas

Recommended BMPs are described below for sources contributing FIB to the Lower and Upper Bays during wet weather[40]. Although the number of wet weather areas of interest identified in Section 6.0 is much greater than those prioritized for dry weather, recreator exposure is highly reduced during wet weather (EOA 2001, Soller 2006). Therefore, for the purpose of this SMP, BMPs designed to reduce FIB from wet weather sources and pathways are considered to be a much lower priority than BMPs described in the previous section for dry weather sources and pathways. The highest priority wet weather sites identified in Section 6.0 are:

- Newport Dunes North
- Newport Dunes East
- Newport Dunes West
- Newport Dunes Middle
- 10th Street
- North Star Beach
- Lido Yacht Club
- Bayshore Beach
- 19th Street
- Alvarado/Bay Island

Based on estimates of FIB contributions to the Lower and Upper Bays presented in Section 5.0, and modeling conducted by DeGeorge et al. (2003), Pednekar et al. (2007) and Grant et al. (2009), stormwater runoff that transports FIB from urban, agricultural and natural sources appears to contribute a large majority of the FIB to sites in the Lower Bay during wet weather. Priority urban and agricultural sources of FIB include pet waste, fertilizers applied to landscaped areas and at nurseries, horse boarding facilities, sanitary sewer overflows, and leaking sewer lines. Natural sources that may also contribute to wet weather FIB concentrations in the Bay include waste from terrestrial wildlife, tidal washing of Bay sediment and water bird droppings.

Due to the numerous sources that likely contribute FIB to the Lower and Upper Bays during wet weather, the recommended approach differs from that described for dry weather priority areas. Recommended BMPs prioritized as high priority are those that address contributions of FIB and pathogens from human-associated sources during wet weather. Medium priority BMPs include those that reduce contributions of FIB onto the surface of the watershed from sources during dry weather. Lower priority BMPs include those that address minor FIB sources or the urban runoff pathway during wet weather, which would likely meet significant engineering limitations due to the required storage and treatment of large volumes of water during infrequent and limited storm events BMPs (i.e., diversions or on-site disinfection). Recommended BMPs to address FIB in the Lower and Upper Bays during wet weather are presented in Table 9.7.

[40] Wet weather is defined as those days with ≥ 0.2 inches of precipitation plus 3 days following the rain event.

Table 9.7. Recommended BMPs to reduce FIB at in the Upper and Lower Bays during wet weather.

| Source/BMP Category | Recommended BMP | Recommended Implementation Level |
|---|---|---|
| *Urban Runoff* | | |
| Domestic Pet Waste | Ordinance Enforcement | Medium |
| | Public Education and Outreach | Medium |
| | Bag Dispenser Program at Parks/Waterfront Areas | Medium |
| Fertilizers & Over-Irrigation | Model IPM Program Implementation | Medium |
| | Identification of Properties Over-Irrigating and Promotion of Smart Controllers | Medium |
| | Adoption of Water Conservation in Landscaping Ordinance | Medium |
| | Public Education and Outreach | Medium |
| Illegal Discharges & Illicit Connections | Implementation of ID/IC Programs | Medium |
| | Source Characterization via Sanitary Surveys | Medium |
| Municipal Maintenance | Implementation of Model Municipal Maintenance Program | Medium |
| Urban Runoff Treatment | Natural Treatment Systems in the San Diego Creek Watershed | Medium |
| | Advanced Treatment (on-site disinfection or diversion) | Low |
| *Vessel Waste* | | |
| Vessel Discharges | Enforcement of No Discharge Zone and Local Ordinances | High |
| Pumpout Stations | Implementation of Pumpout Station Operation, Maintenance and Inspection Programs | High |
| *Other Urban Sources* | | |
| Septic Systems | Public Education and Outreach | High |
| Sewer Lines | Inspection and Possible Replacement of Sewer Lines at Current Level of Effort | High |
| SSOs & Spills | BMPs for Reducing SSOs and Sewage Spills | High |
| Swimmer Shedding | Public Education and Required Showering Prior to Swimming | Low |
| *Agricultural Runoff* | | |
| Nurseries | Implementation of Runoff Reduction Measures | Medium |
| | Periodic Site Inspections | Medium |
| Equestrian-Related Activities | Implementation of Equestrian-Related BMPs to Protect Water Quality | Medium |
| *Natural Sources* | | |
| Wildlife | Relocating or Hazing Birds from Lower Bay Beaches | Low |
| Veg/Sed/Biofilm | Implementation of Municipal Maintenance & Vegetation Waste Management Programs | Medium |

## 9.3 Recommended Technical Studies to Reduce Uncertainties[41]

As described in Sections 4.0 through 7.0, numerous technical studies have been conducted by local agencies and researchers in attempts to characterize the contribution of FIB from sources and pathways to Newport Bay. However, uncertainties remain in our understanding contributions of FIB from specific sources and pathways to geographical areas of interest where exceedances of water objectives/criteria are observed. Technical studies intended to reduce these uncertainties in four key topic areas are introduced below. Before these recommendations are implemented further scoping is likely needed to ensure results are meaningful and of a high level of confidence.

### 9.3.1 Evaluating the Relative Contributions of FIB from Biofilms

One possible source of FIB to Newport Bay may be biofilms[42]. Previous studies in Newport Bay have shown that small masses of biofilm (100g) collected from within municipal stormdrain systems can harbor and support the growth of millions of *Enterococci bacteria* and increase the concentration of FIB in discharges from municipal stormdrain systems during weather (Pednekar 2007). Although these studies provided valuable information on the ability of biofilms to impact water quality, a key question that remains unanswered is:

*What is the relative contribution of bioflims in dry and wet weather discharges from urban runoff conveyance systems?*

It is recommended that a technical study be conducted in an attempt to shed light on this important question. One possible study design could include rinsing selected urban runoff conveyance systems with disinfected potable water to simulate dry and wet weather flows, and collecting and analyzing water discharged for FIB and possible speciation/phenotyping. The study should be conducted during a time that minimizes dry weather runoff into the conveyance system (i.e., late afternoon), allowing better characterization of in-system sources such as bioflims. Alternatively, FIB concentrations from storm drains (i.e., outfalls) could be compared to samples collected from street curbs during summer and winter to assess the relative contribution of FIB from biofilms. Other studies could include those that attempt to determine FIB desorption rates from biofilms. Technical studies designed to develop a better understanding of the concentrations (or loads) of FIB directly attributable to this natural source would assist watershed mangers in revising the TMDL. It is estimated that this study would be of low to moderate cost ($50,000 to $75,000), while developing highly important information specific to source management.

### 9.3.2 Further Investigation of Santa Ana Delhi Channel Sources and Impacts

As described in Section 5.0, it is clear that FIB concentrations in dry weather discharges from the Santa Ana Delhi channel measured upstream of the channel/Bay interface are consistently higher than those from San Diego Creek or Big Canyon Wash. Furthermore, due to elevated FIB concentrations in Santa Ana Delhi channel[43] dry weather discharges, FIB loads from this tributary are similar to those from the much larger tributary - San Diego

[41] Recommendations presented in this section are those of the authors'. Recommendations are assumed to be of the highest priority based on existing information and may not include all studies required to fully understand FIB contributions to Bay water quality concerns.
[42] A biofilm is a slime layer which naturally develops when bacteria attach to vegetation, stone, metal, or wood. In nature, nonfilament-forming microorganisms (i.e., coliform bacteria) can stick to the surface of the biofilm in a location that provides an optimal growth environment (i.e., pH, dissolved oxygen, nutrients).
[43] Because the SAD sampling site is within the tidal prism, FIB concentrations from the SAD watershed may be higher than measured due to dieoff of FIB that likely occurs as organisms are exposed to higher salinities in the tidal prism.

Creek. To our knowledge, no explanations for the higher FIB concentrations in Santa Ana Delhi channel discharges have been verified.

In addition to FIB concentrations, uncertainties remain in the degree to which dry weather discharges from the Santa Ana Delhi channel impact water quality in the Upper and Lower Bays. As described in Section 7.3.1, it is currently unclear whether dry weather discharges of FIB from Santa Ana Delhi channel currently contribute to exceedances of water quality objectives/criteria in the Upper and Lower Bays, thus creating uncertainty in whether management actions should be focused on sources in the Santa Ana Delhi watershed.

Data collection efforts have recently begun to begin addressing these uncertainties[44]. Weekly samples were collected concurrently at: 1) the historic Santa Delhi Channel at Irvine Boulevard sampling location; 2) the walking path bridge; and, 3) the closest accessible point to the channel/Bay interface (Birds Only Signpost) from May through August 2009. From this small sample set, there is some indication of natural attenuation of bacteria levels in the lower sections of the channel prior to discharge to the Bay. Based on the further analysis of this information in the future, additional data collection may be warranted to provide greater confidence in conclusions. Types of monitoring that may assist watershed managers in better understanding the extent of impacts attributable to discharges from the Santa Ana Delhi channel during dry weather include longitudinal studies of FIB concentrations or discharge tracer studies from the mouth of the channel to the outlet to the Upper Bay. If results suggest that FIB discharged from the Santa Ana Delhi channel contribute to exceedances of water quality objectives/criteria in the Bay, then additional source identification studies such as sanitary surveys are recommended. A sanitary survey is based on a physical inspection of the water system and how the system is operated and maintained. In general, it is recommended that sanitary surveys are conducted during dry weather periods in concert with water quality monitoring within the tributary with the goal of developing a conceptual model of the relative contributions of both watershed (e.g., over-irrigation) and “in-system” sources (e.g., wildlife and biofilms). Additional or enhanced BMPs designed to address urban FIB sources in the Santa Ana Delhi watershed may also be warranted.

### 9.3.3 Enhanced Source Identification at Dry Weather Priority Areas

As discussed earlier, four geographical areas of interest[45] in Newport Bay have been identified for enhanced BMP implementation due to exceedances of water quality objectives/criteria during dry weather. Of the four, studies designed to begin identifying sources have only been conducted in two areas of interest – Western Newport Bay (WNB)[46] and the Upper Bay[47]. Technical studies similar to those conducted by Pednekar et al. (2007) in WNB that incorporate sampling of high priority urban runoff drains during dry weather and additional studies designed to identify land-based sources are recommended for 10$^{th}$ Street Beach and Bayside Drive Beach priority areas to refine assumptions regarding priority FIB sources presented in Section 7.0. Preliminary planning level costs for each study are estimated to be between $50,000 and $75,000.

In addition, studies designed to better characterize FIB in sediment are also recommended at the four dry weather geographical areas of interest. Sampling shallow sediments during

[44] Personal communication with Amanda Carr, County of Orange.
[45] Western Newport Bay, 10$^{th}$ Street Beach, Bayside Drive Beach and Upper Bay
[46] Pednekar et al. (2007)
[47] Grant et al. (2009)

routine water sampling may provide information to assist watershed managers in determining if sediments are significant sources of FIB to the water column and responsible for exceedances of water quality objectives/criteria at priority sites.

### 9.3.4 Quantification of Contributions from Natural Sources

An important step in the development FIB source management recommendations and TMDLs is to accurately quantify loads from anthropogenic (urban and agricultural) and natural sources. Initial efforts to quantify contributions of FIB to the surface of the Bay watershed and directly to the Bay from various sources were presented in Section 5.0. However, as described, these estimates have an inherent level of uncertainty and should only be used as rough estimates intended to form hypotheses for further testing. If watershed mangers choose to explicitly include considerations of FIB contributions from natural sources into the Newport Bay Fecal Coliform TMDL, additional technical studies will be needed.

Questions that would likely need to be answered prior to explicitly incorporating into the Basin Plan considerations of water quality objective/criteria exceedances due to natural sources may include:

- What are the “background” ranges of FIB concentrations in Newport Bay associated with natural sources during dry weather?
- What is the frequency to which FIB entirely from natural sources exceed water quality objectives/criteria?
- How do the ranges of FIB concentrations associated with natural sources compare with those associated with anthropogenic sources?

A study designed to answer similar questions in Southern California freshwater creeks was recently conducted by Tiefenthaler et al. (2009). The results were then used by the San Diego Regional Water Quality Control Board to adopt a Basin Plan Amendment that incorporates provisions for bacteria WQOs to account for loading from natural uncontrollable sources within the context of TMDLs. Based upon the success and practicality of this study and its regulatory implementation, a similar study should be considered for Newport Bay to establish either a “reference” condition or natural source exclusion approach (see Section 9.4.1).

## 9.4 Additional Recommendations

In addition to the BMP recommendations presented in Sections 9.1 and 9.2, and technical studies presented in Section 9.3, recommended modifications to existing water quality standards, the Newport Bay Fecal Coliform TMDL, and FIB monitoring in the Newport Bay are provided below.

### 9.4.1 Modifications to Existing Water Quality Standards

***Revisions to Bacteria Water Quality Objectives***

Two recommendations are provided regarding revisions to current water quality objectives and criteria described in Section 3.3. First, although marine water quality criteria based on *Enterococcus* have been promulgated by USEPA on behalf of the State of California and are therefore applicable for regulatory purposes, they have not been formally included into the Basin Plan, Therefore, as a matter of clarity, it is recommended that the Basin Plan be

updated expeditiously to incorporate both *Enterococcus* geometric mean and Upper Percentile Values.[48] Secondly, epidemiological studies suggest and USEPA guidance indicates that *Enterococcus* is currently the most acceptable indicator of human health risk associated with primary water contact recreational uses. As described by USEPA (2004b), water quality criteria based on fecal coliforms are not as protective of human health as those based on *Enterococcus* promulgated by USEPA in 2004. Therefore, it is recommended that as the Basin Plan is updated to incorporate *Enterococcus* criteria, the current water quality objectives based on fecal coliform bacteria also be rescinded. Please note that due to the formal Basin Plan amendment process required for revisions to water quality objectives, implementing these recommendations could take substantial time (i.e., 1 to 2 years).

### 9.4.2 Revisions to Basin Plan Implementation Section (Including TMDL)

Since the TMDL was adopted in 1999, significant information has been developed on the magnitude and extent of water quality exceedances at various locations in the Bay (OCHCA 2008, Grant et al. 2009), the relative contribution of FIB from anthropogenic and natural sources (RBF 2003, Grant et al. 2004, RBF 2004, Jeong et al. 2005, Jiang et al 2005, Pednekar 2007, Grant et al. 2009), and differences in FIB concentrations and controllability between wet and dry weather. The following recommendations are based on the results of these studies.

#### *Revisions to TMDL Source Categories*

In the TMDL, four source categories are described and assigned load or wasteload allocations: 1) urban runoff, 2) agricultural runoff, 3) natural sources, and 4) vessel waste. With the exception of natural sources, FIB discharges from sources in each source category are regulated by specific policies or permits. Through the development of the SMP, however, additional FIB sources that may impact water quality in the Bay were identified. These sources are included in the “other urban sources” category described in Section 5.0 and include failing septic systems, leaking sewer lines and swimmer shedding. Each of these sources in the “other urban sources” category has a separate and distinct regulatory program than those in the other TMDL source categories. Therefore, for consistency with existing regulatory programs it is recommended that the Basin Plan be amended to explicitly include an additional FIB source category termed “other urban sources”.

#### *Incorporation of Reference System and/or Natural Source Exclusion Provisions*

As described in Section 5.1, natural uncontrollable sources of FIB exist in the Newport Bay watershed. Furthermore, recent studies have shown that exceedances of bacteria water quality objectives frequently occur in water bodies that receive runoff from predominately undeveloped watersheds (Tiefenthaler et al. 2009). This indicates that natural uncontrollable sources of FIB such as wildlife feces, sediment resuspension, tidal washing of sediments, regrowth on beach wracks, vegetation, biofilm and algal mats can cause exceedances of bacteria water quality objectives on their own, without contributions from anthropogenic sources.

To account for contributions of FIB to the Bay from natural sources, two approaches have been developed and implemented in Southern California[49]. The first is a Reference System Antidegradation Approach (RSAA), which is generally based on the concept of controlling

[48] The inclusion of all Upper Percentile Values (UPVs) included EPA (2004) is recommended.

[49] Basin Plan Amendment adopted by the San Diego Regional Water Quality Control Board on May 14, 2008 that incorporates a natural sources and reference system approach.

FIB from anthropogenic sources so that bacteriological water quality is at least as good as that in a reference system. A reference system is a watershed and the beach to which the watershed discharges that is minimally impacted by anthropogenic activities that can affect bacterial densities in the water body (Regional Board 2008). Under the reference system and antidegradation approach, a certain frequency of exceedances of bacteria water quality objectives is allowed. The allowed frequencies of exceedances are either the observed frequency of exceedances in the selected reference system or the targeted water body, whichever is less.

The second approach used in Southern California that is designed to consider natural sources of FIB when implementing water quality objectives is the Natural Source Exclusion Approach (NSEA) Implementation of bacteria water quality objectives using the NSEA is generally based on the concept that all anthropogenic sources of FIB to a water body must be controlled and the working assumption that the remaining indicator bacteria do not pose a unacceptable health risk to those recreating in the water body.

There are several notable cases in which the RSAA and/or NSEA have been adopted and/or used over the last several years in Southern California. These include bacteria TMDLs in Santa Monica Bay; Malibu Creek; Ballona Creek, Ballona Estuary, Sepulveda Channel, and Los Angeles Harbor; and the multiple watersheds addressed in the recently proposed amendment to the Water Quality Control Plan for the San Diego Region. Based on the application of these approaches in other regions in Southern California, it is recommended that a RSAA and/or NSEA be developed and incorporated into the Santa Ana Basin Plan.

### *Revisions to TMDL Targets and Load/Wasteload Allocations*

Load and wasteload allocations are developed through TMDLs and applied to specific sources or source categories. Load allocations (LAs) apply to non-point sources of FIB and wasteload allocations (WLAs) apply to point sources. Both types of allocations serve as the level at which sources can contribute a constituent of concern and not exceed water quality standards within a water body. As evident in the numerous bacteria/pathogen TMDLs adopted in Southern California and throughout the U.S., allocations can be personified many ways. For example, TMDL allocations can be based on FIB concentrations (i.e., number of FIB per 100 mL) or loads (i.e., number of FIB discharged per a specified timeframe). Allocations based on FIB concentrations, such as those in the Newport Bay Fecal Coliform TMDL, are based on FIB concentrations set at the Water Quality Objective/Criteria. Those WLA/LAs are typically based on loads are developed through quantitative modeling exercises.

Allocations have also been developed for TMDLs for Southern California water bodies using an “allowable exceedance days” method[50]. Using this methodology, an allowable number of exceedance days for each monitoring site was adopted to ensure that two criteria were met: (1) bacteriological water quality is at least as good as that of a largely undeveloped (i.e., reference) system, and (2) there is no degradation of existing bacteriological water quality. The number of allowable exceedances days was based on the exceedance frequency at the reference beach site. The allowable exceedance days method is typically implemented in concert with either a RSAA or NSEA.

[50] Bacteria TMDL for Harbor Beaches of Ventura County (Kiddie Beach and Hobie Beach).

Regardless of the method used to develop WLAs and LAs, progress towards achieve water quality standards, TMDL targets and WLA/LAs should be measurable through monitoring activities. Because both natural and anthropogenic sources contribute to locations at which monitoring is conducted (e.g., urban runoff drains, tributaries, and Bay sites), tracking progress towards achieving WLA/LAs is currently challenging using a concentration-based approach. Therefore, we recommend that an alternative approach be considered (e.g., allowable exceedances) when revising WLA/LAs and revisions to the TMDL and Basin Plan be conducted accordingly.

### *Revisions to Load and Waste Load Allocations based on Seasonal Variations*

For many pollutants, concentrations and loads differ significantly between seasons and weather conditions (i.e., storm events and dry weather periods). So not surprisingly, analyses presented in Section 4.0 indicate that significant differences exist in FIB concentrations between dry and wet weather FIB datasets. The number of recreators in the Bay also varies greatly between seasons and weather conditions (see Section 3.0). Additionally, the effectiveness of BMPs to reduce FIB discharges to the Bay also differ significantly between dry and wet weather conditions.

All of these factors play a part in level of risk to human health associated with recreating in Newport Bay. Other TMDLs for bacteria/pathogens in Southern California[51] have explicitly incorporated seasonal variations by developing separate waste load allocations for different time periods based on public health concerns and observed natural background levels of exceedance of bacterial indicators. Therefore, based on these factors, it is recommended that during TMDL revisions consideration be given to developing targets, load/wasteload allocations, and requirements separately for dry and wet weather conditions in Newport Bay.

### *Source Monitoring Plan and Revisions to TMDL Monitoring Requirements*

Requirements for routine monitoring in Newport Bay and tributaries are include in the TMDL and Basin Plan. At a minimum, required monitoring includes the collection of at least five samples per 30-days at total of 34 sites specified in the Basin Plan. These sites are currently monitored for *Enterococcus*, fecal coliform and total coliform by OCHCA. Data are posted on the OCHCA website and summarized annually in monitoring reports submitted to the Water Board.

In addition to the routine monitoring requirement, the TMDL requires that a plan be proposed to the Water Board by responsible entities for evaluation and source monitoring to determine compliance with the WLAs and LAs. We recommend that the plan prioritize monitoring locations, FIB sources, and identify opportunities to more efficiently implement routine monitoring requirements.

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[51] Including Santa Monica Bay Beaches, Malibu Creek and Beaches in the San Diego Region.

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# APPENDIX A-1:

# RESPONSES TO COMMENTS RECEIVED ON THE DRAFT NEWPORT BAY FECAL COLIFORM SOURCE MANAGEMENT PLAN (DISTRIBUTED/PRESENTED FEBRUARY 17, 2009)

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**SECTION 1.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 1 | 1 | Regional Board staff | added text: water body listed *for pathogens* | The requested change was made. |
| 1 | 1 | Regional Board staff | Management Plan is the Source Management Plan or SMP based on the Prop 13 contract | The requested change was made. |
| 1 | 1 | Regional Board staff | added: *Based on EPAs newest marine bacteria objectives, this plan will address Enterrococcus as well as fecal coliform issues.* | A sentence was added on page 1 to indicated that the SMP addresses both FC and ENT. |
| 1 | 1 | Regional Board staff | think the #1 question is How many exceedances of ENT and FC WQ standards and where are those exceedances? | The questions are in no particular order of imprtance. Numbers were replaced with bullets to make this clearer. The question you point out is currently included in bullet #2. |
| 1.3 | 7 | Regional Board staff | what happened to 1.3 PURPOSE AND SCOPE OF SOURCE MANAGEMENT PLAN? | This section was incorporated into the main introduction and there fore was not needed. |
| 1 | 1 | Orange County Great Park/City of Irvine | Second paragraph. Second sentence. Recommended wording changes are shown. These data indicate potential raise some concerns regarding the potential for illness in those individuals recreating in the Bay. | The requested change was made. |
| 1 | 1 | Orange County Great Park/City of Irvine | Third paragraph. First sentence. Modify to read: ……with the ultimate goal of protecting human health and applicable beneficial uses. | The requested change was made. |
| 1 | 1 | Orange County Great Park/City of Irvine | The Primary Management Questions are provided in Section 1.0, paragraph 3. Although these questions were likely developed some time ago, it is suggested that the following be considered for Question No. 3. What are the most important sources, pathways and environmental fate of FIB and which contribute to present problematic conditions? | This minor change was made. |
| 1.1 | | Orange County Great Park/City of Irvine | Second paragraph, below Table 1.1 Recognizing the complexity of the bacterial water quality problem, the paucity of relevant data on bacterial sources, | This minor change was made. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**SECTION 1.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 1.1 | 5 | Regional Board staff | Note that entire Bay is REC-1, not just lower bay, and although swimming is prohibited in upper bay, kayaking canoeing and other nonmotor boating activities are NOT prohibited, therefore unless a Basin Plan Amendment is adopted, the entire Bay must be addressed in the SMP | The entire bay is addressed in the SMP. Because this was the first time we mention swimming, we felt it was important to point out that swimming is not allowed (by law) in certin areas of the Bay. This and the existing beneficial uses are further described in Section 3.0. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 2.0**

| SECTION | PAGE # | REVIEWED BY | COMMENT | RESPONSE |
|---|---|---|---|---|
| 2.1 | | Orange County Great Park/City of Irvine | Fourth paragraph. End of second sentence. Remove extra period (.). | The requested change was made. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 3.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 3.1 | | Orange County Great Park/City of Irvine | First paragraph. First sentence. Consider the following revisions: Under California law, Beneficial Uses **are the ways that water** *establish how a body of water* can be used for the benefit of people or wildlife. Examples include drinking, swimming, industrial and agricultural water supply, and the support of fresh and saline aquatic habitats. As required by Section 303 of the Federal Clean Water Act (33 USC §1313), Uses in California are designated and adopted into a Water Quality Control Plan (Basin Plan) by **Regional Water Quality Control Boards (**Regional Board**)**. These designations are not final until approved by the State Water Resources Control Board, the Office of Administrative Law (OAL) and the U.S. EPA (EPA). | bold=remove, italics=add: Requested changes were made. |
| 3.1.1 | | Orange County Great Park/City of Irvine | List of bullets. First bullet. There is not Table 6 in the document. It may be referring to Table 6 in a different document that is not included here. Please edit accordingly. | Table name was changed to 3.2. |
| 3.1.2 | 18 | Orange County Great Park/City of Irvine | Second paragraph. Please consider the following changes: The results <u>of</u> both the qualitative and quantitative surveys showed that the five most abundant species in Newport Bay included Protothaca staminea (Common Littleneck Clam), Tagelus affinis (Neighbor Tagelus), Tagelus subteres (Lesser Tagelus), Chione undatella (Frilled Venus), and Macoma nasuta (Bent-Nosed Clam). These five species accounted for over 86% of all shellfish collected (KLI and EOA 2004). The number of shellfish species was highest at sites in Lower Newport Bay <u>at MC7</u> and progressively declined at sites located further into the northern reach of Upper Newport Bay <u>at NUB1</u> (Figure 3.4). | Requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 3.3.1 | | Orange County Great Park/City of Irvine | First sentence for the section. States: Over the last 90 years, water quality criteria for bacteria have continued to evolve. It seems out of place and an incomplete statement since this section and the section that follows which is titled "1986 U.S. EPA Criteria and 2000 BEACH Act" cover the period from 1976 to 2007 (statement regarding future regulations expected by 2012). That's a span of about 30 years. Please consider editing or removing the sentence. | Requested change was made. |
| 3.3.2 | | Orange County Great Park/City of Irvine | Third paragraph. Last sentence. There is no Table 8. This may possibly be referring to Table 3.4. Please verify and amend as appropriate. Also check same citation in second paragraph in the same section on page 22. | Table name was changed to 3.4. |
| 3.3.2 | | Orange County Great Park/City of Irvine | Last paragraph. Third sentence. Please consider the following change. Near-term needs were defined as specific research and **science** *scientific* activities that could be accomplished in 2 to 3 years to support development of new or revised criteria by 2012 (U.S. EPA 2007). | Requested change was made. |
| 3 | | Linda Candelaria (Regional Board) | Table 3.2 recreational use levels at OC monitoring sites only? | The Use Assessment conducted by EOA in 2000 only provided information on the OCHCA monitored beaches. To our knowledge, there is no information on Use Levels at unmonitored beaches/sites in the Bay. Text was added to indicate that the Use Level of the channels and Upper Bay are assumed to be "low" due to state law and local ordinances prohibiting swimming in these areas. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 4.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 4 | 28 | Regional Board staff | current FIB concetrations in Newport Bay are listed as 2002-08 - is 02-08 acceptable as current or should we use last 2 years? | Based on comments received and a reevaluation of the OCHCA data, 2004 through 2007 was selected as the timeframe to represent "current" water quality condition.This timeframe represents a a substantial period of time and include both relatively dry and wet years. |
| 4.2.2 | 30 | Regional Board staff | this section should be expanded and list of priorities that TAC outlined should be included later | This section was expanded to further discuss the findings/results of the Prop 13 Source ID Project. |
| 4.2.2 | 33-34 | Regional Board staff | table 4.2, 4.3: list % exceedances for OC monitoring sites, wet and dry; note in wet, many sites have >50% exceedance 13/31 FC, 11/31 ENT and in wet Fc and Ent exceedances are all >15%; in dry-only 5 sites >10% FC exceedances (DunesN, Bayside Dr Beach, Newport Blvd Bridge, 33rd St, NStar Beach) –7 sites >10% ENT exceedences (DunesN,W, 10th St, Bayside Dr Beach, Newport Blvd Bridge, 33rd St, 43rd St) | No change is needed. Please note that tables 4.3 and 4.4 now illustrate DRY weather data and tables 4.5 and 4.6 illustrate WET weather data. |
| 4.3? | | Regional Board staff | figure 4.11 prop 13 data only shows ent- need to show E coli too; dry and Feb 07 clearly show that delhi has highest means; in storm 06 - ENT means are highest at SDCk mouth BTO4. | Water quality criteria and objectives for marine recreational waters, such as the Bay, are based on either fecal coliform or Enteroccocus. E. coli is used for freshwaters. Therefore, E. coli was not considered when determining the exceedances of water quality criteria/objectives. |
| 4.3 | 16 | Regional Board staff | Move section 1.3 here and change title to ADDITIONAL PERTINENT TECHNICAL STUDIES | The requested change was made. |
| 4.2.2 | 30 | Bob Stein | second paragraph, 1st sentence. Please check the report; I believe the enterococcus concentrations in the bed sediments increased from BTO 4 to BTO 11 | The commenter is correct. The text was edited as suggested. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4 | | Orange County Great Park/City of Irvine | Second paragraph. Second sentence. Please consider the following change. The majority of these data were collected by the Orange County Health Care Agency (OCHCA) beginning **at** *in* 1986 at beach sites and locations on the Bay margins. | The requested change was made. |
| 4 | | Orange County Great Park/City of Irvine | Last paragraph. Last sentence. As applicable, each will be discussed in this section or within Section 5.0 (Sources) or *Section* 6.0 (Pathways). | The requested change was made. |
| 4.1.1 | | Orange County Great Park/City of Irvine | Third paragraph. Fourth and fifth sentence. Please consider the following changes. The first phase was a gradual reduction between the mid 1980s and **approximately** *sometime during* 2000. The second phase is a more dramatic reduction between 2000 and **the present time** *2008* . | The requested change was made. |
| 4.1.1 | | Orange County Great Park/City of Irvine | Fourth paragraph. Consider the following changes. First, *an evaluation to identify if* OCHCA **may have** made significant changes in sampling and/or laboratory methodologies at some point during the record of data collection *was performed* . However, through discussions with OCHCA staff no significant changes have been made in sampling or laboratory procedures during the period of record that could have caused the observed decreases in FIB concentrations. | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.1.1 | | Orange County Great Park/City of Irvine | Fourth paragraph. Last sentence. Since each yearly data set was combined into one data point it is unlikely that a "sharp decline" would be evident in the graph presented in Figure 4.2. If a change took place mid-year, it is possible that it would impact datasets for two years and show a gradual decline. For example, see data points for 2000, 2001 and 2002. Although we probably know that this decline is due to the decrease in the >10,000 MPN/100 mL (per Figure 4.4), it may not be appropriate to make the statement as currently written. Please consider deleting the sentence: **Additionally, if a change in procedure did occur, the effect would not be a gradual decrease in FIB overtime, rather a sharp decline in a single year.** | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.1.2 | | Orange County Great Park/City of Irvine | It would be very interesting to add the number of data points >10,000 MPN/100mL to the graph in Figure 4.4 possibly by adding a scale on the right hand side of the graph. The percent change in the relative number of samples >10,000 MPN/100mL is valid if the total number of samples has remained fairly stable over the time period, but more importantly over the last ten years. | We have added the total number of samples to the Figure 4.4, however we disagree with the commenters' suggestion that the decerase in the % of samples greater than 10,000 is only valid if the total number of samples has remained fairly stable over the time period. Rather, as indicated in the text, one of the most important parts of the validity of this analysis is whether the range and variability of concentrations has been annually characterized. Because samples have been consistently collected during both: a) times when low concentrations are generally expected (i.e., dry weather) and, b) times when higher concentrations are expected (i.e., wet weather) over the entire data collection period, it is fair to assume that range and variabilty have been characterized well enough to conduct this analysis. Additionally, sites used in this comparison have generally remained the same overtime. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.1.2 | Orange County Great Park/City of Irvine | | Please verify the timeframe of the implementation of the San Joaquin Marsh and the Back Bay Drain Diversion. In the text (second paragraph, page 26) it indicates they were "during a similar timeframe" but the figure shows a three year span between the two events. The graph shows the San Joaquin Marsh event approximately on January 1997 and the Back Bay Drain Diversion approximately on January 2000. The text reads and could be edited as shown: Specifically, the San Joaquin Marsh natural treatment system began receiving San Diego Creek water in the late 1990's and the Back Bay drain diversion project also began eliminating dry weather flows into the Dunes recreational area during a similar timeframe early January 2000. | The text was edited to clarify that the San Jouquin Marsh went into effect in 1997 and the Back Bay Drain began to be diverted in March 2001. |
| 4.1.2 | | Orange County Great Park/City of Irvine | First paragraph. Please consider the changes noted below. In addition to evaluating long-term trends in FIB concentrations in Newport Bay, annual variability in concentrations was also examined to determine if the frequency of "high" (>10,000 ***MPN/100mL*** ) FIB concentrations have also decreased over time. | The requested change was made. |
| 4.1.2 | | Orange County Great Park/City of Irvine | Second paragraph. Please consider the changes noted below and verify the citation referencing Figure 9 which most likely should be Figure 4.3. Figures 4.3 and 4.4 illustrate the changes in annual fecal coliform variability over the term of *the* OCHCA monitoring program (1986-2008). The temporal trends in bay-wide fecal coliform variability are illustrated as Box-whisker10 plots in Figure 4.3. | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.1.2 | | Orange County Great Park/City of Irvine | Third paragraph. Second sentence. Inspection of these data clearly illustrate that the occurrence of fecal coliform concentrations >10,000 *MPN/100mL* has decreased substantially over the course of the monitoring program and is currently relatively stable at less than 2%. | The requested change was made. |
| 4.1.2 | | Orange County Great Park/City of Irvine | Figure 4.4. Please consider changing “>10,000 organisms/100mL” to “>10,000 MPN/100mL” to be consistent with the units used throughout the document. | The requested change was made. |
| 4.1.2 | | Orange County Great Park/City of Irvine | Figures 4.3, 4.5 and 4.6. Please verify the label for the Y axis and the need for the -1 entry at the end. For example, in Figure 4.6: Enterococcus MPN/100mL-1 | The Y axes for all graphs illustrating concentrations was changed to delete the -1 and instead refer to concentrations as MPN/100mL |
| 4.2.1 | | Orange County Great Park/City of Irvine | First paragraph. Last sentence. Please consider the following change. Fecal coliform and *Enterococcus* concentrations for OCHCA monitoring sites are presented as box-whisker plots in Figures 4.5 and 4.6, respectively. | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.2.1 | | Orange County Great Park/City of Irvine | Second paragraph. The last bullet seems unnecessary, but edits are suggested. It could be deleted. Please consider the following edits to the bullet entries. The median fecal coliform concentration at most sites throughout the Bay was 10 MPN /100mL *(the detection limit).*<br>The sites that have median values higher than 10 MPN/100mL are located either in Newport Dunes *(all four sites),* Upper Bay (Vaughn's Launch), West Newport Bay (Newport Blvd Bridge, 33rd St., and 43rd St.) or near Bayside Drive.<br>All sites had median values *were below 100 MPN/100mL* **that are** *and* substantially less than 200 *MPN/100mL* which correspond to the log mean water quality standard value (note that log mean and median values would be expected to be comparable provided that the data can be reasonably represented by a lognormal distribution).<br>**Most of the** *The only* sites that exhibit **the greatest** variability in fecal coliform concentrations are the sites that also had median values higher than 10 MPN/100mL. Other sites that also exhibited substantial variability include 38th St., 10th St., and Ski Zone. | The requested changes were made. |
| 4.2.1 | | Orange County Great Park/City of Irvine | To better illustrate the observation in bullet 3, consider adding the water quality standard as a horizontal line on the graph in Figure 4.5. | A redline depicting the Upper Percentile Value was added to Figure 4.5 and 4.6. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.2.1 | 29 | Orange County Great Park/City of Irvine | second set of bullets. Please consider the following changes. The assumption made for the comment is that the detection limit for the Enterococcus test is 2 MPN/100mL, please verify. Also, as noted above, it would be helpful to show the water quality standard of 35 MPN/100mLon the graph in Figure 4.6. The median Enterococcus concentration at most sites throughout the Bay was 10 MPN /100mL or less *with a detection limit of 2 MPN/100mL.* This value is lower than the geometric mean water quality standard of 35 MPN /100mL.<br>Many sites had at least one observation greater than the single sample maximum water quality standard value of 104 *MPN/100mL*. | The requested change was made. |
| 4 | | Orange County Great Park/City of Irvine | First sentence. The text indicates there are “nine Bay-to-Ocean (BTO) transect sites”, but Figure 4.7 shows eight and also “These sites are numbered BTO4 to BTO11” which would also indicated there are eight stations. | The requested change was made. |
| 4 | | Orange County Great Park/City of Irvine | Tables 4.2 and 4.3. Consider changing the headings from “organisms/100mL” to “MPN/100mL”. | The requested change was made. |
| 4.2.4 | 35-36 | Orange County Great Park/City of Irvine | Pages 35 – 36 have some formatting errors that show Sections 4.4, 4.5, 4.6 and 4.7 as blank with either the information missing or the section number being incorrect. Figure numbers are also altered in this section. They go from Figure 4.3 to Figure 4.11. Figures 4.4 through 4.10 are either missing or the numbering is incorrect. | The requested change was made. |
| 4.9 | 39 | Orange County Great Park/City of Irvine | Fourth paragraph. Correct several typographical errors. NB?, Bathing capitalized, two periods at the end of the paragraph. | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.9 | 40 | Orange County Great Park/City of Irvine | Last two sentences. The Proposition 13 Grant is not described below. Consider removing or editing the sentence: The approaches employed in this study were applied to Newport Bay during the Proposition 13 Grant described below. With respect to application of this work to Newport Bay, the results should be considered preliminary as the results have not yet been peer reviewed or otherwise externally validated. | The suggested text was added as a footnote. |
| 4 | | Linda Candelaria (Regional Board) | figures 4.5, 4.6 do not show wet/dry differences, put tables 5, 6 (TM#2) back in to show wet/dry data | The tables requested are now included in this section. They are also further described in Section 6.0. |
| 4.2.2 | | Linda Candelaria (Regional Board) | Source Identification Study- enterococcus and E coli (prop 13 study) this section is incomplete and should be expanded to show major results from Prop 13 study which were extensive - should also include tributary results as this is part of whole study and part of big picture w/respect to Bay management - the transect study also collected sediment data which is not addressed at all, nor are other prop 13 studies summarized here - and a list of prioroties that TAC outlined should be included later in management section 9 | We agree that Prop 13 Project had many significant findings. Not all are discussed in this section because we are focusing on data that provide information on the "current" water quality condition in the Bay, which is not the objective of all data collection efforts in Prop 13. That said, the text was revised to include additional information on longitudinal trends of FIB in sediment to provide a conceptual understanding of why we might see the opposite spatial trend in water coumn FIB. Additional information on creek and storm drain concentrations, phenotyping and source id, and modeling results are discussed in later sections. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.2.2 | | Linda Candelaria (Regional Board) | 2nd paragraph: In summary, ranges and median concentrations of Enterococcus in water ~~**decreased from tributaries to Upper Bay to Lower Bay**~~ **appear to decline with closer proximity to the ocean,** suggesting that dilution or dieoff plays a role at Lower Bay sites (Figure 4.7). Within the Bay, sites in Upper Bay had the highest concentrations, followed by Lower Bay sites and the offshore control site (BTO12). **Among Lower Bay sites, samples collected from BTO8 had relatively high concentrations. This particular site is located in West Newport Bay, in a region with relatively poor tidal mixing and inputs of dry and wet weather urban runoff (e.g., from Arches Drain). NO -In water, log mean ENT concentrations at Arches were also low similar to rest of Bay -ENT concentrations in sediments, however, were Higher in the Lower Bay than Upper -ENT and Ecoli concentrations in water and Ecoli concentrations in sediments DECREASED from tributaries to Lower Bay, while ENT concentrations in sediments INCREASED from Upper to Lower Bay -this is important altho we dont have explanations at this time** | We agree. The text was revised as suggested. |
| 4.2.2 | | Linda Candelaria (Regional Board) | -other Prop13 studies should also be summarized | The intention of this section is to summarize what is known about FIB concentrations in the Bay. Other Prop 13 Project studies were not sampled for this objective and are therefore not described in this section. Other sections provide details on the findings of other pertinent studies that were conducted as part of the Prop 13 Project that are not described here. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.2.2 | | Linda Candelaria (Regional Board) | figure 4-11 only shows ENT, need E coli graphs too. Dry and Feb 07- clearly show that Delhi has the highest medians (as well as means shown above), instorm 06 ENT medians are highest at SDCk mouth (BTO4): is this significant? (question for all, not directed to you) | No change is needed. |
| 4.9 | | Linda Candelaria (Regional Board) | additional pertinent studies still doesn't include OC study with boats out of marina vs boats in | We have been unable to obtain this report after repeated requests, and therefore as not included in the discussion of other pertinent studies. We cannot include information on this report without first reviewing. |
| 4.3 | 10 | Linda Candelaria (Regional Board) | figure-effects of storm events, if OC is using 0.2" to denote a storm event, the SMP should use the same number | The definition of "wet weather" was revised to be consistent with OCHCA rain advisories. |
| 3.1? | 11 | Linda Candelaria (Regional Board) | FC and ENT % exceedances, add tributary data to present whole picture | This section is specific to Newport Bay as is not intended to discuss pathways of FIB to the Bay such as tributaries or stormwater drains. These pathways are discussed in detail in Section 5.0. |
| 3.1? | 12 | Linda Candelaria (Regional Board) | figure - for Prop 13, only ENT is presented add E coli data | As discussed, water quality criteria and objectives for marine recreational waters, such as the Bay, are based on either fecal coliform or Enteroccocus. E. coli is used for freshwaters. Therefore, only Enterococus and fecal coiforms are pertinent to the discussion of exceedances. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 5.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 5.1 | 1 | Regional Board staff | questions the usage of the phrase "sources are defined as substances or *activities* …" because the list of sources are pet waste, fertilizers, wildlife, etc and are not activities | Language was changed to include substances, activities or processes |
| 5.1 | 1 | Regional Board staff | the TMDL includes 5 source categories (urban, ag, natural dunes (swimmer shedding) and vessel waste) not four | The requested change was made. |
| 5.1 | 1 | Regional Board staff | This is the Source Management Plan (SMP) not the Management Plan | The requested change was made. |
| 5.1.1 | 3 | Regional Board staff | This section "Natural vs. Anthropogenic sources" should be moved or taken out, because it is not good to start with a disclamer that natural sources are not controllable. Take it out or just define the 5 source categories | Text regarding the controlability of natural sources was removed. However, the section regarding the definition of natural sources remains. |
| 5.2 | 3 | Regional Board staff | if you are changing the definition of urban from Prop 13, you should note this | Not sure how the definition of urban used in the SMP differs from Prop 13 definition |
| 5.2.1 | 4 | Regional Board staff | the average number of pets per household seems high | The estimates of the number of pets in the watershed included in the Draft SMP were high. A calculation error was found that revised based on guidance provided by the American Veterinary Medical Association. |
| 5.2.1 | | Regional Board staff | left out horses - lots of horses in area | Horses are now included in the discussion of potential sources, however, no information was available regarding the number of horse estiamted to be present in the watershed and loading estimates were therefore not included. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 5.2.1 | 4 | Regional Board staff | a number in the text doesn't match a number in table 5.2; says number of cats and dog in the table doesn't match what is in the preceeding text; disagrees with 0% reduction due to management actions for their dogs because many people pick up their dog poo (how did you go from 74,000 cats and dogs in table 2 (TM#2) to #s of dogs and cats here?) | See above. The error was found and corrected. |
| 5.2.2 | 5 | Regional Board staff | predominate should be predominant | The requested change was made. |
| 5.2.2 | 5 | Regional Board staff | did you contact City NB about their application rates of fertilizers? | BMP summaries and this section was discused with and reviewed by City of Newport Beach staff. |
| 5.2.2 | 5 | Regional Board staff | want median E. coli here with the median Enterrococcus stated; this is a concentration based TMDL -#organisms per day is not as relevant as concentration | The purpose of this and all source loading estimates is to better understand the relative contributions from different sources to the surface of the watershed and the Bay. All estimates have uncertainties. However, this assists in understanding which sources may be impacting water quality at particular sites of interest discussed in Section 7.0. |
| 5.2.2 | 5 | Regional Board staff | asks what the difference between over irrigation and dry weather flow in the following statement: "Flow estimates from dry weather runoff (e.g., over-irrigation and car washing) have not been estimated for the Newport Bay watershed." Suggests taking out sentence. | Dry weather runoff includes excess water from car and sidewalk washing AND landscape irrigation. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 5.2.2 | 5 | Regional Board staff | really not sure why you are converting ENT to fecal coliform | Fecal coliforms were not analyzed as part of the study (Grant et al. 2009). ENT concentrations therefore needed to be ocnverted so concentrations and laodings from this soruce could be compared to others. |
| 5.2.2 | 5 | Regional Board staff | need large drain vs small drain estimates (gallons per day) | Both were used in the loading calculation. Both are now included in Section 5.0 and TM#2. |
| 5.2.2 | 6 | Regional Board staff | this is a concentration based TMDL. Organisms per day are irrelevant-- take out | The purpose of this is to better understand the relative contributions from different sources to the surface of the watershed and the Bay. This assists in understanding which sources may be impacting water quality at particular sites of interest discussed in Section 7.0. |
| 5.2.2 | 6 | Regional Board staff | we need to look at FC and ENT, not meaningful to convert ENT to fecal | Nearly all literature reviewed estaimtes the mass of FC per unit of waste excreted. Estimates of ENT are not available for most sources, and therefore were not included. |
| 5.3 | 7 | Regional Board staff | asks if agricultural land uses include nurseries | Yes. Nurseries are included in the agricultural source category. |
| 5.3 | 7 | Regional Board staff | asks what "some samples" means in reference to the UCE study and asks what percentage | The study results are not well reported and therefore we do not feel comfortable stating a "% of samples". The text now states that a portion of samples… |
| 5.3 | 7 | Regional Board staff | asks for conclusions in this paragraph, also asks "what about nurseries?" | Nurseries were included in this dicussion and conclusions are stated. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 5.4 | 7 | Regional Board staff | has a problem with this section: "we have data from Newport from Grant study that shows bacti waste from vessels does not appear to be major source –there is also an OCHCA study for empty vs full marina which you still do not include (talk to Larry H.) -your estimates should not trump data from Newport Bay -at a minimum this section should be worded like the swimmer shedding study section which says that this MAY be a source" | We agree that the Grant study concluded that water quality impacts from vessel waste could not be detected. However, in our opinion, due to the deisgn of the study and the limited data available, one cannot conclude that vessel are NOT a source. That said, we have revised text to state that vessels MAY be a source. |
| 5.5.1 | 8 | Regional Board staff | asks "RBF??" after RBF 2003 is cited | RBF is a consulting firm that the County has had under contract to conduct a variety of stormwater-related studies. Similar to EOA, the consulting firm goes by the initials RBF. |
| 5.5.2 | 12 | Regional Board staff | types of soils present are not highly effective at removing FIB from the water if water table is high as on peninsula and small islands | Agreed. However, there are still no data to calculate loading rates for leaking sewer lines. |
| 5.6 | | Regional Board staff | add in-bay sediments section as source | A section was added on sediment. |
| 5.6.1 | 14 | Regional Board staff | waterfowl also contribte FIB, also left out coyotes | Waterfowl loading estimates are included in Section 5.0 |
| 5.6.1 | 15 | Regional Board staff | adds the word "other" into a sentence about "other wildlife" contributions of FIB vs waterfowl contributions | Requested change was made. |
| 5.6.2 | 16 | Regional Board staff | wants section on In-Bay sediments as a source | A section was added on sediment. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 5.7 | 18 | Regional Board staff | data from Newport Bay does not support vessel waste loading estimates | These are estimates based on the rate of illegal discharges developed through surveys. These rates were reduced by 80% due to management actions in place. Text was also added to state that study results indicate that water quality impacts due to vessel waste have not been observed and therefore these estimates are likely high. |
| 5.7 | 18 | Regional Board staff | suggests putting section 6.2 (Potential Environmental Fates of FIB) after section 5.7 | Agreed. Fate is now a the end of the Section. |
| 5.2.1 | 44 | Mike Loving | The number of domestic pets per household (1.6 for dogs and 2.1 for cats) seems excessively high. It sounds like the report is saying that the average household has a total of 3.7 dogs and cats. Are the American Veterinary Medical Association estimate based on a nationwide study including both rural and urban areas or is it specific to Orange County? | The estimates of the number of pets in the watershed included in the Draft SMP were high. A calculation error was found that revised based on guidance provided by the American Veterinary Medical Association. Estimates are U.S. averages. |
| 5.2.1 | 44 | Mike Loving | Table 5.2: Estimated fecal coliform loading rates from pets and wildlife onto the Newport Bay watershed. Although the title of the table includes wildlife, none are listed. | The term wildlife was removed from Table 5.2. |
| 5.5.1 | 48 | Mike Loving | Number and Location of Septic Tanks: The 2003 RBF estimate of septic tank locations may be out of date. The use of septic tanks has been discouraged for many years, therefore, the numbers may have decreased significantly since 2003. | Your point is well taken. However, the information provided by RBF is the most current available. Additionally, based on the conclusions that septic systems are not large sources of FIB to the Bay, the number of septic systems currently in the waterhshed is somewhat irrelevant. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 5.6.1 | 53 | Mike Loving | The numbers of raccoons in the watershed seems excessively high. Using an average of 71 raccoons per square mile equates to over 8,000 raccoons in the watershed. What published literature was the basis for this information? Was the literature specific to current conditions in this watershed? Table 5.3. is entitled *Estimated daily fecal coliform deposit rates directly to Newport Bay from waterfowl*, yet the table itself does not list waterfowl, only raccoons and skunks which do not deposit fecal coliform directly to Newport Bay. There should be another table showing other wildlife that deposit fecal coliform directly to Newport Bay along with an estimate of the numbers of wildlife in the Bay and a calculation of how much fecal coliform is deposited directly into the Bay. | After re-examination of the location where the referenced study was conducted, the Newport Bay watershed is much more urbanized and therefore may have less wildlife that originally estimated. To better reflect the number of raccoons in the watershed, the estiamted numbers cited in the referenced study, were reduced by 50%. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 5.6.1 | 53 | Mike Loving | Sea Lions, for example, inhabit the Bay. Several years ago, I provided the County with comments on the Public Health Risk Assessment for the Newport Bay. At that time, I contacted the Newport Harbor Patrol to obtain information on the number of California Sea Lions that are permanent or transient residents of the Bay. I talked to several individuals, including the Watch Commander and his deputy, Pat Douglas, who is on the Bay on a regular basis. They said the numbers of sea lions in the Bay varied greatly but in recent years there had been major problems due to the number of animals in the Bay. The animals tend to occupy the area in the Bay between the bait receiver in the harbor entrance to the Balboa Pavilion but they are also found in the Upper Bay. On more than one occasion, sea lions have been observed at Alton Parkway in the San Diego Creek. Since I talked to the Harbor Patrol, the sea lion population along the West Coast has increased significantly so one must presume the sea lion population in the Bay has increased as well. A sea lion can weigh over 600 pounds and consume up to 8% of its body weight each day and sea lions | Based on your comment, we searched for additional information on the concentration of FIB in seal excrement and the population of seals in the Bay. Information was not available on either, and therefore loading estimates could not be developed. Text was added however to explain that seals may also be contributors of FIB to the Bay, although their relative contribution is currently unknown. |
| 5.2.1 | 44 | Amanda Carr | we need to the text to be clear that it is not 3.7 pets per household, but 1.6 dogs or 2.1 cats. | See response to previous comment on pet waste. An error was found and corrected. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 5.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 5.4 | 47 | Bob Stein | 4th paragraph. Need to provide justification for the 80% reduction. Why wouldn't a 99.99% reduction be appropriate? | An 80% reduction value appeared to be a reasonable estimate based on the information available regarding pet waste management actions described in Section 8.0. If additional information is available on the effectiveness of such actions, please provide and it will be considered. |
| 5.1 | | Orange County Great Park/City of Irvine | The last sentence says that source transport will be discussed in Section 5.0. Please verify since this may possibly be incorrect and instead should say Section 6.0 | The requested change was made. |
| 5.1.2 | | Orange County Great Park/City of Irvine | Please verify. Reference to Section 5.0 should probably be Section 6.0 and reference to Section 8.0 also might be incorrect. | The requested change was made. |
| 5.2.1 | | Orange County Great Park/City of Irvine | Table 6.2 is likely incorrect and should be Table 5.2. Please verify. | The requested change was made. |
| 5.2.3 | | Orange County Great Park/City of Irvine | First paragraph. Last sentence. Illicit connections, for example, may include cross-connections with a sanitary sewer system or interior floor drains at businesses *that have been illegally connected to the stormwater conveyance system or discharge to the watershed.* | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 5.2.3 | | Orange County Great Park/City of Irvine | Second paragraph. **Permittees to the** Santa Ana Regional Board's NPDES municipal stormwater permitt*ees* are required to implement an Illegal Discharge and Illicit Connection Control Program that identifies and responds to non-stormwater *and non-exempt* discharges. These discharges are *not specifically targeted to sources of* **typically not associated with** fecal material, but there are occasions when fecal wastes are discharged onto the watershed or into a stormwater conveyance system. | The requested change was made. |
| 5.4 | | Orange County Great Park/City of Irvine | Fourth paragraph. Last sentence. Coliforms is spelled incorrectly. | The requested change was made. |
| 5.5.1 | 48 | Orange County Great Park/City of Irvine | Second bullet. Please consider the following changes. Inadequate maintenance – Systems must be periodically maintained by pumping the tank to remove accumulated solids, and keeping the inlet, tank, and effluent field clear of roots *and other obstructions.* | The requested change was made. |
| 5.5.1 | | Orange County Great Park/City of Irvine | Table 5.5 should include totals. They are referred to later in Section 7.2. | Totals are now included. |
| 5.5.1 | | Orange County Great Park/City of Irvine | Table 6.6 on page 57 should be labeled Table 5.6. | The requested change was made. |

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.2 | Regional Board staff | asks what number was used when averaging MPNs > than upper detection limit in table 6.2 | The upper detection limit was used. |
| 6.1.2 | Regional Board staff | should note that all median concentrations are abive WQ standards --this is important (says this twice on this page) | WQOs and criteria applicable to the Bay are not applicable to tributaries. |
| 6.1.2 | Regional Board staff | adds the word loading: "Dry and Wet Weather Discharge (Loading) from Tributaries," asks why discharge not loading? "I realize there is a FROM and INTO tributaries but we have been using loading rather than discharge," corrects it again at the bottom of the page | The term discharge is used when talking about flow; loading is used when discussing FIB. |
| 6.1.2 | Regional Board staff | in Annual FIB Loading from Tributaries section take out "best" and just use median because "best" is not a scientific term | The term "best" was removed and replace with "average" or "median" as appropriate. |
| 6.1.2 | Regional Board staff | suggests looking at 90th percentile again | The 90th and 10th percentiles are now used. |
| 6.1.2 | Regional Board staff | asks where this came from: "Because minimum and maximum daily discharge rates were not available, high and low discharge rates were calculated by multiplying the average discharge rate by 10 and 0.1, respectively." questions using 10 and 0.1 | Where data were not available to calculate high and low values, NA (no data available) was used. |
| 6.1.2 | Regional Board staff | Table 6.4: "As I recall in text you said that there was continuous runoff even in dry weather -so why is dry weather 'no runoff'??" | Edits were made to clarify the terms dry and wet weather. |
| 6.1.2 | Regional Board staff | asks what ratio of FC to ENT really tells us: it says nothing about exceedences above WQ stds it just shows ENT/FC ratio is higher in Big Cyn -in addition, WQ std for ENT is much lower than that for FC so it doesnt matter if FC #s are higher than ENT –relationship to WQ std is what's important - suggest taking this section out | This section was removed. |
| 6.1.2 | Regional Board staff | prop 13 data after Big canyon, expand summary of prop 13 data and include major conclusions - include ENT and E coli data | As previously stated, only ENT is discussed in the SMP. Additional text discussing the importance of Santa Ana Delhi Channel loadings is discussed further in Section 7.0. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 6.0**

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.3 | Regional Board staff | suggests moving 6.1.3 (direct inputs) to front of section | Seciton 6.1.3 was moved to the front of the section as requested. |
| 6.2 | Regional Board staff | there are 5 FIB source categories, not 4 | The number of source categories referenced is noe five, not four. |
| 6.2 | Regional Board staff | asks how filtration happens | Bacteria can adsorb to sediment as filtration thorugh soils occurs. |
| 6.2 | Regional Board staff | wants to call inactivation "dieoff" | Inactivation was changed to dieoff. |
| 6.2 | Regional Board staff | asks what "selection" means as a removal process | This was a mistake in the text. Selection was removed. |
| 6.2 | Regional Board staff | says bacteria in pore water is not addressed here or in Figure 6.10 | This section is intended to provide examples of the types of fates possible, not to be inclusive of all fates. |
| 6.2.1 | Regional Board staff | wants section called "Inactivation and Predation" to be called "Dieoff and predation" | The requested change was made. |
| 6.2.2 | Regional Board staff | says deposition is also called sedimentation | If bacteria are adsorbed to sediment, then sedimentation is the mechanism. |
| 6.2.2 | Regional Board staff | Text says: "However, for the most part, documenting the process of FIB deposition in sediments has proven challenging." reviewer says *(again –why?? you might just take out this statement)* | Statement was removed. |
| 6.2.2 | Regional Board staff | questions the word "pseudo," when sediment is called a pseudo-source; says "this is a Lower Bay phenomenon not necessarily caused by closer proximity to ocean –yes highest ENT concentrations are in Lower Bay (many probable causes) but site closest to ocean Rocky Pt has lower ENT conc than rest of Lower Bay," "also may be regrowth in wrack lines" | The term pseudo was removed. |
| 6.3.3 | Regional Board staff | suggests moving this section (Effects of direct inputs into the Bay) to the front of section 6 | This section was moved to the front of the section. |

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.1 | Bob Stein | 3rd paragraph. Are the FIB concentrations measured in the bay near the storm drain outfall? If that is the case, then there are a number of assumptions that are being made that need to be stated in the report. The correct way to measure FIB loading is to measure dry weather flows and FIB concentrations at the inlet to the catch basins. This should be one of the report's recommendations. | Dry weather data for storm drains was measured in the storm drain system. Wet weather data was collected at the drain outlets to the Bay. We agree the location of sampling creates uncertainities and that the most ideal way to measure concentrations attributable to the MS4 is at the catch basin because it eliminates the chance that inflitration and tidal intrusion can effect measurements. However, in this section, we are focused on the discharge FROM drains to the Bay, not what enters the system (FIB entering the system is discussed in the Sources section). We compare loads entering the system to those exsiting later in section 5.0. |
| 6.1.1 | Bob Stein | 1st sentence. What does this mean: "…descriptive statistics were calculated… to establish an average discharge of 97 gallons/day/acre…". Do you mean a linear regression? | Yes. A linear regression was used by Grant et al. (2009) to establish the relationship between drainage area and dry weather flows. The text was revised to better explain. |
| 6.1.1 | Bob Stein | 2nd sentence. Explain how the 11 gal/day/acre was arrived at and mention that it does not conform with data collected by the City of Newport Beach from 11 local drains on the Peninsula and Lido Island. | The 11 gallons was established by Grant et. Al (2009) and we refer the reader to this document. We are unaware of data collected on Lido Island or the Pennisula. |
| 6.1.2 | Bob Stein | Table 6.2. Based on all the assumptions that went into arriving at these numbers, only order of magnitude numbers, along with error estimates, are justified. | We agree. The source loading development was only intended to assist manager in understanding the relative magnitude of FIB loading from different sources. This is now explained at the beginning of the section and order of magnitude estimates are now provided. |

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.2 | Bob Stein | Table 6.4. Something is clearly wrong with the analysis. How can Big Canyon Creek with a flow of around 0.5 cfs have the same FIB loading rates as San Diego Creek with an average flow that is about 100 times larger? | An error was found in the calculation and was corrected. |
| 6 | Orange County Great Park/City of Irvine | FIB need only be defined once at the beginning of the section. | The requested change was made. |
| 6.1.1 | Orange County Great Park/City of Irvine | First paragraph. Please consider the following change. Dry and wet season runoff that does not evaporate, *is captured for use (i.e. landscape irrigation)* or infiltrate, flows through a network of gutters, curbs, and underground pipes….. | Requested change made. |
| 6.1.1 | Orange County Great Park/City of Irvine | Second paragraph. Last sentence. Consider change for consistency These studies together form the dataset used to estimate the high (*75 th* percentile), low (25th percentile) and average concentrations of FIB…….. | Requested change made. |
| 6.1.1 | Orange County Great Park/City of Irvine | Table 6.2 and Table 6.1 are entered in reverse order of when they appear in the text (in which they are introduced). | We have reversed their order. |

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.1 | Orange County Great Park/City of Irvine | Third paragraph. What is “best FIB concentration”? May have intended to say “Average” or “Best Available Average”, according to Table 6.2. See also the section titled “FIB Loading from Stormwater Conveyance Systems” on page 61 for consistency. It also discusses a “Best” (average) FIB loading estimate. See ***bold*** below. The last sentence needs some re-wording. See suggestions: Fecal coliform data collected during wet weather (i.e., storm events) from storm drain outfalls were not readily available for the Newport Bay watershed. Enterococcus concentrations<br>enumerated from wet weather runoff (as opposed to discharge) by Grant et al. (2007) in 2006<br>were used to derive high, low and ***best*** FIB concentrations for wet weather (Table 6.2). It is important to note, however, that microbial growth likely occurs inside conveyance systems and increases FIB concentrations *which are not accounted for* **is not included in these data**, and therefore FIB concentrations may be underestimated. | The term best has now been replaced by "average" and text was added to explain how these estimates were calculated. |
| 6.1.1 | Orange County Great Park/City of Irvine | Second paragraph. Table 5.2 should be Table 6.2 | Requested change was made. |

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.2 | Orange County Great Park/City of Irvine | First paragraph. Last sentence. Consider editing for consistency with previous conclusions regarding analytical methods (bold below) and the implementation timeline for San Joaquin Marsh system. Also, see the third comment regarding analytical methods for Section 4.1.1 – Long-term Trends in FIB Concentrations and the General Comments for Section 4.1.2 - Variability in FIB Concentrations. Currently reads: Possible explanations for the decrease in fecal coliform concentrations include the implementation of the San Joaquin Marsh system on San Diego Creek upstream of the OCHCA sampling site which began in 1997, or changes in analytical methods. | This text was deleted. |
| 6.1.2 | Orange County Great Park/City of Irvine | Second paragraph. Table 5.3 should say Table 6.3. | Requested change was made. |
| 6.1.2 | Orange County Great Park/City of Irvine | Page 69 – reference to Table 5.4 should be Table 6.4 | Requested change was made. |
| 6.1.2 | Orange County Great Park/City of Irvine | Page 71 – second paragraph, reference to Figure 5.9 should be Figure 6.9. | Requested change was made. |

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.1 | Jack Skinner | I am puzzled by a statement on page 60,paragraph one. " Based on these estimates, total estimated average dry weather discharge for the five largest drains and the 209 smaller drains were calculated to be 75,520 gallon/day and 43.057gallons /per day respectively. However on page 3.20 of Dr Poon's study, he states that Bayside Drive drain averaged at least 225,000 gallons a day and probably could have been as high as 500,000 gallons since only part of that flow was measured. The flows for El Paseo drain averaged 81,000 gallons per day. Clearly the estimates for the five large drains were much higher than 75,520 gallons per day reported on page 60. Secondly, the Polaris Drain empties into the Upper Bay. | This section was changed to indicate that the total estimated average discharge for the 5 largest drains is roughly 253,364 gallons/day. This estimate is based on the 97 gallons/acre/day estimate developed by Grant et al. (2009). |
| 6.1.1 | Jack Skinner | Stan Grant revised his estimate of daily flows in the small drains in the lower bay to 11 gallons per acre or about 70 gallons/day for each small drain or about 7700 gallons per day for the 110 small drains. As I recall, I either found or photographed about 110 small drains in the lower bay that would fit with the description for small drains. | The 11 gallons/acre/day was used to establish the estimated dry weather discharge from the 209 small drains. |

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1.1 | Jack Skinner | I suspect that the number of gallons of water calculated coming from the four large drains you used on page 60 does not mirror the high volumes found by Dr. Poon. The enterococci concentrations in the large drains averaged about 5,000/ 100 ml. This is extremely high for urban runoff with no known human fecal imput. I believe Stan's estimate of 5,000 enterococci/100 ml from each small drain requires further verification. He assumed this number from enterococci readings in the pooled curb water nearby the intake for these drains. It seems logical to me that it is important to focus on a study to determine if these high gutter levels are due to regrowth or are vegitative species as reported by Dr. Ott in one of your references. The consitently high numbers of these enterococci in multiple locations on the islands or peninsula are surprising to me after my repeat observations of these areas. It is hard for me to blame dogs or fertilizer for these extremely high numbers. | Based on the results of the analysis presented in the SMP, further investigation of dry weather sources is warranted at some locations (see Section 6.0). We have included a recommendation in Section 9.0 regarding future dry weather studies. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 7.1.2 | 79 | Bob Stein | 2nd paragraph. Confusing. Correlation is a measurement of the strength of the relationship between two variables. Significance indicates how likely a result is due to chance. I think what you are trying to say here is that a correlation between FIB and tides exists and that it is significant. However, you don't say what the strength of the correlation is. Please make this paragraph completely clear. | Text was revised for clarity. |
| 7.1.2 | 79 | Bob Stein | paragraphs 4 and 5. There are a lot of ideas mixed up in these paragraphs. In order to sort this all out, please only address one idea in each paragraph and provide the exact cite for materials used from the Grant studies. | Text was revised to create muliple paragraphs in this section for clarity. |
| 7.1.2 | 78 | Orange County Great Park/City of Irvine | Figure 5.11 is incorrectly labeled; should be Figure 7.1. | Requested change was made. |
| 7.1.2 | 79 | Orange County Great Park/City of Irvine | second paragraph, last sentence. Please consider the following change (original underline removed to allow for edits to be shown). Emphasis with underline as originally shown in the document should remain. These findings suggest that dry weather runoff may have the most detectable impact on Western Newport Bay sites, compared to other areas of the Bay *at low tide* . | Requested change was made. |
| 7.2 | | Orange County Great Park/City of Irvine | First paragraph. Third sentence. Table 5.5 does not provide a total but it is given here in the text as 3.8X1012. Suggest adding totals to Table 5.5. | The suggested totals were added to the table. |
| 7.2 | | County of Orange | Please consider the following revisions to entry 2): 2) Upper Bay Sub-watershed (9 mi2) – assumed to drain to **a combination of** engineered<br>stormwater conveyance system that ultimately discharges to the Bay via stormwater,<br>and Big Canyon Wash (tributary); | Requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 7.2 | | County of Orange | Table 7.2. Please replace “Stormwater Outfalls” with “Storm Drain Outfalls”. | The term "drains' is now used throughout the document, as opposed to outfalls. |
| 7.2 | | County of Orange | Table 7.3. Please replace “Stormwater Outfalls” with “Storm Drain Outfalls” in the last line on the table. | The term "drains' is now used throughout the document, as opposed to outfalls. |
| 7.2 | | County of Orange | Page 85. Second bullet. Please consider the following change. Daily average dry weather discharges of fecal coliforms from pathways that drain the Lower and Upper Bay sub-watersheds are similar or greater than estimated source loadings, suggesting that the build-up and wash-off process described above *is* less obvious during dry weather, when there are consistent patterns of discharge. | Requested change was made. |
| 7 | | Linda Candelaria (Regional Board) | table 7.1: natural sources do not include sediments, sediments were shown to be important in shallow waters; does loading to Bay include loading from tributaries | Sediment is now discussed in the Environmental Fate section. |
| 7 | | Linda Candelaria (Regional Board) | Comparison of source Pathway Loading Estimates: should be looking at fecal AND Enterococcus | Source loading estimates are not available for Enterococcus. |
| 7 | | Linda Candelaria (Regional Board) | tables 7.2, 7.3: in text you said there was continuous runoff even in dry weather - so why is dry weather 'no runoff'? Same for tables in some other sections; (table 7.2 note average -median- loading is similar for 5 large storm drains and all small storm drains in wet and dry - this does not make sense based on Prop 13 data) (table 7.3 note daily loading into lower bay is greater than upper bay and both are greater than loading from Delhi. is this loading on land only? or does it include tributary loading into bay?) | The tables were revised to clarify what area the loading is associated with. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 7 | | Linda Candelaria (Regional Board) | you list average (median) estimates - just use median - additional words such as 'average' or 'best' are just confusing; median from which years? Would be useful to see comparison of long term and last two years; where is this data from? (Table doesn't note reference) | Average is a laypersons word that we find helpful to the reader. Median can be used as a measurement of central tendenacy (an average). The text fully describes where the median, high, and low concentrations came from. References are now included in the Tables as well. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 6.0**

| SECTION | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|
| 6.1 | Regional Board staff | suggests discussing direct vs indirect inputs to the bay here | Added a figure depicting the differences between sources and pathways. |
| 6.1 | Regional Board staff | suggests including section on Direct inputs to Bay here (from p32, 37) and discuss or at least list direct inputs (which were discussed in previous section | Added a figure depicting the differences between sources and pathways. |
| 6.1.1 | Regional Board staff | suggests using the term MS4 system | Although the term MS4 is used in the regulatory context, the term stormwater conveyance system is more illustrative of the pathway itself, especially for the layperson. |
| 6.1.1 | Regional Board staff | reconnaissance is misspelled | Requested change made. |
| 6.1.1 | Regional Board staff | asks "how are you defining runnoff vs discharge?" | Runoff is defined as what flows INTO the stormwater conveyance system. Discharge is what flows OUT of the system. |
| 6.1.1 | Regional Board staff | asks: why 75th and 25th?? I'd like to see 90th percentile so we can know worst case scenarios since you are already using MEDIAN concentrations for ENT & EC | The 90th and 10th percentiles are now used. |
| 6.1.1 | Regional Board staff | want reference for annual stormwater runnoff calculation | The reference is given in the text. Schueler 1987. |
| 6.1.1 | Regional Board staff | in table 6.1, would like to see 90th percentile and average | The 90th and 10th percentiles are now used. |
| 6.1.1 | Regional Board staff | again, would like to see 90th percentile and average | The 90th and 10th percentiles are now used. |
| 6.1.2 | Regional Board staff | suggests adding WQ standard lines to graphs (figures 6.2 and 6.3, 6.4, 6.5) | WQOs and criteria applicable to the Bay are not applicable to tributaries and are therefore not shown. |
| 6.1.2 | Regional Board staff | suggests showing wet vs dry graphs here | Existing box-whisker graphs were broken into separate figures showing wet and dry weather periods. |
| | Regional Board staff | tables 6.2, 6.3 loading estimates: would be better to see 90th, 10th percentiles - as discussed | The 90th and 10th percentiles are now used. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 8.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8 | | County of Orange | adds the word "an" to a sentence | The requested change was made. |
| 8.1 | | County of Orange | deleted Fecal Indicator Bacteria leaving just FIB | The requested change was made. |
| 8.1 | | County of Orange | asks if we need to use source management action? BMP is more commonly used, using a new term is confusing | The term BMP is now used throughout the SMP, as opposed to source management action. |
| 8.1 | | County of Orange | deleted an extra period at the end of the section | The requested change was made. |
| 8.2 | | County of Orange | deleted the word States; deleted National Pollutant Discharge Elimination System-leaving NPDES; | The requested change was made. |
| 8.2 | | County of Orange | deleted an extrat 't' in the word permittees | The requested change was made. |
| 8.2 | | County of Orange | deleted MS4s and uses the word Permittees | The requested change was made. |
| 8.2.1 | | County of Orange | **added text:** "...properly disposing of pet waste to prevent it entering into storm drains which flow directly to waterways and the ocean—untreated—where it can harm human health, marine life and the environment" then adds: **"Furthermore, Permittees provide and stock doggy bag dispensers at select parks (need determined by Permittee) throughout the Newport Bay Watershed. Park signs explain the need for park users to pick up their pet waste."** | Suggested language was added. |
| 8.2.2 | | County of Orange | adds the word 'program' after IPM | The requested change was made. |
| 8.2.2 | | County of Orange | adds the paragraph: In addition to the Model IPM Guidelines, the Orange County Stormwater Program has published the brochure, Tips for Landscape and Gardening, that addresses general landscaping tips and garden/lawn maintenance. The brochure includes information on proper use, storage and disposal of fertilizers and pesticides as well as information on over-watering. | The requested change was made. |
| 8.2.3 | | County of Orange | corrects ID/IC from IC/IC | The requested change was made. |
| 8.2.4 | | County of Orange | OCSD is Orange County *Sanitation* District not Orange County *Sanitary* District | The requested change was made. |
| 8.2.4 | | County of Orange | asks for more information about duration of diversion each year: April-Sept? | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8.2.5 | | County of Orange | adds: they do provide some level of source **control?** including the removal of vegetation that may contain FIB and are therefore described in this section. | The requested change was made. |
| 8.2.5 | | County of Orange | deleted participates to the Stormwater Program and leaves 'permittees' | The requested change was made. |
| 8.2.5 | | County of Orange | changes 2002-2003 to 2002-03 | The requested change was made. |
| 8.2.5 | 100 | County of Orange | adds the text: These include structural BMPs, such as catch basin inlet screens and other proprietary devices that prevent trash and debris entering the catch basin, as well as in-channel trash booms, which recover flotable material. There are three trash booms in the Newport Bay Watershed; Santa Ana Delhi Channel (at Mesa Drive in Newport Beach), El Modena-Irvine Channel (near the Eastern Transportation Corridor), and San Diego Creek (near IRWD treatment plant facility). | The requested change was made. |
| 8.2.5 | | County of Orange | adds words: Since 2002, over 310,000 pounds of trash has been removed **from Orange County's beaches, harbors and creeks** on Cleanup days. | The requested change was made. |
| 8.3 | | County of Orange | deletes University of California Extension (Orange County) leaving UCCE | The requested change was made. |
| 8.3 | | County of Orange | adds (OCCK) next to Orange County Coastkeeper | The requested change was made. |
| 8.3 | | County of Orange | deleted Best Management Practices leaving 'BMP' | The requested change was made. |
| 8.3 | | County of Orange | adds word: Implementing **a** water recycling program to reduce dry weather runoff and water conservation; | The requested change was made. |
| 8.4 | | County of Orange | deletes SWRCB | The requested change was made. |
| 8.4 | | County of Orange | deletes Santa Ana regional water Quality Control Board, leaving: 'Santa Ana Regional Board' | The requested change was made. |
| 8.4 | | County of Orange | adds **Santa Ana** to regional Board | The requested change was made. |
| 8.4 | | County of Orange | deleted Orange County Coastkeeper leaving OCCK | The requested change was made. |
| 8.4 | | County of Orange | changes 'requires' to require | The requested change was made. |
| 8.4 | | County of Orange | deleted Water from Santa Ana Regional Water Board | The requested change was made. |
| 8.4 | | County of Orange | adds **Santa Ana** to regional Board | The requested change was made. |
| 8.5.1 | | County of Orange | capitalizes W in Watershed | The requested change was made. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 8.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8.5.1 | | County of Orange | adds text: . A copy of this brochure with an informational letter was mailed to all residents in the County with septic systems on January 19, 2007. | The requested change was made. |
| 8.5.2 | | County of Orange | 8.5.2: formatted indent, bullets and numbering | The requested change was made. |
| 8.5.2 | | County of Orange | capitalizes W in Watershed twice more | The requested change was made. |
| 8.5.2 | | County of Orange | deleted Orance County Santitation District leaving OCSD | The requested change was made. |
| 8.5.2 | | County of Orange | capitalizes W in Watershed | The requested change was made. |
| 8.5.3 | | County of Orange | 7.5.3 formated bullets and numbering | The requested change was made. |
| 8.5.3 | | County of Orange | added text: sewage spills reported to the Santa Ana Regional Board between 2002 and 2006 were on private property and multi-family residential dwellings, **which** present the greatest threat **to public health and water quality** | The requested change was made. |
| 8.5.3 | | County of Orange | changed who to which | The requested change was made. |
| 8.5.3 | | County of Orange | deleted Waste Discharge Rquirements leaving WDR (twice) | The requested change was made. |
| 8.5.3 | | County of Orange | deleted Orance County Santitation District leaving OCSD | The requested change was made. |
| 8.5.3 | | County of Orange | capitalizes W in Watershed | The requested change was made. |
| 8.5.3 | | County of Orange | adds Sanitary Sewer Overflows to SSOs | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8.5.3 | 103 | County of Orange | adds text: During the Third Permit term, the County and OCSD developed and implemented a coordinated sewage spill prevention and response demonstration project in the Newport Bay Watershed (The "Tustin Area Spill Control (TASC) Demonstration Project"). The TASC included: 1) Development of SSO response procedures; 2) selection of primary and backup sewage spill response contractors for containment and recovery of SSOs; and 3) SSO hands-on field response training for Permittee staff and municipal sewering agency staff.<br><br>In 2007-08, TASC evolved from a demonstration project to a program (now designated CASC, or "Countywide Area Spill control") with the area of implementation broadened to include the cities of Villa Park and Orange. One of the goals for TASC is to gradually phase the implementation of the project throughout the County so that the proactive interagency planning and coordination for sewage spill response can be implemented and/or improved in other watersheds. | The requested change was made. |
| 8.5.3 | | County of Orange | adds "On a jurisdictional scale" to the beginning of a paragraph | The requested change was made. |
| 8.5.3 | | County of Orange | deletes Sewer System Management Plans leaving SSMPs | The requested change was made. |
| 8.5.3 | | County of Orange | capitalizes W in Watershed | The requested change was made. |
| 8.5.4 | | County of Orange | 8.5.4: formats bullets and numbering | The requested change was made. |
| 8.5.5 | | County of Orange | 8.5.5: formats bullets and numbering | The requested change was made. |
| 8.6.1 | | County of Orange | capitalizes W in Watershed | The requested change was made. |
| 8.1 | | Orange County great Park/City of Irvine | 5th sentence: Source controls are designed to reduce the impacts of pollutants once they have entered the environment, and include *such practices as* street sweeping and responses to illegal discharges. | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8.1 | | Orange County great Park/City of Irvine | 6th sentence: Treatment controls are typically structural BMPs or *low impact design features (i.e.* landscape, pervious materials) **features** installed to reduce or slow pollutant inputs into a water body. Examples of treatment BMPs include stormwater treatment ponds and diversions of dry weather flows to wastewater treatment facilities. | The requested change was made. |
| 8.2 | 93 | Orange County great Park/City of Irvine | Several sentences. Please consider the following changes: NPDES permits are issued for a five-year term and have **generally followed a** progressive*ly included more stringent requirements* **pattern**. | The requested change was made. |
| 8.2 | | Orange County great Park/City of Irvine | Industrial and construction stormwater general NDPES permits, *and general municipal stormwater permits under Phase II of the program* are issued by the State Board and enforced by Regional Boards. *Individual* **M***m* unicipal stormwater permits under Phase I are issued to MS4s by Regional Boards. | The requested change was made. |
| 8.2 | | Orange County great Park/City of Irvine | Section 7.2.3 does exist in the document; possibly meant to be 8.2.4. See last sentence in the third paragraph. | The requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8.2.1 | | Orange County great Park/City of Irvine | Second paragraph. Please consider the following revisions. In addition to municipal codes and ordinances, local municipalities have extensive public education and outreach programs **that attempt** to increase awareness of pollution issues and change behaviors that may impact urban runoff quality. The Orange County Stormwater Program has published numerous educational materials on the sources and impacts of urban runoff pollution, and specifically **for** *on* pet waste. **the***The* brochure Tips for Pet Care (Appendix XX) *is a good example of localized outreach materials.* The brochure advises **owners on** outdoor pet bathing methods that reduce runoff into storm drains and informs residents **that** every city has an ordinance which requires picking up and properly disposing of pet waste to prevent it from entering into storm drains which flow directly to waterways and the ocean where it can *be* harm*ful to* human health, marine life and the environment. | The requested change was made. |
| 8.2.3 | | Orange County great Park/City of Irvine | First paragraph. First sentence. Consider the following changes. As described in Section 5.0, illegal discharges are defined as any *non-exempt* , non-permitted disposal into the storm drain system,…… | The requested change was made. |
| 8.2.5 | | Orange County great Park/City of Irvine | First paragraph. Third sentence. The statement indicates that CASQA found municipal programs not to be “effective”, yet in the next section on Street Sweeping, the contrary statements are made regarding the levels of FIBs found in street sweeping debris. Is it possible that CASQA’s statement has been misinterpreted and they may have been referring to the “efficiency” as a matter of cost (cost efficiency) and not removal (efficiency)? | We agree that the text is confusing and therefore the "effectiveness" discusion has been removed. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 9.2 | 108 | Bob Stein | Table 9.1. I concur with EOA's approach to look at the recreational use levels of the beaches. Could we convene a meeting to review the recreational use levels? My impression is that the Dunes beach areas have the highest use, but even that is extremely moderate and generally limited to wading. | Use levels were based on field-based surveys and assessments conducted at 7 sites in 2001 and extrapolated to all OCHCA monitoring sites (EOA 2001). We would be happy to discuss the findings from this study in a forum agreeable to the contract manager. |
| 9.4.2 | 117 | Bob Stein | 2nd paragraph. When you mention Western Newport Bay, do you mean the channels around Newport Island or the western portion of the Harbor around Lido Island.? If it is the latter meaning, then you can only say that flows from the small drains have only been estimated on very limited data and is therefore has not been quantified. | The area around Newport Island and the Arches Drain discharge point is now described as WNB. |
| 9.2.2 | 112 | Bob Stein | 1st sentence. I would welcome a discussion on if the appropriate priority level has been assigned to the listed areas. Perhaps lower priorities should be specified. | The revised site prioritization process was discussed and agree to at the 4/23 TAC meeting. This section was revised to be consistent with this outlined process. |
| 9.3 | 112 | Bob Stein | This section is incomplete. The primary sources of FIB to the Harbor are San Diego Creek and the Santa-Ana Delhi. There is no mention of these sources in this section! | Our understanding of what regions in Newport Bay are impacted by specific sources and pathways is based on previous studies and modeling efforts summarized in Section 7.0. Based on modeling conducted via the Newport Source Identification Study, it appears that discharges from San Diego Creek and Santa Ana Delhi do not significantly impact the Lower Bay during dry weather. Wet weather impacts from these tributaries appear to occur in the Lower Bay during large storm events. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.4 | 114 | Bob Stein | Where is the discussion of prioritization of BMP's for flow vs. sources? | This is an important point and the text was revised to clarify if the recommendations if flow of source reduction oriented. |
| 9.4.2 | 117 | Bob Stein | Please specify what kinds of disinfection you are discussing. | The requested change was made (i.e., chlorination and UV disinfection) |
| 9.4.2 | 120 | Bob Stein | Table 9.9. I don't see how you arrived at these dollar amounts. Until this is carefully explained, this information should be considered invalid . | We refer the reader to the EOA 2001 report for more detail on cost estimates. The report section will be clarified with the following additional language: "EOA (2001) also contains estimates for the cost of diverting dry weather flow to the sanitary sewer system. The costs were based on discussions with OCSD staff at the time. Although there was only a nominal permit fee charged the example diversion project, the annual cost estimate included an allowance for typical treatment plant operational costs associated with treating that volume of diversion flow. The capital cost estimates are for building a diversion structure at the storm drain outfall. Table 9.9 below presents the costs identified in EOA (2001) adjusted to January 2009 dollars using a 20 city average ENRCCI." |
| 9.4.4 | 126 | Bob Stein | 3rd paragraph. The previous paragraphs do not indicate why vessel waste activities should be "considered a high priority". | Text ahs been added to state that due to the density of vessel near and directly adjacent to areas of interest, and the fact that human enteric viruses are believed to be the greatest risk to human health, vessel wastes remain at a high prirority. |
| 9.4 | all | Bob Stein | general comment. I got lost in this chapter. Can you do a simple numerical listing of the recommendations to show the proposed prioritization of actions? | Yes. This numerical prioritization is now included in Section 9.0 of the DRAFT FINAL SMP. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.1 | | Orange County Great Park/City of Irvine | First paragraph. First sentence. Please consider the following changes: As described in Sections 3.0 and 4.0, FIB concentrations and the level of recreational use in Newport Bay varies in both space and time, and therefore the level of human health risk and concern at *a* particular site is also site-specific. Using recreational use information presented by EOA (2001) and OCHCA water quality data collected from 2002-2008, the following questions were posed **the** *to* assist in prioritizing FIB sources and pathways in the Newport Bay watershed: | The requested change was made. |
| 9.2.1 | | Orange County Great Park/City of Irvine | First paragraph. Please consider the following revisions: Based on the results of Use Assessment, the level of use was identified at each OCHCA site (Section 3.0 - Table 3.2) and categorized into four "Use Levels" (Low, Medium, High and Extra High). These Use Levels were then **compared against** *designated the appropriate* single sample maximum (SSM) water quality objectives for fecal coliform (Regional Board 2008) and water quality standards for Enterococcus (EPA 2004) *provided in Table 9.1* **to determine the applicable SSM** and *to* calculate exceedance rates. **Table 9.1 presents the results of this comparison.** | The requested change was made. |
| 9.2.2 | | Linda Candelaria (Regional Board) | If OC uses 0.2" to denote storm event, SMP should also use the same number rather than 0.25" (also Figure in presentation ) | The definition of "wet weather" was revised to be consistent with OCHCA's definition. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.2.2 | | Orange County great Park/City of Irvine | First paragraph. Second sentence. Table 8.1 should probably be Table 9.1. Also see the last sentence – Table 8.4 should be Table 9.4 and Table 8.5 should be Table 9.5. Check remaining table numbering in this section as it appears other tables are incorrectly cited in the text. | The requested change was made. |
| 9.4 | | Orange County great Park/City of Irvine | Verify the third sentence – see bold below. That said, a number of BMPs that likely reduce FIB entering **the Bay degree are currently** implemented by local agencies and stakeholders in the Newport Bay watershed, although the effectiveness of each is mostly unknown. | The requested change was made. |
| 9.4 | | Orange County great Park/City of Irvine | Also, see the fifth sentence and consider the following change. This decline appears to coincide *with* the implementation of two large-scale BMPs - the San Joaquin Marsh natural treatment system on San Diego Creek and the Back Bay…. | The requested change was made. |
| 9.4 | | Orange County great Park/City of Irvine | Second paragraph. Second sentence. Please verify that it is Section 8.0 that should be referenced. | The requested change was made. |
| 9.4 | 116 | Orange County great Park/City of Irvine | Consider the following changes for the section of Domestic Pet Waste. Third bullet. Increased distribution of pet waste bags at public parks and areas frequented by dogs owners and their pets; and, | The requested change was made. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.4 | | Orange County great Park/City of Irvine | The section on Fertilizer Applications and Over-Irrigation has one correction as shown below: All municipalities with*in* the watershed should consider adopting a water conservation in landscaping ordinance based on a preliminary draft ordinance issued by the California Department of Water Resources (DWR) to meet the……. | The requested change was made. |
| 9.4 | | Orange County great Park/City of Irvine | The Section on Illegal Discharges and Illicit Connections (ID/IC) also should be edited as shown: Each municipality in the watershed should continue to implement their existing ID/IC program and any modifications to the program based on the **reissued** *latest municipal stormwate*r NPDES permit **for stormwater**. | The requested change was made. |
| 9.4 | 120 | Orange County great Park/City of Irvine | In the text Figure 8.2 should be Figure 9.2. Please verify and correct. | The requested change was made. |
| 9.4.5 | | Orange County great Park/City of Irvine | The section on Leaking Sewer Lines should indicated that amongst the survey techniques recommended to municipalities and sanitation districts or agencies include dye testing, water tests, etc., the most effective survey tool for sanitary sewer systems is the CCTV which in this section is recommended only for private sewer lateral surveys. Please consider recommending CCTV for all sanitary sewer system inspections and assessments. | Recommendations were made to CCTV specific areas where sewer lines are believed to be potential source of FIB to the Bay. Additionaly, recommendations include requiring CCTVs during transfer of ownership of properties. |
| 9.4.7 | | Orange County great Park/City of Irvine | Please clarify if “Bay Area” refers to “San Francisco Bay Area” and edit accordingly. | Yes. Bay Area is San Francisco Bay Area. The text was clarified. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.4.7 | | Orange County great Park/City of Irvine | Consider deleting bullet number 1 for the Minimum On-Site Communication Program. This recommendation would likely result in approximately 18,000 flyers being lost and/or discarded by beach goers. A better alternative would be to conduct on-site outreach by having an information table during the peak holiday weekends, and staffed by volunteers or non-profit organizations, or the permanent sign or poster. May be best combined into the “Community Outreach Campaign Program”. | We agree. The requested change was made. |
| 9 | | Linda Candelaria (Regional Board) | re: statements in intro - this approach not adequate for the SMP, SMP must address ALL sources (you can have a priorotized framework w/high health risk areas to be addressed first) but SMP must also include baywide strategies, and lower priority areas; SMP should also incude recommendations for Basin Plan amendments and other issues that affect this FC TMDL; also- where is the table of priorities from Prop 13 study that TAC developed? Delhi was #1 problem area and is not addressed in this SMP; check contract - SMP was to be based on Prop13 study results | Statements were revised to indicate that all sources causing or contributing to exceedances of water quality standards are addressed. Prioritization is based on level and magnitude of exceedances, and health risks (exposure). |
| 9.1 | | Linda Candelaria (Regional Board) | Which OCHCA monitoring stations in the Bay have the highest level of recreational use? | This information is incldued in Table 3.2 of the Final SMP and discussed in Section 3.0. |
| 9.1 | | Linda Candelaria (Regional Board) | Which monitoring stations exceed the applicable single sample maximum (SSM) fecal coliform water quality objective OR the SSM Enterococcus water quality standard most frequently during dry and wet weather? | This information is included in Tables ## and further discussed in Section 6.0 in the revised SMP. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8.2.6 | | Orange County great Park/City of Irvine | Please also consider the following changes: Although municipal maintenance BMPs have not been shown to effectively reduce FIB in urban runoff (CASQA 2004), they do provide some level of source *control* including the removal of vegetation that may contain FIB and are therefore described in this section. | The requested change was made. |
| 8.2.7 | | Orange County great Park/City of Irvine | Second paragraph. Last sentence. As described in the following paragraphs, all **participates to the** Stormwater Program **(**Permittees**)** currently implement the Model Program. | The requested change was made. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.1 | | Linda Candelaria (Regional Board) | Figure 9.1: Which areas in the Newport Bay appear to be of concern? **based on what criteria??** | This statement was deleted. |
| 9.1 | | Linda Candelaria (Regional Board) | figure 9.1: Suggest replace 'Level of FIB' with 'Percent Exceedences of FIB Stds' at Long-term Monitoring Stations, ADD Prop13 sites, Tributaries | Prop 13 sites were add to Sections 5.0, 6.0 and 7.0, and are discussed in Section 9.0. |
| 9.2.1 | | Linda Candelaria (Regional Board) | table 9.1: beach designation titles are different from EPA's recent titles for beach use (they match 1986 tables) - moderate use definition may be different from moderate full body contact rec | These use level titles were updated to be consistent with EPA's current titles. |
| 9.2.1 | | Linda Candelaria (Regional Board) | we might want to go with a density measurement for swimmers rather than a straight count - small beaches will never have the same numbers as Dunes thereby skewing other beaches as "high" vs "low" use designations rather than "extra high" OR just use "high" vs "low" use designations similar to what freshwater bacti standards group is doing - for example - do bathers use these areas, or are they concrete ditches? | As discussed in the 5/23 TAC meeting, density would be important if we are concerned about shedding as a major source, which based on studies conducted to-date, do not appear to be a major source. The |
| | | | these designations of rec use at a site may need public review/comment before variable ENT standards can be used; | The use levels are only being used to prioritize sites at this time. They are not intended to be regulatory in nature in the SMP. |
| | | | this ranking system does not address geomean exceedances, and does not address prop 13 sites or rest of Bay | The site/area prioritization process was revised to include both geomean and Upper Percentile Values based on discussions at the TAC and subsequent meetings. |
| 9.2.2 | | Linda Candelaria (Regional Board) | Level of FIB at Long-Term Monitoring Stations If OC uses 0.2" for rainfall, SMP should also use 0.2" rather than 0.25" | The definition of "wet weather" was revised to be consistent with OCHCA's definition. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.2.3 | | Linda Candelaria (Regional Board) | Tables 9.2, 9.3 It doesnt make sense that there are different rankings for same categories between dry and wet weather -ie "High" for [Extra high' rec use-17% exceedence] in dry vs "Medium" for [Extra high' rec use/17% exceedence] in wet -why not just designate a site as "High" use in dry vs "Medium" use in wet ?? then rankings can remain the same - this would become a nonissue if we used high vs low use -Is this EPA designation?? | Based on the revised prioritization process, Tables 9.2 and 9.3 were removed from the SMP. |
| 9.2.4 | | Linda Candelaria (Regional Board) | **Tables 9.4, 9.5 -what does dry weather include?? summer & winter data or just summer?? Might want to include "High" beaches under "Extra High" w/Dunes since they are in high use in summer -this may not be issue if we go with High vs Low designations** | Dry and wet weather definitions are described in Sections 5.0, 6.0, 7.0 and 9.0. |
| 9.3.1 | | Linda Candelaria (Regional Board) | The land area draining directly to West Newport Bay is located within the City of Newport Beach in the Lower Newport Bay sub-watershed. Transport pathways applicable to this area during dry weather include: large and small stormwater outfalls and direct inputs. There are no tributaries draining directly to West Newport Bay. ***Yet there is evidence that WNB and Turning Basin area is impactd by tributary flows AND tides also –check exactly where Newport Blvd Bridge is - West Newport Bay typically refers to the west most area of the Bay NOT area near Arches –this is typically termed the Turning Basin area -ck w/City*** | See responses to comments in section 7.0. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.3.2 | | Linda Candelaria (Regional Board) | Based on previous modeling efforts and sites identified in Table 9.5 as a medium level of concern are likely impacted by all sources and pathways within the proximity of the area. Because of the limited number of days that are considered "wet weather" (i.e., average 21/year) and the limited use documented and observed during this time period, and the inability of BMPs to effectively reduce FIB during storms (Olivieri et al 2006), BMPs recommended for sources during wet weather are confined to pollution prevention and source control activities discussed in the sections below. ***this essentially says we cant really do much to control stormwater so we'll just keep doing current practises -this is not adequate*** | As described by many authors based on the results of many BMP effectiveness studies, reducing FIB in stormwater through treatment is very challenging and does not appear to reduce discharges to below FIB criteria/objectives. Therefore, it is recommended that watershed managers focus on pollution prevention and soruce controls to reduce FIB in stormwater. Additionally, studies are suggested to better characterize soruces to specific wet weather high priority areas. |
| 9.4 | | Linda Candelaria (Regional Board) | recommended new BMPs presented in this section are primarily intended to assist local agencies and stakeholders in reducing human sources of FIB (and enteric pathogens), even though the overwhelming majority of quantifiable FIB sources in the Newport Bay watershed are of non-human origin. ***this may be true based on sources but we dont know impacts of pet or wildlife bacteria on humans - or bacteria in biofilms, sediments***<br>Recommended BMPs to reduce FIB in Newport Bay are presented by TMDL source category and source. ****Really need list or table of recommendations; also need to address priority list from Prop13 study** | We agree. However, summaries of disease incidents indicate that an overwhelming percentage of all illness is associated with human entric viruses. Hopefully results from epidemiological studies currently being conducted in Southern California at beaches impacts by non-human sources will assist in better understanding non-human FIB source impacts. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.4.2 | | Linda Candelaria (Regional Board) | add italicized to sentence: Based on the results of the management prioritization process described earlier in this section, dry weather runoff from stormwater outfalls *and tides* appear to be contributing to exceedances of water quality objectives in Western Newport Bay (Newport Boulevard Bridge). | As discussed with the commentor, impacts of tides transporting FIB from other areas to WNB is still an open question. The text was revised to discuss all the possible sources based on existing information. |
| 9.4.2 | | Linda Candelaria (Regional Board) | However, based on the results of the Recreational Use Assessment conducted by EOA (2001), very few individuals (if any) have been observed using this area for full body contact recreation. **this is not an issue w/respect to prioritizing sites, but w/respect to water quality in Bay -ALL sites need to be addressed and ALL sites need to meet standards** | Understood. The use level is only intended assist in the prioritization process at this time. |
| 9.4.2 | | Linda Candelaria (Regional Board) | *so it seems recommendation here (WNB) is more studies –there is already much data and Prop13 study was supposed to most issues -however, one study that may be helpful is to collect sediment samples simultaneously w/water samples at shallow monitoring sites –we dont know whether bacti in sediments is high in shallow waters (beach sites) except in mudflats sites -as I recall there was sediment work in Dunes study* | Agreed. Developing a better understanding of whether the higher concentrations in WNB are due to "new" inputs from the watershed, or from sediment |
| 9.4.2 | | Linda Candelaria (Regional Board) | Fertilizer Applications and Over-Irrigation ***What about biosolids use?? this may be why urban areas may have high bacti if biosolids are used as fertilizers on golf courses, urban parks*** | Through our literature review and as indicated in the text, biosolids are assumed to be a minor source of FIB to the Bay, compared to traditional fertilizers. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.4.2 | | Linda Candelaria (Regional Board) | Illegal Discharges and Illicit Connections (ID/IC) ***attach a sample ID/IC plan in appendix??*** | The current ID/IC program implemented by the County (CASC) is recommended for continued implementation. |
| 9.4.2 | | Linda Candelaria (Regional Board) | Municipal Maintenance Activities ***attach a sample Model Program in appendix??*** | We are not aware of a "model" municipal maintenance program. Rather programs are required by NPDES permits and are speficic to the muncipalities implementing such programs. |
| 9.4.2 | | Linda Candelaria (Regional Board) | *****Prop13 data shows SADelhi as #1 Priority area in Newport Bay, and Priority list developed by TAC calls for Sanitary survey up the Delhi*** | A sanitary survey of SAD is now included in the recommended technical studies/BMPs. |
| 9.4.2 | | Linda Candelaria (Regional Board) | ***–This Priority list developed by the TAC from Prop13 conclusions does not appear in this document and needs to be addressed*** | This section noe addresses all findings in the priority list developed by the TAC. |
| 9.4.2 | | Linda Candelaria (Regional Board) | Identification of Natural Sources – In addition to, or in concert with stormwater conveyance system surveys, it is recommended that a small study be conduct that will assist in better identifying the contribution of FIB to the Bay from biofilms within the conveyance system. The study should be conducted during a time that minimizes dry weather runoff into the system (i.e., late afternoon), allowing better characterization of in-system sources. ***or sample end of pipe like originally discussed for Prop13 –can sample curb then end of pipe, then you can subtract to determine biofilm or in-pipe contribution -what we want is end of pipe sample to determine actual loading (like we're doing for metals storm drain study)*** | Agreed. The suggestion will be included in the SMP. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.4.2 | | Linda Candelaria (Regional Board) | ***Potential Dry Weather Treatment or Diversion of Arches Drain and Other Pathways*** However, on-site disinfection of urban runoff ***onsite disinfection (in Bay ) would likely not be recommended by RB staff*** (in combination with pretreatment suspended sediment removal) and diversion of dry weather flows have been successfully implemented in Southern California. | The commented is noted, but this BMP remains an option that should be considered and is therefore included in the SMP. |
| 9.4.2 | | Linda Candelaria (Regional Board) | **Table 9.8** Existing Dry Weather Diversions to the Sanitary Sewer System[1] **Only one site in Newport Bay –do we want whole table??** | This table is intended to show that there are a number of existing dry weather diversions in Southern California. It is not intended to be specific to Newport Bay. |
| 9.4.2 | | Linda Candelaria (Regional Board) | **Table 9.12**. Estimated Costs for Treating 0.19 MGD Diverted Dry Weather Flow. ***Why 0.19MGD?? refers to which storm drain??*** | These are estiamted costs based on existing diversions, not specific to Newport Bay. |
| 9.4.3 | | Linda Candelaria (Regional Board) | **Agricultural Runoff** ***there is an Ag study done in LA that demonstrates that ag runoff is not insignificant -do you know of this study??*** | We are not aware of the study that the commentor mentions and therefore it was not included in the review of existing information fo the SMP. |
| 9.4.3 | | Linda Candelaria (Regional Board) | BMPs - ***maybe have No Diapers signs or Clean Diapers signs or 'dont swim sick' signs -it would be difficult for swimmers to shower before swimming at most places except maybe Dunes*** | We only suggest showering before swimming at the Dunes. The suggestion of signage regarding swim diapers was included. |
| 9.4.4 | | Linda Candelaria (Regional Board) | ***refering to vessel waste discharges*** (in particular due dry weather periods) should be considered a high priority and responded to quickly and effectively by the appropriate agencies.***respond how?? –explain*** | Additional text was added to better explain the BMP recommended. |

**Response to Comments on DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.4.4 | | Linda Candelaria (Regional Board) | ***Swimmer Shedding suggest putting this section after Vessel Waste since it is a TMDL task or as 1 st section under Anthropogenic sources (same in Section 5 –Sources)*** | As discussed, this source is included under the "other urban sources" category. |
| 8.5.1?? | | Linda Candelaria | how about kids have to wear clean diapers or no diapers?? | This suggestion was included. |
| 8.7 | | Linda Candelaria (Regional Board) | report cites "a number of large scale BMPs" - need list of all large scale BMPs | Large scale BMPs we are aware and are included in Section 8.0 are: a) the Bach Bay Drain Diversion; b) Newport Dunes Drain Plugs; and c) the Arches Drain Bioswale. The Michelson Water Reclamation Plant is also discussed in Section 8.0. |
| 8.9 | | Linda Candelaria (Regional Board) | pull out recommendations in each section or better - make list/table of all recommendatiions | A table summarizing all recommended BMPs was added to Section 9.0 - Prioritization of BMPs. |

# APPENDIX A-2:

# RESPONSES TO COMMENTS RECEIVED ON THE FINAL DRAFT NEWPORT BAY FECAL COLIFORM SOURCE MANAGEMENT PLAN (DISTRIBUTED ONLY TO ORANGE COUNTY AND REGIONAL BOARD STAFF)

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**SECTION 1.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 1 | 1 | County of Orange | 1st paragraph, 6th line. Suggests chaning "a high quality esuary" to "a high value estuary." "Quality" may imply water quality, which due to the number of TMDLs is considered impaired | Requested change was made. |
| 1 | 1 | County of Orange | 2nd paragraph, last line – add “for the Bay” to the end of the sentence. | Requested change was made. |
| 1 | 1 | County of Orange | 2nd paragraph 4th line. Suggest changing "These data" to "These early data" | Requested change was made. |
| 1 | 1 | County of Orange | suggest adding small locational map of bay in OC or Southern CA. This would push the text down a bit and fix a later formatting issue – see Comment 3.2 | A regional map was added to shoe the location of Newport Bay in the context of Southern California. |
| 1 | | Regional Board | line 3. is made up of two **connected** water bodies | Requested change was made. |
| 1 | | Regional Board | table 1.2. change heading: **Tasks to be addressed** required by the Newport Bay Fecal Coliform TMDL (Regional Board 1999). | Requested change was made. |
| 1.1 | 1 | County of Orange | 2nd paragraph, line 5. add “within the Bay” after “die-off or tidal flushing”. | Requested change was made. |
| 1.1 | 1 | County of Orange | 2nd paragraph, line 3. change “incorporated in the TMDL in the fact” to “incorporated in the TMDL due to the fact”. | Requested change was made. |
| 1.1 | 2 | County of Orange | table 1.1. Las should be LAs | Requested change was made. |
| 1.2 | 2 | County of Orange | Title: Use official grant project Title “Proposition 13 Grant Newport Bay Fecal Coliform Source Identification and Management Plan | Requested change was made. |
| 1.2 | 2 | County of Orange | 1st paragraph. The layout of the text with respect to table 1.2 and the list of grant subtasks is a bit confusing. Both the table and the numbered list on page 6 refer to “Tasks”. Please move the last sentence of the paragraph to just above the number list on page 6. | Requested change was made. |
| 1.2 | 6 | County of Orange | 3rd paragraph. line 3 – change “…Project is and is" to Project is further” | Requested change was made. |
| 1.2 | | Regional Board | line 6. contribution of natural and **urban** sources, | Requested change was made. |
| 1.2 | | Regional Board | adds to subtask 1: **(contract task 2.1.1);** | Requested change was made. |
| 1.2 | | Regional Board | adds to subtask 2: **(contract task 2.1.2);** | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 2.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 2 | 1 | County of Orange | Line 3. “and includes **all or portions of** the cities…” | Requested change was made. |
| 2 | 1 | County of Orange | line 12. does the “proposed MCAS El Toro Habitat Reserve” refer to an area of the Great Park or the FAA property? Need to clarify. | A footnote was added stating " The proposed El Toro NWR was a part of the El Toro Marine Corps Air Station and encompasses approximately 890 acres. The Federal Aviation Authority (FAA) currently has ownership of the property." |
| 2.1 | 1 | County of Orange | 3rd paragraph, line 3-4. Isn’t Costa Mesa a part of this subwatershed? | Yes. Costa Mesa was added to the list of cities. |
| 2.1 | 1 | County of Orange | 3rd paragraph, line 3. Isn’t Newport Beach part of this subwatershed? | Yes. Newport Beach was added to the list of cities. |
| 2.1 | 1 | County of Orange | 4th paragraph, line 3. also includes Orange and Tustin. | Yes. Orange and Tustin was added to the list of cities. |
| 2.1 | 1 | County of Orange | table 2.1. the total areas within the watershed by city to not match County calculations, (see table in comments document "SMP DRAFT FINAL Chapter 1-4 Comments Amanda.doc") | County calculations provided are now used in Table 2.1. |
| 2.1 | | Regional Board | line 2 San Diego Creek/Peters **Canyon** Wash | Requested change was made. |
| 2.2 | 3 | County of Orange | 1st paragraph, line 3. change industrial to commercial | Requested change was made. |
| 2.2 | 4 | County of Orange | 1st paragraph, line 1. “two-large scale ~~geographical~~ **water resource**…” | Requested change was made. |
| 2.2 | 4 | County of Orange | 1st paragraph, line 2. “These ~~include~~ **are**…” | Requested change was made. |
| 2.2 | 4 | County of Orange | 2nd paragraph, line 5. “The preserve is ~~currently~~…” | Requested change was made. |
| 2.2 | | Regional Board | Is table 2.2 from FC TMDL?? If so please reference | INo. The County of Orange created this table as a result of the TMDL. |
| 2.3 | 4 | County of Orange | 1st paragraph, line 7. “…Orange Public ~~Facilties and Resources~~ **Works**…” | Requested change was made. |
| 2.3 | 4 | County of Orange | 1st paragraph, line 8. “…~~and various environmental groups~~ **Orange County Coastkeeper and Stop Polluting Our Newport (SPON).** | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**SECTION 1.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 1.2 | | Regional Board | adds to subtask 3: **(contract task 2.1.3);** | Requested change was made. |
| 1.2 | | Regional Board | adds to subtask 4: **(contract task 2.1.4).** | Requested change was made. |
| 1.2 | | Regional Board | paragraph 2: Information gained through the Source ID Project is currently being finalized and is included in the **Newport Bay Fecal Indicator Bacteria** Source **Identification** Project Report (Grant et al. 2009). | Requested change was made. |
| 1.2 | | Regional Board | paragraph 3: the second task (Source **Prioritization and Management Plan Development**) of the Proposition | Requested change was made. |
| 1.3 | 6 | County of Orange | 1st bullet. change overtime to over time | Requested change was made. |
| 1.3 | 6 | County of Orange | 2nd bullet. "Are current conditions problematic, and if so, at which locations and ~~during~~ **under** what ~~time of year~~ **conditions**" | Requested change was made. |
| 1.3 | 6 | County of Orange | 3rd bullet. "What are the most important sources, pathways and **factors affecting** environmental fate…" | Requested change was made. |
| 1.3 | 7 | County of Orange | last line. change "working document" to "living document". | Requested change was made. |
| 1.3 | | Regional Board | adds to paragraph 1: **Sources will be prioritized based on the nature and magnitude of loading, water quality impacts, and control feasibility. The SMP will recommend source control, treatment control and pollution prevention measures for the Bay, and localized implementation measures for specific sources where possible. These recomendations will be tied to the goals and timeframes of the Fecal Coliform TMDL.** | Requested change was made. |
| 1.3 | | Regional Board | bullet 1: changes text: • **Do FIB concentrations exceed water quality criteria**, and if so, at which locations and under what conditions (Sections 4.0 & 6.0)? And asks: What do you mean by problematic?? -better to state whether FIB concentrations exceed WQ criteria | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**SECTION 1.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 1.3 | | Regional Board | bullet 2: adds text: • **What locations have the highest frequency of FIB exceedences and/or highest magnitude of exceedences, and when do these occur? Also, which sites have high FIB concentrations and exceedences year round?** And states: The two most important questions are whether FIB concentrations exceed WQ criteria and where, and what is frequency & magnitude of exceedences -I moved trend item to #3 because 1st 2 statements are more important | Requested change was made. |
| 1.3 | | Regional Board | bullet 4: FIB and which contribute to present **FIB exceedences** (Sections 5.0 and 7.0)? | Requested change was made. |
| 1.3 | | Regional Board | bullet 5: and transport to the Bay, **and are they effective at reducing FIB concentrations** (Section 8.0)? | The determination of whether an existing BMP is effective was not an objective of the evaluation, and therefore the request |
| 1.3 | | Regional Board | comment on paragraph after bullets: Report is now called Newport Bay Fecal Indicator Bacteria Source Identification Project, SMP should be termed Newport Bay Fecal Indicator Bacteria Source Management Plan | To remain consistent with the grant/contract, the words "fecal coliform" remain in the title. |
| 1.3 | | Regional Board | cahnges paragrap after bullets: "Therefore, this SMP should be considered a living**/working** document…" and also comments: Should also add this comment on 2nd page after title so everyone knows up front | Requested change was made. |
| 1.3 | | Regional Board | wants reference for Footnote #2 | USEPA 2000 was included. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 3.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 3 | | Regional Board | paragraph1: and the results of previous **beneficial use** assessments designed | Requested change was made. |
| 3.1 | 1 | County of Orange | 2nd paragraph, line 1 – "Under California law, **b**eneficial **u**ses…" | Requested change was made. |
| 3.1 | 1 | County of Orange | 2nd paragraph, line 4 – "…(33 USC 1313), **u**ses in…" | Requested change was made. |
| 3.1 | 1 | County of Orange | 3rd paragraph, line 1 – "…by the ~~Santa Ana~~ Regional Board…" | Requested change was made. |
| 3.1 | 2 | County of Orange | 1st paragraph, line 5 – "…~~suggesting that there are inconsistencies between the Basin Plan and local prohibitions.~~" | Requested change was made. |
| 3.1 | 3 | County of Orange | 1st paragraph, line 1 – "~~Based on the information presented in this section, it appears that there are inconsistencies between the Basin Plan and State/Municipal Codes with regard to where REC-1 (swimming) uses exist. In an effort to clarify these contradicting codes/laws,~~ …" | Requested change was made. |
| 3.1 | 4 | County of Orange | 1st paragraph, line 2 – "~~a variety of public agencies in Orange County contracted with~~ EOA Inc. (EOA) **was contracted to…**" | Requested change was made. |
| 3.1 | 5 | County of Orange | Table 3.2 no sites are bolded indicating evaluation in the Use Assessment. | Requested change was made. |
| 3.1 | 6 | County of Orange | 1st paragraph, line 3 – "…~~establish~~ **illustrate** recreational use levels." | Requested change was made. |
| 3.1 | 6 | County of Orange | 1st paragraph , line 8 – add at end, "The application of use levels to sites within the Bay in the SMP is for illustrative purposes only and is not a formal regulatory designation." | Requested change was made. |
| 3.1 | | Regional Board | paragraph 1: as described by **the Beneficial Use Assessment for REC-1** (EOA (2001). Also comments: "use this or report title" | Requested change was made. "REC-1 Assessment" is now used throughout the SMP when referring to this study. |
| 3.1.1 | | Regional Board | adds after quote: **However, swimming is allowed at many small beaches along this main channel.** | This is a quote from the muncipal code and therefore the text was not added. |
| 3.1.1 | | Regional Board | says this is a good note: The application of use levels to sites within the Bay in the SMP is for illustrative purposes only and is not a formal regulatory designation. | Agreed. |
| 3.2 | 10 | County of Orange | 1st Paragraph, line 9 – "…California, ~~any~~ number of FIB…" | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 3.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 3.2 | 11 | County of Orange | 1st Paragraph, line 1 – remove sentence "Over the last 90 years…" | Requested change was made. |
| 3.2 | 11 | County of Orange | 1st paragraph, line 6 – please confirm that the NTAC said that total coliforms were greatly influenced by stormwater runoff. | Requested change was made. |
| 3.2 | 11 | County of Orange | 1st paragraph, line 7 – "…~~say~~ **find** that about 18%..." | Requested change was made. |
| 3.2 | 11 | County of Orange | 3rd paragraph, line 4-5 – "This WQO is still present in the Basin Plan Today." Please add actual text – the wording is different than the EPA language cited in the text. | Requested change was made. |
| 3.2 | | County of Orange | table 3.4 make sure entire table is kept together | Requested change was made. |
| 3.2 | | Regional Board | first paragraph, first line: microbes, **such as viruses**, exist in very small | Requested change was made. |
| 3.2 | | Regional Board | 1st paragraph, last line: Depending on the region of California, **concentration of** FIB may be used as water quality objectives. | Text was added stating that "…California, **different types and concentrations** of FIB…" |
| 3.3 | | Regional Board | after table 3.4 notes: "you had an extensive history in TM#1 –should include as Appendix" | An appendix describing the history of WQOs/Criteria is now included. |
| 3.3.2 | | Regional Board | first paragraph: concluded that **some regions in** the State of | Requested change was made. |

Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan
Section 4.0

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 4 | 1 | County of Orange | 2nd Paragraph, line 2 – "…majority of these data **applicable to current water quality standards** were collected…" | Requested change was made. |
| 4 | | Regional Board | Figs 4.2, 4.3, 4.4: add geomean standards line | Geomean standard lines were added. |
| 4 | | Regional Board | Figs 4.2 and 4.7: why use medians rather than means -they are not directly comparable to geomean standard as logmean?? | Medians are a function of a box plot. Means cannot be plotted using box plots. |
| 4 | | Regional Board | Figs 4.6, 4.7 (FC, ENT) -<br>Why is there only a midpoint for N St on both graphs?? | The variability of data is very low for this site. The 25th and 75th percentiles are equal to the median and therefore only a single line is illustrated. |
| 4 | | Regional Board | There are no graphs showing % exceedences of data (old comment) | Tables 4.3 - 4.6 show the % exceedances for each site. Adding a figure would be redundant and therefore was not added. |
| 4 | | Regional Board | Be sure to include Feb07 data in wet season data and note in text | February 2007 were included. The text was updated to indicate this. |
| 4 | | Regional Board | Fig 4.9: Box-whisker plots of fecal coliform (A) and Enterococcus (B) concentrations from 2004-2007 at the 31 OCHCA monitoring sites during dry and wet weather. **It would be useful to see this information by site** | Creating box whiskers for each of the 31 sites would take considerable time and resources and is beyond the the scope of the project. Information on each the variability and central tendancy of concentrations during dry and wet weather at each site is incldued in Appendix C. |
| 4 | | Regional Board | Tables 4.5, 4.6: **Might want to add column for "%exceedence of 10X SSM" (or 20 or whatever maximum you use) to Tables 4.5, 4.6 (FC, ENT-wet weather) -this will introduce this concept for Chp6** | Adding the requested column to Table 4.3 - 4.6 is redundant with Table 6.13 and 6.14 and were therefore not added to these tables. |

Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan
Section 4.0

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4 | | Regional Board | foot note 1: These sites were located in the main channel of the Bay, and therefore may not fully represent the concentration of FIB at high use beach areas. **not true –ALL BAY IS LISTED AS REC1 -Suggest replacing "recreation areas" with "high use beach areas"**<br>**Same comment as old comment –see below**<br>Table 7. Log mean Enterococcus and E. coli concentrations and associated standard deviations of Newport Bay sites sampled during the Source Identification Study (Grant et al. 2007).<br>**W/RESPECT TO FOOTNOTE –THE WHOLE BAY IS LISTED FOR REC SO MAIN CHANNEL SHOULDNT BE DIFFERENTIATED FROM 'RECREATION AREAS' -IF YOU WANT TO SPECIFY BEACHES VS MAIN CHANNEL THAT'S DIFFERENT** | Footnote was changed to state: "These sites were located in the main channel of the Bay, and therefore may not fully represent the concentration of FIB at sites where full body contact recreation is probable (i.e., beach sites). |
| 4.? | 12 | County of Orange | 2nd Paragraph, line 3 – "..6.4 present **and** compare.." | Requested change was made. |
| 4.? | 20 | County of Orange | last paragraph – should this study be included here? What relevance or conclusions were drawn? The text indicates that it is preliminary and not peer reviewed – should it be included at all? | Study was removed from summary due to draft status. |
| 4.1.1 | 1 | County of Orange | 1st paragraph, line 1 – "Between January 1986 and December **2007?**..." | Text was changed to more accurately state that "From January 1986 through December 2007.." |
| 4.1.1 | | Regional Board | 1st paragraph, 1st sentence comment: **Ecoli was analyzed until 1999, then Fecal coliform has been analyzed since 2000 –pls talk to Larry Honeybourne** | After review of methods and types of FIB monitored with OCHCA staff, there is consensus that although methods have changed, Fecal Coliforms have been analyzed from 1986 to present day. |
| 4.1.1 | | Regional Board | 3rd paragraph comment: **Ecoli was analyzed until 1999, then Fecal coliform has been analyzed since 2000 –pls talk to Larry Honeybourne** | See response directly above. |
| 4.1.1 | | Regional Board | 5th paragraph, 1st sentence comment: **See above –EC monitoring from 86-99, FC monitoring from 2000 to present** | See response directly above. |

Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan
Section 4.0

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 4.1.2 | 5 | County of Orange | Figure 4.4 – there is no box-whisker for 2007. | There is no box or whisker because the variability in FC concentrations in 2007 is minimal. A large majority (>75%) of samples collected in 2007 were at the detection limit and therefore the boxes and the whiskers are the same as the median. |
| 4.1.2 | | Regional Board | 2nd paragraph: What is difference btwn Figs 4.2 and 4.4?? | They are similar, but illustrate two different ranges and types of central tendancy measurements. Figure 4.2 illustrates the 90th and 10th percentiles and the log mean. Figure 4.4 illustrates the 25th and 75th percentiles and median. |
| 4.1.3 | | Regional Board | 2nd paragraph: Wonder if part of decreasing trend is due to analysis of FC concentrations instead of E coli -Ecoli is a subset of FC –maybe FC that are not Ecoli are decreasing more than Ecoli –maybe ask Larry | See response above regarding types of TB analyzed.. |
| 4.2.1 | | Regional Board | 1st paragraph: As described above, OCHCA has collected FIB data in the Bay since 1986. During that time period the number of sites sampled has changed, as well as the sampling frequency and analytical methods used by OCHCA. **Describe changes** | A monitoring site and methods summary is now included as Appendix C. |
| 4.2.1 | | Regional Board | 3rd paragraph: Based on these criteria, OCHCA **Fecal coliform and Enterococcus??** data collected | Requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 4.2.1 | | Regional Board | bullet: • **ADD All medians are below Fecal coliform geomean criteria. Is this even valid to compare medians w/geomean criteria??** The sites that have median values higher than 10 MPN/100mL are located either in Newport Dunes, Upper Bay (Vaughn's Launch), West Newport Bay (Newport Blvd Bridge and 33rd St.), Lido Yacht Club or near Bayside Drive. | It is generally agreed in the scientific community that bacteria concentrations are log-normally distributed. This is why geometric means (as opposed to arithmetic means) are used when setting water quality criteria. As populations (datasets) approach pure log-normality, medians and geometric means become near equal (also described in the Source ID Project). Therefore, for the purposes of this analysis, medians and geomeans are assumed to be comparable. When comparing against water quality criteria/objectives in Section 6.0 for the purposes of prioritizing sites, only the geomean is used. |
| 4.2.1 | | Regional Board | bullet: • Most of the sites that exhibit the greatest variability in fecal coliform concentrations are the sites that also have median values higher than 10 MPN/100mL. **Might list sites w/tails above geomean** Other sites that also exhibit substantial variability include 43rd St. and Ski Zone. | Requested change was made. |
| 4.2.1 | | Regional Board | bullet: • **All medians are below the Enterococcus geomean criteria**. The geometric mean Enterococcus concentration **thought these were medians in graphs** at nearly all (28 of 31) sites throughout the Bay is 10 MPN /100mL or less (method detection limit 2 CFU/100mL), substantially lower than the geometric mean water quality criteria of 35 MPN /100mL. | Text was changed to refer to the median, as opposed to the geomean. |
| 4.2.2 | | Regional Board | 2nd paragraph: Dry season data were collected from July through October 2006, and wet season from March through April 2006 **include Feb07 data and note.** | Requested change was made. |

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.2.2 | | Regional Board | 3rd paragraph: ). Interestingly, as described in Section 5.0, Enterococcus concentrations in bedded sediments had an inverse relationship to water column concentrations. **not necessarily inverse relationship but ENT sediment concentrations are highest in Lower Bay** | Text was revised to state: "Interestingly, as described in Section 5.0, Enterococcus concentrations in bedded sediments had higher concentrations in the Lower Bay, compared to the Upper Bay." |
| 4.3 | 10 | County of Orange | Figure 4.7 (A), BTOs 1-3 are not shown on the map. For comparison to (B) they should be included. | A map showing BTOs 1, 2 and 3 is now included. |
| 4.3 | | Regional Board | Figure 4.8: List tributaries that were analyzed and are presented in graph. | In the caption, tributaries are now listed. |
| 4.3 | | Regional Board | Table 4.2: If rainfall is low in 06, why are there more wet days in 06 compared to 05?? | Based on our review of the rainfall data, in 2006, a number of small (~0.2in) isolated storms occurred, creating more rain advisory days, but less than average rainfall. |
| 4.3 | | Regional Board | Examination of dry **and wet??** weather data presented in Tables 4.3 to 4.6 illustrate many salient points. Specifically, the OCHCA 2004 to 2007 dry and wet weather fecal coliform and Enterococcus datasets reveal that: | Requested change was made. |
| 4.3 | | Regional Board | Bullet: • Sites that exceeded the fecal coliform SSM greater than 10% of the time, also had the highest rates of Enterococcus SSM exceedances among all sites. **for wet or dry??** | Text was revised to state that "Sites that exceeded the fecal coliform SSM greater than 10% of the time **during dry or wet weather**, also had the highest rates of Enterococcus SSM exceedances among all sites |
| 4.3 | | Regional Board | Bullet: • Median Enterococcus concentrations in samples collected during storm events are greater than those collected during the wet (storm) season, which are greater than dry season samples; **Report graphs say storm season rather than wet** and, | Text was revised to be consistent with Figure 4.10. |

Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan
Section 4.0

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 4.3 | | Regional Board | Other TMDL report data are still not used –WNB bacti study and Marina study -see comment old p21 WHERE IS WEST NEWPORT STUDY, MARINA STUDY??<br>you mentioned the studies in next section, but did not discuss the data w/reference to sites monitored<br>data from WNB study show certain sites with high bacti concentrations and conclusions are informative for mgt purposes - | The data used in this to assess current water quality conditions were from long-term datasets. Data and conclusions from the Marina and WNB studies are discussed and used thuroughly in Sections 5.0, 7.0, and 9.0. |
| 4.4 | | Regional Board | 1st paragraph: Also reference RB reports for WNB and Marina studies –they are on RB8 website | A summary of the "Marina" study is included and referenced as Jeong et al. 2005. The "WNB" study is thuroughly discussed in sections 5.0 and 7.0 |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 5.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 5.1 | 5 | Regional Board | 1st paragraph, **Urban AND Natural sources of bacti are both deposited on watershed and in tributaries –naming only urban sources for #1 and natural sources for #2 is a false separation** | Text was revised to provide examples of both natural and urban sources of FIB. |
| Table 5.1 | 5 | Regional Board | Paragraph 3: ***Your Table14 from TM#1 was more accurate and informative because it showed Tributaries, Stormdrains, Direct inputs and Sediments –this table is redundant and categorizes FIB sources by category -old categories for Tribs, Stormdrains etc are important. Using this table you could put applicable sources under correct category, for example Domestic Pet Waste under 1) Urban runoff etc, and have have Transport Pathways as headers across top***<br>***It is important though to include the original pathway information because dividing everything into Wor B is inadequate***<br>***Also –all sources in Fig5.1 are NOT included in Table5.1 below*** | Although we agree that Table 14 in TM#1 is informative to the relationship between pathways and soruces, the focus of this table is the relationship between sources v.TMDL source category. Therefore the existing Table 5.1 was kept in the SMP. |
| 5.1.2 | 8 | Regional Board | ***3rd paragraph: Should probably have 2 urban categories -urban runoff, and urban sources -the intent of the urban runoff category in the FC TMDL was to address ALL urban sources so maybe we need to use the term urban sources instead of urban runoff***<br>***in any case –both urban sources should be together so 'other urban sources' should probably follow 'urban runoff' and 'the Dunes' should follow those*** | The term "Other Urban Sources" is now used throughout the document instead of anthropogenic sources. The Dunes is not a separate soruce category in the TMDL, as it does not have a separate Load or Wasteload Allocation. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 5.0**

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| 5.1.4 | 8 | Regional Board | 4th paragraph add: **while the channels and storm drains carry both urban, agricultural and natural sources runoff,** The urban runoff source category focuses on runoff from urban sources **~~is comprised of an amalgamation of anthropogenic and natural sources, including activities and processes that deposit FIB onto the surface of the watershed and within the urban runoff conveyance system.~~ No -This is not the intent of the FC TMDL –urban runoff should just address urban sources although we realize that the channels and drains carry both 'urban runoff' and 'agricultural runoff' and 'natural runoff' While the channels and drains carry both urban and ag and natural runoff, the idea of the urban runoff category is to address 'runoff from urban sources' Ag and Natural source runoff should be addressed under the corresponding categories** | We agree that the Urban Runoff source category in the context of the TMDL should address urban sources specific to urban runoff. Text was changed to indicate that only anthropogenic sources are included in the urban runoff source category. |
| 5.1.4 | 9 | Regional Board | 4th paragraph add: **We might think about revising these TMDL categories later on and look at 1-FIB inputs to the Bay from watershed –urban, agricultural, natural, 2-FIB inputs from within the Bay –urban, natural, 3-Dunes Recreation Area** | Point is well taken and should be discussed prior to revising TMDL. |
| 5.1.4 | 9 | Regional Board | 2nd paragraph asks question**: shouldnt this be 'or'** | Yes. Text was revised. |
| 5.1.4 | 9 | Regional Board | 2nd paragraph asks question: **Any estimates on Enterococcus??** | Through our literature review, only fecal coliform excreation rates were found. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 5.0**

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|---|---|---|---|---|
| 5.1.4 | 9 | Regional Board | 3rd paragraph add**: Some estimates on #horses in area are needed –See comments at beginning of Chp -Also need to address Livestock in UNB or Upper SDCk - goats, chickens, cattle, as well as horses**<br>**There are also NB City ordinances re: horses, and likely City ordinances in other cities in watershed**<br>**Also recall that this is a concentration based TMDL –loading #s are useful to determine which sources are biggest problem but related concentration #s would be helpful** | Text was added stating that a number of horse stables and boarding facilities existing in the watershed. Also, horse riding is frequent on trails in the upper bay and San Diego Creek watershed. Therefore, horse are a likely source of FIB. Other livestock are also mentioned. Loading estimates, however are not provided due to the lack of information. |
| 5.1.4 | 11 | Regional Board | 1st paragraph asks question: **in residential areas??.** | Although it is believed that dry weather runoff primarily orignates from residential over watering/irrigation, Everest International did not equate all dry weather runoff to this land use. |
| 5.1.4 | 11 | Regional Board | 2nd paragraph asks question: **did you contact City NB about their appplication rates of fertilizers?? comments 2/09** | Compiling and georeferencing application rates for fertilizers on municipal properties is beyond the scope of the SMP. Fertilizers applied by homeowners are not currently tracked. |
| 5.1.4 | 11 | Regional Board | 2nd paragraph: **Both Enterococcus and E. coli were enumerated from runoff samples, although Fecal Coliforms were not. Median Enterococcus concentrations were 5,129 organisms/100mL.** | Because fecal coliforms are the FIB that has the most data associated with sources, only fecal coliforms are reported. Enterococcus concentrations are included in Technical Memrandum #2, which is referenced in this section. |
| 5.1.4 | 11 | Regional Board | 2nd paragraph asks question: **Is there a reason you took out Enterococcus info from last draft?? It should be included just dont convert ENT to Fecal coliform** | See comment directly above. |
| 5.1.4 | 11 | Regional Board | 3rd paragraph asks question: **watershed??** | the word "watershed" was added. |
| 5.1.4 | 11 | Regional Board | 4th paragraph asks question: **What happened to ENT estimates?? -include ENT estimates.** | See comment re: ENT above. |
| 5.1.4 | 12 | Regional Board | 2nd paragraph asks question: **How infrequent?? Be more specific. Include other Urban Sources here then include Section for Dunes Rec Area.** | Text was added to better state the approximate number. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 5.0**

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|---|---|---|---|---|
| 5.1.5 | 13 | Regional Board | 1st paragraph asks question: **What about livestock?? goats, chickens, cattle -should we address here or under pets?? this hasnt been discussed yet** | Livestock is breifly discussed under domestic pets. |
| 5.1.6 | 13 | Regional Board | 2nd paragraph add: **Might Add 'and Pumpout Stations' not sure whether pumpout stations fits better here or with sewer lines –probably here since it handles vessel waste** | Pump-Out Facilities was added to the title. |
| 5.1.6 | 13 | Regional Board | 4th paragraph add: **but this estimate is based on everyone dumping their loads and we know That isnt true** | As described in Appendix E and EOA 2001, the estimate was not based on "everyone" dumping their loads. Rather survey were conducted to determine the frequency of loads be disposed of improperly. That frequency was determined to be 10%. |
| 5.1.6 | 13 | Regional Board | 6th paragraph asks question: **Why 80% -there is no justification for this number.** | The commentor is correct 80% is based on best professional judgement and should be considered a first order estimate. We would be happy to include a different % if one is recommended. |
| 5.1.6 | 13 | Regional Board | last paragraph add: **still need to include OC marina study where marina was empty for a while, then full –talk to Larry H. comments** | This study was never forwarded to the authors after repeated requested. Therefore, the results of the study were not included in the SMP. |
| 5.1.7 | 14 | Regional Board | 1st paragraph add: **Just call 'Other Urban Sources' to fit w/TMDL categories** | Requested change was made. |
| 5.1.7 | 16 | Regional Board | 1st paragraph asks question: **Thought old sewer pipes were made from vitrified clay with cement joints.** | Correct. Text was revised. |
| 5.1.7 | 16 | Regional Board | 3rd paragraph asks question: **What about earthquakes?? any statistics on that??** | Although earthquakes can forseeably cause pipe deterioration or separations, no statistics were found to quantify. |
| 5.1.7 | 17 | Regional Board | 1st paragraph : **–thought this was 10th St)** | Text now states, near 10th street. |

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| 5.1.7 | 17 | Regional Board | 2nd paragraph: add: . **True but if concentrations are high enough, some bacti could be released** Alternatively, FIB could possibly travel below sanitary sewer lines via coarser granular material and make its way to the Bay, although this transport process also seems unlikely. **Whyis this unlikely?? there is no data to support this statement unless you have reference.** Regardless of the likelihood of these transport processes occurring in the Newport Bay watershed, it is not possible at this time to quantify contributions of FIB to the Bay from leaking sanitary sewers. **However, this should definitely be on the radar to keep track of leaking sewers and estimate how much bacti is released from these.** | Statement was removed regarding the likelihood of FIB moving along granular material under sewer lines. |
| 5.1.7 | 18 | Regional Board | 4th paragraph asks question: **Is there no data on SSOs in Newport Bay watershed?? This average estimate could be low or high** | Readily available data was used to calculate the estimate from SSOs. Compling data on SSOs specific to the Newport Bay watershed is resource intensive and beyond the resources available for the SMP and was therefore not compiled. |
| 5.1.7 | 19 | Regional Board | 1st paragraph add: Swimmer Shedding **This could essentially be under Dunes heading as this is main swimming area** | Although the Dunes is the main swimming areas in the Bay, there are many other small beaches that swimmer shedding could also impact. Therefore, the heading of "swimmer sheeding" remains. |
| 5.1.7 | 19 | Regional Board | 2nd paragraph asks question: **Are there estimates on loading from kids (esp toddlers in diapers) vs adults??** | Through our literature review we did not find estimates specific to children. |
| 5.1.8 | 19 | Regional Board | last paragraph: Wildlife, including waterfowl (e.g., gulls, geese, ducks) ~~**small**~~ land mammals (e.g., skunks and raccoons, **coyotes, rodents)**, **and** marine mammals (e.g., **sea lions,** seals) ~~**and rodents (e.g., rats)**~~ | Requested changes were made. |

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| 5.1.8 | 20 | Regional Board | 1st paragraph add: **(also rabbits, coyotes and birds)…**asks question**: Did you talk to DFG about wildlife in Newport watershed?? they might have better estimates than just cutting literature numbers by 50%.** Add: Appendix XX. **Rabbits, mice estimates?? Maybe we can examine FIB loads coming off natural areas compared to FIB loads coming off urban areas to get more accurate numbers –after all, not ALL feces will be washed into channels/drains. This seems to be an inaccurate way of establishing load –we should be trying to collect runoff samples from natural vs urban areas - see comments 1st p** | Authors queried DFG, but they did not have numbers readily available. See Section 9.0 for future studies regarding quantifiying natural sources. |
| 5.1.8 | 20 | Regional Board | last paragraph add: In addition to **other** wildlife **(waterfowl are wildlife)** | Wildlife are now termed "terestrial wildlife" to make the distiniction between water birds and wildlife. |
| 5.1.8 | 21 | Regional Board | 1st paragraph asks question: **Do we have estimates of ENT for water birds??** | Only fecal coliform excretion rates were found. |
| 5.1.8 | 22 | Regional Board | 3rd paragraph add: **Not sure if this is correct –I thought a certain %age of isolates wasnt ENT, then out of the total ENT spp approx 50% were plant-assoc ENT and approx 50% were fecal ENT –check w/Charlie** | The text states that of the Enterococcus isolated, 50% were fecal-associated. This statement is consistent with the Source ID report. |
| 5.1.8 | 23 | Regional Board | paragraph continuing from pg. 22 asks question: From a water quality perspective, biofilms are interesting **interesting??**because bacteria may detach from the surface of the biofilm and enter water column. | Text was changed to state "…biofilms are of interest…" |
| 5.1.8 | 23 | Regional Board | 2nd paragraph asks question: **What about ENT assoc w/Debris Mats??** | A paragraph on debris mats is now included at the end of Section 5.1.8. |
| 5.1.8 | 23 | Regional Board | last paragraph on page add: **Some microbiologists show that there is crossover (from plants to humans) and that plant –associated ENTcan actually be passed through the human gut.** | Through our literature review, we have found no references to support this assertion. If references could be provided, then the authors would consider making this statement. |

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| 5.1.8 | 23 | Regional Board | ADD IN-BAY SEDIMENTS SECTION AS SOURCE | Sediments can be referred to as both a sink and source. FIB can be trapped and transpoted via sediment, and FIB may replicate/grow in sediment. A discussion of sediments as a source is now included in this section as well. |
| 5.2.2 | 24 | Regional Board | 4th paragraph asks question: **I thought it was 214 in Lower Bay –maybe more in Upper Bay** | Based on information in the Source ID Project Report (including maps) and plotting of storm drain locations identified through the Source ID project, there are 214 small and large drains in both the Upper and Lower Bay. This does not include stormdrains in SAD, SDC, or BCW watersheds. |
| 5.2.2 | 25 | Regional Board | 1st paragraph asks question: **Doesnt OC Stormwater program monitor fecal coliform??** | Very little Newport Bay data are available on fecal coliform concentrations of sotrmwater discharges. |
| 5.2.2 | 27 | Regional Board | 4th paragraph asks question: The fraction of annual rainfall that is expected to produce runoff (Pj) was calculated at 0.6 **units??** using rainfall data from 1987 to 2007 . | Percentage is now included as well. |
| 5.2.2 | 28 | Regional Board | Table 5.8 asks question: **What happened to old Table 6.2?? It showed FC,ENT average concentrations (or was it median??) and drain flow -should keep original table or put concentration/flow data into a table preceding this one so all info from Table 6.,2 is still in this section -did Table 6.2 represent dry or wet or annual loading??** | All information that was included in the previous 6.2.2 is included in this section and Appendix E. |
| 5.2.2 | 29 | Regional Board | Table 5.9 asks question: **Table 5.9. High, average and low FIB loading rates from all storm drains discharging to Newport Bay during wet weather. It is surprising that there are no high/low average concentrations and loadings for FC –why dont we have this information?? - even if you have to use upper detection limit for FC as a low 'high' estimate it would be better than no estimate** | The reason no wet weather loading rates for fecal coliform are included is because limited data are available on the concentrations of fecal coliforms in drain discharges during wet weather. |

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| 5.2.3 | 30 | Regional Board | 1st paragraph asks question: **Last draft showed data from 02-08 –why the switch?? this changes the medians dramatically –for ENT, median dry and wet were 67 and 9300 organisms/100mL –that's a whole lot higher in wet medians for FC for dry and wet were 190 and 9500 organisms/100mL -again this is a huge change for a 2yr difference in data set –so again –why the switch?? should at least note these numbers for 02-08 in text** | As described in Section 5.0, the dataset from 2004-2007 was used instead of 2002-2008 because: 1) A detection limit change occurred in 2003 making data comparisons more difficult between pre- and post 2003, and 2) the entire 2008 dataset was not available when data analysis began. The authors and the TAC are comfortable that the selected timeframe is representative of "current" conditions. Based on ranifall data, the dataset is representative of a broad range of hydrological conditions that impact FIB concentrations. |
| 5.2.3 | 30 | Regional Board | Figure 5.7 add: **from 2/09 –add geomean standards lines** | Geomean lines were not added because ENT and FC water quality objectives/criteria are not applicable to freshwater sites on these tributaries. |
| 5.2.3 | 31 | Regional Board | Figure 5.8 add: **from 2/09 –add geomean standards lines** | See comment directly above. |

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| 5.2.3 | 32 | Regional Board | Table 5.10 add: **As stated in text above, the switch from 2002-08 to 2004-08 data decreases the average concentrations for FC and ENT esp in wet weather FC AND ENT concentrations esp for San Diego Ck (02-08 wet –San Diego Ck, FC-9500, ENT-9300, Delhi FC-3,000, ENT-2700, Big Cyn FC-520, 190), not so different for dry weather –San Diego Ck FC-190, ENT-67, Delhi FC-520, ENT-287, Big Cyn FC-150, ENT-92 from Table 6.3 last draft also note that for 02-08 data ALL ENT wet and dry concentrations were above the geomean std except low estimate for San Diego Ck, for FC all dry weather estimates in Delhi and high estimates in San Diego Ck and Big Cyn were above geomean std, and all wet weather estimates were above geomean std -this changes for 2004-08 data set**<br>**Change of data set needs better justification -why the change??** | See comment above regarding reasoning for change in timeframe representing "current' conditions. |
| 5.2.3 | 33 | Regional Board | 1st paragraph add: **Again for 2002-08 data, average concentrations for Delhi were FC-3,000, ENT-2700 for wet, and FC-520, ENT-287 for dry** | See comment above regarding reasoning for change in timeframe representing "current' conditions. |
| 5.2.3 | 33 | Regional Board | Figure 5.9 add: **add geomean standards lines** | Geomean lines were not added because ENT and FC water quality objectives/criteria are not applicable to freshwater sites on these tributaries. |
| 5.2.3 | 33 | Regional Board | Figure 5.10 add: **add geomean standards lines** | See comment above. |
| 5.2.3 | 34 | Regional Board | Figure 5.11 add: **add geomean standard lines** | See comment above. |
| 5.2.3 | 34 | Regional Board | Figure 5.12 add: **add geomean standard lines** | See comment above. |

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| 5.2.3 | 37 | Regional Board | Table 5.11 asks question: **Why are these numbers different from Table 6.4 –last version –many of these concentrations are LOWER than those in old Table 6.4 –in many cases an Order of Magnitude Lower –Why the change??**<br>**also there were high and low numbers for Big Cyn Wash –now there are none –What happened to these numbers??** | Based on comments received, the analysis of discharge using existing data was reviewed and errors regarding the calculations were corrected. |
| 5.2.3 | 37 | Regional Board | last paragraph add: Based on the estimated daily loadings of fecal coliform and Enterococcus from tributaries presented in Table 6.4, the following salient points were identified:<br><br>For all tributaries, dry and wet weather loading rates for fecal coliforms are greater than o**r nearly equal** to those for Enterococcus; | Requested change was made. |
| 5.2.4 | 39 | Regional Board | Table 5.12 add: **Loads in this table do not match Loads in Table 5-11 -where did these Load #s come from??** | One error was found in the table and corrected. All estimates presented in earlier sections now match Tale 5.12. |
| 5.2.4 | 39 | Regional Board | 3rd paragraph asks question: Median fecal coliform concentrations in samples collected from drains are substantially (2 to 20x) higher than those from tributaries; **concentrations or loads??** | Concentrations. Loads are similar. |
| 5.2.4 | 46 | Regional Board | 1st paragraph add: **In transect studies or microcosm studies?? However, microcosm studies showed that FIB from San Diego Creek (fresh water) survived better in sterilized Bay water than the reverse, this might indicate that salt water predators rather than salinity have an impact on FIB in fresh water inputs.** | Possibly. No revisions were requested. |
| 5.2.5 | 46 | Regional Board | last paragraph heading add: **This section should go under 'Natural Sources' as sediment is both a source and a sink** | Requested change was made. |

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| 5.2.5 | 47 | Regional Board | 1st paragraph add: **This is interesting and gets back to the question of whether FIB are sorbed to particles (including flocked clays) or free cells –the question remains as to how to separate particles w/sorbed FIB from free cells since flocked clays (in marine waters) likely contain much of the FIB, but since clays are <2um and FIB cells are 1um the difficulty lies in separating the two fractions** | We agree. Commentary noted. |
| 5.2.5 | 47 | Regional Board | 3rd paragraph add: In Newport Bay, Grant et al. (2009) found that Bay sediments have high concentrations of Enterococcus, and relatively low concentrations of E. coli **especially in Lower Newport Bay**. | Requested change was made. |
| | | | Observed Enterococcus concentrations in Bay sediments were between 40 MPN/10 grams and 4000 MPN/10 grams. Additionally, Enterococcus concentrations had considerable temporal. **Temporal or spatial??.....** | Temporal |
| 5.2.5 | 48 | Regional Board | continued from previous paragraph on pg. 47: **so high FIB concentrations in sediments might affect water quality in shallow waters (ie at beaches). It would be useful to investigate the relationship between sediment and water FIB concentrations in shallow sediments by monitoring sediment and water FIB concentrations at beach sites during routine monitoring by OCHCA. .** | Although interesting, it is unclear why the commentor would suggest that sediment sampling should be a high priority activity counducted in the future, such as studies suggested in Section 9.3. From a BMP perspective, if sediment were found to be a source of FIB to shallow waters, we are not clear on what BMPs would be suggested. Therefore, studies/monitoring characterizing sediments were not included. |
| 5.3.1 | 40 | Regional Board | 2nd paragraph #1 asks queston: expect Polaris and 130 small drains); **except?? are you saying that 130 small drains are not in Lower Bay?? might be better to put number that IS in Lower Bay –which I thought was around 200** | Based on lats and longs provided by Dr. Grant, 130 small drains discharge directly to the Lower Bay. The remaining 79 discharge to the Upper Bay (as defined in Section 2.0). |
| 5.3.1 | 40 | Regional Board | #4 - why do you say 'assumed to' in all of these –isnt this the reality that these areas drain into the given channels/drains?? | Assumptions of data quality and acuracy (i.e., locations and numbers of drains) are made when using datasets from other sources. Therefore, the term assumption was used. For easier reading, this term was removed, although assumptions remain. |

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| 5.3.1 | 41 | Regional Board | Table 5.13 add: **Might include column for Direct Inputs to Bay for easy comparison -Show these designated areas on a map -Are these estimates considered to be year round??**<br>**also –should include Big Cyn Wash as separate tributary –this is how it was treated in Prop13 study and you have separate loading #s for this trib. in Tables 5-10 -5-12.** | We chose not to include direct inputs in this table because this table depicts FIB loads ONTO the SURFACE of THE WATERSHED, not direct inputs. Direct inputs are presented in Table 5.12. |
| 5.3.2 | 42 | Regional Board | 1st paragraph add: **Loading rates should be calculated for ENT also –Although we dont have ENT numbers for various sources (pet, wildlife waste etc.), we Do have ENT concentrations coming out of various drains and tributaries –we can use these numbers -It would also be useful to do these calculations w/FC to determine difference between estimates based on literature values for sources and actual measurements of FC from drains** | Fecal coliform was used for comparison purposes, which are further described in section 5.3.3. In the future, if additional ENT information is available for sources, then ENT comparisons can be made. |
| 5.3.2 | 42 | Regional Board | Table 5.13 add: ****In Lower Bay Separate OUt largest storm drains and small storm drains, also ADD Totals to bottom of Table -then we can compare loads by source vs loads by measured concentrations -see comments below when you calculate totals here compared to Totals in Table 5-13, totals here are close to an order of magnitude lower in each category -this is important information** | Information comparing FIB loading from large and small storm drains is located in Section 5.2.2. Here, loads are estimated by subwatershed, and not separated out by large and small drains. The reader can take the loading estimates from Section 5.2.2 and apply them here to loads by sub-watershed if he/she chooses. Add loading by large and small drains here again would be redundant. |

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| 5.3.3 | 44 | Regional Board | 3rd paragraph add: • Daily average dry **weather discharges of fecal coliforms from pathways (dry weather pathway loading)** ~~**that receive drainage**~~ from the Lower and Upper Bay sub-watersheds are similar or greater than estimated source contributions to the watershed, **isnt this less than??** suggesting that the build-up and wash-off process described above is less obvious during dry weather, when there are consistent patterns of discharge. **this sentence is confusing –rephrase -from Table 5-15 wet OR dry weather pathway loading are never greater than estimated contributions from sources, however, wet weather pathway loading is always greater than dry weather pathway loading -even Total pathway loading (which you should show in last Table (should be 5-14) is less than source loading** | This section was revised to compare "annual" loads, which allows for a better comparison between source contriubtions and pathway loadings. |
| 5.3.3 | 44 | Regional Board | Table 5.14 add: **Should be 5.15** | Requested change was made. |
| 5.4 | 44 | Regional Board | Last paragraph title add: 5.4 Potential Environmental Fates of FIB **this seems to be a misplaced section –might fit better after Natural Sources??** | This section is intended to explore what is know about the possible fates of FIB once they enter the water column or sediment. This is an imporant section because up until this point, only loadings to the Bay have been explored. |

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Section 6.0

| SECTION | PAGE | COMMENTOR | COMMENT | RESPONSE |
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| 6.1 | | County of Orange | remove first paragraph, I think this raises more questions than it answers. | Requested change was made. |
| 6.1 | | County of Orange | 2nd paragraph "The goal ~~was~~ **is** to use the most scientifically defensible.." | Requested change was made. |
| 6.1.1 | | County of Orange | 1st paragraph "The upper bay is currently a high ~~quality~~ **value** shallow…" | Requested change was made. |
| 6.1.1 | | County of Orange | 1st paragraph"The lower Bay **is an active harbor and** ~~currently~~ has a complex…" | Requested change was made. |
| 6.1.1 | | County of Orange | 2nd paragraph "…the Lower and Upper Bays where ~~the~~ recreational activities occur…" | Requested change was made. |
| 6.1.1 | | County of Orange | 3rd paragraph "Sites locations are ~~located~~ along the margins of the Bay and are intended to ~~geographically~~ represent…" | Requested change was made. |
| 6.? | | County of Orange | There needs to be a section discussing stratifying the data into wet and dry sections and what qualifies a wet designation (OCHCA cutoff). | Requested change was made. |
| 6.1.2 | 3 | County of Orange | 1st paragraph "Because ~~of~~ there are…" | Requested change was made. |
| 6.1.2 | 3 | County of Orange | 1st paragraph "…scientifically sound and regulatory acceptable approach~~es~~…The~~se~~ approaches and metrics….for the purposes of **prioritizing sites/areas for management action consideration** ~~identifying the most problematic sites/areas in Newport Bay~~. | Requested change was made. |
| 6.1.2 | 3 | County of Orange | 2nd paragraph – define first use of UPV | Requested change was made. |
| 6.1.2 | 4 | County of Orange | Table 6.1 – need to specify over what period the log/geomean is calculated – perhaps call it the Long term Geomean – I assume it is over the entire data period. If this is a long term geomean, need to use the term throughout the document. | Requested change was made. |
| 6.1.2 | 4 | County of Orange | 3rd paragraph "…two UPV metrics **for Enterococcus** were selected…" | Requested change was made. |
| 6.1.2 | 5 | County of Orange | Table 6.2 caption "…to identify ~~the most problematic~~ sites/areas…" | Requested change was made. |

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| 6.1.2 | 5 | County of Orange | table 6.2 rationale/justification – this is the same as the rationale for the geomean – should have different information for different metrics. Can't say UPVs are a reliable measure of long term water quality. Can't say compared to UPVs, UPVs are less subject to random variation. | Requested change was made. |
| 6.1.3 | 7 | County of Orange | 2nd paragraph "…each score would be multiplied **by** 33%) | Requested change was made. |
| 6.2 | | County of Orange | table 6.6/6.7 – Need to include the actual value of the metric for each category like in table 6.8 for BTO sites. | Requested change was made. |
| 6.2 | | County of Orange | last paragraph "Prioritization of the sites listed above is described in Section 6**.4**" | Requested change was made. |
| 6.3 | | County of Orange | table 6.9/6.10 – see comment on table 6.6. | Requested change was made. |
| 6.3 | | County of Orange | table 6.12 caption "..Newport Bay sites based on total…" | Requested change was made. |
| 6.4 | 24 | Regional Board | Title ADD: **Site Prioritization of Newport Bay** remove: ~~**Potential Areas of ConcernInterest in Newport Bay**~~ | Title was changed to "Prioritization of Areas in Newport Bay" |
| 6.4 | 24 | Regional Board | 1st paragraph remove:...~~**areas/sites of interest... To assist in the prioritization of source management actions directed at reducing impacts associated with FIB and pathogens, sites within Newport Bay first need to be prioritized…Metric scores presented in the previous section provide important information on the status of water quality at a given site. However, from a public health perspective, additional factors (e.g., level of recreational us) should be considered to help focus limited resources towards the most critical issues and effective FIB management strategies. The process used in this SMP to develop a list of prioritized sites for source mangagement consideration incorporated the following guiding principles (ordered by priority):**~~ | Requested change was made. |
| 6.4 | 24 | Regional Board | Remove 2nd and 3rd paragraph. | Requested change was made. |
| 6.4.1 | 24 | Regional Board | 1st paragraph add: grammatical changes to second sentence | Requested change was made. |
| 6.4.1 | 24 | Regional Board | 2nd paragraph add: grammatical changes to 3rd sentence. | Requested change was made. |

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| 6.4.1 | 24 | Regional Board | Table 6.11 (changes within table and heading) remove: ~~**A comparison between r**~~Recreational use levels at OCHCA~~**in**~~ monitoring ~~**Newport Bay**~~ sites identified by EOA ~~**for OCHCA Stations (EOA**~~ (2001) and assigned to Newport Bay FIB Source Identification Project monitoring stations, ~~**and applicable Upper Percentile Value (UPV) Water Quality Objectives and Criteria based on level of recreational use.**~~ | Requested change was made. |
| 6.4.1 | 25 | Regional Board | Paragraph before Table 6.12: ~~**Based on these guiding principles, Table 6.12 was created to assist in assigning each site a relative level of priority (high, medium or low)**~~**.** | Requested change was made. |
| 6.4.1 | 25 | Regional Board | Table 6.12 changes | Requested change was made. |
| 6.4.2 | 26 | Regional Board | 1st paragraph: Using the ~~**the dry and wet weather**~~prioritization factors described in section ~~**prioritization system presented in Table**~~ 6.4.1~~**12**~~, each dry or wet weather priority site/area ~~**of interest**~~ in Newport Bay ~~**potential area of concern**~~ was assigned a relative priority ranking. Results for ~~potential~~ ~~**areas of concerninterest**~~ priority sites during dry weather are presented in Table 6.13 and Figure 6.3**,** ~~**and wet weather results are presented in Table 6.14 and Figure 6.4.**~~ . Results for potential ~~**areas of interest**~~~~priority~~ sites during wet weather are presented in Table 6.14 and Figure 6.4. | Requested change was made. |
| 6.4.2 | 27 | Regional Board | Table 6.13 remove: ~~**in Newport Bay**~~ at the end of first sentence in header. Changes within table. | Requested change was made. |
| 6.4.2 | 32 | Regional Board | Table 6.14 remove from header sentence: ~~**Priority areas identified for FIB source management in Newport Bay during wet weather.**~~ **ADD:** Priority areas of interest in Newport Bay identified for FIB source management consideration during wet weather. Changes within table. | Requested change was made. |
| 6.5 | 37 | Regional Board | 1st paragraph: replace ~~**concern**~~ with interest. ADD in last sentence of paragraph: in sources, pathways and ranges of concentrations | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph replace: ~~**four**~~ Enterococus with three… | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph remove from 1st sentence: ~~**and wet**~~ | Requested change was made. |

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| 6.5 | 37 | Regional Board | 2nd paragraph ADD second sentence: Two Enterococus and two fecal coliform metrics were used for wet weather datasets. | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph 3rd sentence: Metrics were ~~**then**~~ scored and summed to identify which sites should be considered "geographical priority areas ~~of concerninterest"~~ in Newport Bay where FIB source management should be considered. | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph 4th sentence: These priority sites/areas ~~**(i.e., areas of concerninterest)**~~ were then ~~**prioritized**~~ priority ranked on a scale of 1 to 4 (1 being the greatest concern) for dry and wet weather, based on metric scores, the degree of recreational use ~~**and metric scores**~~, and the magnitude of water quality objective/criteria exceedances. | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph Bullet 1: ADD in 2st sentence: priority sites REMOVE: ~~**meeting the areas of concern/interest definition**~~ | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph Bullet 2: ADD in 1st sentence: priority sites Remove in 1st sentence: ~~**areas of concerninterest**~~ ADD to 1st sentence: and therefore no sites received a priority 1 or 2 ranking. | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph Bullet 2: Remove from 2nd sentence: …~~**medium**~~ priority 3, and eight ranked as low priority ~~**4 were above the area of concern definition, while all other sites were below.**~~ ADD : However, sites in dry weather are higher priority in general than sites in wet weather, since most recreational use occurs in dry weather. | Requested change was made. |
| 6.5 | 37 | Regional Board | 2nd paragraph Bullet 3: Remove from 1st sentence: ~~**met the area of concerninterest definition**~~ ADD: are defined as priority sites. Four sites ranked as priority 1, ~~**Eight**~~ six sites ranked as ~~**high**~~ priority 2, ~~**two**~~ twenty-eight sites ranked as ~~**meduim**~~ priority 3, and ~~**thirty**~~ two sites ranked as low priority 4 | Requested change was made. |
| 6.5 | 37 | Regional Board | last paragraph remove: ~~**Areas of concern**~~ ADD: The Priority Sites…described. | Requested change was made. |

Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan
Section 7.0

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 7.1 | | Regional Board | table 7.1: Should include Regional Board reports as well as published papers in this list | We are not clear on what additional "Regional Board" reports and published papers the commentor is referring to. |
| 7.3.1 | | Regional Board | title: 7.3.1 Bay-Scale Water Quality Impacts of Tributary Flows on Channels **what channels??** | "…on channels" was removed from the title. |
| 7.3.1 | | Regional Board | 2nd paragraph: before last sentence, comments: "You might want to check this conclusion as this has been a point of debate –the Delhi is an engineered channel and therefore does not overflow it's banks into the mudflats. The model shows that concentrations at sites below the Delhi are lower than predicted so ALL of the bacti from the Delhi does not get to the main channel, however, the model does NOT demonstrate that none of the bacti from the Delhi gets into the main channel." | After discussion with Regional Board staff, text was included to explain the uncertainites associated with ROI model predictions. |
| 7.3.1 | | Regional Board | 3rd paragraph: comments on 1st sentence: –not true for Delhi –look at Fig8-10-also Fig8-11 | After discussion with Regional Board staff, text was included to explain the uncertainites associated with ROI model predictions. |
| 7.3.1 | | Regional Board | 3rd paragraph comment: Include ROI figure for ENT dry weather –Fig 8-10 Prop13 report | Because model predictions are inconsistent with empirical data collected, Figure 8-10 from the Prop 13 report was not included. |
| 7.3.2 | | Regional Board | 2nd paragraph: after 2nd sentence comments: I dont recall this being a conclusion –that loading rate of 5 large drains is similar to cum.loading rate of small drains, but that cum.loading from all storm drains is equal to median loading from SDCk (with most of loading from 5 large drains) see Chp8 Conclusion #6 | Based on loading rates described in Section 5.0 of the SMP, rates of SDC, combined 5 large drains, and combined small drains are similar (within an order-of-magnitude). |
| 7.3.2 | | Regional Board | 3rd paragraph: after 2nd sendence comments: In wet weather, they might also cumulatively impact water quality in the Lower Bay since most are located there. | Agreed. Text was added to make sure this is likely. |
| 7.3.3 | | Regional Board | 1st paragraph: "Enterococcus concentrations were significantly higher at both near-drain sites and sites 100 feet away from the shoreline during this study" **higher than what??.** | Text was added to clarify. |

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| 7.3.3 | | Regional Board | 1st paragraph comment: from Prop13 report, wq along shoreline worsens also because during high tide fresh water is held in drain by tide, then during ebb tide that fresh water is released from drain into near shore area and diffusion process begins –to deeper water and along shoreline. Prop13Chp7, SMPFig7.2 | We believe that the text currently in Section 7.3.3 and Figure 7.2 states what the commentor is requested and therefore was not revised. |
| 7.3.4 | | Regional Board | questions second sentence of 1st paragraph: **Where is above conclusion in Prop13 report?? –In Chp8, text actually states** :<br>"In Section8.3 –Bird droppings '...bird droppings are likely to be the dominant cause of water quality violations at beach sites visited by even a modest number of birds (such as sites in Upper Newport Bay, see DITS study, Chapter 6). BUT Last para Section8.3 states 'Based on the above results it appears that bird droppings and tidal washing of contaminated sediment are both likely causes of ENT marine bathing water standard exceedences at beach sites in Newport Bay...As such, these results should be regarded as more illustrative than conclusive.'<br><br>AND In Conclusion#5 'Shore-based non-point sources of FIB...Tidal washing of contaminated sediments and bird droppings...are very likely to cause sporadic exceedences of marina bathing water standards in ankle depth waters."<br>**So above text demonstrates association with not only bird droppings but also contaminated sediments and association is noted at beach sites or in ankle depth waters.** | Text was revised to more accurately state that: 1. Based on analyses and modeling conducted by Grant et al. (2009), the presence of even a modest number of water birds at shoreline sites, such as in the Upper Bay, can cause exceedances of water quality criteria at beach/shoreline sites.<br>2. Grant et al. (2009) concluded that FIB concentrations in sediments collected from the sub-tidal and intertidal areas of Newport Bay are well within the range to cause exceedances of water quality criteria at shoreline/beach sites in Newport Bay. |
| 7.3.4 | | Regional Board | questions last sentence of last paragraph: "These results, however, are likely site-specific and further data collection is needed to better understand how sediment impacts water quality in Lower Newport Bay at locations of interest. " **This conclusion appears to be speculative on your part and should be removed unless you can show reference in Prop13 report** | Text was revised to state that "These results, however, ~~are likely~~ **may be** site-specific and further data collection is ~~needed~~ **recommended** to better understand how sediment impacts water quality in Lower Newport Bay at locations of interest. " |

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| 7.4.1 | | Regional Board | comments on section title: 7.4.1 Western Newport Bay (38th St., 33rd St., Newport Blvd. Bridge & BTO 8) **ADD use category to each of these sections (Recreational Use Level –moderate etc)** | Tables 7.2 and 7.3 now include the level of priority for each site, which includes the recreational use level. The recreational use level was not added because it is contained in these tables and adding rec level would make the section title too long. |
| 7.4.1 | | Regional Board | 1st paragraph, last line: area (i.e., North of **PCH** (Highway 101)). | Requested change was made. |
| 7.4.1 | | Regional Board | 2nd paragraph, line 7: significant pathways of FIB to WNB **in dry weather.** Then asks you: If experts in their field are saying that loading from the tributaries Does impact WNB then why is this left out??<br>I might agree that tribs dont likely influence WNB (technically the area W of Newport Blvd Bridge) but they likely do impact the Turning Basin (area just E of Newport Blvd Bridge and part of what you are calling WNB) including Arches drain and BTO8. | We are unclear as to what "experts" have shown that tributary flows during DRY WEATHER impacts WNB, Newport Blvd Bridge or the turning basin. Please forward us their reports or expert opinions for citing in the SMP. |
| 7.4.1 | | Regional Board | 4th paragraph comment: Also potentially cleaning of grease traps by restaurants, dock cleaning, dumping of fish guts by fishermen, pumpout station leaks/misuse etc | We have conducted a review of available literature and can not find information suggesting that grease itself is a source of FIB to pathways or water bodies. If information can be provided that coaberates the suggestion that grease is a source, please forward to us. Pumpstations were added to the list. |
| 7.4.1 | | Regional Board | figure 7.3 comment: BTO5 is not located in this area | Figure was changed to show BTO8 instead of BTO5 |
| 7.4.2 | | Regional Board | table 7.2 comment: reorganize according to ch 6 rankings. Also asks: Why are there 2 listings for Upper Bay Channel for Upper Newport Bay?? What do each of these represent??<br>Wont this Table likely change based on Revisions to Chp6?? | Priority levels for each site/area are now included in Table 7.2. The listing for Upper Bay Channel and Upper Newport Bay were revised to BTO4, BTO 5, and BTO8. |

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| 7.4.2 | | Regional Board | table 7.2: in "Newport Blvd Bridge" cell asks: is this site same as Arches?? | Our understanding from discussions with OCHCA staff is that "Newport Blvd Bridge (NBB)" samples are taken very near the bridge, while "Arches Drain" sites are taken at the Arches drain outfall point, which is roughly 100 feet away from NBB. |
| 7.4.2 | | Regional Board | 3rd paragraph comment: Also potentially cleaning of grease traps by restaurants, etc | We have conducted a review of available literature and can not find information suggesting that grease itself is a source of FIB to pathways or water bodies. If information can be provided that coaberates the suggestion that grease is a source, please forward to us. |
| 7.4.3 | | Regional Board | 2nd paragraph: after 2nd sentence comments: Water birds are found everywhere in Bay. | True, but some areas appear to have more water birds than other based on discussions with OCHCA staff and Jack Skinner. |

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| 7.4.4 | | Regional Board | section title comment: 7.4.4 Upper Bay (Vaughns Launch, Ski Zone, BTO 5 & BTO 4) **It might be useful to separate out these sites -monitoring results show different concentrations in BTO4 vs BTO5 and their influences are different –they are pretty far apart and localized impacts may be different –BTO4 is just below SDCk, BTO5 is below the Delhi, Vaughn;s Launch is below Big Cyn Wash** | Sites were grouped together based on the quality and quantity of information regarding the level of impacts from specific sources. If information is available that indicates that sites within a geographical area (e.g., Upper Newport Bay) are impacted by different soruces, then sites were separated out in section 7.4. If information was not available to distinguish sources, then sites were grouped by area. In the case of Upper Newport Bay, we found little to no information regarding different sources impacting BTO4 and BTO5. Therefore, they were grouped together. If additional information is collected to better distinguish sources, then the SMP can be updated to separate sources. Text was added at the beginning of section 7.4 to clarify this point. |
| 7.4.4 | | Regional Board | 2nd paragraph, 2nd and 3rd sentences: Measured concentrations of Enterococcus in the main tidal channel suggest that the Santa Ana Delhi channel is not a significant source of Enterococcus to the Upper Bay during dry weather periods **NOT TRUE –see comments above about Delhi –model ONLY showed that concentrations predicted downstream based on Delhi FIB concentrations are higher than what is observed –model does NOT demonstrate that FIB from Delhi does not get into main channel –this conclusion is an extrapolation and is NOT based on data. Revise conclusion based on revised Prop13 report.** | After discussion with Regional Board staff, text was included to explain the uncertainites associated with ROI model predictions. |

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| 7.4.4 | | Regional Board | 2nd paragraph, 4th sentence through the end: Although this tributary does not appear to be a significant pathway of FIB to the Upper or Lower Bay during dry weather **Again NOT True based on Figure8-10 in Prop13 report,** consistently elevated concentrations of Enterococcus have been observed at the OCHCA monitoring site **which OCHCA monitoring site ??** (see Section 5.0) and therefore, watershed managers may choose implement source identification and/or management actions specific to the Santa Ana Delhi watershed. **Exactly –elevated concentrations of ENT have been shown in BTO 5 also at certain samplings**<br>****The above conclusions need to be revised based on the revised text in Prop13 report**<br>**ADD at end of this para "Further testing is being conducted in Santa Ana Delhi to determine FIB concentrations closer to Delhi mouth."** | After discussion with Regional Board staff, text was included to explain the uncertainites associated with ROI model predictions. |
| 7.4.4 | | Regional Board | 4th paragraph, line 4: in the Upper Bay **at beach sites** | Reuested changed was made. |
| 7.4.4 | | Regional Board | 4th paragraph comment on 3rd sentence: Specifically, loading rates of FIB from waterfowl alone are sufficient enough to cause exceedances of Water Quality Objectives/Criteria in the Upper Bay (Grant et al. 2009). **Again -Where is this in Prop13 report??** | Section 8.3.2 of the Source ID Project Report states: "Given the very large loading rates predicted for this non-point source, bird droppings are likely to be the dominant cause of water quality violations at beach sites visited by even a modest number of birds (such as sites in Upper Newport Bay, see DITS study, Chapter 6)." |
| 7.4.4 | | Regional Board | 5th paragraph comment: **There are also many horses above San Diego Creek and Santa Ana Delhi areas.** | Horses were added as a potential source to SDC and SAD. |
| 7.5 | | Regional Board | 1st paragraph; would like to add a second sentence: **Wet weather is defined as ... (include definition again here so that people are reminded of what constitutes wet weather)** | Definition is now included as a footnote. |
| 7.5 | | Regional Board | 3rd paragraph, line 2: appear to impact water quality **in wet weather** | Requested change was made. |

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| 7.5.6 | | Regional Board | Table 7.3 comments: reorganize according to Ch6 rankings. . Tributaries should be ranked higher for Newport Dunes & DeAnza, Balboa Island, and Harbor ENtrance Channel<br>Since Pet waste, and wildlife waste get into storm water these should probably be rated higher for wet weather, also biofilms should be higher contributer since storm drains are getting flushed out | Because sites ranked in Section 6.0 are now grouped into geographical areas, the reorganization and including the priority level in the table was not feasible. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 8.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
|---|---|---|---|---|
| 8.1.1 | 4 | Regional Board | continuation from previous page, last paragraph, add: **INclude types of pets that this brochure addresses, and management of horse waste.** | Requested change was made. |
| 8.1.2 | 4 | Regional Board | 3rd paragraph asks question: **Is this program related to urban runoff or agric runoff or both??** | Urban Sources. |
| 8.1.2 | 5 | Regional Board | 2nd paragraph asks question: what is HOA? | Home Owners Association. |
| 8.1.4 | 8 | Regional Board | 1st paragraph add: **For future, might also think about plugging storm drains in WNB in summer –does City already do something like that?? WNB is an isolated and stagnant area –this might decrease FIB levels.** | We don't believe that the City of Newport Bay plugs storm drains during dry weather. |
| 8.1.5 | 9 | Regional Board | continued from previous paragraph, page 8, asks question: **What about cats?? Many of them roam around** | Cats are now also included in the discussion. |
| 8.1.5 | 9 | Regional Board | last paragraph asks question: **Does this include cleaning of storm drains or just catch basins?? Is debris removed or are catch basins scraped to remove biofilms??** | Drainage facility maintenance includes sediment removal in catch basins, pipes and channels. Debris is removed. Based on existing information, it does not appear that municipalities "scrap" drainage facilities during removal of debris. |
| 8.3 | 11 | Regional Board | 2nd paragraph asks question: **by city ordinance??** | By the USEPA. |
| 8.3 | 12 | Regional Board | 3rd paragraph asks question: Additionally, two marinas hired a **mobile??** pumpout service | We are unsure if the pumpout service is mobile. Therefore, the text was left vague at this time. |
| 8.3 | 13 | Regional Board | 1st paragraph add: **A statewide marina permit is also being developed by the State Water Resouces Control Board and the Regional Boards through the NPS –Marina program, and will include requirements for bacteria as well as oil and grease and other pollutants. It is in draft form at present and will go through public review likely in 2010.** | Requested change was made. |
| 8.4.5 | 15 | Regional Board | 2nd paragraph asks question: **Arent swimmers at Dunes supposed to shower before swimming??** | Based on existing information, it does not appear that swmmer at the Dunes are required to shower prior to swimming. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 8.0**

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| 8.6 | 15 | Regional Board | 5th paragraph add: **From Comments 2/09 -Still need list of ALL large scale BMPs** | All large-scale BMPs we are aware of are listed and summarized in this section. |
| 8.6.2 | 16 | Regional Board | 1st paragraph asks question: **You state that effectiveness of ...sediment basins in reducing FIB concentrations... has not been fully evaluated -Has there been ANY evaluation??** | Text was changed to indicate that the effectiveness of these basins has not been assessed. |
| 8.7 | 16 | Regional Board | 2nd paragraph 2nd bullet asks question: **Should mention BMPs for crop lands.** | Requested change was made. |
| 8.8 | 17 | Regional Board | **ADD Recommendations for Future BMPs** | See Section 9.0 |
| 8.8 | 18 | Regional Board | Table 8.1 add: **The Dunes should be one of the major categories since it is listed separately in FC TMDL including swimmer shedding even if action is No BMPs (diversion is a Dunes activity)** | As discussed, the Dunes did not receive a WLA and was not an explict source category in the TMDL, and was therefore not included as a category in this table. |
| 8.8 | 19 | Regional Board | Table 8.1, column BMP Program, row Vessel Waste Controls, **ADD Marina permit in development** | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

| SECTION | PAGE # | COMMENTOR | COMMENT | RESPONSE |
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| 9 | | Regional Board | table 9.1: natural sources needs to be addressed in this table | The natural soruce category was added to the table as requested, but there are no known BMPs or regulatory programs for natural sources. |
| 9 | | Regional Board | sediments must also be addressed in Table 9.1 and as a section under Natural Sources (also discuss wrack line and algal mats) | Sediments are now listed in Table 9.1. |
| 9 | | Regional Board | There are no site specific recommendations –only source category BMPs that are then ranked as to importance for ea site (tables) - there should be a list of recommended site specific BMPs | In section 9.2, BMPs are prioritized by geographical areas for dry and wet weather. |
| 9 | | Regional Board | as a site specific BMP, there should be a visual inspection of drainage areas for ALL priority sites as to Use designation –eg commercial areas w/restaurants (may clean grease traps outside), city parks or golf courses that use biosolids, residential areas w/pets etc | Visual inspections are included in sanitary surveys, which are recommended for prority areas. |
| 9 | | Regional Board | there is no discussion of proposed monitoring (or proposed modification of routine monitoring) to determine effectiveness of BMPs -a monitoring section should be added after priority site discussion (see 9.3 in this document) | A "Source Monitoring Plan" is being developed by Orange County outside of the SMP. The SMP describes this process in section 9.4.2. |
| 9 | | Regional Board | there are no site specific recommendations for wet weather sites or even list of priority wet weather sites (although it is made clear that dry weather sites are a priority over wet weather sites, all sites were ranked for wet weather, therefore some effort should be made to discuss site specific recommendations for high priority sites in wet weather | Little to no information is available to assist prioritization of sources for specifc sites during dry weather. Modeling and monitoring indicate that "watershed" sources appear to be the most important sources during wet weather. Therefore, focusing on pollution prevention and source cotnrol is the most logical step in reducing impacts that occur as a result of wet weather. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9 | | Regional Board | This chapter doesnt flow from Chp8 -BMPs sections and categories set up in Chp8 do not carry over into Chp9 -Source categories in Chp8 should match those in Chp9 (esp urban runoff BMPs, natural source BMPs) | Source categories are now consistent between sections. |
| 9 | | Regional Board | for source categories, much information in Chp9 is redundant compared to Chp8 –why not combine Chps and include recommended BMPs at end of source category sections in Chp8?? then follow w/priority site sections at end of Chp8 or as Chp9 | Chapter 9 is intended to be a stand alone section that could be used by agencies impementing the TMDL. We have revised the section as much as possible to reduce redundancy. |
| 9 | | Regional Board | Under Urban runoff BMPs -–there is no mention of biosolids in fertilizer section, there is no section on over-irrigation /water conservation etc, | In Section 5.0, it is explained that through the review of FIB sources specific to Newport Bay watershed, biosolids are not used significantly. Therefore, BMPs are discussed and are recomended based on the current information available on usage. If biosolids become more of a potential source (i.e., increase in application) in the watershed, recomended BMPs should be revised accordingly. |
| 9 | | Regional Board | It would be useful to show priority designation of each section in title eg Septic Systems (Low priority), Vessel Waste (High priority) etc | Priority is based on potential impacts to specific geographical areas and therefore may be different between areas. Priorities therefore could not be added. |
| 9 | | Regional Board | with respect to BMPs by Priority Sites (Areas of Interest) -Recommend having one table for Dry Sites and one table for Wet Sites - easier to compare priority levels for various dry and wet sites - also –there seem to be no new BMPs recommended for any of these sites | There are tables for each dry weather geographical area of interest. Due to the lack of information on source of FIB duriing wet weather, only one table is included for all sites. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9 | | Regional Board | with respect to sources outlined in text for ea priority site –applicable sources would be more visible if they were listed as bullets rather than included in text paragraphs -also include explanation as to how applicable sources were determined | Requested change was made. |
| 9 | | Regional Board | sediment studies - We need to conduct sediment studies w/OCHCA beach monitoring because sediments were shown to have high bacti counts in Jiang's study in the Dunes, and in the Prop13 study ENT concentrations exceeded the marine standard esp in the Lower Bay. Jiang showed bacti concentrations in water were low therefore concluding that swimmers had little impact on the Dunes water quality. | It is unclear why sediment sampling should be a priority activity counducted in the future. Therefore, studies characterizing sediments were not included. |
| 9 | | Regional Board | **There is a tendency in text to override results of studies done by other agencies/researchers** -eg In Newport Bay, Jiang et al. (2004) concluded that swimmers and swimmer-induced sediment resuspension do not appear to be the cause of observed increases of FIB in Newport Dunes swimming areas. However, due to remaining uncertainties of the impacts of swimmers to water quality at Dunes swimming areas, it is recommended that the management company... **While I agree w/potential management practises, swimmer shedding appears to be a small or no input of bacteria to Newport Bay based on Jiang's Dunes study** | Recommendations are not only based on information provided in various studies, but on best professional judgement of the authors, who have extensive experience bacteria management, urban runoff, and microbial risk assessment. |
| 9.1 | | County of Orange | 1st paragraph, 5th line: That said, ~~a~~ decreases in long-term average concentrations | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.1 | | County of Orange | table 9.1: adds **IWRD** to cell next to Sanitary Sewer Overflows cell | Requested change was made. |
| 9.1 | | Regional Board | under 9.1 Recommended BMPs –would be useful to list BMPs as "current BMPs to be expanded" or "new BMPs" 9.1 Recommended BMPs -would also be useful to list agency that will implement BMPs (eg Cities, County etc) -many programs noted in the BMPs are not defined as to what these programs entail (eg FOG program) -is program information included in appendices?? | Table 9.2 does what is suggested. It was move to section 9.1 as requested. |
| 9.1 | | Regional Board | table 9.1 heading: Public agencies and stakeholders in the Newport Bay watershed, associated primary areas of interest, and potential regulatory mechanisms for control FIB in Newport Bay. **Suggest calling this ' FIB Source Categories with their primary areas of interest, public agency/stakeholders and regulatory mechanisms for FIB control in Newport Bay'** | Requested change was made. |
| 9.1 | | Regional Board | table 9.1: note in this table that category of "other urban sources" is not yet listed as category in tmdl –might include after urban runoff | Table was rearranged to put other urban sources directly after urban runoff. |
| 9.1 | | Regional Board | table 9.1: need to include natural sources as a category in this table (wildlife waste (birds and mammals), sediemtns as a source of wrack line, algal mats) | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.2 | | Regional Board | table 9.2: this Table really belongs in source category section -possibly near introduction of categories because everything is laid out in this table and it would facilitate discussion of source categories<br>this table really identifies BMPs by source category rather than site specific source category<br>-Im not sure that using this table for ea site is best way to go since these are already being implemented<br>what we might do is have these source category BMPs in general, then add site specific BMPs after each site description | Table 9.2 was moved to section 9.1. |
| 9.2 | | Regional Board | table 9.2: ordinance enforcement **city ordinance?? County??** | City/County |
| 9.2 | | Regional Board | table 9.2: Public outreach **focused on whom? (for domestic pet waste, fertilizers and over irrigation, septic tank systems)** | Residents and dog-walkers |
| 9.2 | | Regional Board | table 9.2: Identification of Properties Over-Irrigating and Promotion of Smart Controllers **commercial?? residential??** | Residential and commerical |
| 9.2 | | Regional Board | table 9.2: Adoption of Water Conservation in Landscaping Ordinance **commercial?? residential??** | Residential and commerical |
| 9.2 | | Regional Board | table 9.2: Advanced Treatment (on-site disinfection or diversion) **filters??** | Not sure what filters the commentor is referring to? Filters typically used in proprietary devices designed to treat urban runoff have mixed success and were therefore not recommended. |
| 9.2 | | Regional Board | table 9.2: Enforcement of No Discharge Zone and Local Ordinances **by whom??** | USEPA and local municipalities. |
| 9.2 | | Regional Board | table 9.2:Implementation of Runoff Reduction Measures **runoff reduction from where??** | From nurseries. |

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**Section 9.0**

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| 9.2 | | Regional Board | table 9.2: Periodic Site Inspections **inspections of what??** | Nurseries |
| 9.2 | | Regional Board | table 9.2: Relocating or Hazing Birds from Lower Bay Beaches **what does DFG think about this??** | DFG was not contacted regarding this recommendation. As stated in the text, prior to beginning such a BMP, the appropriate regulatory agencies and the possibly the greater public should be notified. |
| 9.2 | | Regional Board | table 9.2: add sections under Natural Sources for Biofilm and Sediemnts **( Sediment monitoring* to correspond w/OCHCA WQ monitoring at beach sites )** | A biofilm section was added to the Table as requested. Sediments were not added. As stated above, it is unclear why sediment sampling should be a priority activity counducted in the future. Therefore, studies/monitoring characterizing sediments were not included. |
| 9.2 | | Regional Board | table 9.2: might add section on WQ standards issues such as BU designations | Table 9.2 is intended to list BMPs in a general since. Recommendations for changes to standards is incldued at the end of Section 9.0 |
| 9.2 | | Regional Board | Table 9.2: Sediment monitoring should be conducted at beach sites w/OCHA WQ monitoring to determine if sediments are a source of FIB to shallow waters. | Iit is unclear why sediment sampling should be a priority activity counducted in the future. If sediment is found to be a source of FIB to shallow waters, we are not clear on what BMPs would be suggested. Therefore, studies/monitoring characterizing sediments were not included. |
| 9.0 | | Regional Board | 3rd paragraph: With regard to water quality in the Bay, many of the public agencies are regulated by State and Federal policies and laws to implement BMPs designed to reduce the impacts of FIB and associated pathogens from their respective sources or pathways to the Bay. **this sentence is wordy and not clear** | Sentence was revised to state "With regard to water quality in the Bay, many of the public agencies are **required** by State and Federal policies and laws to implement BMPs designed to reduce the impacts of FIB and associated pathogens from their respective sources or pathways to the Bay. |
| 9.1.1 | | County of Orange | 1st paragraph, 3rd line: Discharges from municipal ~~urban runoff conveyance~~ **stormdrain** systems to the Bay | Requested change was made. |
| 9.1.1 | | County of Orange | 2nd paragraph, line 2: wet weather runoff flowing into ~~urban runoff conveyance~~ **municipal stormdrain** systems | Requested change was made. |

**Response to Comments on FINAL DRAFT Newport Bay Fecal Coliform Source Management Plan**
**Section 9.0**

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| 9.1.1 | | County of Orange | 2nd paragraph line 7: illicit discharges ~~are also believed~~ **may contribute** to ~~be~~ sources to urban runoff. | Requested change was made. |
| 9.1.1 | | County of Orange | ID/IC bullets: bullet 2: identification study on ~~urban runoff conveyance~~ **municipal stormdrains** discharging directly | Requested change was made. |
| 9.1.1 | | County of Orange | ID/IC bullets: bullet 3: studies suggest that ~~this tributary~~ **Santa Ana Delhi Channel** is a significant | Requested change was made. |
| 9.1.1 | | County of Orange | ID/IC bullets: bullet 3: a sanitary survey in the ~~Santa Ana Delhi~~ channel watershed | Requested change was made. |
| 9.1.1 | | County of Orange | Municipal Maintenance Activities bullets: Bullet 2: enhance flushing of ~~urban runoff conveyance~~ **municipal stormdrain**s identified | Requested change was made. |
| 9.1.1 | | County of Orange | Urabn Runoff Treatment bullets: bullet 2: conducted in ~~urban runoff conveyance~~ **municipal stormdrain** systems | Requested change was made. |
| 9.1.1 | | Regional Board | Pollution Prevention and Source Controls BMPs **(ADD BMPs to end of title)** | Section 9.1.1. is now titled "Pollution Prevention and Source Control BMPs" |
| 9.1.1 | | Regional Board | domestic pet waste bullets: -half of these bullets list actual BMPs the other half refers to BMPs -this section should list the actual BMPs related to Pet Waste rather than refer to 'BMPs' | Text was revised in all sections of 9.0 to more actively state the recommended BMP. |
| 9.1.1 | | Regional Board | domestic pet waste bullet 1: Define 'appropriately dispose' (has anyone looked at the effect of people collecting pet waste into plastic bags and disposing in trash?? –that results in tons of pet waste in land fills, it is common knowledge that viruses leach from diapers in landfills –what about bacteria?? ) | We assume this is commentary and no revisions are needed. |
| 9.1.1 | | Regional Board | domestic pet waste bullet 2: ...recommend appropriate pollution prevention BMPs. **such as?? be specific w/BMPs** | Text was revised in all sections of 9.0 to more actively state the recommended BMP. |

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**Section 9.0**

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| 9.1.1 | | Regional Board | Fertilizer Applications and Over-Irrigation bullets: this section should include Biosolids control as in Chp8 | Biosolids were add to the section. |
| 9.1.1 | | Regional Board | Fertilizer Applications and Over-Irrigation bullet 1: (include definition of acronyms for people who dont know what they mean), | Accronyms are now spelled out. |
| 9.1.1 | | Regional Board | Fertilizer Applications and Over-Irrigation bullet 4: other water conversation practices Enhance public education to residents on the water quality impacts of improper disposal of domestic pet waste **ADD (such as planting native or drought tolerant vegetation), or conducting enforcement if necessary.** | Requested change was made. |
| 9.1.1 | | Regional Board | ID/IC bullets: the following bullets should be moved to the Municipal maintenance Activities section: Conduct a focused source identification study on municipal stormdrains discharging directly to dry weather areas of interest in Newport Bay to further identify sources of FIB.<br>If recommended technical studies suggest that Santa Ana Delhi Channel is a significant contributor of FIB to the Upper and/or Lower Newport Bay (see Section 9.3), conduct a sanitary survey in the channel watershed. Examples of effective sanitary survey protocols are provided in Appendix ##.<br>**Two above items relate to storm drain issues rather than ID/IC** | Municipal stormwater programs typically conduct these types of investigations via their Illegal Discharge and Illicit Connection (IC/IC) programs, therefore this BMP recommendation remains in this section. |

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| 9.1.1 | | Regional Board | Municipal Maintenance Activities bullet 1 comment: a study of the contribution of FIB from biofilm has not yet been conducted and there have been no storm drains identified to date as “high contributors of FIB via biofilm” this should be listed as future recommended study | See biofilm study described in 9.3.1 |
| 9.1.1 | | Regional Board | Urban runoff treatment section: "The following paragraphs briefly describe other urban runoff treatment options that should only be considered if the recommended enhanced pollution prevention and source control BMPs described above do not effectively reduce FIB at areas of concern in Newport Bay." **why should urban runoff treatment options only be considered if the recommended enhanced pollution prevention and source control BMPs are not effective?? Include explanation for this statement esp. since text states below that IRWD plans to construct wetlands** | Text was added to explain that stormwater treatement BMPs are not highly effective in treating bacteria. The IRWD natural treatment system is not focused on bacteria, but rather has a secondary benefit is FIB concentrations are reduced. |
| 9.1.2 | | Regional Board | 1st paragraph: This seems redundant –wasnt this explained in Chp8?? | This section is no redundant with Section 8.0, rather further describes recommend BMPs. |
| 9.1.2 | | Regional Board | 3rd paragraph comment: Statewide Marina permit will also address vessel waste –this was noted in my Chp8 comments but it is not included here | Reference to the forthcoming Statewide Marina Permit is now included in the text |
| 9.1.3 | | Regional Board | paragraph 2: tributaries or ~~urban runoff conveyance~~ **municipal stormdrain** systems associated | The more general term urban runoff conveyance system is used throughout the SMP to refer to the storm drainage system that may be privately or muncipally owned. |
| 9.1.3 | | Regional Board | Sanitary Sewer Overflows and spills section, second bullet: An enhanced educational outreach program **outreach to whom??** should be developed | Text was added to focus on businesses |

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| 9.1.3 | | Regional Board | Sanitary Sewer Overflows and spills section, third bullet: (CASC) Program **should be continued**, including the development | Requested change was made. |
| 9.1.3 | | Regional Board | Sanitary Sewer Overflows and spills section, sixth bullet: laterals be inspected before any remodel **remodel of what??** of a specified dollar value | Text was added: home or business |
| 9.1.3 | | Regional Board | Swimmer Shedding section, 1st paragraph, line 10: and swimming in these areas, **ADD or put clean diapers on children before entering the water.** | Swim diapers are recommended over "clean regular diapers" |
| 9.1.3 | | Regional Board | Swimmer Shedding section, 1st paragraph: The swimmer shedding study was pretty comprehensive, yet text talks about 'remaining uncertainties' take out the following text: . due to remaining uncertainties of the impacts of swimmers to water quality at Dunes swimming areas" | Although we believe that due to the limited density of swimmers, even at the Dunes, swimmer shedding is a low priority source of FIB, one sutdy does not reduce all uncertainty. I n the Authors' review of the Swimmer Shedding study, there are a number of uncertainies that remain. Specifically, studies conducted by Elmir et al., 2007 and Sunderland et al. 2007 suggest that in a more controlled environment swimmer shedding is an important factor in FIB concentrations. Text was not revised due to these uncertainties and the potential for human entric pathogens realted to swimmer sheddding. |
| 9.1.4 | | Regional Board | 1st paragraph comments: BMPs should be listed here (again –it would be more efficient and understandable if Chps8 & 9 were combined and recommended BMPs were listed under ea section, then summarized at end in a list)<br>W/respect to agricultural runoff, there is no mention of cropland (particularly strawberries) BMPs, and while much ag land is going to development, there is still some land in row crops. | Depending on the geographical areas of focus, recommended BMPs are lsited in many different places in Section 9.0. General BMPs are listed in Section 9.0. Other area specifc BMPs are listed in Section 9.2. Specific BMPs realted to agricultural land uses are included in Appendices I and J. |

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| 9.1.5 | | County of Orange | paragraph 2: With regard to biofilm in ~~urban runoff conveyance~~ **municipal stormdrain** systems or tributary channels, it is recommended that as a first step, attention be given to better characterizing the contribution of FIB from this source to areas of interest in the Bay. Specific characterization studies are more fully described in Section 9.2. Recommended BMPs associated with vegetation entering ~~urban runoff convyenace~~ **municipal stormdrain** systems include those described for urban runoff municipal maintenance (Section 9.1.2). | See comment above regarding use of term. |
| 9.1.5 | | Regional Board | 1st paragraph, 1st sentence: Natural sources of FIB include Bay and watershed wildlife, vegetation, biofilm and algal mats. **ADD also sediments, wrack line.** | sediments were added. |
| 9.1.5 | | Regional Board | 1st paragraph, line 4: no BMPs are recommended aside from those described in the urban runoff section.**such as??** | The reader can refer to Section 9.1..1. Listing BMPs here again would be redundant. |
| 9.1.5 | | Regional Board | end of 2nd paragraph: include those described for urban runoff municipal maintenance (Section 9.1.2). **such as??** | The reader can refer to Section 9.1..1. Listing BMPs here again would be redundant. |

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| 9.1.5 | | Regional Board | comments: Where is section on Sediment trapping (from Chp8)??<br>-ADD section on Sediments as Source category<br>–Sediments are important in several ways<br>–FIB adsorbs to sediments<br>1 –In Bay sediments are source of bacteria to water column when resuspended, due to deposition and regrowth<br>2 –Sediments in shallow waters may have more impact on water quality<br>2 –Sediments entering Bay, via tributaries and runoff, carry FIB -bacterial load coming into Newport Bay may be reduced w/reduced sediment load –relates to Sediment TMDL | As described in section 5.0, sediments can be referred to as both a sink and source. FIB can be trapped and transpoted via sediment, and FIB may replicate/grow in sediment. A discussion of sediments as a source is now included in section 9.1.5 - Natural Soruces along with algal and debris mats. Other than reducing the sediment load to the Bay, however, there are no specific BMPs for sediment. |
| 9.2.1 | | County of Orange | 1st paragraph, last line: directly to WNB via ~~urban runoff conveyance~~ **municipal stormdrains.** | See comment above regarding use of term. |
| 9.2.1 | | County of Orange | 3rd paragraph,lines 6 and 8: …~~, and~~ **T**herefore**, BMPs to address these sources** are recommended as high priority for implementation in areas draining directly to Bayside Drive Beach via ~~urban runoff conveyance~~ **municipal stormdrains**. These and | See comment above regarding use of term. |
| 9.2.1 | | County of Orange | 5th paragraph, last line: Street Beach via ~~urban runoff conveyance~~ **municipal stormdrains.** | See comment above regarding use of term. |

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| 9.2.1 | | Regional Board | Western Newport Bay (38th St., 33rd St., Newport Blvd. Bridge & BTO 8) section, 1st paragraph: **since text states that water quality data from Arches has not yet been analyzed, this should be your first recommendation for this site, also visual inspections should be recommended for each site to determine sources present there are also boats in this area –vessel waste is possible source, Arches drain drains area of commercial facilities like restaurants etc –these sources should be added to sources above** | With the exception of resturants, the requested change was made. |
| 9.2.1 | | Regional Board | Western Newport Bay (38th St., 33rd St., Newport Blvd. Bridge & BTO 8) section: **ADD text below**<br>**Recommend:**<br>**1-Analyze OCHCA data to determine if bioswales have reduced FIB concentrations in Arches drain, especially in dry weather.**<br>**2-If FIB concentrations exceed water quality criteria, conduct sanitary survey up the Arches drains to determine sources of bacteria, and implement control measures for those sources.**<br>**3-Also –at each site –Visual inspections in drainage area of potential FIB sources –eg restaurants, city parks or golf courses that use biosolid fertilizers, residential areas w/pets, horse stables/riding areas.** | The requested change was made. |

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| 9.2.1 | | Regional Board | table 9.3: **Recommend one table for Dry sites and one for Wet so that prioritizations for sites are easily comparable** | Recommendations change between dry weather priority areas due to contributions from source and pathways. BMPs recommended for wet weather are general due to the limited inforamtion on specific wet weather sources. Therefore, wet and dry BMP tables were not added together. This can be done later if so chosen. |
| 9.2.1 | | Regional Board | table 9.3: **add rows for Biofilm and Sediemnts under Natural Sources** | Biofilm was added to vegetation. Sediment was added to Muni Mntc. |
| 9.2.1 | | Regional Board | Bayside drive Beach section: **(based on old Tables 6.9, 6.10, we should be looking at BaySHORE Beach rather than Bayside Dr Beach)**<br>**Also in Table 6.13, note that Bayside is listed, but BaySHORE is a higher priority in old Tables 6.9, 6.10.** | Priorities are based on data agreed to by the TAC and described in Section 6.0. Bayside Dr. Beach met the criteria for a priority site and is therefore listed. |
| 9.2.1 | | Regional Board | Bayside drive Beach section, paragraph 1: **define minimal exceedences** | 15.6% of rolling geomean |
| 9.2.1 | | Regional Board | 10th Street Beach section, 1st sentence: **Define minimal exceedences** | 11.0% of rolling geomean |

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| 9.2.1 | | Regional Board | Upper Bay section comments: There was no “administrative error”, pursuant to the Clean Water Act ALL waters are presumed to be swimmable/fishable unless designated otherwise through a Use Attainability Analysis, hence all of Newport Bay is designated as REC-1. Delete highlighted sentence. ADD text below<br>Recommend:<br>1-Analyze new OCHCA data collected above and near mouth of Santa Ana Delhi and San Diego Creek to determine FIB concentrations and FIB loads entering Newport Bay from these tributaries, especially in dry weather.<br><br>2-If FIB concentrations exceed water quality criteria, conduct sanitary survey up the Santa Ana Delhi or San Diego Creek to determine sources of bacteria, and implement control measures for those sources.<br>3-Review RMA model for hydrodynamics of Upper Bay, in particular, review the flow of Delhi waters into the Upper Bay, then Lower Bay<br>4-W/respect to natural sources, in particular bird waste –recommend conducting microcosm study to determine dieoff rates of undiluted bird feces –we still dont know dieoff rates of undiluted bird feces -if dieoff rate in fiel | Language was changed to indicate that "…considerations should be given to resolving inconsistencies between State Law and the existing REC-1 Beneficial Use designation of the Upper Bay." Recommendations regarding studies of SAD and modeling are included in Section 9.3 |

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| 9.2.2 | | Regional Board | Might reiterate here definition of wet weather to remind everyone what “wet” means and that “wet weather” days are limited<br>Recommend at least listing priority sites in wet weather<br>ADD<br>Priority Sites in Wet Weather (based on prioritization ranking in Chp6 –Table6.14)<br>Newport Dunes West<br>Newport Dunes North<br>Newport Dunes Middle<br>Newport Dunes East<br>North Star Beach<br>BTO4, 5, 6, 7<br>10th Street Beach<br>Bayshore Beach<br>Lido Yacht Club<br>BTO8 | Requested change was made. |

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| 9.2.2 | | Regional Board | 2nd paragraph: Why is over-irrigation an issue in wet weather?? –most people turn off their sprinklers in wet weather. It is possible however, that stormwater runoff which washes over grass/plants captures fertilizer from landscaped areas, and potentially plant-based bacteria. Also stormwater will transport bacteria from pet waste, horse stables, wildlife waste as stated above.<br>Wonder if bird waste is also a higher problem in wet weather because stormwater washes more bird waste into Bay from sediments surrounding Bay.<br>Are illicit connections/illegal discharges really a problem in wet?? Wouldnt most ICs be done in the summer?? What about IDs?? There is likely more overflow of sewers in wet??<br>What sources increase during wet weather?? Can these be controlled in some way?? | Text was revised to state: "Priority urban and agricultural sources of FIB include pet waste, fertilizers applied to landscaped areas and at nurseries, horse boarding facilities, sanitary sewer overflows, and leaking sewer lines. Natural sources that may also contribute to wet weather FIB concentrations in the Bay include waste from terrestrial wildlife, tidal washing of Bay sediment and water bird droppings. |
| 9.2.2 | | Regional Board | table 9.7: change - recommended BMP implementation levels to high (all domestic pet waste and ID/IC BMPs; Public outreach on fertilizers; and implementation of MMMP under Municipal Maintenance. Also comments: If land based sources are highest contributor in wet weather, then priorities of these sources should be high. Since text already stated that priorities in wet weather are lower than those in dry weather, land based sources should have higher priority in this table. | BMP Priority is based on the following: High Priority - those that address contributions of FIB and pathogens from human-associated sources during wet weather. Medium priority - those BMPs that reduce contributions of FIB onto the surface of the watershed from sources during dry weather. Lower priority - BMPs include those that attempt to treat urban runoff at large costs (i.e., diversions or on-site disinfection) and with significant engineering limitations due to the necessity to store large volumes of water prior to treatment during infrequent and limited storm events. |

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| 9.3 (NEW) | | Regional Board | adds this section: 9.3 Evaluation of Monitoring Program | Revisions to the monitoring progam is a separate task that will be completed following the SMP finalization. See section 9.4.2 |
| 9.3.1 | | County of Orange | 1st paragraph: replace "urban runoff conveyance" with "municipla stormdrain" four times | See comment above regarding use of term. |
| 9.3.1 | | County of Orange | 1st paragraph, second to last line: cost ($10,000 to **$**50,000), while developing | Requested change was made. |
| 9.3.1 (NEW) | | Regional Board | adds this section: 9.3.1 Routine Monitoring - continued routine monitoring for continued analysis of sites in Newport Beach. Section to include: Evaluate monitoring program -<br>How will routine monitoring be modified to address enhanced/new BMPs??<br>ie How do we show effectiveness of BMPs?? and are BMPs improving water quality??<br>Right now there are no measures of BMP effectiveness<br><br>How will routine monitoring be modified to address priority sites??<br><br>Describe current monitoring program<br>Describe recommended monitoring program to evaluate effectiveness of BMPs<br>Describe recommended monitoring program to evaluate priority sites<br>Describe how Orange Co. will coordinate monitoring w/other public health agencies | Revisions to the monitoring progam, including the development of specific monitoring/management questions that need to be adressed, and strategies to answer priority questions will be developed via a separate task that will be completed following the SMP finalization. See section 9.4.2 |

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| 9.3.1 (old) | | Regional Board | 2nd paragraph: allowing better characterization of in-system sources such as bioflims. **ADD or determine FIB concentrations from storm drain outlets compared to curb samples (this will show biofilm contribution) and analyze biofilm scrapings –samples in summer and winter (Prop13 study sampled in Jan and Nov as wet and dry, but Nov sampling was a few days after storm). Lab studies could also be conducted to determine desorption rate of FIB from biofilms.** | Additional studies (as recommended) are also described. |
| 9.3.1 (old) | | Regional Board | 2nd paragraph: It is estimated that this study would be of low to moderate cost ($10,000 to $50,000), while developing highly important information specific to source management. **Change estimate to $50,000-$75,000).** | Cost estimates were updated as suggested. |
| 9.3.2 | | County of Orange | 3rd paragraph, last line: address anthropogenic **sources** in the Santa Ana Delhi | Requested change was made. |
| 9.3.2 (old) | | Regional Board | 1st paragraph: ...FIB loads from this tributary are similar to those from the much larger tributary - San Diego Creek. **ADD (In addition, samples from Santa Ana Delhi were taken within the tidal prism while samples from San Diego Creek were taken above the tidal prism, which suggests that FIB concentrations entering the Bay from San Diego Creek could be lower than originally predicted.)** | We assume to commentor is suggesting that dieoff may have occurred at the SAD sampling site because it is within the tidal prism. A footnote was added to suggest as such. |

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| 9.3.3 (old) | | Regional Board | 1st paragraph comments: The purpose of Pednekar's study was to analyze FIB concentrations from storm drains in WNB and corresponding Bay sites in summer and winter, NOT to identify sources of FIB in this area. Only a few biofilm samples were collected concurrently w/storm drain samples as this was not the major effort of this study. What we need for these site specific studies is to conduct sanitary survey up the storm drains (in particular, Arches), and also to do visual inspections of areas to determine what FIB sources are in the area eg-city parks or golf coarses that may use biosolids, restaurants that may clean grease traps in parking lots, residential areas w/lots of pets, horse stables, hospital areas etc. | We agree the main purpose of the Pednekar study was not to ID sources, but by sampling biofilm, a potential source was identified. The text is only suggesting that studies should be similar to those conducted by Pednekar et al. Additional text was added to make sure this is clear. |
| 9.3.4 (old) | | Regional Board | 1st bullet: What are the "background" ranges of FIB concentrations in Newport Bay associated with natural sources during dry weather? **What are you calling background??** | Background is general term that should be better defined throught the quantification of "natural" sources. |
| 9.3.4 (old) | | Regional Board | 2nd bullet: What is the frequency to which FIB entirely from natural sources exceed water quality objectives/criteria? **this is where bird feces dieoff study comes in** | Agreed. |

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| 9.3.4 (old) | | Regional Board | see attached document for additional future studies (some are listed below, some of these addressed above)<br>**Bacti -Sediment sampling for bacti (ENT, E.coli) to coordinate w/Beach WQ Monitoring around Newport Bay by OCHCA<br><br>**Bacti -Determine die-off rate for undiluted bird feces esp in Upper Bay<br><br>**Bacti –Monitoring in SADelhi and SDCk above and below tidal influence and near mouth<br>-Determine residence time and dilution in SADelhi?? –(dye study??)<br>-also sampling of sediments at same time as water<br><br>**Bacti –Storm drain studies/Biofilm - Determine bacti load from storm drains (outlets) and compare to curb samples (this will tell biofilm contribution), also analyze biofilm scrapings<br>-sample in summer and winter –(last study sampled in Jan (wet weather) and Nov (dry or wet??) but no summer<br><br>**Bacti –FIB load carried by sediments entering from tributaries must be determined - relates to Sediment TMDL | Many of the studies recommended by the commentor have been suggested in Section 9.3, and no changes to text are needed.<br><br>Sediment sampling - see previous comment. |

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| 9.4 (old) | | Regional Board | section heading; 9.5 Regulatory Recommendations and TMDL Revisions (proposed by the County of Orange) **(added Co of Orange to title of this section since Regional board staff do not necessarily support all of these recommendations )** | These recommendations are those of the Author's, not the Regional Board's. A footnote was added at the beginning of this section to notify the reader of this. |
| 9.4.1 (old) | | Regional Board | 1st paragraph comments: Last statement isnt correct, beneficial uses are currently denoted as “existing” OR “potential” in the Basin Plan. (It would likely be difficult to show that REC1 is not an “existing” use in Upper Newport Bay.) | REC-1 uses for the Upper and Lower Bays are existing. Test was revised to make sure this is clear. |
| 9.4.1 (old) | | Regional Board | 2nd paragraph comments: Prohibition of use is not one of the federal UAA criteria that must be satisfied in order to revise a beneficial use. Delete entire section. | Text was added to suggest that a UAA MAY be needed to dedesignate the Upper Bay as supporting a REC-1 Use. |
| 9.4.1 (old) | | Regional Board | 3rd paragraph comments: ADD Note that it will take some time to revise the bacterial standards since any revisions to the Basin Plan must go through the Basin Plan amendment process which includes public review and comment of the proposed revisions. | Requested change was made. |
| 9.4.2 | | County of Orange | 6th paragraph, first line: RSAA and/or NSEA have been **adopted and/or** used over the last | Requested change was made. |
| 9.4.2 | | County of Orange | 8th paragraph, last line: changes NSAA to NSEA. | Requested change was made. |
| 9.4.2 | | County of Orange | 9th paragraph, 2nd line: WLA/LAs should be ~~tractable~~ **mearurable** through | Requested change was made. |

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| 9.4.2 (old) | | Regional Board | 2nd paragraph comments: It was intended that all urban sources fall under urban runoff category.<br>Explain why another category is required -ie what is the practical benefit of another urban category??<br>Sediments might also be listed as a source under urban runoff category.<br>Another way to divide these sources is to look at WithinBay Sources and Sources Entering the Bay –then use the other source categories (urban, ag, natural etc) | These "other urban sources" are separated from urban runoff because they are outside of the responsibility of stormwater (urban runoff) programs as defined by current NPDES permits. Therefore, from a regulatory perspective, the separation allows ease of permitting and policy development. Text was revised to explain. |
| 9.4.2 (old) | | Regional Board | 3rd paragraph: Furthermore, recent studies have shown that exceedances of bacteria water quality objectives frequently occur at beaches that receive runoff from predominately undeveloped watersheds.<br>**which studies?? include reference** | Tiefenthaler et al. (2009) |
| 9.4.2 (old) | | Regional Board | 3rd paragraph, lines 6 and 7: This indicates that natural uncontrollable sources of indicator bacteria such as wildlife feces, bacterial resuspension from disturbed sediment **or from tidal washing of sediments**, regrowth on the beach wrack, **vegetation, biofilm and algal mats** can cause exceedances of bacteria water quality objectives on their own, without contributions from anthropogenic sources.<br>**Sources not consistent from earlier sections to this section –hence additions. ADD bold black text above.** | Requestd change was made. |

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| 9.4.2 (old) | | Regional Board | 7th paragraph: **dont recall any bacterial tmdls that are based on loads NOT concentrations –references??** | There are many examples throught the U.S. of loads-based TMDLs. Referenced are not cited for either loads or concentration-based TMDLs, but references can be provided upon request. |
| 9.4.2 (old) | | Regional Board | 8th paragraph: **be consistent w/terminology** (allowable exceeded "days method" vs. "approach") | Text was revised to be consistent. |
| 9.4.2 (old) | | Regional Board | 10th paragraph: "Additionally, the type of BMP used and the effectiveness of BMPs to reduce FIB discharges to the Bay also differ significantly between dry and wet weather conditions."<br>**And yet BMPs in tables appear to be the same for wet and dry ie type of BMP doesnt change between wet and dry –explain** | Text was revised to state that only the effectiveness of BMPs differ signifacntly between wet and dry conditions. |
| 9.4.2 (old) | | Regional Board | 13th paragraph: **Explain what is meant by 'identify opportunities to more effectively implement routine monitoring requirements' ??** | This statement is meant to be broad. Determining whether more effective ways to monitor are possible is part of the plan devleopment. |

# APPENDIX B:
# A BRIEF HISTORY OF BACTERIA WATER QUALITY CRITERIA

## A Brief History of Bacteria Water Quality Criteria

In 1914, the United States Public Health Service (U.S PHS) set a standard requiring that drinking waters not show evidence of coliform organisms (U.S. Treasury Department 1914). Shortly after the development of those drinking water standards, the U.S. PHS pursued concurrent investigations of the role of recreational and shellfish waters in enteric disease transmission by compiling data on outbreaks (Frost 1925, Stokes 1927a, 1927b). Stokes (1927a, 1927b) reported that a 1921 epidemic of typhoid fever was unquestionably attributable to bathing in polluted waters (NRC 2004).

Around 1950, several proposed guidelines for recreational waters were being developed throughout the U.S. (APHA 1949, Cox 1951, Scott 1951, Streeter 1951). By the mid-1950s, a variety of bacterial indicator standards had appeared in the United States. In 1956, Garber reported that the City of Los Angeles was conducting a survey of standards for recreational waters in 13 jurisdictions. The State of Illinois used *Enterococcus*, while the remaining jurisdictions used total coliforms. Statistical reporting varied over a wide range: eight jurisdictions used either a geometric mean or a median for total coliforms; three used an arithmetic mean; four used a percentage that could not be exceeded; and three used absolute maximums. The most common standard was a requirement that total coliforms not exceed 1,000 per 100 mL (NRC 2004).

Of particular importance were the studies conducted in the late 1940s and early 1950s by the U.S. PHS at bathing beaches on Lake Michigan at Chicago, Illinois; on the Ohio River at Dayton, Kentucky; and on Long Island Sound at Mamaroneck and New Rochelle, New York (Stevenson 1953). All of the studies followed a similar design. Two beaches with different water quality were selected at each location, except at the Dayton location where a beach with high quality water could not be found. At the Dayton location, a large public swimming pool was used as a substitute for the high quality beach. Each location was chosen because, in addition to beaches having suitable water quality, there was a large residential population nearby that used the beaches. Cooperating families used a calendar system that allowed them to record their swimming activity and illnesses on a daily basis for the entire summer. They recorded gastrointestinal, respiratory, and other symptoms such as skin irritations. The water quality was measured on a routine basis, using total coliform bacteria as the indicator organism (U.S. EPA 1986).

The results of the Lake Michigan beach study indicated that there were no excess illnesses of any type in swimmers at beaches that had median total coliform densities of 91 and 180 per 100 mL over a swimming season when compared to the number of illnesses in the total study population. The water quality similarity at the two Lake Michigan beaches was unexpected, as previous experience had indicated that there was a difference in water quality at the beaches. A second method of analysis compared the illness observed in the week following three days of high total coliform density with that observed following swimming on three days of low coliform density. The analyses showed that there was a significantly greater illness rate in individuals who swam on the three days when the geometric mean total coliform density was 2300/100 mL, as compared to illness rates in swimmers who swam on the three days when the geometric mean total coliform density was 43 per 100 mL. A difference was not observed when the geometric mean total coliform density on high and low days was 732 and 32 per 100 mL respectively. Data from the Ohio River study indicated that swimmers who swam in water with a median total coliform density of 2300 per 100 mL had an excess of gastrointestinal illness when compared to an expected

rate calculated from the total study population. No other associations between swimming and illness were observed. The results of two marine bathing beach studies showed no association between illness and swimming in water containing 398 and 815 total coliforms per 100 mL (U.S. EPA 1986).

In 1968 the National Technical Advisory Committee (NTAC), convened by the U.S. Federal Water Pollution Control Administration was charged with proposing microbiological criteria for recreational waters. The NTAC determined that a fecal coliform measurement was more appropriate than a total coliform measurement because the fecal coliform measurement is more specific. The coliform water quality index used during the U.S. PHS epidemiological studies was translated into a fecal coliform index by using the ratio of fecal coliforms to total coliforms (~18%) at the location on the Ohio River where the original study had been conducted in 1949. Using this proportion, the NTAC found that the equivalent of 2300 total coliforms per 100 mL, the density at which a statistically significant swimming-associated gastrointestinal illness was observed, was about 400 fecal coliforms per 100 mL. The NTAC suggested that a detectable risk was undesirable and, therefore proposed one-half of that density, 200 fecal coliform per 100 mL, as the density at which a health risk occurred. The NTAC also suggested that the use of the water should not cause a detectable health effect more than 10% of the time. Thus, they established the recommended criterion for recreational waters (log mean of 200/100mL and 90th percentile of 400/100mL) (U.S. EPA 1986).

The U.S. EPA (1976) recommended this criterion again in 1976 even though it had been criticized on a number of issues. Henderson (1968) published one of the earliest critiques of the recommended criterion. He noted the paucity of epidemiological data in support of any numerical ceilings based on fecal indicators and criticized the one proposed as to the poor quality of the database, the derivation of the specific limits and the indicator system used. Moore (1975) objected to the selection of only part of the data from the Lake Michigan study to develop the 200 fecal coliforms per 100 mL recreational water criterion. He observed that the agency had ignored opposite findings in the Lake Michigan studies. He pointed out that the inclusion of all illnesses reported during the week after a bathing episode made the association of these ailments with the bathing episode tenuous. He also claimed there was no way of knowing how the incidence of skin irritations in bathers who swam on clean days compared to the frequency of diarrhea in those who swam on other days, because all the illnesses reported were lumped together (U.S. EPA 1986).

Cabelli et al. (1985) suggested other weaknesses in the U.S. PHS study design which would have precluded the identification of swimming-associated, pollution-related illnesses if, in fact, they occurred. They pointed out that "swimming" was "poorly defined and that it was unknown whether “swimming” study participants actually immersed their bodies, much less their heads, in the water. They also criticized this limitation and the use of the calendar method for recording "swimming" episodes and illnesses as precluding the inclusion of beach-going but nonswimming control groups in the studies. Moreover, the use of the calendar approach with nearby residents and the day-to-day variability in the pollution levels at the beaches increased the probability of a given individual's exposure to different levels of pollution during the incubation period of the illness.

This criticism ultimately resulted in a National Research Council (NRC) opinion that “no specific recommendation is made concerning the presence or concentrations of microorganisms in bathing water because of the paucity of valid epidemiological data” (NRC 1972). The NRC also criticized the fecal coliform measurement itself because thermotolerant

bacteria, such as *Klebsiella* spp. are included in this group but are not necessarily fecal in origin.

The Environmental Protection Agency, in 1972, initiated a series of studies at marine and fresh water bathing beaches, designed to correct the perceived deficiencies of the U.S. PHS studies. One goal of the U.S. EPA studies was to determine if swimming in sewage-contaminated water carries a health risk for bathers; and, if so, to what type of illness. If a quantitative relationship between water quality and health risk was obtained, two additional goals were to determine which bacterial indicator is best correlated to swimming-associated health effects and if the relationship is strong enough to provide a criterion (U.S. EPA 1986).

The marine studies were conducted at bathing beaches in New York City, New York, Boston, Massachusetts, and at Lake Pontchartrain, near New Orleans, Louisiana. Two beaches were selected at each site; one that received very little or no contamination and the other whose water quality was barely acceptable with respect to local recreational water quality standards. In the New York City and Boston Harbor studies, the “barely acceptable” beaches were contaminated with pollution from multiple sources, usually treated effluents that had been disinfected (U.S. EPA 1986).

The freshwater studies were conducted on Lake Erie at Erie, Pennsylvania and on Keystone Lake outside of Tulsa, Oklahoma. The “barely acceptable” beaches at both sites were contaminated by effluents discharged from single point-sources (U.S. EPA 1986). In these studies, subjects self-diagnosed all reported symptoms. The results of these studies indicated that symptom categories unrelated to gastroenteritis usually did not show a significant excess of illnesses at either of the paired beaches at each study location. Moreover, significantly increased swimming-associated gastroenteritis rates were always observed at the more polluted of the paired beaches at each study location. Statistically significant swimming-associated gastroenteritis rates were not observed at any of the relatively unpolluted beaches. The occurrence of a statistically significant excess of swimming-associated gastroenteritis in swimmers who bathed at beaches that were more polluted is indicative that there is an increased risk of illness from swimming in water contaminated with treated sewage (U.S. EPA 1986). This finding, which was observed at both marine and fresh water locations, was important because it placed in proper perspective the relationship between water contaminated with treated sewage and health risks for swimmers. This association was not very well defined in earlier studies (U.S. EPA 1986).

The data from the three years of the New York City study (marine water) were analyzed in two ways. The first was by grouping trial days with similar indicator densities from a given swimming season and the second was by looking at each entire summer. For both analyses, *Enterococcus* showed the strongest relationship to gastroenteritis. *E. coli* was a very poor second and all of the other indicators, including total coliforms and fecal coliforms showed very weak correlations to gastroenteritis. Subsequent studies, including the freshwater trials, used *Enterococcus* and *E. coli*. The researchers also included fecal coliforms in subsequent studies because of their status as an accepted criterion (U.S. EPA 1986).

The freshwater studies were analyzed only by summer. The correlation between gastroenteritis and *E. coli* was slightly greater than that for *Enterococcus*; however, statistical analysis indicated that the two values were not significantly different. Fecal coliforms showed no correlation to swimming associated gastroenteritis rates. The

similarities in the relationships of *E. coli* and *Enterococcus* to swimming associated gastroenteritis in freshwater indicate that these two indicators are equally efficient for monitoring water quality in freshwater, whereas in marine water environments only *Enterococcus* provided a good correlation (U.S. EPA 1986).

The quantitative relationships between the rates of swimming associated health effects and bacterial indicator densities were determined using regression analysis. Linear relationships were estimated from data grouped by summers or trials with similar indicator densities. The data for each summer were analyzed by pairing the geometric mean indicator density for a summer bathing season at each beach with the corresponding swimming-associated gastrointestinal illness rate for the same summer. The swimming-associated illness rate was determined by subtracting the gastrointestinal illness rate in nonswimmers from that for swimmers. These two variables from multiple beach sites were used to calculate a regression coefficient, y-intercept and 95% confidence intervals for the paired data. In the marine studies the total number of points for use in regression analysis was increased by collecting trial days with similar indicator densities from each study location and placing them into groups. The swimming-associated illness rate was determined as before, by subtracting the nonswimmer illness rate of all the individuals included in the grouped trial days from the swimmer illness rate during these same grouped trial days (U.S. EPA 1986).

Based on the studies described above, the U.S. EPA did not recommend a change in the stringency of its bacterial criteria for recreational waters (U.S. EPA 1986). U.S. EPA's evaluation of the bacteriological data indicated that using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 mL would cause an estimated 8 illnesses per 1,000 swimmers at fresh water beaches and 19 illnesses per 1,000 swimmers at marine beaches. U.S. EPA indicated that these relationships are only approximate and are based on applying ratios of the geometric means of the various indicators from the U.S. EPA studies to the 200 per 100 mL fecal coliform criterion, and that these are U.S. EPA's best estimates of the accepted illness rates for areas which apply the U.S. EPA fecal coliform criterion (U.S. EPA 1986).

The current *E. coli* and *Enterococcus* criteria (U.S. EPA 1986) were developed as log-linear relations between indicator densities and the previously noted levels of accepted illness rates. The equations developed by Dufour and Cabelli were used to calculate the geometric mean indicator densities corresponding to the accepted gastrointestinal illness rates for steady state dry weather conditions (U.S. EPA 1986). Single-sample maximum allowable densities were also promulgated relating allowable single sample maximum values to the relative level of use expected to occur at recreational sites.

In 2000, the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) was signed into law, amending the Federal Clean Water Act (CWA) with two significant provisions. First, the BEACH Act amended the CWA by adding section 303(i), which requires states and tribes that have coastal recreation waters (e.g., California) to adopt new or revised water quality standards by April 10, 2004, that are "as protective of human health as" the U.S. EPA’s 1986 criteria. For those states that fail to establish standards by this date, the BEACH Act also directs U.S. EPA to promulgate standards for states. Secondly, sections 104(v) and 304(a) were also added to the CWA, which together require U.S. EPA to conduct studies associated with pathogens and human health and to publish new or revised CWA section 304(a) criteria for pathogens and pathogen indicators based on those studies.

Based on review of bacteria standards adopted by the states, in 2000 the U.S. EPA concluded that the State of California has adopted standards as protective as the nationally recommended criteria for only some of their coastal recreation waters. Because the State of California did not adopt revised standards by the date set forth in the Beach Act, the U.S. EPA promulgated revised standards for California in 2004.

# APPENDIX C:

# DESCRIPTIVE STATISTICS FOR DATA COLLECTED AT OCHCA MONITORING SITES IN NEWPORT BAY

**Appendix C-1. Descriptive statistics for fecal coliform bacteria collected at 31 OCHCA monitoring sites in Newport Bay from 2002 to 2008 during dry weather (< 0.25 inches of rain in the two days before sample collection) and wet weather (> 0.25 inches of rain in the two days before sample collection).**

| Station ID | Station Name | Wet Weather | | | | | Dry Weather | | | | | All Samples | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | 25th % | Median | 75th % | Maximum | Minimum | 25th % | Median | 75th % | Maximum | Minimum | 25th % | Median | 75th % | Maximum |
| BNB01 | Park Avenue | 10 | 10 | 20 | 1170 | 14000 | 10 | 10 | 10 | 10 | 4800 | 10 | 10 | 10 | 20 | 14000 |
| BNB02 | Onyx Avenue | 10 | 75 | 340 | 2000 | 8200 | 10 | 10 | 10 | 20 | 9800 | 10 | 10 | 10 | 30 | 9800 |
| BNB03 | Ruby Avenue | 10 | 30 | 610 | 4100 | 9400 | 10 | 10 | 10 | 10 | 18000 | 10 | 10 | 10 | 20 | 18000 |
| BNB05 | Bayshore Beach | 10 | 20 | 900 | 3750 | 8000 | 10 | 10 | 10 | 20 | 9600 | 10 | 10 | 10 | 20 | 9600 |
| BNB07 | Via Genoa | 10 | 10 | 20 | 180 | 6600 | 9 | 10 | 10 | 30 | 7000 | 9 | 10 | 10 | 30 | 7000 |
| BNB09 | 43rd Street | 10 | 10 | 20 | 600 | 15000 | 10 | 10 | 20 | 117.5 | 7200 | 10 | 10 | 20 | 120 | 15000 |
| BNB10 | 38th Street | 10 | 37.5 | 340 | 3450 | 18000 | 10 | 10 | 10 | 60 | 23400 | 10 | 10 | 10 | 70 | 23400 |
| BNB11 | 33rd Street | 10 | 100 | 1820 | 3800 | 6600 | 10 | 10 | 20 | 110 | 27200 | 10 | 10 | 30 | 148 | 27200 |
| BNB12 | Rhine Channel | 10 | 10 | 20 | 100 | 4200 | 10 | 10 | 10 | 50 | 20400 | 10 | 10 | 10 | 50 | 20400 |
| BNB14 | 19th Street | 10 | 10 | 15 | 477.5 | 3800 | 9 | 10 | 10 | 50 | 8000 | 9 | 10 | 10 | 50 | 8000 |
| BNB15 | 15th Street | 10 | 10 | 10 | 205 | 4400 | 10 | 10 | 10 | 20 | 14000 | 10 | 10 | 10 | 20 | 14000 |
| BNB17 | 10th Street | 10 | 115 | 700 | 3750 | 11000 | 10 | 10 | 10 | 50 | 4400 | 10 | 10 | 10 | 70 | 11000 |
| BNB18 | Alvarado/Bay Island | 10 | 25 | 450 | 3100 | 10000 | 10 | 10 | 10 | 30 | 5800 | 10 | 10 | 10 | 30 | 10000 |
| BNB20 | Sapphire Avenue | 10 | 20 | 280 | 1375 | 5000 | 10 | 10 | 10 | 20 | 580 | 10 | 10 | 10 | 20 | 5000 |
| BNB21 | Abalone Avenue | 10 | 10 | 110 | 1295 | 7800 | 9 | 10 | 10 | 10 | 1110 | 9 | 10 | 10 | 10 | 7800 |
| BNB22 | N Street Beach | 10 | 20 | 170 | 520 | 8000 | 6 | 10 | 10 | 10 | 31400 | 6 | 10 | 10 | 10 | 31400 |
| BNB23 | Rocky Point | 10 | 10 | 30 | 445 | 5800 | 10 | 10 | 10 | 10 | 1000 | 10 | 10 | 10 | 10 | 5800 |
| BNB24E | Newport Dunes East | 60 | 350 | 2000 | 6400 | 19000 | 10 | 10 | 30 | 110 | 15000 | 10 | 10 | 30 | 130 | 19000 |
| BNB24M | Newport Dunes Middle | 10 | 40 | 80 | 440 | 8000 | 10 | 10 | 10 | 60 | 11000 | 10 | 10 | 20 | 70 | 11000 |
| BNB24N | Newport Dunes North | 80 | 340 | 2600 | 5600 | 17000 | 10 | 10 | 45 | 150 | 24400 | 10 | 10 | 50 | 170 | 24400 |
| BNB24W | Newport Dunes West | 20 | 120 | 1000 | 5800 | 18000 | 10 | 10 | 20 | 62.5 | 180000 | 10 | 10 | 20 | 80 | 180000 |
| BNB25 | Vaughns Launch | 20 | 80 | 120 | 5000 | 28000 | 10 | 10 | 20 | 60 | 14000 | 10 | 10 | 20 | 70 | 28000 |
| BNB26 | Ski Zone | 10 | 10 | 10 | 77.5 | 510 | 10 | 10 | 10 | 85 | 56000 | 10 | 10 | 10 | 85 | 56000 |
| BNB28 | North Star Beach | 10 | 65 | 1000 | 3500 | 21000 | 10 | 10 | 10 | 30 | 18000 | 10 | 10 | 10 | 30 | 21000 |
| BNB29 | Promontory Point | 10 | 10 | 170 | 940 | 5200 | 10 | 10 | 10 | 10 | 2000 | 10 | 10 | 10 | 10 | 5200 |
| BNB30 | De Anza | 10 | 60 | 990 | 6000 | 17000 | 10 | 10 | 10 | 20 | 9200 | 10 | 10 | 10 | 20 | 17000 |
| BNB31 | Garnet Avenue | 10 | 32.5 | 710 | 2850 | 7800 | 10 | 10 | 10 | 30 | 2400 | 10 | 10 | 10 | 30 | 7800 |
| BNB32 | Lido Yacht Club | 10 | 20 | 50 | 80 | 7000 | 10 | 10 | 10 | 42.5 | 16000 | 10 | 10 | 10 | 50 | 16000 |
| BNB33 | Bayside Drive Beach | 10 | 20 | 70 | 140 | 5000 | 10 | 10 | 40 | 130 | 9200 | 10 | 10 | 40 | 130 | 9200 |
| BNB34 | Grand Canal | 10 | 10 | 30 | 120 | 6000 | 2 | 10 | 10 | 40 | 8000 | 2 | 10 | 10 | 40 | 8000 |
| BNB35 | Newport Blvd Bridge | 10 | 252.5 | 2300 | 4450 | 54000 | 10 | 10 | 50 | 250 | 22200 | 10 | 10 | 50 | 280 | 54000 |

**Appendix C-2. Descriptive statistics for *Enterococcus* bacteria collected at 31 OCHCA monitoring sites in Newport Bay from 2002 to 2008 during dry weather (< 0.25 inches of rain in the two days before sample collection) and wet weather (> 0.25 inches of rain in the two days before sample collection).**

| Station ID | Station Name | Wet Weather | | | | | Dry Weather | | | | | All Samples | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | 25th % | Median | 75th % | Maximum | Minimum | 25th % | Median | 75th % | Maximum | Minimum | 25th % | Median | 75th % | Maximum |
| BNB01 | Park Avenue | 2 | 4 | 20 | 1455 | 16000 | 2 | 2 | 5 | 10 | 1730 | 2 | 2 | 6 | 10 | 16000 |
| BNB02 | Onyx Avenue | 2 | 44.5 | 305 | 2585 | 14000 | 2 | 2 | 8 | 10 | 1000 | 2 | 2 | 10 | 20 | 14000 |
| BNB03 | Ruby Avenue | 2 | 16 | 210 | 2800 | 12000 | 2 | 2 | 6 | 10 | 2800 | 2 | 2 | 8 | 10 | 12000 |
| BNB05 | Bayshore Beach | 2 | 45 | 600 | 7300 | 33800 | 2 | 2 | 10 | 10 | 5200 | 2 | 2 | 10 | 20 | 33800 |
| BNB07 | Via Genoa | 2 | 4 | 20 | 210 | 7000 | 2 | 2 | 6 | 10 | 19800 | 2 | 2 | 8 | 10 | 19800 |
| BNB09 | 43rd Street | 4 | 10 | 56 | 200 | 12000 | 2 | 4 | 10 | 40 | 7600 | 2 | 4 | 10 | 43 | 12000 |
| BNB10 | 38th Street | 2 | 17.5 | 265 | 1305 | 22000 | 2 | 4 | 10 | 32 | 17000 | 2 | 4 | 10 | 38.5 | 22000 |
| BNB11 | 33rd Street | 2 | 34 | 200 | 2000 | 36800 | 2 | 6 | 20 | 74 | 13000 | 2 | 6 | 21 | 84 | 36800 |
| BNB12 | Rhine Channel | 2 | 2 | 10 | 358 | 8000 | 2 | 2 | 10 | 20 | 16000 | 2 | 2 | 10 | 20 | 16000 |
| BNB14 | 19th Street | 2 | 2 | 8 | 102.5 | 3200 | 2 | 2 | 10 | 21.5 | 24400 | 2 | 2 | 10 | 24 | 24400 |
| BNB15 | 15th Street | 2 | 2 | 10 | 155 | 3000 | 2 | 2 | 4 | 10 | 18400 | 2 | 2 | 4 | 10 | 18400 |
| BNB17 | 10th Street | 4 | 70 | 750 | 5000 | 28800 | 2 | 2 | 10 | 30 | 12800 | 2 | 2 | 10 | 40 | 28800 |
| BNB18 | Alvarado/Bay Island | 2 | 70.5 | 300 | 3450 | 22600 | 2 | 4 | 10 | 20 | 600 | 2 | 4 | 10 | 26 | 22600 |
| BNB20 | Sapphire Avenue | 2 | 10 | 244.5 | 1740 | 17000 | 2 | 2 | 8 | 10 | 950 | 2 | 2 | 10 | 10 | 17000 |
| BNB21 | Abalone Avenue | 2 | 8.5 | 95 | 1185 | 22000 | 2 | 2 | 6 | 10 | 2400 | 2 | 2 | 6 | 10 | 22000 |
| BNB22 | N Street Beach | 2 | 10 | 200 | 1515 | 5000 | 2 | 2 | 2 | 10 | 110 | 2 | 2 | 2 | 10 | 5000 |
| BNB23 | Rocky Point | 2 | 10 | 28 | 225 | 5400 | 2 | 2 | 6 | 10 | 19000 | 2 | 2 | 6 | 10 | 19000 |
| BNB24E | Newport Dunes East | 10 | 227 | 1800 | 8500 | 36800 | 2 | 4 | 10 | 30 | 5600 | 2 | 4 | 10 | 40 | 36800 |
| BNB24M | Newport Dunes Middle | 2 | 6 | 26 | 160 | 21000 | 2 | 4 | 10 | 24 | 35000 | 2 | 4 | 10 | 30 | 35000 |
| BNB24N | Newport Dunes North | 24 | 315 | 1740 | 11250 | 32000 | 2 | 8 | 10 | 42 | 9000 | 2 | 8 | 20 | 50 | 32000 |
| BNB24W | Newport Dunes West | 6 | 45 | 1525 | 13750 | 30000 | 2 | 4 | 10 | 28 | 8200 | 2 | 4 | 10 | 30 | 30000 |
| BNB25 | Vaughns Launch | 24 | 144 | 1065 | 7050 | 59000 | 2 | 8 | 20 | 60 | 24000 | 2 | 8 | 20 | 70 | 59000 |
| BNB26 | Ski Zone | 2 | 8 | 40 | 60.5 | 140 | 2 | 10 | 10 | 54 | 98000 | 2 | 10 | 10 | 60 | 98000 |
| BNB28 | North Star Beach | 2 | 102.5 | 1600 | 14000 | 47000 | 2 | 4 | 10 | 25 | 9600 | 2 | 4 | 10 | 34 | 47000 |
| BNB29 | Promontory Point | 2 | 8 | 40 | 1380 | 14000 | 2 | 2 | 2.5 | 10 | 3300 | 2 | 2 | 4 | 10 | 14000 |
| BNB30 | De Anza | 2 | 109.5 | 800 | 9800 | 30000 | 2 | 2 | 8 | 10 | 4800 | 2 | 2 | 10 | 10 | 30000 |
| BNB31 | Garnet Avenue | 8 | 20 | 200 | 3700 | 18000 | 2 | 2 | 10 | 14.5 | 1000 | 2 | 2 | 10 | 20 | 18000 |
| BNB32 | Lido Yacht Club | 2 | 2 | 10 | 100 | 12000 | 2 | 2 | 10 | 20 | 29000 | 2 | 2 | 10 | 20 | 29000 |
| BNB33 | Bayside Drive Beach | 4 | 8 | 50 | 210 | 15000 | 2 | 8 | 20 | 50 | 16600 | 2 | 8 | 20 | 54 | 16600 |
| BNB34 | Grand Canal | 2 | 2 | 20 | 315 | 12000 | 2 | 2 | 8 | 10 | 13000 | 2 | 2 | 8 | 10 | 13000 |
| BNB35 | Newport Blvd Bridge | 2 | 235 | 880 | 3000 | 16000 | 2 | 4 | 25 | 140 | 25200 | 2 | 6 | 30 | 200 | 25200 |

# APPENDIX D:

# A HISTORY OF BACTERIOLOGICAL ENUMERATION METHODS UTILIZED BY OCHCA IN NEWPORT BAY AND TRIBUTARIES

**Appendix D. A history of bacteriological enumeration methods utilized by Orange County Health Care Agency in Newport Bay and tributaries (OCHCA 2009).**

| OCHCA Laboratory | | 1986 | 1987-1994 | 1995-1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENTEROLERT | ENTERO | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| EPA 1600 | ENTERO | | | | | | | | | | | | X | X | X | X | X |
| MF (APHA 9230 C) | ENTERO | | | | | | | | X | X | | | | | | | |
| COLILERT 18 | FC | | | | | X | X | X | | | | | | | | | |
| MTF by EC (APHA 9221 E.1 | FC | X | X | X | X | X | X | X | X | | | | | | | | |
| MF (APHA 9222 D) | FC | | | | | | | | X | X | X | X | X | X | X | X | X |
| COLILERT 18 | TC | | | | | | X | X | | | | | | | | | |
| MTF (APHA 9221 B) | TC | X | X | X | X | X | X | X | X | | | | | | | | |
| MF (APHA 9222 B) | TC | X | X | X | | | | | X | X | X | X | X | X | X | X | X |

# APPENDIX E:

# FORMULA AND DATA INPUTS USED TO CALCULATE FECAL INDICATOR BACTERIA LOADING FROM SOURCES IN NEWPORT BAY

**Appendix E-1. Formula and Data Inputs used to calculate Fecal Coliform Loading from Domestic Pets (cats and dogs).**

| Number of Domestic Pets in Newport Bay Watershed | Value | Reference |
|---|---|---|
| Total # Households in Newport Bay Watershed (H) | 40,000 | U.S. 2000 Census data normalized to NB watershed |
| Percentage of Dog Owning Households ($H_D$) | 37.2% | http://www.avma.org/reference/marketstats/ownership.asp#formulas |
| Percentage of Cat Owning Households ($H_C$) | 32.4% | http://www.avma.org/reference/marketstats/ownership.asp#formulas |
| Number of Dogs per dog-owning households (DDH) | 1.6 | http://www.avma.org/reference/marketstats/ownership.asp#formulas |
| Number of Cats per cat-owning households (CCH) | 2.1 | http://www.avma.org/reference/marketstats/ownership.asp#formulas |
| **Total Number of Dogs in Watershed ($W_D$) = H x $H_D$ x DDH** | **23,808** | |
| **Total Number of Cats in Watershed ($W_C$) = H x $H_C$ x CCH** | **27,216** | |
| | | |
| **FIB Production from Domestic Pets** | | |
| Percentage of Dogs that Deficate Outside (DO) | 100% | http://www.avma.org/reference/marketstats/ownership.asp#formulas |
| Percentage of Cats that Deficate Outside (CO) | 44% | Dabritz et al. (2006) |
| Percentage of Dog Owners that don't pick up Pet Waste (DP) | 20% | Assumed level of effectiveness for source control activities based on review of BMPs. |
| Percentage of Cat Owners that don't pick up Pet Waste (CP) | 100% | |
| Average Fecal Coliform production per Dog (organisms/day) ($FC_{Dogs}$) | $1 \times 10^9$ | Weiskel, P., B. Howes, G. Heufelder (1996). Coliform Contamination of a Coastal Embayment: Sources and Transport Pathways. Environmental Science & Technology. 30 (6), 1872-1881 |
| Average Fecal Coliform production per Cat (organisms/day) ($FC_{Cats}$) | $1 \times 10^9$ | |
| | | |
| **Fecal Coliform Loading from Dogs (organisms/day) $L_{Dogs}$= $W_D$ x DO x DP x $FC_{Dogs}$** | **$4.8 \times 10^{12}$** | |
| **Fecal Coliform Loading from Cats (organisms/day) $L_{Cats}$= $W_C$ x CO x CP X $FC_{Cats}$** | **$1.2 \times 10^{13}$** | |

**Appendix E-2. Formula and Data Inputs used to calculate *E. Coli* Loading from Fertilizers/Over-Irrigation.**

| | 5 Large Drains to Bay | 209 Small Drains to Bay | Drains to Tributaries | Total | Reference |
|---|---|---|---|---|---|
| Average Dry Weather Discharge Rate ( gal/day/acre) | 97 | 11 | 54 | | Everest International 2004; Pednekar et al. 2007; Grant et al. 2009 |
| Urban Land Area (Acres) | 2,612 | 3,914 | 31,004 | 37,530 | Orange County Stormwater Program 2008 |
| Residential Land Use Area (Acres) | 1,055 | 1,581 | 15,406 | 18,043 | |
| Total Dry Weather Discharge (gal/day) | 253,364 | 43,057 | 1,674,202 | 1,970,623 | |
| | | | | | |
| Average *E. coli* in Dry Weather Runoff (organisms/100mL) | 794 | 794 | 794 | | Grant et al. 2009 |
| Average *E. coli* in Dry Weather Runoff (organisms/gallon) | 30,056 | 30,056 | 30,056 | | |
| | | | | | |
| **Total *E. coli* in Dry Weather Runoff (organisms/day)** | **$7.6 \times 10^{10}$** | **$1.3 \times 10^{9}$** | **$5.0 \times 10^{10}$** | **$3.9 \times 10^{10}$** | |

**Appendix E-3. Formula and Data Inputs used to calculate Fecal Coliform Loading from Vessel Waste.**

| | Weekday | Weekend | Total | Reference |
|---|---|---|---|---|
| Estimated Fecal Coliform Load (organisms/day) | $9.9 \times 10^{10}$ | $4.0 \times 10^{11}$ | | EOA 2001 |
| Days per year | 251 | 114 | 365 | |
| Estimated Fecal Coliform Load (organisms/year) | $2.5 \times 10^{13}$ | $4.6 \times 10^{13}$ | $7.1 \times 10^{13}$ | |
| % of Fecal Coliform Load | 35.3% | 64.7% | 100% | |
| Average Fecal Coliform Load (organisms/day) | | | $1.9 \times 10^{11}$ | |
| % Reduction due to Management Actions | | | 80% | Grant et al. 2004 |
| | | | | |
| **Estimated Fecal Coliform Load (organisms/day)** | | | **$3.9 \times 10^{10}$** | |

**Appendix E-4. Formula and Data Inputs used to calculate Fecal Coliform Loading from Wildlife (raccoons and skunks).**

| | Value | Reference |
|---|---|---|
| Urban Land Area in watershed w/o Rds and Transportation (sq mi) | 116 | Orange County Stormwater Program 2008 |
| | | |
| Raccoons | | |
| Average number of Raccoons (animals/sq mi) | 71 | Broadfoot et al. 2001, Riley et al. 1998 |
| Adjusted average number of Raccoons in Newport Bay watershed (animals/sq mi) | 36 | |
| Estimated total number of Raccoons in urban land areas in the Newport Bay watershed | 4125 | |
| Estiamted Fecal Coliform excretion rate for Raccoons (organisms/day) | $1 \times 10^{8}$ | USEPA 2000 |
| **Estimated Fecal Coliform discharge to the surface of the watershed by Raccoons (organisms/day)** | **$4.1 \times 10^{11}$** | |
| | | |
| Skunks | | |
| Average number of Skunks (animals/sq mi) | 4 | Broadfoot et al. 2001 |
| Adjusted average number of Skunks in Newport Bay watershed (animals/sq mi) | 2 | |
| Estimated total number of Skunks in urban land areas in the Newport Bay watershed | 212 | |
| Estiamted Fecal Coliform excretion rate for Skunks (organisms/day) | $1 \times 10^{8}$ | USEPA 2000 |
| **Estimated Fecal Coliform discharge to the surface of the watershed by Skunks (organisms/day)** | **$2.1 \times 10^{10}$** | |

# APPENDIX F:
# TIPS FOR PET CARE BROCHURE

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Pet waste and pet care products can be washed into the storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never put pet waste or pet care products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
**Orange County Stormwater Program**
at **(714) 567-6363**
or visit
**www.ocwatersheds.com**

To report a spill,
call the
**Orange County 24-Hour Water Pollution Problem Reporting Hotline**
at **(714) 567-6363**.

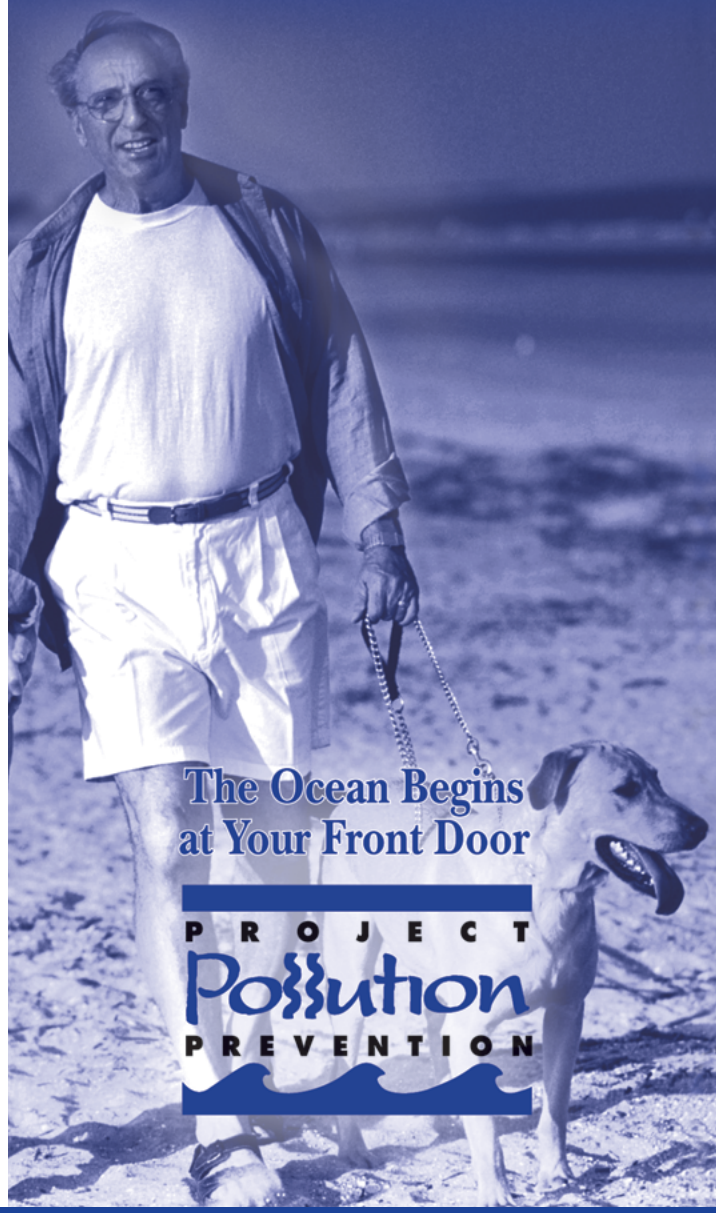
**For emergencies, dial 911.**

The tips contained in this brochure provide useful information to help prevent water pollution while caring for your pet. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

Printed on Recycled Paper

Help Prevent Ocean Pollution:

# Tips for Pet Care



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

# Tips for Pet Care

Never let any pet care products or washwater run off your yard and into the street, gutter or storm drain.

## *Washing Your Pets*

Even biodegradable soaps and shampoos can be harmful to marine life and the environment.

- If possible, bathe your pets indoors using less-toxic shampoos or have your pet professionally groomed. Follow instructions on the products and clean up spills.

- If you bathe your pet outside, wash it on your lawn or another absorbent/ permeable surface to keep the washwater from running into the street, gutter or storm drain.

## *Flea Control*

- Consider using oral or topical flea control products.

- If you use flea control products such as shampoos, sprays or collars, make sure to dispose of any unused products at a Household Hazardous Waste Collection Center. For location information, call **(714) 834-6752**.

## *Why You Should Pick Up After Your Pet*

It's the law! Every city has an ordinance requiring you to pick up after your pet. Besides being a nuisance, pet waste can lead to water pollution, even if you live inland. During rainfall, pet waste left outdoors can wash into storm drains. This waste flows directly into our waterways and the ocean where it can harm human health, marine life and the environment.

As it decomposes, pet waste demands a high level of oxygen from water. This decomposition can contribute to killing marine life by reducing the amount of dissolved oxygen available to them.

Have fun with your pets, but please be a responsible pet owner by taking care of them and the environment.

- Take a bag with you on walks to pick up after your pet.

- Dispose of the waste in the trash or in a toilet.

PROJECT Pollution PREVENTION

# APPENDIX G:
# TIPS FOR MAINTAINING A SEPTIC TANK SYSTEM BROCHURE

For more information,
please call the
**Orange County Stormwater Program**
at **(714) 567-6363**
or visit
**www.ocwatersheds.com**

To report a sewage spill during
normal business hours
(8:00 AM to 5:00 PM), call the
**Health Care Agency**
at **(714) 433-6419**
To report a sewage spill AFTER
normal business hours, on
weekends or holidays,
call **(714) 628-7008**

**For emergencies, dial 911.**

The tips contained in this brochure provide useful information to help prevent water pollution. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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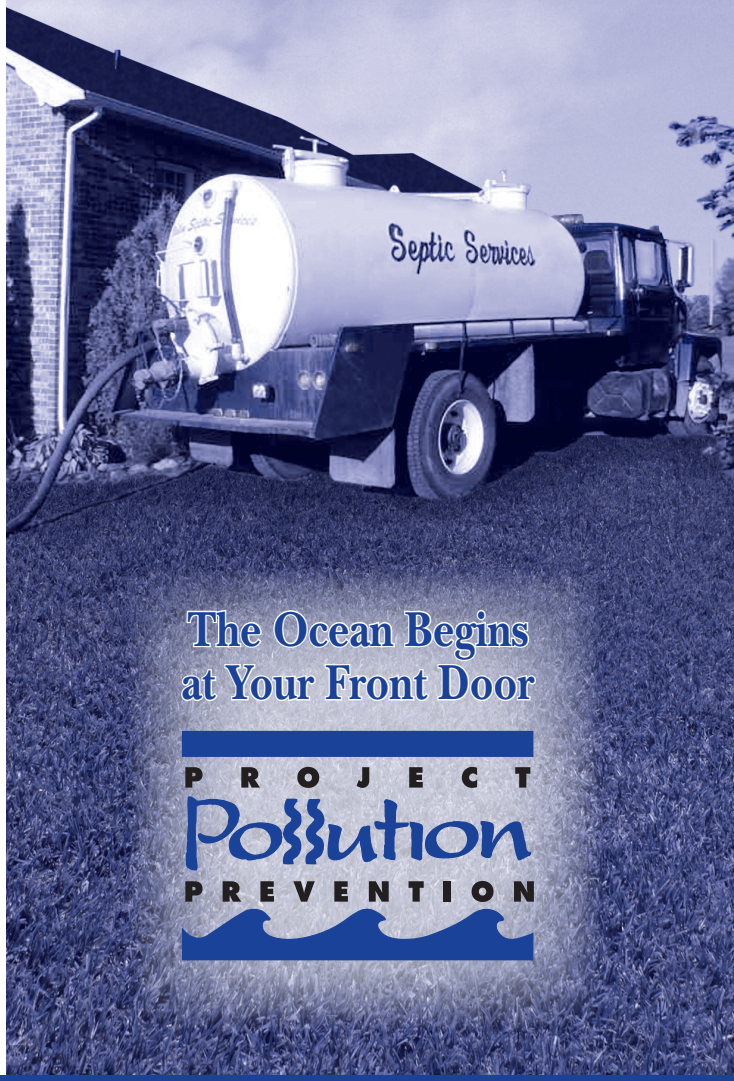
Help Prevent Ocean Pollution:

# Tips for Maintaining a Septic Tank System




The Ocean Begins
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Pollution
PREVENTION

# Tips for Maintaining a Septic Tank System

Households that are not served by public sewers usually depend on a septic tank system* to treat and dispose of wastewater. A well designed, installed and regularly maintained septic system can provide years of reliable service. However, when these systems fail to operate properly, significant damage can occur to property and the environment. The homeowner is responsible for these damages and may be subject to fines. Therefore, it is important to follow these simple tips when using a septic tank system:

## *Conserve Water*

The more wastewater produced, the more the soil must absorb. By conserving water, the life of the drain field will be extended and the chance of a system failure is decreased.

Reduce your water use by:

- Using water saving devices
- Repairing leaky faucets and plumbing fixtures
- Reducing toilet reservoir volume or flow
- Taking shorter showers
- Washing only full loads of dishes and laundry

## *Never Flush Harmful Materials Into The Septic Tank*

Grease, cooking oils, newspaper, paper towels, rags, coffee grounds, sanitary napkins and cigarettes do not easily decompose in the tank. Chemicals such as solvents, oils, paints and pesticides are harmful to the system's operation and may pollute the groundwater. For information on the proper disposal of household hazardous waste, call **1-800-CLEANUP**. Also, never use septic tank additives, commercial septic tank cleaners, yeast, sugar, etc. These products are not necessary and some may be harmful to your system.

## *Keep Runoff Away From The System*

Water from surfaces such as roofs, driveways or patios should be diverted away from the septic tank and drain field area.

## *Protect The System From Damage*

Keep traffic, such as vehicles, heavy equipment or livestock off your drain field or replacement area. The pressure can compact the soil or damage pipes. Also check your septic system map prior to constructing buildings or a pool on the property. The area over the absorption field and tank should be left undisturbed with only grass on top. Trees or shrubs, which may clog and damage the drain, should be created from the area.

## *Keep Records*

Know where the septic tank is and have a diagram of its location. Also, keep up-to-date, accurate maintenance records.

## *Inspect The System*

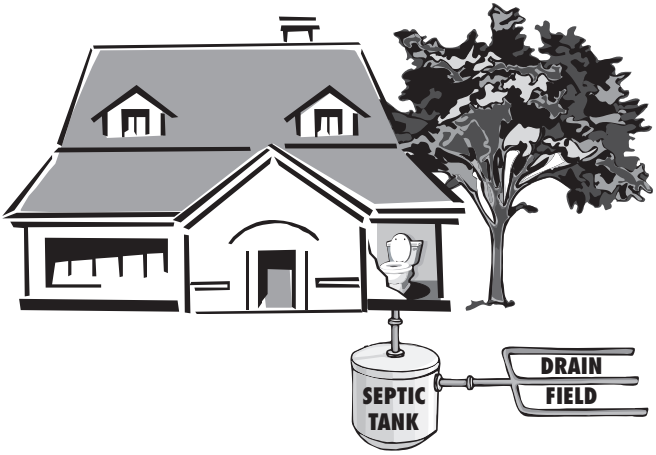
Monitor the system yearly to insure it is not at an "early warning level." Inspect the drain field and down slope areas for odors, wet spots, or surfacing of sewage. This may be an early indication of a problem with the system. Also, have the system inspected by a licensed septic tank professional every three to five years.

## *Pump The Tank When Needed*

Routine pumping can prevent failures, such as clogging and backup into the home.

## *Never Enter The Septic Tank*

Poisonous gases or the lack of air can be fatal. A professional should complete any work to the tank.




* Contact your local collection agency or city for assistance in determining if your home is served by a septic tank.

# APPENDIX H:

# BEST MANAGEMENT PRACTICES: A WATER QUALITY FIELD GUIDE FOR NURSERIES

# Best Management Practices

## *A Water Quality Field Guide for Nurseries*

**Darren L. Haver**

SOUTHERN CALIFORNIA EDITION

*Includes Guidelines for Southern California Edison Properties*

University of California
Agriculture and Natural Resources

# Best Management Practices

## *A Water Quality Field Guide for Nurseries*

SOUTHERN CALIFORNIA EDITION

Cooperative Extension, Orange County
Agriculture & Natural Resources
University of California

*Best Management Practices - A Water Quality Field Guide for Nurseries* was developed as a joint project between the University of California Cooperative Extension Orange County, Orange County Coastkeeper, Orange County Farm Bureau, and Southern California Edison. Our goal was to create a simple water quality field guide for small to medium-sized nurseries operating in urban environments. This field guide provides nursery growers as well as land owners, operators, employees, and stormwater municipal personnel with a straightforward list of Best Management Practices (BMPs) to reduce pollutants from entering urban storm drains, creeks, bays, and the ocean.


**Author**

Darren Haver, Ph.D.
*Watershed Management Advisor*
*University of California Cooperative Extension*


Photographs included herein are for the express purpose of demonstrating proper BMPs. Photographs depicting improper practices were staged and no implication should be made that a nursery is not in compliance with regulations.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Division of Agriculture and Natural Resources

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SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

**Special Notice to Nurseries with Southern California Edison (SCE) License Agreements**

**Implementation of any of the BMPs listed in this handbook requires prior written approval by Southern California Edison. BMPs listed in this handbook are provided as guidelines for nursery operators. Follow Southern California Edison's guidelines for BMP approval described on pages 30 and 31 of this handbook.**


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# Introduction

## *Water Quality Regulations*

Federal, state, and local government, in response to concerned citizens, have mandated that nurseries eliminate or reduce wastewater discharges from their operations, especially if they exceed established water quality criteria. The authority of agencies to regulate discharges is contained in federal and state water quality laws, and local codes.

Clean Water Act of 1972 - The Clean Water Act (CWA) of 1972, administered federally by the United States Environmental Protection Agency (USEPA), developed two programs to address water quality: the National Pollutant Discharge Elimination System (NPDES) and the Total Maximum Daily Load (TMDL).

NPDES Program - The federal NPDES program requires point source dischargers to mitigate their effluent to meet specific water quality standards based upon the best available control technologies. A point source is defined as any 'discernable, confined, and discrete conveyance' and generally includes water treatment facilities, industrial factories, and urban storm conveyance systems. Agriculture has historically been exempt from the NPDES permit program.

In California, the federal NPDES program is implemented by the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (RWQCB). The SWRCB and each of the nine RWQCBs within the state are given the task of enforcing the Clean Water Act as well as state water quality laws and regulations.

California's Porter-Cologne Act, enacted prior to the 1972 Clean Water Act, requires each RWQCB to establish basin plans containing policies, beneficial uses, water quality objectives, and implementation plans. Under the Porter-Cologne Act, RWQCBs can issue Waste Discharge Requirement (WDR) permits to individuals discharging into state waters to ensure that water quality objectives are not violated. If it is determined that a nursery's discharges are resulting in the impairment of a water body, the Regional Water Quality Control Board may issue a cease and desist order and require a WDR permit for further discharges to occur. The WDR sets water quality requirements that must be met by all discharges that occur during the period of time that the permit is issued to an individual. Several RWQCBs have issued WDRs to nurseries in areas of the state adjacent to sensitive waterbodies or when concerned local citizen or environmental groups expressed concern over the discharge of surface runoff from a facility.

On a regional basis, the RWQCB may also issue an agricultural waiver. Waivers require that all facilities must meet minimum established requirements in order to continue discharging wastewater; these requirements always require implementation of Best Management Practices (BMPs) and may also require individuals establish individual or group monitoring programs. Nurseries located in highly urbanized areas may also be regulated under the Municipal Storm Water Permitting Program or MS4 permit.

TMDL Program – Total Maximum Daily Loads are defined as the quantitative amount of a pollutant a water body can tolerate on a daily basis, while meeting established water quality standards. Each state is required by Section 303(d) of the CWA to identify "impaired" waterbodies and establish maximum loading limits, a TMDL, for each pollutant causing the impairment. The process requires that all point and nonpoint sources

be identified and assigned a pollutant allocation that shall not be exceeded in order to protect the beneficial uses of the designated water body. Beneficial uses include wildlife habitat, recreation, drinking water source, agriculture, and shellfish harvesting. The 303(d) list of impaired waterbodies contains information on which beneficial uses are impaired and by what pollutants. The list is updated every two years and is available for viewing on the SWRCB or RWQCB websites. (Refer to section on Water Quality Related References.)

Groundwater – California's Pesticide Contamination Prevention Act (PCPA) of 1985 required the California Department of Food and Agriculture to establish numerical values for specific characteristics of pesticides in order to provide information on those pesticides that potentially could contaminate groundwater. Numerical values are established for the following characteristics: water solubility, soil adsorption coefficient ($K_{oc}$), hydrolysis half-life, soil metabolism under anaerobic and aerobic conditions, and field dissipation of pesticides. Knowledge of these pesticide properties prior to the use of a pesticide enables the user to minimize or eliminate the risk of the pesticide impacting surface and ground waters. The University of California Riverside has developed an interactive pesticide manager web site to assist the user in determining if the pesticide being utilized, taking into account site specific conditions, has the potential to enter surface or ground waters. (http://www.pw.ucr.edu)

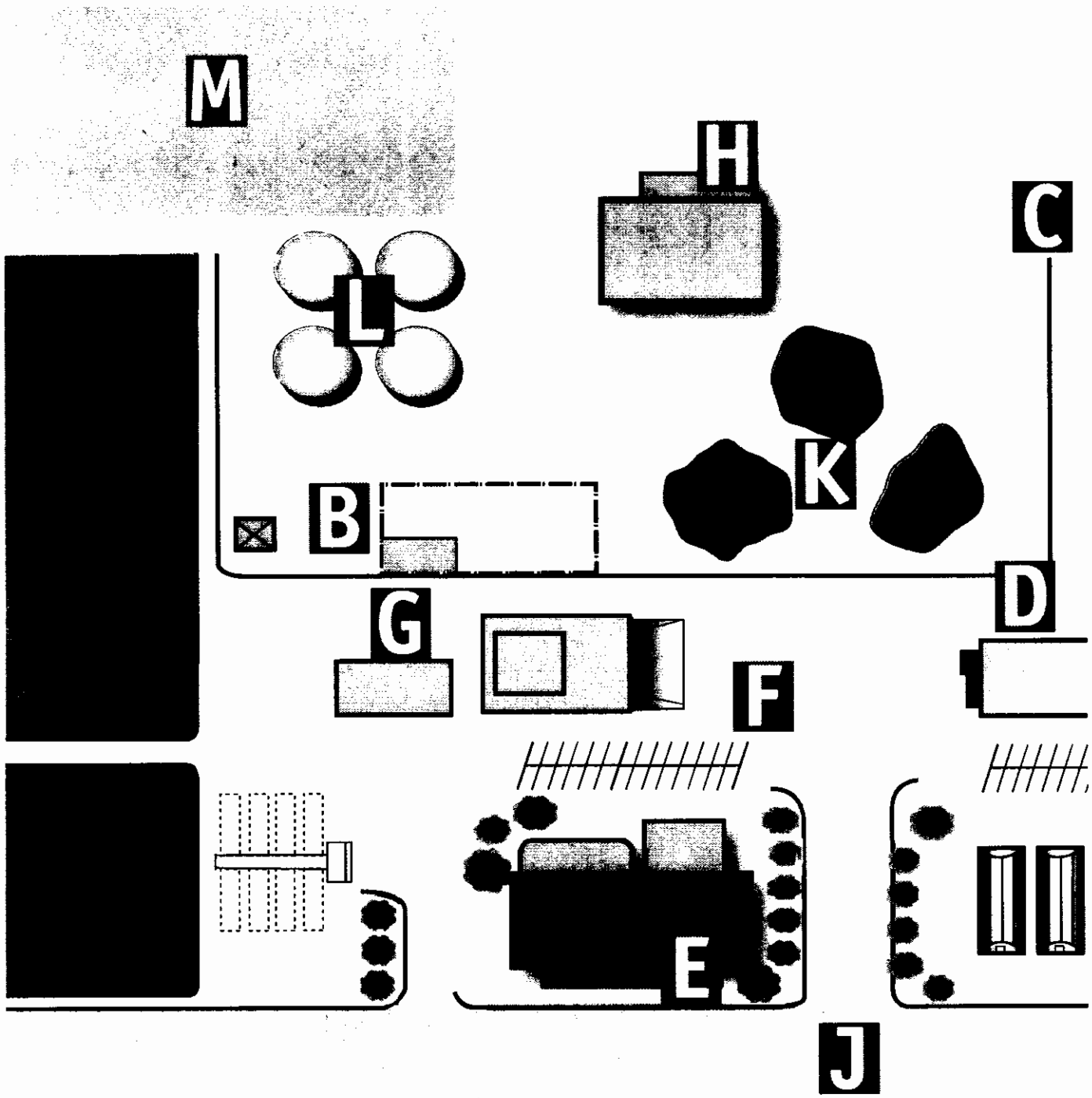
## *Impacts on Nursery Industry*

It is imperative that growers are fully aware of the impact, if any, of their operation on the beneficial uses of local waterbodies. The following steps should be taken by existing and planned nursery operations:

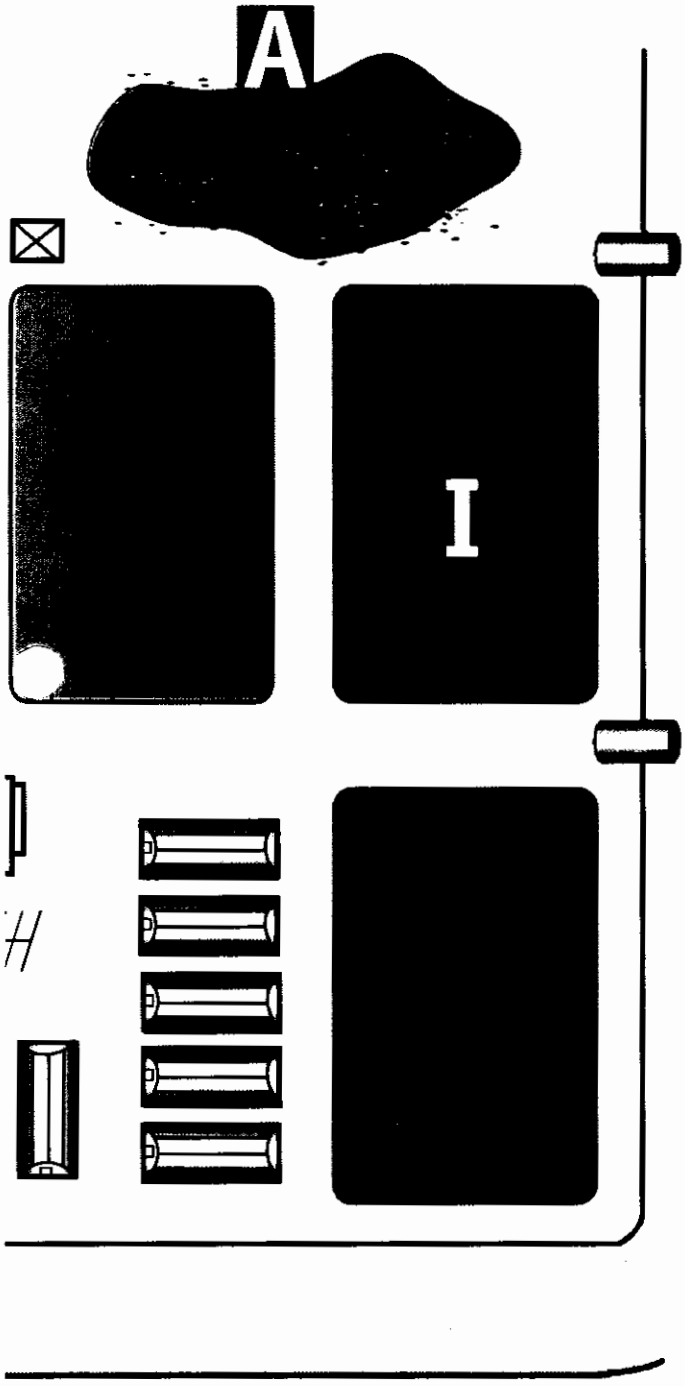
- Determine which RWQCB governs where your operation exists.
- Inventory streams, lakes, estuaries, or other water bodies that may be impacted by discharges from your operation.
- Obtain a copy of the appropriate RWQCB Basin Plan to determine the local water quality objectives.
- Be an active stakeholder in the development of TMDLs for water bodies that your facility impacts.
- Be aware that if you discharge, a WDR may be requested by RWQCB.
- Be prepared to work closely with the RWQCB, local water agencies, and other regulatory agencies on developing appropriate controls for discharges from your facility.
- Determine the need for permits prior to installing structural BMPs, such as retention basins, sediment traps, etc.
- Monitor flow and basic nutrient concentrations in discharges regardless if you operating under a WDR. Protect yourself against inaccurate data.
- Know the basic properties of the pesticides utilized at your operation and how they could potentially impact local waters.

In order for the nursery industry to act in accordance with the numerous water quality regulations, it is imperative that more efficient fertilization, irrigation and pest management programs are developed and implemented by growers.

# Sample Nursery Layout




**←Creek Draining to Ocean**

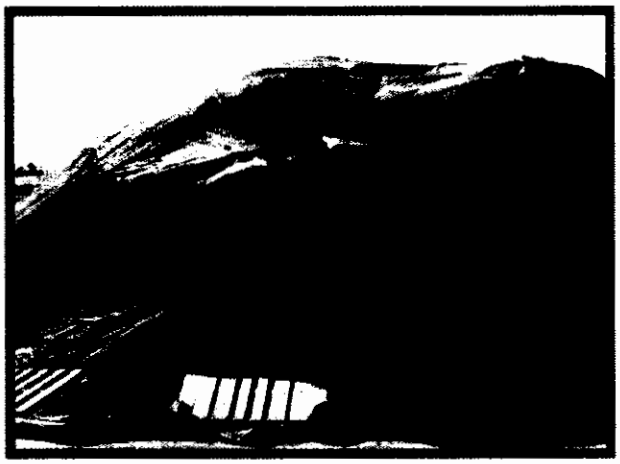



- **A** Composting Area
- **B** Fertilizer Storage
- **C** Restroom and Trash Facilities
- **D** Maintenance Areas
- **E** Non-Production Landscape Areas
- **F** Parking Lots & Loading Docks
- **G** Pesticide Storage
- **H** Potting Area
- **I** Production Areas
- **J** Roads
- **K** Soil Storage & Mixing Areas
- **L** Water Collection & Storage
- **M** Water Treatment

# A Composting Area

*Potential Pollutants:* •Nutrients •Pathogens •Pesticides •Sediment •Trash

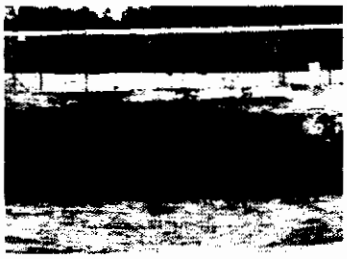
- Isolate composting area from water conveyance systems, lakes, and overland storm flow.
- Provide adequate buffering around composting piles utilizing vegetation, berms, or wattles.
- Properly secure a tarp over compost piles to protect soil and debris from mobilization during storm events.



Example of a compost pile covered with tarps to protect from storm events.

Example of a straw wattle placed around the perimeter of a compost pile to minimize movement of sediment based and pollutants during storm events.

*Don't:*



Compost pile is located near perimeter of nursery and lacks any form of protection from storm events.

EDISON

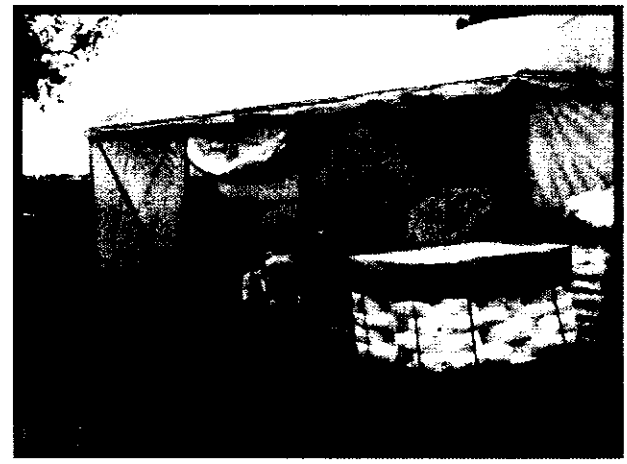
Composting on SCE land is not allowed. Dispose of used soil and decaying plant material in appropriate trash containers.

# Fertilizer Storage

**B**

*Potential Pollutants:* •Nutrients •Trash

- Store bags or non-waterproof containers on pallet(s) covered with plastic tarps or inside a storage area to protect from rain.
- Fertilizer tanks should have a secondary containment system made with an impermeable concrete, metal or synthetic material.
- Place empty containers or bags in a trash can with a lid.
- Open bags should be sealed and stored in a location to prevent accidental spillage.
- Mix and load fertilizers on an impermeable surface, such as concrete or tarp, to permit complete and easy clean up of spills.
- Clean up any spillage immediately as well as repair any torn bags.



Example of a proper covered fertilizer storage area.

Example of secondary containment around fertilizer tanks.

***Don't:***

Example of improperly stored fertilizer bags - unsealed and not placed in a covered storage area or up on a pallet and covered.

EDISON

Fertilizer storage tanks are not allowed on SCE property.

# C Restroom and Trash Facilities

*Potential Pollutants:* •Nutrients •Pathogens •Trash

- Portable restrooms should be maintained on a regular schedule to avoid leaks or spills from contaminating surrounding areas.

- Trash should be placed in containers at all times. Utilize lids at all times to prevent trash from being carried into storm drains by wind and storm events.

Example of a well-maintained portable restroom located in the container growing area.

Example of a trash container placed in the container growing area, properly secured, and covered with a lid.

*Don't:*

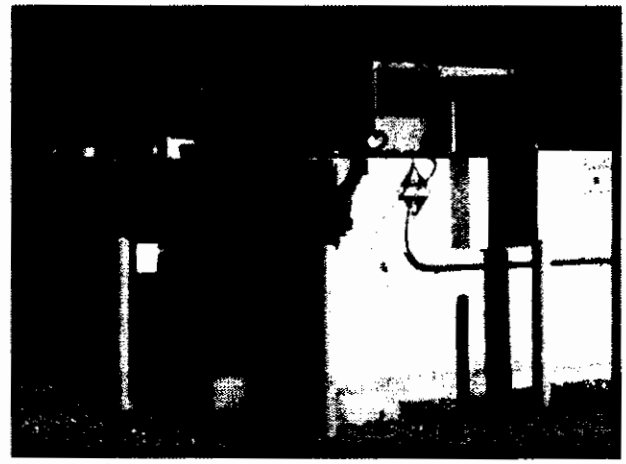
Garbage containers left uncovered are potential sources of pollutants that can be carried into storm drains by wind and storm events.

# Maintenance Areas

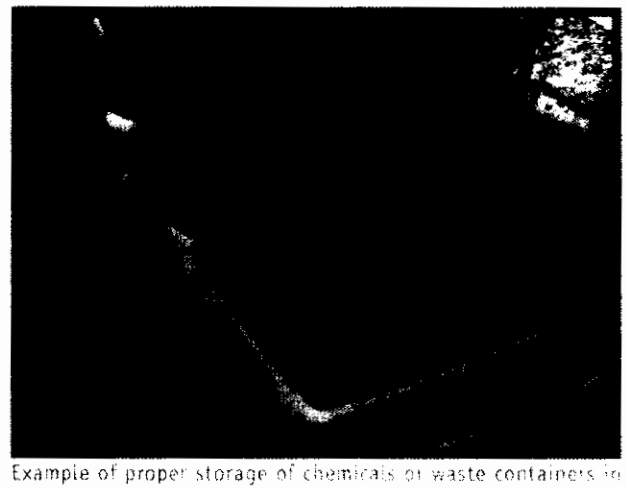
**D**

*Potential Pollutants:* •Automobile/Equipment Fluids •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Provide secondary containment for fuel areas.
- Place fueling area on a relatively flat impervious surface (2-4%).
- Use a berm around fueling area to prevent run-on, especially from storms.
- Store and dispose of all hazardous waste and oil as required by law.
- Surround larger maintenance area with landscape, vegetative buffers, or gravel.
- Equipment and equipment parts should be stored under a tarp or a covered storage area to keep stormwater from washing chemicals, such as oil, off-site into nearby storm drains.



Example of a secondary containment area for containing fuel spills.



Example of proper storage of chemicals or waste containers in secondary containment areas.

EDISON

Flammable and hazardous materials, such as fuel, may not be stored on SCE property.

*Don't:*

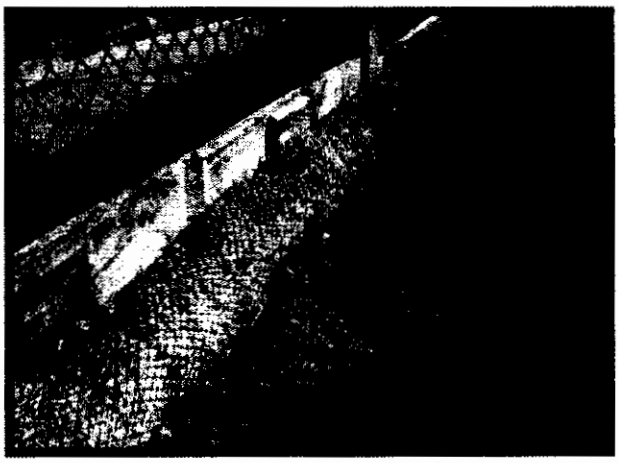
Example of improper storage of unused equipment and parts.

# E Non-Production Landscape Areas

*Potential Pollutants:* •Automobile/Equipment Fluids •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Utilize these landscape areas as buffers throughout the nursery to collect stormwater or irrigation water.
- Minimize the use of pesticides and nutrients in these areas except when necessary to maintain plant health.
- Protect hillsides from erosion using plastic, wattles, or vegetation for stabilization.
- Reduce off-site sediment movement utilizing sandbags, straw, or coir fiber rolls around perimeter fences & near entrances.

Example of non-production area planted with vegetation to stabilize hillside.



Protect the perimeter of nursery from erosion using wattles.

*Don't:*

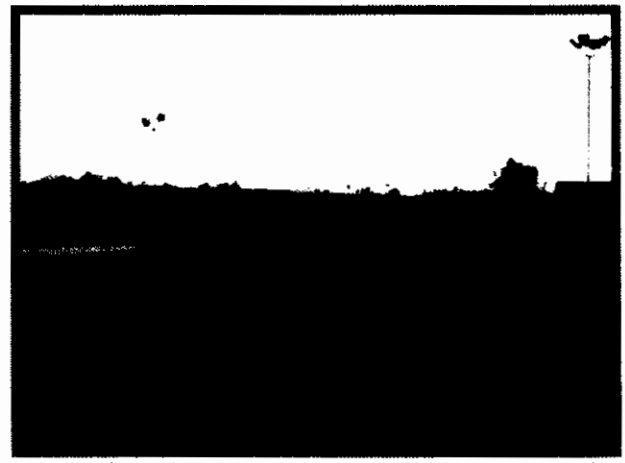
Non-production areas where vegetation, fabrics, or gravel have not been utilized, resulting in signifcant erosion.

# Parking Lots & Loading Docks

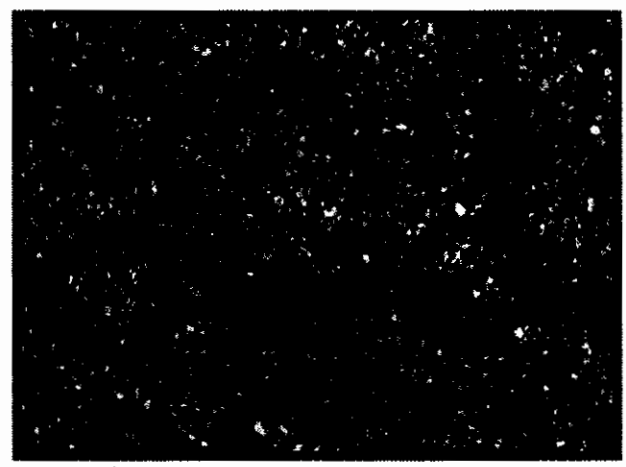
F

*Potential Pollutants:* •Automobile/Equipment Fluids •Sediment •Trash

- Cover parking lot with a layer of gravel to allow infiltration.
- Utilize decomposed granite with a binder or gravel to provide a stable parking surface while still allowing infiltration.
- If impervious surfaces are used such as concrete or asphalt, utilize vegetative filters, gravel sumps or wattles around perimeter to filter pollutants.
- Use plastic grids or approved substitute to stabilize gravel in critical areas such as driveway entrances.
- Utilize shaker or corrugated steel plate in driveway entrances to keep gravel and soil from tracking on to streets.

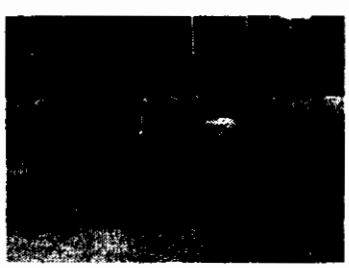


Example of a loading dock protected with a thick layer of 3/4" or larger gravel.



Example of plastic grids used to hold gravel applied to driveway entrance.

*Don't:*

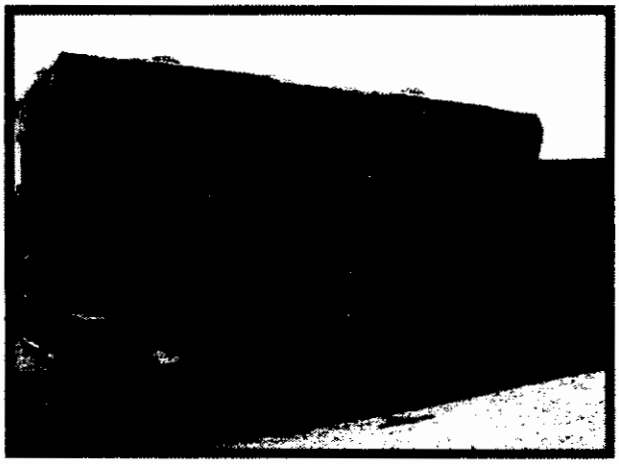


Driveway entrance slopes to street and lacks adequate erosion stabilization such as additional gravel, a corrugated steel plate, or plastic grids.

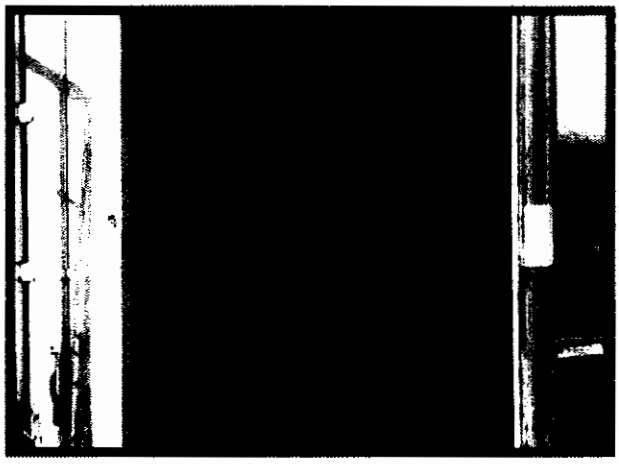
# G Pesticide Storage

*Potential Pollutants:* •Pesticides •Trash

- Follow all state laws regarding storage of pesticides.
- Store empty pesticide containers in trash can with a lid until transported to an approved disposal site. (Contact local Agriculture Commissioner's Office for a list of sites.)
- Storage, handling and disposal of pesticides (including mixing, loading, and cleaning practices) should not occur in the vicinity of a well, waterbody or storm drain.
- Install a secondary system to contain any spills or leaks.
- Clean up any spills immediately using proper spill kit and dispose of material as required by law.
- Store pesticide application equipment in enclosed or covered location.



Example of a properly designed and maintained pesticide storage area.



Example of a container used to store pesticide application equipment reducing the chance of pesticide residues from being washed off during storm events.

*Don't:*

Example of improper storage and disposal of empty pesticide containers.

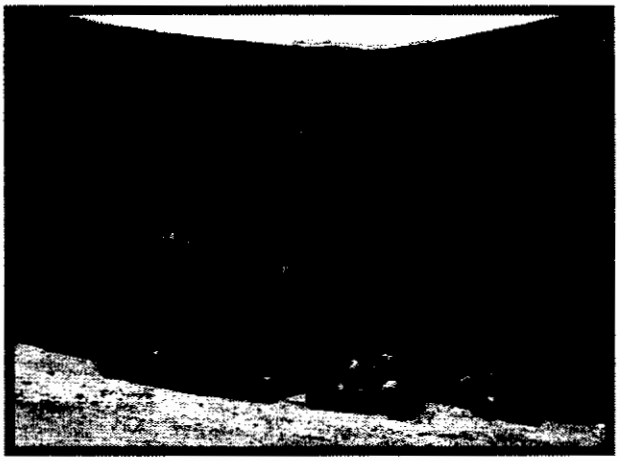
# Potting Area

H

*Potential Pollutants:* •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Potting areas should be covered to minimize movement of loose soil from canning equipment.
- Spilled potting soil should be cleaned up regularly to prevent its movement in rain and irrigation water, especially if fertilizers and pesticides are incorporated.
- Utilize a graveled area for watering new transplants where runoff can be contained and allowed to infiltrate.

Example of a permanent structure covering a potting area reducing the exposure of loose soil from storm events.



Example of a temporary structure erected over a potting area.

*Don't:*

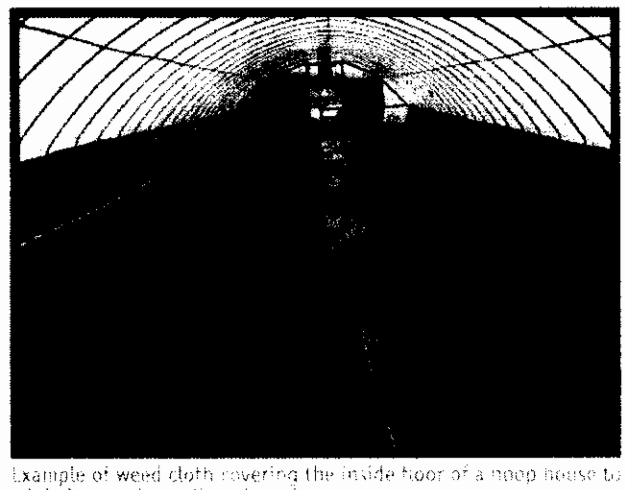
Example of a potting area lacking any type of soil stabilization resulting in significant erosion during storm events.

# I Production Areas

*Potential Pollutants:* •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Perform regular tests of distribution uniformity on irrigation delivery systems and make corrections if necessary.
- Minimize or eliminate the use of fertilizer injection if overhead sprinklers are utilized to irrigate. Shift to using controlled-release and slow-release fertilizers.
- Place plants on gravel, geotextile, or weed cloth to allow infiltration and minimize erosion even inside greenhouse structures.
- If recycling water, minimize contact of runoff with bare surfaces utilizing concrete to line runoff trenches.
- Slope production areas 2-4% to prevent ponding and to allow runoff to flow into vegetative buffers or gravel sumps for filtering.

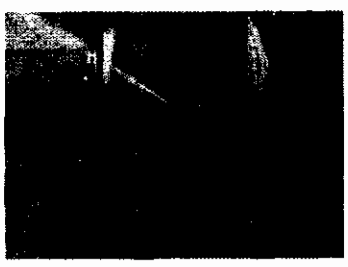
Example of drip irrigation in a 5-gallon container.



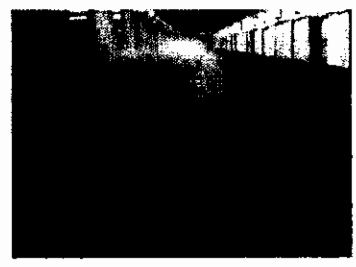
Example of weed cloth covering the inside floor of a hoop house to minimize weed growth and erosion.

EDISON SCE does not allow grade changes.

*Don't:*



Examples of poor irrigation practices leading to excessive runoff carrying pesticides, nutrients, and sediment.



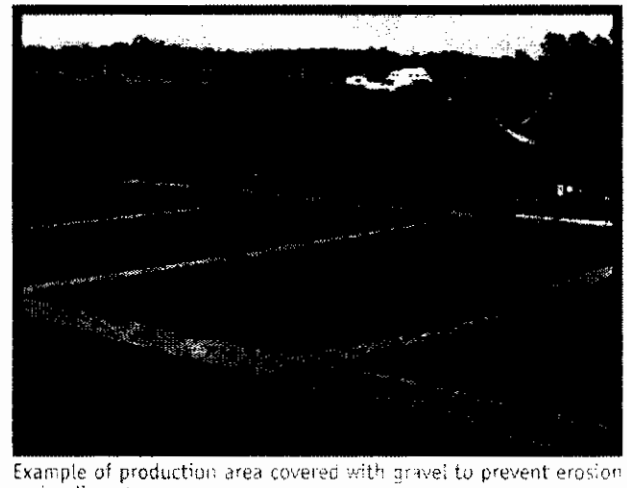
# Production Areas (cont'd)

I

*Potential Pollutants:* •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Implement an integrated pest management (IPM) program which includes monitoring for pests, establishing tolerance thresholds, and developing treatment protocols utilizing least toxic strategies first.
- Apply pesticides directly to the target minimizing drift and overspray, especially in areas irrigated with overhead sprinklers.
- Clean up spills of soil, especially those containing incorporated pesticides.
- Apply the minimal amount of irrigation to maintain optimum plant growth and health.
- Consolidate containers and turn off irrigation in areas not in production (requires individual on/off valves at each sprinkler head).

Example of irrigation utilizing drip tape.



Example of production area covered with gravel to prevent erosion and sediment movement.

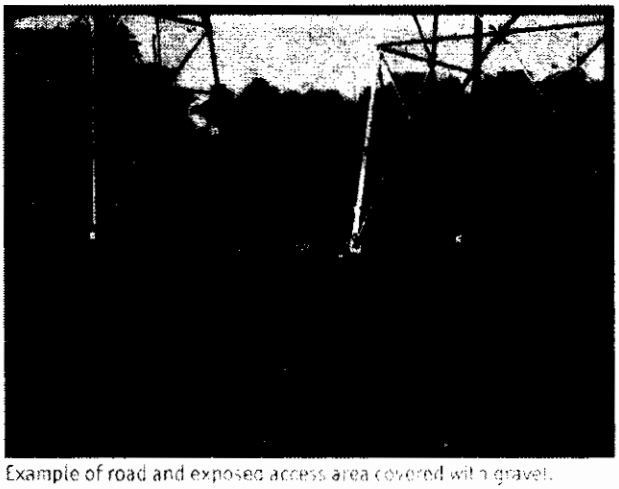
*Don't:*

Irrigation and storm events mobilize soil and associated chemicals spilled in production areas.

# J Roads

*Potential Pollutants:* •Automobile/Equipment Fluids •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Maintain a layer of gravel on roads near critical locations such as next to drainage areas, creeks, paved roads, and parking lots.
- Apply polyacrylamides (PAM) prior to storm events to reduce erosion and sediment movement.
- Utilize decomposed granite with a binder to stabilize roads in critical locations.
- Minimize or eliminate irrigation runoff from roads, especially if gravel is not used.
- When decomposed granite or gravel is not utilized, direct runoff into vegetated areas to catch sediment.
- If erosion is significant, install trap in road to collect sediment.



Example of road and exposed access area covered with gravel.

Example of sediment trap installed in road to trap sediment.

*Don't:*

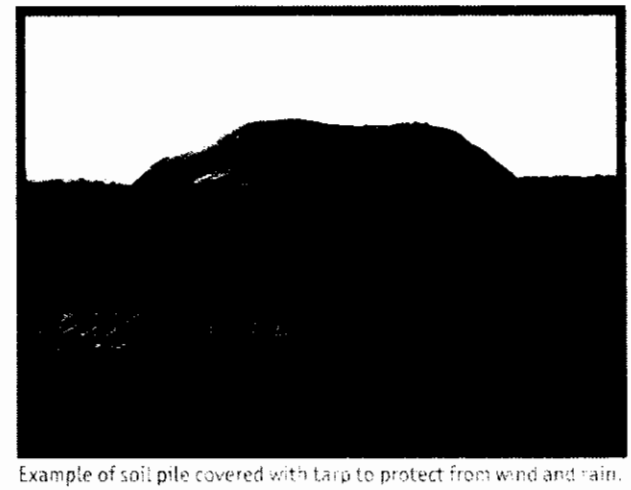
Example of unprotected road surfaces.

# Soil Storage & Mixing Areas

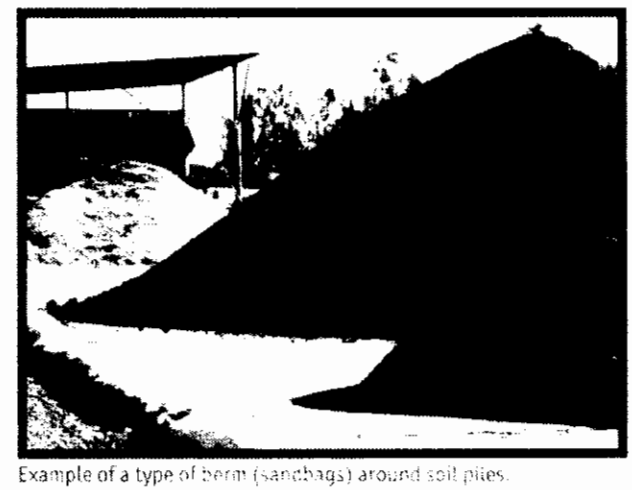
K

*Potential Pollutants:* •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Locate soil storage and mixing as far away from water conveyance systems as possible.
- Protect soil from rain and wind by storing under covered structures or securely fastened tarps prior to inclement weather.
- Utilize soil incorporated with fertilizers and pesticides immediately; do not store for extended periods.
- Surround soil storage areas with straw/rice/coir wattles or some type of berm.



Example of soil pile covered with tarp to protect from wind and rain.



Example of a type of berm (sandbags) around soil piles.

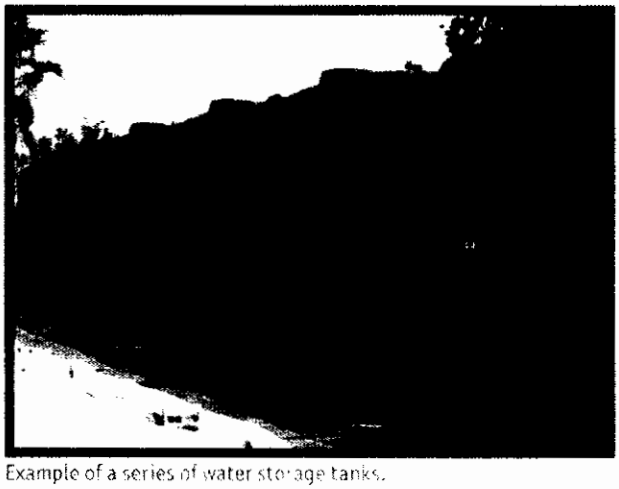
*Don't:*

Soil piles lacking any protection from storm events.

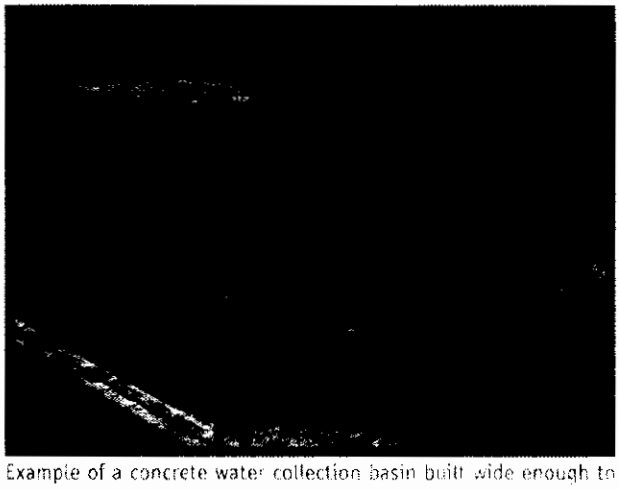
# L Water Collection & Storage

*Potential Pollutants:* •Nutrients •Pathogens •Pesticides •Sediment •Trash

- Reduce sediment build-up in storage tanks or reservoirs by minimizing runoff over exposed surfaces.
- Minimize wear and tear on pumping equipment by controlling sediment movement at its source.
- Utilize recycled water for irrigating non-production landscaped areas.
- Fertilizer rates should be altered taking into account the nutrient content of the collected water.
- Line reservoirs with an impervious material, such as a professional pond liner.
- Maintain reservoirs properly to prevent algae buildup and eliminate mosquito populations. Seek professional assistance prior to installation.
- Fence in reservoirs and provide safety equipment to prevent accidental drownings.



Example of a series of water storage tanks.



Example of a concrete water collection basin built wide enough to accommodate equipment to remove sediment.

*Don't:*

EDISON

Water collection and storage are not allowed on SCE property due to structural engineering requirments.

# Water Treatment

M

*Potential Pollutants:* •Nutrients •Pathogens •Pesticides •Sediment •Trash

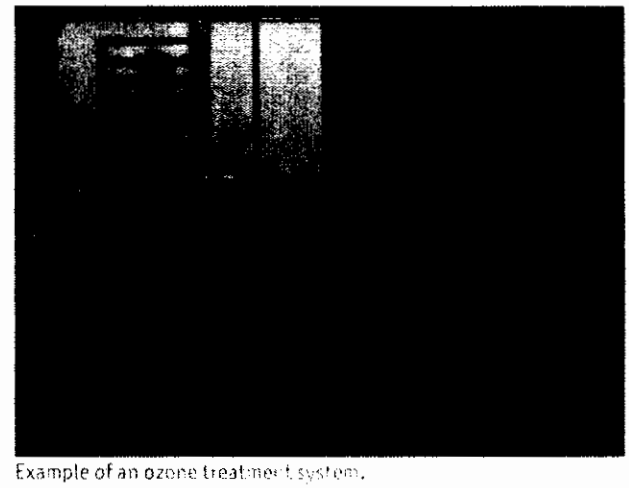
- Obtain professional assistance when designing, installing, or maintaining a water treatment system.

  Types of treatment systems include:

  - heat
  - microfiltration
  - ultraviolet
  - ozone
  - chlorination

- Thoroughly understand the advantages and disadvantages of each type of treatment prior to selecting a system.

Example of an ultraviolet (UV) treatment system.



Example of an ozone treatment system.

*Don't:*

EDISON

Water treatment is not allowed on SCE property due to structural engineering requirements.

# Water Quality Related References

## *Water Quality Related Web Sites*

### *Best Management Practices*

California Stormwater Quality Association Handbooks
http://www.cabmphandbooks.com/

UCCE San Diego Agricultural Water Quality Program Grower Resources
http://cesandiego.ucdavis.edu/Clean%5FWater/Grower_Resources.htm

UC Cooperative Extension -The Farm Water Quality Plan: Farm Water Planning Series
(Pub. # 9002) http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=9002

California Department of Transportation Stormwater Manuals and Handbooks
http://www.dot.ca.gov/hq/construc/stormwater/manuals.htm

County of Orange – OC Watersheds Documents
http://www.ocwatersheds.com/StormWater/documents_bmp_intro.asp

University of California, Riverside – PesticideWise
http://www.pw.ucr.edu

### *Laws, Regulations, and Ordinances*

County of San Diego – Project Clean Water
http://www.projectcleanwater.org/html/programs.html

County of San Diego – Land Use and Environment Group/Agriculture/Weights and Measures
http://www.sdcounty.ca.gov/awm/ag_water.html

County of Orange – OC Watersheds
http://www.ocwatersheds.com/StormWater/swp_documents_intro.asp

County of Riverside – Flood Control and Water Conservation District – Storm Water Program
http://www.floodcontrol.co.riverside.ca.us/stormwater/

County of Los Angeles – Department of Public Works
http://ladpw.org/WMD/npdes/

County of Ventura – Stormwater Quality Management Program
http://www.vcstormwater.org/regulations.html

## *Regulations*

### Federal

Clean Water Act (National Pollutant Discharge Elimination System, Total Maximum Daily Load)
Coastal Zone Act Reauthorization Amendments of 1990

### State

Porter-Cologne Water Quality Act
Nonpoint Source Program Plan – required under Clean Water Act

### Regional

Agricultural Waivers
Basin Plan, WDRs
Total Maximum Daily Loads – required under Clean Water Act for polluted waters listed on California's 303(d) list.

## *Agencies Involved in Water Quality Issues*

### Federal

US Environmental Protection Agency (USEPA)
U.S. Fish and Wildlife Service (USFW)
Army Corps of Engineers (ACOE)
National Oceanic and Atmospheric Administration (NOAA)

### State

State Water Resources Control Board (SWRCB)
California Department of Fish and Game (CDFG)
California Department of Pesticide Regulation (CDPR)
California Coastal Commission (CCC)

### Regional

Regional Water Quality Control Board (RWQCB - 9 regions in state)

### Local

County (various departments including stormwater and planning)
City (various departments including stormwater and planning)

* *Construction of structural BMPs to alter flow into or in natural waterways requires permitting from one or more agencies listed above.*

# Glossary

### Berm

A curb, ledge, wall or mound used to prevent the spread of contaminants.

### Best Management Practice (BMP) or Management Practice (MP)

A practice or combination of practices that are the most effective and practicable (including technological, economical, and institutional considerations) means of controlling point or nonpoint source pollutants at levels compatible with environmental quality goals.

### Binder

A binder is a material used to bind together two or more other materials in mixtures.

### Geotextile

A woven fabric capable of passing water but able to hold back soil.

### Integrated Pest Management (IPM)

The use of different techniques in combination to control pests, with an emphasis on methods that are least injurious to the environment and most specific to the particular pest.

### Municipal Storm Water Permitting Program

NPDES program to regulate discharges from municipal separate storm sewer systems (MS4s).

### Nutrients

Chemicals that are needed by plants and animals for growth (eg, nitrogen, phosphorus). In water resources, if other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation, and subsequent decay of plants, especially algae. Some nutrients can be toxic to animals at high concentrations.

### Pathogens

A pathogen is a bacterium, virus or parasite that causes or is capable of causing disease. Pathogens may contaminate water and cause waterborne disease.

### Pervious

Pervious materials permit water to enter the ground by virtue of their porous nature or by large spaces in the material.

### Pesticides

Chemical substances used to control pests. Pesticides often have unintended toxic effects on living organisms in soil and water.

### Polyacrylamides (PAM)

Chemical soil stabilizer that when applied according to recommendations reduces the quantity of suspended sediments in surface water runoff by flocculation (gathering together small particles to form larger particles).

### Sediments

Soil, sand, and minerals washed from land into water, usually after rain. They pile up in reservoirs, rivers and harbors, destroying fish and wildlife habitat, and clouding the water so that sunlight cannot reach aquatic plants.

### Total Maximum Daily Load (TMDL)

A Total Maximum Daily Load describes the amount of a pollutant that a waterway can receive without violating water quality standards. 2) The TMDL process provides a flexible assessment and planning framework for identifying load reductions or other actions needed to attain water quality standards (ie, water quality goals to protect aquatic life, drinking water, and other water uses).

## *Acronyms*

**BMP** - Best Management Practices

**CWA** - Clean Water Act

**MS4** - Municipal Separate Storm Sewer System

**NPDES** - National Pollutant Discharge Elimination System

**PCPA** - Pesticide Contamination Prevention Act

**QAPP** - Quality Assurance Project Plan

**RWQCB** - Regional Water Quality Control Boards

**SWRCB** - State Water Resources Control Board

**TMDL** - Total Maximum Daily Load

**USEPA** - United States Environmental Protection Agency

**WDR** - Waste Discharge Requirement

*For a listing of agency acronyms see page 25*

# BMP Recordkeeping

**A** Composting Area

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**B** Fertilizer Storage

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**C** Restroom & Trash Facilities

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**D** Maintenance Areas

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**E** Non-Production Areas

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**F** Parking Lots & Loading Docks

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## G Pesticide Storage

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## H Potting Area

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## I Production Areas

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## J Roads

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## K Soil Storage & Mixing Area

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## L Water Collection & Storage

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## M Water Treatment

| BMP Name | Installation Date | Maintenance Frequency |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

# SCE BMP Approval Guidelines

SOUTHERN CALIFORNIA
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The following criteria are provided to aid in the submission of a BMP list for SCE consideration and approval prior to implementation by the licensee. Submission of a BMP list for approval should be done well in advance of the next wet weather season (October - March).

- ☐ Select BMPs from handbook (excluding any BMPs not allowed on SCE property).
- ☐ Submit 5 copies of existing SCE approved plot plan with proposed location(s) and dimensions of each BMP.
- ☐ Verify any clearance requirements from SCE facilities for proposed BMPs. Location of BMPs should not impede access to SCE towers, poles, or conductors.
- ☐ A template submission letter (opposite page) is provided for your convenience and should accompany your plot plan.
- ☐ Send complete package to your appropriate Southern California Edison Right of Way Agent.

Date

Southern California Edison
Corporate Real Estate
14799 Chestnut St.
Westminster, Ca 92683

Subject: Request for Approval to Construct BMPs

Account No._____

Property No._____

Site Location:_____

Attached for Southern California Edison's review and approval is a plot plan depicting the location of proposed BMPs that are being considered for the area which we currently license from Southern California Edison.

Please provide your written approval if you concur with these proposed improvements. We understand that we will not move forward without prior written approval from Southern California Edison. We can be reached at (___) ___-____.

Sincerely,

Nursery Licensee

_____

*The Best Management Practices - A Water Quality Field Guide for Nurseries aids nursery growers in identifying potential pollutants and selecting practices to reduce or eliminate their impact on water quality. The design of the field guide allows the grower to document the date a practice is initiated, its maintenance requirements, and if the practice is successful.*


***The following individuals provided assistance with design, layout, and content of the handbook.***

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*Watershed Management Advisor*
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*University of California Cooperative Extension*

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An EDISON INTERNATIONAL Company

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*Manager Corporate Environmental Policy*
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ORANGE COUNTY COASTKEEPER

Ray Heimstra
*Associate Director - Projects*
*Orange County Coastkeeper*

ORANGE COUNTY FARM BUREAU

Kathy Nakase
*Executive Director*
*Orange County Farm Bureau*

# APPENDIX I:

# EQUESTRIAN-RELATED WATER QUALITY BEST MANAGEMENT PRACTICES

# Equestrian-Related
# Water Quality Best Management Practices

**A Cooperative Effort among Private and Public Entities**
**in**
**Orange and San Diego Counties, California**
**in response to NPDES permits issued by the**
**Santa Ana and San Diego**
**Regional Water Quality Control Boards**

It is the hope of the Task Force that the equestrian community will embrace and implement the BMPs contained within this document as reasonable requests to help curtail pollution into local water bodies including San Diego and Orange County creeks, bays, and the Pacific Ocean.

**June 2004**

**Acknowledgments**

The following persons and organizations participated in the development of this document and their time and effort is greatly appreciated.

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Task Force Attendees & Contributors:
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John Carroll, Rancho Sierra Vista Equestrian Center
Dean Daggett, Camp Cookie
Vincent Fortuna, Leisure World Stables, Laguna Woods
John Frank, Camp Cookie
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Kim Gould, Las Vaqueras
Patty Harris, Rancho Sierra Vista Equestrian Center
Karen Hauptly, County of Orange
Leigh Ann Howard, San Luis Rey Downs Thoroughbred Training Center
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Jason Jackson, USDA Natural Resource Conservation Service
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Steve Mayville, Santa Ana Regional Water Quality Control Board
Andrea Richard, County of Orange
Erica Ryan, City of Rancho Santa Margarita / City of Los Alamitos
Dr. Julie Ryan-Johnson, President of the San Juan Capistrano Equestrian Coalition
Mike Settipane, Leisure World Stables, Laguna Woods
Sandra Verrall, City of Laguna Woods
Kathy Weldon, City of Encinitas

Questions regarding this document should be directed to Mr. Ziad Mazboudi at the City of San Juan Capistrano, California. See the “Information Contacts” section on page 15.

Portions of the glossary located at the back of this document were reprinted from *Horse Keeping: A Guide to Land Management for Clean Water* with permission from the Council of Bay Area Resource Conservation Districts.

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## Regulatory Background

The 1972 Federal Water Pollution Control Act, subsequently known as the Clean Water Act (CWA), established the National Pollutant Discharge Elimination System (NPDES) Program. Throughout the State of California, the State Water Resources Control Board (SWRCB) is the designated agency responsible for the implementation of the Federal Clean Water Act requirements. Implementation is done locally, through permits issued to California counties by the nine (9) Regional Water Quality Control Boards working for the SWRCB. In certain circumstances, the Regional Boards issue special permits to individual facilities. Orange and San Diego Counties are governed by the Santa Ana and San Diego Regional Boards, which have issued NPDES Permits to the County of Orange and the County of San Diego as the "Principle Permittees" in charge of implementing the provisions of the Clean Water Act and the NPDES Permits ("Permits"). The Permits are reviewed annually and updated every five years. For Orange County, the Permits were extensively revised in early 2002, directing the County of Orange, the incorporated cities, and the Orange County Flood Control District (collectively known as the "Permittees") to examine how pollution from runoff is handled, mitigate the sources of pollution and require substantial fines and legal action for non-compliance.

The Permittees, in their commitment to maintain a clean environment, developed Storm Water Local Implementation Plans (LIPs) (also known as Jurisdictional Urban Runoff Management Plans (JURMPs) in the San Diego Region), which were then submitted to the Regional Boards in 2003. The Local Implementation Plans regulate runoff from all properties in the Permittees respective jurisdictions. The LIPs also contain a list of actions that may be implemented to help reduce or eliminate pollution from specific activities. These activities are referred to as Best Management Practices or BMPs.

The Regional Boards, as part of their duties under the Federal Clean Water Act, are also responsible for identifying "pollutants of concern," which are those pollutants that cause water bodies to be impaired for identified beneficial uses ("impaired water bodies"). For example, the Santa Ana Regional Board has determined the pollutants of concern for the Newport Bay Watershed in Orange County, California, are fecal coliform (a type of bacteria), sediment, toxics, and nutrients because these pollutants have impaired the use of Newport Bay for identified beneficial uses such as water contact recreation (REC-1), shellfish harvesting (SHELL), and others. For San Diego and Orange Counties, many beaches and lower reaches of creeks have been identified as impaired water bodies with fecal coliform and sediment most commonly listed as the pollutants of concern. The Regional Boards have listed fecal coliform as a pollutant of concern because it is an indicator of potential viruses and pathogens that cause swimmer-associated sickness in water bodies. Therefore, the Permittees have been charged with finding and reducing the amount of fecal coliform and sediment coming from land uses within their jurisdictions in an effort to curtail the impact of human activities on beaches, creeks, and the Pacific Ocean. (For more information on equestrian-related pollutants, please see the next section, "How Can Horse Waste and Equestrian Activities Impair Water Quality?")

During the process of writing the LIPs, the Permittees worked together to identify water quality related BMPs for activities that might take place within each Permittee's jurisdiction. Among the pollutants of concern the Permittees worked to address were bacteria and sediments as well as other pollutants such as petroleum hydrocarbons, chemicals, nutrients, and other materials that might affect the quality of water bodies. As a result, the Permittees came up with categories of activities and identified the specific BMPs that could be used within each of those categories to curtail the quantity of the pollutants in the impaired water bodies. During the process, the Permittees identified a lack of applicable BMPs that could apply to the equestrian community. Unfortunately, Orange County does not have its own Resource Conservation District, so in an effort to identify appropriate equestrian BMPs for Orange County, some South Orange County cities decided to start the process of researching BMPs by referencing already available documents from other Resource Conservation Districts such as *Stable and Horse Management in the Santa Monica Mountains*, prepared by the Resource Conservation District of the Santa Monica Mountains, *Backyard Ranches: A Horse Management Program for San Diego County*, prepared by the San Diego County Association of Resource Conservation Districts, and *Horse Keeping: A Guide to Land Management for Clean Water*, prepared by the Council of Bay Area Resource Conservation Districts.

In July 2003, the San Diego Regional Water Quality Control Board required the South Orange County Permittees to identify minimum required BMPs when they issued a directive to: "clearly identify which Best Management Practices (BMPs) are the minimum that will be required and how the City will require the specific BMPs for...existing development in accordance with Permit Sections F.2 and F.3." In response to this directive, the same South Orange County cities who had been researching appropriate BMPs for the equestrian community decided to form a Horses and Water Quality Task Force to gain input from the public and formulate a series of minimum BMPs that were agreeable to all parties involved. It was decided early on to recruit members from neighboring counties including San Diego County cities and agencies in the hope of expanding the base of knowledge of the Task Force and to share in the fruits of the labors of the Task Force. The first meeting of the Task Force was held in August 2003 at the San Juan Capistrano Community Center with Ziad Mazboudi from the City of San Juan Capistrano serving as the Chair of the Task Force. The Task Force finished their work in April 2004, and this document is the fruition of the efforts of those people listed in the Acknowledgments section of this document.

It is the hope of the Task Force that the equestrian community will embrace and implement the BMPs contained within this document as reasonable requests to help curtail pollution into local water bodies including San Diego and Orange County creeks, bays, and the Pacific Ocean.

## How Do Horse Waste and Equestrian Activities Impair Water Quality?

Although horse wastes (manure, urine and soiled bedding) are organic, biodegradable materials, many of their physical, biological and chemical properties (such as sediment, phosphorous, nutrients, and bacteria) can be detrimental to water quality and can adversely affect human health and aquatic life in water bodies. Many of the nutrients ingested by horses return to the environment in feces and urine. When carried by runoff to streams and lakes, excessive amounts of these same nutrients can stimulate unwanted algae blooms in creeks and streams, causing a decrease in dissolved oxygen in water, which stifles aquatic life.[1]

Some activities, such as heavy grazing or pasture use, remove the soil's vegetative cover and can expose the soil surface. Exposed soil is easily transported by runoff to streams and creeks, and excessive sediment can fill pools, smother aquatic habitats, and cover food supplies.[1]

Bacteria, such as fecal coliform, are present in horse manure. As previously discussed, the Regional Boards have listed fecal coliform as a pollutant of concern because it is an indicator of potential viruses and pathogens that cause swimmer-associated sickness in water bodies.

Chemicals used during horse grooming and shelter/living area maintenance may cause adverse health effects to humans and are toxic to aquatic life.

[1]Paraphrased from *Horse Owners Guide to Water Quality Protection* published by the Council of Bay Area Resource Conservation Districts

## Expectations from the Equestrian Community

The Permittees have been charged with the challenging task by the Regional Boards of preventing pollutants to the maximum extent practicable from reaching local water bodies. In response to this challenge, the Permittees worked with equestrian community representatives, the environmental community and the public to develop BMPs that may be implemented while not inhibiting the public's ability to conduct business, curtail recreational use of horses or the enjoyment of land uses. Therefore, the Permittees expect that the equestrian community will implement the suggested minimum BMPs to the maximum extent practicable taking into consideration time, monetary, and other direct and indirect costs associated with improving water quality. Many of the suggested BMPs require little or no monetary expenditures, such as following the directions on horse grooming products to prevent chemicals from reaching waterways, while others will require monetary expenditures, such as drainage control improvements. The Permittees recognize that existing facilities, which have been operating for many years, will require a longer period of time to implement some of the suggested BMPs that require monetary expenditures, compared to newly proposed equestrian facilities that are expected to incorporate necessary and appropriate BMPs into the designs of their facilities.

Therefore, in recognition of the fundamental difference between existing and proposed equestrian facilities in their abilities to implement BMPs to the maximum extent practicable, the Permittees suggest two different paths for evaluating BMPs to be implemented at existing versus newly proposed facilities.

For existing facilities, such as commercial stables, residential properties with a stable, or individuals owning horses on residential properties, owners should perform the following tasks in order to analyze what BMPs should be implemented.

> *Task 1: Inventory and map your resources.* Draw a map of the site and note natural water features (including drainage flow characteristics), property improvements (e.g. corral fences, wash areas, buildings associated with care and stabling, access roads, etc.), vegetation, slopes, bare areas, and other characteristics that affect water drainage and water quality.
>
> *Task 2: Identify, assess, and prioritize potential problem areas.* Take a walk around the facility, preferably during or immediately after a heavy rainfall. Use the site map developed and take notes. For example, draw arrows on the site map to show runoff and drainage patterns. Assess situations and prioritize areas in need of attention like manure storage problems such as rain water coming into contact with stockpiled manure and washing downhill into streams or creeks. Prioritize the areas needing attention. Those areas or activities that are directly contributing to pollution must receive the highest priority. As a guidance, the BMPs within this document highlight situations of concern to the Permittees.

*Task 3: Develop solutions.* Use the BMPs within this document to address problem areas and activities.

*Task 4: Schedule and properly install BMPs.* Write down a work plan and stick to it. Document current and past practices that help to curtail pollution into creeks and streams.

*Task 5: Maintain BMPs.* A mismanaged or unmaintained BMP will not work.

Existing facility owners are encouraged to develop a Water Quality Management Plan as a mechanism by which to document to the local jurisdiction that the facility is progressing toward compliance with the applicable local NPDES Program.

For proposed facilities, owners must develop a Water Quality Management Plan (WQMP) for review and approval by the governing Permittee. A WQMP should describe commitments to installation and maintenance of site design, source control and treatment control BMPs listed below that can be readily incorporated for use on the project or other BMPs, which have been demonstrated to work equally well. The WQMP should also reflect language that the above tasks were completed and information from the tasks was taken into account in the WQMP.

For additional information or assistance, contact your City or County NPDES Coordinator.

## Runoff Best Management Practices

The goal of runoff management is to prevent the transport of pollutants into receiving waters to the maximum extent practicable by separating "clean water" from "contaminated water" and reducing erosion caused by runoff. Below is a list of examples that could be used to reach these objectives, whenever practical or feasible. Some of these BMPs are more applicable to existing facilities, while others are applicable to new facilities. If a stable operator (commercial or residential) chooses to use other techniques or methods, he/she is required to demonstrate the efficacy of the alternative technique or method to the local jurisdiction in charge of the storm water program.

A. Roof Runoff Related BMPs

Direct roof runoff away from high-use, bare, un-vegetated and manure storage areas. This could include the use of gutters and downspouts, subsurface drains to collect water and divert from buildings, or any other available technology.

B. Facility Runoff Related BMPs

Runoff from areas containing manure, bedding, or feed debris represents the most significant source of pollutants from equestrian facilities. Preventative measures could include some of the below listed examples. Generally these serve to prevent and minimize the runoff that comes into contact with manure, bedding, or feed debris being carried off the facility and into a storm drain.

1. Separate barnyards, paddocks, and manure storage areas from any waterways with buffer strips of vegetation to filter sediments and absorb nutrients in runoff.
2. Divert surface runoff around areas with pollutants by constructing berms, ditches, underground pipelines or other methods.
3. Locate NEW buildings and confinement areas away from creeks, steep slopes, and floodplains. Check with the local jurisdiction regarding zoning or flood plain issues.
4. Maintain vegetation and replant bare areas to reduce erosion.
5. Control potential runoff from water troughs with automatic waterers or other means.
6. Improve infiltration and drainage, in and around arenas, paddocks, turnouts and service roads by using base rock and sand or other appropriate measures.
7. If water basins and waste ponds are used, water should not remain for more than 72 hours because of the likelihood of attracting mosquitoes that may carry the West Nile Virus or other diseases.

The additional benefits of runoff management for water quality include a drier barnyard, a healthier horse environment, and better working conditions.

## Erosion Control-Related Best Management Practices

When considering drainage or slope stabilization BMPs, facility operator should seek professional assistance.

A. Horse-Specific Related BMPs

1. Restrict horse access and human activities at horse facilities in wetlands, creeks, creek banks, meadows, and steep hillsides.
2. Keep areas well vegetated and restore bare areas with vegetation.
3. Manage pastures to prevent heavy grazing such as rotating the use of pastures to allow grasses to regrow.
4. Maintain a strip of vegetation downslope of bare areas such as paddocks and turnouts to help trap sediment.

B. Site Drainage Related BMPs

1. Maintain culverts and ditches. Control upslope erosion sources to prevent sediment from filling culverts. Use measures such as fiber rolls to capture sediments upstream of culverts and maintain regularly. Vegetate whenever possible.
2. Keep ditches vegetated with grass to help maintain stability and capture sediments. Longitudinal slopes should not exceed 2.5%. Regularly maintain ditches by clearing sediments and debris. For chronic sediment problems, address the erosion source.
3. Keep inlets clear. Remove debris before the rainy season (October 15 to April 14 each year) and check during and after storms.
4. Properly construct and maintain roads, trails, and parking lots in accordance with local construction requirements. Maintain road and trail surfaces.
5. Regrade roads to smooth the surface and prevent rills from expanding.
6. During construction install and maintain silt fences or straw bale sediment barriers to trap sediment.

C. Slope Stabilization Related BMPs

1. Watch for accelerated erosion on steep slopes, pastures, gullies, and intensively used horse areas.
2. Stabilize slopes with vegetation or other applicable erosion control measures, such as erosion control blankets. Do not plant any invasive species. You may be able to obtain a list of invasive plant species from your local fire department, or your City or County Hazard Reduction Program coordinator.

**Bacteria / Nutrient Transportation Prevention Best Management Practices**

A. Manure Management

1. Remove manure regularly, daily is best, or keep manure under cover such that runoff does not come into contact with manure stockpiles.
    a. Stalls, corrals and wash areas should be cleaned and manure removed on a daily basis.
    b. Paddocks shall be cleaned according to the following schedules:
        i. During the summer dry season (April 15 to October 14 each year): paddocks shall be cleaned at least once every week.
        ii. During the winter rainy season (October 15 to April 14 each year): paddocks shall be cleaned at least twice every week.
2. Provide temporary storage for manure that cannot be disposed of daily – about 15 cubic feet of storage per horse per week. Manure shall not be stored for more than a week on site. See #7 below for composting information.
3. Grade the area surrounding the manure storage area to prevent surface water from reaching the storage area.
4. Store horse waste on an impervious surface (a concrete pad or plastic tarp) and under cover (a roof or tarp) during rains to prevent leaching or runoff of pollutants.
5. Locate manure storage areas away from waterways so that floods or runoff will not wash away waste.
6. Do not dump horse waste on the edge of, or directly into waterways.
7. Consider composting if conditions are suitable. Composting might require permits from various agencies, so ensure to check for local requirements. One of the best manure management practices is to compost manure, although the practice requires space, good setup and operation to have good results. For more information, visit the US Composting Council website http://compostingcouncil.org or other available resources to determine if composting is a good solution for your stable.

B. Building & Site Design

1. Site layout should ensure that structures are placed where adverse effects are minimized and the natural topography, drainage patterns and vegetation remain undisturbed.
2. If no pastures are on site, filter strips should be used to separate riding rings and manure collection from waterways.
3. Set buildings, covered areas, high-use arenas, horse wash racks, manure storage areas, roads, and trails back away from waterways.
4. It is recommended to place gravel below the sand in corrals to percolate wastes and extra water. If bedding is used in corrals, cleaning it up regularly will help prevent it from being collected in rainwater or surface runoff.
5. It is recommended that paddocks have gravel or sand bottom for percolation of water and pollutants, and not be built in areas with a greater than 10% slope.

6. Keep paddocks and corrals as dry as possible during the winter rainy season.

Prior to building and site design, contact your local agency for setback requirements from property lines and other restrictions.

C. Wash Rack Design

1. Do not allow water from horse wash areas to flow into storm drains, creeks, ponds or seasonal drainages.
2. Connect wash racks to the sanitary sewer system, if permitted and possible. Infiltration of wash rack water, if possible, is an acceptable means of disposal. Verify that soil conditions do allow percolation prior to construction.
3. Elevate the wash area from the surrounding ground.
4. Wash water should drain away from the area to a filter strip or other vegetated area. Check to make sure wash water does not cause drainage problems on neighboring properties.
5. Use a shut-off nozzle or low-flow nozzle at the end of the hose.
6. Use horse grooming and health products properly. Follow instructions and use recommended amounts, and clean up spills. Even biodegradable horse grooming and health care products can have a negative effect on water quality.
7. Use plain water to rinse horses - avoid using soap as much as possible.

## General Housekeeping Best Management Practices

A. Integrated Pest Management (IPM) BMPs for Horse Facilities and Surrounding Landscape

Integrated Pest Management is an ecologically based pest control strategy that focuses on long-term prevention and control of pests and their damage. A combination of techniques are used such as inspecting and identifying the pest, learning the pest and host life cycles and biology, removing or reducing the pest habitat when possible, using natural enemies, using resistant plant varieties, using mechanical control for weed removal, monitoring frequently, establishing a threshold for damage, choosing the control tactic and then evaluating the results. Pesticides can be used in an IPM system, but should only be used when all other factors in an IPM strategy are met. Some pesticides are designed to be toxic only to the target pest and will not harm desirable insects.

1. Stabilize bare slopes, use native vegetation whenever possible because native vegetation doesn't require fertilizer.
2. Use IPM techniques to reduce the amount of chemicals, pesticides, fertilizers and herbicides placed on landscaping that may wash away.

Additional information can be found on the University of California, Davis web site at www.ipm.ucdavis.edu

B. Trash / Debris
1. Collect and dispose of trash and debris.
2. Do not allow trash or debris to enter creeks, seasonal streams, storm drains, or ponds.

C. Chemicals
1. Follow directions for all chemical applications.
2. Dispose of unused chemicals at a household hazardous waste (HHW) facility. Call your local jurisdiction for the location of your nearest HHW facility.

## Trails and Access to Waterbodies Best Management Practices

A. Access to Waterbodies

1. Restrict horse access and human activities in wetlands, creeks, creek banks, meadows, and steep hillsides, if possible.
2. Provide bridges over waterbodies, if practical.
3. Designate access points to creeks by using a designated creek crossing point to reduce and control contaminants from entering the creek and to prevent bank erosion.
4. Select a crossing location that will least impact stream banks and riparian vegetation.

B. Trail Signage and Design

1. Use designated trails for horse riding.
2. The grade on any new trail should not exceed 10 percent and trails should be avoided at all costs on slopes steeper than 20 percent.
3. If a trail must be built on a steep slope, the trail should switch back and forth down the slope. On steep grades, there is a greater chance that erosion will occur.
4. Consider drainage patterns when building new trails. To reduce the potential erosion of the trail from rainwater and runoff, trails should be built so that water sheet flows across the trail. Trails parallel to the flow increases erosion of the trail, and the water will create deep treads in the trail that may render it unusable.
5. Berms should be constructed as appropriate to direct storm water away from the trail.
6. Whenever possible, provide a buffer area between trails and waterways.

**Other Permits Issued by the Environmental Protection Agency and State Water Resources Control Board**

In December 2002, the Environmental Protection Agency revised the Clean Water Act regulation for Concentrated Animal Feeding Operations, or CAFOs changing the thresholds at which a horse stable operation becomes a CAFO. CAFO designations are assigned ONLY by the Regional Boards and not by the Permittees. Consequently, the Regional Boards enforce CAFO regulations. The information presented herein is for information only to stable owners. The EPA updates its rules frequently; therefore, contact your Regional Board for the latest CAFO rules and for answers to any questions regarding CAFO regulations.

A horse stable operation can be classified a "Large CAFO," a "Medium CAFO," or a "Designated CAFO" if the following requirements are met:

- "Large CAFO"
  - It is an animal feeding operation; and
  - Has at least 500 horses.
- "Medium CAFO"
  - It is an animal feeding operation; and
  - Has at least 150 horses; and
  - Has a manmade ditch or pipe that carries manure or wastewater from your operation, or the horses come into contact with surface water running through the area where they're confined.

Additionally, any size operation can be a "Designated CAFO" if the Regional Board inspects the operation and determines that it's adding pollutants to surface waters.

The requirements for all horse CAFO Permits may include:

- Implementing a nutrient management plan;
- Submitting annual reports to the Regional Board;
- Keeping the permit current until the operation is closed and all manure is removed; and
- Keeping records of the nutrient management practices for at least five years.

Nutrient management plans for all horse CAFOs may include provisions for:

- Assuring adequate manure storage capacity;
- Proper handling of dead animals and chemicals;
- Diverting clean water from the production area;
- Keeping animals out of surface water;
- Using site specific conservation practices;
- Developing ways to test manure and soil;
- Assuring appropriate use of nutrients when spreading manure; and
- Keeping records of nutrient management practices.

Additional information can be found by accessing the EPA web site at **www.epa.gov/npdes/caforule** or the USDA web site at **www.usda.gov**

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## Glossary

**Best Management Practices or BMPs.** Actions that may be implemented to help reduce or eliminate pollution for specific activities such as horse grooming.

**Clean water.** Rainfall that has not come into contact with a pollutant such as horse manure, or picked up pollutants.

**Concentrated water.** Water flow that has increased in volume and velocity due to either natural drainage or human-made diversion of drainage.

**Contaminant.** The impairment of water quality by waste to a degree that creates a hazard to public health through the spread of disease.

**Corral.** A fenced area that holds one horse.

**Creek.** A watercourse smaller than a river. Used in this guide to cover all sizes and types of fresh water bodies such as rivers and streams. May or may not have a year-round surface flow.

**Erosion.** The wearing away of land surface by wind or water. Occurs naturally from weather or runoff, but can be intensified or accelerated by human activity.

**Facility.** In this document, the areas used in caring for horses (i.e. barns, paddocks, turnouts, arenas, etc.) whether for a single residential backyard horse or a larger boarding operation.

**Horse waste.** Manure, urine, bedding material, and feed debris.

**Impervious / impermeable surface.** Any surface that cannot be easily penetrated by water, such as roofs, compacted soils, and paved areas.

**Integrated Pest Management or IPM.** An ecologically based pest control strategy that focuses on long-term prevention and control of pests and their damage.

**Local Implementation Plan (LIP) or Jurisdictional Urban Runoff Management Plan (JURMP).** A document written by an individual Permittee that specifies how the Permittee will comply with Regional Board Permits for water quality.

**Manure.** In this document, manure includes both the feces and urine from horses.

**Non-point source pollution.** The diffuse discharge of pollutants that can occur over an extensive area, such as a pasture, as opposed to point source pollution that can be pinpointed to a specific location, such as an outlet at a sewage treatment plant.

**Nutrient.** The portion of any element or compound that can be readily absorbed and assimilated to nourish plants; examples include nitrogen and phosphorus. Even in small amounts, these same nutrients can have a harmful effect on water quality. Horse manure can degrade water quality because it is rich in nutrients.

**Paddock.** A fenced area that holds multiple horses. These areas are typically bare because the area is heavily used.

**Pasture.** A large fenced area that is used for grazing. Usually this area has some grass cover because the number of horses contained within the area does not cause the grass to be trampled from heavy use.

**Permittee.** The local jurisdiction or district responsible for the implementation of Regional Board Permits or Orders. In Orange and San Diego Counties, these are the County of Orange, the County of San Diego, the Cities of Orange and San Diego Counties, and the flood control districts. In addition, individual facilities could be considered Permittees, based upon meeting a prescribed animal count threshold at a facility (e.g. CAFO permit).

**Pollutant.** The presence of a substance in such quantities that when it reaches a body of water, soil, or air, it is degrading in effect that it impairs their usefulness or renders them offensive.

**Polluted water.** Water that has become adversely affected physically, chemically, or biologically by chemicals and other additives, such as manure, sediment, bedding material, and feed debris.

**Runoff.** Water from rain or other sources (for example, from a hose or horse wash rack not connected to the sewer system) that do not infiltrate into the ground but runs over land surface and into creeks or the MS4.

**Sediment.** The soil material, both mineral and organic, that is suspended, is being transported, or has been moved from its site of origin by erosion and has come to rest on the land surface or at the bottom of creeks, ditches, or other areas.

**Sanitary Sewer (or Sewer system):** Carries water from indoor drains to wastewater treatment plants, typically carries sewage.

**Storm Drain also known as Municipal Separate Storm Sewer System or MS4:** The system that contains catch basins usually located at the edge of a street, which carries and releases untreated water from rain or other runoff sources into channels, rivers and ultimately the ocean.

**Turnout.** A high-use area where horses are “turned out” for exercise after being confined in stalls. Turnouts can be exercise lots, small paddocks, pens, or corrals. These areas are typically bare and not managed as pastures.

**Water quality.** Describes the chemical, biological, and physical characteristics of water. The quality of water can limit its specific use or ability to support various beneficial uses such as water supplies for municipalities, recreation, and fish and wildlife habitat.

**Watershed.** Total land area that drains into a particular creek, river system, or bay. It includes major and minor creeks, seasonal drainages, hillsides, and floodplains. The ridges that separate drainage between watersheds define watershed boundaries.

# APPENDIX J:

# PRELIMINARY PLANNING LEVEL COST ESTIMATES FOR FECAL INDICATOR BACTERIA BMPS

## Urban Runoff Diversion and Treatment

Planning Level Costs for Dry Weather Flow Diversion to a Treatment Facility

An evaluation of dry weather diversions to the sanitary sewer systems in the County of Orange, including costs, was documented in the *Orange County Stormwater Program Dry Weather Diversion Study* (RBF 2003). The study documented management criteria, in addition to costs, that should be considered when evaluating source control options for a dry weather storm drain discharge. One of the issues discussed was the wastewater treatment plant agency's acceptance of the dry weather diversion discharged to its sanitary sewer system. Currently the Orange County Sanitation District (OCSD) accepts dry weather diversions to its treatment plant, without imposing a fee, as long as all diversions sources are under 4 million gallons per day (MDG). Once this threshold is exceeded all of the diversion sources will be charged a treatment fee. The study recommended the 4 MGD threshold not be exceeded and also stated that dry weather diversions to the sanitary sewer system should be considered a temporary, short term practice.

The study presented data on dry weather diversion projects currently implemented in the County. There were twenty-five projects for which flow in gallons per day (GPD), year built, set up costs and monthly O&M costs data were available. The costs were adjusted to current (January 2009) costs using the 20 city average Engineering Construction Cost Index (ENRCCI) index. These costs are presented in Table J.1 below. The total annual cost was calculated by adding the set-up costs annualized using a 6% interest rate over 20 years and multiplying the monthly O&M cost by 6 months.

**Table J.1** Existing Dry Weather Diversions to the Sanitary Sewer System[1]

| Location | Permittee | Year Built | Flow mgd | Set-up Cost[2] | Monthly O&M Cost[2] | Total Annual Cost[3] |
|---|---|---|---|---|---|---|
| Barranca St. @ Cliff Dr | Laguna Beach | 2001 | 0.001 | $114,562 | $706 | $13,884 |
| Fisherman's Cove | Laguna Beach | 1998 | 0.002 | $14,441 | $231 | $2,602 |
| 5th Ave @ Coast Hwy | Laguna Beach | 1999 | 0.002 | $14,110 | $341 | $3,237 |
| Dumond Dr./Victoria Beach | Laguna Beach | 1997 | 0.005 | $14,674 | $571 | $4,660 |
| 1131 Back Bay Dr (Newport Dunes) | Newport Beach | Feb-97 | 0.009 | $88,913 | $1,614 | $17,169 |
| El Paseo@Laguna Ave (Main Beach) | Laguna Beach | 1998 | 0.010 | $43,323 | $1,061 | $10,016 |
| Linda Ln @ Via Mecha | San Clemente | Aug. 2001 | 0.014 | $53,523 | $1,602 | $14,117 |
| Los Lobos (est. loc) | San Clemente | Aug. 2001 | 0.029 | $6,690 | $1,979 | $12,437 |
| Bluebird Canyon | Laguna Beach | 1997 | 0.030 | $44,022 | $2,232 | $17,098 |
| Cleo St. @ Gaviota | Laguna Beach | 2001 | 0.035 | $114,562 | $2,081 | $22,132 |
| 9731 Flounder Dr @ D02 (Flounder PS) | Huntington Beach | Feb. 2000 | 0.072 | $41,635 | $1,041 | $9,751 |
| 9211 Yorktown Ave @ D02 (Yorktown PS) | Huntington Beach | Feb. 2000 | 0.072 | $41,635 | $1,041 | $9,751 |
| 19661 Chesapeake Ln @ D02 (Adams PS) | Huntington Beach | Feb. 2000 | 0.072 | $41,635 | $1,041 | $9,751 |
| Talbert Channel (D02) | County of Orange | Apr-97 | 0.120 | $1,769,064 | $6,929 | $190,528 |
| Laguna Cyn @ Forest Ave | Laguna Beach | 1987 | 0.140 | $29,105 | $1,100 | $9,052 |
| 9221 Indianapolis Ave @ D02 (PS) | Huntington Beach | Feb. 2000 | 0.144 | $41,635 | $1,388 | $11,833 |
| 10101 Hamilton Ave @ E01 (Hamilton PS) | Huntington Beach | Feb. 2000 | 0.144 | $41,635 | $1,388 | $11,833 |
| Aliso Creek/ Sulphur Creek Confluence | Laguna Nigel | Apr-96 | 0.175 | $61,614 | $5,354 | $37,314 |
| Greenville Banning Channel | County of Orange | Apr-97 | 0.215 | $2,071,279 | $6,929 | $215,975 |
| Aliso Creek (J01), at mouth | County of Orange | Apr-97 | 0.234 | $515,977 | $5,455 | $76,173 |
| 20192 Midland Ln @ E01 (Meredith PS) | Huntington Beach | Feb. 2000 | 0.288 | $41,635 | $2,082 | $15,996 |
| 2201 Malibu Ln @ D02 (Banning PS) | Huntington Beach | Jun-95 | 0.288 | $47,215 | $2,361 | $18,140 |
| 8612 Hamilton St @ D01(Newland PS) | Huntington Beach | Jun-95 | 0.288 | $47,215 | $2,361 | $18,140 |
| Santa Ana Channel (E01) | County of Orange | Apr-97 | 0.295 | $1,474,220 | $6,929 | $165,702 |
| 8151 Atlanta Ave @ D01(Atlanta PS) | Huntington Beach | Jun-95 | 0.504 | $47,215 | $3,148 | $22,861 |

Notes:

1. Reference: *Orange County Stormwater Program Dry Weather Diversion Study* (RBF Consulting October 2003)
2. Capital and O&M costs adjusted from the year built to January 2009 dollars using the 20 city average ENRCCI.
3. Total annual cost = set-up cost annualized at 6% over 20 years + monthly O&M costs * 6 months.

EOA (2001) also contains estimates for the cost of diverting dry weather flow to the sanitary sewer system. The costs were based on discussions with OCSD staff at the time. Although there was only a nominal permit fee charged the example diversion project, the cost estimate included an allowance for typical treatment plant costs associated with treating that volume of diversion flow. Table J.2 below presents the costs identified in EOA (2001) adjusted to January 2009 dollars using a 20 city average ENRCCI.

**Table J.2.** Estimated Costs for Diverting Small Dry Weather Urban Runoff Flows[1]

| | **Example Projects** | |
|---|---|---|
| Average Flow MGD | 1.1 | 0.04 |
| Capital Cost | $452,000 | $91,000 |
| Annualized Capital Cost[2,3] | $39,000 | $8,000 |
| Operating Cost[2] | $239,000 | $9,000 |
| **Total Annual Cost ($/year)** | **$279,000** | **$17,000** |

Notes:
1. Reference: *Newport Bay in the Public Health Risk Assessment for the Newport Bay Watershed: Recreational Contact and Microbiological Risk* report (EOA September 2001).
2. Annualized capital cost based on a design life of 20 years and a return rate of 10%.
3. 2001 Report costs were adjusted to January 2009 dollars using a 20 city average ENRCCI.

Because of uncertainties in which elements were included in the “set up” costs for the projects listed in Table J.2 and because the operating costs for these projects do not reflect treatment plant costs associated with the diverted flow the costs in Tables 9.8 and 9.9 cannot be compared. Costs can also vary widely depending on site specific variables.

The actual costs (Table J.1) and estimated costs (Table J.2) were plotted in Figure J.1 to determine if scalable cost estimates could be made for pathways that local agencies may choose to divert dry weather flows to the sanitary sewer system – Arches (~0.0437 MGD), El Paseo (~0.0509 MGD) and Polaris (~0.0373 MGD) drains and the Santa Ana Delhi channel (1.3 MGD). Based on Figure J.1 the stormwater outfall dry weather diversions are estimated to annually cost between $10,000 and $20,000, whereas the Santa Ana Delhi Channel could be greater than a $250,000 total annual cost. The latter should be viewed as a very rough estimate, given that there are no actual cost data available for flows greater than 0.5 MGD. It should also be noted that such a large flow could place all dry weather diversions in jeopardy of exceeding the OCSD four MGD thresholds.

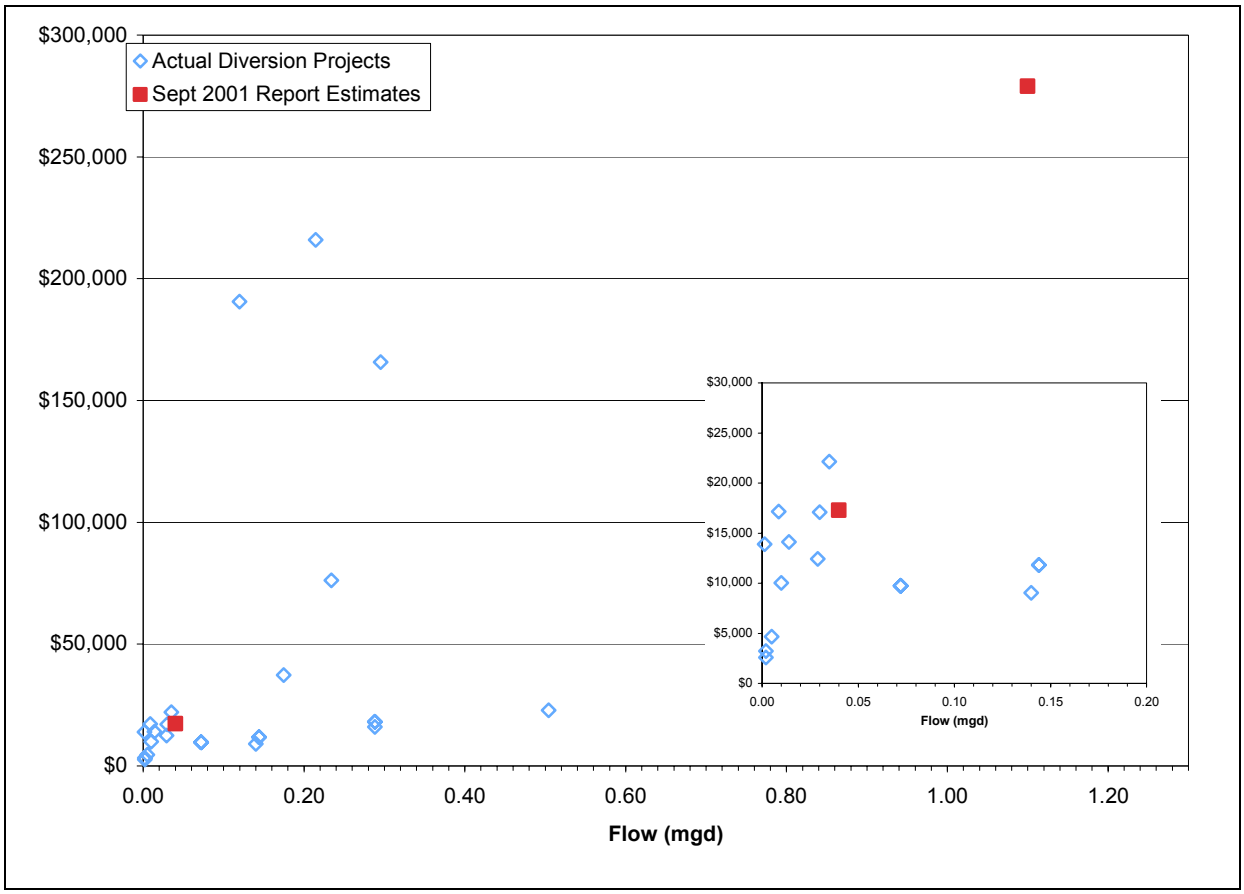


**Figure J.1**.Total Annual Costs of Dry Weather Diversions to the Sanitary Sewer System as Reported by RPF (2003) and estimated by EOA (2001).

## Planning Level Costs for Treatment of Dry Weather Urban Runoff

In addition to diversion costs, planning level cost estimates for the treatment of dry weather flows from the Santa Ana Delhi Channel and selected large stormwater outfalls were developed from two literature sources and compared to reported costs of dry weather discharge treatment facilities. The planning level costs are intended to estimate initial capital and annual operation and maintenance (O&M) costs and provide a rough estimate of the cost that may be associated with this specific option. The costs do not take into account site specific conditions that can increase costs such as property values, condition of land, ease of construction and other special conditions. In addition, general treatment options are discussed based on limited water quality and flow data. A more detailed analysis of a specific site may show different treatment processes or sizes are needed.

Planning level costs were previously developed by EOA (2001) for treating four dry weather pathways to Newport Bay. This report assumed that the level of treatment needed to reduce fecal coliform inputs to the Newport Bay would be equivalent to disinfected tertiary recycled water treatment required under California's Title 22. Because the literature costs used were based on treatment of domestic wastewater, the analysis reflected a "reduced" treatment train since not all of the unit processes typically

found in a wastewater treatment plan would be required to treat urban runoff and channel dry weather flows.

The costs were estimated for a treatment train that included facilities for diversion, pumping, coarse screening, grit removal, filtration and disinfection. Both chlorination and UV disinfection were considered in the development of cost estimates. The chlorination option for disinfection also included the cost of dechlorination which would be required if the water were discharged back to a creek or the Bay.

Treatment costs were derived primarily from *The Cost of Wastewater Reclamation in California* (Richard et. al 1992). This reference presents detailed estimates for twelve different treatment trains at three different flow rates. Several assumptions were made in the EOA (2001) to translate these wastewater reclamation costs to the treatment train proposed to treat dry weather diversions. Such adjustments were facilitated by the fact that the 1992 reference included capital costs for individual unit processes in the treatment train (e.g. headworks consisting of pumping, screening and grit removal, filtration, chlorination, etc.). Site-wide costs including site development, process-yard piping, instrumentation, electrical distribution controls, electrical services, and operations/maintenance buildings were also provided. These site-wide costs generally amounted to 50% of the total cost of the unit processes. Costs for design, administrative and legal were estimated as an additional 35% of total capital costs. A range of unit capital costs was presented for the chosen treatment components.

Annual operating and maintenance costs were also estimated from Richard et al. (1992). These costs include personnel charges, power costs, spare parts, chemicals and solids handling fees. The annual operating and maintenance costs were estimated from incremental operation and maintenance costs associated with upgrading a wastewater treatment plant with filtration because the proposed treatment train was a subset of those in the reference document. Planning level cost estimates from literature sources are presented in Table J.3.

The same methodology used by EOA (2001) to translate the above capital and O&M costs to treatment options identified for the Newport Bay watershed is also used below (Table J.4) to estimate total costs for treating dry weather flows from the Santa Ana Delhi Channel and Arches, El Paseo and Polaris stormwater outfalls (i.e., drains) . The high end of the capital and O&M cost ranges were used and adjusted from January 1990 to January 2009 dollars using the 20 city average ENRCCI. The costs were then annualized using a 6% interest rate over 20 years.

**Table J.3.** Range of Estimated Costs for a "Reduced" Reclamation Plant Treatment Train (in 1992 million dollars).[1]

| Component | 1 mgd | 5 mgd | 10 mgd |
|---|---|---|---|
| Capital Costs | | | |
| Headworks[2] | 0.620-0.650 | 1.06-1.115 | 1.640-1.730 |
| Filters[2] | 0.170-0.340 | 0.56-1.215 | 1.095-1.920 |
| Chlorination[2,4] | 0.270-0.295 | 0.60-0.585 | 0.820-1.125 |
| Dechlorination[3] | 0.135-0.148 | 0.300-0.293 | 0.410-0.563 |
| Support Buildings[2] | 0.355 | 0.510 | 0.705 |
| Site-wide Costs (50% of above) [2] | 0.775-0.894 | 1.515-1.859 | 2.335-3.022 |
| Total Construction Cost | 2.325-2.682 | 4.545-5.577 | 7.005-9.065 |
| Engineering/Administrative/ Legal (35% of construction costs) | 0.813-0.939 | 1.591-1.952 | 2.452-3.173 |
| **Total Capital Costs** | **$ 3.14-3.62** | **$ 6.14-7.53** | **$ 9.46-12.24** |
| O&M Costs | | | |
| Labor[2] | 0.011-0.017 | 0.023-0.026 | 0.035-0.042 |
| Power[2] | 0.009-0.017 | 0.012-0.017 | 0.024-0.030 |
| Maintenance[2] | 0.011 | 0.020-0.022 | 0.031-0.045 |
| Chemicals[2] | 0.024 | 0.122 | 0.244 |
| Sludge handling and disposal[2] | 0.001 | 0.003 | 0.005 |
| **Total O&M Costs** | **$ 0.06-0.07** | **$ 0.18-0.02** | **$ 0.34-0.37** |

Notes:

1. Reference: *Newport Bay in the Public Health Risk Assessment for the Newport Bay Watershed: Recreational Contact and Microbiological Risk* report (EOA September 2001).
2. Costs based on data from *The Cost of Wastewater Reclamation in California* (Richard, et. al November 1992).
3. Dechlorination costs estimated at 50% of chlorination costs.
4. Initial UV costs were estimated as twice the corresponding cost for chlorine disinfection, adding approximately 10% to the total capital cost estimates.

**Table J.4.** Estimated Total Costs for Treating Newport Bay Inflows

| Cost Category | Santa Ana Delhi Channel | El Paseo Drain | Arches Drain | Polaris Drain |
|---|---|---|---|---|
| Average Flow (MGD) | 1.3 | 0.051 | 0.044 | 0.037 |
| Design Flow for estimate (MGD) | 5 | 0.051[2] | 0.044[2] | 0.037[2] |
| Capital Cost | 13,409,000 | 802,000 | 721,000 | 645,000 |
| Annualized Capital Cost ($/yr)[1] | 1,169,000 | 70,000 | 63,000 | 56,000 |
| Operating Cost ($/yr) | 338,000 | 16,000 | 14,000 | 12,000 |
| Total Annual Cost ($/yr) | 1,507,000 | 85,000 | 77,000 | 69,000 |

Notes:

1. Annualized capital cost is based on a design life of 20 years and a return rate of 6%.
2. The average flow of this discharge stream was determined to be too low to estimate the cost based on the 1 mgd design flow costs. Therefore, costs for this discharge flow were calculated based on the costs of a 1 mgd plant and assuming a capacity factor exponent of 0.7 (because of economies of scale, the cost to size relationship is not linear).
3. Capital and O&M costs adjusted from January 1990 to January 2009 dollars using the 20 city average ENRCCI.

The *Orange County Stormwater Program Dry Weather Diversion Study* (RBF 2003) also reviewed literature sources to develop cost estimates for treating dry weather diversions at on-site facilities. The report reviewed three treatment alternatives: Clear Creek Systems, wet ponds/constructed wetlands and constructed wetland/vegetated channel. The Clear Creek Systems is a proprietary treatment unit consisting of filtration tanks and UV light treatment. The report cites installation cost for a 0.19 MGD treatment system range from $150,000 to $1,000,000, depending on the equipment housing.

Wet ponds and vegetated channels (both constructed wetlands) reduce pollutants through sedimentation and vegetation uptake. Vegetated channels also reduce pollutants through infiltration. Estimated construction costs for these treatment options include excavation, vegetation, conveyance pipes and installation of riprap, but do not include land costs. Estimated construction costs for 0.19 MGD range from $300,000 to $500,000 for wet ponds and $200,000 to $300,000 for vegetated channels. Maintenance of constructed wetlands will typically include inspection, vector control, vegetation thinning, sediment removal and regrading. Annual O&M costs for both the wet pond and vegetated channel were estimated as $17,000.

These costs were assumed to be in 2003 dollars. The table below (Table J.5) presents the estimated costs adjusted to January 2009 dollars. The costs are then annualized using a 6% interest rate over 20 years. The table also includes the estimated costs using a "reduced" reclamation plant treatment train as described in the EOA (2001) report.

**Table J.5** Estimated Costs for Treating 0.19 MGD Diverted Dry Weather Flow.

| Treatment Type | Capital Cost | O&M Annual Cost | Total Annual Cost |
|---|---|---|---|
| Clear Creek System[1] | 376,000 | 55,000 | 88,000 |
| Wet Basin[1] | 501,000 | 21,000 | 65,000 |
| Constructed Wetland Channel[1] | 376,000 | 21,000 | 54,000 |
| Reduced Reclamation Plant Treatment Train[2] | 402,000 | 8,000 | 43,000 |

Notes:
1. Reference: *Orange County Stormwater Program Dry Weather Diversion Study* (RBF Consulting October 2003)
2. Reference: *Newport Bay in the Public Health Risk Assessment for the Newport Bay Watershed: Recreational Contact and Microbiological Risk* report (EOA September 2001)

This cost comparison table above should not be reviewed as absolute costs or rankings but as order of magnitude planning level costs. There are many variables for both capital and O&M costs. Without explicitly reviewing each element that was included in the cost estimates these should not be directly compared. Because of the large extrapolation involved in estimating the reduced reclamation plant treatment train (1 MGD to 0.19 MGD) this estimate in particular should be viewed as highly uncertain. All of the cost estimates above exclude the land costs and other site specific costs.

There were two additional treatment projects in Southern California for which general capital and O&M cost information were available through personnel communication with City and County staff. The City of Encinitas diverts approximately 0.22 MGD dry weather flow to a UV treatment unit with activated carbon filtration. The construction cost was

$912,000 and annual O&M costs are $30,000. The project was completed in 2003[1]. The County of Orange installed a Clear Creek System treatment system to treat dry weather flow from storm drain (J01P28), a tributary to Aliso Creek. The system, which includes three multimedia filters, two organo-clay filters and two ultra violet light disinfection chambers, began operation July 31, 2003. The design capacity is 0.25 MGD. The system treats approximately 0.1 MGD (Anderson 2005). The total project cost was $752,000 (including design services, permitting, construction, equipment, monitoring and County staff time). Due to excessive backwash cycling the facility ceased operation in late August 2005. Construction of an internal wall and screen/weir in the dissipation basin was an additional $150,000. The projected O&M costs for the 2008-2009 operation is $90,000 (Orange County Public Works June 5, 2008). Table J.6 presents the total costs of these two projects using the same factors as before to adjust and annualize cost.

**Table J.6.** Estimated Costs for Additional Southern California Treatment Projects.

| Municipality | Flow (MGD) | Capital Cost | O&M Annual Cost | Total Annual Cost |
|---|---|---|---|---|
| City of Encinitas | 0.22 | $ 1,164,000 | $ 38,000 | $ 140,000 |
| County of Orange | 0.1 – 0.25 | $ 1,110,000 | $ 90,000 | $ 187,000 |

Notes:
1. Annualized capital cost is based on a design life of 20 years and a return rate of 6%.
2. Capital and O&M costs adjusted to January 2009 dollars using the 20 city average ENRCCI.

The total annual costs of these two projects are over 40% higher than the cost estimates presented. A direct comparison of costs cannot be reasonably made because the specific elements that were included in the provided costs are unknown. In addition, the cost estimates do not include land costs and other site specific costs.

### Vessel Waste BMP Enhancements (Including Pumpstations)

In 2003 the Santa Ana Regional Board *Pumpout Facilities Need Report* identified additional pumpout facilities and dump stations needed in Newport Bay. The report and subsequent State Board Water Quality Order (No. 2004-0017-DWQ) provided estimates for the cost of installing new pumpout facilities, updating an existing facility and installing a dump station (Table J.7). These costs were based on communication with California Department of Boats and Waterways (DBW) staff. Operation and maintenance cost ranges were not provided due to the high level of variability. The same DBW staff was contacted in January 2009 and indicated the cost ranges provide in 2003 have not changed. Costs vary greatly between marinas because of different labor costs and other factors. Costs to maintain the equipment depend on the end user and the age of the equipment, but typically range from $200 - $1,000 annually.

[1] Personal communication with Katherine Weldon, City of Encinitas, and Mike Thornton, San Elijo JPA. The capital costs are considered low for this project because site specific conditions allowed them to co-locate this treatment system at a nearby existing facility. There were many site advantages including no land acquisition, existing pumping facility, security gates, etc.

**Table J.7.** Estimated Costs of Improving Vessel Waste Management Programs.

| Vessel Waste BMP | Estimated Cost[1] |
|---|---|
| Installing new pump station | $20,000 - $40,000 |
| Replace/update existing pump station | $3,000 - $10,000 |
| Install dump station | $2,000 - $10,000 |
| Annual O&M | $200 - $1,000 |

Notes:

1. Reference: Personnel communication with Kevin Atkinson, California Department of Boats and Waterways (January 12, 2009).

The Regional Board report also identified the need for a Vessel Sewage Disposal Program. This program, defined in Regional Board Order No. R8-2005-011, would ensure proper use, operation and maintenance of the existing pumpout facilities and dump stations. The cost of this program would include public education and outreach costs, as well as agency staff time to inspect facilities for proper use and management. Public outreach and education costs are discussed at the end of Section 8.0 (Public Education and Outreach BMPs). An expensive, broad-based, multi-media program may not be necessary because there is a well defined target audience of boaters and marina staff. Public outreach messages and outlets could be crafted to fit these two audiences.

# APPENDIX K:
# EXAMPLE SANITARY SURVEY METHODS/FORMS

# GREAT LAKES BEACHES ROUTINE ON-SITE SANITARY SURVEY

| | |
|---|---|
| Name of Beach: | Date and Time of Survey: |
| Beach ID: | Surveyor Name(s): |
| Sampling Station(s)/ID: | Surveyor Affiliation: |
| STORET Organizational ID: | |

## PART I – GENERAL BEACH CONDITIONS

Air Temperature: _____ °C or °F

Wind: Speed (mph) _____
Direction (e.g., E or 90°) _____ (From which direction the wind is coming)

Rainfall: ☐ <24 hours ☐ <48 hours ☐ <72 ☐ >72 hours since last rain event and _____ inches or _____cm rainfall measured

Rain Intensity: ☐ Misting ☐ Light Rain ☐ Steady Rain ☐ Heavy Rain ☐ Other

Weather Conditions:

| Sky Condition | ☐ Sunny | ☐ Mostly Sunny | ☐ Partly Sunny | ☐ Mostly Cloudy | ☐ Cloudy |
|---|---|---|---|---|---|
| Amount of cloud coverage | No Clouds | 1/8 to 2/8 | 3/8 to 1/2 | 5/8 to 7/8 | Total Coverage |

Wave Intensity: ☐ Calm ☐ Normal ☐ Rough Wave Height: _____ft ☐ Estimated or ☐ Actual

Longshore current speed and direction (cm/sec, S or 180°):

Comments/Observations

## PART II – WATER QUALITY

Bacteria Samples Collected (list samples collected from beach water and potential pollution sources, if applicable—see Part IV)

| Sample Point | Sample # | Parameter (*E. coli*, enterococci, etc.) | Comments: |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Water Temperature: _____ °C or °F Change in Color? ☐ yes ☐ no If yes, describe _____

Odor: ☐ None ☐ Septic ☐ Algae ☐ Sulfur ☐ Other _____

Turbidity: ☐ Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque or NTU:

Comments/Observations

## PART III – BATHER LOAD

Total number of people in the water: _____ Total number of people out of the water: _____

Total number of people at the beach: _____

List of Activities Seen (optional):

| Type of Activity | | | | |
|---|---|---|---|---|
| Number of People | | | | |

Comments/Observations

## PART IV – POTENTIAL POLLUTION SOURCES

Sources of Discharge:

| Type | River(s) | Pond(s) | Wetland(s) | Outfall(s) | Other (specify): |
|---|---|---|---|---|---|
| Name(s) of Source(s) | | | | | |
| Amount (H, M, L) | | | | | |
| Flow Rate (M/sec) | | | | | |
| Volume | | | | | |
| Characteristics | | | | | |

Did you collect any bacteria samples from the sources listed in the table above? ☐ yes ☐ no

If "Yes", did you list the samples in the table in Part II, Water Quality? ☐ yes ☐ no

Floatables present: ☐ yes ☐ no Please circle the following floatables if found:

| Type | Street litter | Food-related litter | Medical items | Sewage-related | Building materials | Fishing related | Household waste | Other: |
|---|---|---|---|---|---|---|---|---|
| Example | Cigarette filters | Food packing, beverage containers | Syringes | Condoms, tampons | Pieces of wood, siding | Fishing line, nets, lures | Household trash, plastic bags | |

Amount of Beach Debris/Litter on Beach: ☐ None ☐ Low (1-20%) ☐ Moderate (21-50%) ☐ High (>50%)

Type of Debris/Litter Found (please circle)

| Type | Street litter | Food-related litter | Medical items | Sewage-related | Building materials | Fishing related | Household waste | Tar | Oil/ Grease | Other: |
|---|---|---|---|---|---|---|---|---|---|---|
| Example | Cigarette filters | Food packing, beverage containers | Syringes | Condoms, tampons | Pieces of wood, siding | Fishing line, nets, lures | Household trash, plastic bags | Tar balls | Oil slick | |

Amount of Algae in Nearshore Water: ☐ None ☐ Low (1-20%) ☐ Moderate (21-50%) ☐ High (>50%)

Amount of Algae on Beach: ☐ None ☐ Low (1-20%) ☐ Moderate (21-50%) ☐ High (>50%)

Circle the types of algae found

| Type | Periphyton | Globular | Free floating | Other |
|---|---|---|---|---|
| Description | Attached to rocks, stringy | Blobs of floating materials | No obvious mass of materials | Please describe |

Circle the color of algae found

| Light green | Bright green | Dark green | Yellow | Brown | Other |
|---|---|---|---|---|---|

Presence of Wildlife and Domestic Animals

| Type | Geese | Gulls | Dogs | Other (specify) |
|---|---|---|---|---|
| Number | | | | |

List the number of each species of bird found dead on the beach

| Type | Common loons | Herring gulls | Ring-billed gulls | Double crested cormorants | Long-tailed ducks | White-winged scoter | Horned grebes | Red-necked grebes | Other |
|---|---|---|---|---|---|---|---|---|---|
| Number found dead | | | | | | | | | |

Number of dead fish found on the beach: _____

Comments/Observations (continue on back if necessary):

# GREAT LAKES BEACHES ROUTINE ON-SITE SANITARY SURVEY METHODS

## PART I – GENERAL BEACH CONDITIONS

Air Temperature: ☐ Liquid-in-glass thermometer ☐ Electronic thermometer ☐ Weather report from local airport
☐ Weather report from local weather station ☐ Other (describe): _____

Wind Speed and Direction:
☐ Wind vane for direction ☐ Wind sock for direction and speed ☐ Anemometer for wind speed
☐ Aerovane for wind direction and speed ☐ Weather report from local airport ☐ Weather report from local weather station
☐ Other (describe): _____
☐ Distance from station: (ft / mi)

Weather Conditions: ☐ Visual observations ☐ Other (describe): _____

Rainfall: ☐ Rain gauge ☐ Weather report ☐ Other (describe): _____

☐ Distance from station or gauge: (ft / mi)

Longshore Current Speed: ☐ Stick with fishing reel with water balloon on end ☐ Ball and tether
☐ Other (describe): _____

Wave Height: ☐ Visual examination of wave height ☐ Graduated stick and ranging pole
☐ Other (describe): _____

## PART II – WATER QUALITY

Water temperature: ☐ Multiprobe ☐ Electronic meter ☐ Graduated thermometer ☐ Report from local radio station
☐ Report from NOAA weatherband radio ☐ Other (describe): _____

Turbidity: ☐ Simple visual observation ☐ Visual test kit ☐ Titrimetric test kit ☐ Nephelometer/Turbidimeter
☐ Other (describe): _____

## PART III – BATHER LOAD

Numbers of People Participating in Various Activities: ☐ Counting by surveyor ☐ Counting by lifeguards ☐ Photos
☐ Turnstyles ☐ Other (describe): _____

## PART IV – POTENTIAL POLLUTION SOURCES

Sources of Discharge:
(a) Source identification: ☐ Visual observation ☐ WWTP Notification/Report ☐ Other (describe): _____

(b) Flow/velocity or Volume measured: ☐ Mechanical flow meter ☐ Electric flow meter ☐ USGS Gauging Station ☐ WWTP Notification/Report ☐ Orange (float) and stopwatch ☐ Other (describe): _____

Floatables Present: ☐ Visual observation ☐ Cleanup event results ☐ Other (describe): _____

Amount and Type of Beach Debris/Litter on Beach: ☐ Visual observation ☐ Cleanup event results
☐ Other (describe): _____

Algae in Nearshore Water and Beach:
(a) Amount and Color: ☐ Visual observation ☐ Other (describe): _____

(b) Identification: ☐ Field guide or internet site for taxonomic identification (describe): _____
☐ Other (describe): _____

Presence of Wildlife and Domestic Animals: ☐ Counting using hand-held counter, and if necessary, binoculars
☐ Other (describe): _____

Dead birds:
(a) Amount: ☐ Visual observation ☐ Other (describe): _____

(b) Identification: ☐ Field guide or internet site for taxonomic identification (describe): _____
☐ Other (describe): _____

Dead fish:
(a) Amount: ☐ Visual observation ☐ Other (describe): _____

(b) Identification: ☐ Field guide or internet site for taxonomic identification (describe): _____
☐ Other (describe): _____