U.S. Environmental Protection Agency
Region IX

Total Maximum Daily Loads for Pesticides, PCBs, and Sediment Toxicity in Oxnard Drain 3

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Executive Summary

The United States Environmental Protection Agency (USEPA) Region IX entered into an amended consent decree with several environmental groups on March 22, 1999. *Heal the Bay, Inc., et al., v. Browner*, No. C 98-4825 SBA (N.D. Ca.). That decree, as further amended, requires development of TMDLs for many waterbody pollutant combinations, including Oxnard Drain 3 by March 2013. To meet the consent decree deadline, USEPA is establishing Total Maximum Daily Loads (TMDLs) in Oxnard Drain 3 for chlordane, DDT, dieldrin, PCBs, toxaphene, and sediment toxicity.

Oxnard Drain 3 is a canal parallel to the shore carrying water from a system of agricultural drains and seasonal duck hunting ponds located near Oxnard, CA in the Calleguas Creek watershed. Most of the land immediately surrounding Oxnard Drain 3 is an undeveloped wetland which supports a great diversity of wildlife, including endangered species.

USEPA analyzed water, sediment, and fish tissue data in Oxnard Drain 3 and found bifenthrin, chlordane, chlorpyrifos, DDT, dieldrin, PCBs, and toxaphene in concentrations causing impairments of standards which protect human health and aquatic life. Chlordane, DDT, dieldrin, PCBs, and toxaphene are often called legacy pollutants since concentrations of these chemicals persist in the environment despite enactment of regulations to restrict and/or end their use. Bifenthrin and chlorpyrifos are pesticides currently applied to urban structures, landscaping, and agricultural crops.

TMDL allocations are expressed as water, bed sediment, and suspended sediment concentrations. A sediment toxicity allocation is included at the base of each subwatershed. TMDL targets are selected by choosing the concentration that is protective of aquatic life, benthic organisms, wildlife, and human health. Where saltwater and freshwater values exist, the lower concentration is selected because Oxnard Drain 3 is of intermediate salinity. Required reductions in pollutant concentrations range from small to 100% depending on the particular pollutant and media.

1 Introduction

USEPA Region IX is establishing Total Maximum Daily Loads (TMDLs) in Oxnard Drain 3 for bifenthrin, chlordane, chlorpyrifos, DDT, dieldrin, PCBs, toxaphene, and sediment toxicity. The ChemA fish tissue impairment is addressed by the individual TMDL targets for chlordane, dieldrin, and toxaphene. Previously Oxnard Drain 3 has also been called Rio de Santa Clara, Arnold Road Drain, L Street Drain, and occasionally confused with Oxnard Drain 1 (Figure 1).

Figure 1. Location of Oxnard Drain 3

1.1 Regulatory Background

Section 303(d) of the Clean Water Act (CWA) requires that each State "shall identify those waters within its boundaries for which the effluent limitations required by section 1311(b)(1)(A) and section 1311(b)(1)(B) are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in USEPA guidance (USEPA, 2000b). A TMDL is defined as the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background. See, 40 CFR 130.2(i). TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numeric water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. 40 CFR 130.7(c).

The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA does not approve a TMDL submitted by a state, USEPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

As part of its 1998 regional water quality assessments, the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWCQB, 1998). These are referred to as “listed” or “303(d) listed” waterbodies. A schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved between USEPA and several environmental groups on March 22, 1999. *Heal the Bay Inc., et al. v. Browner*, No. C 98-4825 SBA (N.D. Ca). For the purpose of scheduling TMDL development, the decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units.

This report addresses waterbody impairment combinations identified in Analytical Unit 8 of the consent decree. Under the amended consent decree, USEPA must approve or establish these TMDLs by March 24, 2013. The State is unlikely to complete adoption of these TMDLs in time to meet the consent decree deadline; therefore, USEPA is establishing these TMDLs.

USEPA performed a review and analysis of available monitoring data and information for pollutants within Analytical Unit 8 in the consent decree described above. Data associated with the 2008-2010 303(d) list was evaluated to determine if any water quality conditions had changed (either from impaired to non-impaired or vice versa). This report includes an evaluation of available data and confirms the impairments for Oxnard Drain 3. TMDLs have been developed to address the impairments. Table 9 summarizes the waterbody impairment combinations addressed by this report.

1.2 Elements of a TMDL

Guidance from USEPA (2000b) identifies seven elements of a TMDL. This report contains these seven elements in the following Sections:

Problem Statement. Section 2 reviews the evidence used to include each waterbody on the 303(d) list. A description of the water quality standards, beneficial uses, water quality objectives, and numeric targets that form the basis for each listing is reviewed.

Numeric Targets. Section 3 includes the numeric targets based on the numeric and narrative water quality objectives stated in the Basin Plan as well as sediment quality guidelines and fish tissue guidelines. These targets are used for calculation of TMDLs. Load reductions and pollutant allocations in these TMDLs are developed to ensure that these numeric targets for the impaired waterbodies are met.

Source Assessment. This step is a qualitative and quantitative estimate of point sources and nonpoint sources of pollutant loading in each subwatershed. The source assessment considers seasonality and flow. The approach for determining source assessments is described in Section 4.

Linkage Analysis. This analysis demonstrates how the sources of pollutant compounds in each waterbody are linked to the observed conditions in the impaired waterbody. Section 5 describes the linkage analysis for each impairment.

TMDLs and Pollutant Allocations. The total loading capacity for each waterbody is determined as the amount of pollutant loading a waterbody can receive without causing impairment. Each pollutant source is allocated an allowed quantity of pollutant loading that it may discharge. Allocations are designed such that the waterbody will not exceed numeric targets for any of the compounds. Point sources and areas draining to municipal separate stormwater systems (MS4s) are given wasteload allocations, and nonpoint sources are given load allocations. Section 6 explains the TMDLs and allocations.

Implementation Recommendations. Section 7 describes the plans, regulatory tools, or other mechanisms by which the wasteload allocations and load allocations may be achieved. The Regional Board has responsibility to implement these TMDLs and incorporate them into permits. They may choose to develop implementation plans in a separate document in the future.

Monitoring Recommendations. Monitoring each waterbody is recommended to ensure that the wasteload allocations and load allocations are achieved and numeric targets are no longer exceeded. Section 7 provides details on monitoring recommendations.

2 Problem Statement

Oxnard Drain 3 (CAR40311000020000228150910) is listed as impaired for ChemA, chlordane, DDT, dieldrin (included in ChemA), PCBs, toxaphene, and sediment toxicity (note: the nitrogen impairment was addressed by a previous TMDL) (SWRCB, 2010).

2.1 Environmental Setting

Oxnard Drain 3 is located near Oxnard, CA in the Calleguas Creek watershed (Figure 2). The highly managed Oxnard Drain 3 watershed largely overlaps with the Mugu Lagoon subwatershed and the Ormond Beach project area. The drain is 3.3 miles long and typically about 50 feet wide. Freshwater enters Oxnard Drain 3 through a system of agricultural drainage canals and seasonal ponds in a duck club. Oxnard Drain 3 also experiences muted tidal action from leaking tide gates connected to Mugu Lagoon.

Historically, a coastal drainage canal parallel to the shoreline carried surface water from the Oxnard Industrial Drain, J Street Drain, and Hueneme Drain southward to Mugu Lagoon. This canal first appears in a 1945 aerial photo, appears to still be operational in the 1951 photo, and appears to have become dilapidated and non-operational by the 1959 photo (Williams, 1982). Aerial photographs indicate that the current configuration of Oxnard Drain 3 dates back to at least the 1990s (Figure 2).

Almost all of Oxnard Drain 3 lies within the Point Mugu Naval Air Base. Although on naval property, most of the land immediately surrounding Oxnard Drain 3 is an undeveloped wetland (Figure 3) which supports a great diversity of wildlife. Over 200 migratory bird species utilize the Ormond Beach area, and more shorebird species are known to use Ormond Beach than any other site in Ventura County. Six threatened and endangered species and six species of concern have been identified in the area (Ormond Beach Wetlands Restoration Project, 2011).

Human recreation is restricted to the area off naval property, near Arnold Road. Visitors are not allowed to fish, boat, or swim in the drain but fishing is known to occur (J. Stedler, 2010 and C. Lin, 2010). Bird watching is a popular recreational activity near Oxnard Drain 3.

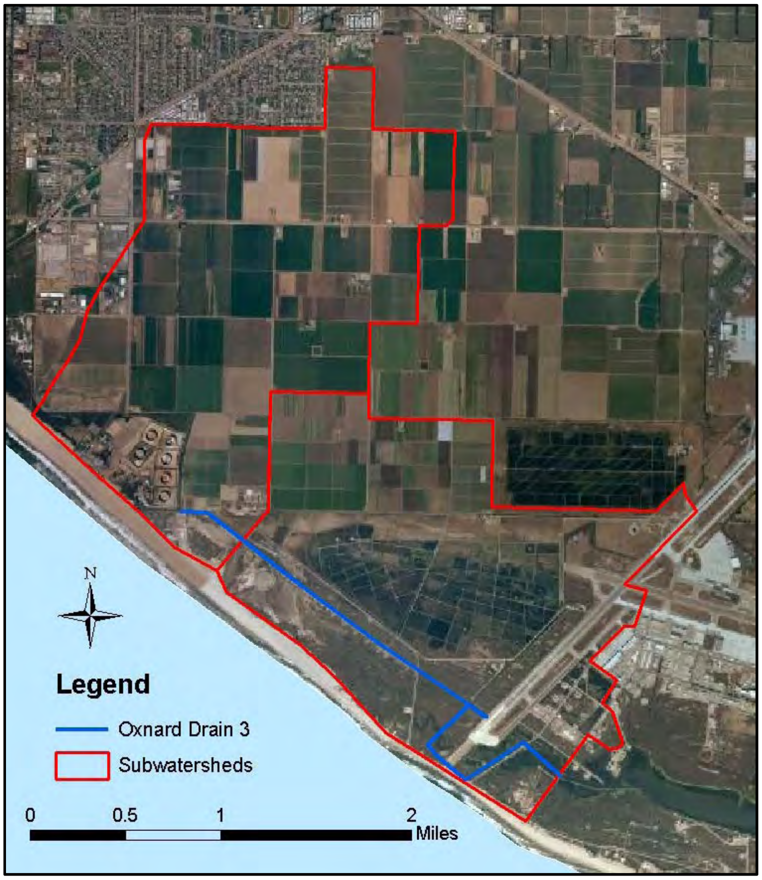

Figure 2. Oxnard Drain 3 aerial view

Figure 3. Oxnard Drain 3

The surrounding Oxnard Plain supports a large variety of agricultural crops. These fields drain into ditches which then discharge to Oxnard Drain 3 (Figure 4). There are also freshwater wetlands, created on a seasonal basis to support duck hunting clubs, which occasionally flow into Oxnard Drain 3 (Figure 5).

Water leaving Oxnard Drain 3 discharges into Mugu Lagoon, one of the few remaining significant saltwater wetland habitats in southern California. Although there are tide gates within Oxnard Drain 3, the water level and salinity fluctuate slightly based upon the tide. Philip Williams & Associates measured similar fluctuations in water surface elevation immediately upstream and downstream of the tide gate, although elevations on the upstream side of the gate were higher – presumably due to freshwater runoff or tidal pumping (PWA, 2000). The salinity on average is around 3 parts per thousand. Therefore, Oxnard Drain 3 is considered a brackish waterbody.

Figure 4. Agricultural drains flowing into Oxnard Drain 3

Figure 5. Duck Club pond which occasionally flows into Oxnard Drain 3.

2.1.1 Watershed Boundaries

Most of the Oxnard Drain 3 watershed consists of land leveled by human activities (Figure 6). Oxnard Drain 3 lies along the coastal edge of the Oxnard Plain, an extensive low-lying alluvial fan between the Santa Ynez and Santa Monica Mountains built by ancient sediments deposited from the Santa Clara River (PWA, 2000).

The subwatershed boundaries for Oxnard Drain 3 shown in Figure 6 were based on personal communications with Ventura County, Oxnard Drainage District 2 (Ferguson Case Orr Patterson LLP), the City of Oxnard, and observation (2010). The northern subwatershed drains 1,955 acres; the southern subwatershed drains 2,005 acres. The spatial coverage network for storm drains and canals/ditches were supplied by the City of Oxnard and USGS's National Hydrography Dataset (NHD), respectively (personal communication, 2010).

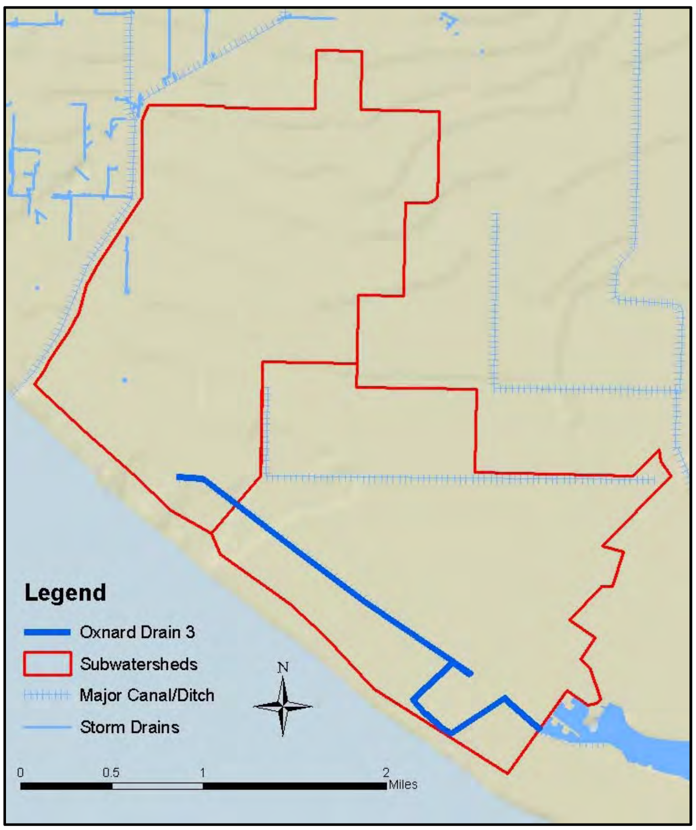

Figure 6. Elevation, Water Networks, and Subwatershed Boundaries

2.1.2 Land Use

Land uses identified in the Oxnard Drain 3 watershed are shown in Figure 7. The spatial coverage network for land use was supplied by the California Department of Water Resources (2000). The northern subwatershed is predominately agricultural with small sections of native vegetation and urban land. The southern subwatershed includes an equal mix of native vegetation, urban, and agricultural lands.

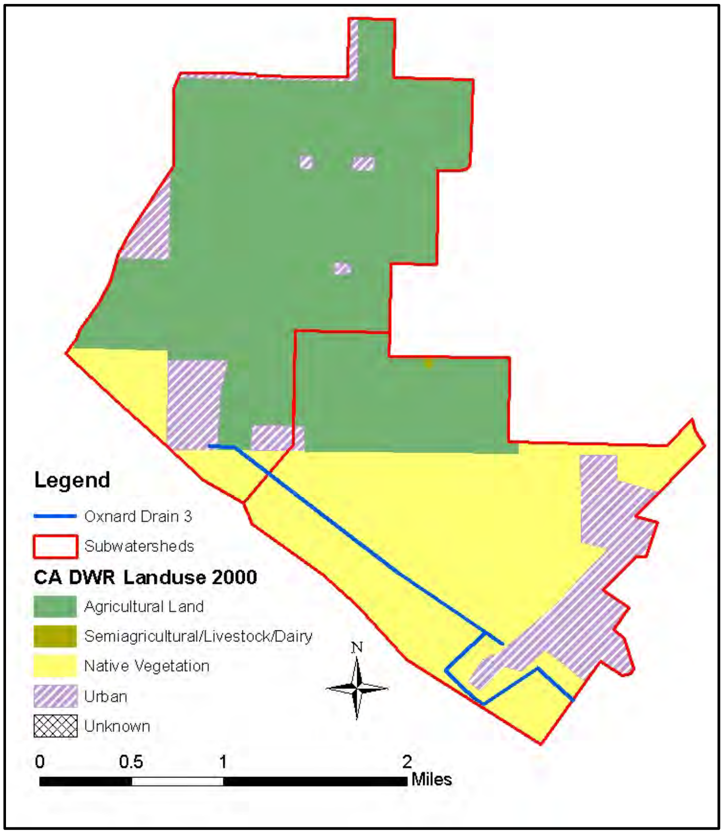

Figure 7. Land use in Oxnard Drain 3 Subwatersheds

2.2 Water Quality Standards

California state water quality standards include the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Boards in Basin Plans. The Basin Plan describes numeric and narrative water quality objectives for beneficial uses in the Los Angeles Region (LARWQCB, 1994). The California Toxics Rule (CTR) includes numeric water quality criteria for certain human health and aquatic life designated uses. See, 40 CFR 131.38. The objectives and criteria for the impairments addressed in this document are described below.

2.2.1 Beneficial Uses

The Los Angeles Region Basin Plan designates beneficial uses for water bodies in the Los Angeles Region. These uses are recognized as existing (E), intermittent (I), or potential (P) uses. Beneficial use designations were not specifically identified in the Basin Plan for Oxnard Drain 3. Therefore, the downstream segment's (Mugu Lagoon) beneficial uses apply. The Water Quality Control Plan for the Los Angeles Region (LARWQCB, 1994) designates the beneficial uses applicable to Oxnard Drain 3 as:

BIOL – Preservation of Biological Habitats. Uses of water that support designated areas or habitats such as Areas of Special Biological Significance (ASBS), established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.

COMM – Commercial and Sport Fishing. Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including but not limited to, uses involving organisms intended for human consumption or bait purposes.

EST – Estuarine Habitat. Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

MAR – Marine Habitat. Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

MIGR – Migration of Aquatic Organisms. Uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.

NAV - Navigation. Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

RARE - Rare, Threatened, or Endangered Species. Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

REC1 - Water Contact Recreation. Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, waterskiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

REC2 - Non-contact Water Recreation. Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

SHELL – Shellfish harvesting. Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

SPWN - Spawning, Reproduction and/or Early Development. Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

WET - Wetland Habitat. Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

WILD - Wildlife Habitat. Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Table 1 contains the beneficial use designations relevant to this report (LARWQCB, 1994).

Table 1. Beneficial Use Designations of Oxnard Drain 3

Waterbody name	Hydro Unit	Beneficial Uses
Mugu Lagoon (downstream of Oxnard Drain 3)	403.11	Existing: NAV, REC 2, COMM[a], EST, MAR, WILD[b], BIOL, RARE[c, d], MIGR[e], SPWN[e], SHELL[a], WET Potential: REC1[f]

a Limited public access precludes full utilization
b Marine habitats of the Channel Islands and Mugu Lagoon serve as pinniped haul-out areas for one or more species (i.e., sea lions)
c One or more rare species utilize all ocean, bays, estuaries, and coastal wetlands for foraging and/or nesting.
d Habitat of the Clapper Rail
e Aquatic organisms utilize all bays, estuaries, lagoons and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas which are heavily influenced by freshwater inputs.
f Area is currently under control of the Navy: swimming is prohibited.

2.2.2 Water Quality Objectives and Criteria

The Basin Plan describes numeric and narrative water quality objectives for beneficial uses in the Los Angeles Region (LARWQCB, 1994). The California Toxics Rule (CTR) includes numeric water quality criteria for certain human health and aquatic life designated uses. The objectives and criteria for the impairments addressed in this document are described below.

Bioaccumulation

The Basin Plan states that “Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels which are harmful to aquatic life or human health.”

California Toxics Rule

The CTR established numeric water quality criteria for certain human health and aquatic life designated uses. See, 40 CFR 131.38. Numeric criteria established by the CTR relevant to the impairments addressed by these TMDLs are identified in Table 2.

Pesticides

The Basin Plan states that “No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.”

Polychlorinated Biphenyls (PCBs)

The Basin Plan states that:

> “The purposeful discharge of PCBs … to waters of the Region, or at locations where the waste can subsequently reach waters of the Region, is prohibited.
>
> Pass-through or uncontrollable discharges to waters of the Region, or at locations where the waste can subsequently reach water of the Region, are limited to 70 pg/L (30 day average) for protection of human health and 14 ng/L and 30 ng/L (daily average) to protect aquatic life in inland fresh waters and estuarine waters respectively.”

Toxicity

The Basin Plan states that “All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological response in, human, plant, animal, or aquatic life.”

Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water in California", known as the "Antidegradation Policy", protects surface and ground waters from degradation. The Basin Plan states that "Under California's Antidegradation Policy, any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies."

The numeric targets in Section 3 are water column, sediment, and/or fish tissue concentrations that are intended to result in attainment of the beneficial uses, water quality objectives and criteria discussed above. Targets are provided to ensure protection of both human health and wildlife, consistent with the beneficial uses associated with Oxnard Drain 3. The methods by which the targets were developed are discussed below by media.

2.2.2.1 Selection of Water Quality Targets

Water column targets are based on Oxnard Drain 3's beneficial uses, and the water quality objectives and criteria referenced in Section 2.2.2.

To protect the beneficial uses, and meet the water quality objectives and criteria applicable to Oxnard Drain 3, USEPA has identified water column TMDL targets for the following pollutants: chlordane; 4,4'-DDT; 4,4'- DDE; 4,4'-DDD; dieldrin; total PCBs; and toxaphene. Table 2 identifies the CTR-established numeric criteria for each of those pollutants (USEPA, 2000a). Since Oxnard Drain 3 is brackish, the CTR-established numeric criteria for both freshwater and saltwater must be attained. See, 40 CFR 131.38(c)(3). Likewise, since Oxnard Drain 3 has aquatic life and human health designated uses, the CTR-established numeric criteria to protect both aquatic life and human health must be attained. See, 40 CFR 131.38(a) and (d).

A comparison between water quality targets is provided in Table 2. For chlordane, DDT, DDE, DDD, dieldrin, and total PCBs, the most stringent water column targets are the CTR-established numeric criteria for protection of human health. The "aquatic organism consumption only" criterion is applicable to Oxnard Drain 3 and accounts for human health risk associated with bioaccumulation directly from the water column. For toxaphene, the most stringent water column target is the CTR-established numeric criterion for protection of aquatic life (USEPA, 2000a). As indicated in Table 2, the target derived from the CTR-established criterion for toxaphene (0.0002 ug/L) is identical to the recommended criteria for toxaphene published by USEPA pursuant to CWA, section 304(a) (USEPA, 1986).

Table 2. Comparison of Water Quality Targets

Pollutant/ Water Target (ug/L)	CTR HH (30 day average) other waters (aquatic org consumption only) -fresh	CTR HH (30 day average) other waters (aquatic org consumption only) - salt	CTR CC (4 day average) freshwater aquatic life protection	USEPA CC (4 day average) freshwater aquatic life protection	CTR CC (4 day average) salt water aquatic life protection	USEPA CC (4 day average) salt water aquatic life protection	USEPA HH 1 in a million cancer risk, Other Waters (aquatic org consumption only)
Chlordane	0.00059	0.00059	0.0043	0.0043	0.004	0.004	0.00081
4,4'-DDT	0.00059	0.00059	0.001	0.001	0.001	0.001	0.00022
4,4'-DDE	0.00059	0.00059	-	0.001	-	0.001	0.00022
4,4'-DDD	0.00084	0.00084	-	0.001	-	0.001	0.00031
Dieldrin	0.00014	0.00014	0.056	0.056	0.0019	0.0019	0.000054
Total PCBs	0.00017	0.00017	0.014	0.014	0.03	0.03	0.000064
Toxaphene	0.00075	0.00075	0.0002	0.0002	0.0002	0.0002	0.00028

Note: Highlighted cells show the selected Oxnard Drain 3 water column TMDL targets.

2.2.2.2 Selection of Sediment Quality Targets

There are no numeric WQOs in the Basin Plan for pesticides and PCBs in sediments. However, pesticides and PCBs have an affinity for organic matter and will partition from water to organic substances such as sediment, benthic organisms, and fish. The levels of contamination in sediment are important because they are a crucial pathway for pollutant accumulation in fish and other edible species (such as clams and mussels). Partitioning of pesticides and PCBs from water through fish skin is also important, but does not result in the high accumulation caused by the continuous ingestion of contaminated organisms in most fish species. In the absence of numeric objectives in the Basin Plan for pesticides and PCBs in sediment, USEPA has identified two categories of sediment targets: targets derived from sediment quality guidelines; and targets derived using biota-sediment accumulation factors. Targets derived from sediment quality guidelines are designed to protect sediment biota from excessive toxic pollutants. Sediment targets derived using biota-sediment accumulation factors (BSAF) are designed to attain fish tissue targets.

Targets Derived from Sediment Quality Guidelines

Sediment quality guidelines (SQGs) are developed from field and laboratory studies to predict the toxicity of pollutants on sediment-dwelling organisms. MacDonald et al. (2000) compiled a set of all the published SQGs and used the resulting geometric mean value to establish concentration-based SQGs for threshold and probable effect concentrations of individual contaminants. SQGs use a variety of metrics, including: Probable Effects Concentrations (PECs); Threshold Effects Levels (TELs); Probable Effects Levels (PELs); Effects Range Medium (ERM) values, Threshold Effects Concentrations (TECs); and Effects Range Low (ERL) values. PECs, TELs, PELs, and ERMs are the concentrations at which harmful effects on sediment-dwelling organisms are expected to occur. TECs and ERLs describe the concentration of contaminant that is not expected to have harmful effects on sediment-dwelling organisms.

As noted above, there are no numeric WQOs in the Basin Plan for pesticides and PCBs in sediments. Instead, the Regional Board assesses the quality of sediments using freshwater PEC, saltwater TEL, saltwater PEL, or saltwater ERM values for all pollutants except DDT (MacDonald et al., 2000 and Long et al., 1995). The sediment quality guideline-derived value for assessing DDT in saltwater is consistent with a DDT assessment concentration developed in the USEPA United Heckathorn Superfund Record of Decision (1994). The sediment quality targets obtained using the State's PEC, TEL, PEL and ERM methodology, for both saltwater and freshwater, are identified in Table 3.

As the State recommends, PECs, TELs, PELs, and ERMs were used to assess impairments, and the more conservative TECs and ERLs were considered as TMDL targets. Sediment Quality Guideline targets have been used in similar pesticide and PCB TMDLs in the Los Angeles region.

Targets Derived Using Biota-Sediment Accumulation Factor (BSAF)

To ensure protection of both human health and wildlife, it is also important to consider the potential for bioaccumulation in aquatic organisms and the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans). Thus a separate sediment target calculation was conducted to ensure that fish tissue concentration goals are supported by the sediment concentration. The fish goals may be translated through biota-sediment accumulation factor (BSAF) calculations to estimate associated sediment targets. This is done on a site-specific basis.

Specifically, a sediment target to achieve the desired fish concentration can be calculated based on a biota-sediment bioaccumulation (a BSAF approach) using the equation below,

$$C_{BSAF-sed-target} = C_{fish-target} \cdot C_{sed} \div C_{fish}$$

where C_{fish} is the average trophic level 3 (i.e. carp) fish tissue pollutant concentration in the past ten years, C_{sed} is the average sediment pollutant concentration in the past ten years, $C_{fish-target}$ is the TMDL fish tissue target (Selection of Fish Tissue Targets, Section 2.2.2.3), and $C_{BSAF-sed-target}$ is the BSAF-derived sediment target. The BSAF-based target concentrations were calculated using only recent data collected in the past 10 years because loads and exposure concentrations are likely to have declined steadily since the cessation of production and use of certain pesticides and PCBs.

The sediment quality targets derived using the biota-sediment accumulation factors are identified in Table 3. Water, sediment, and fish tissue data for dieldrin and PCBs in Oxnard Drain 3 within the past ten years were below the minimum detection limit. Consequently, no BSAF-derived targets for those pollutants were considered.

In order to protect beneficial uses in a brackish environment, the targets derived from the sediment quality guidelines and the targets derived using the biota-accumulation factor were compared, for both freshwater and saltwater, and the lowest of those targets for each pollutant were used in these TMDLs. Table 3 compares all relevant sediment targets and highlights the selected TMDL targets in the far right column.

Table 3. Comparison of Sediment Targets

	Sediment Quality Guidelines				BSAF derived	Oxnard Drain 3 (brackish) TMDLs	
	Freshwater		Saltwater				
	Assessment	target	assessment	target	target	assessment	target
Pollutant/ Sediment Target (ug/dry kg)	PEC	TEC	TEL, PEL, ERM, or other*	ERL		minimum of fresh and salt assessment	minimum of fresh, salt, and BSAF
Chlordane	17.6	3.24	6	0.5	1.91	6	0.5
Dieldrin	61.8	1.9	8	0.02	N/A	8	0.02
Total DDTs	572	5.28	590	1.58	1.95	572	1.58
4,4'-DDD	28	4.88	20	2	-	20	2
4,4'-DDE	31.3	3.16	27	2.2	-	27	2.2
4,4'-DDT	62.9	4.16	7	1	-	7	1
Total PCBs	676	59.8	400	22.7	N/A	400	22.7
Toxaphene	2	1	0.1	-	1.61	0.1	0.1

* Choice of TEL, PEL, ERM, or other is determined by the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (SWRCB, 2004). The "other" target refers to a bioaccumulative DDT value used by USEPA in the United Heckathorn Superfund Record of Decision (1994).

2.2.2.2.1 Selection of Water Quality Targets Addressing Sediment Toxicity Due to Bifenthrin and Chlorpyrifos

California has identified Oxnard Drain 3 as impaired due to sediment toxicity. Monitoring data relevant to Oxnard Drain 3's sediment conditions are referenced in Section 2.3 and 2.4. After review of that data, USEPA agrees that Oxnard Drain 3 is impaired due to sediment toxicity, and concludes that bifenthrin and chlorpyrifos contribute to that toxicity.

Bifenthrin and chlorpyrifos are pesticides which are toxic to aquatic invertebrates at very low concentrations. Use of bifenthrin, a pyrethroid pesticide, has been increasing in agriculture, commercial, and residential pest control (Amweg et al. 2005). Researchers have found widespread sediment toxicity due to bifenthrin, including waterbodies in southern California (Bay et al. 2010, Phillips et al. 2010, Delgado-Moreno et al. 2011, and Weston et al. 2008). Due to the widespread presence of pyrethroids at levels toxic to aquatic organisms, the Los Angeles Regional Water Quality Control Board is proposing prioritization of bifenthrin and other pyrethroids for their next water quality standards update (LARWQCB, 2011). Despite the cancellation of urban residential sales, chlorpyrifos, an organophosphate pesticide, continues to be applied to crops in the Oxnard Drain 3 watershed. Bifenthrin and chlorpyrifos in the water column preferentially bind to sediment where they are moderately persistent. Thus, benthic organisms can be exposed to elevated bifenthrin and chlorpyrifos concentrations for extended periods (Amweg et al. 2005 and Green et al. 1996).

Four sediment toxicity tests conducted in 1993 and 1994 demonstrated toxicity to *Rhepoxynius abronius* and *Eohaustorius estuarius*. These toxicity tests were statistically significant using a t-test and relative to the Minimum Significant Difference (MSD) value. Two sediment toxicity tests conducted in October 2010 with *Hyallela azteca* showed no toxicity. However, the two 2010 toxicity tests were conducted during the dry season, and corresponded to bifenthrin concentrations of 0.067 ug/g organic carbon (OC) and less than the detection limit of 0.022 ug/g OC and chlorpyrifos concentrations below the detection limits of 0.217 and 0.631 ug/g OC. The October 2010 sediment concentrations may have been very low due to larger than normal quantities of algae and detritus to which bifenthrin and chlorpyrifos can partition (Rogers et al. 2009). Additional sediment monitoring conducted in 2009 and 2010 found sediment concentrations for bifenthrin as high as 0.71 ug/g OC and sediment concentrations for chlorpyrifos as high as 1.65 ug/g OC. The bifenthrin sediment no observable effect concentration (NOEC) is 0.13 ug/g OC (Amweg et al. 2005). A chlorpyrifos sediment NOEC was not found in a literature search. The chlorpyrifos lowest observable effect concentration (LOEC) is 0.13 ug/g OC (Green, 1996). USEPA review of the entire data set confirms that Oxnard Drain 3 remains impaired for sediment toxicity.

The concentrations of bifenthrin and chlorpyrifos in the water column of Oxnard Drain 3 further support the conclusion that the waterbody is impaired and that bifenthrin and chlorpyrifos contribute to the sediment toxicity impairment. Monitoring in 2007-2010 found that concentrations of bifenthrin in the water column exceeded the University of California Davis (UC Davis) chronic freshwater target (0.0006 ug/L) in at least 5 of 15 samples, and that the concentration of chlorpyrifos exceeded the USEPA salt water aquatic life protection chronic concentration (0.0056 ug/L) in 5 of 15 samples. The UC Davis criteria report was developed using a peer reviewed methodology for deriving water quality criteria for the protection of aquatic life (TenBrook et al. 2010). The UC Davis Water Quality Criteria Report for Bifenthrin was peer-reviewed and made available for public comment (Palumbo et al., 2010). The USEPA salt water aquatic life chronic concentration is the most protective of the criteria supporting Oxnard Drain 3's beneficial uses (USEPA, 1986b). Equilibrium partitioning of bifenthrin and chlorpyrifos in a waterbody such as Oxnard Drain 3 occurs over time, as the pollutants move from sediment to the water column, and move from the water column to sediment. Accordingly, water column concentrations of the pollutants are relevant evidence when estimating the concentrations of the pollutant in the sediment, and sediment concentrations are relevant when estimating the concentrations of the pollutants in the water column (Delgado-Moreno et al. 2011). The high concentrations of bifenthrin and chlorpyrifos detected in the water column during 2007-2010 further support the conclusion that those pollutants contribute to the sediment toxicity in Oxnard Drain 3.

USEPA has determined that the water column concentrations derived from the peer-reviewed UC Davis bifenthrin report and the USEPA Ambient Water Quality Criteria report for chlorpyrifos are appropriate targets to address the sediment toxicity that impairs Oxnard Drain 3. In considering these water column concentrations, USEPA utilized equilibrium partitioning calculations to translate the sediment NOEC or LOEC to water concentrations (USEPA, 2008b). The water concentration based on equilibrium partitioning with sediment at NOEC or LOEC concentrations was three times lower than the bifenthrin UC Davis target and the USEPA chlorpyrifos criteria. Although the equilibrium calculation suggests water column concentrations should be more stringent than the UC Davis bifenthrin target and USEPA chlorpyrifos criteria, USEPA selects the UC Davis and USEPA targets because they are based on larger data sets and a wider range of species. Attaining and maintaining water column concentrations of bifenthrin and chlorpyrifos at or below their respective targets should assure those pollutants no longer contribute to the waterbody's sediment toxicity. USEPA notes that attaining and maintaining water column concentrations of those pollutants at or below the targets will also assure that impairments due to those pollutants' presence in the water column are appropriately controlled.

2.2.2.3 Selection of Fish Tissue Targets

Beneficial uses may also be impaired if concentrations of pesticides and PCBs in fish tissue are sufficiently high to pose potential adverse health impacts from the ingestion of sport-caught or local fish. Tissue concentrations of pesticides and PCBs biomagnify in the food chain. Pesticide and PCB levels increase with the species' trophic level and organisms at the top of a food chain system will have the highest accumulation of pesticides and PCBs. Pesticide and PCB accumulation also increases with the age of the organisms, and pollutants reside mostly in the lipid portions of the fish. The top predators and fatty fish species in a given waterbody tend to have the highest concentrations of pesticides and PCBs, but concentrations are also elevated in fish that feed directly in contaminated sediment. Top predators (such as bass) are often target species for sport fishermen. Risks to human health from the consumption of contaminated fish are based on long-term, cumulative effects, rather than concentrations in individual fish. Therefore, the criterion should not be applied to the extreme case of the most-contaminated fish within a target species; instead, the criterion is most applicable to average concentrations in top predator species and fish that are popular for consumption.

In 2008, California's Office of Environmental Health Hazard Assessment (OEHHA) developed fish contaminant goals (FCGs) for the following common contaminants in California sport fish: chlordane; DDTs; dieldrin; methylmercury; PCBs; selenium; and toxaphene (OEHHA, 2008). OEHHA's FCGs are "estimates of contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week (32 g/day), prior to cooking, over a lifetime". *Id.* OEHHA also indicates that FCGs can provide a starting point for criteria development. *Id.* OEHHA developed the FCGs for the pesticides and PCBs to address carcinogenic and non- carcinogenic risks. OEHHA (2008) applied the following methodology to calculate the carcinogenic and non-carcinogenic sets of FCGs:

> *For each chemical, the toxicological literature was reviewed to establish an acceptable non-cancer reference dose (RfD; an estimate of daily human exposure to a chemical that is likely to be without significant risk of adverse effects during a lifetime) and/or a cancer slope factor (an upper-bound estimate of the probability that an individual will develop cancer over a lifetime as a consequence of exposure to a given dose of a specific carcinogen).*

The FCGs developed by OEHHA for pollutants addressed by these TMDLs are identified in Table 4.

The Threshold Tissue Residual Levels (TTRLs) identified in Table 4 are derived from CTR human health criteria for "consumption of organisms only". USEPA developed the CTR human health criteria by determining organochlorine pesticide and PCB concentrations in edible fish tissue that would pose a health risk to humans consuming 6.5 grams per day of fish. These fish tissue concentrations were then converted to water column concentrations using a bioconcentration factor (BCF), which is the ratio of the chemical concentration in fish to the chemical concentration in water. TTRLs are calculated by eliminating the BCF from the human health criteria equation, thereby reverting back to the original fish tissue concentration upon which the CTR human health criteria are based.

Fish tissue targets are an important part of these TMDLs because they most directly address potential human health impacts from consumption of contaminated fish or other aquatic organisms. The FCG and TTRL concentrations applicable to PCBs and the pesticides relevant to this TMDL are on the same order of magnitude. The existing Calleguas Creek TMDLs addressing the portion of the Mugu Lagoon watershed that overlaps with the watershed addressed by this TMDL established TTRL fish tissue targets. In order to achieve consistency with the Mugu Lagoon watershed TMDLs, USEPA has selected the TTRLs listed in Table 4 as the fish tissue targets for Oxnard Drain 3.

Neither FCGs nor TTRLs have been established for chlorpyrifos; accordingly, USEPA is using the USEPA human health screening value for recreational anglers as the fish tissue target for chlorpyrifos.

Table 4. Comparison of Fish Tissue Targets

	OEHHA Cancer Risk FCGs (ug/kg)	Threshold Tissue Residual Levels (TTRLs) (ug/kg)
Bifenthrin	-	-
Chlordane	5.6	8.3
Chlorpyrifos	-	1200*
DDT, total	21	-
4,4'-DDD	-	45
4,4'-DDE	-	32
4,4'-DDT	-	32
Dieldrin	0.5	0.65
PCBs, total	3.6	5.3
Toxaphene	6.1	9.8

*USEPA human health screening value for recreational anglers (USEPA. 2000c)

2.3 BASIS FOR LISTING

Impairments addressed by this TMDL were originally described in the Los Angeles Regional Water Quality Control Board's 1996 assessment (LARWQCB, 1996). Waterbody-pollutant combinations found to be either not supporting or partially supporting a beneficial use were identified as impairments on the State's resultant 303(d) list. The impairments were described relative to the USEPA 305(b) beneficial uses, which are broad federal beneficial use categories described under the federal guidance for 305(b) reporting. The beneficial uses established by California for the waterbodies addressed in these TMDLs are analogous to the beneficial uses described in the federal guidance for 305(b) reporting, as shown in Table 5. The water quality standards and assessment methodology used in California's 1996 assessment are not identical to the State's current water quality standards and assessment methodology. The current standards used in these TMDLs are summarized in Section 2.2.2. Regional Board currently follows California's Impaired Waters Guidance in making 303(d) listing and delisting decisions (SWRCB, 2005). One of the major differences between the assessment methodology used by the State in 1996 and the State's current practice is that the partially supporting category no longer exists.

Table 5. Linkage between California and Federal Beneficial Uses

Federal Beneficial Use	California Beneficial Use Code
Aquatic Life	WILD, WET, RARE, EST, MAR, BIOL, MIGR, SPWN
Primary Contact Recreation	REC1
Secondary Contact Recreation	REC2
Fish Consumption	COMM, SHELL

Table 6 summarizes the listing information related to the impairments identified by the Regional Board in 1996 and further assessed by the State Board in 1998 (LARWQCB, 1996 and SWRCB, 1998). California has also identified Oxnard Drain 3 as an impaired water for which a TMDL is required in its subsequent 303(d) lists, including the most recent 2008/2010 303(d) list of impaired waters. Data collected after the original listing is discussed in the following section.

Table 6. Original Listing Information

Pollutant	1996 Use Support Status	Sample Type (Year)
ChemA **	Not Supporting: Aquatic Life and Fish Consumption	Tissue ('89, '90, '91)
Chlordane	Not Supporting: Aquatic Life and Fish Consumption	Tissue ('89, '90, '91)
DDT	Not Supporting: Aquatic Life and Fish Consumption	Tissue ('89, '90, '91)
PCBs	Not Supporting: Aquatic Life and Fish Consumption	Tissue ('91)
Toxaphene	Not Supporting: Aquatic Life and Fish Consumption	Tissue ('89, '90, '91)
Sediment Toxicity	Not Supporting: Aquatic Life	Sediment Toxicity ('93, '94): poor survival rates

** ChemA pesticides include aldrin, chlordane, dieldrin, endrin, endosulfan, heptachlor, heptachlor epoxide, hexachlorocyclohexane (including lindane), and toxaphene.

2.4 CURRENT CONDITIONS

Water, sediment, and fish tissue samples were collected by a variety of organizations. Table 7 summarizes the monitoring data for Oxnard Drain 3. Station names labeled ROD3, Arnold Road, and 01T_ODD3_ARN are the same location. Samples from that location were collected where Arnold Road crosses over Oxnard Drain 3. Additional details regarding monitoring data are discussed in the Appendix.

Table 7. Monitoring Groups Summary

Monitoring Group	Station Name(s)	Media	Dates
Bay Protection and Toxic Cleanup Program	Mugu/Oxnard Ditch #1*	Sediment	1993, 1994
USEPA & RB4	ROD1, ROD2, ROD3	Water, Sediment, Tissue	2009, 2010
Navy	ODD3	Water, Sediment**	1994, 1998, 1999
Surface Water Ambient Monitoring Program (SWAMP), Toxic Substance Monitoring (TSM)	403.11.02	Tissue	1989, 1990, 1991, 1997
UC-Riverside, Survey for Occurrence of Replacement Pesticides in Region 4 Watersheds	Arnold Road	Water, Sediment	2009
Ventura County Agricultural Irrigated Lands Group (VCAILG)	01T_ODD3_ARN	Water	2007, 2008, 2009

*Oxnard drains were misnamed in this study
**The Navy sediment samples were a composite of the top 15 cm of sediment. This is deeper than most benthic organisms are exposed to.

Monitoring data was compared to the targets described in Section 2.2.2. The rates of exceedances of the targets are summarized in Table 8.

Water quality monitoring results from 2007-2010 show exceedances of the targets for bifenthrin, chlordane, chlorpyrifos, total DDT, and toxaphene. Bifenthrin exceeded the target in at least 5 of 15 samples (note: two samples were below the detection limit but the detection limit was greater than the target). Chlorpyrifos exceeded the target in 5 of 15 samples. Chlordane exceeded the target in at least 7 of 17 samples (note: 10 samples were the below detection limit but the detection limit was greater than the target). Total DDT exceeded the target in 17 of 17 samples. Toxaphene exceeded the target in at least 11 of 17 samples (note: six samples were below the detection limit, but the detection limit was greater than the target). The 2007-2010 water column data for dieldrin and PCBs were all less than the detection limits which are higher than the relevant targets. The Navy water column data from the 1990's had at least 3 DDT exceedances, at least 1 chlordane exceedance, and dieldrin and PCB data were below the detection limit which was above the relevant target. After considering the sampling data, USEPA concludes that the impairments identified by the State related to ChemA, chlordane, DDT, PCBs, and toxaphene, continue to exist.

Sediment monitoring results from 2009 and 2010 were compared to the sediment assessment targets. Chlordane exceeded the ERM target in 9 of 11 samples. DDT exceeded the PEC in 1 of 11 samples. Toxaphene exceeded the TEL target in all 11 samples. The highest sediment concentration for bifenthrin was 0.71 ug/g OC. The highest sediment concentration for chlorpyrifos was 1.65 ug/g OC. All 2009 and 2010 dieldrin and total PCB sediment samples indicated concentrations less than the targets established for assessing those pollutants. The Navy sediment data from the 1990's had 1 DDT exceedance, 0 PCB exceedances, 3 chlordane exceedances, and at least 1 dieldrin exceedance.

Two sediment toxicity tests conducted in October 2010 with *Hyallela azteca* showed no toxicity. However, those two toxicity tests were conducted during the dry season and corresponded to low bifenthrin and chlorpyrifos sediment concentrations. Four sediment toxicity tests conducted in 1993 and 1994 demonstrated toxicity to *Rhepoxynius abronius* and *Eohaustorius estuarius*. These toxicity tests were statistically significant using a t-test and relative to the MSD value. USEPA review of the entire data set confirms that Oxnard Drain 3 remains impaired for sediment toxicity.

Two fish tissue samples were collected in 2010. Chlordane, DDT, and toxaphene each exceeded the TTRL target applicable to that pollutant, in both samples. The two fish tissue samples collected in 2010 indicated concentrations of PCBs less than the applicable target, and indicated non-detect (but the detection limit was greater than the target) for dieldrin. Fish tissue samples collected between 1989 and 1997 exceeded the fish tissue targets for ChemA, chlordane, DDT, dieldrin, PCBs, and toxaphene.

No other chemicals analyzed were consistently above detection limits or targets. In particular, the following chemicals in ChemA were not detected in water, sediment, or tissue samples: aldrin, endrin, endosulfan, heptachlor, heptachlor epoxide, and hexachlorocyclohexane. Accordingly, USEPA is not establishing TMDLs for these chemicals. The ChemA fish tissue impairment is addressed by the individual TMDL targets for chlordane, dieldrin, and toxaphene.

Table 8. Summary of Monitoring Data from Groups in Table 7

	Number of Exceedances / Number of Samples Collected		
Pollutant/Media	**Water**	**Sediment**	**Tissue**
Bifenthrin	At least 5 / 15	No targets	No targets
Chlordane	At least 8 / 26	12 / 16	7 / 7
Chlorpyrifos	5 / 15	No targets	0 / 2
Total DDT	At least 20 / 26	2 / 16	7 / 7
Dieldrin	All non-detect, above standard	1 / 16	At least 5/7
Total PCBs	All non-detect, above standard	0 / 16	3 / 7
Toxaphene	At least 11 / 17	11 /11	7 / 7

Note: When detection limits were above the target, a sample was not counted as an exceedance.

The dieldrin and PCB results show improvement over time. However, after review of the entire data set, USEPA concludes that Oxnard Drain 3 remains impaired due to dieldrin and PCBs. USEPA has sought to address dieldrin and PCBs in these TMDLs in a manner that is consistent with the TMDLs in the neighboring Calleguas Creek watershed.

Table 9 identifies the waterbody-pollutant combinations addressed by this document, the impairments governed by the consent decree entered in Heal the Bay Inc. v. Browner, and impairments addressed by a previous TMDL (LARWQCB, 2002).

Table 9. Summary of Impairments Addressed

Impairment Addressed in this Document and Included in Consent Decree	Impairment addressed by another USEPA approved TMDL
Chlordane	Nitrogen[3]
Dieldrin[1]	
DDT	
PCBs	
Toxaphene	
ChemA[2]	
Sediment Toxicity	

[1] Dieldrin was included in the consent decree through the ChemA listing.
[2] ChemA fish tissue impairment is addressed by the individual TMDL targets for chlordane, dieldrin, and toxaphene.
[3] Calleguas Creek Nitrogen TMDL (LARWQCB, 2002) as clarified in a letter from Strauss (2009).

3 Numeric Targets

The Basin Plan designates water column concentrations associated with human health and aquatic life beneficial uses. The Basin Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). USEPA (1986b) and UC Davis (Palumbo et al., 2010) water column concentrations are used for pollutants where CTR criteria do not exist. Sediment numeric targets are based on the sediment quality guidelines defined in Long et al. (1995) and MacDonald et al. (2000). The sediment guidelines have been recommended by the State Water Resources Control Board for interpretation of narrative objectives under the 303(d) listing policy. Fish tissue concentration targets are the threshold tissue residual levels (TTRLs) defined by CTR for fish consumption. Numeric targets and allocations are expressed as DDT congeners rather than total DDT for consistency with the Calleguas Creek watershed TMDLs. The numeric targets are listed in Table 10. See Section 2.2.2, Table 2, Table 3, and Table 4 for additional details on the selection of numeric TMDL targets.

Table 10. TMDL Targets

Pollutant / Medium	Water, chronic (ug/L)	Sediment (ug/dry kg)	Fish Tissue (ug/wet kg)
Bifenthrin	0.0006	-	-
Chlordane, total	0.00059	0.5	8.3
Chlorpyrifos	0.0056	-	1200
4,4'-DDT	0.00059	1	32
4,4'-DDE	0.00059	2.2	32
4,4'-DDD	0.00084	2	45
Dieldrin	0.00014	0.02	0.65
PCBs, total	0.00017	22.7	5.3
Sediment Toxicity	-	No significant chronic sediment toxicity (See below for more details)	-
Toxaphene	0.0002	0.1	9.8

Note: See below for sediment toxicity and ChemA TMDL targets.

ChemA pesticides include aldrin, chlordane, dieldrin, endrin, endosulfan, heptachlor, heptachlor epoxide, hexachlorocyclohexane (including lindane), and toxaphene. Aldrin, endrin, endosulfan, heptachlor, heptachlor epoxide, and hexachlorocyclohexane were not detected in water, sediment, or tissue in Oxnard Drain 3. The ChemA fish tissue impairment is addressed by the individual TMDL targets for chlordane, dieldrin, and toxaphene.

The sediment targets established for the individual pollutants listed above address sediment toxicity due to pollutants identified in the Oxnard Drain 3's sediment to date. However, the risk remains that sediment toxicity due to currently unknown causes will prevent remediation of the listed impairment. Accordingly, this TMDL establishes a numeric sediment toxicity target that assesses the sediment's toxic effects upon benthic organisms. The sediment toxicity target is no chronic toxicity based on sediment toxicity tests. Sediment is toxic if a sediment sample is significantly more toxic than the laboratory control, where the following two criteria are met: (1) a separate-variance t-test determines there is a significant difference ($p<0.05$) in mean toxicity test organism response (e.g., percent survival, percent normal development) between the sediment sample and the laboratory control, and (2) the mean organism response in that toxicity test is lower than a certain percentage of the control value, as determined by the 90th percentile Minimum Significant Difference (MSD).

Statistical significance in a t-test is determined by dividing an expression of the difference between sample and control by an expression of the variance among replicates. The sediment toxicity target uses a "separate variance" t-test that adjusts the degrees of freedom to account for variance heterogeneity among samples. If the difference between sample and control is large relative to the variance among replicates, then the difference is considered significant. In many cases, however, low between-replicate variance will cause a comparison to be considered significant, even though the magnitude of the difference can be small. The magnitude of difference that can be identified as significant is termed the Minimum Significant Difference (MSD), which is dependent on the selected alpha level, the level of between-replicate variation, and the number of replicates specific to the experiment. With the number of replicates and alpha level held constant, the MSD varies with the degree of between-replicate variation. The "detectable difference" inherent to the toxicity test protocol can be determined by identifying the magnitude of difference that can be detected by the protocol 90% of the time (Schimmel et al., 1994; Thursby and Schlekat, 1993). This is accomplished by determining the MSD for each t-test conducted, ranking them in ascending order, and identifying the 90th percentile MSD (the MSD that is larger than or equal to 90% of the MSD values generated).

Current Bay Protection and Toxic Cleanup Program detectable difference (90th percentile MSD) values are listed in Table 11. Sediment samples with toxicity test results lower than the values given, as a percentage of control response, are considered toxic if the result is also significantly different from the control in the individual t-test. The following describes how a toxic effect would be identified in sediment (SWRCB, 1996):

"In toxicity tests, the MSD represents the smallest difference between the control mean and a treatment mean (the effect size) that leads to the statistical rejection of the null hypothesis (H0: no difference). Any effect size equal to or larger than the MSD would result in a finding of statistically significant difference. For example, if the control mean for mysid growth were 80 ug/mysid and the MSD were 20, any treatment with mean mysid weight less than or equal to 60 ug would be significantly different from the control and considered toxic."

Table 11. 90th Percentile Minimum Significant Difference (MSD) Values and Threshold Percentage of Control Values used in Determining Statistically Significant Sample Toxicity (SWRCB 1998)

Protocol	MSD	% of Control	N
Eohaustorius solid-phase	25	75	385
Abalone water (5 reps)	10	90	131
Abalone water (3 reps)	36	64	336
Abalone water (all reps)	32	68	467
Mytilus porewater	20	80	223
Neanthes Surv. solid-phase	36	64	335
Neanthes Wt solid-phase	56	44	335
Rhepoxynius solid-phase	23	77	720
Urchin Dev. porewater (5 reps)	22	78	309
Urchin Dev. porewater (3 reps)	45	55	630
Urchin Dev. porewater (all)	40	60	939
Urchin Fertilization	12	88	79
Urchin Dev. SWI	41	59	109

4 Source Analysis

This section identifies the potential sources of pollutants that discharge into the impaired Oxnard Drain 3. Pollutants can enter surface waters from both point and nonpoint sources. Point sources include discharges from a discrete human-engineered outfall. These discharges are regulated through National Pollutant Discharge Elimination System (NPDES) permits and state waste discharge requirements (WDRs). Nonpoint sources discharge pollutants that reach surface waters from a number of diffuse land uses and activities that are not regulated through NPDES permits. The discussion below presents general information for point and nonpoint sources.

4.1 POINT SOURCES

The NPDES permits in the watershed draining to Oxnard Drain 3 include municipal separate storm sewer system (MS4) permits and general industrial stormwater permits. Figure 8 shows the jurisdictions and permits in the Oxnard Drain 3 watershed.

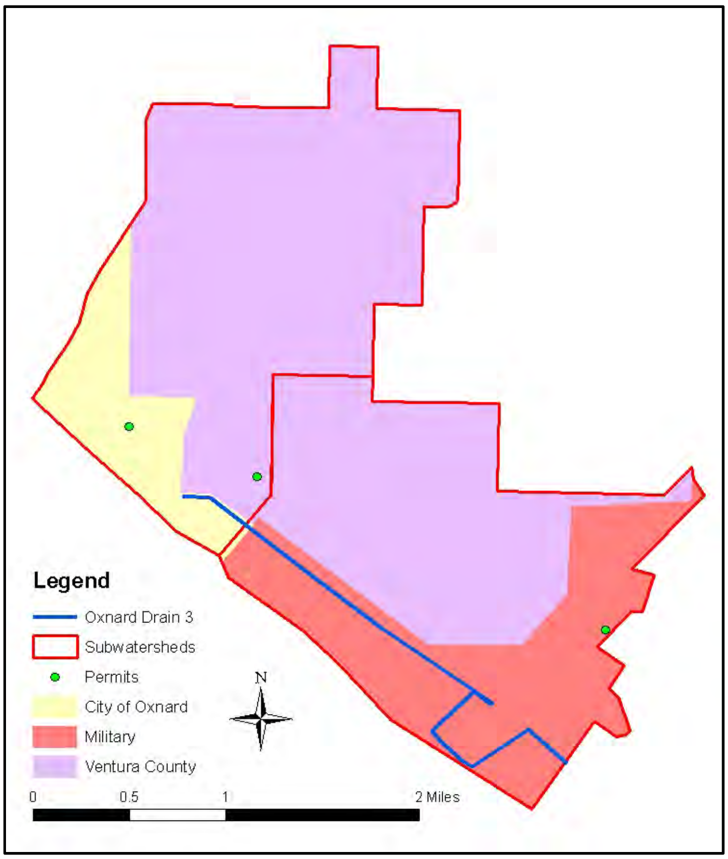

Figure 8. Permittees in the Oxnard Drain 3 Subwatersheds

4.1.1 Stormwater Permits

Stormwater runoff is regulated through the Ventura County MS4 permit, the statewide Construction Activities Stormwater General Permit, and the statewide Industrial Activities Stormwater General Permit. The permitting process defines these discharges as point sources because stormwater is discharged from the end of a stormwater conveyance system. Since the industrial stormwater discharges are governed under NPDES permits, these discharges are treated as point sources in these TMDLs.

MS4 Stormwater Permits

In 1990, USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent pollutants from being washed by stormwater runoff into MS4s (or from being discharged directly into the MS4s) and then discharged into local waterbodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a stormwater management program as a means to control polluted discharges.

Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations, and hazardous waste treatment. Large and medium MS4 operators are required to develop and implement Stormwater Management Plans that address, at a minimum, the following elements:

- Structural control maintenance
- Areas of significant development or redevelopment
- Roadway runoff management
- Flood control related to water quality issues
- Municipally owned operations such as landfills and wastewater treatment plants
- Municipally owned hazardous waste treatment, storage, or disposal sites
- Application of pesticides, herbicides, and fertilizers
- Illicit discharge detection and elimination
- Regulation of sites classified as associated with industrial activity
- Construction site and post-construction site runoff control
- Public education and outreach

The Ventura County MS4 Permit was renewed in July 2010 (Order No. R4-2010-0108; CAS004002) and is on a five-year renewal cycle. This permit covers 12 co-permittees, including 10 incorporated cities, the County of Ventura, and the Ventura County Flood Control District.

General Stormwater Permits

In 1990, USEPA issued regulations for controlling pollutants in stormwater discharges from industrial sites equal to or greater than five acres. The regulations require dischargers of stormwater associated with industrial activity to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) to reduce or prevent nonconventional and toxic pollutants in stormwater discharges and authorized non-storm discharges. On December 8, 1999, USEPA expanded the NPDES program to include stormwater discharges from construction sites that resulted in land disturbances equal to or greater than one acre.

In 1997, the State Board issued a statewide general NPDES permit for Discharges of Stormwater Associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ; CAS000001). This Order regulates stormwater discharges and authorized non-stormwater discharges from 10 specific categories of industrial facilities, including but not limited to, manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility. The facilities which have filed for coverage under the General Industrial Stormwater permit in the Oxnard Drain 3 watershed are listed in Table 12.

During wet weather, runoff from industrial sites has the potential to contribute pollutant loadings. During dry weather, the potential contribution of pollutant loadings from industrial stormwater is low because non-stormwater discharges are prohibited or authorized by the permit only under the following circumstances: when they do not contain significant quantities of pollutants, where Best Management Practices (BMPs) are in place to minimize contact with significant materials and reduce flow, and when they are in compliance with Regional Board and local agency requirements.

In 2009, the State Board issued a statewide general NPDES permit for Discharges of Stormwater Runoff Associated with Construction Activities (Order No. 2009-0009-DQW; CAS000002). During wet weather, runoff from construction sites has the potential to contribute pollutant loadings. During dry weather, the potential contribution of pollutant loadings is low because discharges of non-stormwater are authorized by the permit only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants. There are currently no active facilities in the Oxnard Drain 3 watershed with coverage under the General Construction Stormwater permit.

Table 12. General Industrial Stormwater Permits

Type of NPDES Permit	Subwatershed	Facility	Disturbed Area (Acres)
General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001)	Northern	Ormond Beach Generating Station	38
General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001)	Northern	Agromin Organics Recycling	8
General Industrial Stormwater (Order No. 97-03-DWQ, CAS000001)	Southern	US Navy Point Mugu	4575

4.1.2 Other Permits

There are two types of non-stormwater NPDES permits: individual and general permits. An individual NPDES permit is classified as either a major or a minor permit. Other than the MS4 permits, there are no major individual NPDES permits in the watershed draining to Oxnard Drain 3. The discharge flows associated with minor individual NPDES permits and general NPDES permits are typically less than 1 million gallons per day (MGD). General NPDES permits often regulate episodic discharges (e.g., dewatering operations) rather than continuous flows.

Pursuant to 40 CFR parts 122 and 123, the State Board and the regional boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources involve the same or substantially similar types of operations, discharge the same type of waste, require the same type of effluent limitations, and require similar monitoring. The Regional Board has issued general NPDES permits for six categories of discharges: construction and project dewatering, petroleum fuel cleanup sites, volatile organic compounds (VOCs) cleanup sites, potable water, non-process wastewater, and hydrostatic test water. There are currently no active facilities in the Oxnard Drain 3 watershed with coverage under the construction and project dewatering, petroleum fuel cleanup sites, volatile organic compounds (VOCs) cleanup sites, potable water, non-process wastewater, or hydrostatic test water general NPDES permits.

4.2 NONPOINT SOURCES

A nonpoint source is a source that discharges via sheet flow or natural discharges, as well as agricultural stormwater discharges and return flows from irrigated agriculture. Nonpoint sources include atmospheric deposition directly onto water, land areas that flow directly into a waterbody (and do not drain through a storm drain system), and agricultural flows.

4.3 SOURCES IN THE WATERSHED

Organochlorine (OC) Pesticides and PCBs are chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. In particular, they include a number of chlorinated legacy pollutants known or suspected to be carcinogenic and/or toxic to humans and wildlife. OC Pesticides and PCBs include a number of now-cancelled chlorinated pesticides (e.g., chlordane, DDT, dieldrin, toxaphene) and polychlorinated biphenyls (PCBs) that are causes of impairment in Oxnard Drain 3. OC Pesticides and PCBs are problematic because they do not break down easily, concentrate in organisms, and can be transported great distances. The primary concerns for Oxnard Drain 3 are the high levels found in fish. Their continuous cycling in the food chain and accumulation in sediments creates difficulties in their removal from water systems. While concentration in sediment and organisms may be high, concentrations in the water column are often undetectable.

The US has cancelled the manufacture or use of all the pollutants considered OC Pesticides (chlordane, dieldrin, DDT, and toxaphene) and PCBs that are listed as causes of impairment in Oxnard Drain 3. However, the past use of these chemicals was so widespread and unrestricted that there are still loads of these chemicals coming from waste and storage facilities as well as old equipment that used or contained the contaminants. Chlordane, DDT, dieldrin, and toxaphene were also widely applied for agricultural and domestic pest control purposes. Areas of concern include waste facilities that may contain old transformers, industrial sites, agriculture lands, and some residences that were treated heavily for pests (for example: chlordane was a popular termiticide in the 1970s). Even areas that do not have a history of OC Pesticides and PCBs use or storage are vulnerable due to atmospheric deposition, often derived from transcontinental transport. Continued research and findings repeatedly demonstrate that these pollutants are ubiquitous.

Conversely, bifenthrin and chlorpyrifos are currently applied pesticides which cause acute and chronic water column and sediment toxicity to aquatic organisms. They have a strong affinity for soil particles and moderately long half-lives on the order of several months (Palumbo et al., 2010 and TenBrook et al., 2010). Although bifenthrin and chlorpyrifos degrade much faster than organochlorine pesticides, they persist in the environment long enough to cause chronic toxicity to aquatic life (Amweg et al. 2005 and Green et al. 1996). Since bifenthrin and chlorpyrifos are not as persistent as OC pesticides, reduced concentrations of bifenthrin and chlorpyrifos in the water column will rapidly improve aquatic health and the sediment concentrations will slowly degrade and decrease. The main problem with bifenthrin and chlorpyrifos is that both are highly toxic to aquatic life and are currently being applied to agricultural fields and urban areas in the Oxnard Drain 3 watershed. Thus, runoff adds new inputs of bifenthrin and chlorpyrifos to the Oxnard Drain 3 ecosystem.

In order to quantitatively understand the sources of these pollutants, water and sediment samples were collected in June 2010 in the Oxnard Drain 3 watershed. Source analysis sampling locations were Mugu Lagoon, a groundwater well in the duck club, and agricultural drains along Arnold Road, Edison Road, and Casper Road (Figure 9).

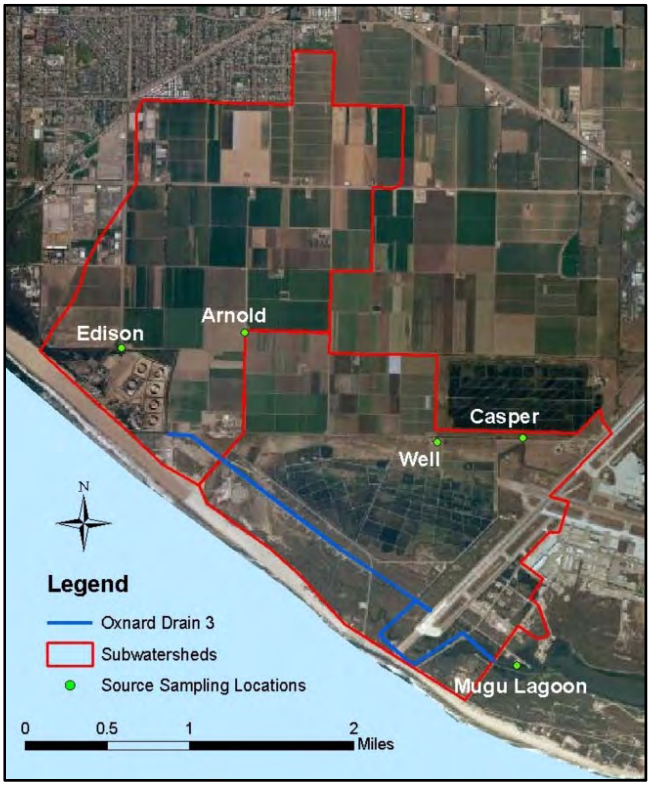

Figure 9. Source Analysis Sampling Locations

Based on one sampling event, the estimated percent reduction needed to achieve the water and sediment TMDL targets is displayed in Table 13 and Table 14, respectively. Percent reduction was calculated by dividing the required change in concentration by the current concentration and then multiplying by 100%. If no analytes were detected in a sample, percent reduction was calculated using the detection limit. Most pollutants were not detected in water samples. However, the agricultural drain along Casper Road had high concentrations of chlordane, DDD, DDE, DDT, and toxaphene in water. The water concentration of toxaphene in the agricultural drain along Edison Road was also very high. Sediment concentrations in the Oxnard Drain 3 watershed often need over a 90% reduction in order to achieve TMDL targets.

Table 13. Estimated percent reduction needed for sources to meet water TMDL targets

Location/ Pollutant	Bifenthrin	Chlordane, total	Chlorpyrifos	DDD	DDE	DDT	Dieldrin	PCBs, total	Toxaphene
Arnold	0*	41	0*	16	41	41	86	83	98
Mugu Lagoon	0*	43	0*	19	43	43	87	84	98
Casper	0*	89	0*	97	99	97	85	82	100
Edison	0*	42	0*	17	42	42	86	83	100
Well	0*	37	0*	11	37	37	85	82	98

Note: Gray cells indicate that the measured concentration was below detection limits.
* The one sample collected was below the target concentration. However, samples collected during another season or after rain may require pollutant reductions.

Table 14. Estimated percent reduction needed for sources to meet sediment TMDL targets

Location/ Pollutant	Bifenthrin	Chlordane, total	Chlorpyrifos	DDT, total	Dieldrin	PCBs, total	Toxaphene
Arnold	N/A	91	N/A	99	98	0*	100
Mugu Lagoon	N/A	62	N/A	89	98	0*	99
Casper	N/A	66	N/A	96	99	0*	100
Edison	N/A	95	N/A	99	98	0*	100

Note: Gray cells indicate that the measured concentration was below detection limits.
* The one sample collected was below the target concentration. However, samples collected during another season or after rain may require pollutant reductions.

The source analysis above only describes one sampling event. Concentrations can vary significantly by season and after rain. Therefore the reductions above should be considered as estimates only. Seasonal plots of bifenthrin and chlorpyrifos use are shown in Figure 10 and Figure 11 (CALPIP, 2011). The heaviest application of bifenthrin is between September and November while most chlorpyrifos applications occur in August.

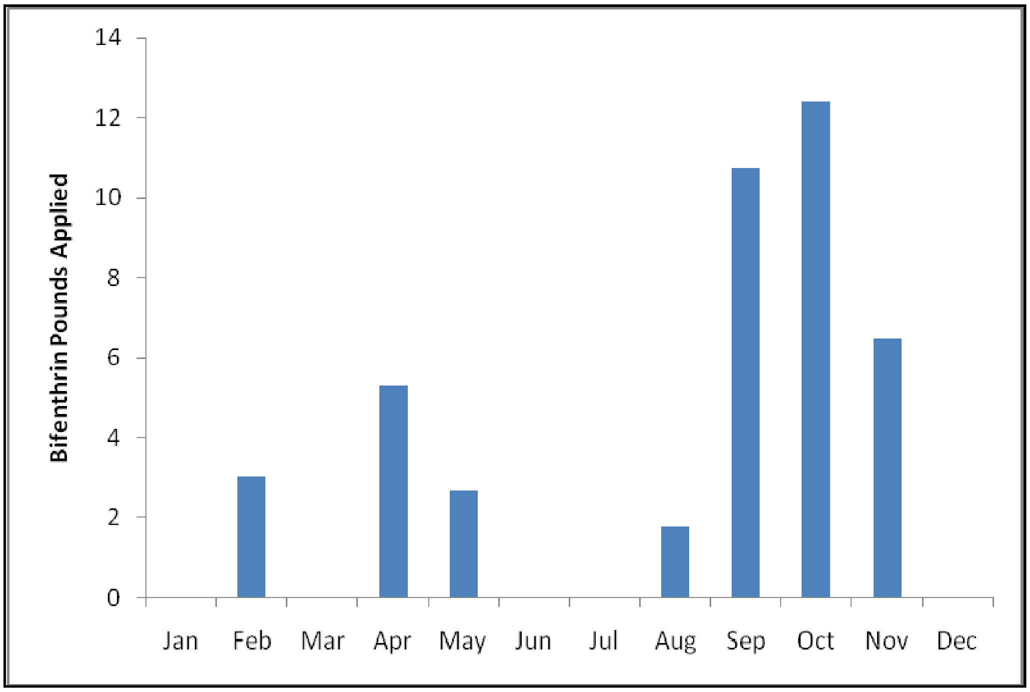

Figure 10. Average monthly bifenthrin use in Oxnard Drain 3 watershed (2007-2009)

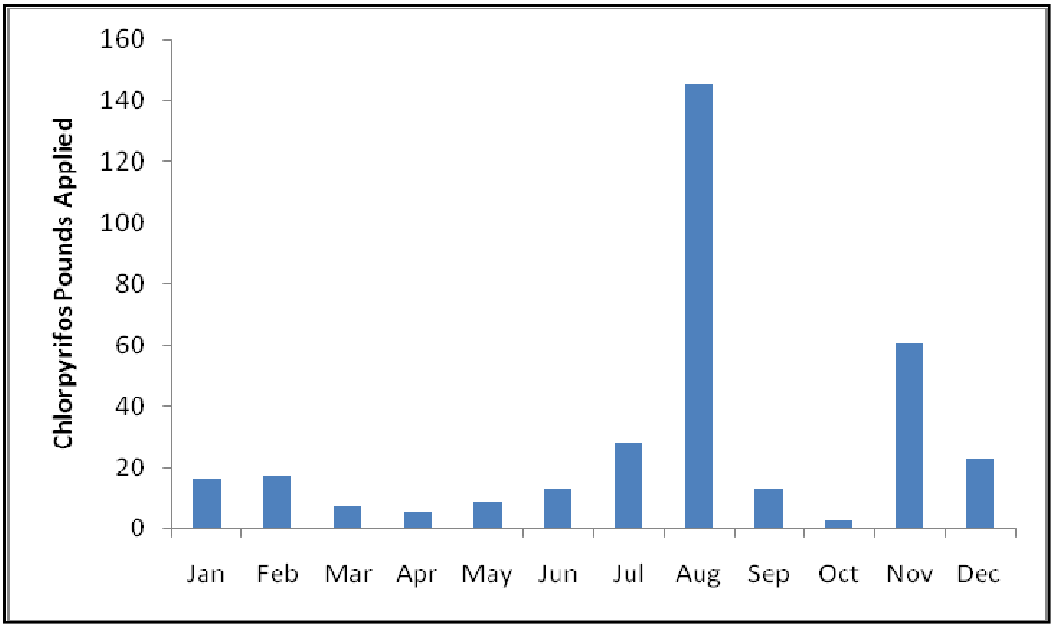

Figure 11. Average monthly chlorpyrifos use in Oxnard Drain 3 watershed (2007-2009)

Atmospheric deposition is incorporated into the indirect loading from watershed runoff. Direct deposition to the Oxnard Drain 3 surface is considered negligible.

Water from the northern section of Oxnard Drain 3 is pumped to the duck club to seasonally flood land. This relocation of water is not a source of pollutant loading. Instead, it likely decreases pollutant concentrations in Oxnard Drain 3 because only a fraction of the water pumped to the duck club will return to Oxnard Drain 3.

One core sample from Oxnard Drain 3 was collected in order to gain a rudimentary understanding of the historical sediment trend. This information is presented in the Appendix.

In summary, the sources of chlordane, DDT, dieldrin, PCBs, and toxaphene are historical sediments that either are currently in Oxnard Drain 3 or could potentially be transported there from other sediments in the watershed. Bifenthrin and chlorpyrifos are currently being applied to urban structures, landscaping, and agricultural crops and are transported via stormwater and irrigation runoff water to Oxnard Drain 3.

5 Linkage Analysis

The linkage analysis defines the connection between the selected indicators, the associated numeric targets, and the identified sources. This enables a translation from numeric targets in fish tissue to water and sediment loading rates.

Bioaccumulatives

Organochlorine (OC) pesticides (chlordane, DDT, dieldrin, and toxaphene) and PCBs are chemical substances that persist in the environment, bioaccumulate through the food web, and can cause adverse effects to human health, aquatic organisms, and wildlife. The primary concerns of OC pesticides and PCBs for Oxnard Drain 3 are the high levels found in fish. The OC pesticides and PCBs of concern have low solubility and a high affinity for organic solids and lipids. Thus, concentrations present in the sediment can result in unacceptable concentrations in fish tissue even when concentrations in the water column are below criteria or non-detectable.

Sediment concentration targets necessary to prevent bioaccumulation in fish were estimated using the Biota-Sediment Accumulation Factor (BSAF) for that contaminant. Starting from the TTRL fish tissue concentration target (see Section 2.2.2.3), the BSAF allows calculation of the necessary sediment concentration to support uses. The loading capacity for sediment-associated OC pesticides and PCBs is then determined from the more protective of the sediment concentration target to meet the TTRL and any other applicable targets for sediment, such as the sediment quality guidelines designed to protect benthic organisms (see Section 2.2.2.2). These loading capacities are expressed as a sediment concentration applicable to both sediments already stored in the drain and new sediment washed into the drain, as well as water column concentrations.

Direct Effect Pollutants

The primary concerns for bifenthrin and chlorpyrifos are acute and chronic water and sediment toxicity to aquatic organisms. For bifenthrin, toxicity is believed to occur primarily by interaction with water whereas the bioavailability of chlorpyrifos is site and species specific. Bifenthrin and chlorpyrifos have a strong affinity for soil particles and moderately long half-lives on the order of several months (Palumbo et al., 2010 and TenBrook et al, 2010). Although bifenthrin and chlorpyrifos degrade much faster than organochlorine pesticides, they persist in the environment long enough to cause chronic toxicity to aquatic life (Amweg et al. 2005 and Green et al. 1996). Numeric sediment criteria do not exist for either of these pollutants. Bifenthrin biomagnification factors are not known, but it biaccumulates in terrestrial food chains via consumption of contaminated aquatic organisms (USEPA, 2010). Chlorpyrifos does not biomagnify in aquatic organisms (Varó et al., 2002). Since bifenthrin and chlorpyrifos are not as persistent as OC pesticides, reduced concentrations of bifenthrin and chlorpyrifos in the water column will rapidly improve aquatic health and the sediment levels will slowly degrade and decrease.

The main difficulty with bifenthrin and chlorpyrifos is that both are extremely toxic to aquatic life and are currently being applied to agricultural fields and urban areas in the Oxnard Drain 3 watershed. Thus, runoff adds new inputs of bifenthrin and chlorpyrifos to the Oxnard Drain 3 ecosystem. Water column bifenthrin and chlorpyrifos will interact with suspended and bottom sediments to reach equilibrium, increasing sediment concentrations when water column concentrations are high, and increasing water column concentrations when sediment concentrations are high (Delgado-Moreno et al, 2011). As noted in Section 2.2.2.2.1, these TMDLs establish water quality targets to address sediment toxicity due to bifenthrin and chlorpyrifos. USEPA believes that implementation of those water quality targets will also help protect Oxnard Drain 3 from impairment of its aquatic life beneficial uses due to bifenthrin and chlorpyrifos in the water column.

Sediment Toxicity

The sediment toxicity targets cannot feasibly be converted into a load and divided into portions to be allocated to sources. It is assumed that WLAs and LAs for bifenthrin, chlordane, chlorpyrifos, DDT, dieldrin, PCBs, and toxaphene will address the sediment toxicity problem.

All TMDL loading capacities for OC pesticides, PCBs, bifenthrin, and chlorpyrifos will protect aquatic life, benthic organisms, wildlife, and human health.

6 TMDLs and Allocations

The goals of these TMDLs are to reduce pollutant concentrations in the water column and sediment to protect aquatic life and to decrease pollutant concentrations in fish tissue to levels safe for human consumption.

TMDLs are comprised of wasteload allocations (WLA), load allocations (LA), and a margin of safety (MOS), as shown below. WLAs are assigned to point source contributors of pollutants and LAs are assigned for non-point source contributions. A margin of safety is explained later in this section.

$$TMDL = \sum WLA + LA + MOS$$

Allocations are assigned on a concentration basis to water and sediment (Table 15), with the goal of attaining the TMDL target concentrations identified for water and sediment, as well as fish tissue (Table 10). The concentration allocations apply to water and sediment entering the drain and within the drain. Although allocations are expressed in terms of water and sediment concentrations, TMDL compliance will be measured according to achievement of all numeric targets (including fish tissue concentration) in addition to compliance with wasteload allocations and load allocations.

Note that since these TMDLs are being expressed as concentrations in water and sediment, the loading capacity is equal to the TMDL target concentrations. The wasteload allocations and load allocations are also equal to the TMDL target concentrations in water and sediment. The margin of safety is implicit. Allocations are assigned for these TMDLs by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

Table 15. TMDL numeric targets used for wasteload and load allocations

Pollutant / Medium	Water Allocations, chronic (ug/L)	Sediment[1,2] Allocations (ug/dry kg)	Alternate Sediment[1,3] Allocations (ug/dry kg)
Bifenthrin[4]	0.0006	-	-
Chlordane, total	0.00059	0.5	3.3
Chlorpyrifos[4]	0.0056	-	-
4,4'-DDT	0.00059	1.0	0.3
4,4'-DDE	0.00059	2.2	2.2
4,4'-DDD	0.00084	2.0	2.0
Dieldrin	0.00014	0.02	4.3
PCBs, total	0.00017	22.7	180
Sediment Toxicity	-	No significant chronic sediment toxicity (See below and Section 3 for more details)	-
Toxaphene	0.0002	0.1	360

1: Sediment concentrations associated with suspended sediment and Oxnard Drain 3 bottom sediment.
2: Sediment allocations apply if there are fish tissue or sediment toxicity exceedances. All sediment allocations are ERLs, except toxaphene. Toxaphene does not have an ERL, so the TEL concentration was selected.
3: The alternate sediment allocation applies when the fish tissue target and the sediment toxicity allocation are achieved in Oxnard Drain 3. The alternate sediment allocation concentrations match the Mugu Lagoon TMDL allocations.
4: Bifenthrin and chlorpyrifos allocations included to address the sediment toxicity impairment.

Due to the neighboring Calleguas Creek and Mugu Lagoon TMDLs, USEPA is setting two sediment allocations. The alternate sediment allocation applies for a particular pollutant if the fish tissue targets and the sediment toxicity allocation are achieved in Oxnard Drain 3. Otherwise, the sediment allocation applies. This approach provides consistency with the Mugu Lagoon TMDLs while ensuring that the aquatic life, recreation, and fish consumption beneficial uses are attained.

The sediment toxicity allocation is no chronic toxicity based on sediment toxicity tests. Sediment is toxic if a sediment sample is significantly more toxic than the laboratory control, where the following two criteria are met: (1) a separate-variance t-test determines there is a significant difference ($p<0.05$) in mean toxicity test organism response (e.g., percent survival, percent normal development) between the sediment sample and the laboratory control, and (2) the mean organism response in that toxicity test is lower than a certain percentage of the control value, as determined by the 90^{th} percentile Minimum Significant Difference (MSD). See Section 3 for specific MSDs and a further explanation of the sediment toxicity allocation. Sediment toxicity allocations cannot simply be converted into a load and divided into portions to be allocated to sources. Additionally, the loading capacity of a stream with regard to a toxicant causing unknown toxicity is inherently unknown and cannot easily be allocated. Consequently, toxicity allocations equal to the numeric targets are set at the lowest point of each of the subwatersheds. This provides a mechanism to address all sources contributing to toxicity where the individual dischargers additively cause an in-stream exceedance of the toxicity targets. Exceedance of the toxicity target will be a trigger mechanism for initiation of the TRE/TIE process as described in USEPA's Region 8, 9 and 10 Toxicity Training Tool (2010b).

6.1 WASTELOAD ALLOCATION

The entire watershed of Oxnard Drain 3 is contained in MS4 jurisdictions, and watershed loads are therefore assigned wasteload allocations (WLAs). All other permitted facilities also receive WLAs.

Relevant permit numbers are:

- County of Ventura (including the City of Oxnard): Board Order 01-182 (as amended by Order No. R4-2010-0108), CAS004002
- General Industrial Stormwater: Order No. 97-03-DWQ, CAS000001, or subsequent permits, see Table 12

The water and sediment wasteload allocations are shown in Table 16. The wasteload allocations for water include dissolved pollutants and pollutants associated with suspended sediment. The TMDL fish tissue targets in Table 10 are also expected to be achieved. Section 7.1 provides recommendations regarding monitoring, including fish tissue monitoring.

Table 16. Wasteload Allocations in Oxnard Drain 3

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation
Northern	Ventura County	MS4 Stormwater[1]	All concentrations in Table 15
Northern	City of Oxnard	MS4 Stormwater[1]	All concentrations in Table 15
Northern	Ormond Beach Generating Station	General Industrial Stormwater[1, 2]	All concentrations in Table 15
Northern	Agromin Organics Recycling	General Industrial Stormwater[1, 2]	All concentrations in Table 15
Southern	Ventura County	MS4 Stormwater[1]	All concentrations in Table 15
Southern	US Navy Point Mugu	General Industrial Stormwater[1, 2]	All concentrations in Table 15

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations

6.2 LOAD ALLOCATION

A load allocation is assigned to the legacy pollutant mass stored in the Oxnard Drain 3 bed sediment which is causing impairment to fish tissue. This constitutes an in-place load, rather than an ongoing load. The responsible jurisdictions (Naval Base Ventura County and the City of Oxnard) should achieve the pollutant concentrations in Table 15 in Oxnard Drain 3 bed sediments.

The Oxnard Drainage District 2 in conjunction with the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Waiver) program is responsible for water and suspended sediment that flow into Oxnard Drain 3 from agricultural fields that are not covered under a permit. The net direct atmospheric deposition of pesticides and PCBs to the drain surface is insignificant and is not assigned a load allocation. Load allocation concentrations are specified in Table 15.

The water and sediment load allocations are shown in Table 17. The load allocations for water include dissolved pollutants and pollutants associated with suspended sediment. The TMDL fish tissue targets in Table 10 are also expected to be achieved. Fish tissue monitoring recommendations are provided in Section 7.1.

Table 17. Load Allocations in Oxnard Drain 3

Subwatershed	Responsible Jurisdiction	Input	Load Allocation
Waterbody (Southern subwatershed section)	Naval Base Ventura County	Oxnard Drain 3 bed sediments	All concentrations in Table 15
Waterbody (Northern subwatershed section)	City of Oxnard	Oxnard Drain 3 bed sediments	All concentrations in Table 15
Northern and Southern	Oxnard Drainage District 2	Discharges from agricultural drains (water and suspended sediment)	All concentrations in Table 15
Northern and Southern	Agriculture Dischargers	Discharges from agricultural drains (water and suspended sediment)	All concentrations in Table 15
Northern and Southern	Ventura County Game Reserve	Surface water flow and suspended sediment	All concentrations in Table 15

6.3 RELATIONSHIP TO NEIGHBORING TMDLS

The Oxnard Drain 3 TMDLs are consistent with the Calleguas Creek Watershed OC Pesticides TMDLs (Regional Board adopted July 2005; USEPA approved March 14, 2006). Both sets of TMDLs adopted the same sediment and fish targets. Since the entire Calleguas Creek Watershed was listed on the 2002 303(d) list for 52 pollutant/waterbody combinations, six subwatersheds were delineated to set distinct pollutant load and wasteload allocations and better implement actions to reduce the loads. These subwatersheds included Mugu Lagoon, Revolon Slough, Calleguas Creek, Arroyo Simi, Arroyo Las Posas, and Conejo Creek. ERL concentrations were set as the sediment target and allocations for those reaches or subwatersheds with existing sediment listings, observed sediment toxicity, or fish tissue impairment. For example, the Revolon Slough subwatershed included a sediment listing from 2002, showed data with sediment toxicity, and consequently, ERL concentrations were set as the sediment allocations for the applicable constituents. In this way, waterbodies with sediment or fish tissue exceedances were given ERL concentrations as sediment allocations. This example is comparable to the Oxnard Drain 3 TMDLs.

The Mugu Lagoon subwatershed included a sediment listing for the DDT congeners (4,4'-DDT, 4,4'-DDD, 4,4'-DDE), and thus, ERL concentrations were set as the sediment targets. However, the Mugu Lagoon subwatershed did not have a sediment listing, show sediment toxicity, or fish impairment for chlordane, dieldrin, PCBs or toxaphene. Consequently, existing condition sediment concentrations were set as the sediment allocations to prevent future elevated levels. These existing condition concentrations were based on the mean concentrations collected at the relevant reach.

In Oxnard Drain 3 there are sediment and fish impairments, thus ERL concentrations are set as the load and wasteload allocations. This is consistent with Calleguas Creek watershed TMDL methodology. Since there is such a large overlap between the Oxnard Drain 3 and Mugu Lagoon watersheds and for ease of implementation, alternate sediment allocations are also allowed if the fish tissue targets and the sediment toxicity allocation are achieved in Oxnard Drain 3 (See Section 6).

6.4 MARGIN OF SAFETY

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water and sediment quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. These TMDLs contain an implicit MOS based on conservative assumptions. The more protective of the freshwater and saltwater water and sediment targets were selected to protect brackish species. In addition, the allocations are set based on the lower of either the BSAF-derived sediment target or the sediment quality guideline target to ensure achievement of the fish tissue targets.

6.5 CRITICAL CONDITIONS

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. These TMDLs protect beneficial uses by reducing fish tissue concentrations, protecting benthic biota in sediment, and reducing water column concentrations to levels safe for aquatic life and human health. Because fish bioaccumulate OC pesticides and PCBs, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations of OC pesticides and PCBs. WLAs and LAs in these TMDLs are assigned as concentrations and are protective during all seasons in both high and low flow conditions. These TMDLs therefore protect critical conditions.

6.6 DAILY LOAD EXPRESSION

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. These TMDLs include a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Since the allocations are expressed as concentrations in water and sediment, the daily maximum allowable load is calculated from the daily water flow multiplied by the TMDL water allocation concentration plus the daily sediment load multiplied by the TMDL sediment allocation concentration. The maximum allowable daily load must be met on all days, and the concentration-based WLAs and LAs must also be met.

Following NPDES regulations, NPDES permits should include both concentration-based and mass-based water quality-based effluent limits based on wasteload allocations.

6.7 FUTURE GROWTH

USEPA regulates chlordane, DDT, dieldrin, toxaphene, and PCBs under the Toxic Substances Control Act (TSCA), which generally bans the manufacture, use, and distribution in commerce of the chemicals in products at concentrations of 50 parts per million or more, although TSCA allows USEPA to authorize certain uses, such as to rebuild existing electrical transformers during the transformers' useful life. Therefore, no additional allowance is made for future growth in the OC pesticides and PCBs TMDLs.

If new permitted sources begin operating in the Oxnard Drain 3 watershed they will be required to meet the concentration-based WLAs and LAs shown in Table 15. Since allocations are assigned on a concentration basis, these TMDLs will not need to be revised to accommodate new permittees.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

7 Implementation Recommendations

Implementation measures may be developed in the future by the Regional Board through an implementation plan, NPDES permits, or other regulatory mechanisms such as State waste discharge requirements (WDRs), conditional waivers of WDRs, and/or enforcement actions. This section describes USEPA's recommendations to the Regional Board as to the implementation procedures and regulatory mechanisms that could be used to provide reasonable assurances that water quality standards will be met.

Wasteload allocations are expressed in Table 16. The concentration-based wasteload allocations should be incorporated into the appropriate MS4 and general industrial stormwater permits.

Regional Board may regulate nonpoint pollutant sources through the authority contained in sections 13263 and 13269 of the California Water Code, in conformance with the State Water Resources Control Board's Nonpoint Source Implementation and Enforcement Policy. The Regional Board may also regulate existing bed sediment through a Cleanup and Abatement Order and the California Water Code 13267 or other appropriate authorities. Load allocations are expressed in Table 17.

The requirements necessary to achieve the allocations to discharges from irrigated lands should be administered through the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Agricultural Waiver, Order No. R4-2010-0186), subsequent renewals, or other Regional Board orders. Owners and/or operators of irrigated agricultural lands are the implementing parties responsible for achieving the allocations. The Conditional Agricultural Waiver requires water quality monitoring and BMP implementation where monitoring shows impacts by agricultural discharges. Owners and/or operators of irrigated agricultural land must enroll in the Conditional Agricultural Waiver or, alternatively, submit a report of waste discharge and apply for a discharge permit. The Conditional Agricultural Waiver is in effect for a period of five years and must be renewed every five years. The existing 2010 waiver requires monitoring for pollutants associated with agricultural operations, including pyrethroids, OC pesticides, OP pesticides, toxaphene, and water toxicity. There are currently no requirements for sediment toxicity or PCBs. These constituents should be added as water and sediment quality limits, and should be included in the monitoring requirements when the Conditional Agricultural Waiver is renewed or other Regional Board order is issued.

For any implementation plan, identification of appropriate management measures and prioritization of areas for implementation are critical steps to determine prior to beginning implementation. Local stakeholder involvement and a schedule for implementation are also integral to any plan. Interim measureable milestones for assessing implementation status should be incorporated into a regular monitoring and adaptive management program aimed at determining whether load reductions are being achieved, and whether progress is being made towards attaining water quality standards. More information on watershed-based planning can be found in the USEPA publication "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" (2008).

If necessary, the Oxnard Drain 3 TMDLs may be revised as the result of new information (See Section 7.1 Monitoring Recommendations). Due to the largely overlapping watersheds, USEPA recommends that future revisions to the Calleguas Creek Watershed TMDLs incorporate the Oxnard Drain 3 TMDLs.

OC Pesticides and PCB Impairments

The manufacture and use of chlordane, DDT, dieldrin, PCBs, and toxaphene is currently cancelled in the U.S. except for certain limited uses of PCBs authorized by USEPA. Source control BMPs and pollutant removal are the most suitable courses of action to reduce OC pesticides and PCBs in Oxnard Drain 3. Internal waterbody storage is one of the greatest contributing sources and driving factors affecting fish tissue concentrations. The most effective remedial actions and/or implementation efforts will focus on addressing the internal Oxnard Drain 3 storage, such as removal of contaminated sediments.

When properly conducted, removal of contaminated drain sediments, or dredging, can be an effective remediation option. The object of sediment dredging is to eliminate the pollutants that have accumulated in sediments at the drain bottom. Dredging is optimal in waterbodies with known spatial distribution of contamination because sediment removal can focus on problem areas. However, no spatial pattern of pollutant contamination was apparent in Oxnard Drain 3. Removal of the contaminated sediments reduces the pollutants available to in-drain cycling by discontinuing exposure to benthic organisms and reducing water column loading, resulting in reduced bioaccumulation in higher trophic level fish. Potential negative effects of dredging include increased turbidity and lowered dissolved oxygen concentrations in the short term, disruption of endangered bird habitat, disturbance to the benthic community, and reactivation of buried sediment and any associated pollutants. Also, clean fill may need to be placed on top of the dredged areas so the newly lowered elevation in Oxnard Drain 3 does not act as a surface or subsurface drain of the surrounding wetlands.

In some cases, sediment capping may be appropriate to sequester contaminated sediments below an uncontaminated layer of sediment, clay, gravel, or media material. Capping is effective in restricting the mobility of OC pesticides and PCBs; however, it is most useful in deep waterbodies and is likely not a viable solution for Oxnard Drain 3. Capping implementation should be restricted to areas with sediments that can support the weight of a capped layer, and to areas where hydrologic conditions of the waterbody will not disturb the cap.

The in-drain options for remediation are costly, but would be the only way to achieve full use support in a short timeframe. However, it is also true that the OC pesticides and PCBs in question are no longer manufactured and are likely to decline in concentration due to dilution by clean sediment and natural attenuation. Natural attenuation includes the chemical, biological, and physical processes that degrade compounds, or remove them from drain sediments in contact with the food chain, and reduce the concentrations and bioavailability of contaminants. These processes occur naturally within the environment and do not require additional remediation efforts; however, natural attenuation often requires decades before observing significant improvement.

USEPA recommends conducting a special study to determine the most appropriate remediation option for the Oxnard Drain 3 bed sediment. Multiple core samples throughout Oxnard Drain 3 should be collected. The core samples will provide information on the depth of contamination which influences the depth and cost of potential dredging actions. Also, if the majority of the pollution is confined to certain areas, only those hot spots would be dredged while the remainder of the drain could be left to naturally attenuate the pollutants. The information from this special study would better inform the Regional Board whether dredging, monitored natural attenuation, or a combination of the two is the best way forward.

Removing persistent pollutants from the top of the watershed is critical to ensure that the incoming pollutant loads do not re-contaminate Oxnard Drain 3. Loading from the watershed will decline over time due to natural attenuation. However, this may take decades. Therefore, it may be necessary to dredge contaminated sediment from agricultural drains in the watershed.

Bifenthrin and Chlorpyrifos

Bifenthrin and chlorpyrifos are pesticides currently applied to urban structures, landscaping, and agricultural crops in the Oxnard Drain 3 watershed. Since they degrade at a moderate rate, if inputs are reduced, the in-drain sediment concentrations should decrease within a couple years. USEPA recommends that people voluntarily reduce their application of bifenthrin and chlorpyrifos, thus reducing the new inputs to the Oxnard Drain 3 watershed. Ideally bifenthrin and chlorpyrifos would not be replaced by other pesticides which may pose similar toxicity risks to aquatic life. Switching to organic farming practices would reduce the loadings of bifenthrin and chlorpyrifos and ensure that alternate pesticides do not create a new toxicity problem.

If landowners choose to continue application of pesticides, source control BMPs to decrease the mobilization and runoff of pesticide contaminated water and sediment to agricultural drains should be installed. Since BMPs also have the potential to control discharges of OC pesticides and PCBs, the implementation of BMPs should be coordinated to achieve the maximum benefit for all constituents of concern.

Sediment Toxicity

As discussed in previous sections, it is assumed that WLAs and LAs for bifenthrin, chlordane, chlorpyrifos, DDT, dieldrin, PCBs, and toxaphene will address the sediment toxicity problem.

If additional constituents are identified as contributing to sediment toxicity and these constituents are not appropriately addressed by other TMDLs, an implementation plan to address these constituents should be developed. Exceedance of the toxicity target will be a trigger mechanism for initiation of the TRE/TIE process as described in USEPA's Region 8, 9 and 10 Toxicity Training Tool (2010b).

Existing Management Plans

The California State Coastal Conservancy has developed an Ormond Beach Wetland Restoration Feasibility Study, which is based on a comprehensive data analysis and prioritization of actions to achieve multiple short- and long-term goals (2009). The Watershed Management Plan for Calleguas Creek also contains additional implementation information in the neighboring area. TMDL implementation activities proposed for Oxnard Drain 3 should be consistent with previous studies and assessments, and coordinated with existing watershed-based planning, restoration, and monitoring efforts in the watershed. A modified Calleguas Creek watershed management plan should incorporate the Oxnard Drain 3 TMDLs.

In the Oxnard Drain 3 TMDLs, compliance must be met by achieving the wasteload and load allocations, in addition to meeting the numeric targets. Similarly, the Calleguas Creek Technical report stated:

Although allocations are expressed in terms of sediment concentration, TMDL progress will be measured according to achievement of all numeric targets in addition to compliance with wasteload allocations and load allocations. Thus, any margin of error associated with the implicit use of BAFs and assumption of equal percent reduction across media (from fish tissue and water to sediment) might affect the validity of percent reduction in sediment concentration in the short term but will not affect achievement of numeric targets in the long run. (Technical Report for Calleguas Creek Watershed OC Pesticides & PCBs TMDL, April 25, 2005)

As such, USEPA recommends that during the revision of the Calleguas Creek Watershed Basin Plan, the intent of the above language be included to match the Oxnard Drain 3 TMDLs language for meeting numeric targets and allocations. This will improve the consistency for both TMDLs.

7.1 MONITORING RECOMMENDATIONS

To provide reasonable assurances that the assigned allocations are met and will result in compliance with the pesticide, PCB, and sediment toxicity targets, a commitment to continued monitoring and assessment is warranted. The purposes of such monitoring will be: 1) to determine compliance with wasteload and load allocations, 2) to determine if the numeric targets outlined in these TMDLs are attained in Oxnard Drain 3, 3) to evaluate whether numeric targets and allocations need to be adjusted to attain beneficial uses, 4) to evaluate the efficacy of control measures instituted to achieve the allocations and associated load reductions, and 5) to document trends over time in OC pesticide and PCB fish tissue concentrations, bifenthrin and chlorpyrifos water column concentrations, and sediment toxicity.

In order to determine compliance, end-of-pipe effluent limitations and sampling may be the most appropriate. USEPA recommends that the permitting authority include Oxnard Drain 3 and end-of-pipe monitoring at representative locations to determine compliance with permit limits and TMDL allocations. Furthermore, USEPA recommends the monitoring program include at least quarterly water column sampling, yearly sediment monitoring, and fish tissue monitoring every three years. Environmentally relevant detection limits should be used (i.e. detection limits lower than applicable target), if available at a commercial laboratory. Standard operating procedures should be followed during all sample collections. In particular, pyrethroids can sorb to collection containers so the standard operating procedure by Hladik et al. should be followed (2009).

Water quality monitoring should measure the following parameters: total suspended sediments, bifenthrin, total chlordane, chlorpyrifos, 4,4’-DDD, 4,4’-DDE, 4,4’-DDT, dieldrin, total PCBs, and toxaphene. In Oxnard Drain 3, measurements of the temperature, dissolved oxygen, pH and electrical conductivity should also be taken with a water quality probe along with a Secchi depth measurement. All efforts should be made to include at least two wet weather-sampling events during the wet season (October through April). Ideally one wet weather sample would correspond to a season of high bifenthrin and/or chlorpyrifos application to agricultural crops.

Sediment monitoring should measure the following parameters: total organic carbon, bifenthrin, total chlordane, chlorpyrifos, 4,4’-DDD, 4,4’-DDE, 4,4’-DDT, dieldrin, total PCBs, toxaphene, and toxicity. USEPA recommends sediment toxicity testing which includes testing a minimum of three species for lethal and non-lethal endpoints. Toxicity testing may include: the 28-day and 10-day amphipod mortality test, the sea urchin fertilization testing using sediment pore water, and the bivalve embryo testing of the sediment/water interface. The chronic 28-day and shorter-term 10-day amphipod tests may be conducted in the first year. The amphipod *Hyalella azteca* is currently known to be the most sensitive species to bifenthrin and therefore is recommended for toxicity testing. USEPA recommends that if there is no significant difference in the results of the 28-day and 10-day tests conducted in the first year, then the less expensive 10-day test can be used throughout the rest of the monitoring, with some periodic 28-day tests. USEPA recommends sediment toxicity monitoring be conducted annually to provide sufficient data over the implementation timeframe to evaluate changes in sediment quality due to implementation actions. USEPA recommends that if sediment objectives are exceeded or sediment toxicity is observed at any time, sampling frequency for both sediment and sediment toxicity should be accelerated to semi-annually thereafter until sediment objectives are not exceeded and sediment toxicity is not observed. TIEs should be initiated on toxic samples. Responsible jurisdictions may form a group to perform sediment toxicity monitoring and follow up TRE/TIE assessments, as necessary, at the base of each subwatershed. Additional sediment toxicity monitoring may be required further upstream in order to more accurately locate toxic sources and determine compliance.

To demonstrate whether fish tissue targets have been attained a composite sample of skin-off fillets from at least five common carp each measuring at least 350mm in length should be analyzed for all TMDL constituents.

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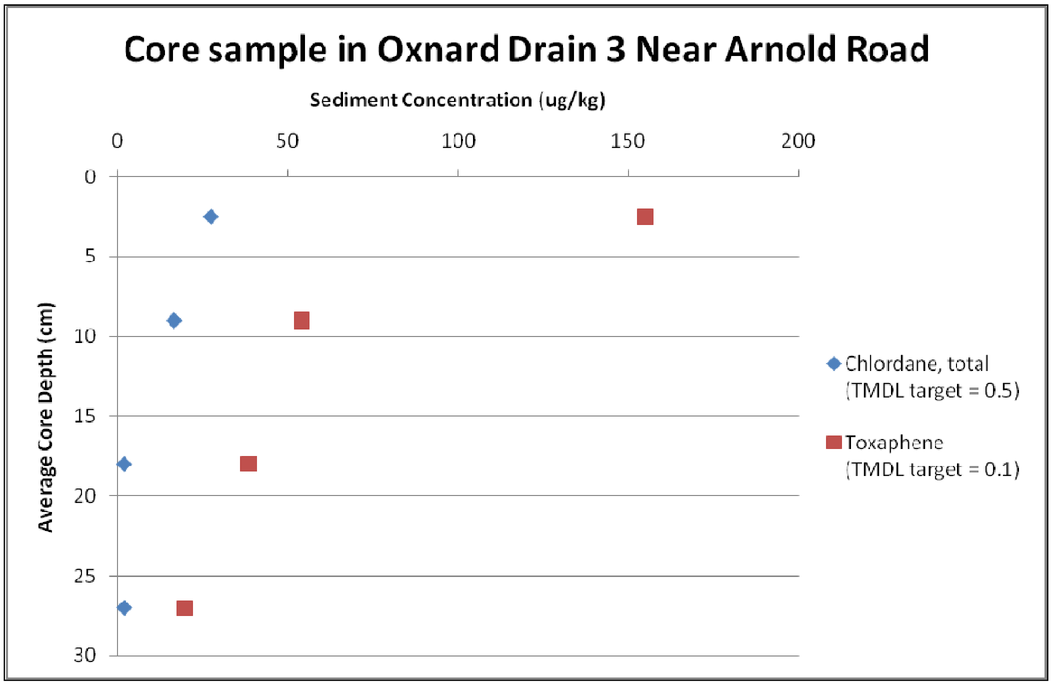
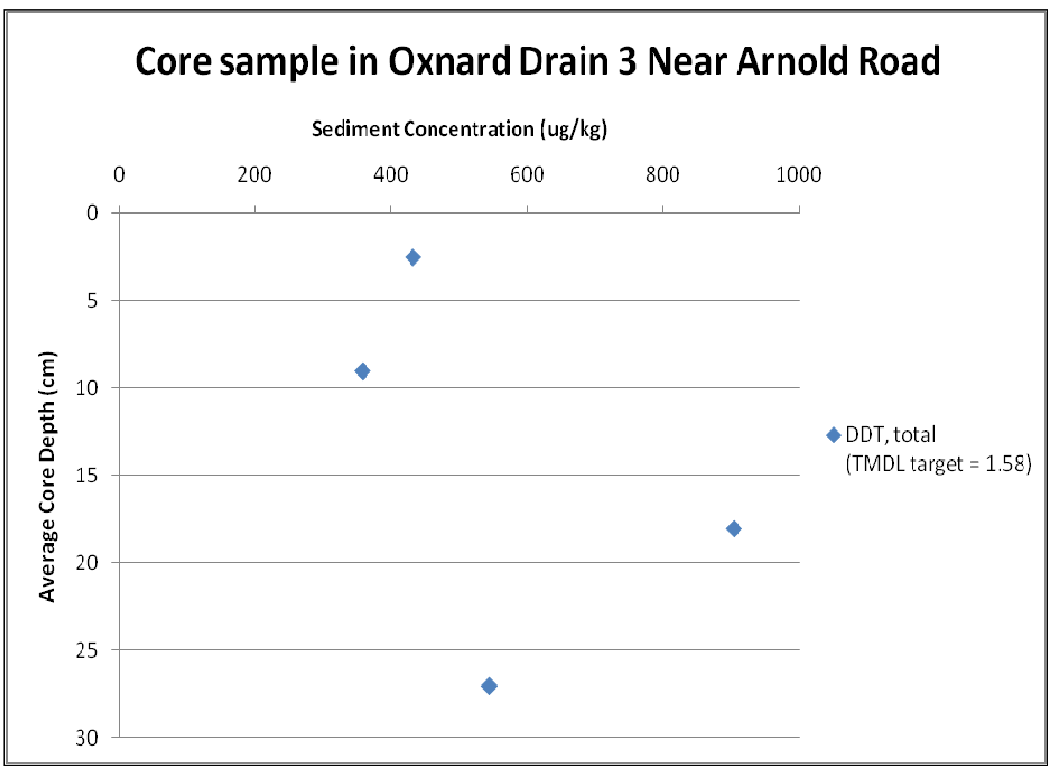
9 Appendix

A sediment core sample was collected on June 9, 2010 in Oxnard Drain 3 near Arnold Road. Chlorpyrifos, dieldrin, and PCBs were below the detection limit. Total chlordane, toxaphene, and total DDT sediment concentrations are shown at different depths below.





The raw sampling data provided below is grouped by location in Oxnard Drain 3, then by date. Samples labeled “OD3 Arnold Rd” where collected in Oxnard Drain 3 near the Arnold Road bridge which includes sampling stations named 01T_ODD3_ARN, Arnold Road, ROD3, and 403.11.02. Samples labeled “OD3 middle” were collected in Oxnard Drain 3 near the tide gate accessible by a dirt road which includes sampling station ROD 2. Samples labeled “OD3 Ditch Rd” where collected in Oxnard Drain 3 near the Ditch Road bridge which includes sampling station ROD1. DL means detection limit.

Location	Date	Group	Media	Parameter (units)	Result
OD3 Arnold Rd	6/7/89	TSM	Fish Tissue	ChemA (ug/kg)	8860
OD3 Arnold Rd	6/7/89	TSM	Fish Tissue	Total Chlordane (ug/kg)	1916
OD3 Arnold Rd	6/7/89	TSM	Fish Tissue	Total DDT (ug/kg)	19270
OD3 Arnold Rd	6/7/89	TSM	Fish Tissue	Dieldrin (ug/kg)	64
OD3 Arnold Rd	6/7/89	TSM	Fish Tissue	Total PCBs (ug/kg)	< DL
OD3 Arnold Rd	6/7/89	TSM	Fish Tissue	Toxaphene (ug/kg)	6800
OD3 Arnold Rd	6/12/90	TSM	Fish Tissue	ChemA (ug/kg)	469
OD3 Arnold Rd	6/12/90	TSM	Fish Tissue	Total Chlordane (ug/kg)	155
OD3 Arnold Rd	6/12/90	TSM	Fish Tissue	Total DDT (ug/kg)	2000
OD3 Arnold Rd	6/12/90	TSM	Fish Tissue	Dieldrin (ug/kg)	14
OD3 Arnold Rd	6/12/90	TSM	Fish Tissue	Total PCBs (ug/kg)	< DL
OD3 Arnold Rd	6/12/90	TSM	Fish Tissue	Toxaphene (ug/kg)	300
OD3 Arnold Rd	6/17/91	TSM	Fish Tissue	ChemA (ug/kg)	1695.8
OD3 Arnold Rd	6/17/91	TSM	Fish Tissue	Total Chlordane (ug/kg)	333.8
OD3 Arnold Rd	6/17/91	TSM	Fish Tissue	Total DDT (ug/kg)	5744
OD3 Arnold Rd	6/17/91	TSM	Fish Tissue	Dieldrin (ug/kg)	67
OD3 Arnold Rd	6/17/91	TSM	Fish Tissue	Total PCBs (ug/kg)	858
OD3 Arnold Rd	6/17/91	TSM	Fish Tissue	Toxaphene (ug/kg)	1200
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	ChemA (ug/kg)	1105.0
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	ChemA (ug/kg)	1317.8
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Total Chlordane (ug/kg)	265.0
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Total Chlordane (ug/kg)	282.8
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Total DDT (ug/kg)	5019
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Total DDT (ug/kg)	5143
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Dieldrin (ug/kg)	26
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Dieldrin (ug/kg)	25
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Total PCBs (ug/kg)	110.7
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Total PCBs (ug/kg)	99.1
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Toxaphene (ug/kg)	814
OD3 Arnold Rd	7/16/97	TSM	Fish Tissue	Toxaphene (ug/kg)	1010
OD3 Arnold Rd	6/4/07	VCAILG	Water	Bifenthrin (ug/L)	< 0.005
OD3 Arnold Rd	6/4/07	VCAILG	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 Arnold Rd	6/4/07	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	6/4/07	VCAILG	Water	Total Chlordane (ug/L)	0.0029
OD3 Arnold Rd	6/4/07	VCAILG	Water	Total DDT (ug/L)	0.0664
OD3 Arnold Rd	6/4/07	VCAILG	Water	Toxaphene (ug/L)	< 0.01
OD3 Arnold Rd	9/10/07	VCAILG	Water	Bifenthrin (ug/L)	< 0.005
OD3 Arnold Rd	9/10/07	VCAILG	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 Arnold Rd	9/10/07	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	9/10/07	VCAILG	Water	Total Chlordane (ug/L)	< 0.001
OD3 Arnold Rd	9/10/07	VCAILG	Water	Total DDT (ug/L)	0.0698

Location	Date	Group	Media	Parameter (units)	Result
OD3 Arnold Rd	9/10/07	VCAILG	Water	Toxaphene (ug/L)	< 0.01
OD3 Arnold Rd	12/19/07	VCAILG	Water	Bifenthrin (ug/L)	0.0122
OD3 Arnold Rd	12/19/07	VCAILG	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 Arnold Rd	12/19/07	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	12/19/07	VCAILG	Water	Total Chlordane (ug/L)	< 0.001
OD3 Arnold Rd	12/19/07	VCAILG	Water	Total DDT (ug/L)	0.1038
OD3 Arnold Rd	12/19/07	VCAILG	Water	Toxaphene (ug/L)	< 0.01
OD3 Arnold Rd	1/5/08	VCAILG	Water	Bifenthrin (ug/L)	< 0.0005
OD3 Arnold Rd	1/5/08	VCAILG	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 Arnold Rd	1/5/08	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	1/5/08	VCAILG	Water	Total Chlordane (ug/L)	0.0016
OD3 Arnold Rd	1/5/08	VCAILG	Water	Total DDT (ug/L)	0.1742
OD3 Arnold Rd	1/5/08	VCAILG	Water	Toxaphene (ug/L)	< 0.01
OD3 Arnold Rd	1/24/08	VCAILG	Water	Bifenthrin (ug/L)	< 0.0005
OD3 Arnold Rd	1/24/08	VCAILG	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 Arnold Rd	1/24/08	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	1/24/08	VCAILG	Water	Total Chlordane (ug/L)	0.0163
OD3 Arnold Rd	1/24/08	VCAILG	Water	Total DDT (ug/L)	0.3717
OD3 Arnold Rd	1/24/08	VCAILG	Water	Toxaphene (ug/L)	< 0.01
OD3 Arnold Rd	5/20/08	VCAILG	Water	Bifenthrin (ug/L)	< 0.0005
OD3 Arnold Rd	5/20/08	VCAILG	Water	Chlorpyrifos (ug/L)	0.0075
OD3 Arnold Rd	5/20/08	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	5/20/08	VCAILG	Water	Total Chlordane (ug/L)	0.0043
OD3 Arnold Rd	5/20/08	VCAILG	Water	Total DDT (ug/L)	0.0796
OD3 Arnold Rd	5/20/08	VCAILG	Water	Toxaphene (ug/L)	< 0.01
OD3 Arnold Rd	2/6/09	VCAILG	Water	Bifenthrin (ug/L)	0.0091
OD3 Arnold Rd	2/6/09	VCAILG	Water	Chlorpyrifos (ug/L)	0.4443
OD3 Arnold Rd	2/6/09	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	2/6/09	VCAILG	Water	Total Chlordane (ug/L)	0.0108
OD3 Arnold Rd	2/6/09	VCAILG	Water	Total DDT (ug/L)	0.2152
OD3 Arnold Rd	2/6/09	VCAILG	Water	Toxaphene (ug/L)	0.524
OD3 Arnold Rd	2/9/09	RB4 & UC-Riverside	Water	Bifenthrin (ug/L)	0.00465
OD3 Arnold Rd	2/9/09	RB4 & UC-Riverside	Water	Chlorpyrifos (ug/L)	0.1285
OD3 Arnold Rd	2/9/09	RB4 & UC-Riverside	Sediment	Bifenthrin (ug/kg)	5.5
OD3 Arnold Rd	2/9/09	RB4 & UC-Riverside	Sediment	Chlorpyrifos (ug/kg)	12.85
OD3 Arnold Rd	3/19/09	USEPA	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	3/19/09	USEPA	Water	Total Chlordane (ug/L)	< 0.001
OD3 Arnold Rd	3/19/09	USEPA	Water	Total DDT (ug/L)	0.082
OD3 Arnold Rd	3/19/09	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 Arnold Rd	3/19/09	USEPA	Water	Toxaphene (ug/L)	0.24
OD3 Arnold Rd	3/19/09	USEPA	Sediment	Dieldrin (ug/kg)	< DL
OD3 Arnold Rd	3/19/09	USEPA	Sediment	Total Chlordane (ug/kg)	39.1
OD3 Arnold Rd	3/19/09	USEPA	Sediment	Total DDT (ug/kg)	766.7
OD3 Arnold Rd	3/19/09	USEPA	Sediment	Total PCBs (ug/kg)	< 1

Location	Date	Group	Media	Parameter (units)	Result
OD3 Arnold Rd	3/19/09	USEPA	Sediment	Toxaphene (ug/kg)	186.56
OD3 Arnold Rd	5/27/09	RB4 & UC-Riverside	Water	Bifenthrin (ug/L)	0.000895
OD3 Arnold Rd	5/27/09	RB4 & UC-Riverside	Water	Chlorpyrifos (ug/L)	0.00425
OD3 Arnold Rd	5/27/09	RB4 & UC-Riverside	Sediment	Bifenthrin (ug/kg)	5.05
OD3 Arnold Rd	5/27/09	RB4 & UC-Riverside	Sediment	Chlorpyrifos (ug/kg)	1.9
OD3 Arnold Rd	8/4/09	VCAILG	Water	Bifenthrin (ug/L)	< 0.0005
OD3 Arnold Rd	8/4/09	VCAILG	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 Arnold Rd	8/4/09	VCAILG	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	8/4/09	VCAILG	Water	Total Chlordane (ug/L)	< 0.001
OD3 Arnold Rd	8/4/09	VCAILG	Water	Total DDT (ug/L)	0.0681
OD3 Arnold Rd	8/4/09	VCAILG	Water	Toxaphene (ug/L)	0.32477
OD3 Arnold Rd	8/13/09	USEPA	Water	Dieldrin (ug/L)	< 0.001
OD3 Arnold Rd	8/13/09	USEPA	Water	Total Chlordane (ug/L)	< 0.001
OD3 Arnold Rd	8/13/09	USEPA	Water	Total DDT (ug/L)	0.0718
OD3 Arnold Rd	8/13/09	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 Arnold Rd	8/13/09	USEPA	Water	Toxaphene (ug/L)	0.23
OD3 Arnold Rd	8/13/09	USEPA	Sediment	Dieldrin (ug/kg)	< DL
OD3 Arnold Rd	8/13/09	USEPA	Sediment	Total Chlordane (ug/kg)	19.93
OD3 Arnold Rd	8/13/09	USEPA	Sediment	Total DDT (ug/kg)	3.5
OD3 Arnold Rd	8/13/09	USEPA	Sediment	Total PCBs (ug/kg)	< 1
OD3 Arnold Rd	8/13/09	USEPA	Sediment	Toxaphene (ug/kg)	196.67
OD3 Arnold Rd	9/17/09	RB4 & UC-Riverside	Water	Bifenthrin (ug/L)	0.0031
OD3 Arnold Rd	9/17/09	RB4 & UC-Riverside	Water	Chlorpyrifos (ug/L)	0.00835
OD3 Arnold Rd	9/17/09	RB4 & UC-Riverside	Sediment	Bifenthrin (ug/kg)	3.15
OD3 Arnold Rd	9/17/09	RB4 & UC-Riverside	Sediment	Chlorpyrifos (ug/kg)	1.6
OD3 Arnold Rd	12/17/09	RB4 & UC-Riverside	Water	Bifenthrin (ug/L)	< 0.0005
OD3 Arnold Rd	12/17/09	RB4 & UC-Riverside	Water	Chlorpyrifos (ug/L)	0.1234
OD3 Arnold Rd	12/17/09	RB4 & UC-Riverside	Sediment	Bifenthrin (ug/kg)	3.45
OD3 Arnold Rd	12/17/09	RB4 & UC-Riverside	Sediment	Chlorpyrifos (ug/kg)	2.55
OD3 Arnold Rd	6/9/10	USEPA	Water	Bifenthrin (ug/L)	< 0.00048
OD3 Arnold Rd	6/9/10	USEPA	Water	Chlorpyrifos (ug/L)	< 0.00095
OD3 Arnold Rd	6/9/10	USEPA	Water	Dieldrin (ug/L)	< 0.952
OD3 Arnold Rd	6/9/10	USEPA	Water	Total Chlordane (ug/L)	< 0.001
OD3 Arnold Rd	6/9/10	USEPA	Water	Total DDT (ug/L)	0.04776
OD3 Arnold Rd	6/9/10	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 Arnold Rd	6/9/10	USEPA	Water	Toxaphene (ug/L)	0.15

Location	Date	Group	Media	Parameter (units)	Result
OD3 Arnold Rd	6/9/10	USEPA	Sediment	Bifenthrin (ug/kg)	4.99
OD3 Arnold Rd	6/9/10	USEPA	Sediment	Chlorpyrifos (ug/kg)	< 14.4
OD3 Arnold Rd	6/9/10	USEPA	Sediment	Dieldrin (ug/kg)	< 2.87
OD3 Arnold Rd	6/9/10	USEPA	Sediment	Total Chlordane (ug/kg)	26.77
OD3 Arnold Rd	6/9/10	USEPA	Sediment	Total DDT (ug/kg)	461
OD3 Arnold Rd	6/9/10	USEPA	Sediment	Total PCBs (ug/kg)	< 2.87
OD3 Arnold Rd	6/9/10	USEPA	Sediment	Toxaphene (ug/kg)	430
OD3 Arnold Rd	10/1/10	USEPA	Sediment	Bifenthrin (ug/kg)	0.971
OD3 Arnold Rd	10/1/10	USEPA	Sediment	Chlorpyrifos (ug/kg)	< 9.09
OD3 Arnold Rd	10/1/10	USEPA	Sediment	Dieldrin (ug/kg)	< 1.82
OD3 Arnold Rd	10/1/10	USEPA	Sediment	Total Chlordane (ug/kg)	64.6
OD3 Arnold Rd	10/1/10	USEPA	Sediment	Total DDT (ug/kg)	436.91
OD3 Arnold Rd	10/1/10	USEPA	Sediment	Total PCBs (ug/kg)	< 1.82
OD3 Arnold Rd	10/1/10	USEPA	Sediment	Toxaphene (ug/kg)	87.1
OD3 middle	3/19/09	USEPA	Water	Dieldrin (ug/L)	< 0.001
OD3 middle	3/19/09	USEPA	Water	Total Chlordane (ug/L)	< 0.001
OD3 middle	3/19/09	USEPA	Water	Total DDT (ug/L)	0.1016
OD3 middle	3/19/09	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 middle	3/19/09	USEPA	Water	Toxaphene (ug/L)	0.26
OD3 middle	3/19/09	USEPA	Sediment	Dieldrin (ug/kg)	< DL
OD3 middle	3/19/09	USEPA	Sediment	Total Chlordane (ug/kg)	13.67
OD3 middle	3/19/09	USEPA	Sediment	Total DDT (ug/kg)	275.5
OD3 middle	3/19/09	USEPA	Sediment	Total PCBs (ug/kg)	< 1
OD3 middle	3/19/09	USEPA	Sediment	Toxaphene (ug/kg)	139.52
OD3 middle	8/13/09	USEPA	Water	Dieldrin (ug/L)	< 0.001
OD3 middle	8/13/09	USEPA	Water	Total Chlordane (ug/L)	1.2986
OD3 middle	8/13/09	USEPA	Water	Total DDT (ug/L)	0.0783
OD3 middle	8/13/09	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 middle	8/13/09	USEPA	Water	Toxaphene (ug/L)	0.21
OD3 middle	8/13/09	USEPA	Sediment	Dieldrin (ug/kg)	< DL
OD3 middle	8/13/09	USEPA	Sediment	Total Chlordane (ug/kg)	18.7
OD3 middle	8/13/09	USEPA	Sediment	Total DDT (ug/kg)	364.7
OD3 middle	8/13/09	USEPA	Sediment	Total PCBs (ug/kg)	< 1
OD3 middle	8/13/09	USEPA	Sediment	Toxaphene (ug/kg)	220.33
OD3 middle	6/9/10	USEPA	Water	Bifenthrin (ug/L)	< 0.0005
OD3 middle	6/9/10	USEPA	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 middle	6/9/10	USEPA	Water	Dieldrin (ug/L)	< 1.04
OD3 middle	6/9/10	USEPA	Water	Total Chlordane (ug/L)	< 0.001
OD3 middle	6/9/10	USEPA	Water	Total DDT (ug/L)	0.0942
OD3 middle	6/9/10	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 middle	6/9/10	USEPA	Water	Toxaphene (ug/L)	0.229
OD3 middle	6/9/10	USEPA	Sediment	Bifenthrin (ug/kg)	3.57
OD3 middle	6/9/10	USEPA	Sediment	Chlorpyrifos (ug/kg)	< 7.59
OD3 middle	6/9/10	USEPA	Sediment	Dieldrin (ug/kg)	< 1.52
OD3 middle	6/9/10	USEPA	Sediment	Total Chlordane (ug/kg)	5.69
OD3 middle	6/9/10	USEPA	Sediment	Total DDT (ug/kg)	119.89
OD3 middle	6/9/10	USEPA	Sediment	Total PCBs (ug/kg)	< 1.52
OD3 middle	6/9/10	USEPA	Sediment	Toxaphene (ug/kg)	73.90

Location	Date	Group	Media	Parameter (units)	Result
OD3 Ditch Rd	3/19/09	USEPA	Water	Dieldrin (ug/L)	< 0.001
OD3 Ditch Rd	3/19/09	USEPA	Water	Total Chlordane (ug/L)	< 0.001
OD3 Ditch Rd	3/19/09	USEPA	Water	Total DDT (ug/L)	0.0624
OD3 Ditch Rd	3/19/09	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 Ditch Rd	3/19/09	USEPA	Water	Toxaphene (ug/L)	0.22
OD3 Ditch Rd	3/19/09	USEPA	Sediment	Dieldrin (ug/kg)	< DL
OD3 Ditch Rd	3/19/09	USEPA	Sediment	Total Chlordane (ug/kg)	15.1
OD3 Ditch Rd	3/19/09	USEPA	Sediment	Total DDT (ug/kg)	320.6
OD3 Ditch Rd	3/19/09	USEPA	Sediment	Total PCBs (ug/kg)	< 1
OD3 Ditch Rd	3/19/09	USEPA	Sediment	Toxaphene (ug/kg)	322.3
OD3 Ditch Rd	8/13/09	USEPA	Water	Dieldrin (ug/L)	< 0.001
OD3 Ditch Rd	8/13/09	USEPA	Water	Total Chlordane (ug/L)	0.3858
OD3 Ditch Rd	8/13/09	USEPA	Water	Total DDT (ug/L)	0.3259
OD3 Ditch Rd	8/13/09	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 Ditch Rd	8/13/09	USEPA	Water	Toxaphene (ug/L)	0.47
OD3 Ditch Rd	8/13/09	USEPA	Sediment	Dieldrin (ug/kg)	< DL
OD3 Ditch Rd	8/13/09	USEPA	Sediment	Total Chlordane (ug/kg)	< 1
OD3 Ditch Rd	8/13/09	USEPA	Sediment	Total DDT (ug/kg)	198.1
OD3 Ditch Rd	8/13/09	USEPA	Sediment	Total PCBs (ug/kg)	< 1
OD3 Ditch Rd	8/13/09	USEPA	Sediment	Toxaphene (ug/kg)	173.57
OD3 Ditch Rd	6/9/10	USEPA	Water	Bifenthrin (ug/L)	< 0.0005
OD3 Ditch Rd	6/9/10	USEPA	Water	Chlorpyrifos (ug/L)	< 0.001
OD3 Ditch Rd	6/9/10	USEPA	Water	Dieldrin (ug/L)	< 0.973
OD3 Ditch Rd	6/9/10	USEPA	Water	Total Chlordane (ug/L)	< 0.001
OD3 Ditch Rd	6/9/10	USEPA	Water	Total DDT (ug/L)	0.0689
OD3 Ditch Rd	6/9/10	USEPA	Water	Total PCBs (ug/L)	< 0.001
OD3 Ditch Rd	6/9/10	USEPA	Water	Toxaphene (ug/L)	0.137
OD3 Ditch Rd	6/9/10	USEPA	Sediment	Bifenthrin (ug/kg)	17.2
OD3 Ditch Rd	6/9/10	USEPA	Sediment	Chlorpyrifos (ug/kg)	< 18.3
OD3 Ditch Rd	6/9/10	USEPA	Sediment	Dieldrin (ug/kg)	< 3.65
OD3 Ditch Rd	6/9/10	USEPA	Sediment	Total Chlordane (ug/kg)	17.69
OD3 Ditch Rd	6/9/10	USEPA	Sediment	Total DDT (ug/kg)	457.84
OD3 Ditch Rd	6/9/10	USEPA	Sediment	Total PCBs (ug/kg)	< 3.65
OD3 Ditch Rd	6/9/10	USEPA	Sediment	Toxaphene (ug/kg)	241
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Total Chlordane (ug/kg)	91.7
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Total Chlordane (ug/kg)	22.77
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Chlorpyrifos (ug/kg)	< 9.97
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Chlorpyrifos (ug/kg)	< 9.84
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Total DDT (ug/kg)	3526.8
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Total DDT (ug/kg)	1760.3
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Dieldrin (ug/kg)	< 1.99
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Dieldrin (ug/kg)	< 1.97
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Total PCBs (ug/kg)	< 2.0
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Total PCBs (ug/kg)	< 2.0
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Toxaphene (ug/kg)	1160
OD3 Ditch Rd	6/9/10	USEPA	Fish Tissue	Toxaphene (ug/kg)	226
OD3 Ditch Rd	10/1/10	USEPA	Sediment	Bifenthrin (ug/kg)	< 0.901
OD3 Ditch Rd	10/1/10	USEPA	Sediment	Chlorpyrifos (ug/kg)	< 9.01

Location	Date	Group	Media	Parameter (units)	Result
OD3 Ditch Rd	10/1/10	USEPA	Sediment	Dieldrin (ug/kg)	< 1.8
OD3 Ditch Rd	10/1/10	USEPA	Sediment	Total Chlordane (ug/kg)	10.01
OD3 Ditch Rd	10/1/10	USEPA	Sediment	Total DDT (ug/kg)	200.38
OD3 Ditch Rd	10/1/10	USEPA	Sediment	Total PCBs (ug/kg)	< 1.8
OD3 Ditch Rd	10/1/10	USEPA	Sediment	Toxaphene (ug/kg)	26.7