IV. SEDIMENT QUALITY OBJECTIVES

A. AQUATIC LIFE – BENTHIC COMMUNITY PROTECTION

Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative objective shall be implemented using the integration of multiple lines of evidence (MLOE) as described in Section V of Part 1.

B. HUMAN HEALTH

Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health. This narrative objective shall be implemented as described in Section VI of Part 1.

V. BENTHIC COMMUNITY PROTECTION

A. MLOE APPROACH TO INTERPRET THE NARRATIVE OBJECTIVE

The methods and procedures described below shall be used to interpret the Narrative Objective described in Section IV.A. These tools are intended to assess the condition of benthic communities relative to potential for exposure to toxic pollutants in sediments. Exposure to toxic pollutants at harmful levels will result in some combination of a degraded benthic community, presence of toxicity, and elevated concentrations of pollutants in sediment. The assessment of sediment quality shall consist of the measurement and integration of three lines of evidence (LOE). The LOE are:

- ***Sediment Toxicity***—Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. The sediment toxicity LOE is used to assess both pollutant related biological effects and exposure. Sediment toxicity tests are of short durations and may not duplicate exposure conditions in natural systems. This LOE provides a measure of exposure to all pollutants present, including non-traditional or unmeasured chemicals.
- ***Benthic Community Condition***—Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments*. The benthic community LOE is used to assess impacts to the primary receptors targeted for protection under Section IV.A. Benthic community composition is a measure of the biological effects of both natural and anthropogenic stressors.
- ***Sediment Chemistry***—Sediment chemistry is the measurement of the concentration of chemicals of concern* in surficial sediments. The chemistry LOE is used to assess the potential risk to benthic organisms from toxic pollutants in surficial sediments. The sediment chemistry LOE is intended only to evaluate overall exposure risk from chemical pollutants. This LOE does not establish causality associated with specific chemicals.

B. LIMITATIONS

None of the individual LOE is sufficiently reliable when used alone to assess sediment quality impacts due to toxic pollutants. Within a given site, the LOEs applied to assess exposure as described in Section V.A. may underestimate or overestimate the risk to benthic

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communities and do not indicate causality of specific chemicals. The LOEs applied to assess biological effects can respond to stresses associated with natural or physical factors, such as sediment grain size, physical disturbance, or organic enrichment.

Each LOE produces specific information that, when integrated with the other LOEs, provides a more confident assessment of sediment quality relative to the narrative objective. When the exposure and effects tools are integrated, the approach can quantify protection through effects measures and also provide predictive capability through the exposure assessment.

C. Water Bodies

1. The tools described in the Sections V.D. through V.I. are applicable to Euhaline* Bays and Coastal Lagoons* south of Point Conception and Polyhaline* San Francisco Bay that includes the Central and South Bay Areas defined in general by waters south and west of the San Rafael Bridge and north of the Dumbarton Bridge.
2. For all other bays and estuaries where LOE measurement tools are unavailable, station assessment will follow the procedure described in Section V.J.

D. Field Procedures

1. All samples shall be collected using a grab sampler.
2. Benthic samples shall be screened through:
   a. A 0.5 millimeter (mm)-mesh screen in San Francisco Bay and the Sacramento-San Joaquin Delta;
   b. A 1.0 mm-mesh screen in all other locations.
3. Surface sediment from within the upper 5 cm shall be collected for chemistry and toxicity analyses.
4. The entire contents of the grab sample, with a minimum penetration depth of 5 cm, shall be collected for benthic community analysis.
5. Bulk sediment chemical analysis will include at a minimum the pollutants identified in Attachment A.

E. Laboratory Testing

All samples will be tested in accordance with U.S. Environmental Protection Agency (USEPA) or American Society for Testing and Materials (ASTM) methodologies where such methods exist. Where no EPA or ASTM methods exist, the State Water Board or Regional Water Quality Control Boards (Regional Water Boards) (collectively Water Boards) shall approve the use of other methods. Analytical tests shall be conducted by laboratories certified by the California Department of Health Services in accordance with Water Code Section 13176.

F. Sediment Toxicity

1. Short Term Survival Tests—A minimum of one short-term survival test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 2.

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Table 2. Acceptable Short Term Survival Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint*
Eohaustorius estuarius	Whole Sediment	10 days	Survival
Leptocheirus plumulosus	Whole Sediment	10 days	Survival
Rhepoxynius abronius	Whole Sediment	10 days	Survival

2. Sublethal Tests—A minimum of one sublethal test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 3.

Table 3. Acceptable Sublethal Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint
Neanthes arenaceodentata	Whole Sediment	28 days	Growth
Mytilus galloprovincialis	Sediment-water Interface	48 hour	Embryo Development

3. Assessment of Sediment Toxicity—Each sediment toxicity test result shall be compared and categorized according to responses in Table 4. The response categories are:
   a. Nontoxic—Response not substantially different from that expected in sediments that are uncontaminated and have optimum characteristics for the test species (e.g., control sediments).
   b. Low toxicity—A response that is of relatively low magnitude; the response may not be greater than test variability.
   c. Moderate toxicity—High confidence that a statistically significant toxic effect is present.
   d. High toxicity—High confidence that a toxic effect is present and the magnitude of response includes the strongest effects observed for the test.

Table 4. Sediment Toxicity Categorization Values

Test Species/ Endpoint	Statistical Significance	Nontoxic (Percent)	Low Toxicity (Percent of Control)	Moderate Toxicity (Percent of Control)	High Toxicity (Percent of Control)
Eohaustorius Survival	Significant	90 to 100	82 to 89	59 to 81	< 59
Eohaustorius Survival	Not Significant	82 to 100	59 to 81		<59
Leptocheirus Survival	Significant	90 to 100	78 to 89	56 to 77	<56
Leptocheirus Survival	Not Significant	78 to 100	56 to 77		<56
Rhepoxynius Survival	Significant	90 to 100	83 to 89	70 to 82	< 70
Rhepoxynius Survival	Not Significant	83 to 100	70 to 82		< 70
Neanthes Growth	Significant	90 to 100*	68 to 90	46 to 67	<46
Neanthes Growth	Not Significant	68 to 100	46 to 67		<46
Mytilus Normal	Significant	80 to 100	77 to 79	42 to 76	< 42
Mytilus Normal	Not Significant	77 to 79	42 to 76		< 42

* Expressed as a percentage of the control.

4. Integration of Sediment Toxicity Categories—The average of all test response categories shall determine the final toxicity LOE category. If the average falls midway between categories it shall be rounded up to the next higher response category.

G. BENTHIC COMMUNITY CONDITION

1. General Requirements.
   a. All benthic invertebrates in the screened sample shall be identified to the lowest possible taxon and counted.
   b. Taxonomic nomenclature shall follow current conventions established by local monitoring programs and professional organizations (e.g., master species list).
2. Benthic Indices—The benthic condition shall be assessed using the following methods:
   a. Benthic Response Index (BRI), which was originally developed for the southern California mainland shelf and extended into California's bays and estuaries. The BRI is the abundance-weighted average pollution tolerance score of organisms occurring in a sample.
   b. Index of Biotic Integrity (IBI), which was developed for freshwater streams and adapted for California's bays and estuaries. The IBI identifies community measures that have values outside a reference range.
   c. Relative Benthic Index (RBI), which was developed for embayments in California's Bay Protection and Toxic Cleanup Program. The RBI is the weighted sum of: (a) several community parameters (total number of species, number of crustacean species, number of crustacean individuals, and number of mollusc species), and abundances of (b) three positive, and (c) two negative indicator species.
   d. River Invertebrate Prediction and Classification System (RIVPACS), which was originally developed for British freshwater streams and adapted for California's bays and estuaries. The approach compares the assemblage at a site with an expected species composition determined by a multivariate predictive model that is based on species relationships to habitat gradients.
3. Assessment of Benthic Community Condition—Each benthic index result shall be categorized according to disturbance as described in Table 5. The disturbance categories are:
   a. Reference—A community composition equivalent to a least affected or unaffected site.
   b. Low disturbance— A community that shows some indication of stress, but could be within measurement error of unaffected condition.
   c. Moderate disturbance—Confident that the community shows evidence of physical, chemical, natural, or anthropogenic stress.
   d. High disturbance—The magnitude of stress is high.
4. Integration of Benthic Community Categories—The median of all benthic index response categories shall determine the benthic condition LOE category. If the median falls between categories it shall be rounded up to the next higher effect category.

Table 5. Benthic Index Categorization Values

Index	Reference	Low Disturbance	Moderate Disturbance	High Disturbance
Southern California Marine Bays				
BRI	< 39.96	39.96 to 49.14	49.15 to 73.26	> 73.26
IBI	0	1	2	3 or 4
RBI	> 0.27	0.17 to 0.27	0.09 to 0.16	< 0.09
RIVPACS	> 0.90 to < 1.10	0.75 to 0.90 or 1.10 to 1.25	0.33 to 0.74 or > 1.25	< 0.33
Polyhaline Central San Francisco Bay				
BRI	< 22.28	22.28 to 33.37	33.38 to 82.08	> 82.08
IBI	0 or 1	2	3	4
RBI	> 0.43	0.30 to 0.43	0.20 to 0.29	< 0.20
RIVPACS	> 0.68 to < 1.32	0.33 to 0.68 or 1.32 to 1.67	0.16 to 0.32 or > 1.67	< 0.16

H. SEDIMENT CHEMISTRY

1. All samples shall be tested for the analytes identified in Attachment A—This list represents the minimum analytes required to assess exposure. In water bodies where other toxic pollutants are believed to pose risk to benthic communities, those toxic pollutants shall be included in the analysis. Inclusion of additional analytes cannot be used in the exposure assessment described below. However, the data can be used to conduct more effective stressor identification studies as described in Section VII. F.
2. Sediment Chemistry Guidelines—The sediment chemistry exposure shall be assessed using the following two methods:
   a. Chemical Score Index (CSI), that uses a series of empirical thresholds to predict the benthic community disturbance category (score) associated with the concentration of various chemicals (Table 6). The CSI is the weighted sum of the individual scores (Equation 1).

      Equation 1. $CSI = \Sigma(w_i \times cat_i)/\Sigma w$

      Where: cat_i = predicted benthic disturbance category for chemical I;
      w_i = weight factor for chemical I;
      Σw = sum of all weights.

   b. California Logistic Regression Model (CA LRM), that uses logistic regression models to predict the probability of sediment toxicity associated with the concentration of various chemicals (Table 7 and Equation 2). The CA LRM exposure value is the maximum probability of toxicity from the individual models (P_{max})

      Equation 2. $p = e^{B0+B1\,(x)} / (1 + e^{B0+B1\,(x)})$

      Where: p = probability of observing a toxic effect;
      B0 = intercept parameter;
      B1 = slope parameter; and
      x = concentration the chemical.

Table 6. Category Score Concentration Ranges and Weighting Factors for the CSI

Chemical	Units	Weight	Score (Disturbance Category)			
			1 Reference	2 Low	3 Moderate	4 High
Copper	mg/kg	100	≤52.8	> 52.8 to 96.5	> 96.5 to 406	> 406
Lead	mg/kg	88	≤ 26.4	> 26.4 to 60.8	> 60.8 to 154	> 154
Mercury	mg/kg	30	≤ 0.09	> 0.09 to 0.45	> 0.45 to 2.18	> 2.18
Zinc	mg/kg	98	≤ 112	> 112 to 200	> 200 to 629	> 629
PAHs, total high MW	µg/kg	16	≤ 312	> 312 to 1325	> 1325 to 9320	>9320
PAHs, total low MW	µg/kg	5	≤ 85.4	> 85.4 to 312	> 312 to 2471	> 2471
Chlordane, alpha-	µg/kg	55	≤ 0.50	> 0.50 to 1.23	> 1.23 to 11.1	>11.1
Chlordane, gamma-	µg/kg	58	≤ 0.54	> 0.54 to 1.45	> 1.45 to 14.5	> 14.5
DDDs, total	µg/kg	46	≤ 0.50	> 0.50 to 2.69	> 2.69 to 117	> 117
DDEs, total	µg/kg	31	≤ 0.50	> 0.50 to 4.15	> 4.15 to 154	> 154
DDTs, total	µg/kg	16	≤ 0.50	> 0.50 to 1.52	> 1.52 to 89.3	> 89.3
PCBs, total	µg/kg	55	≤11.9	> 11.9 to 24.7	> 24.7 to 288	> 288

Table 7. CA LRM Regression Parameters

Chemical	Units	B0	B1
Cadmium	mg/kg	0.29	3.18
Copper	mg/kg	-5.59	2.59
Lead	mg/kg	-4.72	2.84
Mercury	mg/kg	-0.06	2.68
Zinc	mg/kg	-5.13	2.42
PAHs, total high MW	µg/kg	-8.19	2.00
PAHs, total low MW	µg/kg	-6.81	1.88
Chlordane, alpha	µg/kg	-3.41	4.46
Dieldrin	µg/kg	-1.83	2.59
Trans nonachlor	µg/kg	-4.26	5.31
PCBs, total	µg/kg	-4.41	1.48
p,p' DDT	µg/kg	-3.55	3.26

3. Assessment of Sediment Chemistry Exposure—Each sediment chemistry guideline result shall be categorized according to exposure as described in Table 8. The exposure categories are:
   a. Minimal exposure—Sediment-associated contamination* may be present, but exposure is unlikely to result in effects.
   b. Low exposure—Small increase in pollutant exposure that may be associated with increased effects, but magnitude or frequency of occurrence of biological impacts is low.
   c. Moderate exposure—Clear evidence of sediment pollutant exposure that is likely to result in biological effects; an intermediate category.
   d. High exposure—Pollutant exposure highly likely to result in possibly severe biological effects; generally present in a small percentage of the samples.

Table 8. Sediment Chemistry Guideline Categorization Values

Guideline	Minimal Exposure	Low Exposure	Moderate Exposure	High Exposure
CSI	< 1.69	1.69 to 2.33	2.34 to 2.99	>2.99
CA LRM	< 0.33	0.33 to 0.49	0.50 to 0.66	> 0.66

4. Integration of Sediment Chemistry Categories—The average of all chemistry exposure categories shall determine the final sediment chemistry LOE category. If the average falls midway between categories it shall be rounded up to the next higher exposure category.

I. INTERPRETATION AND INTEGRATION OF MLOE

Assessment as to whether the aquatic life sediment quality objective has been attained at a station is accomplished by the interpretation and integration of MLOE. The categories assigned to the three LOE, sediment toxicity, benthic community condition and sediment chemistry are evaluated to determine the station level assessment. The assessment category represented by each of the possible MLOE combinations reflects the presence and severity of two characteristics of the sample: severity of biological effects, and potential for chemically-mediated effects.

1. Severity of Biological Effects—The severity of biological effects present at a site shall be determined by the integration of the toxicity LOE and benthic condition LOE categories using the decision matrix presented in Table 9.
2. Potential for Chemically-Mediated Effects—The potential for effects to be chemically-mediated shall be determined by the integration of the toxicity LOE and chemistry LOE categories using the decision matrix presented in Table 10.

Table 9. Severity of Biological Effects Matrix

		Toxicity LOE Category			
		Nontoxic	Low Toxicity	Moderate Toxicity	High Toxicity
Benthic Condition LOE Category	Reference	Unaffected	Unaffected	Unaffected	Low Effect
	Low Disturbance	Unaffected	Low Effect	Low Effect	Low Effect
	Moderate Disturbance	Moderate Effect	Moderate Effect	Moderate Effect	Moderate Effect
	High Disturbance	Moderate Effect	High Effect	High Effect	High Effect

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Table 10. Potential for Chemically Mediated Effects Matrix

		Toxicity LOE Category			
		Nontoxic	**Low Toxicity**	**Moderate Toxicity**	**High Toxicity**
Sediment Chemistry LOE Category	Minimal Exposure	Minimal Potential	Minimal Potential	Low Potential	Moderate Potential
	Low Exposure	Minimal Potential	Low Potential	Moderate Potential	Moderate Potential
	Moderate Exposure	Low Potential	Moderate Potential	Moderate Potential	Moderate Potential
	High Exposure	Moderate Potential	Moderate Potential	High Potential	High Potential

3. Station Level Assessment—The station level assessment shall be determined using the decision matrix presented in Table 11. This assessment combines the intermediate classifications for severity of biological effect and potential for chemically-mediated effect to result in six categories of impact at the station level:
   a. Unimpacted—Confident that sediment contamination is not causing significant adverse impacts to aquatic life living in the sediment at the site.
   b. Likely Unimpacted—Sediment contamination at the site is not expected to cause adverse impacts to aquatic life, but some disagreement among the LOE reduces certainty in classifying the site as unimpacted.
   c. Possibly Impacted—Sediment contamination at the site may be causing adverse impacts to aquatic life, but these impacts are either small or uncertain because of disagreement among LOE.
   d. Likely Impacted—Evidence for a contaminant-related impact to aquatic life at the site is persuasive, even if there is some disagreement among LOE.
   e. Clearly Impacted—Sediment contamination at the site is causing clear and severe adverse impacts to aquatic life.
   f. Inconclusive—Disagreement among the LOE suggests that either the data are suspect or that additional information is needed before a classification can be made.

Table 11. Station Assessment Matrix

		Severity of Effect			
		Unaffected	**Low Effect**	**Moderate Effect**	**High Effect**
Potential For Chemically-Mediated Effects	Minimal Potential	Unimpacted	Likely Unimpacted	Likely Unimpacted	Inconclusive
	Low Potential	Unimpacted	Likely Unimpacted	Possibly Impacted	Possibly Impacted
	Moderate Potential	Likely Unimpacted	Possibly Impacted or Inconclusive[1]	Likely Impacted	Likely Impacted
	High Potential	Inconclusive	Likely Impacted	Clearly Impacted	Clearly Impacted

[1] Inconclusive category when chemistry is classified as minimal exposure, benthic response is classified as reference, and toxicity response is classified as high.

The station assessment resulting from each possible combination of the three LOEs is shown in Attachment B. As an alternative to Tables 9, 10 and 11, each LOE

category can be applied to Attachment B to determine the overall condition of the station. The results will be the same regardless of the tables used.

4. Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective.
   a. The categories designated as **Unimpacted** and **Likely Unimpacted** shall be considered as achieving the protective condition at the station. All other categories shall be considered as degraded except as provided in b. below.
   b. The Water Board shall designate the category **Possibly Impacted** as meeting the protective condition if the studies identified in Section VII.F demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or waterbody. In this situation, the Water Board will consider only the Categories **Likely Impacted** and **Clearly Impacted** as degraded when making a determination on receiving water limits and impaired water bodies described in Section VII.

J. MLOE Approach to Interpret the Narrative Objective in Other Bays and Estuaries

Station assessments for waterbodies identified in Section V.C.2. will be conducted using the same conceptual approach and similar tools to those described in Sections V.D-H. Each LOE will be evaluated by measuring a set of readily available indicators in accordance with Tables 12 and 13.

1. Station assessment shall be consistent with the following key principles of the assessment approach described in Sections V.D. through V.I:
   a. Results for a single LOE shall not be used as the basis for an assessment.
   b. Evidence of both elevated chemical exposure and biological effects must be present to indicate pollutant-associated impacts.
   c. The categorization of each LOE shall be based on numeric values or a statistical comparison.
2. Lines of Evidence and Measurement Tools—Sediment chemistry, toxicity, and benthic community condition shall be measured at each station. Table 12 lists the required tools for evaluation of each LOE. Each measurement shall be conducted using standardized methods (e.g., EPA or ASTM guidance) where available.
3. Categorization of LOEs—Determination of the presence of an LOE effect (i.e., biologically significant chemical exposure, toxicity, or benthic community disturbance) shall be based on a comparison to a numeric response value or a statistical comparison to reference stations. The numeric values or statistical comparisons (e.g., confidence interval) used to classify a LOE as Effected shall be comparable to those specified in Sections V.F-H. to indicate High Chemical Exposure, High Toxicity, or High Disturbance. Reference stations shall be located in an area expected to be uninfluenced by the discharge or pollutants of concern in the assessment area and shall be representative of other habitat characteristics of the assessment area (e.g., salinity, grain size). Comparison to reference shall be accomplished by compiling data for appropriate regional reference sites and determining the reference envelope using statistical methods (e.g., tolerance interval).

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Table 12. Tools for Use in Evaluation of LOEs

LOE	Tools	Metrics
Chemistry	Bulk sediment chemistry to include existing list (Attachment A) plus other chemicals of concern	CA LRM P_{max} Concentration on a dry weight basis
Sediment Toxicity	10-Day amphipod survival using a species tolerant of the sample salinity and grain size characteristics. e.g., *Hyalella azteca* or *Eohaustorius estuarius*	Percent of control survival
Benthic Community Condition	Invertebrate species identification and abundance	Species richness* Presence of sensitive indicator taxa Dominance by tolerant indicator taxa Presence of diverse functional and feeding groups Total abundance

Table 13. Numeric Values and Comparison Methods for LOE Categorization

Metric	Threshold value or Comparison
CA LRM	Pmax > 0.66
Chemical Concentration	Greater than reference range or interval
Percent of Control Survival	*E. estuarius*: < 59 *H. azteca*: < 62 or SWAMP criterion
Species Richness	Less than reference range or interval
Abundance of Sensitive Indicator Taxa	Less than reference range or interval
Abundance of Tolerant Indicator Taxa	Greater than reference range or interval
Total Abundance	Outside of reference range or interval

4. Station Level Assessment—The station level assessment shall be determined using the decision matrix presented in Table 14. This assessment combines the classifications for each LOE to result in two categories of impact at the station level:
   a. Unimpacted—No conclusive evidence of both high pollutant exposure and high biological effects present at the site. Evidence of chemical exposure and biological effects may be within natural variability or measurement error.
   b. Impacted—Confident that sediment contamination present at the site is causing adverse direct impacts to aquatic life.

Table 14. Station Assessment Matrix for Other Bays and Estuaries

Chemistry LOE Category	Toxicity LOE Category	Benthic Condition LOE Category	Station Assessment
No effect	No effect	No effect	Unimpacted
No effect	No effect	Effect	Unimpacted
No effect	Effect	No effect	Unimpacted
No effect	Effect	Effect	Impacted
Effect	No effect	No effect	Unimpacted
Effect	No effect	Effect	Impacted
Effect	Effect	No effect	Impacted
Effect	Effect	Effect	Impacted

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5. Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective— The category designated as **Unimpacted** shall be considered as achieving the protective condition at the station.

VI. HUMAN HEALTH

The narrative human health objective in Section IV. B. of this Part 1 shall be implemented on a case-by-case basis, based upon a human health risk assessment. In conducting a risk assessment, the Water Boards shall consider any applicable and relevant information, including California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and USEPA Human Health Risk Assessment policies.

VII. PROGRAM OF IMPLEMENTATION

Implementation of Part 1 shall be conducted in accordance with the following provisions and consistent with the process shown in Figures 1 and 2.

A. DREDGE MATERIALS

1. Part 1 shall not apply to dredge material suitability determinations.
2. The Water Boards shall not approve a dredging project that involves the dredging of sediment that exceeds the objectives in Part 1, unless the Water Boards determine that:
   a. The polluted sediment is removed in a manner that prevents or minimizes water quality degradation.
   b. The polluted sediment is not deposited in a location that may cause significant adverse effects to aquatic life, fish, shellfish, or wildlife or may harm the beneficial uses of the receiving waters, or does not create maximum benefit to the people of the State.
   c. The activity will not cause significant adverse impacts upon a federal sanctuary, recreational area, or other waters of significant national importance.

B. NPDES RECEIVING WATER AND EFFLUENT LIMITS

1. If a Water Board determines that discharge of a toxic pollutant to bay or estuarine waters has the reasonable potential to cause or contribute to an exceedance of the SQOs, the Water Board shall apply the objectives as receiving water limits.
2. The Permittee shall be in violation of such limits if it is demonstrated that the discharge is causing or contributing to the SQO exceedance as defined in Section VII.C.
3. Receiving water monitoring required by an NPDES permit may be satisfied by a Permitee's participation in a regional SQO monitoring program described in Section VII.E.
4. The sediment chemistry guidelines shall not be translated into or applied as effluent limits. Effluent limits established to protect or restore sediment quality shall be developed only after:
   a. A clear relationship has been established linking the discharge to the degradation,

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b. The pollutants causing or contributing to the degradation have been identified, and

c. Appropriate loading studies have been completed to estimate the reductions in pollutant loading that will restore sediment quality.

These actions are described further in Sections VII.F and VII.G. Nothing in this section shall limit a Water Board's authority to develop and implement waste* load allocations* for Total Maximum Daily Loads. However, it is recommended that the Water Boards develop TMDL allocations using the methodology described herein, wherever possible.

C. EXCEEDANCE OF RECEIVING WATER LIMIT

Exceedance of a receiving water limit is demonstrated when:

1. Using a binomial distribution*, the total number of stations designated as not meeting the protective condition as defined in Sections V.I.4. or V.J.4. supports rejection of the null hypothesis* as presented in Table 15. The stations included in this analysis will be those located in the vicinity of the discharge and identified in the permit, and
2. It is demonstrated that the discharge is causing or contributing to the SQO exceedance, following the completion of the stressor identification studies described in Section VII.F.
3. If studies by the Permittee demonstrate that other sources may also be contributing to the degradation of sediment quality, the Regional Water Board shall, as appropriate, require the other sources to initiate studies to assess the extent to which these sources are a contributing factor.

Table 15. Minimum Number of Measured Exceedances Needed to Exceed the Direct Effects SQO as a Receiving Water Limit

Sample Size	List If the Number of Exceedances Equals or Is Greater Than
2 – 24	2*
25 – 36	3
37 – 47	4
48 – 59	5
60 – 71	6
72 – 82	7
83 – 94	8
95 – 106	9
107 – 117	10
118 – 129	11

Note: Null Hypothesis: Actual exceedance proportion $\leq$ 3 percent. Alternate Hypothesis: Actual exceedance proportion > 18 percent. The minimum effect size* is 15 percent.

*Application of the binomial test requires a minimum sample size of 16. The number of exceedances required using the binomial test at a sample size of 16 is extended to smaller sample sizes.

Exceedance will require the Permittee to perform additional studies as described in Sections VII.F and VII.G.

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D. Receiving Water Limits Monitoring Frequency

1. Phase I Stormwater Discharges and Major Discharges—Sediment Monitoring shall not be required less frequently than twice per permit cycle. For Stations that are consistently classified as unimpacted or likely unimpacted the frequency may be reduced to once per permit cycle. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase I Stormwater Permitees.
2. Phase II Stormwater and Minor Discharges—Sediment Monitoring shall not be required more often then twice per permit cycle or less then once per permit cycle. For stations that are consistently classified as unimpacted or likely unimpacted, the number of stations monitored may be reduced at the discretion of the Water Board. The Water Board may limit receiving water monitoring to a subset of outfalls for Phase II Stormwater Permitees.
3. Other Regulated Discharges and Waivers—The frequency of the monitoring for receiving water limits for other regulated discharges and waivers will be determined by the Water Board.

E. Sediment Monitoring

1. Objective—Bedded sediments in bays contain an accumulation of pollutants from a wide variety of past and present sources discharged either directly into the bay or indirectly into waters draining into the bay. Embayments also represent highly disturbed or altered habitats as a result of dredging and physical disturbance caused by construction and maintenance of harbor works, boat and ship traffic, and development of adjacent lands. Due to the multitude of stressors and the complexity of the environment, a well-designed monitoring program is necessary to ensure that the data collected adequately characterizes the condition of sediment in these water bodies.
2. Permitted Discharges—Monitoring may be performed by individual Permitees to assess compliance with receiving water limits, or through participation in a regional or water body monitoring coalition as described under VII.E.3, or both as determined by the Water Board.
3. Monitoring Coalitions—To achieve maximum efficiency and economy of resources, the State Water Board encourages the regulated community in coordination with the Regional Water Boards to establish water body-monitoring coalitions. Monitoring coalitions enable the sharing of technical resources, trained personnel, and associated costs and create an integrated sediment-monitoring program within each major water body. Focusing resources on regional issues and developing a broader understanding of pollutants effects in these water bodies enables the development of more rapid and efficient response strategies and facilitates better management of sediment quality.
    a. If a regional monitoring coalition is established, the coalition shall be responsible for sediment quality assessment within the designated water body and for ensuring that appropriate studies are completed in a timely manner.
    b. The Water Board shall provide oversight to ensure that coalition participants are proactive and responsive to potential sediment quality related issues as they arise during monitoring and assessment.
    c. Each regional monitoring coalition shall prepare a workplan that describes the monitoring, a map of the stations, participants and a schedule that shall be submitted to the Water Board for approval.

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4. Methods—Sediments collected from each station shall be tested or assessed using the methods and metrics described in Section V.
5. Design.
   a. The design of sediment monitoring programs, whether site-specific or region wide, shall be based upon a conceptual model. A conceptual model is useful for identifying the physical and chemical factors that control the fate and transport of pollutants and receptors that could be exposed to pollutants in the sediment. The conceptual model serves as the basis for assessing the appropriateness of a study design. The detail and complexity of the conceptual model is dependent upon the scope and scale of the monitoring program. A conceptual model shall consider:
      - Points of discharge into the segment of the waterbody or region of interest
      - Tidal flow and/or direction of predominant currents
      - Historic and or legacy conditions in the vicinity
      - Nearby land and marine uses or actions
      - Beneficial uses
      - Potential receptors of concern
      - Changes in grain size salinity water depth and organic matter
      - Other sources or discharges in the immediate vicinity.
   b. Sediment monitoring programs shall be designed to ensure that the aggregate stations are spatially representative of the sediment within the water body.
   c. The design shall take into consideration existing data and information of appropriate quality.
   d. Stratified random design shall be used where resources permit to assess conditions throughout a water body.
   3. Identification of appropriate strata shall consider characteristics of the water body including sediment transport, hydrodynamics, depth, salinity, land uses, inputs (both natural and anthropogenic) and other factors that could affect the physical, chemical, or biological condition of the sediment.
   f. Targeted designs shall be applied to those Permitees that are required to meet receiving water limits as described in Section VII. B.
6. Index Period—All stations shall be sampled between the months of June through September to be consistent with the benthic community condition index period.
7. Regional Monitoring Schedule and Frequency.
   a. Regional sediment quality monitoring will occur at a minimum of once every three years.
   b. Sediments identified as exceeding the narrative objective will be evaluated more frequently.
8. Evaluating Waters for placement on the Section 303(d) list —In California, water segments are placed on the section 303(d) list for sediment toxicity based either on toxicity alone or toxicity that is associated with a pollutant. The listing criteria are contained in the State Water Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (2004)(Listing Policy). Part 1 adds an additional listing criterion that applies only to listings for exceedances of the narrative sediment quality objective for aquatic life protection in Section IV.A. The criterion under Part 1 is described in subsection a. below and the relationship

between the sediment toxicity listing criteria under the Listing Policy and the criterion under Part 1 is described in subsections b. and c., below.

1. Water segments shall be placed on the section 303(d) list for exceedance of the narrative sediment quality objective for aquatic life protection in Section IV.A. of Part 1 only if the number of stations designated as not achieving the protective condition as defined in Sections V.I. and V.J. supports rejection of the null hypothesis, as provided in Table 3.1 of the State Water Board's Listing Policy.
2. Water segments that exhibit sediment toxicity but that are not listed for an exceedance of the narrative sediment quality objective for aquatic life protection in Section IV.A. shall continue to be listed in accordance with Section 3.6 of the Listing Policy.
3. If a water segment is listed under Section 3.6 of the Listing Policy and the Regional Water Board later determines that the applicable water quality standard that is impaired consists of the sediment quality objective in Section IV.A. of Part 1 and a bay or estuarine habitat beneficial use, the Regional Water Board shall reevaluate the listing in accordance with Sections V.I and V.J. If the Regional Water Board reevaluates the listing and determines that the water segment does not meet the criteria in subsection a. above, the Regional Water Board shall delist the water segment.

F. STRESSOR IDENTIFICATION

If sediments fail to meet the narrative SQOs in accordance with Sections V. and VI. the Water Boards shall direct the regional monitoring coalitions or Permittees to conduct stressor identification.

The Water Boards shall assign the highest priority for stressor identification to those segments or reaches with the highest percentage of sites designated as Clearly Impacted and Likely Impacted.

Where segments or reaches contain Possibly Impacted but no Clearly or Likely Impacted sites, confirmation monitoring shall be conducted prior to initiating stressor identification.

The stressor identification approach consists of development and implementation of a work plan to seek confirmation and characterization of pollutant-related impacts, pollutant identification and source identification. The workplan shall be submitted to the Water Board for approval. Stressor identification consists of the following studies:

1. Confirmation and Characterization of Pollutant Related Impacts—Exceedance of the direct effects SQO at a site indicates that pollutants in the sediment are the likely cause but does not identify the specific pollutant responsible. The MLOE assessment establishes a linkage to sediment pollutants; however, the lack of confounding factors (e.g., physical disturbance, non-pollutant constituents) must be confirmed. There are two generic stressors that are not related to toxic pollutants that may cause the narrative to be exceeded:
   a. Physical Alteration—Examples of physical stressors include reduced salinity, impacts from dredging, very fine or coarse grain size, and prop wash from passing ships. These types of stressors may produce a non-reference condition* in the benthic community that is similar to that caused by pollutants. If impacts to a site are purely due to physical disturbance, the LOE characteristics will likely show a degraded benthic community with little or no toxicity and low chemical concentrations.

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b. Other Pollutant Related Stressors—These constituents, which include elevated total organic carbon, ammonia, nutrients and pathogens, may have sources similar to chemical pollutants. Chemical and microbiological analysis will be necessary to determine if these constituents are present. The LOE characteristics for this type of stressor would likely be a degraded benthic community with possibly an indication of toxicity, and low chemical concentrations.

To further assess a site that is impacted by toxic pollutants, there are several lines of investigation that may be pursued, depending on site-specific conditions. These studies may be considered and evaluated in the work plan for the confirmation effort:

a. Evaluate the spatial extent of the Area of Concern. This information can be used to evaluate the potential risk associated with the sediment, distinguish areas of known physical disturbance or pollution and evaluate the proximity to anthropogenic source gradient from such inputs as outfalls, storm drains, and industrial and agricultural activities.

b. Body burden data may be examined from animals exposed to the site's sediment to indicate if pollutants are being accumulated and to what degree.

c. Chemical specific mechanistic benchmarks* may be applied to interpret sediment chemistry concentrations.

d. Chemistry and biology data from the site should be examined to determine if there is a correlation between the two LOE.

e. Alternate biological effects data may be pursued, such as bioaccumulation* experiments and pore water toxicity or chemical analysis.

f. Other investigations that may commonly be performed as part of a Phase 1 Toxicity Identification Evaluation* (TIE).

If there is compelling evidence that the SQO exceedances contributing to a receiving water limit exceedance are not due to toxic pollutants, then the assessment area shall be designated as having achieved the receiving water limit.

2. Pollutant Identification—Methods to help determine cause may be statistical, biological, chemical or a combination. Pollutant identification studies should be structured to address site-specific conditions, and may be based upon the following:

a. Statistical methods—Correlations between individual chemicals and biological endpoints (toxicity and benthic community).

b. Gradient analysis—Comparisons are made between different samples taken at various distances from a chemical hotspot to examine patterns in chemical concentrations and biological responses. The concentrations of causative agents should decrease as biological effects decrease.

c. Additional Toxicity Identification Evaluation efforts—A toxicological method for determining the cause of impairments is the use of toxicity identification evaluations (TIE). Sediment samples are manipulated chemically or physically to remove classes of chemicals or render them biologically unavailable. Following the manipulations, biological tests are performed to determine if toxicity has been removed. TIEs should be conducted at a limited number of stations, preferably those with strong biological or toxicological effects.

d. Bioavailability*—Chemical pollutants may be present in the sediment but not biologically available to cause toxicity or degradation of the benthic community. There are several measures of bioavailability that can be made. Chemical and

toxicological measurements can be made on pore water to determine the availability of sediment pollutants. Metal compounds may be naturally bound up in the sediment and rendered unavailable by the presence of sulfides. Measurement of acid volatile sulfides and simultaneously extracted metals analysis can be conducted to determine if sufficient sulfides are present to bind the observed metals. Similarly, organic compounds can be tightly bound to sediments. Measurements of sediment organic carbon and other binding phases can be conducted to determine the bioavailable fraction of organic compounds. Solid phase microextraction (SPME) or laboratory desorption experiments can also be used to identify which organics are bioavailable to benthic organisms.

e. Verification—After specific chemicals are identified as likely causes of impairment, analysis should be performed to verify the results. Sediments can be spiked with the suspected chemicals to verify that they are indeed toxic at the concentrations observed in the field. Alternately, animals can be transplanted to suspected sites for *in situ* toxicity and bioaccumulation testing.

When stressor Identification yields inconclusive results for sites classified as Possibly Impacted, the Water Board shall require the Permittee or regional monitoring coalition to perform a one-time augmentation to that study or, alternatively, the Water Board may suspend further stressor identification studies pending the results of future routine SQO monitoring.

3. Sources Identification and Management Actions.
   a. Determine if the sources are ongoing or legacy sources.
   b. Determine the number and nature of ongoing sources.
   c. If a single discharger is found to be responsible for discharging the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the discharger to take all necessary and appropriate steps to address exceedance of the SQO, including but not limited to reducing the pollutant loading into the sediment.
   d. When multiple sources are present in the water body that discharge the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the sources to take all necessary and appropriate steps to address exceedance of the SQO. If appropriate, the Regional Water Board may adopt a TMDL to ensure attainment of the sediment standard.

G. Cleanup and Abatement

Cleanup and abatement actions covered by Water Code section 13304 for sediments that exceed the objectives in Chapter IV shall comply with Resolution No. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304), Cal. Code Regs., tit. 23, §§2907, 2911.

H. Development of Site-Specific Sediment Management Guidelines

The Regional Water Boards may develop site-specific sediment management guidelines where appropriate, for example, where toxic stressors have been identified and controllable sources of these stressors exist or remedial goals are desired.

Development of site-specific sediment management guidelines is the process to estimate the level of the stressor pollutant that will meet the narrative sediment quality objective. The guideline can serve as the basis for cleanup goals or revision of effluent limits described in B. 4

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above, depending upon the situation or sources. All guidelines when applied for cleanup, must comply with 92-49.

Guideline development should only be initiated after the stressor has been identified. The goal is to establish a relationship between the organism's exposure and the biological effect. Once this relationship is established, a pollutant specific guideline may be designated that corresponds with minimum biological effects. The following approaches can be applied to establish these relationships:

1. Correspondence with sediment chemistry. An effective guideline can best be derived based upon the site-specific, or reach- specific relationship between the stressor pollutant exposure and biological response. Therefore the correspondence between the bulk sediment stressor concentration and biological effects should be examined.
2. Correspondence with bioavailable pollutant concentration. The concentration of the bioavailable fraction of the stressor pollutants is likely to show a less variable relationship to biological effects that bulk sediment chemistry. Interstitial water analysis, SPME, desorption experiments, selective extractions, or mechanistic models may indicate the bioavailable pollutant concentration. The correspondence between the bioavailable stressor concentration and biological effects should be examined.
3. Correspondence with tissue residue. The concentration of the stressor accumulated by a target organism may provide a measure of the stressor dose for some chemicals (e.g., those that are not rapidly metabolized). The tissue residue threshold concentration associated with unacceptable biological effects can be combined with a bioaccumulation factor or model to estimate the loading or sediment concentration guideline.
4. Literature review. If site-specific analyses are ambiguous or unable to determine a guideline, then the results of similar development efforts for other areas should be reviewed. Scientifically credible values from other studies can be combined with mechanistic or empirical models of bioavailability, toxic potency, and organism sensitivity to estimate guidelines for the area of interest.
5. The chemistry LOE of Section V.H.2, including the threshold values (e.g. CSI and CALRM), shall not be used for setting cleanup levels or numeric values for technical TMDLs.

VIII. GLOSSARY

BENTHIC: Living on or in bottom of the ocean, bays, and estuaries, or in the streambed.

BINOMIAL DISTRIBUTION: Mathematical distribution that describes the probabilities associated with the possible number of times particular outcomes will occur in series of observations (i.e., samples). Each observation may have only one of two possible results (e.g., standard exceeded or standard not exceeded).

BIOACCUMULATION: A process in which an organism's body burden of a pollutant exceeds that in its surrounding environment as a result of chemical uptake through all routes of chemical exposure; dietary and dermal absorption and transport across the respiratory surface.

BIOAVAILABILITY: The fraction of a pollutant that an organism is exposed to that is available for uptake through biological membranes (gut, gills).

CHEMICALS OF CONCERN (COCS): Pollutants that occur in environmental media at levels that pose a risk to ecological receptors or human health.

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CONTAMINATION: An impairment of the quality of the waters of the State by waste to a degree that creates a hazard to the public health through poisoning or through the spread of disease. "Contamination" includes any equivalent effect resulting from the disposal of waste whether or not waters of the State are affected (CWC section 13050(k)).

EFFECT SIZE: The maximum magnitude of exceedance frequency that is tolerated.

ENCLOSED BAYS: Indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes, but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

ENDPOINT: A measured response of a receptor to a stressor. An endpoint can be measured in a toxicity test or in a field survey.

ESTUARIES AND COASTAL LAGOONS: Waters at the mouths of streams that serve as mixing zones* for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and salt water occurs in the open coastal waters. The waters described by this definition include, but are not limited to, the Sacramento-San Joaquin Delta as defined by Section 12220 of the California Water Code, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

EUHALINE: Waters ranging in salinity from 25–32 practical salinity units (psu).

INLAND SURFACE WATERS: All surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

LOAD ALLOCATION (LA): The portion of a receiving water's total maximum daily load that is allocated to one of its nonpoint sources of pollution or to natural background sources.

MECHANISTIC BENCHMARKS: Chemical guidelines developed based upon theoretical processes governing bioavailability and the relationship to biological effects.

MIXING ZONE: A limited zone within a receiving water that is allocated for mixing with a wastewater discharge where water quality criteria can be exceeded without causing adverse effects to the overall water body.

NONPOINT SOURCES: Sources that do not meet the definition of a point source as defined below.

NULL HYPOTHESIS: A statement used in statistical testing that has been put forward either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved.

OCEAN WATERS: Territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. Discharges to ocean waters are regulated in accordance with the State Water Board's California Ocean Plan.

POINT SOURCE: Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock,

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concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

POLLUTANT: Defined in section 502(6) of the CWA as "dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."

POLLUTION: Defined in section 502(19) of the CWA as the "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." *Pollution* is also defined in CWC section 13050(1) as an alternation of the quality of the waters of the State by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses.

POLYHALINE: Waters ranging in salinity from 18–25 psu.

REFERENCE CONDITION: The characteristics of water body segments least impaired by human activities. As such, reference conditions can be used to describe attainable biological or habitat conditions for water body segments with common watershed/catchment characteristics within defined geographical regions.

SPECIES RICHNESS: The number of species in a sample.

SURFICIAL SEDIMENTS: Those sediments representing recent depositional materials and containing the majority of the benthic invertebrate community.

STATISTICAL SIGNIFICANCE: When it can be demonstrated that the probability of obtaining a difference by chance only is relatively low.

TOXICITY IDENTIFICATION EVALUATION (TIE): Techniques used to identify the unexplained cause(s) of toxic events. TIE involves selectively removing classes of chemicals through a series of sample manipulations, effectively reducing complex mixtures of chemicals in natural waters to simple components for analysis. Following each manipulation the toxicity of the sample is assessed to see whether the toxicant class removed was responsible for the toxicity.

WASTE: As used in this document, waste includes a discharger's total discharge, of whatever origin, i.e., gross, not net, discharge.

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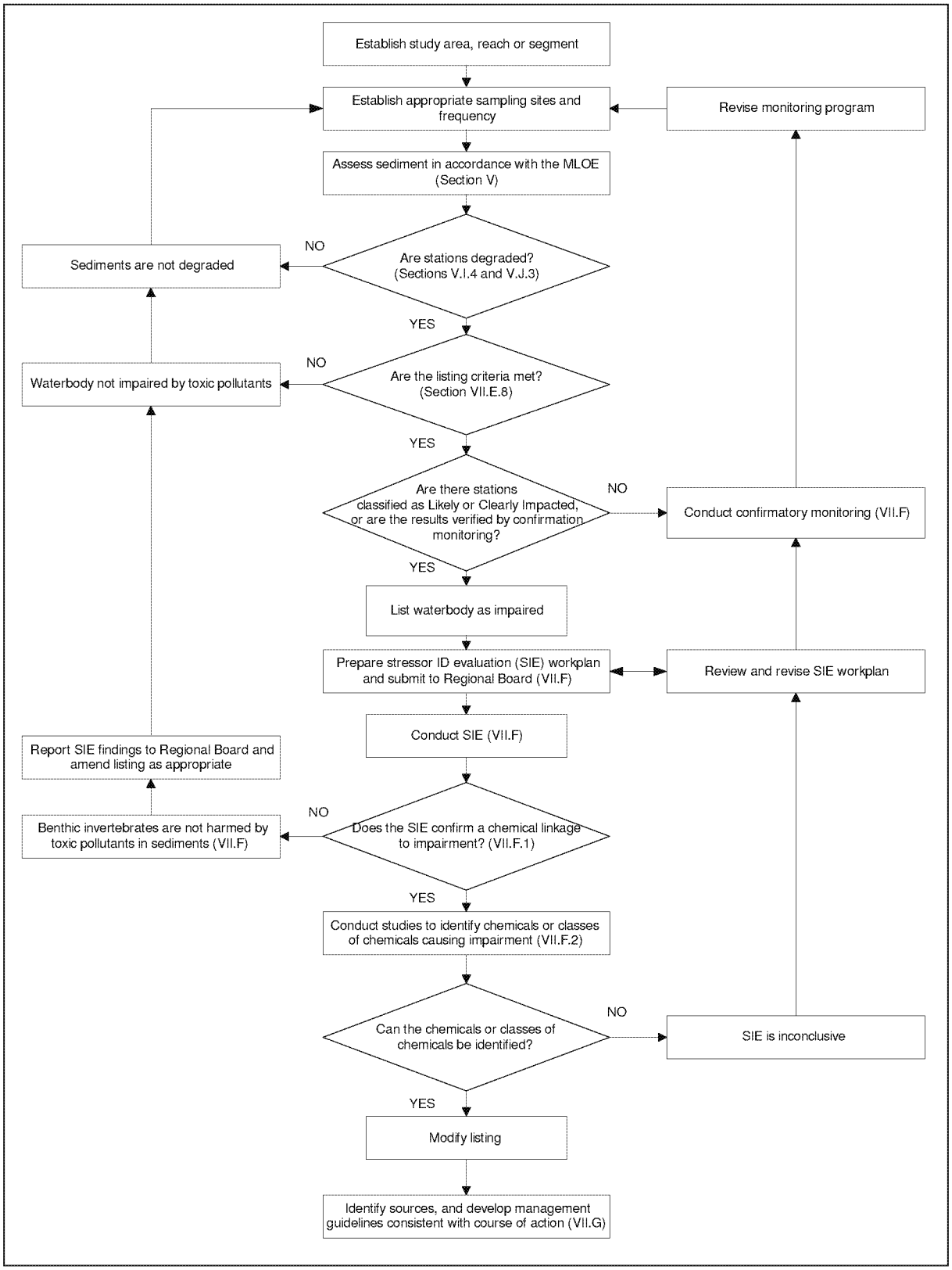

Figure 1. Waterbody Assessment Process

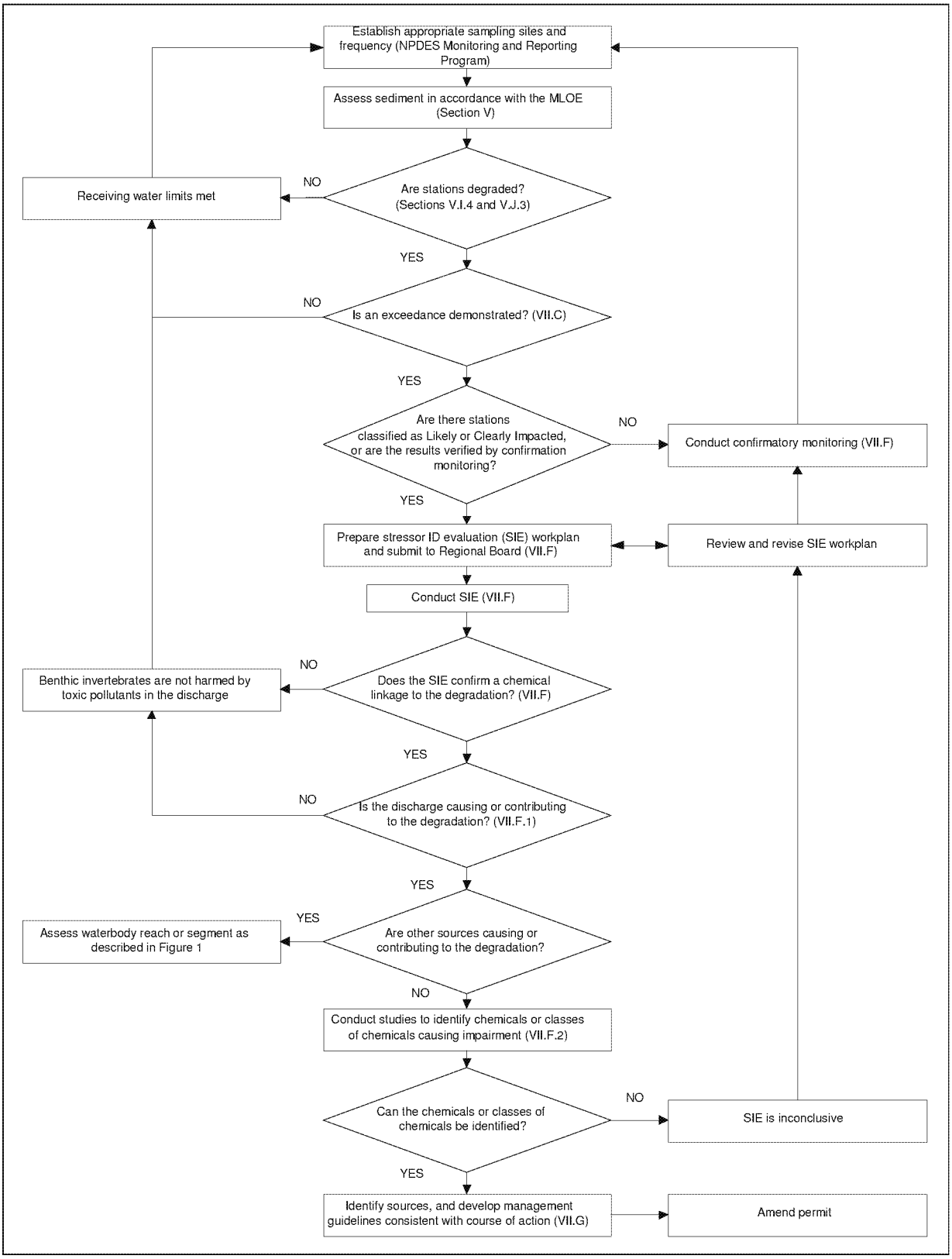

Figure 2. Point Source Assessment Process

Attachment A. List of chemical analytes needed to characterize sediment contamination exposure and effect.

Chemical Name	Chemical Group	Chemical Name	Chemical Group
Total Organic Carbon	General	Alpha Chlordane	Pesticide
Percent Fines	General	Gamma Chlordane	Pesticide
		Trans Nonachlor	Pesticide
Cadmium	Metal	Dieldrin	Pesticide
Copper	Metal	o,p'-DDE	Pesticide
Lead	Metal	o,p'-DDD	Pesticide
Mercury	Metal	o,p'-DDT	Pesticide
Zinc	Metal	p,p'-DDD	Pesticide
		p,p'-DDE	Pesticide
		p,p'-DDT	Pesticide
Acenaphthene	PAH	2,4'-Dichlorobiphenyl	PCB congener
Anthracene	PAH	2,2',5-Trichlorobiphenyl	PCB congener
Biphenyl	PAH	2,4,4'-Trichlorobiphenyl	PCB congener
Naphthalene	PAH	2,2',3,5'-Tetrachlorobiphenyl	PCB congener
2,6-dimethylnaphthalene	PAH	2,2',5,5'-Tetrachlorobiphenyl	PCB congener
Fuorene	PAH	2,3',4,4'-Tetrachlorobiphenyl	PCB congener
1-methylnaphthalene	PAH	2,2',4,5,5'-Pentachlorobiphenyl	PCB congener
2-methylnaphthalene	PAH	2,3,3',4,4'-Pentachlorobiphenyl	PCB congener
1-methylphenanthrene	PAH	2,3',4,4',5-Pentachlorobiphenyl	PCB congener
Phenanthrene	PAH	2,2',3,3',4,4'-Hexachlorobiphenyl	PCB congener
Benzo(a)anthracene	PAH	2,2',3,4,4',5'-Hexachlorobiphenyl	PCB congener
Benzo(a)pyrene	PAH	2,2',4,4',5,5'-Hexachlorobiphenyl	PCB congener
Benzo(e)pyrene	PAH	2,2',3,3',4,4',5-Heptachlorobiphenyl	PCB congener
Chrysene	PAH	2,2',3,4,4',5,5'-Heptachlorobiphenyl	PCB congener
Dibenz(a,h)anthracene	PAH	2,2',3,4',5,5',6-Heptachlorobiphenyl	PCB congener
Fluoranthene	PAH	2,2',3,3',4,4',5,6-Octachlorobiphenyl	PCB congener
Perylene	PAH	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	PCB congener
Pyrene	PAH	Decachlorobiphenyl	PCB congener

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Attachment B. Station assessment category resulting from each possible MLOE combination

LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
1	Minimal	Reference	Nontoxic	Unimpacted
2	Minimal	Reference	Low	Unimpacted
3	Minimal	Reference	Moderate	Unimpacted
4	Minimal	Reference	High	Inconclusive
5	Minimal	Low	Nontoxic	Unimpacted
6	Minimal	Low	Low	Likely unimpacted
7	Minimal	Low	Moderate	Likely unimpacted
8	Minimal	Low	High	Possibly impacted
9	Minimal	Moderate	Nontoxic	Likely unimpacted
10	Minimal	Moderate	Low	Likely unimpacted
11	Minimal	Moderate	Moderate	Possibly impacted
12	Minimal	Moderate	High	Likely impacted
13	Minimal	High	Nontoxic	Likely unimpacted
14	Minimal	High	Low	Inconclusive
15	Minimal	High	Moderate	Possibly impacted
16	Minimal	High	High	Likely impacted
17	Low	Reference	Nontoxic	Unimpacted
18	Low	Reference	Low	Unimpacted
19	Low	Reference	Moderate	Likely unimpacted
20	Low	Reference	High	Possibly impacted
21	Low	Low	Nontoxic	Unimpacted
22	Low	Low	Low	Likely unimpacted
23	Low	Low	Moderate	Possibly impacted
24	Low	Low	High	Possibly impacted
25	Low	Moderate	Nontoxic	Likely unimpacted
26	Low	Moderate	Low	Possibly impacted
27	Low	Moderate	Moderate	Likely impacted
28	Low	Moderate	High	Likely impacted
29	Low	High	Nontoxic	Likely unimpacted
30	Low	High	Low	Possibly impacted
31	Low	High	Moderate	Likely impacted
32	Low	High	High	Likely impacted
33	Moderate	Reference	Nontoxic	Unimpacted
34	Moderate	Reference	Low	Likely unimpacted
35	Moderate	Reference	Moderate	Likely unimpacted
36	Moderate	Reference	High	Possibly impacted
37	Moderate	Low	Nontoxic	Unimpacted
38	Moderate	Low	Low	Possibly impacted
39	Moderate	Low	Moderate	Possibly impacted
40	Moderate	Low	High	Possibly impacted
41	Moderate	Moderate	Nontoxic	Possibly impacted
42	Moderate	Moderate	Low	Likely impacted
43	Moderate	Moderate	Moderate	Likely impacted
44	Moderate	Moderate	High	Likely impacted

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LOE Category Combination	Sediment Chemistry Exposure	Benthic Community Condition	Sediment Toxicity	Station Assessment
45	Moderate	High	Nontoxic	Possibly impacted
46	Moderate	High	Low	Likely impacted
47	Moderate	High	Moderate	Likely impacted
48	Moderate	High	High	Likely impacted
49	High	Reference	Nontoxic	Likely unimpacted
50	High	Reference	Low	Likely unimpacted
51	High	Reference	Moderate	Inconclusive
52	High	Reference	High	Likely impacted
53	High	Low	Nontoxic	Likely unimpacted
54	High	Low	Low	Possibly impacted
55	High	Low	Moderate	Likely impacted
56	High	Low	High	Likely impacted
57	High	Moderate	Nontoxic	Likely impacted
58	High	Moderate	Low	Likely impacted
59	High	Moderate	Moderate	Clearly impacted
60	High	Moderate	High	Clearly impacted
61	High	High	Nontoxic	Likely impacted
62	High	High	Low	Likely impacted
63	High	High	Moderate	Clearly impacted
64	High	High	High	Clearly impacted

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CALIFORNIA

Water Boards

STATE WATER RESOURCES CONTROL BOARD

REGIONAL WATER QUALITY CONTROL BOARDS

Office of Public Affairs: (916) 341-5254
Office of Legislative Affairs: (916) 341-5251
Office of the Ombudsman (916) 341-5254

P.O. Box 100, Sacramento, CA 95812-0100
www.waterboards.ca.gov

Water Quality information: (916) 341-5455
Water Rights information: (916) 341-5300
Financial Assistance information: (916) 341-5700

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CENTRAL COAST REGION (3)
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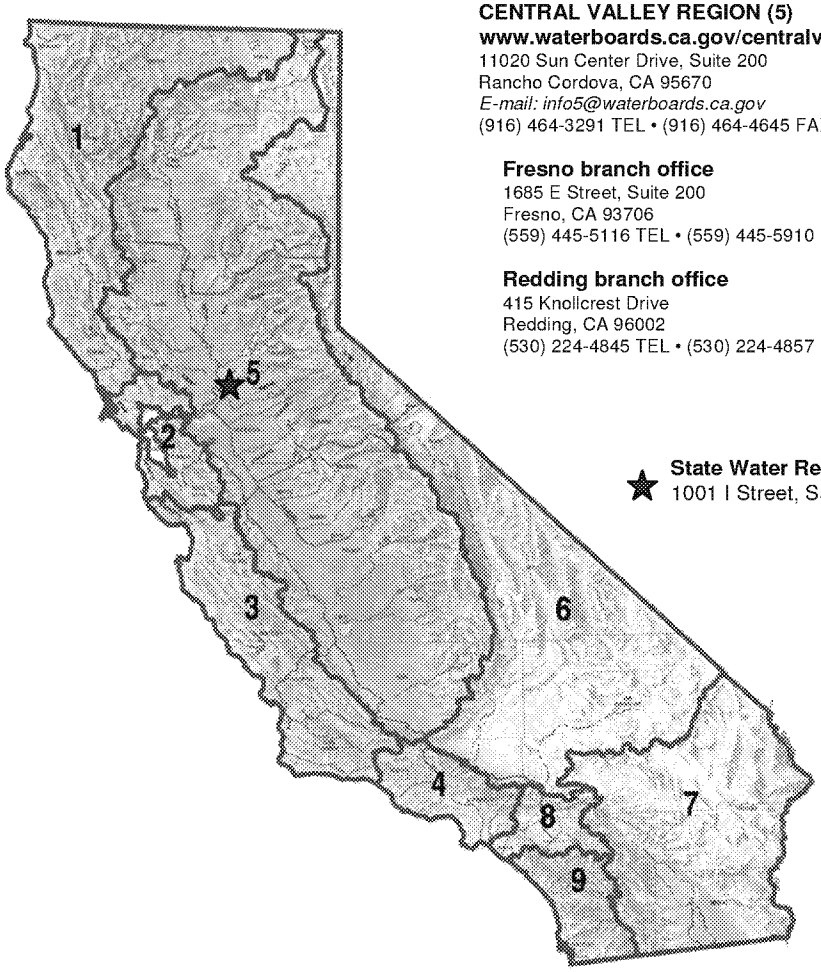
(858) 467-2952 TEL • (858) 571-6972 FAX



★ **State Water Resources Control Board** (Headquarters)
1001 I Street, Sacramento, CA 95814

State of California
Arnold Schwarzenegger, Governor

California Environmental Protection Agency
Linda S. Adams, Secretary

State Water Resources Control Board
Charles R. Hoppin, Chair

APPENDIX H:

ATTACHMENT A TO RESOLUTION NO. R11-008

DRAFT

Amendment to the Water Quality Control Plan – Los Angeles Region

to Incorporate the

Total Maximum Daily Load for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on May 5, 2011

Amendments

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Chapter 7. Total Maximum Daily Loads (TMDLs)
Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDL

This TMDL was adopted by:
The Regional Water Quality Control Board on **May 5, 2011.**

This TMDL was approved by:
The State Water Resources Control Board on **[Insert date].**
The Office of Administrative Law on **[Insert date].**
The U.S. Environmental Protection Agency on **[Insert date].**
This TMDL is effective on **[Insert date].**

The elements of the TMDL are presented in Table 7-40.1 and the Implementation Plan in Table 7-40.2.

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7-40.1 Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDL – Elements

TMDL Element	Regulatory Provisions
Problem Statement	The waters of Dominguez Channel and the Greater Los Angeles and Long Beach Harbor area[1] are impaired by heavy metals and organic pollutants. These water bodies are included on the State's Clean Water Act 303(d) impaired waters list for one or more of the following pollutants: cadmium, chromium, copper, mercury, lead, zinc, chlordane, dieldrin, toxaphene, DDT, PCBs, certain PAH compounds, benthic community effects and toxicity. These impairments exist in one or more environmental media—water, sediment, or tissue. Impairments in fish tissue are for DDT, PCBs, toxaphene, chlordane and dieldrin. Beneficial uses designated in these waters to protect aquatic life include the marine habitat use (MAR) and rare, threatened or endangered species habitat use (RARE). In addition, the estuaries (EST) are recognized as areas for spawning, reproduction and/or early development (SPWN), migration of aquatic organisms (MIGR), and wildlife habitat (WILD). Dominguez Channel also has an existing designated use of warm freshwater habitat (WARM) and the Los Angeles River Estuary has the designated use of wetland habitat (WET). Beneficial uses associated with human use of these waters include recreational use for water contact (REC1), non-contact water recreation (REC2), industrial service supply (IND), navigation (NAV), commercial and sport fishing (COMM), and shellfish harvesting (SHELL). Because of the impairments, these waterbodies fail to fully support the designated beneficial uses. The goal of this TMDL is to protect and restore fish tissue, water and sediment quality in Dominguez Channel and Greater Los Angeles and Long Beach Harbor waters by remediating contaminated sediment and controlling the sediment loading and accumulation of contaminated sediment in the Harbors.
Numeric Targets	Applicable water quality objectives for this TMDL are narrative objectives for Chemical Constituents, Bioaccumulation, Pesticides, and Toxicity in the Basin Plan and the numeric water quality criteria promulgated in 40 CFR section 131.38 (the California Toxics Rule (CTR)). In addition, sediment condition objectives were determined using the State Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (SQO Part 1) and the sediment quality guidelines.[2] The following tables provide the water, sediment and fish tissue targets for the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDLs. **<u>Water Column Targets</u>** Water targets were determined by this Basin Plan and the California Toxics Rule (CTR). Site-specific conversion factors were developed to convert CTR acute dissolved metal criteria to total recoverable metals using *The Metals Translator Guidance for Calculating a Total Recoverable Permit Limit From a Dissolved Criterion* EPA 823-B-96-007. Because exceedances of CTR criteria were only observed in freshwaters of the Dominguez

[1] Dominguez Channel includes the Dominguez Channel Estuary and Torrance Lateral Channel and Greater Los Angeles/Long Beach Harbor waters include Inner and Outer Harbor, Main Channel, Consolidated Slip, Southwest Slip, Fish Harbor, Cabrillo Marina, Inner Cabrillo Beach, Los Angeles River Estuary, and San Pedro Bay.

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Channel during wet weather, targets are set for wet weather only. Site-specific wet-weather conversion factors were calculated using paired dissolved and total metals data and the statistical method outlined in the Guidance.

Dissolved Metals and Organic Compounds Targets

Pollutant	Criteria for the Protection of Aquatic Life (µg/L)				Criteria for Protection of Human Health (µg/L) For consumption of:
	Freshwater		Saltwater		Organisms only
	Acute	Chronic	Acute	Chronic	
Dissolved Metals					
Copper	6.99*	4.95*	4.8	3.1	-
Lead	30.14*	1.17*	210	8.1	-
Zinc	65.13*	65.66*	90	81	-
Mercury	-	-	-	-	0.051
Organic Compounds					
Chlordane	n/a	n/a	0.09	0.004	0.00059
4,4'-DDT	1.1	0.001	0.13	0.001	0.00059
Total PCBs	-	0.014	-	0.03	0.00017
Benzo[a]pyrene**	-	-	-	-	0.049
Dieldrin	0.24	0.056	0.71	0.0019	0.00014

*Freshwater aquatic life criteria for Cu, Pb and Zn are expressed as a function of total hardness (mg/L) in the water body. Values presented correspond to median hardness from 2002 to 2010 of 50 mg/L based upon Los Angeles County Department of Public Works data from Station ID S28 (n = 35).
- means that no criteria were established for California.

**CTR human health criteria were not established for total PAHs. Therefore, the CTR criteria for individual PAHs of 0.049 µg/L are applied individually to benzo(a)pyrene, benzo(a)anthracene, and chrysene. The CTR human health criterion for Pyrene is 11,000 µg/L. Other PAH compounds in the CTR shall be screened as part of the TMDL monitoring.

Total Recoverable Metals, Freshwater Targets

Metal	Acute Dissolved CTR Criteria	Conversion Factor*	Acute Total Recoverable Metals
Copper	6.99	0.722	9.7
Lead	30.14	0.706	42.7
Zinc	65.13	0.935	69.6

* Site-specific conversion factors were calculated using Los Angeles County Department of Public Works data from Station ID S28 using the data record 2002-2010 (n = 35), which had a median hardness of 50 mg/L. Site-specific conversion factors maybe recalculated based on updated data at the time of permit issuance, modification, or renewal.

[2] Long, ER, LJ Field and DD MacDonald. 1998. *Predicting Toxicity in Marine Sediments with Numerical Sediment Quality Guidelines*, *Environ. Toxicol. Chem.* **17**:4, 714-727. MacDonald, DD, CG Ingersoll and TA Berger. 2000. *Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems*. Arch. Environ. Contam. Toxicol. **39**:20-31.

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Freshwater toxicity target: This TMDL also establishes a numeric toxicity target of 1.0 toxicity unit, chronic (1.0 TUc) to address toxicity.

TU_c = Toxicity Unit, chronic = 100/NOEC (no observable effects concentration)

Targets based on new toxicity criteria that achieve the narrative Toxicity objective of Chapter 3 of this Basin Plan may substitute for the TU_c of 1, when those new criteria are adopted and in effect.

Sediment Targets

Sediment targets were determined by the narrative standards of this Basin Plan, the SQO Part 1 and the sediment quality guidelines of Long et al. (1998) and MacDonald et al. (2000), which are recommended by the State Listing Policy. The fresh water sediment numeric targets for Dominguez Channel are based on the freshwater Threshold Effect Concentration (TEC) sediment guidelines compiled by the National Oceanic and Atmospheric Administration (NOAA) in the Screening Quick Reference Tables (SQuiRTs). The marine sediment quality guidelines of Effect Range Low (ERL), also from NOAA SQuiRTs, were used to establish the numeric targets for marine sediment for the greater Los Angeles and Long Beach Harbor waters. These TECs and ERLs are set as the sediment quality thresholds for the calculation of loading capacity and allocations. This TMDL anticipates that revisions to specific sediment quality targets may be determined by development of site-specific sediment quality values (SQV).

Sediment targets

Metals	Freshwater Sediment (mg/kg)	Marine Sediment (mg/kg)
Cadmium	n/a	1.2
Copper	31.6	34
Lead	35.8	46.7
Mercury	n/a	0.15
Zinc	121	150
Chromium	n/a	81
Organics	**Marine Sediment (µg/kg)**	
Chlordane, total	0.5	
Dieldrin	0.02	
Toxaphene	0.10*	
Total PCBs	22.7	
Benzo[a]anthracene	261	
Benzo[a]pyrene	430	
Chrysene	384	
Pyrene	665	
2-methylnaphthalene	201	
Dibenz[a,h]anthracene	260	
Phenanthrene	240	

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Hi MW PAHs	1700
Lo MW PAHs	552
Total PAHs	4,022
Total DDT	1.58

*Toxaphene value from *Technical Guidance for Screening Contaminated Sediments*, New York State, Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources (1999), assumes 1% TOC.
n/a indicates that a fresh water sediment target is not established in this TMDL for this constituent, since impairments for the constituent is in saltwater only.

These sediment targets are not intended to be used as 'clean-up standards' for navigational, capital or maintenance dredging or capping activities; rather they are long-term sediment concentrations that should be attained after reduction of external loads, targeted actions addressing internal reservoirs of contaminants, and environmental decay of contaminants in sediment. In addition, the categories designated in the SQO Part 1 as **Unimpacted** and **Likely Unimpacted** by the interpretation and integration of multiple lines of evidence shall be considered as the protective narrative objective for sediment toxicity and benthic community effects. The thresholds established in the SQO Part 1 are based on statistical significance and magnitude of the effect. Therefore, this TMDL implicitly includes sediment toxicity and benthic community targets by its use of the SQO Part 1.

Fish Tissue and Associated Sediment Targets

Fish tissue targets were determined from *Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene*, developed by OEHHA (2008) to assist agencies in developing fish tissue-based criteria for pollution mitigation or elimination and to protect humans from consumption of contaminated fish. Associated sediment targets required to achieve the fish tissue targets were determined from several sources depending on the contaminant.

Fish Tissue and Associated Sediment Targets

Pollutant	Fish Tissue Target (µg/kg wet)	Associated Sediment Target (µg/kg dry)
Chlordane	**5.6**	**1.3** [b]
Dieldrin	**0.46**	**n/a**
Total DDT	**21**	**1.9** [b]
Total PCBs	**3.6**	**3.2** [c]
Total PAHs	**5.47** [a]	**n/a**
Toxaphene	**6.1**	**0.1** [d]

[a] Total PAHs in fish from EPA screening value.
[b] Chlordane and total DDT associated sediment values from SFEI (2007) "Indicator development and framework for assessing indirect effects of sediment contaminants", SFEI Contribution #524.
[c] Total PCBs - associated sediment target from Gobas, F. and J. Arnot (2010) "Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA", ET&C **29**:6, 1385-95.
[d] Toxaphene value from New York State (1999), assumes 1% TOC.
n/a indicates that an associated sediment target is not established in this TMDL at this time because there is no BSAF in literature to use in the calculation. If BSAFs are developed in the future, associated sediment targets for dieldrin and/or PAHs may be added during reconsideration of the TMDL.

Source Analysis	Monitoring data from NPDES discharges and land use runoff coefficients were used to estimate the magnitude of metals, organo-chlorine pesticides, PCBs, and PAHs loads to Dominguez

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	Channel and Greater Los Angeles and Long Beach Harbor waters. PCBs, DDT, dieldrin, and chlordane are legacy pollutants for the most part, yet, they remain present in the environment, bound to fine-grained particles. Because they are legacy pollutants and are subject to environmental decay, their concentrations are gradually decreasing over time. When these particles become waterborne, the chemicals are ferried to new locations. Urban runoff and rainfall higher in the watersheds mobilize the particles, which are then washed into storm drains and channels that discharge to the Dominguez Channel and greater Harbor waters. Metals and PAHs are currently generated or deposited in the watersheds and are then washed into storm drains and channels that discharge to the Dominguez Channel and greater Harbor waters. Briefly there are several categories of pollutant sources to the waters of concern in these TMDLs. Point sources include stormwater and urban runoff (MS4) and other NPDES discharges, including but not limited to Port operations, Terminal Island Water Reclamation Plant (TIWRP), refineries, and generating plants. Nonpoint sources include existing contaminated sediments and direct (air) deposition. **Dominguez Channel waters:** The major point sources of organo-chlorine pesticides, PCBs, and metals into Dominguez Channel are stormwater and urban runoff discharges. Nonpoint sources include atmospheric deposition and fluxes from contaminated sediments into the overlying water. Current loads of metals into Dominguez Channel were estimated using Loading Simulation Program in C++ (LSPC) model output from simulated flows for 1995-2005. Monitoring data from NPDES discharges and land use runoff coefficients were analyzed along with Channel stream flow rates to estimate the magnitude of metal loadings. In recognition of the wide variety of stream flow rates generated by various rainfall conditions, flow duration curves were utilized to analyze the metals loading during wet weather. **Greater Los Angeles and Long Beach Harbor waters:** A variety of activities over the past decades in the four contributing watersheds (Dominguez Channel, Los Angeles River, San Gabriel River and the nearshore watershed) and in the Harbors themselves have contributed to the sediment contamination. The contaminated sediments are a reservoir of historically deposited pollutants. Stormwater runoff from manufacturing, military facilities, fish processing plants, wastewater treatment plants, oil production facilities, and shipbuilding or repair yards in both Ports discharged untreated or partially treated wastes into Harbor waters. Current activities also contribute pollutants to Harbor sediments. In particular, stormwater runoff from port facilities, commercial vessels (ocean going vessels and harbor craft), recreational vessels, and the re-suspension of contaminated sediments via natural processes and/or anthropogenic activities including (ship) propeller wash within the Ports also contributes to transport of pollutants within the Harbors. Loadings from the four contributing watersheds are also potential sources of metals, pesticides, PCBs, and PAHs to the Harbors. The major nonpoint source of pesticides and PCBs to the greater Harbor waters is the current sediments. The re-suspension of these sediments contributes to the fish tissue impairments. In addition, atmospheric deposition may be a potential nonpoint source of metals to the watershed, through either direct deposition or indirect deposition.

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	Current loading of metals, PAHs, DDT and PCBs to contaminated sediments within the Dominguez Channel Estuary and Greater Harbor waters was estimated using monitoring data from special studies and water body surface area for air deposition; discharge results for refineries and TIWRP; and Environmental Fluid Dynamics Code (EFDC) model output for 2002-2005. Model inputs included the existing average sediment concentration in the top 5 cm of bed sediments and the total sediment deposition rate per waterbody.
Linkage Analysis	The linkage analysis connects pollutant loads to the numeric targets and protection of beneficial uses of Dominguez Channel and Greater Los Angeles and Long Beach Harbor waters. To represent the linkage between source contributions and ambient water and sediment response, two dynamic water quality models were developed to simulate source loadings and transport of the listed pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor waters. The Environmental Fluid Dynamics Code (EFDC) and Loading Simulation Program in C++ (LSPC) models were selected to simulate the pollutants in this TMDL. **LSPC for freshwater loadings of metals and total PAHs, DDT, and PCBs.** LSPC was developed for Dominguez Channel based on information initially provided by SCCWRP for this watershed. In addition, Los Angeles River and San Gabriel River LSPC models were updated from earlier TMDL models. Model development throughout the Los Angeles Region relies on Event Mean Concentrations (EMC) as well as simulated flows to estimate pollutant loadings. Flow data records for 1995-2005 were used to calibrate LSPC models for each watershed; similar simulation time frames were used to generate simulated flows for each watershed. Dominguez Channel freshwater metals TMDLs examined only wet weather flows; however, LSPC output for dry and wet weather conditions was applied to all estuarine and marine receiving waters. The nearshore watershed was analyzed and modeled using LSPC by breaking it into 67 subwatersheds that discharge directly to the Greater Los Angeles and Long Beach Harbor waters. These sub-watersheds were then aggregated by receiving waterbody; e.g. nearshore contributions to Inner Harbor consisted of stormdrains and surface (sheet) flows that discharge directly into the Inner Harbor. The table below shows total loads from the four contributing watersheds to the Greater Harbor waters. Overall, the Los Angeles River is the largest freshwater contributor of pollutants to the greater Harbor waters; flows from the Los Angeles River primarily impact water quality in eastern San Pedro Bay. The Inner Harbor receives the bulk of the loading from the nearshore watershed. Comparative Watershed Loading to Greater Harbor Waters

Contaminant	LSPC Modeled Existing Loading by Watershed (1995-2005)							
	Dominguez Channel		Los Angeles River		San Gabriel River		Nearshore Watershed	
	Percent of Total Loading	Average Daily Load (kg/day)	Percent of Total Loading	Average Daily Load (kg/day)	Percent of Total Loading	Average Daily Load (kg/day)	Percent of Total Loading	Average Daily Load (kg/day)
Wet Conditions								
Sediment	5.6%	1.88E+05	72.0%	2.79E+06	20.4%	4.90E+05	1.9%	6.54E+04
Total Copper	4.3%	3.58E+01	81.1%	7.85E+02	12.5%	7.51E+01	2.1%	1.78E+01
Total Lead	3.0%	2.08E+01	71.5%	5.67E+02	23.3%	1.15E+02	2.2%	1.53E+01

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Total Zinc	5.0%	3.56E+02	72.2%	5.89E+03	20.2%	1.02E+03	2.6%	1.84E+02
Total DDT	9.2%	2.20E-02	89.5%	2.46E-01	0.7%	1.15E-03	0.7%	1.59E-03
Total PAH	8.0%	2.04E+00	70.2%	2.07E+01	16.1%	2.95E+00	5.8%	1.50E+00
Total PCB	2.3%	1.38E-02	97.5%	6.86E-01	0.1%	3.11E-04	0.2%	9.92E-04
Dry Conditions								
Sediment	0.7%	8.57E+01	19.0%	2.27E+03	80.1%	1.01E+04	0.1%	1.54E+01
Total Copper	2.6%	2.56E-01	48.7%	4.69E+00	40.8%	4.18E+00	8.0%	7.78E-01
Total Lead	0.9%	3.48E-02	19.8%	7.86E-01	72.9%	3.07E+00	6.5%	2.59E-01
Total Zinc	0.9%	5.65E-01	30.4%	1.90E+01	62.6%	4.15E+01	6.2%	3.89E+00
Total DDT	7.7%	1.90E-05	83.0%	2.01E-04	9.3%	2.38E-05	0.0%	2.88E-10
Total PAH	6.8%	7.06E-02	62.7%	6.39E-01	30.4%	3.29E-01	0.0%	4.18E-05
Total PCB	1.8%	1.06E-05	97.1%	5.59E-04	1.1%	6.43E-06	0.0%	1.45E-10

The EFDC was used to model hydrodynamics and water and sediment quality of the greater Los Angeles and Long Beach Harbor waters. The EFDC model applied a simulated time period of 2002-2005. The model was calibrated with numerous sediment monitoring studies, including Los Angeles and Long Beach Harbor's 2006 sediment characterization study, which yielded sediment, porewater and overlying water concentrations as well as results from highly sensitive monitoring devices for detecting DDT, PCBs, and PAHs in the water column. The EFDC model also considered ocean water (outside breakwater) conditions and fine and coarse sediment transport and deposition. Ultimately the EFDC model was integrated with LSPC output – hourly for three watersheds, daily for nearshore watersheds – to model metals, PAHs, PCBs, and DDT (total) sediment concentrations in the receiving waters. The annual total (clean) sediment deposition rate for the top 5 cm (active sediment layer) was multiplied by the corresponding existing sediment pollutant level or the TMDL sediment quality target to yield pollutant load within each waterbody.

Annual (clean) Sediment Deposition Rates per (salt)Waterbody

Waterbody Name	TMDL Zone	Area (acres)[1]	Area (m^2)[1]	Total Deposition (kg/yr)[2]
Dominguez Channel Estuary	01	140	567,900	2,470,201
Consolidated Slip	02	36	147,103	355,560
Inner Harbor - POLA	03	1,539	6,228,431	1,580,809
Inner Harbor - POLB	08	1,464	5,926,130	674,604
Fish Harbor	04	91	368,524	30,593
Cabrillo Marina	05	77	310,259	38,859
Cabrillo Beach	06	82	331,799	27,089
Outer Harbor - POLA	07	1,454	5,885,626	572,349
Outer Harbor - POLB	09	2,588	10,472,741	1,828,407
Los Angeles River Estuary	10	207	837,873	21,610,283
San Pedro Bay	11	8,173	33,073,517	19,056,271

[1] Area obtained from GIS layer of the 2006 303(d) list. Available at: http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_gis.shtml

[2] Sediment deposition rates were calculated by approximating the average mass of total sediment (fine and coarse particles) deposited in each waterbody annually based on 2002-2005 EFDC output. Sediment flux for each grid cell,

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	which is dependent on watershed inputs as well as tidal movements between waterbodies, was obtained from the EFDC model output. These values were summarized across each TMDL waterbody, resulting in the average deposition of both sediment fines and sand by waterbody. The total deposition rate is simply the sum of the rates for fines and sand and this value is the waterbody-specific average annual (clean) sediment deposition rate. The EFDC model was used to evaluate several management scenarios and relative contributions from various inputs to support water quality management decisions in Dominguez Channel and Greater Los Angeles and Long Beach Harbor waters. Preliminary results for two scenarios indicate that reducing freshwater input loads may not be sufficient to achieve target concentrations in water and sediments; thus reductions in contaminant levels in bed sediments may be required.
Loading Capacity	Loading capacity was calculated for both Dominguez Channel (wet weather) and in the Dominguez Channel Estuary and Greater Harbor waters (dry and wet weather). <u>Dominguez Channel wet weather metals TMDLs</u>: During wet weather, the loading capacity is a function of the volume of water in the Channel. Given the variability in wet-weather flows, the concept of a single critical flow was not justified. Instead, a load duration curve approach was used to establish the wet-weather loading capacity. The load duration curve was developed by multiplying the wet-weather flows by the in-stream numeric targets. The resulting curves identify the allowable load for a given flow. The wet-weather TMDLs for copper and zinc are defined by these load duration curves. Loading capacities were calculated by multiplying the daily volume by the appropriate numeric water quality target or, in the case of lead, the observed existing average concentration. The wet-weather loading capacity applies to any day when the maximum daily flow measured at a location within the Dominguez Channel is equal to or greater than 62.7 cfs, which is the 90th percentile of annual flow rates from estimated/modeled flow rates. The freshwater toxicity TMDL is equal to 1 TUc. <u>Dominguez Channel Estuary and Greater Harbor waters, metals and organics in sediment TMDLs:</u> Loading capacities for Dominguez Channel Estuary and Greater Harbor waters were calculated by estimating the sediment load (based on modeled sediment deposition rates) multiplied by the sediment quality target. The active sediment layer was defined as the top 5 cm of sediment; the habitat of approximately 95% of benthic organisms. In addition, chlordane, dieldrin, toxaphene and mercury TMDLs were defined for specific waterbodies as equivalent to the concentration-based sediment quality target.
Waste Load and Load Allocations	Final waste load allocations (WLA) are assigned to stormwater dischargers (MS4, California Department of Transportation (Caltrans), general construction and general industrial dischargers), and other NDPES dischargers. Final load allocations (LAs) are assigned to direct atmospheric deposition and bed sediments in both wet and dry weather. Dominguez Channel freshwater allocations are set for wet weather only because exceedances have only been observed in wet weather. Mass-based allocations have been set where sufficient data was available to calculate mass-based allocations, otherwise, concentration-based allocations have

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	been set. Interim WLA and LA are intended to not allow any decrease in current facility performance. Interim allocations shall be met upon the effective date of the TMDL. Interim and final WLAs and LAs shall be included in permits and/or other Board orders in accordance with state and federal regulations and guidance. **INTERIM ALLOCATIONS** **1. Dominguez Channel Freshwater Interim Allocations** **A. Freshwater Toxicity Interim Allocation wet weather** An interim allocation of 2 TUc applies to each source, including all point sources assigned a WLA and all nonpoint sources assigned a LA. The freshwater toxicity interim allocation is set at 2 TUc based on current monitoring results performed by the Los Angeles County Department of Public Works, which have shown average values of less than 2 TUc. The fresh water interim allocation shall be implemented as a trigger requiring initiation and implementation of the TRE/TIE process as outlined in US EPA's "Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination System Program" (2000) and current NPDES permits. The fresh water interim allocation shall be implemented in accordance with US EPA, State Board and Regional Board resolutions, guidance and policy at the time of permit issuance, modification or renewal. **B. Freshwater Metals Interim Allocations - wet weather only** Interim water allocations are assigned to stormwater dischargers (MS4, Caltrans, general construction and general industrial stormwater dischargers) and other NPDES dischargers. Interim water allocations are based on the 95th percentile of total metals data collected from January 2006 to January 2010 using a log-normal distribution. The use of 95th percentile values to develop interim allocations is consistent with NPDES permitting methodology. Regardless of the interim allocations below, permitted dischargers shall ensure that effluent concentrations and mass discharges do not exceed levels that can be attained by performance of the facility's treatment technologies existing at the time of permit issuance, reissuance or modification. Concentration-based Dominguez Channel and Torrance Lateral freshwater interim metal allocations **Total Copper** / **Total Lead** / **Total Zinc** **allocation (µg/L)**: 207.51 / 122.88 / 898.87 **2. Dominguez Channel Estuary and Greater Los Angeles and Long Beach Harbor Waters:** Interim sediment allocations are assigned to stormwater dischargers (MS4, Caltrans, general construction and general industrial stormwater dischargers) and other NPDES dischargers. Interim sediment allocations are based on the 95th percentile of sediment data collected from 1998-2006. The use of 95th percentile values to develop interim allocations is consistent with NPDES permitting methodology. For waterbodies where the 95th percentile value has been equal to, or lower than, the numeric target, then the interim allocation is set equal to the final allocation. Regardless of the interim sediment allocations below, permitted dischargers shall

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ensure that effluent concentrations and mass discharges do not exceed levels that can be attained by performance of the facility's treatment technologies existing at the time of permit issuance, reissuance or modification.

Sediment, interim concentration-based allocations

Waterbody	Pollutant (mg/kg sediment)					
	Copper	Lead	Zinc	DDT	PAHs	PCBs
Dominguez Channel Estuary	220.0	510.0	789.0	1.727	31.60	1.490
Long Beach Inner Harbor	142.3	50.4	240.6	0.070	4.58	0.060
Los Angeles Inner Harbor	154.1	145.5	362.0	0.341	90.30	2.107
Long Beach Outer Harbor (inside breakwater)	67.3	**46.7**	**150**	0.075	**4.022**	0.248
Los Angeles Outer Harbor (inside breakwater)	104.1	**46.7**	**150**	0.097	**4.022**	0.310
Los Angeles River Estuary	53.0	**46.7**	183.5	0.254	4.36	0.683
San Pedro Bay Near/Off Shore Zones	76.9	66.6	263.1	0.057	**4.022**	0.193
Los Angeles Harbor - Cabrillo Marina	367.6	72.6	281.8	0.186	36.12	0.199
Los Angeles Harbor - Consolidated Slip	1470.0	1100.0	1705.0	1.724	386.00	1.920
Los Angeles Harbor - Inner Cabrillo Beach Area	129.7	**46.7**	163.1	0.145	**4.022**	0.033
Fish Harbor	558.6	116.5	430.5	40.5	2102.7	36.6

Numbers in **bold** are also the final allocation.

Compliance with the interim concentration-based sediment allocations may be demonstrated via any one of three different means:

1. Demonstrate that the sediment quality condition of **Unimpacted** or **Likely Unimpacted** via the interpretation and integration of multiple lines of evidence as defined in the SQO Part 1, is met; or
2. Meet the interim allocations in bed sediment over a three-year averaging period; or
3. Meet the interim allocations in the discharge over a three-year averaging period.

FINAL ALLOCATIONS

1. Dominguez Channel Freshwater Allocations

A. **Freshwater Toxicity Allocation in wet weather**

A final allocation of 1 TUc, or its equivalent based on any Statewide Toxicity Policy, applies to each source, including all point sources assigned a WLA and all nonpoint sources assigned a LA.

B. **Freshwater Metals Allocations in wet weather**

Wet-weather allocations are assigned to Dominguez Channel and all upstream reaches and tributaries of Dominguez Channel (above Vermont Avenue).

Allocations are assigned to both point (WLA) and nonpoint sources (LA). A mass-based LA has been developed for direct atmospheric deposition. A mass-based waste load allocation (WLA) is divided between the MS4 permittees and Caltrans under its NPDES stormwater