PART F. Organochlorine (OC) Compounds

This support document provides the technical details of the accompanying TMDL document and has been provided for readers interested in the approach, the assumptions, and the data used to develop the organochlorine TMDLs. The organization of this document is as follows:

Section I Pollutant Properties, outlines the chemical and physical properties of the organochlorine compounds for which TMDLs have been developed. Because of the persistent nature of these pollutants and their known impact on the environment, there is a substantial body of literature available that describes their properties. This section provides a summary of the values used to characterize the pollutant properties used in the TMDL analysis.

Section II Calculation of Loading Capacities and Existing Loads, outlines the process and scientific rationale used to calculate the loading capacities and existing loads and presents the calculations for each of the organochlorine compounds. For each compound, all equations, input parameters, and assumptions have been included, along with text that describes how the information was used in the analysis.

Section III References, includes complete citations for each of the references included in the document.

Appendix 1, Data Analysis and Source Assessment, includes the data used to support the organochlorine TMDL analysis.

I. Pollutant Properties

The organochlorine compound TMDLs have been presented in a single document because, as a class of compounds, they possess unique physical and chemical properties that influence their persistence, fate, and transport in the environment. Although these properties differ among the organochlorine compounds, they all exhibit an ability to resist degradation, associate with sediments or other solids, and to accumulate in the tissue of invertebrates, fish, and mammals. In fact, it is their unique properties that have contributed to both their efficacy as pesticides and industrial products and their persistence and accumulation in the environment. Because these unique properties are important factors in identifying and applying the technical procedures used to calculate the TMDLs, this section has been included to provide a better understanding of each of the compounds. The summaries have been developed by reviewing published reports and are focused on the properties that influence their behavior in the environment. This information provides a better understanding of these compounds and supports the TMDL analysis through the selection of values to represent environmental processes.

Polychlorinated biphenyls

Polychlorinated biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). An important property of PCBs is their general inertness; they resist both acids and alkalis and have thermal stability. This made them useful in a wide variety of applications, including dielectric fluids in transformers and capacitors, heat transfer fluids, and lubricants. In general, PCBs are relatively insoluble in water, and the solubility decreases with increased chlorination. Photolysis is the more significant process of degradation than hydrolysis or oxidation. Degradation can occur under both aerobic and anaerobic conditions. The greater the chlorine content of the PCB, the longer the half-life, ranging from days to years (ATSDR

Although it is now illegal to manufacture, distribute, or use PCBs, these synthetic oils were used for many years as insulating fluids in electrical transformers and in other products such as cutting oils (GE, 1999). In 1976, the manufacture of PCBs was prohibited because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils. Historically, PCBs have been introduced into the environment through discharges from point sources and through spills and accidental releases. Although point source contributions are now controlled, nonpoint sources may still exist. For example, refuse sites and abandoned facilities may still contribute PCBs to the environment. Once in a waterbody, PCBs become associated with solid particles and typically enter sediments (Wisconsin DNR, 1997).

DDT

DDT (1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane) is an insecticide that was once widely used on agricultural crops and to control disease-carrying insects. Because of potential harm to wildlife and human health, the use of DDT was banned in the United States in 1972, except for public health emergencies. One pesticide, Dicofol, is a currently registered pesticide and an

active source of DDT. Dicofol was permitted to contain up to 15% DDT until 1987, afterwards only 0.015% DDT is allowed as the active ingredient. DDT is still used in some other countries.

DDT degrades into two metabolites: DDD and DDE. DDD was also historically used as a pesticide, but its use has also been banned. One form of it has been used medically to treat cancer of the adrenal gland. DDE has no commercial use. DDT has a half-life in air of less than 2 days and does not dissolve easily in water. Other characteristics include:

- DDT adheres strongly to soil particles and does not move quickly to ground water—its half-life in soil ranges from 2–15 years.
- DDT will evaporate from soil and surface water into the air and is broken down by sunlight or by microorganisms in soil or surface water.
- DDT in soil usually breaks down to form DDE or DDD.
- DDT accumulates in plants and in the fatty tissues of fish, birds, and animals.

Chlordane

Chlordane was used as a pesticide in the United States from 1948 to 1988. Because of concern about environmental and human health impacts, EPA banned the use of chlordane in 1983 except to control termites; all uses have been banned since 1988. Until 1983, chlordane was used as a pesticide on crops such as corn and citrus and on home lawns and gardens. The following characteristics of chlordane affect its fate in the environment:

- Chlordane adheres strongly to soil particles at the surface and is not likely to enter groundwater.
- Chlordane has the ability to stay in the soil for over 20 years.
- Chlordane can leave soil by evaporation to the air.
- Chlordane does not dissolve easily in water.
- Chlordane accumulates in the tissues of fish, birds, and mammals.

Dieldrin

Dieldrin is an insecticide that was used from 1950 to 1970 on crops such as corn and cotton. Because of concerns about damage to the environment and the potential harm to human health, EPA banned all uses of dieldrin in 1974 except to control termites. In 1987, EPA banned all uses. Characteristics of dieldrin that affect its fate in the environment include:

- Dieldrin binds tightly to soil and slowly evaporates to the air.
- Dieldrin breaks down very slowly.
- Dieldrin in soil can accumulate in plants.
- The pesticide, Aldrin, rapidly changes to Dieldrin in plants and animals.
- Dieldrin is stored in body fat and leaves the body very slowly.

Toxaphene

The insecticide Toxaphene contains over 670 chemicals and was one of the most heavily used insecticides in the United States until 1982, when it was banned for most uses. All uses were banned in 1990. It was used primarily in the southern U.S. to control insect pests on cotton and other crops. It was also used to control insect pests on livestock and to kill unwanted fish in lakes. Toxaphene may enter the environment from hazardous waste sites or by evaporation. Other characteristics that affect its fate in the environment include the following:

- Toxaphene does not dissolve well in water, so it is more likely to be found in air, soil, or sediment at the bottom of lakes or streams, than in surface water.
- Toxaphene breaks down very slowly in the environment.
- Toxaphene accumulates in fish and mammals.

Summary of Organochlorine Compound Properties

All organochlorine compounds addressed in this analysis have properties that contribute to their ability to concentrate in biota and magnify in the food chain. These chemicals also have considerable persistence in soils and sediment. Although information on exactly how long these chemicals persist in the environment varies depending on the environmental conditions, they are all found in several media in Newport Bay and San Diego Creek despite the lack of active sources. Consistent with their physical properties, these chemicals are typically not observed in the water column but instead are observed in sediment and fish and mussel samples, as indicated by data collected as part of the CA State Mussel Watch program (SMW 1993 - 2000). Data collected over 20 years shows evidence of declining fish tissue concentrations for these compounds; however, this trend is uncertain in freshwater and saltwater sediments.

The three key properties of the organochlorine compounds used to calculate the TMDLs include:

- Octanol-water partition coefficients (Kow) are a laboratory-measured property that provides a measure of the tendency of a substance to prefer non-aqueous or oily environments rather than water and is used as an indicator of the degree to which a substance will bioaccumulate.
- Organic carbon/water partition coefficients (Koc) describe the ratio of a compound adsorbed to solids and in solution, normalized for organic carbon content.
- Bioconcentration factors (BCF) the ratio between the concentration of the chemical in an organism's tissues to the concentration in the surrounding water.

Appropriate values for the TMDL analyses were identified through a search of local, regional, and national values presented in the literature. For this TMDL the following values were selected as shown in Table F-1 and associated references below.

Table F-1. Summary of Properties of the Organochlorine Compounds

	Total PCBs	Total DDT	Chlordane	Dieldrin	Toxaphene
Log Kow	6.261[a]	p,p' DDT = 6.610[b] p,p, DDE = 6.956[c] p,p DDD = 6.217[d]	6.32[e]	5.401[d]	5.5[e]
Log Koc[g]	6.15	p,p' DDT = 6.498 p,p DDE = 6.838 p,p DDD = 6.111 **Mean DDT = 6.48**	6.21	5.31	5.4
BCF[f]	270,000	363,000	37,800	2,993	52,000

[a] Mean of 20 congener values cited for PCB cited in de Bruijn et al. (1989)
[b] mean of two values cited in USGS (2001) One value from de Bruijn et al. (1989) and one value from Brooke et al. (1990)
[c] USGS (2001) from de Bruijn et al. (1989)
[d] de Bruijn et al. (1989)
[e] "Southerland" EPA report
[f] references for the BCF values are presented in Table F-4.
[g]The following general equation was used for converting Log Kow to Log Koc.
Log Koc = 0.00028 + log Kow (0.983) (Hoke et al. 1994).

Review of Sediment Targets

As discussed in the TMDL document, the Santa Ana Regional Board Basin Plan (1995) includes narrative water quality objectives for each of the pollutants addressed in this document (see section II in the summary document). However, to calculate the loading capacities, it was necessary to select a numeric endpoint protective of the narrative standards. The rationale for selecting the numeric endpoints is presented in section VI of the summary document. The endpoints are listed in Table F-2.

Table F-2. Sediment Targets Used in the TMDL Analyses

	PCBs (µg/kg)*	DDT (µg/kg)*	Chlordane (µg/kg)*	Dieldrin (µg/kg)*	Toxaphene (µg/kg)*
San Diego Creek	34.1	6.98	4.5	2.85	0.1
Upper Newport Bay	21.5	3.89	2.26	NR	NR
Lower Newport Bay	21.5	3.89	2.26	0.71	NR
Rhine Channel	21.5	3.89	2.26	0.71	NR

NR: TMDL not required for these pollutant-waterbody combinations
* dry weight

II. Calculation of Loading Capacities and Estimate of Existing Loadings

General Conceptual Approach

The loading capacity for each pollutant represents the maximum loading that a waterbody can assimilate and still meet and maintain water quality standards. For the organochlorine compounds addressed in these TMDLs, long-term loadings at or below the loading capacities should eventually result in reduction in concentrations of these compounds in bottom sediment to levels protective of the standards. A review of available data (see Appendix 1 for a summary of the data used in the TMDL analysis) indicates that bottom sediments currently exhibit elevated organochlorine compound concentrations and it is believed that these elevated levels are primarily associated with the past use and disposal of products containing these compounds. The higher the current concentrations in bottom sediments, the longer it will take to meet standards, even if external sources are reduced.

The approach to determining the loading capacities for each of the organochlorine compounds was similar and was based on an understanding of the sources of these compounds (past, present, and future) and the transport and ultimate fate of these compounds in various environmental media. Based on a review of literature sources, it was observed that organochlorine compound environmental persistence and affinity for adsorbing to sediment and accumulating in biota generally limits their presence in the water column, at least relative to sediment and biota. Additionally, because these compounds are no longer used in the watershed (with the exception of small amounts of DDT associated with Dicofol applications) the primary sources are assumed to be sediment loading associated with watershed runoff and resuspension and transport of previously deposited in-stream sediments. The loading capacities were determined by "back-calculating" the allowable load from the selected sediment target (Table F-2) and the associated estimates of sediment loads.

The calculation of existing organochlorine compound loads, which are not required components of the TMDLs, allows for a relative comparison the estimated current loading to the calculated loading capacity. In contrast to the calculation of the loading capacities, which was accomplished through back calculation from the sediment targets, the existing loadings were based on review and analysis of available multi-media data.

The methodologies used to calculate the loading capacities and existing loads for San Diego Creek and Newport Bay are discussed the following section with separate subsections for each methodology.

Calculation of San Diego Creek Loading Capacity and Existing Loads

Figure F-1 presents a schematic of the approach used to calculate the loading capacity and existing loads for San Diego Creek. The approach relies on the following key information:

- Flow data from gaging station at Campus Drive (USGS and OCPFRD data)
- Suspended sediment concentrations from the RMA modeling study regression analysis (RMA 1997)

- Sediment targets (see Table F-2)
- Partition coefficients (see Table F-1)
- Acute and chronic criteria from the California Toxics Rule (EPA 2000a)
- Fish tissue concentrations (for calculating existing loads)
- Pollutant-specific bioconcentration factors (BCFs)

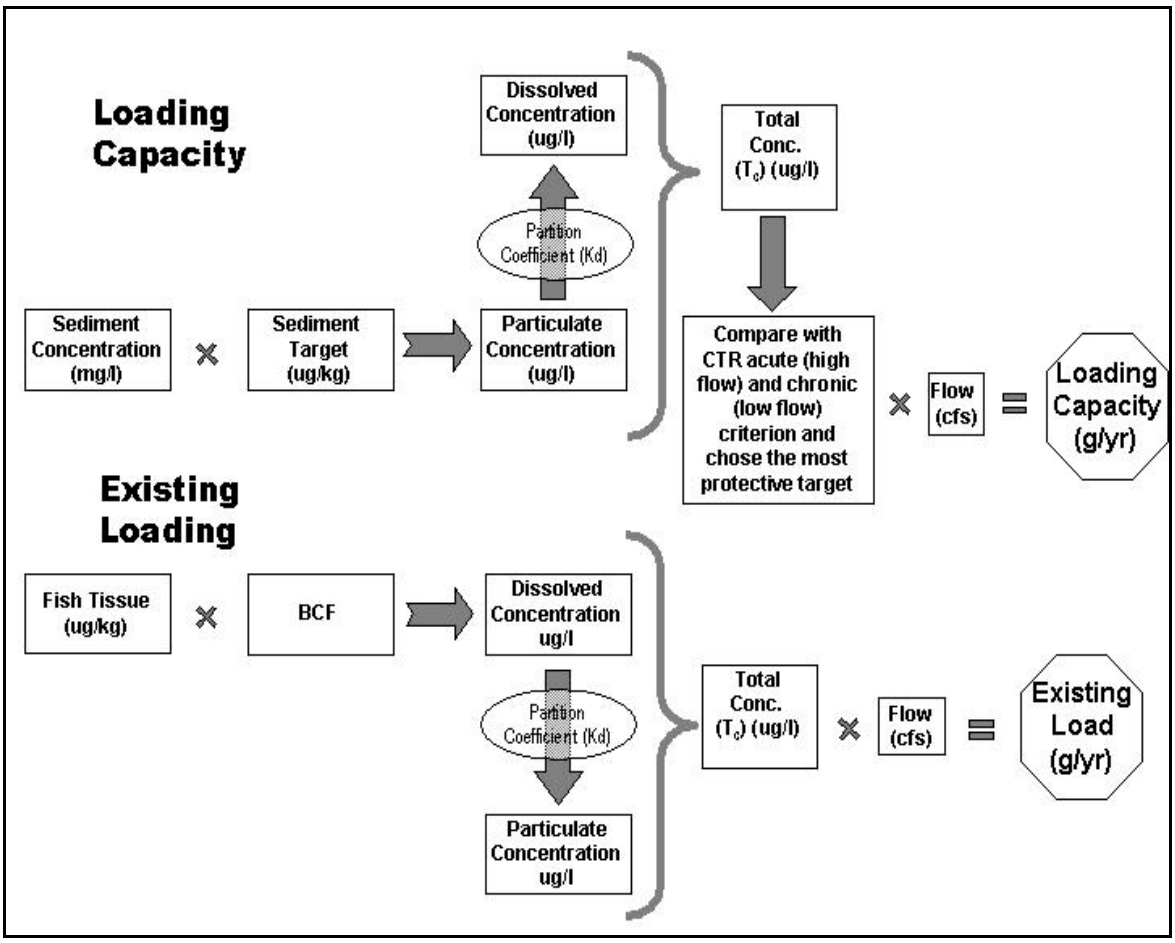

Figure F-1. Approach to Developing Loading Capacities and Existing Loads in San Diego Creek

The analyses for the loading capacity and the existing loads were based on the same general procedures but the availability of data dictated several differences, notably the use of available fish tissue data and bioconcentration factors in the calculation of existing loads. The remainder of this section outlines the procedures, parameters, and values used in the calculation of loading capacities and existing loads.

Loading Capacity

The loading capacity represents the maximum amount of a pollutant a waterbody can assimilate and still meet applicable water quality objectives. For the organochlorine compound TMDLs, sediment targets protective of the objectives were identified and formed the basis for the calculation of the loading capacity. The first step involved using the sediment targets and calculating particulate pollutant concentrations using information on the suspended sediment concentrations in the creek under three flow tiers. Daily flow records available at Campus Drive (USGS 1977-1997) were analyzed and categorized into the following flow tiers:

- Base and low flows: median (15 cfs) for 352 days
- Medium flows: median (365 cfs) for 10 days
- High flows: median (1,595 cfs) for 3 days

The suspended sediment concentration corresponding to each of the flow tiers was calculated based on the observation data and regression results from the Feasibility Report for Upper Newport Bay (RMA 1997). The values are 97, 1,730, and 5,011 mg/L for the base and small, medium, and high flow tiers, respectively. The following is the regression equation used in the analysis:

$$\log(y) = -0.09(\log(x)\text{^}2 + 2.24(\log(x)) - 1.96$$

where: x = flow (cfs)
y = sediment (tons/day)

Because the organochlorine compounds have a strong affinity for sediment, partition coefficients, which describe the ratio of a compound adsorbed to solids and in solution, were identified and used with the particulate concentrations to estimate the dissolved concentration. The sum of the particulate and dissolved concentrations represented the total concentration of the pollutant in the water column.

The total water column concentrations for each flow tier were than compared to either the acute (Criterion Maximum Concentration [CMC]) or the chronic (Criterion Continuous Concentration [CCC]) criterion. The concentrations for each flow tier that were most protective of water quality objectives were summed used with flow data to calculate the loading capacity. The base and low flow and medium flow concentrations were compared to the chronic criteria and the high flow concentrations were compared to the acute criteria. The acute and chronic values were obtained from the California Toxics Rule (USEPA 2000a) and are presented in Table F-3.

The following equations provide the approach for calculating the loading capacities presented in Table F-5.

$$\text{Load (g/yr)} = Cw \times Q \times 28.31 \times 86{,}400 \times Qd \times 0.000001$$

where: Cw = water concentration (µg/L)
Q = flow (cfs)

28.31	=	cubic feet to liter
86,400	=	conversion factor for days per year
Qd	=	number of days of flow (3, 10, or 362)
0.000001	=	conversion factor from μg to g

The values for Cw were calculated using the following equation:

$$Cw = Ct \times Cs \times 1/F_p \times CF$$

where:	Ct	=	pollutant target concentration in sediment (μg/kg)
	Cs	=	sediment concentration (mg/L)
	F_p	=	particulate fraction
	CF	=	conversion factor from mg to kg

The values for F_p were calculated using the following equation:

$$F_p = 1 - F_d$$

$$F_d = \frac{1}{1 + K_d \cdot Cs}$$

where:	K_d	=	pollutant-specific partition coefficient (m^3/g)

Table F-3. CCC (chronic) and CMC (acute) values.

Pollutant	CCC (chronic) (μg/L)	CMC (acute) (μg/L)
PCB	0.014	0.0140
DDT (total)	0.001	1.1000
Chlordane	0.0043	2.4000
Dieldrin	0.056	0.2400
Toxaphene	0.0002	0.7300

Source: EPA (2000a): California Toxics Rule

Existing Loads

The calculation of existing loads (see Figure F-1) was accomplished using the same general procedure outlined above for the loading capacity. The primary differences include:

- Recent fish tissue data were used with BCFs to back calculate the dissolved pollutant concentrations.
- Partition coefficients were used with the dissolved concentrations to estimate the particulate fraction.
- The total concentration and flow were used to calculate existing loads—no comparison to water quality criterion was conducted.

The analysis of existing loads was conducted using fish tissue (red shiner) data collected in June 1998 as part of the Toxic Substances Monitoring Program at the following three locations:

- San Diego Creek/Michelson Drive
- Peters Canyon Channel
- San Diego Creek/Barranca Parkway

The geometric mean of the fish tissue data (Appendix 1) from this source were used because they represented the best available recent data on the accumulation of the organochlorine compounds in aquatic biota.

The next step in the analysis required using the fish tissue concentrations with BCF values for each of the organochlorine compounds to calculate a dissolved pollutant concentration. The selection of appropriate BCF values, which have published values spanning several orders of magnitude, was conducted. Species-specific (i.e., Red Shiner) BCF values were not available therefore values for similar small bottom feeding fish such as the fat head minnow were used (Table F-4).

Table F-4. Bioconcentration factors used in the analysis of existing loadings.

Name	BCF	Reference
PCBs	270,000	EPA Ambient Water Quality Criteria - PCB (Aroclor 1260 - Fathead minnow (female) *Pimehales promelas*)
Dieldrin	2,993	EPA Ambient Water Quality Criteria - Channel catfish (*Ictalurus punctatus*)
DDT	363,000	EPA Ambient Water Quality Criteria - DDT (Common Shiner - *Notropis Cornutus*)
Toxaphene	52,000	EPA Bioaccumulation Testing And Interpretation For The Purpose of Sediment Quality Assessment (Fathead minnow *Pimehales promelas*)
Chlordane	37,800	EPA Ambient Water Quality Criteria - Chlordane (Fathead minnow - *Pimehales promelas*)

Once appropriate BCFs were determined, they were used with the fish tissue concentrations to calculate the dissolved pollutant concentration. In contrast to the approach used to calculate the loading capacity, partition coefficients were used to determine the pollutant concentration in the particulate fraction. The dissolved and particulate concentrations were then summed into a total concentration, which was used with flow data to calculate the existing loads for each pollutant. All of the equations presented above for the calculation of the loading capacity were also used to calculate existing loads. In addition, the following equation was used to calculate the dissolved concentration using the fish tissue concentrations and BCF values.

$$c_w = \frac{TC}{BCF}$$

where: TC = tissue Concentration in µg/kg
BCF = EPA Bioconcentration Factor in L/kg
c_w = dissolved concentration (estimated) in µg/L

Table F-5 presents the loading capacities and existing loadings of the organochlorine compounds for San Diego Creek.

Table F-5. Summary of San Diego Creek Existing Loads and Loading Capacities

	Existing Load (g/year)	Loading Capacity (g/year)
PCB	282.1	2,226.3
DDT	3,733.8	432.6
Chlordane	615.7	314.7
Dieldrin	381.8	261.5
Toxaphene	582.1	8.8

Calculation of Newport Bay Loading Capacity and Existing Loads

The major source of the organochlorine compounds into Newport Bay is upstream loadings from San Diego Creek (88 percent), local drainages, and redistribution of historically deposited sediments within the Bay system. Previous modeling studies, completed by RMA for the U.S. Army Corps of Engineers (USACE) have examined the circulation patterns, and transport and deposition of sediments in Newport Bay (RMA 1998). By examining model calibration results (RMA 1998) for Newport Bay from 1985-1997, the sediment deposition in each region of Newport Bay was estimated. Historic pollutant loads to the bottom sediment were estimated by using observed pollutant concentrations in bottom sediments and net sedimentation rates. Sediment volume was converted to dry weight using an estimated porosity of 0.65.

Figure F-2 presents a schematic of the approach used to calculate the loading capacity and existing loads for Newport Bay. The approach relies on the following key information:

- Sediment deposition rates (from the RMA (1997) model)
- Sediment deposition patterns (from the RMA (1997) model)
- Sediment pollutant targets (used for loading capacity) (see Table F-2)
- Sediment organochlorine concentrations from observation data (used for existing loads)

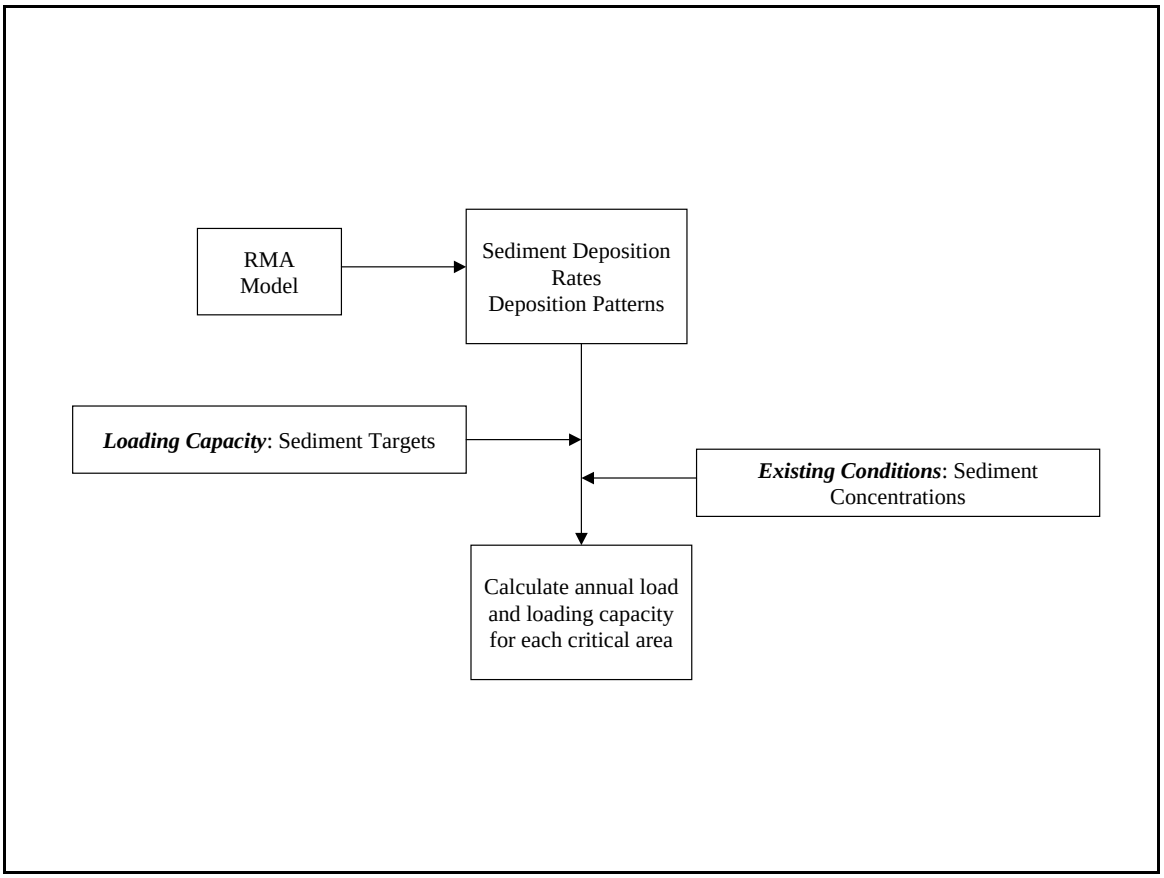

Figure F-2. Approach to Developing Loading Capacities and Existing Loads in Newport Bay

The remainder of this section presents the loading capacity calculations for each of the organochlorine compounds. For each compound, all equations, values applied, and references used in the calculation are included.

Summary of Approach for Calculating Loading Capacities and Existing Loads of Organochlorine Compounds for Newport Bay

The following equation was used with sediment target concentrations (Cs) (Table F-6) to calculate the loading capacities. For existing loadings, the same equation was used with concentrations from existing data substituted for the sediment targets.

$$\text{Load (g/yr)} = Cs \times Ds \times \rho s \times (1 - Ps) \times CF$$

where:

Cs	=	sediment concentration (µg/kg dry)
Ds	=	sediment deposition (m^3/yr)
ρs	=	sediment density (kg/m^3)
Ps	=	sediment porosity
CF	=	conversion factor from µg to g

The values for all parameters used in the analysis for Newport Bay and Rhine Channel are presented in Table F-6.

Table F-6. Parameter values used in the Newport Bay TMDL Analysis.

	Sediment conc. (ug/kg dry)				ρs (kg/m^3)	Ps	CF
	Target Concentration	Observed Concentrations*					
		UNB	LNB	RC			
PCB	21.5	42.8	40.8	93.1	2,500	0.65	0.000001
DDT	3.89	58.7	74.5	7.45			
Chlordane	2.26	12.8	8.94	0.44			
Dieldrin	0.71	1.0	1.0	5.0			

*UNB: Upper Newport Bay; LNB: Lower Newport Bay; and RC: Rhine Channel
Ds (m^3/year): Upper Newport Bay: 81,233.95; Lower Newport Bay: 29,924.01; Rhine Channel: 859.23

Calculations

PCB

Loading Capacity

$$\text{Upper NB Loading Capacity (g/yr)} = 21.5 \times 81{,}234 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Lower NB Loading Capacity (g/yr)} = 21.5 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Loading Capacity (g/yr)} = 21.5 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

Existing Loading

$$\text{Upper NB Existing Loading (g/yr)} = 42.8 \times 81{,}234 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Lower NB Existing Loading (g/yr)} = 40.8 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Existing Loading (g/yr)} = 93.1 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

PCB	Existing Load (g/year)	Loading Capacity (g/year)
Upper Newport Bay	858.7	1528
Lower Newport Bay	409.8	563.0
Rhine Channel	70.02	16.16

DDT

Loading Capacity

$$\text{Upper NB Loading Capacity (g/yr)} = 3.89 \times 81{,}234 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Lower NB Loading Capacity (g/yr)} = 3.89 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Loading Capacity (g/yr)} = 3.89 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

Existing Loading

$$\text{Upper NB Existing Loading (g/yr)} = 58.7 \times 81{,}234 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Lower NB Existing Loading (g/yr)} = 74.5 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Existing Loading (g/yr)} = 7.45 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

DDT	Existing Load (g/year)	Loading Capacity (g/year)
Upper Newport Bay	1080	276.5
Lower Newport Bay	438.4	101.9
Rhine Channel	5.60	2.92

Chlordane

Loading Capacity

$$\text{Upper NB Loading Capacity (g/yr)} = 2.26 \times 81{,}234 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Lower NB Loading Capacity (g/yr)} = 2.26 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Loading Capacity (g/yr)} = 2.26 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

Existing Loading

$$\text{Upper NB Existing Loading (g/yr)} = 12.8 \times 81{,}234 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Lower NB Existing Loading (g/yr)} = 8.94 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Existing Loading (g/yr)} = 0.44 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

Chlordane	Existing Load (g/year)	Loading Capacity (g/year)
Upper Newport Bay	290.7	160.6
Lower Newport Bay	50.20	59.17
Rhine Channel	0.33	1.70

Dieldrin

Loading Capacity

$$\text{Lower NB Loading Capacity (g/yr)} = 0.71 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Loading Capacity (g/yr)} = 0.71 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

Existing Loading

$$\text{Lower NB Existing Loading (g/yr)} = 1.0 \times 29{,}924 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$
$$\text{Rhine Channel Existing Loading (g/yr)} = 5.0 \times 859.23 \times 2{,}500 \times (1 - 0.65) \times 0.000001$$

Dieldrin	Existing Load (g/year)	Loading Capacity (g/year)
Lower Newport Bay	5.93	18.59
Rhine Channel	3.76	0.53

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Appendix 1: Data Analysis and Assessment

This appendix presents the data available to characterize the level of contamination by organochlorine compounds in the Newport Bay watershed. Monitoring data are available for three media: water, sediment, and tissue. The following data summaries are organized by the source/agency.

Orange County Public Facilities and Resources Department (OCPFRD): Sediment data results were available for three DDT compounds and two PCB Aroclors; no data results were available for Chlordane, Dieldrin and Toxaphene. Data were available from 1999 to 2000 for some freshwater tributaries and several sites in Upper and Lower Bay. OCPFRD results (1999/00) for PCBs were used in the analysis of existing loads. Results reported below the MDL were assumed equal to half that value. No data for organics in the water column were available.

***Irvine Ranch Water District (IRWD*):** Limited data were available for 1997 and 1998. All water monitoring data were reported as not detected. One sediment sample was reported as 1 µg/kg for p-p' DDE in October of 1998. This data was not used in the analysis.

Toxic Substance Monitoring Program(TSMP): Species specific fish tissue data was available for organic compounds from 1993 to 1998. The most recent fish tissue data (1998) from three locations in San Diego Creek (San Diego Creek/Michelson Drive, Peters Canyon Channel and San Diego Creek/Barranca Parkway) was used. Results were reported for all organochlorine pollutants in these TMDLs.

Bay Protection and Toxic Cleanup Program Data (BPTCP): This study reports sediment concentrations at various locations in the Newport Bay for PCB, DDT, Chlordane, Toxaphene, and Dieldrin. Sediment sample data in µg/kg was available from two sampling events that took place in 1994 and 1998. This data was used to supplement the most recent sediment sampling data when it was not available (i.e., Dieldrin in Newport Bay).

Newport Bay Sediment Toxicity Studies (SCCWRP 2001a): Sediment samples collected at 10 Newport Bay stations in May 2001 was available. Sediment data in µg/kg for PCB, DDT, Chlordane, and Dieldrin at selected locations was used to estimate the existing loading capacity.

Resource Management Associates report (USACE, 1997 - RMA model):
Estimates of the sediment distribution for the Upper Bay, Lower Bay and Rhine Channel were made using the results of sediment transport model developed by RMA. The model simulates wet and dry conditions as well as the largest storm event from 1985-1997. Because most sediment entering Upper Newport Bay occurs during the storm events, mean daily stream discharge records for San Diego Creek were used to develop a five-day hydrograph that were used to simulate storm event for RMA model. The peak flows for each model simulation years are shown in Table 2 below. A detailed description can be found in the RMA report (RMA, 1997). The sediment deposition rates for Newport Bay were derived from 12-year model simulation results. Although the mean values are used to estimate the sediment budget for the Newport Bay, the sediment deposition rates represents a net deposition over the years.

The following tables list data from different sources by the various sources used in the analysis.

The most recent sediment data (May 2001) was used from the Newport Bay Sediment Toxicity Studies Report, October 23, 2001 (Tables 8, 9 and 10). Where data were not available (dieldrin only), it was supplemented with sampling studies done in 9/19/1994 and from the Orange County Public Facilities and Research Department (OCPFRD 1991 – 2000). Supplemented data are footnoted.

Table 1 Sediment Chemistry Toxicity Data used in the TMDL

Location	Total DDT	Chlordane[a]	Total PCB	Dieldrin
	ug/kg dry	ug/kg dry	ug/kg dry	Ug/kg dry
Unit I basin (NB10)	17.43	3.52	18.00[b]	0.00
Unit II basin (NB9)	14.97	6.41	6.76[c]	1.00[d]
South of Unit II (NB7)	7.1	1.25	18.00[a]	0.00
Downstream to PCH Bridge(NB6)	19.18	1.6	0.00	0.00
Lower Bay (NB1)	1.91	0.00	18.00[b]	0.00
Turning Basin (NB4)	49.81	5.93	22.76	1.00[d]
Newport channel (NB2)	22.8	3.01	0.00	0.00
Rhine Channel (NB3)	7.45	0.44	93.13	5.00[d]

All non-detects were taken as zero

[a]sum of gamma-Chlordane, alpha-Chlordane, trans-Nonachlor, and cis-achlor reported in the Newport Bay Sediment Toxicity Studies Report, October 23, 2001 at each location.

[b]OCPFRD 1999 – 2000 data.

[c]NB8 sediment concentration for Total PCB was used as NB9 was not available.

[d]9/19/1994 Bay Protection and Toxic Cleanup Program data (BPTCP)

Table 2. Peak storm flows USACE, 1997 (RMA model)

	Mean Daily Flow (cfs)					
Water Year	Day 0	Day1	Day2	Day3	Day4	Day5
1985-1986	18	268	530	1589	106	71
1986-1987	24	659	205	69	48	48
1987-1988	13	649	201	17	14	14
1988-1989	10	512	828	15	15	15
1989-1990	13	1772	175	38	18	18
1990-1991	10	1030	2370	1700	47	18
1991-1992	175	2020	2350	712	60	60
1992-1993	410	1950	2979	625	60	40
1993-1994	12	835	200	15	13	13
1994-1995	71	4509	437	397	70	53
1995-1996	24	1600	978	89	24	18
1996-1997	24	1600	978	89	24	18

Table 3. Sediment Deposition rates in Newport Bay – Estimated from the USACE 1997 (RMA model)

Location	Sediment Deposition (m3/year)
Unit I basin	31474.17
Unit II basin	30327.34
South of Unit II	11659.46
Downstream to PCH Bridge	7772.97
Upper Newport Bay Total	**81233.95**
Lower Bay	17444.29
Turning Basin	6782.52
Newport channel	5697.20
Lower Newport Bay Total	**29924.01**
Rhine Channel	859.23

Table 4. Fish Tissue Data in San Diego Creek – Toxic Substance Monitoring Plan (TSMP, 1983 –1998)

Station	Species	Date	Chlordane	Total DDT	Dieldrin	Total PCB	Toxaphene
San Diego Creek/Michelson Drive	Red Shiner	6/9/1998	8.1	203.5	5.7	ND	83.0
Peters Canyon Channel	Red Shiner	6/9/1998	54.8	2168.2	12.5	79.4	330.0
San Diego Creek/Barranca Parkway	Red Shiner	6/9/1998	13.8	458.8	3.2	60.7	91.6
Value used in calc.			**18.3**	**587.2**	**6.1**	**69.4**	**135.9**

Other information reviewed to identify potential sources and to characterize contributions is summarized blow.

Toxic Substance Control Act Facility Database—Federal
Congress enacted the Toxic Substances Control Act (TSCA) of 1976 to protect human health and the environment from the effects of chemicals and other substances that have not undergone appropriate risk screening. To implement its responsibilities under TSCA, EPA maintains the Toxic Substances Control Act database, which tracks the thousands of new chemicals developed by industries each year. A review of the TSCA facility database indicated that no facilities in the watershed handle DDT, Dieldrin, Toxaphene, Chlordane, or PCBs.

Resource Conservation and Recovery Act Information System—Federal
The Resource Conservation and Recovery Act of 1976 (RCRA) gave EPA the authority to control hazardous waste "cradle to grave." This control includes the generation, transportation, treatment, storage, and disposal of hazardous waste. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites.

According to the EPA RCRA Information System (RCRIS) records, the Newport Bay and San Diego Creek watersheds contain about 1,000 RCRA facilities. However, none of these facilities were found to be a possible source of DDT, Dieldrin, Toxaphene, Chlordane, or PCBs.

Comprehensive Environmental Response, Compensation, and Liability Act Information System—Federal
The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides for a federal “Superfund” to clean up uncontrolled or abandoned hazardous waste sites, as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) supports the identification and management of Superfund sites.

EPA Permit Compliance System and Industrial Facility Discharge
A review of the EPA Permit Compliance System (PCS) shows 14 permitted facilities in the watershed. None of these 14 facilities were permitted to discharge DDT, PCBs, Dieldrin, Toxaphene, or Chlordane. The Industrial Facility Discharge (IFD) database was also reviewed for facilities within the watershed. The facilities identified in IFD are permitted surface water discharges that have a small flow and are not expected to significantly affect the waters. No other potential point sources were identified based on review of the IFD database.

DTSC sites—State of California
Thirty-two facilities in the watershed were listed under the California Department of Toxic Substance Control (DTSC) CALSITE database (pers. commun. C. Mah). Only three of those facilities (Table F-2) were found to have the chemicals of concern for this TMDL. There is not enough information available to quantify pesticide loads from these three sites.

Table 4. DTSC Calsite facilities within Newport Bay watershed

Site ID number	Facility Name	City	Chemicals of concern	Comments (from database)	Comments (from OCHCA)
30970007	Tustin Parcel	Tustin	Pesticides near housing project;	Nfa for pesticides (1994);	No information
30280149	McKesson Chemical	Tustin	Pesticides and solvents in drums	Nfa by DTSC (1994); referred to County	No information, not a current site
30280073	Tibbetts Newport Company	Santa Ana	Pesticide containers, paint sludge	Referred to County (1987)	No information, not a current site

Source: DTSC database; Nfa = no further action; PEA = preliminary endangerment assessment; OCHCA=Orange County Health Care Agency