

BMP Strategic Plan

Santa Ana-Delhi and San Diego Creek Sub-
Watersheds



December 4, 2013

Prepared for the
Nitrogen and Selenium Management Program (NSMP) Working Group

by RBF Consulting



Acknowledgements

The thoughtful review and comment of Nitrogen and Selenium Management Program (NSMP) Working Group members is gratefully acknowledged.



Table of Contents

EXECUTIVE SUMMARY	v
1. VISION, REGULATORY GOALS& ORGANIZATION	1
2. BACKGROUND INFORMATION & EARLY ACTION TASKS	5
3. 2013 BMP STRATEGIC PLAN APPROACH	10
3.1. Baseline & Source Control Activities	10
3.1.1. Volume Reduction BMPs	11
3.1.2. Orange County Flood Control District	12
3.1.3. City of Irvine	12
3.1.4. City of Newport Beach	12
3.1.5. City of Santa Ana	12
3.1.6. The City of Costa Mesa.....	13
3.1.7. City of Lake Forest	13
3.1.8. City of Laguna Hills.....	13
3.1.9. City of Tustin	13
3.1.10. IRWD	13
3.2. Phase I: Selenium and Nitrogen Reduction Projects & Offset Mitigation Program Framework	15
3.2.1. Selenium and Nitrate Reduction Projects.....	15
3.2.2. Estimated Selenium Load Reductions	22
3.2.3. Estimated Nitrogen Load Reductions	24
3.2.4. Offset Mitigation Program Framework	25
3.3. Phase II: Regional Monitoring PLAN	27
3.4. Phase III: BMP/Technology Evaluation	28
3.5. Adaptive Management.....	29
4. SUMMARY & SCHEDULE.....	30
REFERENCES	34

List of Tables

Table 1- Agencies enrolled under Order No. R8-2007-0041 (Source: 2009 Draft Selenium TMDL).....	11
Table 2 - IWRD's Rates 2012-2013	14
Table 3 - Active NTS Facilities	17
Table 4 - Groundwater Point Source Discharge Loads	23
Table 5 - Selenium Load Reductions Timeline	24
Table 6 - Estimated Annual Nitrogen Loads at PCW Pipeline Project Diversion Locations	25
Table 7 - PCW Diversion Project Schedule	30
Table 8 - Santa Ana-Delhi Diversion Project Development Schedule	31
Table 9 - Selenium Management Schedule.....	32



List of Figures

Figure 1 – Newport Bay Watershed.....	6
Figure 2 - Location of Demonstration-Scale Cienega Filtration System	16
Figure 3 - Natural Treatment System Locations	18
Figure 4 Conceptual Layout of Peters Canyon Wash Diversion Project	20
Figure 5 – Potential Conceptual Santa Ana-Delhi Diversion Project Site – Bristol Street and Kline Drive.....	22
Figure 6 – Selenium Load Reductions to San Diego Creek from Point-Source Groundwater Dewatering Discharges.....	23

Acronyms and Definitions

2009 NSMP BMP Strategic Plan: BMP Strategic Plan submitted by the NSMP in July of 2009.

2011 NSMP BMP Strategic Plan: BMP Strategic Plan submitted for compliance with the TSO in January 2011

2013 NSMP BMP Strategic Plan: Current BMP Strategic Plan (this document) that replaces the 2009 and 2011 BMP Strategic Plans for the purpose of complying with the General Dewatering Permit and the TSO

µg/L: microgram per liter or part per billion

ARMS: Advanced Reactive Media System

BMP: best management practice

cfs: cubic feet per second

CTR: California Toxics Rule

ECD: Edinger Circular Drain

GW: Groundwater

gpm: gallons per minute

IRWD: Irvine Ranch Water District

mgd: million gallons per day

mg/L: milligrams per liter or part per million

NPDES: National Pollutant Discharge Elimination System

NSMP: Nitrogen and Selenium Management Program

NSMP Funding Partners: Those entities that have executed Agreement D11-066.

NSMP Working Group: NSMP Funding Partners, Regional Board staff, and other non-funding stakeholders.

NTS: Natural Treatment System

O&M: Operations and Maintenance

OCSD: Orange County Sanitation District

ppb: parts per billion or µg/L

PCW: Peters Canyon Wash

PCW Pipeline Participants: Those entities that are funding the PCW Pipeline Project including the County of Orange, City of Irvine, City of Tustin, Caltrans, and IRWD.

Regional Board: Santa Ana Regional Water Quality Control Board

SDC: San Diego Creek

SAD: Santa Ana-Delhi Channel

SADC Project Participants: Those entities that are funding the SADC Diversion Project including the Cities of Costa Mesa, Newport Beach, Santa Ana, Orange County, and Orange County Flood Control District.

Se: selenium

SSO: Site Specific Objective

TMDL: total maximum daily load

TSO: Time Schedule Order



EXECUTIVE SUMMARY

The 2013 Nitrogen and Selenium Management Program (NSMP) Best Management Practice (BMP) Strategic Plan (hereinafter referred to as BMP Strategic Plan or Plan) is a phased plan to attain nitrogen reductions and selenium reductions to help meet selenium fish tissue and bird egg targets to protect beneficial uses in the Santa Ana-Delhi Channel and San Diego Creek Sub-Watersheds (collectively Sub-Watersheds). The NSMP Funding Partners are firmly committed to implementation of the projects identified in this 2013 BMP Strategic Plan.

The Santa Ana Regional Water Quality Control Board (Regional Board) adopted Order No. R8-2004-0021 (General Dewatering Permit) for the Newport Bay Watershed and R8-2005-0079 (Irvine Dewatering Permit) for the City of Irvine to regulate short-term and ongoing groundwater-related discharges with specific focus on nitrogen and selenium. The General Dewatering Permit prompted the establishment of the NSMP and its Working Group to draft and implement a Work Plan. The tasks of the Work Plan, among others, included development of a BMP Implementation Plan/Strategic Plan.

Since 2004, members of NSMP Working Group have completed all Work Plan tasks and thus fulfilled the requirements of the General Dewatering Permit. The General Dewatering Permit was replaced by permit R8-2007-0041, and was amended by Order R8-2009-0045 to include requirements for groundwater cleanup discharges as well as dewatering. In 2009, a Time Schedule Order (TSO) R8-2009-0069 was adopted to amend and extend the General Dewatering Permit. The City of Irvine discharges have continued to be regulated by Order R8-2005-0079, and TSO R8-2009-0070 amended the Irvine Dewatering Permit and extended the time to comply with the Order.

Development of the 2011 BMP Strategic Plan was a requirement of the General Dewatering Permit TSO, and the NSMP Working Group members developed the plan and committed to its implementation. The NSMP Working Group members individually or collectively also implemented several tasks outside the Work Plan but consistent with the 2009 and 2011 BMP Strategic Plans approaches, including:

- Ongoing operation of the Cienega Demonstration Project
- Diversion feasibility studies for the Santa Ana-Delhi Channel and Peters Canyon Wash
- Water balance study for the Swamp of the Frogs (a historic swamp in the San Diego Creek Sub-Watershed where flows from San Diego Creek and the small tributaries that drained the foothills historically drained to it)
- Investigation of new selenium treatment technologies
- Ongoing watershed monitoring
- Identification of priority implementation areas (a requirement of the TSO R8-2009-0069)
- Work to support the development of site-specific objectives for selenium.



To date, implementation of elements of the 2009 and 2011 BMP Strategic Plan and other dischargers' actions to eliminate, avoid and minimize groundwater discharges have reduced more than 200 lbs. of selenium per year in the Sub-Watersheds.

This 2013 BMP Strategic Plan was developed by the NSMP Funding Partners in collaboration with the members of the NSMP Working Group. The approach taken in this 2013 BMP Strategic Plan includes implementation of source controls and selenium and nitrogen reduction projects, watershed monitoring, review of potential new treatment technologies, development of an offset mitigation program, and modifying the Plan as needed based on new information (i.e., this Plan utilizes the principles of adaptive management). The major components include: baseline and source control activities; Phase I - development of major load reduction infrastructure projects and offset mitigation program framework; Phase II - regional monitoring program; Phase III - BMP/technology evaluation; and an adaptive management process to refine future implementation actions based on information obtained. The adaptive management process is intended to accommodate the anticipated regulatory actions affecting selenium and nitrogen management in the Sub-Watersheds including revised TMDLs and potential downstream effects of selenium and nitrogen reduction projects, and will include the development of additional actions if the Vision (see Section 1) of the BMP Strategic Plan is not achieved. A schedule of both the BMP Strategic Plan elements and anticipated regulatory actions is provided.



1. VISION, REGULATORY GOALS, & ORGANIZATION

The 2013 BMP Strategic Plan is a phased plan to attain selenium reductions to help meet fish tissue and bird egg targets being developed to protect beneficial uses in the Sub-Watersheds and nitrogen reduction targets largely in Newport Bay. The NSMP Funding Partners are committed to implementation of the projects identified in this BMP Strategic Plan. The focus of the Plan is interception and diversion of permitted point source discharges from surface waters by the City of Irvine under Orders R8-2005-0079 and Time Schedule Order 2009-0070 (collectively, the Irvine Dewatering Permit), and by short-term dischargers under R8-2007-0041 as amended by R8-2009-0045 and Time Schedule Order R8-2009-0069 (collectively, the “General Dewatering Permit”). Additional benefits of the plan include interception and diversion of diffuse (rising and seeping) nonpoint source groundwater containing high concentrations of selenium. This Plan does not include efforts in the Big Canyon Wash Sub-Watershed, which will be addressed in a separate plan.

The **Vision** of the 2013 BMP Strategic Plan is that waste discharges from groundwater dewatering operations and groundwater cleanup operations will not cause or contribute to exceedances of the applicable water quality standards for selenium and nitrogen. To this end, groundwater dewatering discharges and groundwater cleanup operations will be diverted to the sanitary sewer wherever practical, and qualified offset programs will be implemented to achieve regulatory compliance for groundwater dewatering discharges and groundwater cleanup operations that cannot be diverted (as described below).

The **Regulatory Goals** of the BMP Strategic Plan are the following:

- 1) To establish compliance with the General Dewatering Permit by:
 - A) Reducing or eliminating selenium and nitrogen loads from groundwater dewatering discharges when and where it is feasible to do so as outlined in the proposed Peters Canyon Wash Pipeline and Santa Ana-Delhi Diversion projects; and
 - B) Offsetting excess selenium and nitrogen loads from permitted groundwater dewatering discharges by reducing diffuse non-point source loads when there is no reasonably feasible means to eliminate the point-source loads.
- 2) To establish compliance with the Irvine Dewatering Permit by:
 - A) Reducing or eliminating selenium and nitrogen loads from groundwater dewatering discharges when and where it is feasible to do so as outlined in the proposed Peters Canyon Wash Pipeline project; and
 - B) Offsetting excess selenium and nitrogen loads from groundwater dewatering discharges by reducing diffuse non-point loads when there is no reasonably feasible means to eliminate the point-source loads.



- 3) To establish performance based compliance with the Waste Load Allocation provisions set forth in the MS4 Permit.
- 4) To meet the current (2002) EPA selenium TMDL Tier 1 Waste Load Allocation (WLA) for groundwater dewatering, which address Se loads under low flow conditions.

The vision and regulatory goals of the BMP Strategic Plan are anticipated to be achieved through completing the following near-term, mid-term, and long-term objectives:

Near-Term (Objectives to be completed by 2014-2015)

- 1) Approval of the Peters Canyon Wash Channel Water Capture and Reuse Pipeline and the Santa Ana-Delhi Channel Diversion Project selenium and nitrogen reduction projects and the associated monitoring program (described below) as qualified offset programs for compliance with the General Dewatering Permit and the Irvine Dewatering Permit;
- 2) Extension of Time Schedule Orders R8-2009-0069 and R8-2009-0070 for five years to provide the time needed for development of a revised selenium TMDL and Site Specific Objectives (SSOs), construction of the selenium and nitrogen reduction projects, and post-TMDL reissuance of dewatering permits which incorporate the revised Selenium TMDL and SSOs;
- 3) Performance based compliance with the current and future provisions of the Municipal Separate Storm Sewer System (MS4) Permit;
- 4) Stakeholder participation and funding to support development of a TMDL, including identification of strategies and approaches, such as an offset program, that are expected to be included and serve as a foundation for the implementation plan for the new selenium TMDL.
- 5) Completion of and operation of the identified nitrogen and selenium load reduction projects.
- 6) Establish a long-term monitoring program to assess selenium concentrations in waste discharges, receiving waters, fish tissues and bird eggs and to assess progress toward attaining the applicable water quality standard(s).

Mid-Term (Objectives to be completed by 2016-2017)

- 1) To participate in, and assist the Regional Board staff in developing an appropriate selenium TMDL, including numeric targets (expressed as fish tissue and bird egg concentration targets) to protect fish and birds from selenium impairment.
- 2) To assist the Regional Board staff in revising the selenium TMDL waste load and load allocations to be consistent with the proposed tissue-based numeric targets.



- 3) To assist the Regional Board staff in preparing a formal Implementation Plan for the new selenium TMDL.
- 4) To participate in, and assist the Regional Board staff in preparing selenium SSOs (expressed as fish tissue and bird egg concentration targets) to protect fish and birds from selenium impairment.
- 5) To support the Regional Board with final adoption of the new selenium TMDL.

Long-Term (Objectives to be completed for final adoption by 2018-2019)

- 1) To assist the Regional Board staff in updating and reissuing the General Dewatering Permit and Irvine Dewatering Permit with terms and conditions that are consistent with the revised selenium TMDL Implementation Plan.
- 2) To identify selenium reduction projects as needed in response to the new TMDL Implementation Plan and related regulatory requirements in the new General Dewatering Permit and Irvine Dewatering Permit.
- 3) To periodically reassess treatment technologies and determine whether a reasonably practicable means of selenium reduction/control has become available and is feasible for implementation within the Sub-Watersheds.
- 4) To support the Regional Board with final adoption of selenium SSOs for fish and bird egg tissues taking into account the naturally-occurring background concentrations of selenium in the receiving waters.

The BMP Strategic Plan is organized to clearly identify the efforts and actions to achieve its vision as well as monitoring to verify that the vision has been achieved. **Section 1: Vision, Regulatory Goals & Organization** identifies the intent of the BMP Strategic Plan, what encompasses a successful implementation of the plan (the vision), the regulatory goals, and how the plan is organized. **Section 2: Background Information & Early Action Tasks** outlines the regulatory history and technical background of the NSMP and the Plan. The major components of the Plan are identified in **Section 3: BMP Strategic Plan Approach**, which includes the following activities and phases:

- **Baseline & Source Control Activities** - Includes current and planned actions to reduce inputs of nitrogen and selenium in the Sub-Watersheds.
- **Phase I: Load Reduction Projects & Offset Mitigation Program Framework** - Includes the details of the subregional selenium and nitrogen load reduction infrastructure projects and provides the framework to be used for the development of an offset mitigation program.



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- **Phase II: Regional Monitoring Program** – Includes a description of the watershed monitoring program and how the monitoring program assesses the effects of the load reduction projects and source control activities.
 - **Phase III: BMP/Technology Evaluation** – Includes protocols for future research and an evaluation of Best Management Practices (BMPs) and technologies for removing selenium and nitrogen.
 - **Adaptive Management** – Includes protocols for modifying the implementation measures identified in the 2013 BMP Strategic Plan in response to information obtained through the watershed monitoring program and the BMP technology evaluation.

A summary of the 2013 BMP Strategic Plan and the major implementation milestones are identified in **Section 4: Summary and Schedule**.



2. BACKGROUND INFORMATION & EARLY ACTION TASKS

Until 2003, the Regional Board regulated discharges to surface waters that posed an insignificant (*de minimus*) threat to water quality through an area-wide NPDES permit. However, when this permit was renewed in 2003 by Order No. R8-2003-0061, the Newport Bay Watershed (Watershed), identified in Figure 1, was excluded due to concerns that elevated levels of selenium and nitrogen in short-term groundwater-related discharges would not comply with established Total Maximum Daily Loads (TMDLs) in the Watershed. Thereafter, the Regional Board issued a separate General Dewatering Permit specific to the Watershed for short term discharges (R8-2004-0021). The Board also issued an individual discharge permit to the City of Irvine for ongoing discharges associated with dewatering transportation crossings (R8-2005-0079). The General Dewatering Permit (R8-2004-0021) was replaced by permit R8-2007-0041, which was subsequently amended by R8-2009-0045 to include requirements for groundwater cleanup discharges as well as dewatering. In 2009, Time Schedule Order R8-2009-0069 was adopted to amend and extend Order R8-2007-0041 as amended by Order R8-2009-0045 to provide more time to meet effluent limitations for selenium based on California Toxics Rule (CTR) criterion of 5 ug/L selenium because a reasonably feasible treatment technology did not exist to treat point source discharges of selenium. In 2009, Time Schedule Order R8-2009-0070 was also adopted to amend Order R8-2005-0079 to provide more time to meet effluent limitations for selenium based on the CTR criterion.

Both the General Dewatering Permit and the Irvine Dewatering Permit incorporated an option to implement an alternative compliance approach requiring the formation of a Working Group and preparation and implementation of a Work Plan to develop a comprehensive understanding of and management plan for groundwater-related sources of selenium and nitrogen in the Watershed. Both Order R8-2007-0041 (as amended by Order R8-2009-0045) and R8-2005-0079 also incorporated an alternative compliance approach allowing dischargers to implement approved selenium and/or nitrogen offset programs.

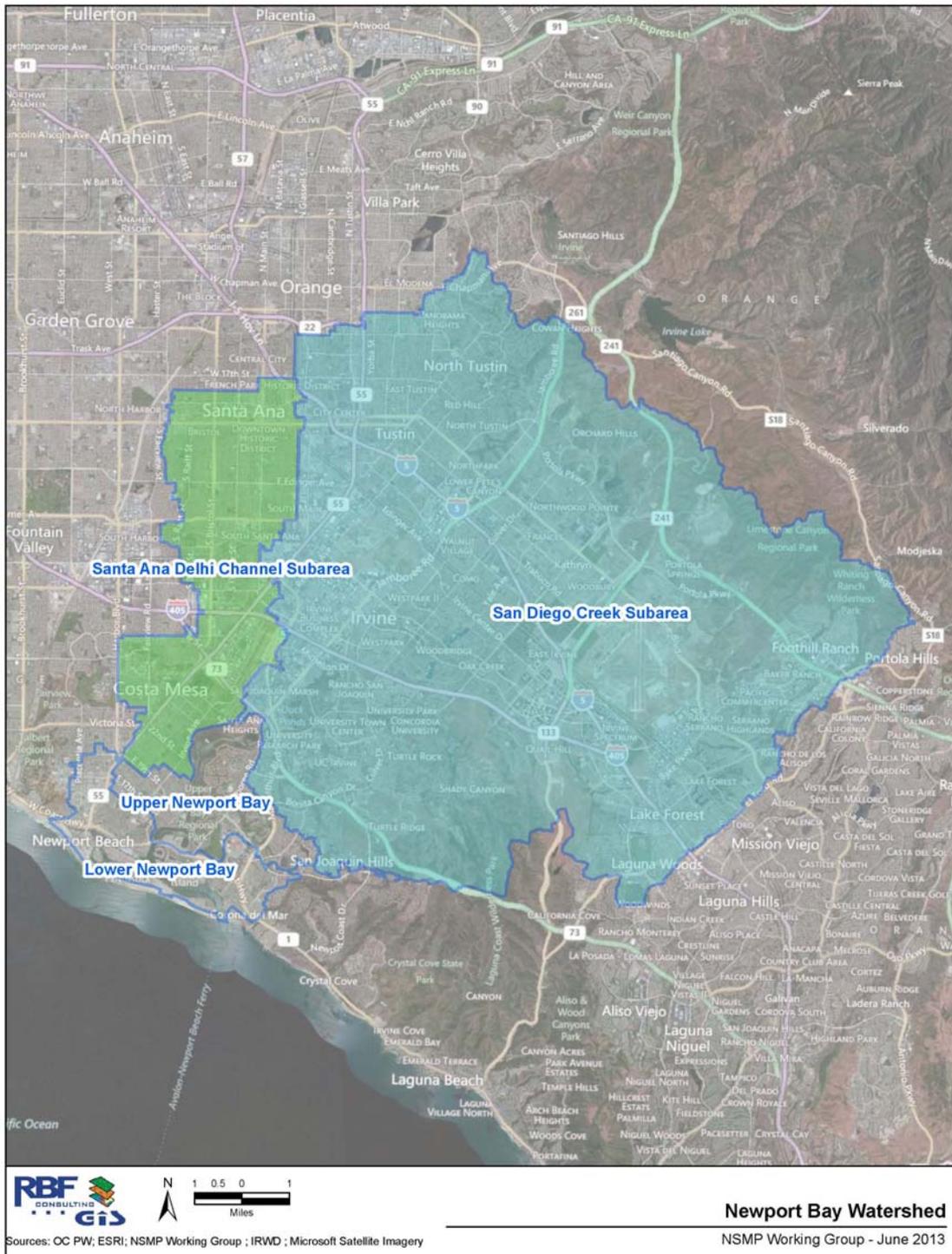
The NSMP was created in response to this General Dewatering Permit and later the Irvine Dewatering Permit. The NSMP goals and objectives include:

- Allow dischargers to establish compliance with the General Dewatering Permit and the Irvine Dewatering Permit by implementing the detailed NSMP Work Plan approved by the Regional Board.
- Develop a comprehensive understanding of and management plan for nitrogen and selenium discharges to surface waters within the Watershed that result from groundwater-related inflows.
- Develop the 2009 BMP Strategic Plan – this 2013 BMP Strategic Plan supersedes all prior draft BMP Strategic Plans, including the July 2009 BMP Strategic Plan and the January 2011 BMP Strategic Plan.



- Allow dischargers to establish performance based compliance with the 2009 MS4 Permit by implementation of the 2013 BMP Strategic Plan.

Figure 1 - Newport Bay Watershed





Early actions tasks were implemented by the NSMP Working Group to better understand the Watershed conditions, meet the required milestones, and define BMP implementation alternatives. This section summarizes each of these early action tasks and accomplishments, which were largely focused on selenium since considerably less information was available than for nitrogen.

Cienega Field Demonstration Project and ABMet® and other technology pilot testing

In 2006-2007 the County of Orange, as part of the NSMP Work Plan, conducted pilot tests of technologies with potential to remove both nitrogen and selenium. The technologies that were pilot tested included reverse osmosis, iron treatment, filtration media, portable wetlands, and adsorption media. A bench scale test of the ABMet® system, a proprietary biological treatment system owned by General Electric was also performed at this time.

In 2008, IRWD collaborated with the City of Irvine on the Cienega Field Demonstration Project, a pilot-scale rock filter system adjacent to Peters Canyon Wash. The project was constructed by IRWD in 2008, followed by 11 months of start-up testing, initial repairs and commissioning. Since October 2009, the project has been drawing approximately 0.3 cfs of surface water from Peters Canyon Wash during dry weather for diversion through the rock filter. Approximately 12 lbs. of selenium and 3,100 lbs. of nitrogen are removed by the Cienega Demonstration Project per year. Additional technical information regarding the project is provided in Section 3.2. The Cienega Field Demonstration Project is an approved offset program that may be used at the City of Irvine's discretion to comply with the Irvine Dewatering Permit.

In 2009 the County of Orange, as part of the NSMP Work Plan, conducted a field pilot scale test of the ABMet® system. As a result of the field pilot test performed by the County, IRWD conducted a field pilot test of the ABMet® system, in 2010 to evaluate the functionality and cost effectiveness of a full-scale project. Despite the positive results of the pilot testing, the full-scale project was not built because of timing and ownership/easement constraints as well as regulatory uncertainty and overall project cost.

Diversion feasibility studies

In addition to conducting the pilot tests, the NSMP Working Group also investigated the feasibility of implementing sewer diversions at various locations associated with high levels of selenium. Notably, the City of Irvine collaborated with several other agencies and commissioned a feasibility study for a sewer diversion project to divert dry weather flows at four locations along Peters Canyon Wash Channel including the Caltrans Groundwater Treatment Facility, Como Channel, Edinger Circular Drain, and Valencia Drain. The diverted flows would be collected and sent to Orange County Sanitation District (OCSD) for treatment and reuse. Similarly, the City of Santa Ana performed a feasibility study for the diversion of flows from the Santa Ana-Delhi Channel to OCSD sewer system (SAD Diversion Project). Additional information regarding these feasibility studies is provided in Section 3.2.



Groundwater – Surface Water Balance Study Swamp of the Frogs

In 2011, the Working Group selected Daniel B. Stephens and Associates (DBS&A) to conduct the Groundwater – Surface Water Balance Study for the Swamp of the Frogs area, the principal source area of selenium in the Sub-Watersheds. The investigation consisted of a hydrogeologic characterization and evaluation of groundwater and surface water sources and sinks over representative water years from 2005 to 2011 in the vicinity of the former Swamp. The characterization and evaluation will be used to guide the type, location, and scale of future selenium reduction projects. The study draft report is currently under final review and findings relevant to the Plan will be considered when available.

Siemens Bench Testing

As part of its ongoing review of new technologies and BMPs capable of removing selenium, the NSMP Working Group investigated the performance and applicability of Advanced Reactive Media System (ARMS) developed by Siemens. Siemens performed one dynamic and two static tests of the ARMS using water samples collected from the Sub-Watersheds. Results from the bench testing have demonstrated that the ARMS process may be able to achieve removal of selenium below the CTR in a laboratory setting, however, the construction of a large-scale ARMS system within the Watershed to treat large flow volumes faces too many challenges, such as land availability and the cost to develop the BMP as a proven technology for application in a non-industrial environment, to be considered a viable treatment option at this time.

Improved Understanding of Selenium Loading Through Continued Monitoring and Data Analysis

Selenium has been regularly monitored as part of Orange County Stormwater Program's NPDES Monitoring Program at several mass emission sites, including one located at the bottom of the San Diego Creek Sub-Watershed (San Diego Creek at Campus). Biweekly water quality sampling (including both dry and wet weather) and continuous flow measurements at this site can be used to calculate the fluxes of selenium at this location. However, these fluxes may differ from selenium fluxes at other locations in the Sub-Watersheds or into Upper Newport Bay because selenium is not a conservative pollutant (such as salt) and is subject to many removal processes (i.e. sinks) as well as transformation and uptake into biota including plants, zooplankton, invertebrates, fish, and birds within the watershed.

For other parts of the Sub-Watersheds, monitoring efforts have been relatively sporadic and not as robust as the Campus station. The diffuse and widespread nature of nonpoint selenium sources further complicates the load estimates for other drainage areas.

The NSMP Working Group started a Tissue Monitoring Program for fish (via tissue) and bird species (via eggs) in 2005. A habitat survey component that identifies and assesses sensitive habitats within the Watershed was added in 2012. Together, these efforts established baseline selenium levels in the biota and in the future will be used to assess progress toward the attainment of the proposed tissue-based TMDL numeric targets



SSOs (see section below). The Selenium Regional Monitoring Program (Se RMP), as outlined in Section 3.3 and in Appendix A, is designed to address the distribution, transport, and transformation of selenium within the Watershed and ecosystem with an emphasis on ecologically sensitive areas. Data from this program can also be used to assess the selenium loads removed to date by selenium reduction projects and to estimate point source discharges (calculated by tracking permitted point source discharges). Data from the Se RMP can also be used to assess how selenium levels observed in the receiving waters and biota compare to regulatory objectives.

Selenium SSOs

The Working Group has investigated the applicability of selenium SSOs for fish tissue and bird eggs for the Watershed. In 2009, a set of SSOs (5 microgram per gram dry weight (ug/g dw) for fish tissue and 8 ug/g dw for bird egg, both based on dry weight) were proposed as part of the numeric targets for the draft Regional Board TMDLs. However, the peer review of these SSOs was deemed insufficient and the stakeholders requested that the conservative fish tissue SSO be reevaluated in light of the fact that there are only invasive fish species present in the watershed, no native fish. As part of the TMDL revision effort, the Working Group retained GEI Consultants to reevaluate the proposed SSOs for fish tissue. Based on extensive literature review and data analysis, GEI has concluded that available data may support a higher fish tissue SSO of 7.8-8.9 ug/g dw for portions of the Watershed that support reproducing centrarchid families (i.e. species most sensitive to selenium). For other portions of the Watershed where no centrarchids are found, the fish tissue SSO for whole-body and egg/ovary tissue numbers for other non-bluegill warm water fish, estimated by GEI, range from 10.9 – 31.0 µg/L dry weight and 22.0 – 42.0 µg/L dry weight, respectively. These recommendations are being considered by Regional Water Board staff, who have requested supporting data and documentation. The additional supporting data and documentation are needed so that Regional Water Board staff can consult with U.S. Fish and Wildlife Service staff to determine the most appropriate whole body fish and egg/ovary tissue concentrations for both bluegill and other non-bluegill warm water fish species present in the watershed that will be protective of the beneficial uses in the Newport Bay Watershed.



3. 2013 BMP STRATEGIC PLAN APPROACH

This 2013 BMP Strategic Plan acknowledges that:

- Currently there are no readily available conventional treatment technologies that can be economically implemented in a reasonably practicable manner to treat selenium in the Sub-Watersheds;
- Diffuse nonpoint groundwater sources in the San Diego Creek Sub-Watershed are the primary source of selenium;
- Source controls and diversion projects are currently the most effective means to remove selenium from the Sub-Watersheds;
- Further refinements of the understanding of selenium (e.g. sources, fate, transport, cycling, etc.) in the Sub-Watersheds is needed;
- It is appropriate to periodically resurvey the scientific and technical literature to determine if more practicable and cost-effective treatment technologies have become available;
- Tissue based selenium SSOs necessary to protect beneficial uses in the Sub-Watersheds must be developed, and then approved by multiple state and federal regulatory agencies, including the Regional and State Water Boards, USFWS, and USEPA.

This 2013 BMP Strategic Plan, therefore, anticipates a phased approach that incorporates adaptive management principles allowing time for construction activities to be completed, response information to be developed, and response to changing regulatory requirements and/or new scientific information. Phase 1 of the Plan focuses on implementation of source control activities and implementation of selenium and nitrogen reduction infrastructure projects, and participation in, and assistance with the development of revised TMDLs and SSOs for selenium. Phase II involves implementation of a watershed monitoring program to evaluate the effectiveness of the source control and selenium and nitrogen reduction projects in the Sub-Watersheds. Phase III includes a literature evaluation of new BMPs and technologies for removal of selenium and nitrogen. The 2013 BMP Strategic Plan will be evaluated after selenium and nitrogen reduction projects have been implemented and are operational for long enough to determine if selenium and nitrate reductions have been achieved. This section identifies the major components of the NSMP Funding Partners approach to achieving selenium and nitrogen reductions in the Sub-Watersheds.

3.1. BASELINE & SOURCE CONTROL ACTIVITIES

Baseline and source control activities include the volume reduction BMP fact sheets that were developed in 2005, the recommendations formulated in the draft Water Balance Report for the Swamp of the Frogs (DBSA, draft 2012), and the irrigation control programs that IRWD implements. The baseline and source control activities prevent or minimize new discharges of selenium and total nitrogen in the Sub-Watersheds as follows:



3.1.1. Volume Reduction BMPs

The General Dewatering Permit and the Irvine Dewatering Permit require all dischargers to implement one or more reasonable BMPs to reduce the volume of discharges. Volume Reduction BMP Fact Sheets were required by the General Dewatering Permit and were developed in 2005 to identify feasible volume reduction BMPs for short-term groundwater related discharges in the Watershed. Five potential volume reduction BMPs were identified: 1) discharge to land; 2) discharge to sewer; 3) evaporation ponds; 4) off-site transportation and disposal; and 5) reinjection. Each volume-reduction BMP fact sheet describes the capacity, cost, land, permit, and monitoring requirements as well as its applicability in the Watershed. Of the five volume-reduction BMPs that were evaluated, three were identified as feasible in the Watershed: 1) discharge to land; 2) discharge to sewer; and 3) off-site transportation and disposal.

The Working Group has taken actions to minimize or eliminate short-term point source discharges in the Watershed. Several enrollees covered by the General Dewatering Permit (see Table 1) have reduced or eliminated their discharges through a range of programmatic actions:

Table 1- Agencies enrolled under Order No. R8-2007-0041 (Source: 2009 Draft Selenium TMDL)

Agency	Facility	Effective Date	Current Discharge
CA Dept. of Transportation District 12	Dewatering-Irvine-Various-Newport Bay	6/14/2005	None (Sewered to IRWD)
Irvine Company	Dewatering, Various locations within the Newport Bay Watershed	12/20/2004	None
Newport Beach City	Dewatering, General	9/24/1998	None
Foothill Eng. & Dewatering, Inc.	Dewatering, Various Newport Bay	11/8/2002	None (Sewer)
Irvine Ranch Water District	Dewatering Sites Within Newport Bay Watershed	4/20/2005	
Golden State Water Company - Anaheim	Dewatering, Various Locations	4/7/2005	
Orange County Flood Control District	Dewatering, Irvine-Newport Bay	2/24/2005	
Tustin City	Dewatering, Newport Bay Watershed	3/28/2005	
Laguna Hills City	Dewatering, Laguna Hills-Newport Bay	3/28/2005	
Lake Forest City	Dewatering, Lake Forest-Newport Bay	3/28/2005	None
Santa Ana City PWD	Dewatering, Santa Ana City Potable Water System	2/24/2006	
Integral Communities I Inc.	GW Cleanup, Sandpoint, Santa Ana	2/27/2008	
Pure Effect Inc.	GW Cleanup-Variou Locations	2/4/2008	
ETCO Investment	Newport Marina/Bridgeport Project	9/11/2008	



3.1.2. Orange County Flood Control District

Orange County Flood Control District's Peters Canyon Channel Widening Project involved excavation below the invert elevation of the channel. Groundwater identified by a sub-surface site characterization study (EEC, 2008) required temporary groundwater dewatering during construction. Dewatering flow was split between two sewer lines, Sweet Shade and Warner Avenue, at a combined rate of 361 gallons per minute over a construction period of 9 months.

Estimated Se Load Removal = 120 lbs.

Estimated N Load Removal = 24,000 lbs.

3.1.3. City of Irvine

The City of Irvine maintains three permanent undercrossing dewatering stations in the Newport Bay Watershed. The Culver Drive and Jeffrey Road pump stations discharge into Como Channel, which is tributary to Peters Canyon Channel. The Jamboree Road pump station discharges into El Modena/Irvine Channel, which is also tributary to Peters Canyon Channel. Historically, the Culver Drive and Jamboree Road stations have discharged an average of 5,000,000 and 262,000 gallons per month and average annual selenium loadings of 12 and 0.46 pounds respectively. Based on observations of operations during the removal and replacement of one pump at the Culver Drive station, the pumps have been adjusted to reduce discharges to approximately 577,000 gallons per month. Beginning in April 2013, similar adjustments were made at the Jamboree Road station, and discharges have been reduced to approximately 20,000 gallons per month. These changes will decrease estimated annual selenium loadings to 1.3 pounds from the Culver station and 0.026 pounds from the Jamboree station to the existing channels. The implementation of revised pump station operations protocols are anticipated to continue during dry weather as long as the undercrossings continue to be maintained in a safe and structurally viable manner.

Estimated Se Annual Load Removal = 15 lbs.

Estimated N Annual Load Removal = 6,000 lbs.

3.1.4. City of Newport Beach

The City of Newport Beach only operates one dewatering station, which is located in the basement of the Newport Beach Central Library. The dewatering station discharges to the sewer. This area is outside of the Sub-Watersheds, but is included to demonstrate the Watershed-wide efforts to sewer dewatering discharges. In addition, all construction dewatering operations (both public and private) within the City follow the guidelines and monitoring protocols listed in the General Dewatering Permit. Additionally, the City operates its own sewer system, so most construction sites dewater to Baker Tanks (or similar) and discharge directly to the sewer system.

3.1.5. City of Santa Ana

The City of Santa Ana is enrolled under the General Dewatering Permit and retains coverage for periodic discharges from potable water wells owned and operated by the City's Water Department. Three wells are located in the area of the Santa Ana Delhi Channel. When these



wells are maintained, they discharge approximately 250,000 gallons per year to the Santa Ana-Delhi Channel.

The City of Santa Ana has adopted a water conservation ordinance (Ordinance No. NS-2781), which identifies permanent water conservation requirements for the City (City of Santa Ana Ordinance No. NS-2781).

3.1.6. *The City of Costa Mesa*

The City of Costa Mesa has ceased its point source discharges and subsequently terminated its coverage under the General Dewatering Permit.

3.1.7. *City of Lake Forest*

The City of Lake Forest is enrolled under the General Dewatering Permit but has had no known discharges to date.

3.1.8. *City of Laguna Hills*

The City of Laguna Hills is enrolled under the General Dewatering Permit but has had no known discharges to date.

3.1.9. *City of Tustin*

The City of Tustin implemented measures to prevent groundwater seepage into its public storm drain system within the Tustin Legacy development. For new public storm drain pipes, pipe joints are required to be gasketed, and either a waterproofing admixture is to be added to the concrete or a PVC liner is wrapped around the pipes. In certain areas a fiberglass reinforced concrete pipe is also used. This was specified to address several groundwater issues in this area, one of which is selenium. This action is in addition to Tustin's participation in the NSMP program. The City has chosen to incorporate these measures into the City's public storm drain system, to protect its waterways from ground water seepage and reserves the right to use this at its sole discretion. It is not economically feasible to incorporate these measures elsewhere in the watershed.

In addition, the City of Tustin adopted a water efficient landscape ordinance in 2009, which requires all planting, irrigation, and landscape-related improvements to conserve water and prevent over irrigation. New projects are required to use California friendly plants and an irrigation system that use devices such as smart timers or a low flow drip system to prevent overwatering and runoff from occurring.

3.1.10. *IRWD*

IRWD is enrolled under the General Dewatering Permit but has limited discharges. IRWD has implemented several volume reduction programs, as discussed below.

IRWD Irrigation Use and Runoff Reduction Programs



IRWD implements numerous programs designed to minimize domestic water use and to prevent over-irrigation and runoff within its service area, which has significant overlap with the Sub-Watersheds. These programs include the following:

- Incentives for turf removal and conversion to climate appropriate, low water use plants and low-flow irrigation
- Conversions from spray irrigation to low-flow drip irrigation
- High efficiency irrigation nozzle incentive programs
- Customer outreach and education programs
- Performance-based irrigation upgrade program

In addition to the above, IRWD also implements a landscape performance certification program, which has the following components:

- Weather-based irrigation controller incentive and installation programs
- Free on-site assistance

A foundational tool in IRWD's successful water use efficiency programs is its rate structure. Since a substantial portion of water consumption in southern California is for outdoor irrigation, IRWD's rate structure helps control over-irrigation and the associated downward percolation of irrigation water and generation of nuisance runoff that carries pollutants, including nutrients, into the receiving water.

The rate structure was instituted to promote the efficient use of water, and is designed to provide customers a significant economic incentive to use the proper amount of water required to serve indoor, landscape, commercial/industrial and institutional demands. This is accomplished by setting a customized "allocation" for each customer account that is based upon a variety of factors such as irrigated area, daily weather characteristics, number of residents, industrial or commercial business type, and other unique characteristics. Water is then sold to customers under a five-tier structure based upon their monthly allocation, as shown in Table 2.

Table 2 - IWRD's Rates 2012-2013

Tier	Rate Per CCF, 2011-2012	Use (As a Percent of Allocation)
Low Volume Discount	\$0.91	0-40%
Conservation Base Rate	\$1.24	41-100%
Inefficient	\$2.76	101-150%
Excessive	\$4.70	151-200%
Wasteful	\$9.84	201% +

CCF = 100 cubic feet of water



Revenue from higher tier, over-allocation water use is “reinvested” to fund tailored programs and rebates for long-term improvements in water use efficiency and to support urban runoff source control and treatment programs.

IRWD also practices extensive water management and control at the water system level. This includes regular meter calibration and replacement, as well as a very aggressive and comprehensive leak detection and repair program that far exceeds the industry standard. Similarly, IRWD has a very proactive maintenance program for its sewer system. A flow monitoring study of the IRWD sewage collection system conducted by Dudek and Associates in June 2006 found that IRWD has a very contained collection system.

IRWD’s nitrogen loads averaged 17 lbs/year during 2004-2006, and 6,636 lbs/year during 2007-2012. IRWD’s selenium loads averaged 0.3 lbs/year during 2004-2006, and 9.5 lbs/year during 2007-2012.

3.2. PHASE I: SELENIUM AND NITROGEN REDUCTION PROJECTS & OFFSET MITIGATION PROGRAM FRAMEWORK

3.2.1. *Selenium and Nitrate Reduction Projects*

Phase I of the BMP Strategic Plan includes the implementation of load reduction projects within the Sub-Watersheds, as well as the establishment of an offset mitigation program framework. These projects at strategic locations in the Sub-Watersheds will provide significant reductions of selenium and nitrogen in the Sub-Watersheds. The offset mitigation program framework will serve as the foundation for translating load reductions into qualified offsets for dischargers in the Sub-Watersheds.

Members of the NSMP Working Group have implemented or are currently planning four load reduction projects. This section describes the characteristics, timeframe, and estimated load removal of selenium and nitrogen for each project.

a. Cienega Demonstration Project

In 2008, IRWD collaborated with the City of Irvine on the Cienega Demonstration Project, a pilot-scale rock filter system adjacent to Peters Canyon Wash. The project was constructed by IRWD in 2008, followed by 11 months of start-up testing, initial repairs and commissioning. Since October 2009, the project has been drawing approximately 0.3 cfs of surface water from Peters Canyon Wash during dry weather for diversion through the rock filter. Figure 2 below identifies the location of the Cienega Demonstration Project.

Since 2010, selenium and nitrogen load removals from the Cienega Demonstration Project have been claimed by the City of Irvine as approved offsets to roadway dewatering projects at Culver Drive, Jamboree Road, and Jeffrey Road. The Cienega Demonstration Projects has removed 15 lbs., 9.8 lbs., and 10.3 lbs. during calendar years 2010, 2011, and 2012, respectively. The discrepancies in annual load removals are, for the most part, related to the non-operation of the demonstration project during construction of the Peters Canyon Channel Widening Project.

Estimated Se Annual Load Removal = 10 to 15 lbs.

Estimated N Annual Load Removal = 3,100 lbs.



Figure 2 - Location of Demonstration-Scale Cienega Filtration System



The system works through the inoculation of source water with local bacteria followed by the addition of electron donor materials to promote microbial-mediated selenium and nitrogen removal under strongly but controlled reducing conditions in the rock filter. A post-treatment oxygenation system restores aerobic conditions in the treated flows before they are discharged to Peters Canyon Wash Channel.

b. IRWD Natural Treatment System

IRWD's San Joaquin Marsh is a system of constructed treatment wetland ponds. The location of the Marsh next to San Diego Creek has created unique opportunities for IRWD to intercept and remove large amounts of nitrogen from the San Diego Creek before it reaches Upper Newport Bay. The Marsh is the central piece of IRWD's Natural Treatment System (NTS), which is a network of constructed wetland ponds throughout the San Diego Creek Sub-Watershed to remove nutrients and bacteria, and potentially other contaminants and prevent these



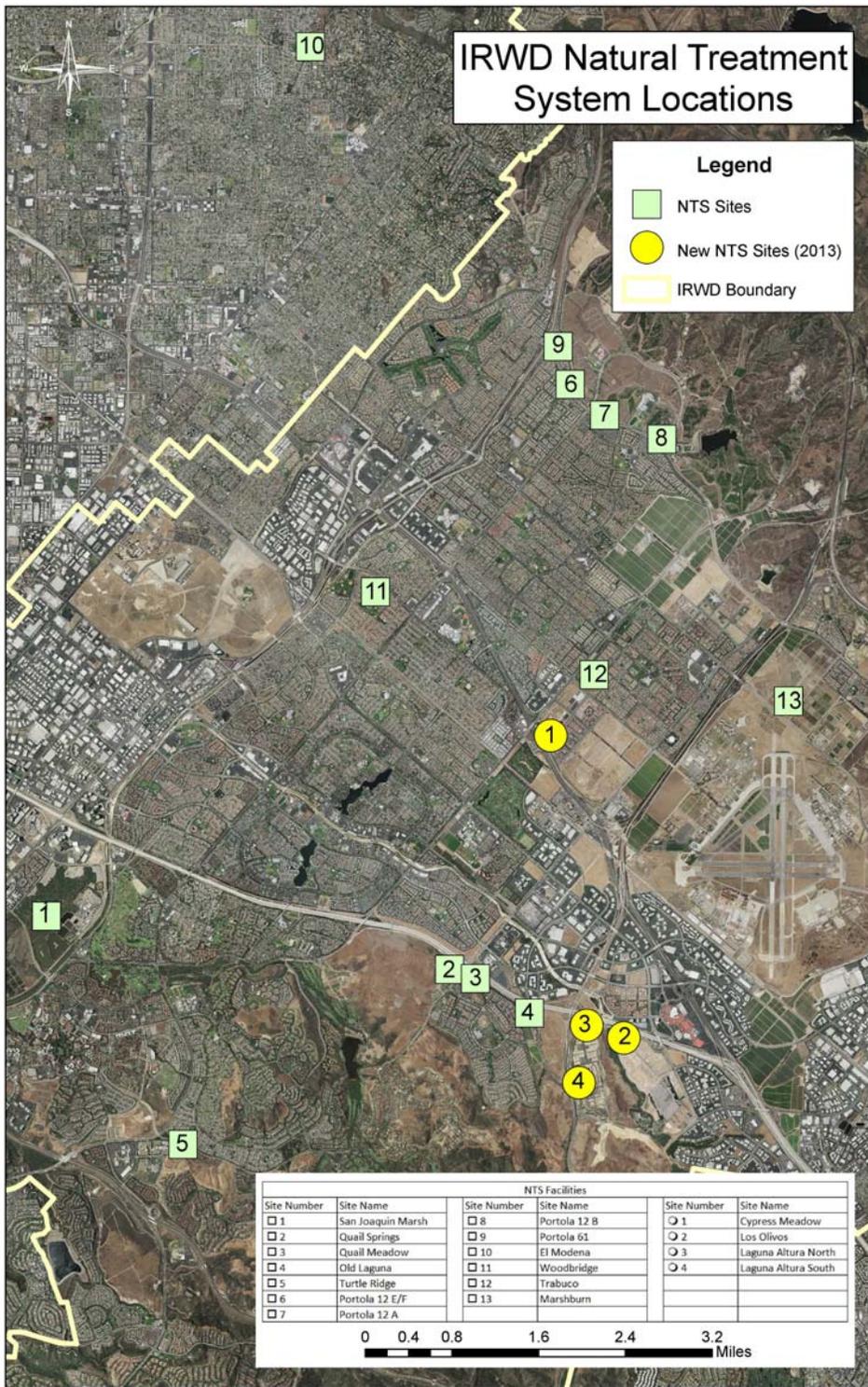
contaminants from reaching the Upper Newport Bay. IRWD completed a NTS Master Plan to address the regional water quality treatment needs by selecting the most strategic locations for implementation of natural treatment systems (2005). Since February 2006, IRWD has implemented 16 additional wetlands in the San Diego Creek Sub-Watershed. Table 3 identifies the name, size, tributary area, and status of each of the 13 NTS active facilities. Performance monitoring of the active NTS facilities is conducted by IRWD; results have demonstrated a significant reduction in nitrogen and removal of other contaminants. More information about the NTS can be found at <http://www.naturaltreatmentsystem.org>.

Table 3 - Active NTS Facilities

NTS Name	Size (ac)	Tributary Watershed (ac)	Status
Cypress Meadow	4	118	Online, January 2013
El Modena	2.6	449	On line, February 2006
Forge	3	485	On line, June 2007
Laguna Altura North	1.4	79	Online, January 2013
Laguna Altura South	1.4	52	Online, January 2013
Los Olivos	3.1	109	Online, January 2013
Lower Eastfoot	3	288	On line, June 2007
Mashburn	22.4	11000	On line, August 2008
Old Laguna	2.5	231	On line, February 2006
Orchard Meadow	2.4	151	On line, June 2008
Port Culver	2.1	243	On line, June 2008
Quail Meadow	1.1	45	On line, February 2006
Quail Springs	9.1	331	On line, February 2006
San Joaquin Marsh	320	75000	On line, September 1997
Trabuco	18.4	22000	On line, August 2008
Turtle Ridge	1.9	229	On line, March 2006
Woodbridge	2.7	17000	On line, July 2008



Figure 3 - Natural Treatment System Locations





c. Peters Canyon Wash Diversion Project

Lower Peters Canyon Wash Channel is located within the historical Swamp of the Frogs, where selenium-laden shallow groundwater enters the storm drain and surface water system via seeps, weepholes, and through the bottom of the unlined channel. These groundwater-associated flows also constitute the principal source of selenium in the Sub-Watersheds. Short term construction-related dewatering by local agencies and longer term discharges at City of Irvine dewatering facilities are relatively minor sources of selenium. Historical groundwater dewatering operations for transportation infrastructure by the California Department of Transportation (Caltrans) have been diverted to IRWD's sanitary sewer system since 2004, but the diversion arrangement is only temporary and cannot be sustained in perpetuity.

With assistance from IRWD, the Cities of Irvine and Tustin, the Orange County Flood Control District, and Caltrans completed a concept feasibility study in 2012 to evaluate the conditions and costs associated with the PCW Pipeline Project, which will intercept and divert selenium and nitrogen discharges at four locations before the discharges enter Peters Canyon Wash Channel.

The feasibility study has led to a preliminary design and grant proposals for the Peters Canyon Wash Channel Water Capture and Reuse Pipeline (PCW Pipeline Project) project, which will divert high selenium and nitrogen groundwater and groundwater-supported surface flows to OCS D for treatment and reuse. The flows to be intercepted include the Caltrans Groundwater Treatment Facility, Como Channel (where City of Irvine dewatering facilities drain to), Edinger Circular Storm Drain, and Valencia Storm Drain. The system will be pressurized and operate continuously during dry weather conditions. OCS D has agreed in concept to accept the discharge from the proposed project as part of its Urban Runoff Diversion Program. Currently, the City of Irvine is the project lead, however, IRWD will be the construction project manager and operator of the system upon completion. The project has been awarded grant funding from Orange County Transportation Authority (OCTA) Measure M2 funding and Prop. 84 funding administered by the State Water Resources Control Board.

The City of Irvine, County of Orange/Orange County Flood Control District, IRWD, the City of Tustin, and Caltrans are the funding partners of the PCW Pipeline Project (the "PCW Pipeline Participants.") The PCW Pipeline Participants are constrained to a reduced timeline to implement the project. Measure M2 grant requirements include awarding the construction contract by June 30, 2014. Planning, design, and permitting phases for the project must be completed beforehand; these phases are anticipated to start in Fall 2013 upon approval from the Regional Board of the offset mitigation program, subsequent approval of the 2013 BMP Strategic Plan, finalization of a funding agreement between the PCW Pipeline Participants, and approval of the Regional Board of extensions of Time Schedule Order 2009-0069 and Time Schedule Order 2009-0070 for five years.

The PCW Pipeline Project will include monitoring to quantify the loads of selenium and nitrogen diverted to OCS D. Continuous flow monitoring will be provided through meters at key locations and water quality samples from the diverted flows will be collected quarterly and analyzed for total nitrogen and total selenium. Exact locations of the meter(s) and sampling point(s) will be determined during the design process. Figure 4 is a layout of the diversion project.

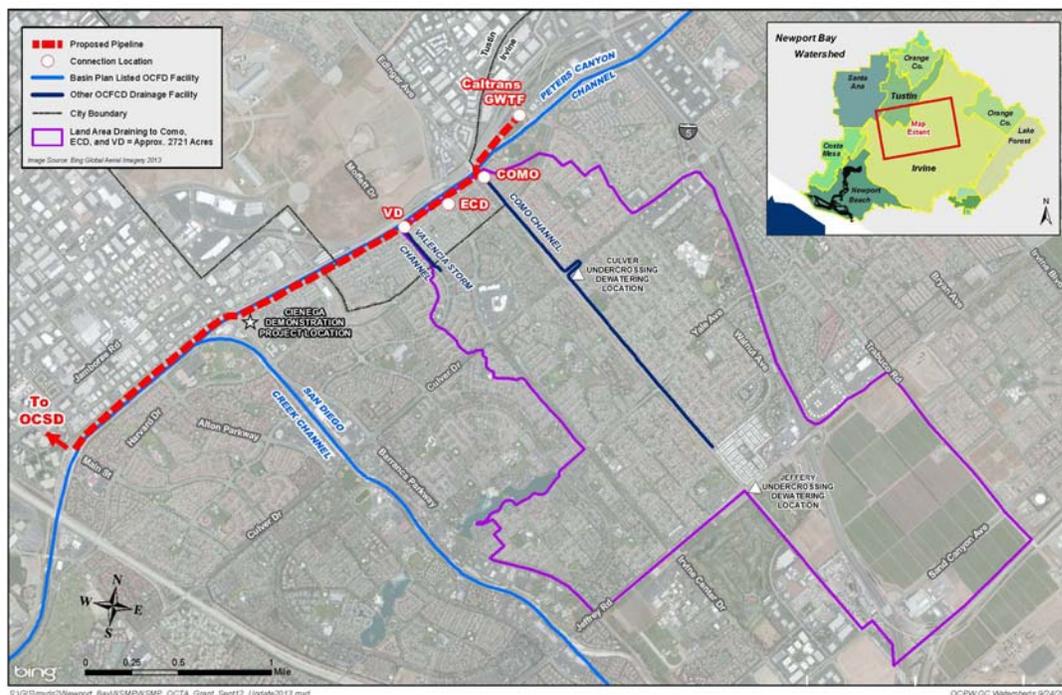


When the proposed PCW Pipeline Project is fully implemented, it will achieve significant selenium reductions. The following description of selenium reductions conservatively assumes that the system will operate on average only 330 days per year, and will be shut down an average of 35 days per year during wet weather.

The PCW Pipeline Project will intercept prior to discharge and remove approximately 229 lbs. per year of selenium from the Peters Canyon Wash/San Diego Creek watershed. The Caltrans dewatering discharges of selenium (≈ 100 lbs./yr.) are currently temporarily sewered by diversion to IRWD. Caltrans is currently negotiating with OCSD to allow their discharge to the PCW pipeline for the full 365 days per year. The PCW Pipeline Project will replace the existing temporary sewerage arrangement with a permanent diversion structure. The remaining selenium diversions (≈ 129 lbs./yr.) will be new load reductions. The new load reductions will be in addition to the on-going selenium reductions (≈ 10 to 15 lbs./yr.) that result from the Cienega Field Demonstration Project.

The City of Irvine dewatering discharges (≈ 15 lbs./yr.) are currently ultimately discharged to Peters Canyon Wash. These discharges are currently brought into compliance with Orders R8-2005-0079 and R8-2009-0070 by implementation of the Cienega Field Demonstration Project. When the PCW Pipeline Project becomes operational, all City of Irvine dewatering discharges from the Culver Road and Jeffrey Road underpass pump stations will be intercepted and diverted before entering Peters Canyon Wash. Anticipated selenium reductions associated with diffuse (rising/seeping) groundwater ≈ 114 lbs./yr., creating additional benefit to, and improving beneficial uses within the watershed.

Figure 4 Conceptual Layout of Peters Canyon Wash Diversion Project



Estimated Se Annual Load Removal = 229 lbs. (129 lbs. of new Se reduction)

Estimated N Annual Load Removal = 67,700 lbs. (23,400 lbs. of new N reduction)



d. Santa Ana-Delhi Channel Diversion Project

The TMDL Compliance Alternatives Report (City of Santa Ana, 2012) identified the Santa Ana-Delhi Channel as a man-made municipal separate storm sewer system consisting of a combination of underground storm drains and below-grade channels armored with rip-rap and concrete lining. Selenium concentrations were highest in surface flows above the confluence of the Santa Ana-Delhi Channel with the Santa Ana Garden Channel (13.4 µg/L). The majority of the runoff from the City of Santa Ana is conveyed via the Santa Ana-Delhi Channel to Upper Newport Bay. This channel has a total tributary area of 8,890 acres, provides drainage for the central portions of Santa Ana and portions of Costa Mesa and Newport Beach, and enters the northwest area of Upper Newport Bay downstream of Irvine Boulevard.

The Cities of Santa Ana, Costa Mesa, and Newport Beach (The SADC Project Participants) have obtained grant funding, and are currently developing engineering for an urban discharge diversion facility to be located in the Santa Ana-Delhi Channel near the intersection of Mesa Drive and Irvine Avenue, adjacent to the Newport Beach Golf Course. The diversion facility will capture and divert urban discharge low-flow into the sanitary sewer system, or for use as irrigation on the adjacent Newport Beach Golf Course. The facility will reduce selenium levels and other water quality constituents of concern including fecal indicator bacteria and nutrients in the lower Santa Ana-Delhi Channel and the brackish and freshwater habitats in Upper Newport Bay.

The estimated annual selenium removal by this diversion project is 40 lbs. per year. The project is receiving grant funding from Orange County Transportation Authority (OCTA) Measure M2 funding. Of the \$4.3 million estimated project cost, about half will be offset by this grant.



Figure 5 – Potential Conceptual Santa Ana-Delhi Diversion Project Site – Bristol Street and Kline Drive



Estimated Se Annual Load Removal = 40 lbs.

Estimated N Annual Load Removal = 10,200 lbs.

3.2.2. Estimated Selenium Load Reductions

Stakeholders in the Sub-Watersheds have reduced selenium loads significantly since 2002. The planned diversion projects will result in significant additional selenium load reductions in the Sub-Watersheds. Figure 6 below identifies selenium load reductions that have occurred in the San Diego Creek Sub-Watershed since 2002 and identifies the anticipated Se load reductions from the PCW Pipeline Project. The PCW Pipeline Project will reduce selenium load by 229 lbs. annually. Note that of this total, 100 lbs. of selenium is currently temporarily sewered by Caltrans and IRWD; this load will be diverted into the new PCW Pipeline Project, thereby making the Caltrans diversion permanent. Approximately 15 lbs of selenium reductions annually will consist of the diversion of the City of Irvine discharges under the Irvine Dewatering Permit. An additional 10 lbs per year is estimated to be necessary to address short-term discharges under the General Dewatering Permit. Remaining selenium reductions (approximately 104 lbs/year of selenium) will benefit the Sub-Watershed. Table 4 below identifies the groundwater point source discharge loads, and Table 5 identifies the timeline of selenium load reduction in the Sub-Watersheds.



Figure 6 – Selenium Load Reductions to San Diego Creek from Point-Source Groundwater Dewatering Discharges

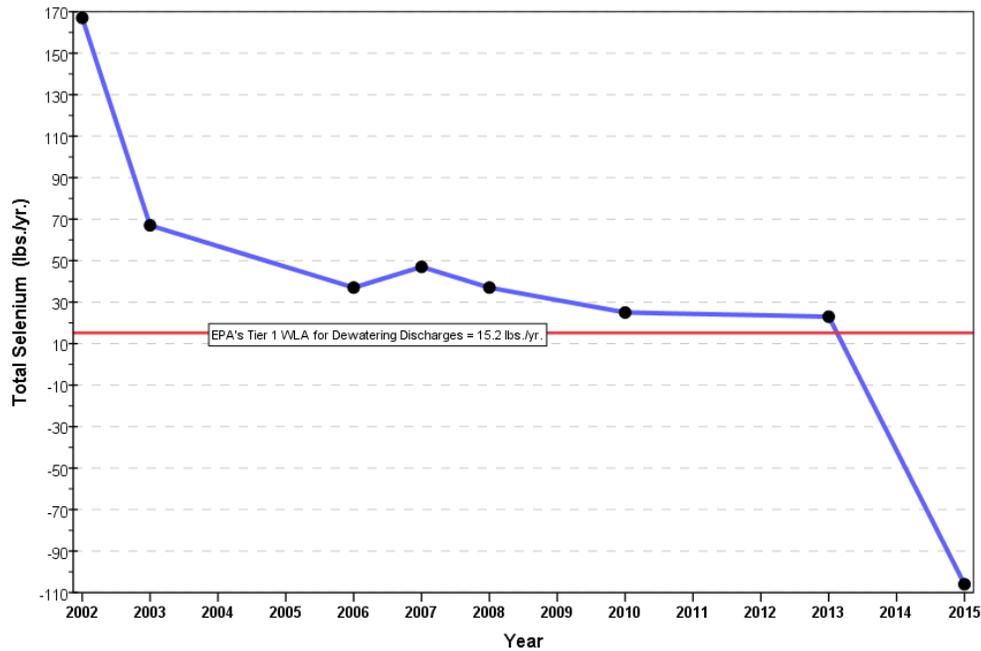


Table 4 - Groundwater Point Source Discharge Loads

Groundwater Point-Source Discharges		Annual Load	EPA's Tier 1 WLA for Dewatering ¹
Category	Discharger		
Long-Term Dewatering	City of Irvine	15 lbs/yr	4.3 lbs/yr
	IRWD	7.8 lbs/yr	
Short-Term Dewatering (Construction)	Foothill Construction (2005-08)	10 lbs/yr	
	IRWD (2007-2013)	1.8 lbs/yr	
Long-Term Clean-up (Sewered Discharges)	MCAS-Tustin	30 lbs/yr	1.6 lbs/yr
Short-Term Clean-up		2 lbs/yr	6.2 lbs/yr
Sewered Discharges	Caltrans	100 lbs/yr	3.1 lbs/yr
Total		166.6 lbs/yr	15.2 lbs/yr

¹ Tier 1 WLA applies to Critical Low Flow Conditions; <20 cfs @ Campus Dr. (≈90th %-tile on hydrograph); Table 4-3 in EPA's 2002 TMDL

**Table 5 - Selenium Load Reductions Timeline**

Year		Selenium Management Measures	Load Reduction (lbs./yr.)	Remaining Load (lbs./yr.)
2002	Post-TMDL	Baseline load for groundwater dewatering discharges		167
2003	Post-TMDL	CalTrans diverts dewatering discharge to IRWD	-100	67
2007	Post-TMDL	MCAS-Tustin diverts dewatering discharge to IRWD	-30	37
2007	Post-TMDL	IRWD construction projects, startup of desalters and discharge from former MCAS El Toro plume wells (2007-12 avg.)	10	47
2008	Post-TMDL	Foothill Engineering ends temporary dewatering discharge	-10	37
2010		Pilot Cienega project offsets City of Irvine's discharges	-12	25
2013		No known discharges from Short-Term Cleanup projects	-2	23
2015		Proposed Peters Canyon Wash Pipeline project	-129	-106

3.2.3. *Estimated Nitrogen Load Reductions*

Stakeholders in the Sub-Watersheds have reduced nitrogen loads significantly since 2002. Regional nitrogen reduction BMPs that have been implemented in the watershed since 2002, including both the Cienega Field Demonstration Project and the San Joaquin Marsh. From 2002-2012 the San Joaquin Marsh has removed an average of approximately 47,000 pounds of total nitrogen per year from the Newport Bay Watershed. Cumulative nitrogen reductions achieved by continued implementation of BMPs since 2002 have brought the watershed into compliance with the final TMDL allocations for nitrogen (Summer Load -153,861 lbs. of nitrogen; Winter Load - 144,364 lbs. of nitrogen). Cumulative nitrogen reductions substantially exceed the requirements established by the nitrogen TMDL to reduce nitrogen loading in the San Diego Creek/Peters Canyon Watershed by 50%.

The planned diversion projects will result in significant additional nitrogen load reductions in the Sub-Watersheds. The following description of nitrogen reductions conservatively assumes that the diversion projects will operate only an average of 330 days per year, and will be shut down an average of 35 days per year during wet weather. The PCW Pipeline Project will reduce nitrogen loads by 23,400 lbs. annually



and the SAD Diversion project by 10,200 lbs. Note that an additional 44,300 lbs. of nitrogen is currently temporarily sewered by Caltrans and IRWD; this load will be diverted into the new PCW Pipeline Project, thereby making the Caltrans diversion permanent, and resulting in a total of 67,700 lbs./yr. that will be intercepted and diverted to OCSD by this project. As measured at the Nutrient TMDL Regional Monitoring Program Barranca station, the PCW Pipeline Project will reduce overall nitrogen loading from this area by approximately 26%. Table 6 below identifies the estimated nitrogen load reductions for the PCW Pipeline Project.

Table 6 - Estimated Annual Nitrogen Loads at PCW Pipeline Project Diversion Locations

Pipeline Diversion Locations	Load Reductions (lbs.)	Load (lbs.)	Load Reduction (%)
Existing In-stream Load Peters Canyon Wash Channel at Barranca Parkway		90,600	
PCW Pipeline Diversion Total	67,700 (23,400 lbs. of new N reduction)		
Estimated Reduction in In-stream Load from PCW Pipeline Project			26%

3.2.4. Offset Mitigation Program Framework

Compliance with CTR numeric selenium criteria remains infeasible because there is currently no readily available, conventional treatment technology that can be economically implemented in a reasonably practicable manner for most point-source discharges. Further, diffuse groundwater sources in the San Diego Creek Sub-Watershed are the primary source of selenium.² Given the complexity of the selenium problem and the limited practicable treatment alternatives, the Regional Board has determined that a collaborative watershed-based approach will be the most effective at reducing selenium. The General Dewatering Permit and the Irvine Dewatering Permit allow dischargers to demonstrate compliance with selenium effluent limitations by participating in an "approved offset program," or by participating in the NSMP.

The NSMP Funding Partners strongly support a collaborative approach and agree that, at present, offset programs provide the only reasonable means for addressing selenium loads in the watershed. Thus, the NSMP Funding Partners are committed to develop the implementation tools and otherwise implement this 2013 BMP Strategic Plan. It is anticipated that offset mitigation will be used to establish regulatory compliance during

² TSO 2009-0070 Finding 12, p. 3.



the development of the TMDLs and the SSOs, and in the future will be included in the revised Se TMDL implementation plan. By the end of 2014, the NSMP Funding Partners will:

- 1) Establish an effective method of accounting for selenium loads discharged and offset in the Sub-Watersheds by the program participants, and for reporting these data to the Regional Board on a regular basis.
- 2) Establish a procedure to document which dischargers are actively participating in each approved offset program and provide written certification of such participation in an annual report to the Regional Board.
- 3) Establish a monitoring and reporting program to evaluate the effectiveness of using offset projects to reduce selenium loads in the water column and monitor effects on fish tissues and bird eggs in the watershed.
- 4) Establish a routine process to review treatment technologies for selenium reduction and determine if a reasonably feasible means of control has become available. If not, certify that treatment remains infeasible as part of the ROWD documentation submitted by the MS4 agencies every five years.

The NSMP Funding Partners understand and accept that certain key principles govern effective implementation of an approved offset program. Among these principles are the following:

- 1) In order to be eligible to demonstrate compliance through an approved offset program, a discharger must first demonstrate that immediate compliance with numeric selenium limitations is infeasible and that it is not reasonably feasible to reduce or eliminate the discharge.
- 2) Selenium discharges that cannot be reduced or eliminated must be offset on at least a 1:1 basis.
- 3) Expiration of offset "credits" will be evaluated on a periodic basis, subject to further refinement through development of the program.
- 4) Offsets may only be used to demonstrate compliance within the same watershed. So, for example, offsets generated in the Santa Ana-Delhi Sub-Watershed cannot be transferred to the San Diego Creek Sub-Watershed or vice versa.
- 5) The qualified offsets and credits may be used to achieve compliance with the TMDL provisions of the MS4 Permit.
- 6) The offset program may be revised from time to time as part of a long-term Adaptive Management strategy (see Section 3.5) to ensure dischargers continue to make best efforts toward mitigating the adverse effects of selenium discharges on the receiving waters.
- 7) Offsets should be encouraged where no feasible or practicable treatment alternative is available and the offset program produces more net water quality improvement or a higher level of environmental protection than would be achieved by prohibiting permitted point-source discharges altogether.



- 8) The PCW Pipeline Participants and the SADC Project Participants, respectively, will, as investors in the PCW Pipeline and the Santa Ana Delhi Diversion Project, respectively, jointly determine, in the context of the offset program developed by the NSMP Funding Partners, the pricing of offsets generated by the BMP infrastructure project in which they have invested.

Implementation of the 2013 BMP Strategic Plan, including the program of approved offsets, is expected to achieve compliance with the selenium Waste Load Allocation for groundwater dewatering in the low flow conditions as set forth in the Selenium TMDL that EPA adopted in 2002. It does so by reducing point-source discharges to the extent feasible by intercepting and diverting significant selenium loads from diffuse non-point sources. In addition implementation of the 2013 BMP Strategic Plan is expected to achieve performance based compliance with the TMDL provisions of the MS4 Permit. In EPA's 2002 TMDL, responsibility for meeting the Load Allocation for diffuse non-point sources was not assigned. The collaborative Watershed approach provides a positive incentive to reduce diffuse non-point source loads voluntarily through an approved offset program while the Regional Board and NSMP Working Group continue to revise the TMDL and develop the long-term Implementation Plan required by state regulation. With the adoption of the Selenium TMDL, elements of the offset mitigation program may need to be revised.

3.3. PHASE II: REGIONAL MONITORING PLAN

The Se RMP outlines multimedia monitoring activities within the Sub-Watersheds and the entire Newport Bay Watershed including Big Canyon Wash for the distribution, transport/transformation, and bioaccumulation of selenium. This Se RMP is designed to assess the progress toward achieving the vision of the BMP Strategic Plan. Certain elements in the Se RMP are designed to evaluate the effectiveness of planned BMPs and their contribution to selenium reduction within the Watershed.

The Se RMP is designed to address the following questions:

- 1) What are the selenium concentrations in the surface waters in the Watershed, and how do they compare with the California Toxics Rule (CTR) criterion and the water quality targets specified in the proposed Regional Board TMDLs?
- 2) What are the selenium concentrations in the targeted biota, and how do they compare with the proposed Regional Board selenium tissue-based site-specific objectives (SSOs)?
- 3) What types of aquatic habitat exist in the watershed, and whether/how these habitats support various fish populations/community structures?
- 4) What are the trends in selenium concentrations in water, sediment, and biota?
- 5) How does selenium transform/cycle within different compartments, including water, suspended particulates, bedded sediment, and biota?



- 6) If certain BMPs are implemented, what are the selenium reductions attributable to the BMPs, and what are the changes observed/measured in the receiving water?

To address the above questions, the Se RMP employs a flexible, tiered, and multimedia approach that maximizes integration with existing watershed monitoring efforts. The regional monitoring efforts include the following tiers:

- Tier 0 (if applicable). Quarterly BMP effectiveness monitoring based on inflow and effluent monitoring and receiving water monitoring upstream and downstream of the BMP;
- Tier 1. Monthly water quality monitoring at existing mass emission sites and quarterly water quality monitoring at two existing Upper Newport Bay monitoring sites;
- Tier 2. Quarterly sediment monitoring at existing mass emission monitoring sites and two existing Upper Newport Bay monitoring sites;
- Tier 3. Annual water quality and sediment monitoring [including collection and analysis of Se in water (including Se species), suspended particulates, bed sediment, and algae] associated with tissue monitoring;
- Tier 4. Annual collection and analysis of fish tissue and bird eggs for Se and habitat survey;
- Tier 5. Ad hoc special studies

Using the tiered approach, the Se RMP focuses more intensive monitoring on areas with high selenium levels, major drainage channels, and ecologically sensitive areas. The locations, sampling frequencies, and monitoring parameters are intended to be flexible and subject to adjustments depending on habitat variability, selenium levels, and sample availability, especially for tissue samples. With review and approval from RB staff, the monitoring efforts may be scaled up or down in response to changes in observed selenium levels in different tiers.

The detailed Se RMP is included as Appendix A.

3.4. PHASE III: BMP/TECHNOLOGY EVALUATION

NSMP Funding Partners will review journal articles, online references, and technical reports, and will communicate with researchers and vendors, to evaluate the most up-to-date information on selenium and nitrogen treatment. The potential for implementation of a newly identified BMP technology in the Watershed will be evaluated on the basis of:

- The selenium removal capability and efficiency;
- The ability to remove nitrogen and other pollutants ;
- The physical requirements and capabilities of the technology's operating flows, land and energy requirements, pre-treatment requirements, modular capabilities,



portability of the treatment, lifespan of the treatment media, start-up and shut-down considerations, and operation and maintenance requirements;

- Any potential discharge concerns, including any issues with selenium speciation, nuisance factors, process waste streams, solid waste disposal, associated permitting requirements and costs;
- The capital and operations and maintenance costs.

Those technologies that are deemed obsolete, based on new technologies, new information, or new regulatory requirements may also be identified as part of this evaluation. Updates on the BMP/Technology evaluation will be included in the County's Annual Report.

3.5. ADAPTIVE MANAGEMENT

The Plan is a living document that embraces the principles of adaptive management. The implementation measures identified in this version of the Plan may be modified in response to information obtained through the ongoing collaborative effort with the Regional Board, BMP/technology evaluations and the Se RMP. Specifically, the adaptive management framework of this Plan incorporates three critical elements: the anticipated regulatory actions; the effectiveness of source control activities and nitrogen and selenium reduction projects; and potential additional actions.

Anticipated regulatory actions including revised TMDLs and programmatic constraints will be actively monitored and integrated into the Plan. The NSMP Funding Partners will contribute to the development of the TMDL, the extension of Time Schedule Order R8-2009-0069, the development of SSOs, and the ongoing development of the offset mitigation program and associated diversion projects.

The NSMP Funding Partners will evaluate the performance of source control activities and nitrogen and selenium reduction projects based on the protocols identified in the Se RMP provided in Appendix A. As defined, monitoring activities will quantify selenium and nitrogen load reductions in water and selenium concentrations in fish tissue and bird eggs. The earliest completion the PCW Pipeline Project is expected in the spring of 2015. A minimum of 2 to 5 years of monitoring is necessary upon completion of the diversion projects to draw initial conclusions on the effectiveness of these diversion projects in achieving the vision of the BMP Strategic Plan.

If the vision of the BMP Strategic Plan has not been achieved at that time, the NSMP Funding Partners will review available information, including but not limited to the applicable regulatory requirements, results of new BMP/technology evaluations, information regarding the effectiveness of the diversion projects, information from the groundwater-surface water balance study, monitoring data, and any other additional relevant information to date. The NSMP Funding Partners will then identify the actions needed to achieve the vision of the BMP Strategic Plan and the schedule for implementation of actions as part of an update to the BMP Strategic Plan.



4. SUMMARY & SCHEDULE

The BMP Strategic Plan was developed by the NSMP Funding Partners with input from the larger Working Group. The Plan adopts a phased approach that relies foremost on the implementation of source controls and selenium and nitrogen reduction projects within the Watershed. The Plan includes other actions to assess selenium and nitrogen reductions in water and selenium concentrations in fish tissue and bird eggs, to assess if beneficial uses are protected in the Watershed, and to identify additional potential implementation actions. Planned activities include watershed monitoring, identification of potential new technologies, development of an offset mitigation program, and adaptive management based on information obtained.

The feasibility of two sewer diversion projects, the PCW Pipeline Project and SAD Diversion Project, has been demonstrated on both technical and cost bases. The NSMP Funding Partners of these two projects will initiate the design and permit phase pending approval by the Regional Board of the BMP Strategic Plan and offset mitigation program. The NSMP Funding Partners of these two projects will let the construction contracts for the projects upon extension of the Time Schedule Order R8-2009-0069, or in conformance with grant requirement deadlines, whichever is later. Tables 7 and 8 below identify the timelines for the PCW Pipeline Project and the SAD Diversion Project and the milestones to be met by both the Funding Partners and the Regional Board to ensure the critical completion of the two projects. Table 9 below provides a selenium management schedule identifying timeframes for regulatory actions and the diversion projects. As noted previously, the NSMP Funding Partners will support the development of the TMDL and SSOs and pursue the ongoing development of the offset mitigation program.

Table 7 - PCW Diversion Project Schedule

Project Development Step	Date (actual/estimated)	Status
Peters Canyon Channel Water Capture and Reuse Pipeline Concept Feasibility Study	March 2012- January 25, 2013	Completed
OCTA Measure M2 Environmental Cleanup Program Tier 2 Grant Application	September 4, 2012	Completed
One Water One Watershed Proposition 84 IRWM Round 2 SAWPA Grant Application	October 1, 2012	Completed
OWOW Prop. 84 IRWM Round 2 SAWPA Grant Selection Notice	December 13, 2012	Completed
OCTA Grant Award Notice	February 25, 2013	Completed
Determination of Project as Approved Offset Program	<i>September 2013</i>	Pending
Project Funding Agreement Consideration by Councils/Boards	<i>September/October 2013</i>	Pending
Prop. 84 IRWM Round 2 DWR Grant Award Notice	<i>October 2013</i>	Pending
Approval of TSO Extensions for Irvine and General	<i>November 2013</i>	Pending



Project Development Step	Date (actual/estimated)	Status
Dewatering Permits to accommodate Project implementation		
Award of Design/Environmental Contract(s)	<i>November 2013</i>	Pending
CEQA Review and Environmental Permitting	<i>December 2013- Summer 2014</i>	Pending
100% Design Completed	<i>Summer 2014</i>	Pending
Award of Construction Contract	<i>Summer, 2014</i>	Pending
Begin Construction	<i>Summer 2014</i>	Pending
Construction Complete	<i>2015</i>	Pending

Table 8 - Santa Ana-Delhi Diversion Project Development Schedule

Santa Ana-Delhi Project Development Schedule		
Activity Description	Date	Status
Santa Ana-Delhi Diversion Project Feasibility Study	July 31, 2012	Completed
OCTA Measure M2 Environmental Cleanup Program Tier 2 Grant Application	September 4, 2012	Completed
OCTA Grant Award Notice/Funding Agreement	May 19, 2013	Completed
Revision of Orange County Sanitation District Dry Weather Urban Runoff Program to accommodate proposed Se diversion projects	June 26, 2013	Completed
Final Conceptual Design Approval by Funding Partners	July 2013	Pending
BMP Strategic Plan Approval by Regional Board	September/October 2013	Pending
Design Contract Amendment Approval by City Council	September/October 2013	Completed
Approval of TSO Extensions for Irvine and General Dewatering Permits to accommodate Project implementation	<i>November 2013</i>	Pending
Design	December 2013-March 2014	Pending
Environmental	December 2013-March 2014	Pending
Army Corps, Regional Board, Fish & Game, County Flood Permits	December 2013-April 2014	Pending
CEQA Approval	December 2013-April 2014	Pending
Easements/ROW Agreements	December 2013-April 2014	Pending
Funding Agreement Approval by Councils/Boards	December 2013	Pending
Bid Construction Contract	April 2014	Pending
Award of Construction Contract	June 2014	Pending
Construction	August 2014-August 2015	Pending



Table 9 - Selenium Management Schedule

#	Element	2013	2014	2015	2016	2017	2018	2019	
1	Time Schedule Order	Current TSO			Proposed TSO Extension Period				
2	Diversion Project	Design Phase		Construction Phase		Operate Diversion and Collect Data to Evaluate BMP Effectiveness			
3	General Dewatering Permits	Current Irvine and General Dewatering Permits ←					→ Authorize New Irvine and General Dewatering Permits		
4	TMDL Development	Draft Revised TMDL		State Approval	Fed. Approval	Implement Revised TMDL			
5	MS4 Permit	RoWD	Draft	Approve	Implement New MS4 Permit			RoWD	
6	Selenium Objective	Develop SSO for Tissues or Water Column (<i>duration uncertain</i>)							

- 1) Current TSO expires December 10, 2014. State law allows a 5-year extension to December 2019. There is also the potential to tie the extension expiration date to the adoption of the TMDL.
- 2) Additional time required to complete construction of the diversion works and collect data required to demonstrate project effectiveness.
- 3) Additional time required to obtain all of the required state and federal regulatory approvals for the revised TMDL. At the time the TSOs were adopted (12/09) these approvals were expected to occur by the end of 2012.



-
- 4) Additional time required to preserve existing permit authorization under The General Dewatering Permit and the Irvine Dewatering Permit. With respect to the General Dewatering Permit, TSO R8-2009-0069 administratively extended the underlying Order of the General Dewatering Permit. Therefore, a TSO extension is required for the General Dewatering Permit to avoid a de facto moratorium on temporary construction dewatering, which would undermine critical financial support for participation in the proposed project. The diversion strategy results in significantly more selenium reduction (≈ 229 lbs. /yr.) than would otherwise occur by disallowing Caltrans dewatering (100 lbs/year), Irvine discharges (15 lbs/year) and temporary construction dewatering (≈ 10 lbs./yr.). The TSO can be terminated early if the Regional Board issues a new General Dewatering Permit (following EPA approval of revised TMDL).
 - 5) Timeline reflects Regional Board staff's preference to issue new MS4 Permit before the revised TMDL has been approved by State Board and USEPA. MS4 Permit may need to be reopened and amended after the revised TMDL has been approved by federal and state authorities.
 - 6) More time is required for Regional Board and NSMP to develop/adopt a SSO for the Newport Bay Watershed. The specific duration of these tasks is unknown at this time.



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APPENDIX A - SELENIUM REGIONAL MONITORING PLAN

**Selenium Regional Monitoring Plan
For
Newport Bay Watershed**

December 2013

Prepared on behalf of the County of Orange, Orange County Flood Control District, and Cities of Costa Mesa, Irvine, Laguna Hills, Laguna Woods, Lake Forest, Newport Beach, Orange, Santa Ana, Tustin, the Irvine Ranch Water District, Irvine Company and Lennar.

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Table of Contents

Executive Summary	v
1. Introduction.....	1
1.1. Watershed Characteristics	1
1.2. Regulatory History	4
1.3. Existing Watershed Monitoring Efforts.....	5
2. Watershed Monitoring Approaches	6
2.1. Monitoring Questions	6
2.2. Flexible Monitoring Design.....	6
2.3. Tiered Approach	6
3. Monitoring Site Description	8
3.1. Monitoring Site Selection.....	8
3.1.1. Factors for Site Selection.....	8
3.1.2. Flexibility in Site Selection.....	8
3.1.3. Dry Weather Requirement	8
3.2. Watershed Sub-Areas and Site Descriptions	8
3.2.1. Upper San Diego Creek Area.....	8
3.2.2. Upper Peters Canyon Wash Area	9
3.2.3. Lower Peters Canyon Wash Area	10
3.2.4. Lower San Diego Creek Area.....	10
3.2.5. San Joaquin Marsh Area	12
3.2.6. Upper Newport Bay and Vicinity Area.....	14
3.2.7. Big Canyon Wash	17
4. Regional Monitoring Plan Details	19
4.1. Tier 0: BMP Effectiveness Monitoring	20
4.2. Tier 1: Monthly/Quarterly Water Quality Monitoring.....	21
4.3. Tier 2: Quarterly Sediment Monitoring	21
4.4. Tier 3 Annual Water, Sediment and Selenium Speciation Monitoring.....	22
4.4.1. Selenium Speciation Monitoring.....	22
4.5. Tier 4 Annual Tissue Monitoring and Habitat Survey	23
4.5.1. Sampling Times and Locations.....	23
4.5.2. Numbers of Tissue Samples	25
4.5.3. Monitoring Parameters	25
4.5.4. Annual Watershed Fish Habitat Survey.....	25
4.6. Tier 5. Ad Hoc Special Studies	25
5. Quality Assurance and Quality Control	27
5.1. SWAMP Comparability	27
5.2. Standardized Sampling Procedure.....	27
5.3. Quality Assurance/Quality Control Procedures	27
5.3.1. Sample Chain of Custody	27
5.3.2. Quality Control Samples	28
5.4. Analytical Methods.....	29
5.5. Data Management.....	29

6. Annual Report and Future Revisions	30
6.1. Annual Reports	30
6.2. Future Revisions.....	30
References.....	31

List of Figures

Figure 1. Map of the Newport Bay Watershed (see Table 1 for names of surface streams)	3
Figure 1. Upper San Diego Creek at Harvard (Station Code: WYL)	9
Figure 3. Central Irvine Channel (Station Code: CIC).....	10
Figure 4. Peters Canyon Wash at Barranca Parkway (Station Code BAR)	11
Figure 5. San Diego Creek at Campus Drive (Station Code: SDM)	11
Figure 6. IRWD San Joaquin Marsh Treatment Wetlands (Station Code: SJM)	12
Figure 7. Aerial Photo of IRWD San Joaquin Marsh Treatment Wetlands.....	13
Figure 8. UCI Fresh Water Marsh Reserve (Station Code: UCI).....	13
Figure 9. Aerial Photo of UCI Fresh Water Marsh Reserve (constructed wetlands are delineated by dashed red lines).....	14
Figure 10. Upper Newport Bay (Station Code: UNB)	15
Figure 11. Santa Ana-Delhi Channel (Station Code: SAD).....	16
Figure 12. Costa Mesa Channel (Station Code: CMC).	16
Figure 13. Big Canyon Wash (Station Code: BCW) in the Big Canyon Nature Park	17
Figure 14. Aerial Photo of Big Canyon Wash Watershed (shaded area) with monitoring sites (see Figure 13) marked in red.	18
Figure 15. Existing watershed NPDES Monitoring Stations in the Se RMP	20
Figure 16. Tier 3 annual water and sediment selenium monitoring sites.	23
Figure 17. Tier 4 tissue monitoring sites.....	24
Figure 18. An example of a chain of custody (CoC)	28

List of Tables

Table 1. Index of surface water channels in the Newport Bay Watershed for Figure 1.....	2
Table 2. Summary of Monitoring Constituents	21

Executive Summary

The Selenium Regional Monitoring Plan (Se RMP) for the Newport Bay Watershed (Watershed) outlines multimedia monitoring activities within the Watershed for the distribution, transport/transformation, and bioaccumulation of selenium. This Se RMP is question-driven and geared toward assessing the progress toward, and attainment of, compliance of the proposed Selenium Total Maximum Daily Loads (TMDLs) and associated selenium site-specific water quality objectives (SSOs). Certain elements in the Se RMP are designed to evaluate the effectiveness of planned best management practices (BMPs) outlined in the BMP Strategic Plan. As such, this Se RMP also assesses the progress toward achieving the vision of the Strategic Plan.

The Se RMP is designed to address the following questions:

- 7) What are the selenium concentrations in the surface waters in the Watershed, and how do they compare with the California Toxics Rule (CTR) criterion and the water quality objectives specified in the proposed Regional Board TMDLs?
- 8) What are the selenium concentrations in the targeted biota, and how do they compare with the proposed Regional Board selenium tissue-based site-specific objectives (SSOs)?
- 9) What types of aquatic habitat exist in the watershed, and whether/how these habitats support various fish populations/community structures?
- 10) What are the trends in selenium concentrations in water, sediment, and biota?
- 11) How does selenium transform/cycle within different compartments, including water, suspended particulates, sediment, and biota?
- 12) If certain BMPs are implemented, what are the selenium reductions attributable to the BMPs, and what are the changes observed/measured in the receiving water?

To address the above questions, the Se RMP employs a flexible, tiered, and multimedia approach that maximizes integration with existing watershed monitoring efforts. The regional monitoring efforts include the following tiers:

- Tier 0 (if applicable). Quarterly BMP effectiveness monitoring based on inflow and effluent monitoring and receiving water monitoring upstream and downstream of the BMP;
- Tier 1. Monthly water quality monitoring at existing mass emission sites and quarterly water quality monitoring at two existing Upper Newport Bay monitoring sites;
- Tier 2. Quarterly sediment monitoring at existing mass emission sites and two existing Upper Newport Bay monitoring sites;
- Tier 3. Annual water quality and sediment monitoring [including collection and analysis of Se in water (including Se species), suspended particulates, bedded sediment, and algae] associated with tissue monitoring;
- Tier 4. Annual tissue monitoring and habitat survey;
- Tier 5. *Ad hoc* special studies.

Using the tiered approach, the Se RMP focuses more intensive monitoring on areas with high selenium levels, major drainage channels, and ecologically sensitive areas. The

locations, sampling frequencies, and monitoring parameters are intended to be flexible and subject to adjustments depending on habitat variability, selenium levels, and sample availability, especially for tissue samples. With review and input from Regional Board staff, the efforts may be scaled up or down depending on observed selenium levels in different tiers.

Water, sediment, and tissue samples from the tiered monitoring will be analyzed to assess compliance with CTR, the proposed TMDL numeric target(s), as well as the tissue-based SSOs. Tier 4 tissue sampling and Tier 3 water/sediment sampling will be conducted concurrently to provide insight to the biogeochemical cycling and bioaccumulation of selenium. If selenium-reduction BMPs are implemented, Tier 0 (BMP effectiveness monitoring) will be activated, and other tiers may be adjusted to quantify potential changes in receiving waters (including responses in the biota) as a result of these BMPs.

To maximize the integration with existing watershed monitoring efforts, the majority of the monitoring sites in the Se RMP are existing watershed monitoring stations, including six NPDES mass loading monitoring sites and two existing Upper Newport Bay monitoring sites (part of the Nutrient TMDL monitoring requirements) with high-frequency water quality and sediment monitoring. The integration will allow better use of historical water quality and flow gaging data from these existing sites and maximize sample collection efficiency.

1. Introduction

1.1. Watershed Characteristics

The Newport Bay Watershed (Watershed) covers an area of 152 square miles (97,280 acres) in central Orange County, California. Cities located partly or fully in the watershed include Orange, Tustin, Santa Ana, Irvine, Lake Forest, Laguna Hills, Costa Mesa, and Newport Beach. Some unincorporated County lands are also located in the Watershed (**Figure 1**). The San Diego Creek watershed is part of the larger Newport Bay Watershed and occupies about 119 square miles. The remainder of the Newport Bay Watershed includes Upper and Lower Newport Bay and other small tributary drainages.

While the Watershed is heavily urbanized, Newport Bay is one of the most important bays in Southern California from both an ecological and recreational perspective. Upper Newport Bay includes a 752-acre State Ecological Reserve (Upper Newport Bay Ecological Reserve and Nature Preserve) where saltwater from the Pacific Ocean mixes with fresh water primarily from San Diego Creek (SDC). Upper Newport Bay provides critical habitats for five threatened or endangered bird species: California least tern, Belding's Savannah sparrow, coastal California gnatcatcher, peregrine falcon, and light-footed clapper rail. The rich salt marshes in Upper Newport Bay provide critical habitat for one endangered plant species (salt marsh bird's-beak). The Bay is also a major stopping place for birds migrating along the Pacific Flyway, and up to 30,000 birds are present from August to April. At least 78 species of fish occur in the Bay, providing recreational opportunities for anglers (mostly in the Lower Bay) and food for predatory birds.

The central portion of the watershed is largely occupied by the relatively flat Tustin Plain, bounded to the northeast by the Santiago Hills and by the San Joaquin Hills to the southwest. The local geology consists of a Cretaceous crystalline basement rock overlain by Tertiary and Quaternary sequences of alluvial, fluvial, and marine sediments and has had a dynamic depositional history (Meixner et al. 2004; Hibbs and Lee, 2000). Most notably, the mid-Miocene Monterey Formation and associated marine sediments have high concentrations of selenium and other trace metals (Isaacs and Rullkötter 2001), and leaching and erosion of the rocks from these geological formations has resulted in gradual release of these elements to fluvial runoff.

Until the mid-1800s, the Santa Ana River drained into Newport Bay, while San Diego Creek and smaller tributaries had no regular outlet and flowed into a large swamp, called Cienega de las Ranas, or Swamp of the Frogs (Swamp; Trimble 1998) and an adjacent ephemeral lake and alkali flat (Hibbs et al, 2008; see **Figure 1**). Over thousands of years, the Swamp collected selenium in its mobile, oxidative form and concentrated the reduced selenium species in its hydric, organic-rich and reducing sediment. However, the process of continuously concentrating selenium by leaching, reduction, and immobilization was interrupted by changes in land use. In the early 1900s, to enable row crop cultivation in the area, the Swamp was drained, vegetation was cleared, and agricultural drainage channels were excavated (Trimble 1998). As the area shifted from agriculture to urban uses during the 20th century, agricultural channels became flood control channels. San Diego Creek, for example, was channelized in 1963 to connect the watershed to Upper Newport Bay.

Draining of the Swamp and subsequent channel incision through the shallow, perched, selenium-rich aquifer has lowered the groundwater table, introducing oxygen into previously hydric and reducing soils, and caused oxidation and mobilization of reducing selenium accumulated in the former Swamp for thousands of years (Hibbs and Lee 2000).

Table 1. *Index of surface water channels in the Newport Bay Watershed for Figure 1*

Hydrological Unit	Channel Name	Hydrological Unit	Channel Name
F01	Santa Ana-Delhi Channel	F15	Sand Canyon Channel
F04	Bonita Channel	F16	Marshburn Channel
F05	San Diego Creek	F17	Bee Canyon Channel
F06	Peters Canyon Wash	F18	Aqua Chinon Channel
F06P08	Edinger Circular Drain	F19	Serrano Creek
F06S02	Valencia Drain	F20	Borrego Canyon Channel
F06S03	Como Channel	F23	Cañada Channel
F06WAR	Warner Channel	F25	Central Irvine Channel
F07	El Modena-Irvine Channel	F26	Rattlesnake Canyon Channel
F08	Lane Channel	F27	Hicks Canyon Channel
F09	Barranca Channel	G02	Costa Mesa Channel
F10	Santa Ana-Santa Fe Channel	G03	Santa Isabel Channel
F14	San Joaquin Channel	G04	Big Canyon Wash

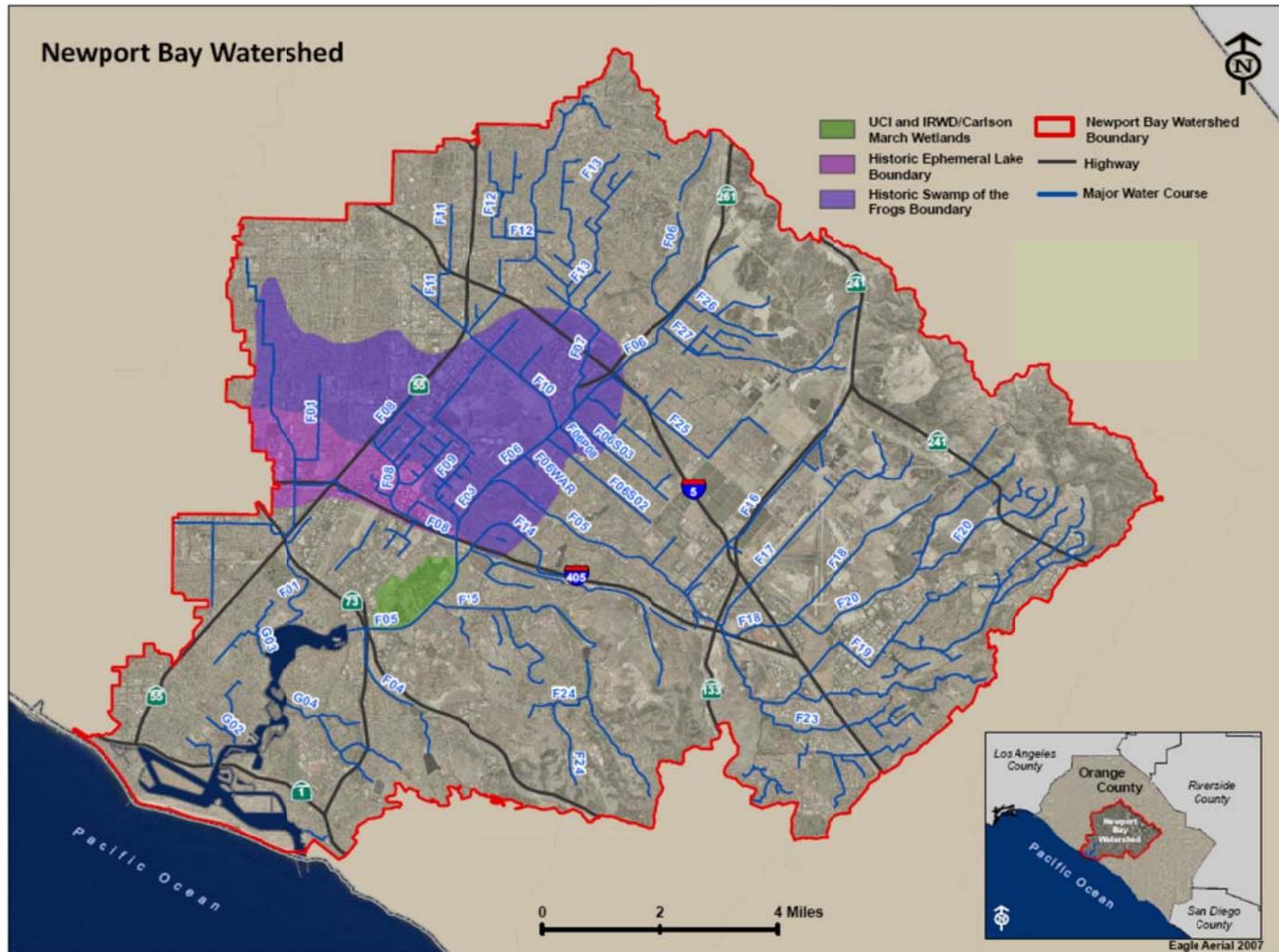


Figure 1. Map of the Newport Bay Watershed (see Table 1 for names of surface streams)

1.2. Regulatory History

On June 14, 2002, the United States Environmental Protection Agency (USEPA) established Total Maximum Daily Loads (EPA TMDLs) for 14 toxic pollutants, including selenium, for San Diego Creek watershed and Newport Bay (USEPA, 2002). The EPA TMDL for selenium was based primarily on exceedances of the California Toxics Rule (CTR) chronic criterion for selenium in freshwater (5µg/L). In December 2004, the Regional Board adopted Order No. R8-2004-0021, NPDES No. CAG998002, General Waste Discharge Requirements for Short-Term Groundwater-Related Discharges and *de minimus* Wastewater Discharges to Surface Waters within the San Diego Creek/Newport Bay Watershed (SARWQCB, 2004)) (General Dewatering Permit). This order was necessitated by the EPA TMDLs and the recognition that groundwater-related discharges had the potential to contribute selenium to the watershed.

In adopting the General Dewatering Permit, the Regional Board recognized that there were no reasonably feasible or practicable selenium treatment technologies to achieve the 4µg/L effluent limitations. Therefore, as allowed by the State Implementation Plan (SIP), the Order provided a 5-year compliance schedule for stakeholders to achieve the selenium limitations prompting the formation of the Nitrogen and Selenium Management Program (NSMP) and the NSMP Working Group. The Working Group is comprised of stakeholders in the Watershed including municipalities, major landowners, water providers, the Regional Board and several environmental organizations. The Working Group developed and implemented a five-year Work Plan to complete the following tasks:

- Task 1: Design and implement a monitoring program, for filling data gaps regarding selenium and nutrients (nitrogen as nitrate) to understand the extent of the ecosystem impacts;
- Task 2: Develop and evaluate BMPs and treatment technologies, to identify those that can reasonably be applied throughout the Watershed to reduce the inputs of nitrogen and selenium;
- Task 3: Develop an offset, trading or mitigation program by building upon the knowledge gained from Tasks 1 & 2 to develop a management program for selenium and nutrients in the watershed;
- Task 4: Evaluate groundwater related sources, loadings and reductions of nutrients;
- Task 5: Develop Site-Specific Objectives (SSOs) for selenium through an understanding of selenium speciation and bioaccumulation in the Watershed; and
- Task 6: Manage and communicate information dissemination to the Working Group and others.

Since the adoption of Order 2004-0021, which was later modified by Order 2007-0041 (SARWQCB, 2007) and amended by Order 2009-0045 and subsequently extended by the Time Schedule Order (TSO) R8-2009-0069, the NSMP Working Group has made significant progress and completed essentially all Work Plan tasks. A significant amount of new knowledge about selenium distribution and biogeochemistry has been gained

through continuous monitoring and special studies; several selenium reduction projects have received grant funding and are expected to result in significant load reductions for both selenium and nitrogen.

1.3. Existing Watershed Monitoring Efforts

Extensive water quality monitoring is conducted in the Watershed as part of the requirements of NPDES Permit No. CAS618030, Orders No. R8-2009-0030 and prior orders. The NPDES Monitoring Program (OCSP, 2005) includes eight elements, of which the Mass Emission Monitoring and Upper Newport Bay Monitoring elements are the most relevant to the Se RMP. The monitoring sites associated with Mass Emission Monitoring are subject to monthly water quality monitoring of all conventional and toxic pollutants including selenium. Sediments are also monitored quarterly for a complete suite of chemical and toxicological constituents, including selenium.

Streamgaging is also conducted at these mass emission stations. For the Upper Newport Bay monitoring element, two sites located in Upper Newport Bay (UNBJAM; near San Diego Creek outfall, and UNBSDC, near Santa Ana-Delhi outfall) are sampled quarterly for both water and sediment, both including selenium in their target constituents.

NSMP conducted watershed monitoring with a focus on selenium since 2005. Notably, the watershed biota monitoring and associated water/sediment monitoring started in 2010. A special study was conducted by County that established a preliminary selenium mass balance for lower Peters Canyon Wash (Ngo et al., 2012). A special study was conducted by the Regional Board staff (Reeder, 2011) at Big Canyon Wash watershed.

In addition, Regional Water Board staff implemented a bioaccumulative constituent trend monitoring program beginning in 2006, which targets collection and analysis of water, sediment and fish tissue in both fresh and saltwater locations in the Newport Bay Watershed. Selenium analysis was included as part of this monitoring program until 2013, when monitoring activities for this program began to be coordinated with monitoring conducted by the NSMP and the Toxicity Reduction and Investigation Program (TRIP), which focuses on legacy and current use pesticides.

2. Watershed Monitoring Approaches

2.1. Monitoring Questions

The purpose of an effective ambient monitoring program is to answer assessment questions. These questions, therefore, should guide the design of the monitoring program. The questions to be addressed by this Selenium Regional Monitoring Plan (Se RMP) are as follows:

- 1) What are the selenium concentrations in the surface waters in the Watershed, and how do they compare with the California Toxics Rule (CTR) criterion and the water quality objectives specified in the proposed Regional Board TMDLs?
- 2) What are the selenium concentrations in the targeted biota, and how do they compare with the proposed Regional Board selenium tissue-based site-specific objectives (SSOs)?
- 3) What types of aquatic habitat exist in the watershed, and whether/how these habitats support various fish populations/community structures?
- 4) What are the trends in selenium concentrations in water, sediment, and biota?
- 5) How does selenium transform/cycle within different compartments, including water, suspended particulates, sediment, and biota?
- 6) If certain BMPs are implemented, what are the selenium reductions attributable to the BMPs, and what are the associated receiving water benefits?

2.2. Flexible Monitoring Design

The Se RMP is intended to be flexible in design to accommodate construction of selenium reduction BMPs and to respond to year-to-year changes in habitat, species availability and abundance, geohydrology, and selenium concentrations in the watershed. The flexibility will be manifested in the following ways: 1) If selenium reduction BMPs are built, inflow and effluent monitoring will be added, and receiving water monitoring sites may be modified to quantify their performance/effectiveness and associated receiving water changes; 2) Water and sediment sampling sites associated with tissue sampling could change year-to-year depending on the location of tissue samples, because they need to be sampled within the foraging ranges of the various fish or bird species. In addition, some bird nesting and fish habitats could change due to flooding during the prior wet season and/or channel maintenance, or drought; 3) Early monitoring data may justify increased or decreased monitoring frequency to balance representativeness and cost-effectiveness. For example, if semiannual monitoring of a site shows limited variations in selenium concentrations, annual monitoring may be justified. Alternatively, if less frequent monitoring reveals large variations in selenium concentrations, more frequent monitoring, or focused studies may be required. 4) Integration with other monitoring programs may require modifications of this Se RMP to achieve optimal cost-effectiveness, efficiency, and to fill data gaps.

2.3. Tiered Approach

The sampling locations are classified into several categories with different sampling frequencies and monitoring parameters. This approach allows for more intensive monitoring of the critical locations (selenium source regions; major drainage channels;

ecologically significant habitats) of the watershed while providing sufficient watershed-wide coverage cost-effectively.

The regional monitoring efforts are classified into the following tiers:

Tier 0 (if applicable). Quarterly BMP effectiveness monitoring based on inflow and effluent monitoring and receiving water monitoring upstream and downstream of the BMP;

Tier 1. Monthly water quality monitoring at existing mass emission sites and quarterly water quality monitoring at two existing Upper Newport Bay monitoring sites;

Tier 2. Quarterly sediment monitoring at existing mass emission monitoring sites and two existing Upper Newport Bay monitoring sites;

Tier 3. Annual water quality and sediment monitoring [including collection and analysis of Se in water (including Se species), suspended particulates, bedded sediment, and algae] associated with tissue monitoring;

Tier 4. Annual tissue monitoring and habitat survey;

Tier 5. Ad hoc special studies

3. Monitoring Site Description

3.1. Monitoring Site Selection

3.1.1. Factors for Site Selection

Monitoring sites have been selected based on existing watershed monitoring efforts, historical selenium data, surface flows, and habitat values. Existing watershed monitoring sites, mostly mass emission sites at major drainage channels, were preferred for their strategic locations in the watershed, ease of access, and available historical water quality and streamgaging data. Other existing monitoring sites located in ecologically sensitive areas were preferred due to their significance in compliance assessment for the proposed TMDLs. For these reasons, Upper Newport Bay, Big Canyon Wash, Lower San Diego Creek/San Joaquin Marsh (both UCI and IRWD portions of the Marsh), and lower Peters Canyon Wash are the focus of the monitoring effort.

3.1.2. Flexibility in Site Selection

As discussed in Section 2, the locations, analytical parameters, and sampling frequencies of these site are flexible and subject to adjustment dependent on environmental conditions. Sampling sites for tissue monitoring are inherently flexible due to uncertainty in availability of tissue samples and interannual variations in habitats.

3.1.3. Dry Weather Requirement

As a result of accessibility and safety issues, all sampling activities will be carried out during dry weather condition. Dry weather is defined as a minimum of 72 hours without precipitation preceding the sampling event.

3.2. Watershed Sub-Areas and Site Descriptions

The Watershed is divided into 7 sub-areas with unique hydrological, selenium loading, and habitat characteristics, and hence different monitoring requirements. These areas include the upper San Diego Creek area, upper Peters Canyon Wash area, lower Peters Canyon Wash area, lower San Diego Creek area, San Joaquin Marsh area (including both UCI and IRWD wetlands), Upper Newport Bay and vicinity area (including lower Santa Ana-Delhi Channel), and Big Canyon Wash.

3.2.1. Upper San Diego Creek Area

The upper San Diego Creek area includes the drainage areas of San Diego Creek Reach 2 (beyond Jeffrey Road in Irvine), Marshburn Channel, Bee Canyon Channel, Aqua Chinon Channel, Borrego Canyon Channel, Serrano Creek, and Cañada Channel (see **Figure 1**). Generally these channels drain the foothills on the northeast side of the Watershed, flow southwest and drain to San Diego Creek.

Upper San Diego Creek at Harvard Avenue (WYL; see **Figure 2**) in the City of Irvine is a mass emission site subject to monthly water quality monitoring, continuous streamgaging, and quarterly sediment monitoring. Average flows are approximately 2 cubic feet per second (cfs) despite its large drainage area (about 1/3 that of the entire watershed). The habitat value is low to marginal with frequent occurrence of mosquitofish and limited foraging by birds.



Figure 1. Upper San Diego Creek at Harvard (Station Code: WYL)

3.2.2. Upper Peters Canyon Wash Area

Peters Canyon Wash (PCW) has two distinctive hydrological regions, upper Peters Canyon Wash and lower Peters Canyon Wash. The upper Peters Canyon Wash area upstream of Como Channel is similar to the upper San Diego Creek area in that these channels (El Modena-Irvine Channel, Central Irvine Channel, Hicks Canyon Channel, and Rattlesnake Canyon Channel) drain foothills with typically low flows in dry season.

Central Irvine Channel (CIC, **Figure 3**) drains a small area in the City of Irvine with mixed urban and agriculture land uses. This site has been selected to represent the upper Peters Canyon Wash area. This site is a mass emission site for monthly water quality monitoring of all constituents including selenium.



Figure 3. Central Irvine Channel (Station Code: CIC)

3.2.3. Lower Peters Canyon Wash Area

The lower Peters Canyon Wash area, between Como Channel and the confluence with San Diego Creek, is a section characterized by high dry weather baseflows supported by seeping groundwater. This section of the Peters Canyon Wash is in the heart of the Swamp of the Frogs (**Figure 1**), where seeping shallow groundwater contributes the majority of selenium loadings of the entire watershed. The main channels that drain into lower Peters Canyon Wash include Santa Ana-Santa Fe Channel, Como Channel, Valencia Drain, and Warner Channel.

Peters Canyon Wash at Barranca Parkway (BAR; **Figure 4**) was selected to represent the lower Peters Canyon area and is a mass emission site subject to Tiers 1 through 4 monitoring as well as continuous streamgaging. The habitat is of moderate quality, with abundant mosquitofish and red shiners. Sand bars and exposed rocks in the middle of the channel provide nesting ground for a small number of birds.

3.2.4. Lower San Diego Creek Area

Lower San Diego Creek is located between the confluence of San Diego Creek-Peters Canyon Wash and Upper Newport Bay. The main stem of San Diego Creek, with slow-moving water in the in-channel sediment basins and abundant vegetation, provides habitat to a large number of bird and fish species. Main drainage channels along lower San Diego Creek include Barranca Channel, Lane Channel, San Joaquin Channel, Sand Canyon Channel, and Bonita Channel (**Figure 1**).



Figure 4. Peters Canyon Wash at Barranca Parkway (Station Code BAR)

San Diego Creek at Campus Drive (SDM; **Figure 5**) was selected to represent the lower San Diego Creek area and is a mass emission site that is subject to Tier 1 through Tier 4 samplings and continuous streamgaging. Located at the bottom of the watershed, this section of San Diego Creek accounts for approximately 85% of the freshwater input into Upper Newport Bay. Therefore, this site is critical for estimating the overall watershed selenium loading.

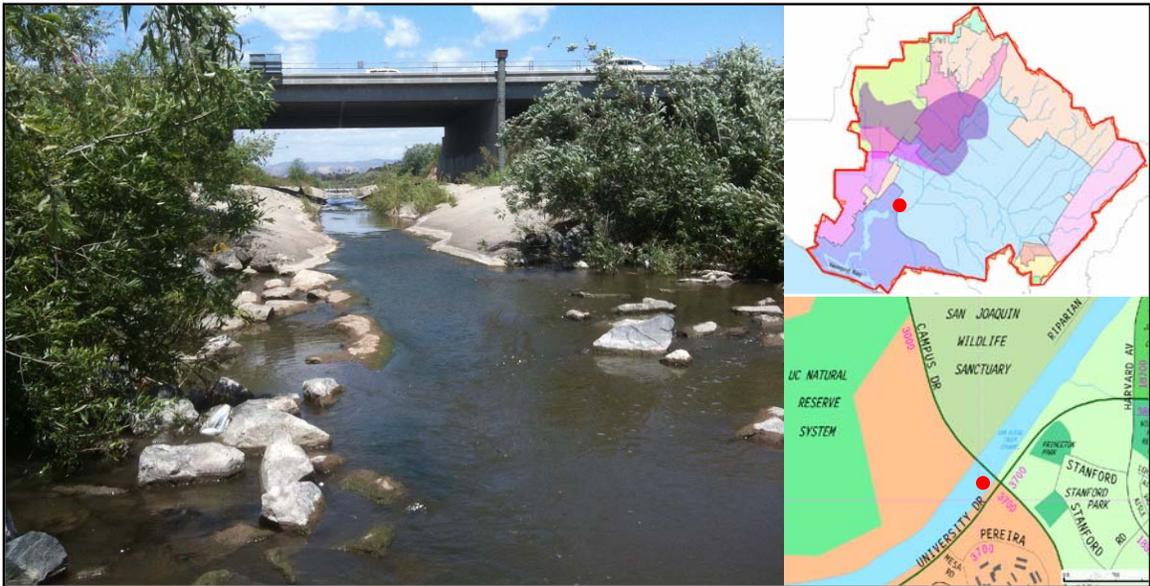


Figure 5. San Diego Creek at Campus Drive (Station Code: SDM)

3.2.5. San Joaquin Marsh Area

The San Joaquin Marsh, which includes both University of California Irvine (UCI) Freshwater Marsh Reserve and Irvine Ranch Water District (IRWD) Treatment Wetlands, provides premium habitat for a wide range of bird species. They are hydrologically connected to the lower San Diego Creek. IRWD diverts dry weather surface flows from San Diego Creek for nutrient removal in its wetlands before releasing it back to San Diego Creek. Some of the diverted water flows to other areas of the San Joaquin Marsh and UCI wetlands, where there is no outlet. The marshes differ dramatically however, in how they are managed.

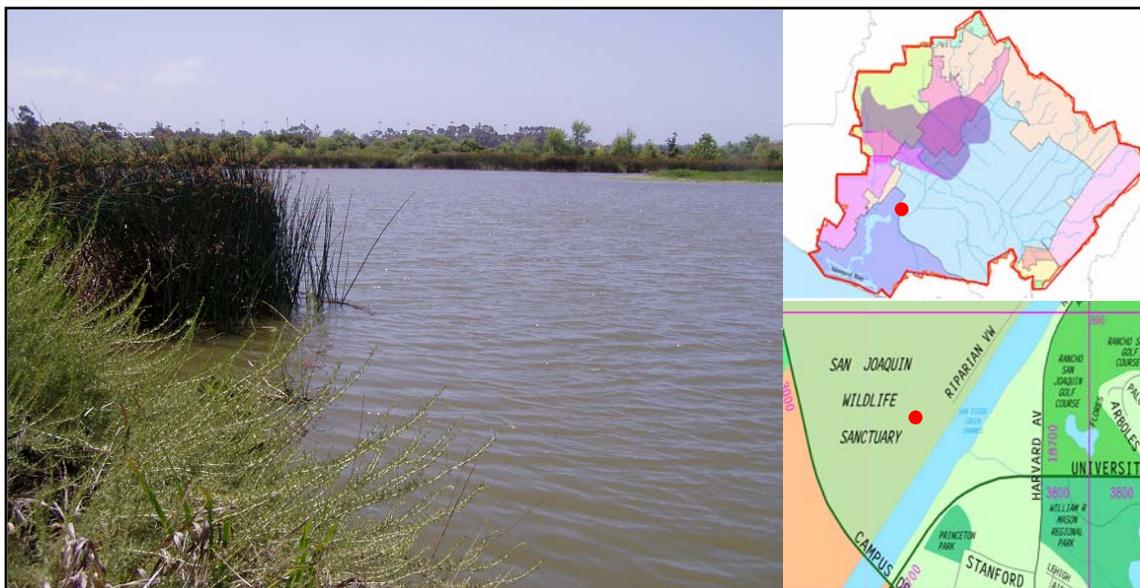


Figure 6. IRWD San Joaquin Marsh Treatment Wetlands (Station Code: SJM)

IRWD San Joaquin Marsh treatment wetlands (SJM, **Figures 6 and 7**) are a series of constructed treatment wetlands that treat diverted dry weather surface water from San Diego Creek and provide major nutrient removal (~60%) and other water quality improvements, including about 30% selenium removal. The wetlands support abundant fish species and provide good foraging areas for many bird species. Due to significant, controlled fluctuations of water levels in these ponds, bird nesting is limited. This area is one of several key areas for tissue sampling, primarily at Pond 2 (**Figure 7**). Other locations could be selected depending on sample availability.

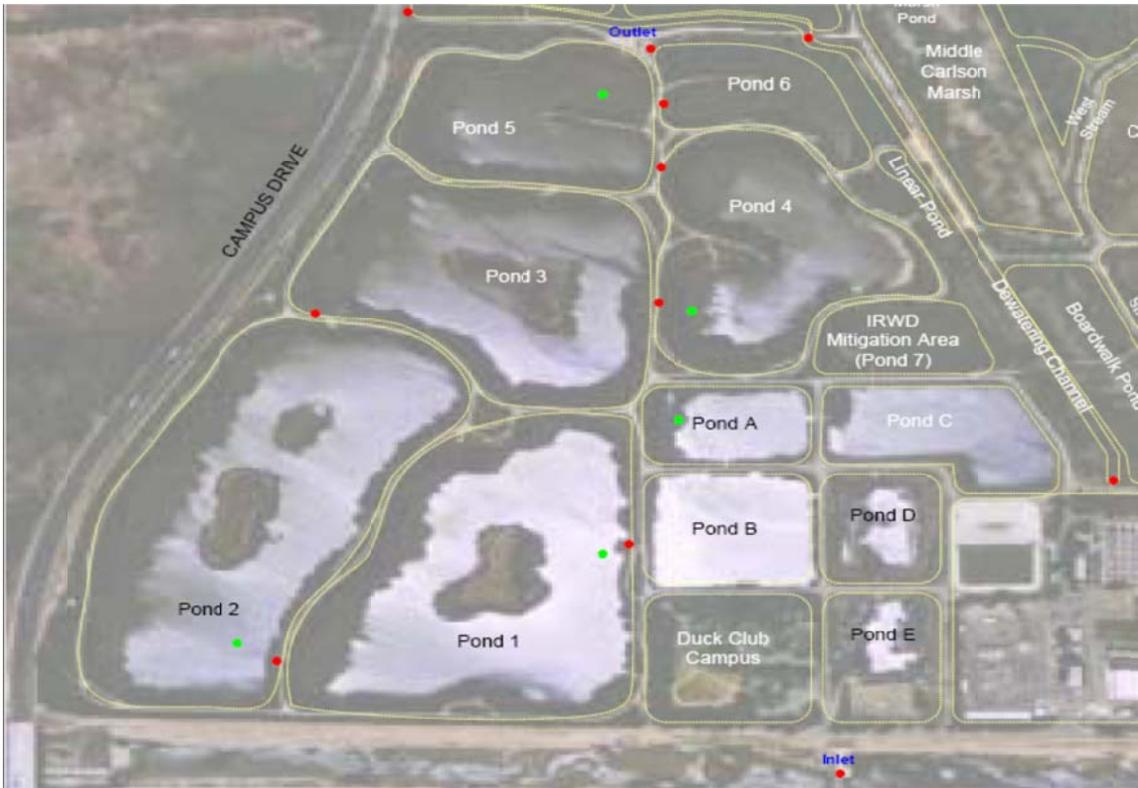


Figure 7. Aerial Photo of IRWD San Joaquin Marsh Treatment Wetlands

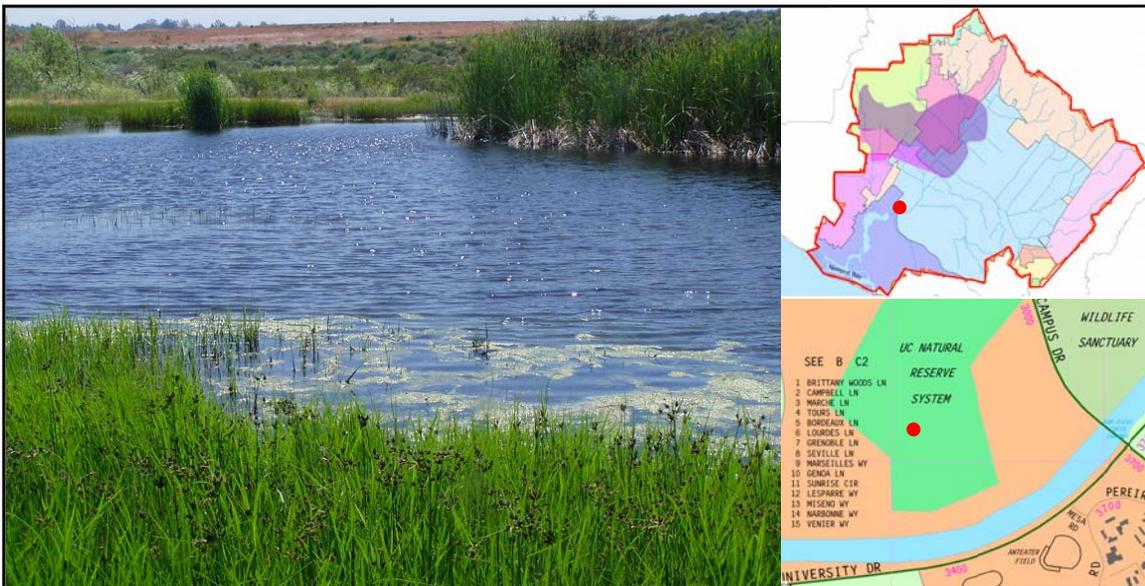


Figure 8. UCI Fresh Water Marsh Reserve (Station Code: UCI).

The wetlands at the UCI San Joaquin Fresh Water Marsh Reserve (UCI Wetlands, **Figures 8 and 9**) provide premium habitats for many bird and fish species and are one of the critical locations for tissue monitoring. Water in the UCI wetlands has three potential sources: 1) surface water diverted from San Diego Creek; 2) stormwater overflow from IRWD wetlands; 3) treated water diverted from IRWD wetlands (**Figure 9**; arrows indicate flow paths). The UCI portion of the San Joaquin Marsh is operated as ephemeral wetlands. During the dry season, the marsh is gradually allowed to dry out and the only water retained is that in the old duck pond area. The UCI marsh attracts numerous nesting birds; however, the only fish present in this portion of the marsh are mosquitofish, which are periodically stocked by Orange County Vector Control District. The wetland area (indicated by dashed red lines in **Figure 9**) is the target sampling area for tissue and water quality monitoring (Tiers 3 and 4).



Figure 9. Aerial Photo of UCI Fresh Water Marsh Reserve (constructed wetlands are delineated by dashed red lines).

3.2.6. Upper Newport Bay and Vicinity Area

This diverse area includes Upper Newport Bay (UNB; **Figure 10**), Santa Ana-Delhi Channel, Santa Isabella Channel, and Costa Mesa Channel. Upper Newport Bay provides high quality habitat for a large number of birds, fish, and plant species and is targeted for all four tiers of sampling except for fish tissue sampling in Tier 4 because there is no applicable criterion for salt water fish. For water and sediment sampling, the

sites are located at UNBJAM and UNBSDC near the outfalls of San Diego Creek and Santa Ana-Delhi Channel, respectively.



Figure 10. Upper Newport Bay (Station Code: UNBJAM, to the east; and UNBSDC, to the west)

Santa Ana-Delhi Channel (**Figure 11**) drains directly into Upper Newport Bay and contributes about 15% freshwater input to the Bay, second only to San Diego Creek. This Sub-Watershed covers 19 square miles of mostly urban land areas. A significant portion of the Swamp of the Frogs and the ephemeral lake is within this Sub-Watershed (see **Figure 1**). The upper part of the channel is mostly riprap or concrete-lined with poor habitat value. The lower portion of the channel in between Irvine Boulevard and Upper Newport Bay has a mixture of riprap, concrete-lined, and earthen banks. The portion close to Upper Newport Bay is tidally influenced and has higher habitat value. The mass emission station, Santa Ana-Delhi Channel at Irvine Boulevard (SAD) is selected and subject to Tiers 1 and 2 samplings.



Figure 11. Santa Ana-Delhi Channel (Station Code: SAD).

Costa Mesa Channel (CMC, **Figure 12**) at Westcliff in the City of Costa Mesa is a mass emission sites that is monitored monthly for water quality (Tier 1). The entire length of the channel is concrete-lined with poor habitat values.



Figure 12. Costa Mesa Channel (Station Code: CMC).

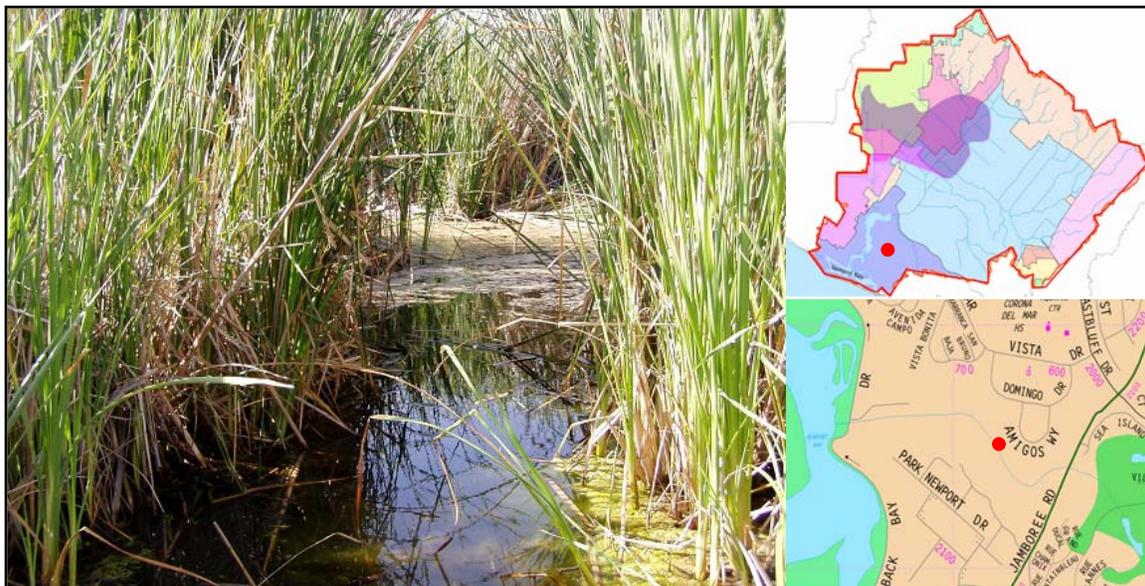


Figure 13. Big Canyon Wash (Station Code: BCW) in the Big Canyon Nature Park

3.2.7. Big Canyon Wash

Big Canyon Wash is a small watershed (2 square miles; **Figures 13 and 14**) that drains directly to Upper Newport Bay. The majority of the watershed (approximately 96%) is urbanized and a large golf course (Big Canyon Golf Course) is located at the center of the watershed. The downstream portion of the canyon is undeveloped and flows into the Upper Newport Bay Ecological Reserve (Big Canyon Creek Nature Park). The estuarine conditions created at the interface between the freshwater flows in the north branch of the lower Big Canyon Creek and saltwater in UNB provide habitat for an endangered plant, the salt marsh bird's beak (*Cordylanthus maritimus*).

Selenium concentrations measured in water samples collected from Big Canyon Wash are similar to those measured in the San Diego Creek Sub-Watershed. Due to its unique geohydrological conditions, however, the biota within this area contains very high levels of selenium. Currently, only annual tissue monitoring is regularly conducted in this Sub-Watershed. In this Se RMP, Tiers 3 and 4 monitoring will be conducted at two locations (Figure 13 and 14).

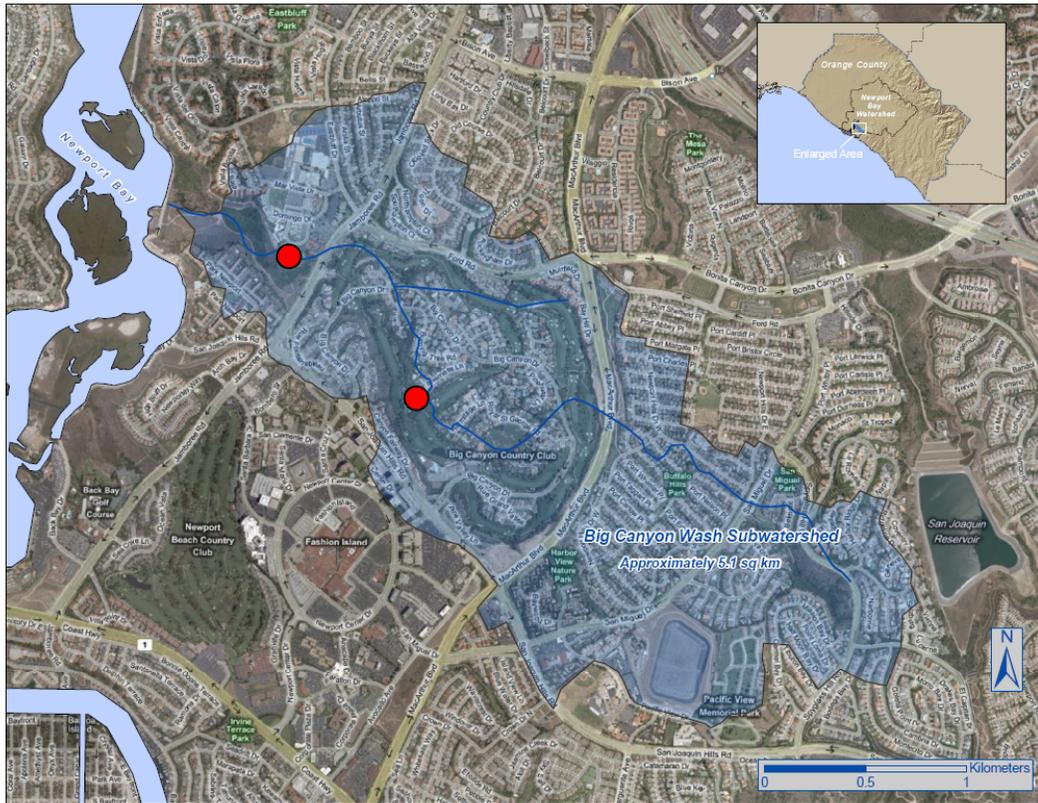


Figure 14. Aerial Photo of Big Canyon Wash Watershed (shaded area) with monitoring sites (see Figure 13) marked in red.

4. Regional Monitoring Plan Details

As mentioned above, to the extent possible, the Se RMP will be integrated with the existing watershed NPDES monitoring effort to the extent possible. Currently, there are seven NPDES monitoring stations in the Newport Bay Watershed that will be utilized for selenium Se RMP, as shown in **Figure 15**. As will be shown below, other locations are added in this RMP.

In summary, the regional monitoring efforts are classified into the following tiers:

Tier 0 (if applicable). Quarterly BMP effectiveness monitoring based on inflow and effluent monitoring and receiving water monitoring upstream and downstream of the BMP;

Tier 1. Monthly water quality monitoring at existing mass emission sites and quarterly water quality monitoring at two existing Upper Newport Bay monitoring sites;

Tier 2. Quarterly sediment monitoring at existing mass emission monitoring sites and at two existing Upper Newport Bay monitoring sites;

Tier 3. Annual water quality and sediment monitoring [including collection and analysis of Se in water (including Se species), suspended particulates, bedded sediment, and algae] associated with tissue monitoring;

Tier 4. Annual tissue monitoring and habitat survey;

Tier 5. Ad hoc special studies

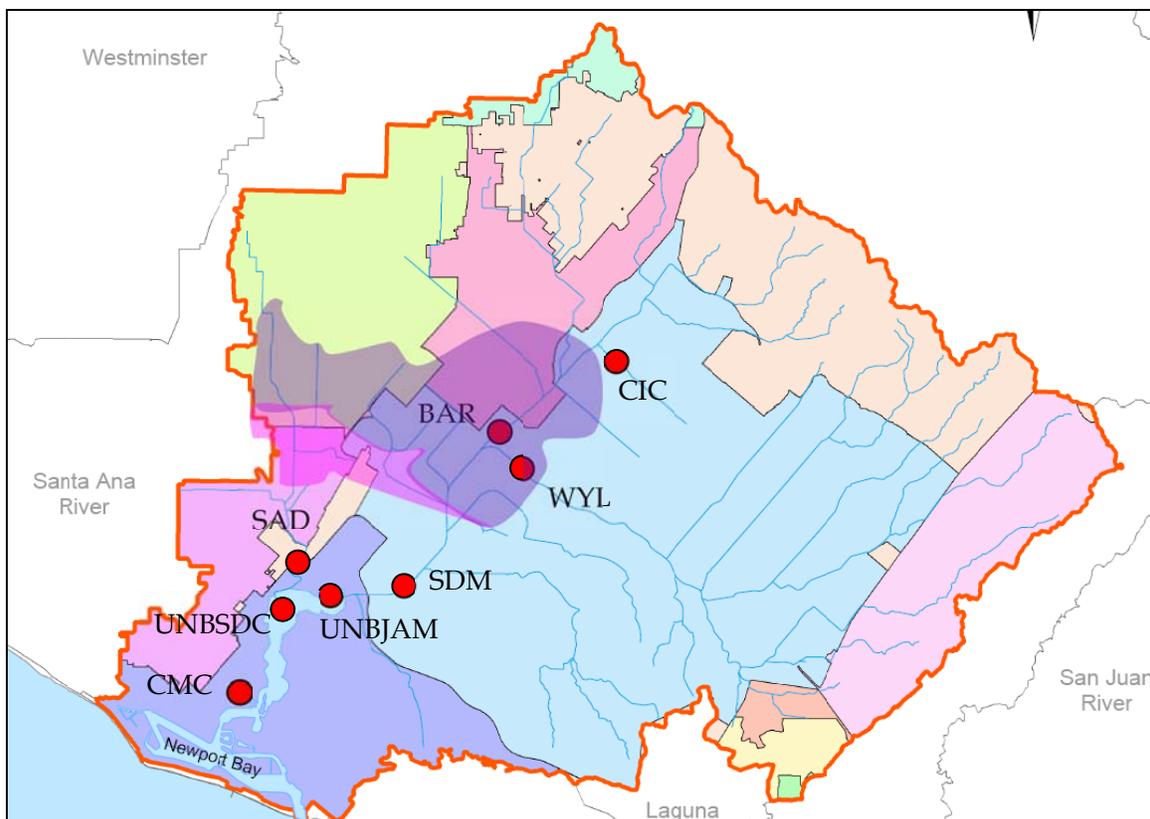


Figure 15. Existing watershed NPDES Monitoring Stations in the Se RMP

4.1. Tier 0: BMP Effectiveness Monitoring

Once a selenium reduction BMP is built, its performance and selenium reduction effectiveness shall be monitored at least quarterly depending on the nature of the project. Depending on the specific treatment processes used, additional monitoring parameters, such as selenium speciation and bacteriological monitoring are warranted to ensure receiving water quality is protected. Details of the BMP effectiveness monitoring will be project-specific and should be included as part of the project documents and are not discussed here. Components of the project-specific monitoring plan should include, baseline conditions prior to the project, monitoring locations and rationale for the monitoring locations, constituents, frequency, and duration. Coordination with Regional Board staff is encouraged during the development and implementation of a project-specific monitoring plan.

Changes in selenium concentrations and bioaccumulation in the receiving waters as a result of selenium reduction BMP(s) can be quantified on both project-specific basis and regionally depending on the location and magnitude of the BMP. For BMPs with significant selenium reduction, monitoring upstream and downstream (outside the mixing zone) of the BMP will be performed. Existing Tier1 mass emission stations (see below) downstream of a project and subject to monthly monitoring can be used as the downstream monitoring site if appropriate. Detailed information will be provided in project-specific BMP effectiveness monitoring plan.

4.2. Tier 1: Monthly/Quarterly Water Quality Monitoring

Monthly water quality monitoring at mass emissions sites (CMC, SAD, SDM, BAR, WYL, and CIC) and quarterly monitoring at UNBJAM/UNBSDC as part of the current watershed monitoring programs (OCSP, 2005) will be utilized to provide high-frequency selenium and water quality data (see **Figure 15** for site locations and Table 2 for the list of target analytes). Of these sites, SDM, UNBJAM, UNBSDC, BAR, and BCW are subject to additional sampling for Tiers 2, 3 and 4, as described below.

4.3. Tier 2: Quarterly Sediment Monitoring

The same existing sites as shown in **Figure 15** are subject to Tier 2 quarterly sediment sampling except for CIC and CMC, which are concrete-lined channels (see Table 2).

Table 2. Summary of Monitoring Constituents

Parameter	Tier 1 Monthly Water Sampling	Tier 2 Quarterly Sediment Monitoring	Tier 3 Annual Water and Sediment Monitoring		Tier 4 Annual Tissue Monitoring
			Water	Sediment	
Nitrate plus Nitrite	X		X		
Total Ammonia	X		X		
Total Kjeldahl Nitrogen (TKN)	X	X	X	X	
Total Nitrogen		X	X	X	
Total Phosphate	X	X	X	X	
Orthophosphate	X		X		
Total Organic Carbon		X		X	
Total Suspended Solids	X		X		
Percent Solids		X		X	X
Chloride	X		X		
Sulfate	X		X		
Total Dissolved Solids	X		X		
Turbidity, pH, Temperature, Electric Conductivity	X		X		

Parameter	Tier 1 Monthly Water Sampling	Tier 2 Quarterly Sediment Monitoring	Tier 3 Annual Water and Sediment Monitoring		Tier 4 Annual Tissue Monitoring
			Water	Sediment	
Hardness	X		X		
Particle Size		X		X*	
Acid/Base/Neutral extractables		X		X	
Total Selenium	X	X	X	X**	X
Selenium Speciation*					
Se ⁶⁺			X		
Se ⁴⁺			X		
selenocyanate			X		
methylseleninic acid			X		
selenomethionine			X		

*: To be carried out by Applied Speciation

**: Total selenium to be analyzed for both bedded sediment as well as suspended sediment. Algae, if found, will be sampled and analyzed for total selenium as well.

4.4. Tier 3 Annual Water, Sediment and Selenium Speciation Monitoring

Selenium in water column, sediment, and suspended particulates will be monitored at 6 sites (BAR, UCI, SJM, SDM, UNB, and BCW; see **Figure 16**), which are located within four tissue-monitoring areas: upper Peters Canyon Wash area, lower San Diego Creek area, Upper Newport Bay, and Big Canyon Wash (see Section 4.4 and **Figure 17**). See **Table 2** for the list of target analytes. Algae, if found, will be sampled and analyzed for total selenium as well.

4.4.1. Selenium Speciation Monitoring

Selenium exists in aquatic environment in many forms, including selenate (Se⁶⁺), selenite (Se⁴⁺), elemental selenium (Se⁰), selenide (Se⁻²), and organoselenium. In most part of the watershed, selenate is the most abundant form of selenium. It is also the most mobile and least bioavailable species. In the lower parts of the watershed (e.g. lower San Diego Creek sediment basins, and San Joaquin Marsh wetlands) and in Big Canyon Wash, where anaerobic and/or lentic conditions are more common, selenate is being reduced to less mobile and more bioavailable species (selenite and organoselenium). Previous studies (e.g. Hibbs and Lee, 2000; Meixner et al, 2004) have indicated that selenium speciation is critical in selenium biogeochemical cycles. Initial uptake of reduced selenium species by suspended particles from water column is likely a critical step in the

bioavailability of selenium (Presser and Luoma, 2009). Therefore, speciation monitoring for water column in the lower parts of the San Diego Creek watershed and Big Canyon Wash is included in this RMP. Applied Speciation, an industry leader in selenium speciation analysis, will conduct the analysis.

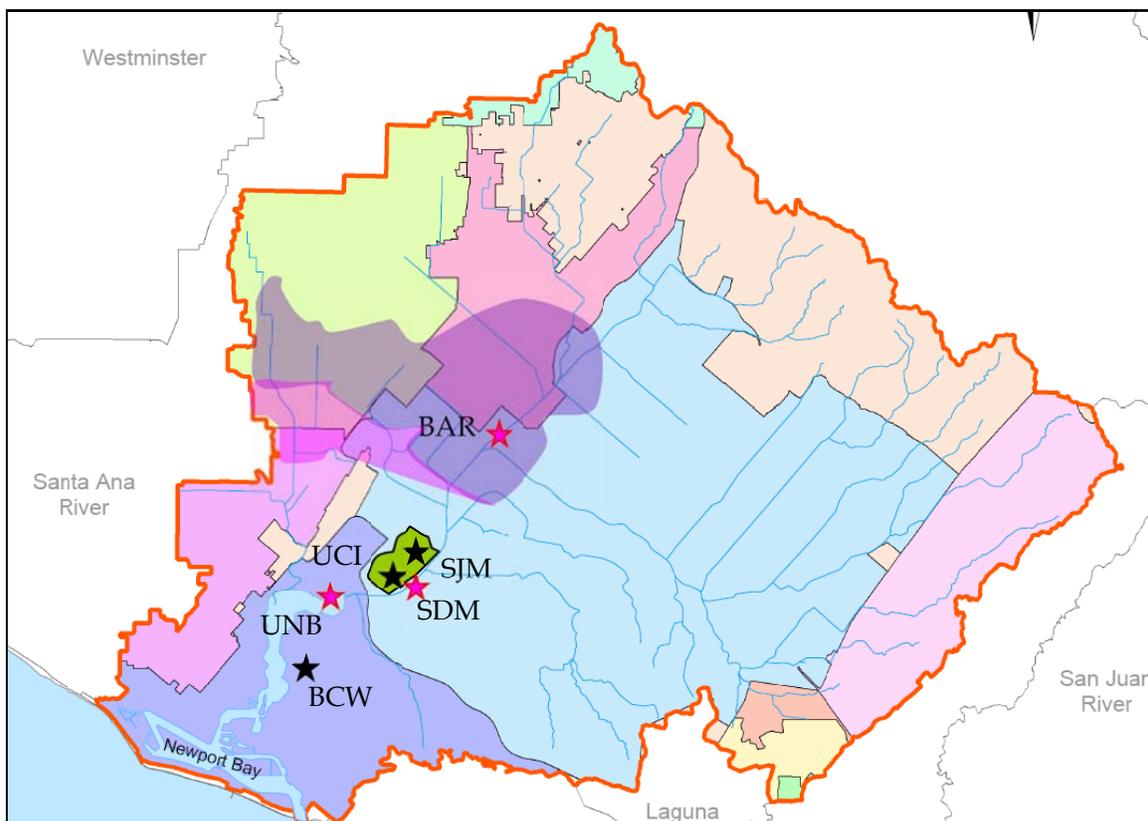


Figure 16. Tier 3 annual water and sediment selenium monitoring sites.

4.5. Tier 4 Annual Tissue Monitoring and Habitat Survey

4.5.1. Sampling Times and Locations

As stated in Section 1.1.2, the proposed RB TMDLs for Newport Bay Watershed are unique in that they are tissue-based. Final compliance with these TMDLs, if adopted, is ultimately evaluated by selenium concentrations in designated fish tissue and bird eggs. Therefore, tissue monitoring is a critical component of this Se RMP. **Figure 17** shows four critical areas for fish and bird egg sampling sites: Lower Peters Canyon Wash (PCW), lower San Diego Creek and UCI/IRWD wetlands (Lower SDC/Wetlands), Upper Newport Bay (UNB), and BCW. The exact locations for the sampling cannot be pre-determined because sampling is largely opportunistic and sampling sites vary from year to year depending on available food items (aquatic invertebrate populations), fish population, and available nesting sites for birds. It is anticipated that the sites will be generally coincident with the sites shown in **Figure 16**. Sampling will be carried out in late spring/early summer from April through August. The exact timing will be determined every year via reconnaissance trips to ensure that sampling takes place during the nesting season of the target bird species (spring, early summer) and

reproduction period of fish (early spring). The actual species collected will be based on the regulatory requirements in effect at the time of collection.

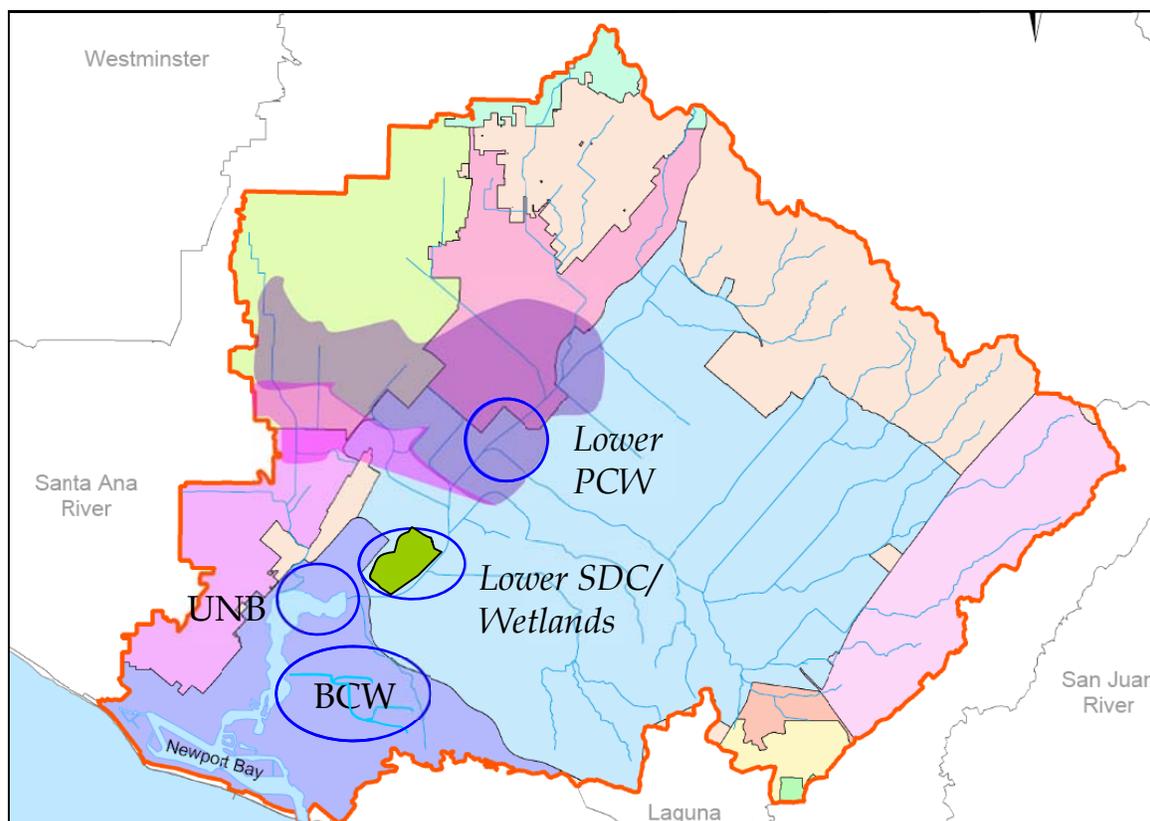


Figure 17. Tier 4 tissue monitoring sites

The fish and bird species selected include those that are likely to be either sensitive to selenium effects and/or the most exposed to selenium. Fish specimens will also be selected based on their importance in the diet of the targeted bird species. As there are no native fish species in the freshwater areas of the watershed, introduced species of fish from the *Centrarchidae* (sunfish and bass) family will be monitored to determine compliance with the TMDL fish tissue target. Because of their widespread occurrence in the watershed and the extensive body of selenium toxicity research for those species, bluegills will be collected in preference to other sunfish species. If bluegills are not present, then other sunfish species or other species (including most sensitive and most exposed species) will be targeted for collection. So far, the following species have been identified in the watershed: bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), pumpkinseed (*Lepomis gibbosus*), largemouth bass (*Micropterus salmoides*), fathead minnow (*Pimephales promelas*), red shiner (*Notropis lutrensis*), mosquitofish (*Gambusia affinis*), threadfin shad (*Dorosoma petenense*), white catfish (*Ameiurus catas*), brown bullhead (*Ameiurus nebulosus*), and common carp (*Cyprinus carpio*).

Bird species selected include species that can act as surrogates for threatened and endangered species (e.g., Forster's tern as a surrogate for the endangered California least

tern) and that are known to nest and feed in the watershed. They include pied-billed grebe (*Podilymbus podiceps*), American coot (*Fulica americana*), black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra americana*), Forster's tern (*Sterna forsteri*), and black skimmer (*Rynchops niger*).

Once fish or bird eggs have been sampled, water, sediment, and suspended particles will be sampled at the nearest locations that are within (or just upstream of) the approximate foraging range of the target species, as specified in Section 4.3 They will be subject to bulk selenium and selenium speciation analyses.

4.5.2. Numbers of Tissue Samples

The targeted numbers of samples for fish tissue analysis should be up to three samples of composited, whole-body fish, consisting of five similar-sized, same-species fish per sample for up to three fish species (up to nine composited fish samples per site). In addition, fish eggs and ovaries from gravid females may be analyzed if USEPA adopts selenium water quality criteria that are based on selenium concentrations in fish eggs and ovaries.

For bird eggs, up to eight bird eggs per site for up to three species should be analyzed. Only one egg can be taken from each nest. In the case where only one egg is in the nest, no sample will be taken.

In general, for both bird eggs and fish, the total number of tissue samples per year is expected to be less than the theoretical maximum number of samples because many of the sites are limited in biota abundance, diversity, and/or accessibility.

4.5.3. Monitoring Parameters

For fish tissue analysis, whole-body analyses as well as dissected tissue samples separating egg/ovary with the rest of the body (if gravid females are available) may be analyzed. For bird eggs, for each individual egg, embryos may be examined for overt teratogenesis and egg contents (embryo, yolk, and albumen) will be analyzed; egg shells are not analyzed for selenium. The analytical parameters for tissue samples are listed in [Table 2](#).

4.5.4. Annual Watershed Fish Habitat Survey

In 2012, the Watershed stakeholders initiated efforts on reconnaissance of existing and potential habitats for fish throughout the Watershed and select sites for regular surveys. These surveys will be combined with tissue sampling whenever possible. The monitoring locations in the lower part of the Watershed, as described above, are by default included in the survey. The surveys include description of physical habitats and age/species composition of fish communities at different flow regimes. The fish species most sensitive to selenium will be given special attention, especially on evidence of reproductive success or failure.

4.6. Tier 5. Ad Hoc Special Studies

Special studies are one-time research projects to address specific questions (outside the questions listed in Section 2.1) as needed, or conducted by outside agencies. Examples of these studies include Peters Canyon Wash Selenium Mass Balance Study (Ngo et al, 2012), Swamp of the Frogs Groundwater-Surface Water Balance Study (DBSA, 2012),

and feasibility studies for several proposed selenium reduction BMPs (e.g. RBF, 2013). NSMP stakeholders has also proposed a multimedia selenium cycling special study that covers lower San Diego Creek and Big Canyon Wash. These studies could provide critical information to the RMP and may be later incorporated into the RMP as needed.

Some regional monitoring programs conducted by outside agencies, such as Southern California Bight Regional Monitoring Program (Bight Program; conducted every 5 years since 1994 by the Southern California Coastal Water Research Project or SCCWRP) and Regional Board’s Bioaccumulative Constituent Trend Monitoring Program (since 2006), provide opportunities for integrating RMP with larger geographic area and/or longer historical trends. Through in-kind support including staff time and equipment usage, Newport Bay stakeholders have participated in these studies in the past and may continue to do so in the future.

5. Quality Assurance and Quality Control

5.1. SWAMP Comparability

In response to requirements in NPDES county-wide municipal stormwater permits, the Orange County Stormwater Program (OCSP), on behalf of the Orange County Flood Control District (OCFCD) and its 34 cities, conducts water and sediment quality monitoring in the drainage network and its respective receiving waters. OCSP has established a draft quality assurance program plan (QAMP; OCSP, 2010) consistent with all the requirements of California’s Surface Water Ambient Monitoring Program (SWAMP; SWRCB, 2008). This QAMP covers all monitoring activities required by County of Orange’s NPDES Stormwater Permit. Some monitoring activities described in this Se RMP, such as the Tiers 1 and 2 monitoring efforts, are explicitly addressed in the QAMP. Other monitoring activities specific to this Se RMP will be incorporated in the QAMP as well and subject to applicable quality assurance/quality control (QA/QC) requirements therein. Therefore, the monitoring efforts in this Se RMP are fully SWAMP-comparable.

5.2. Standardized Sampling Procedure

Sampling of water and sediment will follow the standardized procedures outlined in OCSP’s QAMP (OCSP, 2010). For example, water samples will be collected either by 24-hour autosampler composite (for monthly monitoring) or by simple grab samples (for semiannual and annual samples). Sediment samples will be collected by 0.1m² petite Ponar® grab, or a custom-made pre-cleaned plastic scoop (if applicable). Fine-grained, organic-rich areas will be targeted for sediment sampling, and only the top 2 centimeters of undisturbed sediment will be sampled. Appropriate sampling preservation procedures (acid preservatives and refrigeration) will be strictly followed and recorded. Some water quality parameters (such as pH, conductivity, dissolved oxygen, temperature) can be monitored on site by calibrated multi-probes. These field data will be digitally downloaded upon returning to OCSP’s laboratory.

Fish samples will be collected by one or a combination of the following methods: electro-fishing, kick nets, dip nets, or beach seines. Only the target species (see [Section 4.4.1](#)) will be collected and the rest will be returned to the water. Samples must be sorted and preserved on ice immediately after collection. Dissection of eggs/ovaries will be carried out by trained personnel in the laboratory and treated as separate samples. The egg/ovaries and the remainder of the tissue samples should be labeled and analyzed separately.

For bird egg collection, care must be taken to minimize the disturbance to the nesting birds. Some birds may abandon their nests altogether if disturbed. Only one egg is to be collected from a single nest. No sample will be taken for nests with only one egg.

5.3. Quality Assurance/Quality Control Procedures

5.3.1. Sample Chain of Custody

Chain-of-custody (CoC) documentation is used to reduce the likelihood of sample contamination or mishandling. The CoC form contains the list of the sample log numbers, the numbers of bottles per log number, the required analyses, and identities (names, affiliations, and signatures) of all persons handling those samples (**Figure 18**). A

completed and signed chain-of-custody form is transferred to the contract laboratories or sample courier service prior to submission of samples. OCSP maintains a duplicate chain of custody policy which provides the contract laboratories with an originally signed chain-of-custody form while a second signed chain of custody with the laboratory or courier service signature is returned and filed.

CONTRACT LAB: MWH		CHAIN OF CUSTODY			Entry Set # 30		Page 1 of 1	
Lab PA # N 3 000 003 880					County of Orange Public Facilities Resources Department 1750 S. Douglass Road Anaheim, CA 92806		DATE 2/10/2004	
CONTACT: Bruce Moore (714) 567 6373		PHONE (714) 567 - 6363 FAX (714) 567-622		Sample Ambient <input type="checkbox"/> Cooled <input type="checkbox"/> Frozen <input type="checkbox"/>		Handling _____		
PNIR # _____								
SAMPLE#	Date&Time	#Containers	Matrix	Description	Analyses Required	Remarks	Project #	
WR68297	09.18 2/10/2004	5	FW	GS	NUT OPP POHO		EF03530	
						/21958		
						TEMP 2°C REG LOCK		
	SIGNATURE	PRINT NAME	ORGANIZATION	DATE (m/d/yyyy)	TIME (hh:mm)			
Relinquished by		Theodore van B. van	OC/RDMD	2/10/07	11:37			
Received by		S. MARKITAN	ARCA	2/10/07	14:00			
Relinquished by		M. DELLA	M.W.H.	2-10-4	16:30			
Received by								
Relinquished by								
Received by								
Relinquished by								
Received by								

SCANNED

Figure 18. An example of a chain of custody (CoC)

5.3.2. Quality Control Samples

Of the samples delivered to the contract labs, a minimum of 10-20% are QC samples. Field QC samples include duplicate/split samples, trip blank, and field blank. Other QC samples, including matrix spikes and laboratory control samples (LCS) are also included in the sample batch. In addition to these QC samples from the client side, the contract laboratories have internal QC procedures including instrument blanks, duplicates, matrix spikes, matrix spike duplicates, and reference standards prepared from Standard Reference Materials (SRM).

Upon receipt of the electronic data from the contract laboratories, OC Watersheds will evaluate the QA/QC performance by reviewing the QA/QC report prepared by the contract laboratory, and by evaluating the performance of the contract laboratory by comparing the analytical results of the LCS with its true values. The possibility of contamination in the field or during transit can be controlled by the results of field and trip blank samples.

If QA/QC anomalies are identified, appropriate procedures will be followed to identify the deficiency, including annotating the data, working with field crew and/or contract laboratory to identify and correct any deficiencies, and re-sampling (OCSP, 2010).

5.4. Analytical Methods

For all target constituents to be monitored for water, sediment, and tissue samples (see a complete list in **Table 2**), established EPA standard methods will be used wherever applicable. The contract labs for all the analyses are certified by the California Environmental Laboratory Accreditation Program (ELAP; OCSP, 2005, 2010) administered by California Department of Public Health (CDPH). For analysis without an approved standard EPA method, the best available, peer-reviewed analytical methods will be used.

5.5. Data Management

Data management is an integral part of the QA/QC system at OC Watersheds. Before the samples are delivered to the contract laboratories, all samples including QAQC samples are electronically logged into a database, which also generates sample labels, CoCs, and sample log sheets. Upon delivery of the samples to the contract laboratories, the database electronically notifies the laboratories, which report the analytical data electronically back to the database in turn. The reported data are in Stormwater Monitoring Coalition (SMC) format and will be evaluated by OC Watershed for data processing and QA/QC auditing purposes. Currently, OCSP is working with SCCWRP staff to upload applicable monitoring data, including those generated by the Se RMP, onto the California Environmental Data Exchange Network (CEDEN), as recommended by SWAMP.

6. Annual Report and Future Revisions

6.1. Annual Reports

The monitoring results will be reported annually to the Regional Board by November 15 of each year after the approval of this Se RMP. Data tables could be submitted to Regional Board staff as early as practicable. The focus of the report is to address the questions outlined in [Section 2.1](#). The report shall present all of the new monitoring data obtained from the previous year. Relevant historical data, if applicable, may be synthesized to address long-term trends and/or seasonality of selenium concentrations and loads.

6.2. Future Revisions

As discussed in Chapter 2, the Se RMP is by design flexible and may need to be revised based on changes in habitat, species availability and abundance, geohydrology, and variations in selenium concentrations. Subsequent to the initial approval of this Se RMP, any changes in locations of sampling sites and sampling frequencies will be discussed with and approved by Regional Board staff and included in the Annual Report. Significant revisions of the Se RMP will be subject to approval by the Executive Officer of the Regional Board.

References

1. CH2MHill. 2008, Big Canyon Wash Wetlands Restoration: Baseline Selenium Results. Report prepared for the City of Newport Beach and the Santa Ana Water Quality Control Board.
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