VOLUME III






DRAFT TECHNICAL REPORT FOR TENTATIVE CLEANUP AND ABATEMENT ORDER NO. R9-2011-0001

FOR THE SHIPYARD SEDIMENT SITE • SAN DIEGO BAY, SAN DIEGO, CA

SEPTEMBER 15, 2010

CALIFORNIA Water Boards

STATE WATER RESOURCES CONTROL BOARD

REGIONAL WATER QUALITY CONTROL BOARDS

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
9174 Sky Park Court, Suite 100, San Diego, California 92123-4340
Phone • (858) 467-2952 • Fax (858) 571-6972
http://www.waterboards.ca.gov/sandiego

Documents are available at: http://www.waterboards.ca.gov/sandiego

Draft Technical Report for

TENTATIVE
CLEANUP AND ABATEMENT
ORDER NO. R9-2011-0001

For the Shipyard Sediment Site
San Diego Bay, San Diego, CA

Volume 3 of 3

Adopted by the
California Regional Water Quality Control Board
San Diego Region
on ____________, 2011

Cover Design by Sharon Norton, Graphic Designer

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
9174 Sky Park Court, Suite 100
San Diego, California 92123-4340
Telephone (858) 467- 2952

STATE OF CALIFORNIA

ARNOLD SCHWARZENEGGER, Governor
Linda S. Adams, Agency Secretary, California Environmental Protection Agency

California Regional Water Quality Control Board
San Diego Region

David W. Gibson, Executive Officer
James G. Smith, Assistant Executive Officer

This report was prepared under the direction of

David T. Barker P.E., Chief, Surface Water Basins Branch
Julie Chan P.G., Chief, Ground Water Basins Branch
Craig L. Carlisle P.G., C.E.G., Senior Engineering Geologist

by

Tom Alo, *Water Resources Control Engineer*
Alan T. Monji, *Environmental Scientist*
Benjamin C. Tobler, *Water Resources Control Engineer*
Cynthia Gorham-Test, *Environmental Scientist*
Lisa Honma, *Environmental Scientist*

Table of Contents

32. Finding 32: Alternative Cleanup Levels 32-1

32.1. Regulatory Principles for Setting Alternative Cleanup Levels 32-3

32.1.1. Compliance with Water Quality Standards Related to Sediment Quality 32-4

32.1.2. Risks to Human Health and the Environment 32-6

32.2. Approach for Establishing Alternative Cleanup Levels for Protection of Human Health and Wildlife Beneficial Uses 32-7

32.2.1. Basis for the Surface-Area Weighted Average Concentration 32-7

32.2.2. Calculation of the Surface-Area Weighted Average Concentration 32-9

32.2.3. Surface-Area Weighted Average Concentration Approach 32-11

32.3. Alternative Cleanup Levels Protect Aquatic-Dependent Wildlife Beneficial Uses 32-12

32.4. Alternative Cleanup Levels Protect Human Health Beneficial Uses 32-16

32.5. Alternative Cleanup Levels to Protect Aquatic Life Beneficial Uses 32-28

32.5.1. Analysis for Aquatic Life at Triad Stations 32-28

32.5.2. Analysis for Aquatic Life at Non-Triad Stations 32-31

32.6. Alternative Cleanup Levels Protect Aquatic Life Beneficial Uses 32-34

32.7. Other Considerations Regarding Resolution No. 92-49 32-39

32.7.1. Technological and Economical Feasibility 32-40

32.7.2. Maximum Benefit to the People of the State 32-40

32.7.3. Water Quality Control Plans 32-44

33. Finding 33: Proposed Remedial Footprint and Preliminary Remedial Design 33-1

33.1. Proposed Remedial Footprint 33-2

33.1.1. Exclusion of Station NA22 from the Remedial Footprint 33-3

33.1.2. Remedial Footprint Stations Ranked by SWAC 33-4

33.1.3. Remedial Footprint Polygons Ranked by SS-MEQ 33-5

33.1.4. Remedial Footprint Generally Includes Areas with Highest Concentrations of COCs 33-6

33.2. Evaluation of Estimated Post-Remedial SWACs Relative to Background Sediment Chemistry Levels 33-9

33.3. Preliminary Remedial Design 33-9

33.3.1. Proposed Remedial Footprint Characteristics 33-12

33.4. Upland Source Control in Watershed of MS4 Outfall SW-4 33-13

34. Finding 34: Remedial Monitoring Program 34-1
34.1. Remediation Monitoring 34-1
34.1.1. Water Quality 34-2
34.1.2. Sediment Conditions 34-2
34.1.3. Disposal 34-4
34.2. Post-Remediation Monitoring 34-4
34.2.1. Human Health and Aquatic-Dependent Wildlife 34-5
34.2.2. Post-Remediation SWAC Trigger Concentrations 34-6
34.2.3. Benthic Community Conditions 34-8
34.2.4. Benthic Community Development 34-11
35. Finding 35: Remedial Action Implementation Schedule 35-1
35.1. Resolution No. 92-49 Requirements 35-1
35.2. Remedial Action Implementation Schedule 35-2
35.3. Remedial Actions 35-3
36. Finding 36: Legal and Regulatory Authority 36-1
36.1. Porter-Cologne Water Quality Control Act Jurisdiction 36-1
36.1.1. Water Code Section 13267 36-1
36.1.2. Water Code Section 13304 36-2
36.2. Applicable Federal Regulations 36-2
36.3. Water Quality Control Plan for the San Diego Basin (Basin Plan) 36-6
36.4. Resolution No. 92-49 36-7
36.5. Resolution No. 68-16 36-8
36.6. Policy for Implementation of Toxics Standards 36-8
36.7. Environmental Justice 36-9
37. Finding 37: CEQA Review 37-1
37.1. Guiding Principles for Determination of CEQA Applicability 37-1
37.2. Cleanup and Abatement Order Project Description 37-3
37.3. CEQA Process to Date 37-4
38. Finding 38: Public Notice 38-1
38.1. Public Review Process to Date 38-1
39. Finding 39: Public Hearing 39-1
39.1. Public Hearing 39-1
40. References 40-1

List of Appendices

Appendix for Section 32	Alternative Cleanup Levels
Appendix for Section 33	Proposed Remedial Footprint and Preliminary Remedial Design
Appendix for Section 34	Remedial Monitoring Program

List of Tables

Table 32-1	Target Receptors Associated with San Diego Bay Beneficial Uses	32-5
Table 32-2	Foraging Ranges for Aquatic Dependent Wildlife Receptors	32-8
Table 32-3	Post-Remedial SWACs for the Shipyard Sediment Site	32-12
Table 32-4	Prey Items Used in Risk Estimates	32-13
Table 32-5	Current and Post-Remedial SWACs	32-14
Table 32-6	Exposure Parameters for Aquatic-Dependent Wildlife	32-15
Table 32-7	Geometric Mean TRVs for Tier II Risk Drivers	32-16
Table 32-8	Post-Remedy Hazard Quotient (HQ) Results	32-16
Table 32-9	Estimated Post-Remedial PCB, Mercury, and Copper Tissue Concentrations	32-19
Table 32-10	Variable Values for Risk Scenarios	32-21
Table 32-11	Tissue Concentrations (Threshold Exposure Point)	32-21
Table 32-12	Biota Accumulation Factors	32-22
Table 32-13	SWACs Protective of Human Health at FI=100%	32-22
Table 32-14	Acceptable Total PCB SWACs for Recreational Anglers Assuming Varying Risk Levels and Fractional Intake	32-24
Table 32-15	Acceptable Copper and Mercury SWACs for Recreational and Subsistence Anglers Assuming Varying Risk Levels and Fractional Intake	32-24
Table 32-16	Protectiveness of the Human Health Beneficial Uses of Post-Remedial SWACs	32-25
Table 32-17	Evaluation of Triad “Possibly” Impaired Stations Using MLOE Approach in the Bays and Estuaries Plan	32-29
Table 32-18	Summary of Biological Line-Of-Evidence Results for Toxicity and Benthic Community Endpoints for the Triad Stations Classified as Possibly Impaired Under Scenario 2	32-30
Table 32-19	60% LAET Values for Primary COCs	32-31

Table 32-20 Data from Triad Stations at the Shipyard Sediment Site Used to Develop the SS-MEQ 32-32
Table 32-21 Performance Summary for the SS-MEQ 32-33
Table 32-22 Supplemental Triad Analysis Results and SS-MEQ/60%LAET Predictions .. 32-34
Table 32-23 Site-Specific 60%LAET and SS-MEQ Threshold Exceedences SPI Successional Stage, and Remedial Designations at the Shipyard Sediment Site Non-Triad Stations 32-35
Table 32-24 Summary of Aquatic Life Beneficial Use Protection Analysis 32-39
Table 32-25 Preliminary Contaminant Mass Removal/Containment Estimates 32-42
Table 33-1 Remedial Footprint Polygons Ranked by SWAC 33-5
Table 33-2 Remedial Footprint Polygons Ranked by SS-MEQ 33-6
Table 33-3 Polygons with Highest Individual COCs 33-7
Table 33-4 Polygons with Highest Individual COCs 33-7
Table 33-5 Polygons with Highest Individual COCs 33-7
Table 33-6 Rationale for Exclusion of Polygon from Remedial Footprint 33-8
Table 33-7 Remedial Footprint Details 33-10
Table 33-8 Comparison of Pre- and Post-Remedial SWACs 33-12
Table 34-1 Trigger Concentrations for Primary COCs 34-7

List of Figures

Figure 32-1 Map of Thiessen Polygons at Shipyard Sediment Site Study Area 32-10
Figure 32-2 Percent of Stations Targeted for Remediation as a Function of the Weight-Of-Evidence Category for Aquatic Life Impairment 32-35
Figure 32-3 Distribution of Benthic Infuana Successional Stage at the Shipyard Sediment Site (Figure 8-1; Exponent, 2003) 32-38
Figure 33-1 Polygons Targeted for Remediation 33-2
Figure 33-2 Chollas Creek Mouth Study Area and Shipyard Sediment Site Study Area Sample Location, NA22 33-3
Figure 33-3 Comparison of Post-Remedial SWACs to Background Sediment Chemistry Levels 33-9
Figure 33-4 "North" Dredge Footprint based on SMUs 33-10
Figure 33-5 "South" Dredge Footprint based upon SMUs 33-11
Figure 33-6 Map of Watershed that Drains to MS4 Outfall SW-4 33-14
Figure 34-1 Polygon Groups for Composite Sampling 34-6

Figure 34-2 Flow Diagram for the Sediment Chemistry Ranking Criteria (Low, Moderate, and High) 34-9
Figure 34-3 Flow Diagram for the Toxicity Ranking Criteria (Low, Moderate, and High) 34-10
Figure 35-1 Remedial Action Implementation Schedule 35-4

Acronyms & Abbreviations

AET	Apparent Effects Threshold
AFFF	Aqueous Film Forming Foam
ASTM	American Society of Testing Material
ANOVA	Analysis of Variance
AQUA	Aquaculture Beneficial Use
ARCO	Atlantic Richfield Company
ASTs	Aboveground Storage Tanks
AT & SF	Atchison, Topeka, and Santa Fe Railroad
AVS/SEM	Acid Volatile Sulfide / Simultaneously Extracted Metals
BAF	Biota Accumulation Factor
BAP	Benzo[a]pyrene
Bight 98	Southern California Bight 1998 Regional Marine Monitoring Survey
BIOL	Preservation of Biological Habitats of Special Significance
BMPs	Best Management Practices
BPJ	Best Professional Judgment
BRI-E	Benthic Response Index for Embayments
BSAFs	Biota-to-Sediment Accumulation Factors
BTAG	U.S. Navy/U.S. EPA Region 9 Biological Technical Assistance Group
CAD	Confined Aquatic Disposal
CCC	Criterion Continuous Concentration
CCR	California Code of Regulation
CDFs	Confined Disposal Facilities
CEQA	California Environmental Quality Act
CMC	Criterion Maximum Concentration
CNRSW	Commander Navy Region Southwest
COCs	Contaminants of Concern
COMM	Commercial and Sport Fishing Beneficial Use
CoPC	Chemicals of Potential Concern
CSF	Cancer Slope Factor
CTR	California Toxics Rule
CWA	Clean Water Act
CWC	California Water Code
DFG	California Department of Fish and Game
DRO	Diesel Range Organics
DTSC	California Department of Toxic Substances Control
DWQ	Division of Water Quality
EC50	Median Effective Concentration
EMC	Event Mean Concentration
EqP	Equilibrium Partitioning Approach
ERL	Effects Range Low
ERM	Effects Range Medium
EST	Estuarine Habitat Beneficial Use
FACs	Fluorescent Aromatic Compounds
FSP	Field Sampling Plan
GRO	Gasoline Range Organics
HPAH	High Molecular Weight Polynuclear Aromatic Hydrocarbons
HQ	Hazard Quotient
IND	Industrial Service Supply Beneficial Use
IR	Ingestion Rate
IRIS	Integrated Risk Information System
Kp	Partition Coefficients
LAET	Lowest Apparent Effects Threshold
LC50	Median Lethal Concentration
LOAELs	Low-Adverse-Effects-Levels
LOE	Lines of Evidence
LPAH	Low Molecular Weight Polynuclear Aromatic Hydrocarbons
LPL	Lower Prediction Limit
MAR	Marine Habitat Beneficial Use
MARCO	Marine Construction and Design Company
MEK	Methyl Ethyl Ketone
MIGR	Migration of Aquatic Organisms Beneficial Use
MS4	Municipal Separate Storm Sewer System
MTDB	Metropolitan Transit Development Board

NASSCO	National Steel and Shipbuilding Company
NAV	Navigation Beneficial Use
NAVSTA	Naval Station
NOAA	National Oceanic and Atmospheric Administration
NOAELs	No-Adverse-Effects-Levels
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRTAs	Natural Resource Trustees Agencies
NTR	National Toxics Rule
OHHEA	Office of Environmental Health and Hazard Assessment
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCTs	Polychlorinated Terphenyls
PL	Prediction Limit
PPPAH	Priority Pollutant Polynuclear Aromatic Hydrocarbon
PRGs	Preliminary Remediation Goals
PW	Pore Water
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/ Quality Control
RAP	Remedial Action Plan
RARE	Rare, Threatened or Endangered Species Beneficial Use
REC1	Contact Water Recreation Beneficial Use
REC2	Non Contact Water Recreation Beneficial Use
RfD	Reference Dose
RLs	Response Levels
RME	Reasonable Maximum Exposure
RRO	Residual Range Organics
SCCWRP	Southern California Coastal Water Research Project
SDG&E	San Diego Gas and Electric
SDMC	San Diego Marine Construction Company
SDUPD	San Diego Unified Port District
SHELL	Shellfish Harvesting Beneficial Use
SQGs	Sediment Quality Guidelines
SQGQ	Sediment Quality Guideline Quotient
SS-MEQ	Site-Specific Median Effects Quotient
SVOCs	Semi Volatile Organic Compounds
S-W Diversity	Shannon-Weiner Diversity Index
SWAC	Surface-Area Weighted Average Concentration
SWI	Sediment Water Interface
SWM	Southwest Marine, Inc.
SWCS	Storm Water Conveyance System
SWPPP	Storm Water Pollution Prevention Plan
SWPMP	Storm Water Pollution Monitoring Plan
TBT	Tributyltin
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TR	Tissue Residue (biota-water-sediment equilibrium partitioning approach)
TRGs	Tissue Residue Guidelines
TRI	Toxic Release Inventory
Triad	Sediment Quality Triad
TRV	Toxicity Reference Value
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
TUc	Toxic Unit Chronic
UPL	Upper Prediction Limit
U.S. EPA	U. S. Environmental Protection Agency
U.S. FWS	U. S. Fish and Wildlife Service
VOCs	Volatile Organic Compounds
WDRs	Waste Discharge Requirements
WILD	Wildlife Habitat Beneficial Use
WOE	Weight of Evidence

Preface

The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) is considering development and issuance of a cleanup and abatement order for discharges of metals and other pollutant wastes to San Diego Bay marine sediment and waters at the Shipyard Sediment Site. On April 29, 2005, the San Diego Water Board circulated for public review and comment a tentative version of the cleanup and abatement order (titled tentative Cleanup and Abatement (CAO) Order No. R9-2005-0126). A copy of this document is posted on the San Diego Water Board website at http://www.waterboards.ca.gov/sandiego.

Based on the San Diego Water Board's consideration of public comments submitted on the April 29, 2005, draft CAO and other information, a revised tentative CAO No. R9-2005-0126 and a supporting draft Technical Report (DTR), dated April 4, 2008, were prepared and released for public review. A copy of the revised CAO and DTR is posted on the San Diego Water Board website at http://www.waterboards.ca.gov/sandiego.

On June 9, 2008, Mr. David King, San Diego Water Board Member and Presiding Officer of the prehearing proceedings for this tentative CAO, referred the proceedings to confidential mediation. The Mediation Parties, which included the San Diego Water Board Cleanup Team (Cleanup Team) and other Parties to whom the tentative CAO is directed, through the course of mediation, reached agreement on appropriate cleanup levels, the remedial design, remediation and post-remediation monitoring requirements, and a remedial action implementation schedule. Those agreements are contained in tentative CAO No. R9-2010-0002 and the supporting DTR, which were released for public review on December 22, 2009.

On September 15, 2010 the San Diego Water Board released a revised version of the tentative CAO (see tentative CAO No. R9-2011-0001) and supporting DTR. This version updates and clarifies the tentative CAO and DTR which was previously released on December 22, 2010.

The DTR contained herein is the September 15, 2010 version and provides the rationale and factual information supporting the findings of the tentative CAO No. R9-2011-0001. The text of each CAO finding is presented first followed by a summary of the rationale and factual evidence supporting the finding. A copy of tentative CAO No. R9-2011-0001 and this DTR is posted on the San Diego Water Board website at http://www.waterboards.ca.gov/sandiego.

This September 15, 2010 release of a tentative CAO and draft DTR is not intended to fulfill the San Diego Water Board's formal procedures for adopting a CAO in this matter under the Porter-Cologne Water Quality Control Act. A public hearing schedule and deadline for public comments on a finalized tentative CAO and draft DTR will be established in a future ruling by the San Diego Water Board's Presiding Officer in this matter.

Prior to the issuance of a final CAO and DTR in this matter, the San Diego Water Board will first release a public hearing notice and a final tentative CAO, a final DTR, and a draft Environmental Impact Report (EIR) for public review and comment. The San Diego Water Board will provide an opportunity for all Parties, to whom the CAO is directed or otherwise designated, and interested persons to comment on issues pertaining to the tentative CAO, DTR, draft EIR and other issues described in the hearing notice. The San Diego Water Board's consideration of testimony and written submittals by Parties and interested persons may result in revisions to the tentative CAO and the supporting DTR and draft EIR during the course of the hearing proceedings. Thus the finalized version of the tentative CAO that is ultimately considered for adoption by the San Diego Water Board at the conclusion of the proceedings may differ from the current September 15, 2010 version of the tentative CAO.

32. Finding 32: Alternative Cleanup Levels

Finding 32 of CAO No. R9-2011-0001 states:

Under State Water Board Resolution No. 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304*, the San Diego Water Board may prescribe alternative cleanup levels less stringent than background sediment chemistry concentrations if attainment of background concentrations is technologically or economically infeasible. Resolution No. 92-49 requires that alternative levels must be set at the lowest levels the discharger demonstrates and the San Diego Water Board finds is technologically and economically achievable. Resolution No. 92-49 further requires that any alternative cleanup level shall: (1) be consistent with maximum benefit to the people of the state; (2) not unreasonably affect present and anticipated beneficial uses of such water; and (3) not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards.

The San Diego Water Board is prescribing the alternative cleanup levels for sediment summarized in the table below to protect aquatic life, aquatic-dependent wildlife, and human health based beneficial uses consistent with the requirements of Resolution No. 92-49. Compliance with alternative cleanup levels will be determined using the monitoring protocols summarized in Finding 34 and described in detail of Section 34 of the Technical Report.

Alternative Cleanup Levels: Shipyard Sediment Site

Aquatic Life	Aquatic Dependent Wildlife and Human Health	
Remediate all areas determined to have sediment pollutant levels likely to adversely affect the health of the benthic community.	Surface Weighted Average Concentrations (site-wide)	
	Copper	159 mg/kg
	Mercury	0.68 mg/kg
	HPAHs[1]	2,451 μg/kg
	PCBs[2]	194 μg/kg
	Tributyltin	110 μg/kg

1. HPAHs = sum of 10 PAHs: Fluoranthene, Pyrene, Benzo[a]anthracene, Chrysene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo(a)pyrene, indeno[1,2,3-c,d]pyrene, Dibenz[a,h]anthracene, and Benzo[g,h,i]perylene.
2. PCBs = sum of 41 congeners: 18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, and 206.

In approving alternative cleanup levels less stringent than background the San Diego Water Board has considered the factors contained in Resolution No. 92-49 and the California Code of Regulations, Title 23, section 2550.4, subdivision (d):

Alternative Cleanup Levels are Appropriate. Cleaning up to background sediment quality levels at the Shipyard Sediment Site is economically infeasible. The alternative cleanup levels established for the Shipyard Sediment Site are the lowest levels that are technologically and economically achievable, as required under the California Code of Regulations Title 23 section 2550.4(e).

Alternative Cleanup Levels are Consistent with Water Quality Control Plans and Policies. The alternative cleanup levels provide for the reasonable protection of San Diego Bay beneficial uses and will not result in water quality less than prescribed in water quality control plans and policies adopted by the State Water Board and the San Diego Water Board. While it is impossible to determine the precise level of water quality that will be attained given the residual sediment pollutant constituents that will remain at the Site, compliance with the alternative cleanup levels will markedly improve water quality conditions at the Shipyard Sediment Site and result in attainment of water quality standards at the site.

Alternative Cleanup Levels Will Not Unreasonably Affect Present and Anticipated Beneficial Uses of the Site. The level of water quality that will be attained upon remediation of the required cleanup at the Shipyard Sediment Site will not unreasonably affect San Diego Bay beneficial uses assigned to the Shipyard Sediment Site represented by aquatic life, aquatic-dependent wildlife, and human health. Cleanup of the remedial footprint will restore any injury, destruction, or loss of natural resources.

Alternative Cleanup Levels are Consistent with the Maximum Benefit to the People of the State. The proposed alternative cleanup levels are consistent with maximum benefit to the people of the State based on the San Diego Bay resource protection, mass removal and source control, and economic considerations. The Shipyard Sediment Site pollution is located in San Diego Bay, one of the finest natural harbors in the world. San Diego Bay is an important and valuable resource to San Diego and the Southern California Region. The alternative cleanup levels will result in significant contaminant mass removal and therefore risk reduction from San Diego Bay. Remediated areas will approach reference area sediment concentrations for most contaminants. Compared to cleaning up to background cleanup levels, cleaning up to the alternative cleanup levels will cause less diesel emission, less greenhouse gas emission, less noise, less truck traffic, have a lower potential for accidents, and less disruption to the local community. Achieving the alternative cleanup levels also requires less barge and crane movement on San Diego Bay, has a lower risk of re-suspension of contaminated sediments, and reduces the amount of landfill capacity required to dispose of the sediment wastes. The alternative cleanup levels properly balance reasonable protection of San Diego Bay beneficial uses with the significant economic and service activities provided by the City of San Diego, the NASSCO and BAE Systems Shipyards and the U.S. Navy.

32.1. Regulatory Principles for Setting Alternative Cleanup Levels

Cleaning up to background sediment chemistry levels is not economically feasible at the Shipyard Sediment Site as described in Section 31. Under State Water Board Resolution No. 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304*, the San Diego Water Board may prescribe an alternative cleanup level[1] less stringent than background sediment chemistry concentrations if attainment of background concentrations is technologically or economically infeasible – as long as the less stringent cleanup level is protective of beneficial uses.

In prescribing any alternative cleanup levels less stringent than background the San Diego Water Board must apply section 2550.4 of Title 23 of the California Code of Regulations.[2] The San Diego Water Board can only approve cleanup levels less stringent than background if the Board finds that it is technologically or economically infeasible to achieve background.[3] The alternative levels must also not pose a substantial present or potential hazard to human health or the environment as long as the concentration limit above-background is not exceeded. The San Diego Water Board must consider specific factors pertaining to potential adverse effects on surface water quality and beneficial uses including 1) the potential for health risks caused by human exposure to waste constituents; 2) the potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and 3) the persistence and permanence of the potential adverse effects.[4] The ceiling for alternative cleanup levels is set at the lowest levels the discharger demonstrates and the San Diego Water Board finds is technologically and economically achievable.[5] Alternative cleanup levels that exceed the maximum concentrations that would be allowed under other applicable statutes or regulations are not permissible.

Resolution No. 92-49 further requires that any alternative cleanup level shall: (1) be consistent with maximum benefit to the people of the state; (2) not unreasonably affect present and anticipated beneficial uses of such water; and (3) not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards.[6]

---

[1] An “alternative” cleanup level is one that allows wastes to remain in waters of the State at levels above “background.”

[2] Resolution No. 92-49, Section III.G.

[3] CCR 27, section 2550.4(c).

[4] CCR 27, section 2550.4(d)(2).

[5] CCR 27, section 2550.4(e).

[6] *Id.*

32.1.1. Compliance with Water Quality Standards Related to Sediment Quality

Resolution No. 92-49 requires that alternative cleanup levels should be developed in conformance with Water Quality Control Plans and Policies adopted by the State and Regional Water Boards. The water quality standards and policies contained in these documents provide the basis for sediment cleanup activities, including alternative cleanup levels, under federal and state law.

The State Water Board adopts state policy for water quality control, which is binding on the Regional Water Boards.[7] The State Water Board is also authorized to adopt water quality control plans for waters that require water quality standards under the Clean Water Act and must adopt plans for ocean waters and for enclosed bays and estuaries.[8] The Regional Water Boards are required to adopt water quality control plans, or basin plans, for waters within their respective regions. Water quality control plans designate beneficial uses of water, establish water quality objectives[9] to protect those uses, and contain a program to implement the objectives.[10] The beneficial use designations and water quality objectives (together with an antidegradation policy) constitute water quality standards for purposes of the Clean Water Act.[11]

The San Diego Water Board's Water Quality Control Plan for the San Diego Basin (Basin Plan) designates beneficial uses for San Diego Bay that must be protected against water quality degradation.[12] The beneficial uses and corresponding target receptors are described in Table 32-1 below. Resolution No. 92-49 requires that alternative cleanup levels provide for the reasonable protection of these beneficial uses.

---

7 Water Code section 13140 et seq.

8 Water Code sections 13170, 131702, and 13391.

9 "Water quality objectives" are defined in Water Code section 13050(h) as "the limits or levels water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area."

10 Water Code section 13050(j).

11 Clean Water Act section 303(c)(2)(A); 40 C.F.R. sections 131.3(i), 131.6.

12 Basin Plan (RWQCB, 1994), Table 2-3, Beneficial Uses of Coastal Waters at page 2-47.

Table 32-1 Target Receptors Associated with San Diego Bay Beneficial Uses

TARGET RECEPTORS	AQUATIC LIFE	AQUATIC-DEPENDENT WILDLIFE	HUMAN HEALTH
BENEFICIAL USES	Estuarine Habitat (EST)	Wildlife Habitat (WILD)	Contact Water Recreation (REC-1)
	Marine Habitat (MAR)	Preservation of Biological Habitats of Special Significance (BIOL)	Non-Contact Water Recreation (REC-2)
	Migration of Aquatic Organisms (MIGR)	Rare, Threatened or Endangered Species (RARE)	Shellfish Harvesting (SHELL)
			Commercial and Sport Fishing (COMM)

The San Diego Water Board's Water Quality Control Plan for the San Diego Basin (Basin Plan) contains a narrative water quality objective for toxicity[13] that is applicable to San Diego Bay sediment quality. Resolution No. 92-49 requires that alternative cleanup levels be consistent with this toxicity water quality objective. The narrative toxicity objective provides that:

> *"All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Board.*
>
> *'The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with requirements specified in US EPA, State Water Resources Control Board or other protocol authorized by the Regional Board. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour acute bioassay.*
>
> *'In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged."*

13 Basin Plan, Chapter 3. Water Quality Objectives, Page 3-15.

The State Water Board *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (State Implementation Policy, or "SIP") does not address sediment quality specifically. However Section 1.4.2.2 of the SIP provides that mixing zones shall not result in "objectionable bottom deposits."[14] This term is further defined as "an accumulation of materials or substances on or near the bottom of a water body, which creates conditions that adversely impact aquatic life, human health, beneficial uses, or aesthetics. These conditions include, but are not limited to, the accumulation of pollutants in the sediments and other conditions that result in harm to benthic organisms, production of food chain organisms, or fish egg development."[15]

32.1.2. Risks to Human Health and the Environment

Resolution No. 92-49 also requires that alternative cleanup levels not pose a substantial present or potential hazard to human health or the environment.[16] Alternative cleanup levels should be based upon an evaluation of risks to human health and the environment at the site, and set to reduce the risks to acceptable levels. In order to evaluate existing risks and potential future risks, conceptual models are prepared that identify receptors potentially at risk and the probable exposure pathways. This conceptual model serves as the basis for formulating the human health and ecological risk assessment. At sites where polluted sediments are the primary concern, receptors commonly evaluated include:

- Benthic communities exposed directly to pollutants in sediment,
- Fish exposed directly to pollutants in sediment or indirectly through consumption of pollutants in prey tissue, or
- Birds, marine mammals, and humans also exposed indirectly through consumption of pollutants in prey tissue.

For many receptors, risk is estimated by comparing pollutant concentrations in sediments and prey tissues to calculated risk thresholds developed specifically for those receptors. For other receptors, such as benthic invertebrates, direct measurements such as benthic community metrics, sediment toxicity and chemistry may be applied instead. Typically, those most sensitive receptors identified will become the focus of the remedial effort. Although risk assessments may guide the development of appropriate alternative cleanup levels, the levels must comply with all of the requirements of Resolution No. 92-49.

---

[14] SIP at Page 17.

[15] *Id.* at Appendix 1, Page Appendix 1-4.

[16] Resolution No. 92-49, Section III.G, CCR 23, section 2550.4.

32.2. Approach for Establishing Alternative Cleanup Levels for Protection of Human Health and Wildlife Beneficial Uses

Due to the spatial heterogeneity associated with concentrations in Shipyard Sediment Site sediment and mobility of aquatic-dependent wildlife and angler-targeted game species such as fish and lobster, an approach using surface area-weighted average concentrations (SWACs) was used to assess potential impacts to human health and aquatic-dependent wildlife, as detailed below. The selected alternative cleanup levels for addressing human health and wildlife beneficial use impairments were those SWACs for the primary COCs determined not to pose an unreasonable health risk to humans or aquatic dependent wildlife, and that were the lowest concentrations that were technologically and economically feasible to achieve. As part of the alternative cleanup level approach, an independent evaluation for protection of aquatic life beneficial uses (that did not consider SWACs) was also conducted, and is presented in Section 32.6.

32.2.1. Basis for the Surface-Area Weighted Average Concentration

The evaluation of risks to aquatic dependent wildlife is based on 6 species known to frequent San Diego Bay. The California Wildlife Biology, Exposure Factor, and Toxicity Database (Cal/Ecotox) is a compilation of physiological and ecological parameters and toxicity data for a number of California fish and wildlife.[17] Table 32-2 shows foraging areas that have been used by Cal/Ecotox for estimating chemical exposure via ecological risk assessment. Where Cal/Ecotox information was not available, notes have been made regarding typical migration or ranging habits.

[17] The database has been created by the Office of Environmental Health Hazard Assessment, in collaboration with the University of California at Davis, to provide an information resource for risk assessors conducting ecological risk assessments in California.

Table 32-2 Foraging Ranges for Aquatic Dependent Wildlife Receptors

Species	Published Foraging Area (Acres)	Site Area (Acres)	Ratio of Foraging Area to Site Area	Notes
Surf Scoter	NA	143	NA	Migratory waterfowl - foraging range during feeding dependent on food abundance
Western Grebe	NA	143	NA	Migratory waterfowl - foraging range during feeding dependent on food abundance
Least Tern	8,053	143	56	Cal/Ecotox foraging area
Brown Pelican	685,709	143	4,798	Cal/Ecotox foraging area
California Sea Lion	725,906	143	5,080	Cal/Ecotox foraging area
Pacific Green Sea Turtle	NA	143	NA	Migratory species

Notes: N/A = not applicable

Since these species have foraging ranges many times larger than the Shipyard Sediment Site, it is unlikely that they would be exposed to concentrations found at the Shipyard Sediment Site for an extended period of time. Exposure to sediment chemicals at the Site is best estimated as an average across the entire Site. Thus, evaluating risks to aquatic-dependent wildlife based on a SWAC and 100 percent site usage, as described in Section 32.3 is conservative and protective of beneficial uses represented by aquatic dependent wildlife. In fact, based on the foraging ranges in Table 32-2, using SWACs retains conservatism since the amount of time most species are likely to spend foraging at the site is expected to be low.

The same is true of fish and lobster harvested by anglers. Target species consumed by recreational or subsistence anglers are known to forage over areas near or greater than the size of the Site, depending on the species. Fish and lobster do not limit their movement to the small area represented by a single sediment sample, but range among a much larger area and would be exposed to sediments of varying chemical concentrations throughout the Site and greater San Diego Bay. Based on this, a SWAC for sediment is a more appropriate method for evaluating the exposure to chemicals that fish and lobsters incur during foraging. In turn, this approach allows a much more accurate and realistic estimation of the bioaccumulation of chemicals from Site sediments and prey items. Improvements in the ability to quantify bioaccumulation in fish and lobster facilitate an accurate and realistic estimation of chemical exposure for hypothetical anglers consuming species harvested from the Site, and allow the prediction of potential human health risks associated with chemical concentrations in sediment.

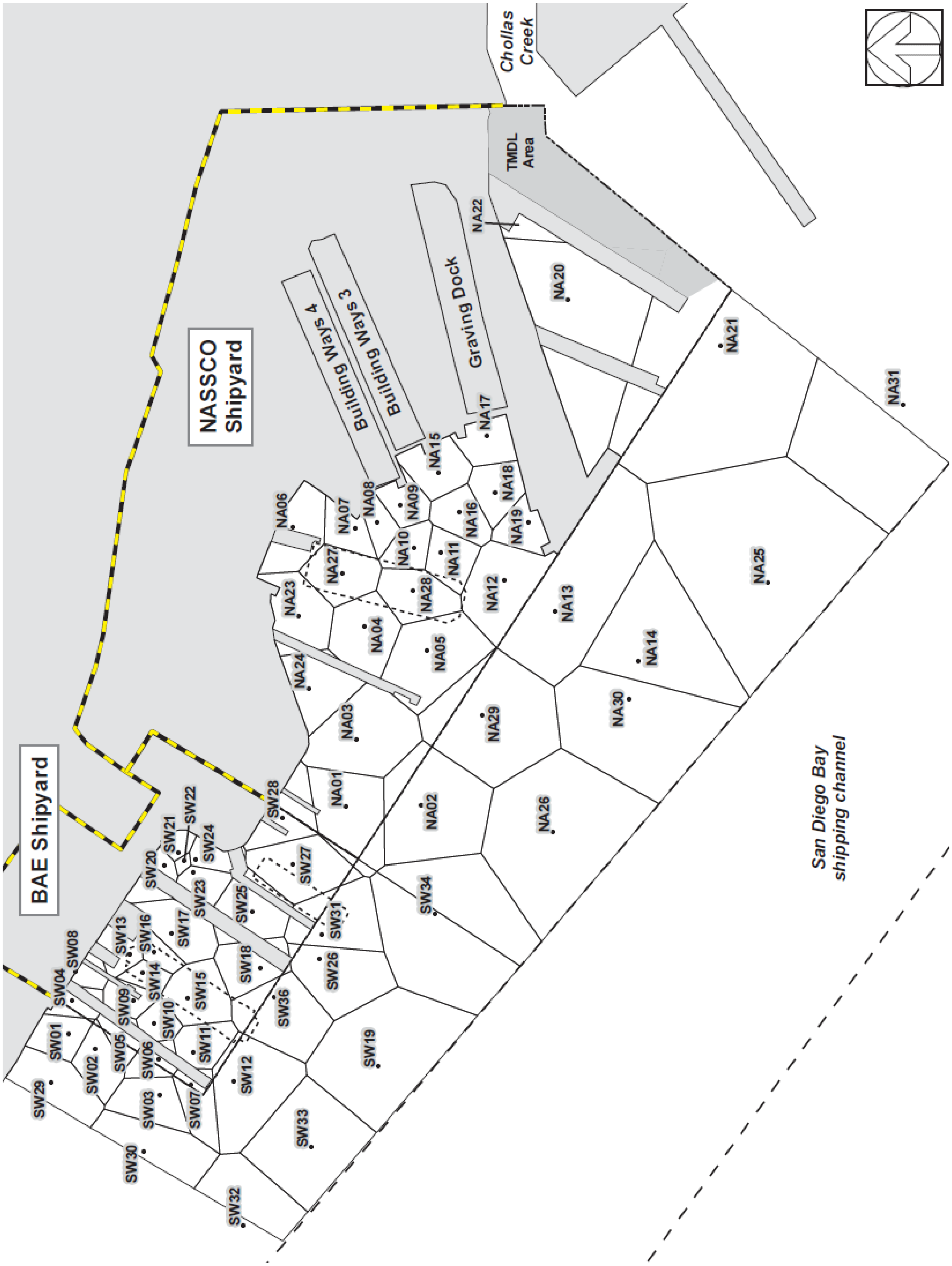
With respect to fish and lobster consumption, the likelihood that anglers will consume fish caught from the same location every day for 30 or more years is low since anglers are likely to utilize different fishing locations from time to time based on fish abundance, which can be seasonal or vary year to year. Therefore, using a SWAC is expected to be conservative with respect to human consumption patterns that would be anticipated.

In conclusion, site-specific SWACs are used to evaluate the remedy protectiveness of beneficial uses represented by aquatic dependent wildlife and human seafood consumption.

32.2.2. Calculation of the Surface-Area Weighted Average Concentration

There are 65 sediment sample stations at the Shipyard Sediment Site. These stations are not equidistant from each other, but were established based on historical activities and the presence of elevated contaminant concentrations detected in earlier phases of investigations. Therefore, some areas of the Site, primarily near the shoreline and toward the north, have a higher density of sampling stations. To calculate the SWAC, a geospatial technique (Thiessen polygons) was used to represent the area represented by each sediment sample. Thiessen polygons are polygons whose boundaries define the area that is closest to each point relative to all other points and are mathematically defined by the perpendicular bisectors of the lines between all points. By defining the area most closely associated with each sampling point, a value for that point (e.g., chemical concentration) can be spatially weighted based on the area it represents. This technique is well established and in use throughout a broad range of sciences, and is being used at many nationally known sediment remedial investigation sites including the Hudson River, Portland Harbor Cleanup, the Duwamish River Cleanup, the Lower Passaic River Cleanup, Fort Ord, and others. Application of this method resulted in 65 polygons of differing sizes as shown in Figure 32-1.

Figure 32-1 Map of Thiessen Polygons at Shipyard Sediment Site Study Area



The concentration of a COC in each polygon was assumed to be the same as the concentration of a COC in the sampling station inside that polygon. This approach allowed for calculating a SWAC for the site. Polygon areas and concentrations were used to calculate the SWAC for the Site, as shown in following equation:

$$\textbf{SWAC} = \frac{\sum_{i=1}^{i=65} A_i C_i}{\sum_{i=1}^{i=65} A_i}$$

Where:

SWAC	=	surface-area weighted area concentration
Ai	=	area of polygon *i*
Ci	=	concentration of chemical in polygon *i*

Each polygon area is multiplied by the concentration of COC in the sampling station in that polygon. The area concentration products are then summed. This sum is divided by the total Site area (sum of the site's 65 polygons).

32.2.3. Surface-Area Weighted Average Concentration Approach

Once the pre-remedial SWAC was calculated as noted in Section 32.2.2, the development of a remedial footprint protective of human health and aquatic dependent wildlife beneficial uses could be completed. Polygons were identified for inclusion into the remedial footprint sequentially based on the degree of contamination they represented. The degree of contamination was determined by ranking each polygon according to the polygon's concentration of primary COCs (PCBs, HPAHs, TBT, Hg, and Cu), weighted evenly by relative COC concentration. This was accomplished by the following procedure: 1) the relative concentration of each primary COC as compared to the SWAC for that COC was calculated; 2) the five primary pollutants of concern relative concentrations to SWAC ratios were summed for each polygon; and 3) the polygons where ranked from high to low. The calculation is shown in the following equation:

$$\textbf{Rank} = \sum_{\textbf{COCs}} \frac{C_{polygon}}{\textbf{SWAC}}$$

The rank equation is used below to show sample calculations for polygons SW04 and NA17.

$$\begin{array}{lccccc} & \textbf{Cu} & \textbf{Hg} & \textbf{HPAH} & \textbf{PCB} & \textbf{TBT} \end{array}$$

$$\textbf{Rank}_{SW04} = \frac{\textbf{1500}}{187} + \frac{\textbf{1.75}}{0.75} + \frac{\textbf{14000}}{3300} + \frac{\textbf{4000}}{308} + \frac{\textbf{3250}}{163} = 47.5$$

$$\textbf{Rank}_{NA17} = \frac{\textbf{510}}{187} + \frac{\textbf{0.85}}{0.75} + \frac{\textbf{2950}}{3300} + \frac{\textbf{550}}{308} + \frac{\textbf{1350}}{163} = 14.8$$

Using this ranking approach, the highest ranked polygons were sequentially considered for inclusion into the remedial footprint.

Protectiveness of the beneficial uses represented by aquatic-dependent wildlife and human health was assessed via estimation of post-remedial SWAC values of the remedial footprint. Post-remedial SWAC calculations were completed with the assumption that the SWAC inside the footprint would be remediated to background concentrations derived in Section 29 of this Technical Report. In reality, the SWAC within the footprint may be less than background levels; however, background concentrations were assumed to incorporate conservatism in the analysis. Protectiveness was evaluated in terms of degree of exposure reduction and comparison to aquatic –dependent wildlife and human health risk assessments (Sections 32.3 and 32.4, respectively). The predicted post-remedial SWACs are shown in Table 32-3.

Table 32-3 Post-Remedial SWACs for the Shipyard Sediment Site

Primary Contaminant of Concern	Post-Remedial SWACs (site-wide)
Copper	159 mg/kg
Mercury	0.68 mg/kg
HPAHs	2,451 μg/kg
PCBs	194 μg/kg
TBT	110 μg/kg

Note: See Appendix for Section 32 for supporting calculations.

32.3. Alternative Cleanup Levels Protect Aquatic-Dependent Wildlife Beneficial Uses

An assessment of risk to wildlife receptors under projected post-remedial conditions was conducted to confirm that the alternative cleanup levels established by economic analysis (Section 31) are adequately protective of aquatic-dependent wildlife beneficial uses. Six aquatic-dependent wildlife receptors were originally selected in the aquatic-dependent wildlife risk assessment (Sections 22 through 24) to evaluate the protection of beneficial uses. The species include: California least tern (*Sterna antillarum brownie*), California brown pelican (*Pelecanus occidentalis californicus*), Western grebe (*Aechmophorus occidentalis*), Surf scoter (*Melanitta perspicillata*), California sea lion (*Zalophus californianus*), and East Pacific green turtle (*Cheloniamydas agassizii*). No unacceptable risks to sea lion were found for any COPC under pre-remedial conditions, therefore this receptor was excluded from the post-remedial risk evaluation. Potential risk to green turtle was only identified for lead. Lead was not selected as a primary COC, and no alternative cleanup level for lead is proposed. However, the proposed remedy will reduce lead levels in surface sediments due to co-occurrence with primary COCs (see Section 29), resulting in mitigation of exposure and risk to wildlife receptors. The proposed remedy is assumed to be protective for lead, as well as the primary COCs, therefore evaluation of post-remedial risk from lead is included here along with the primary COCs.

Expected improvements in the protection of beneficial uses following remediation were estimated by modeling future exposure conditions (principally ingestion of prey) using the series of equations described below.

Future prey tissue concentrations (Ct) were calculated using the following equation:

$$\mathbf{Ct = BAF \times SWAC}$$

Where:

BAF	=	site-specific bioaccumulation factor
SWAC	=	post remedial surface-area weighted average sediment concentration

Site-specific bioaccumulation factors (BAFs) were estimated using current surface-area weighted average concentrations (SWACs) for sediment and the average COC concentrations in prey species tissue (see Table 32-4 for prey items):

$$\mathrm{BAF} = \frac{\mathrm{C}}{\mathrm{SWAC}}$$

Where:

SWAC	=	current spatially weighted average sediment concentration
C	=	average chemical concentration in a receptors prey tissue based on data reported in Exponent (2003).

Table 32-4 Prey Items Used in Risk Estimates

Receptor of concern	Prey Item(s)
CA Brown Pelican	Spotted sand bass
CA Least Tern	Topsmelt and Anchovies
Western Grebe	Topsmelt and Anchovies
Surf Scoter	Benthic mussels
Green Turtle	Eelgrass

Note: Source of information is Table 24-4.

Predicted post-remedial SWACs used in this analysis have been presented elsewhere in this document and are repeated in Table 32-5 for convenience.

Table 32-5 Current and Post-Remedial SWACs

Primary COC	Units	Pre-remedy SWAC	Post-remedy SWAC
Copper	mg/kg	187	159
Mercury	mg/kg	0.75	0.68
HPAHs	µg/kg	3,509	2,451
PCBs	µg/kg	308	194
TBT	µg/kg	162	110
Secondary COC	Units	Pre-remedy SWAC	Post-remedy SWAC
Lead	mg/kg	73	66

Note: See Appendix for Section 32 for supporting calculations.

Exposure estimates for each of the receptors were developed using the daily intake equation presented in Section 24. The equation accounts for exposure to COCs that may occur through the ingestion of prey as well as through the incidental ingestion of sediment:

$$\textbf{Daily Intake}_{\textbf{chemical}} = \frac{\left[(\textbf{CM} * \textbf{IR} * \textbf{FI} * \textbf{AE})_{\textbf{prey}} + (\textbf{CM} * \textbf{IR} * \textbf{FI} * \textbf{AE})_{\textbf{sediment}}\right]}{\textbf{BW}}$$

Where:

CM = post-remedial concentration of the chemical in prey tissue or sediment (mg/kg). Prey tissue concentrations used in this equation were derived using the equation described above, while the sediment concentration was based on the predicted post-remediation SWAC for the COC

IR = ingestion rate of prey or sediment (kg/day)

FI = fraction of the daily intake of prey or sediment derived from the site (unitless area-use factor)

AE = relative gastrointestinal absorption efficiency for the chemical in a given prey or sediment (fraction)

BW = body weight of receptor species (kg)

Table 32-6 presents the exposure parameters used for this analysis. The parameters are the same ones used to evaluate current conditions, and are more fully discussed in Section 24.

Table 32-6 Exposure Parameters for Aquatic-Dependent Wildlife

Receptor of Concern	Estimated Post Remedial Prey Tissue Concentration (CM) (mg/kg dw)	Estimated Post-Remedial Sediment Chemical Concentration (mg/kg dw)	Body Weight (BW) (kg)[1]	Food Ingestion Rate (IR) (kg/day dw)[1]	Sediment Ingestion Rate (IR) (kg/day dw)[1]	Area Use Factor[1] (FI)	Absorption Efficiency[1] (AE)
CA Brown Pelican	chemical specific	chemical specific SWAC	3.174	0.25	0.005	1	1
CA Least Tern	chemical specific	chemical specific SWAC	0.045	0.0053	0.00011	1	1
Western Grebe	chemical specific	chemical specific SWAC	1.2	0.062	0.0031	1	1
Surf Scoter	chemical specific	chemical specific SWAC	1.05	0.056	0.0028	1	1
Green Turtle	chemical specific	chemical specific SWAC	95	0.35	0.0186	1	1

1. Source of information is Table 24-6.

Finally, post remedial protection of beneficial uses for aquatic-dependant wildlife was evaluated by calculating hazard quotients (HQs):

$$\mathbf{HQ} = \frac{\mathbf{DI}_{\mathbf{chemical}}}{\mathbf{TRV}}$$

Where:

DI = total daily intake rate of the chemical (mg/kg body weight-day)
TRV = geometric mean toxicity reference value (mg/kg body weight-day)

The toxicity reference values (TRVs) presented in Table 32-7 are based on the geometric mean of the TRVs (BTAG, NOAELs, and LOAELs) presented in Tables 24-7 and 24-8 of Section 24. The geometric mean addresses the region of uncertainty between the NOAEL and LOAEL. At the NOAEL, no effects are observed. At the LOAEL, effects are observed. Between these two values there is often a significant range over which the effects are uncertain because the data do not exist. The uncertainty is handled by taking an intermediate value that is biased toward the NOAEL by using the geometric mean.

An HQ value less than 1.0 indicates that the chemical is unlikely to cause adverse ecological effects to the receptor of concern. An HQ value greater than 1.0 indicates that the receptor's exposure to the chemical pollutant has exceeded the TRV, which could indicate that there is a potential that some fraction of the population may experience an adverse effect. HQs for all receptors evaluated at the shipyard site had a value less than 1.0 (Table 32-8), indicating that the COCs are unlikely to cause adverse ecological effects and that the post-remedial sediment chemistry conditions are protective of aquatic dependent wildlife and their associated beneficial uses.

Table 32-7 Geometric Mean TRVs for Tier II Risk Drivers

Primary COC	Avian Geometric Mean TRV (mg/kg-day)[1]
Copper	11.0
Mercury	0.084
HPAHs	0.44
PCBs	0.34
TBT[2]	NA
Secondary COC	Avian Geometric Mean TRV (mg/kg-day)[1]
Lead[3]	0.35

Note: See Appendix for Section 32 for supporting calculations.

1. Source of TRVs is from Tables 24-7 and 24-8 of Section 24. The benzo[a]pyrene TRV was used as a surrogate for HPAHs.
2. TBT is not a wildlife risk driver and therefore the geometric mean TRV was not calculated.
3. Suitable reptilian TRVs were not found in the literature (Exponent, 2003). Therefore, avian TRVs were used to estimate potential adverse effects to the East Pacific green turtle.

Table 32-8 Post-Remedy Hazard Quotient (HQ) Results

Receptor of Concern[1]	Copper	Mercury	HPAHs[2]	PCBs	TBT[2]	Lead
Brown Pelican	0.059	0.496	NA	0.327	NA	NA
Least Tern	0.100	0.138	NA	0.415	NA	NA
Western Grebe	0.066	0.073	NA	0.183	NA	NA
Surf Scoter	0.272	0.084	0.265	0.059	NA	NA
Green Turtle	NA	NA	NA	NA	NA	0.245

Note: See Appendix for Section 32 for supporting calculations.

1. TBT is not a wildlife Tier II risk driver and therefore HQs were not calculated. Only surf scoter was identified as a wildlife risk driver in the Tier II ecological risk assessment for HPAH, identified as Benzo[a]pyrene (BAP).

32.4. Alternative Cleanup Levels Protect Human Health Beneficial Uses

Recreational and subsistence fish and lobster consumption scenarios were used to evaluate the post-remedy protectiveness of the alternative cleanup levels with respect to theoretical human health beneficial uses. Measured relationships between sediment concentrations, fish and lobster tissue concentrations, and human health risk were used to estimate post-remedial tissue concentrations from the projected post-remedial SWAC. Both tissue and sediment concentrations associated with human health threshold exposure levels were also calculated for comparison. The details of these calculations are described below.

- BAFs in fish and/or lobster tissue were calculated for all scenarios identified as potential risk drivers in the Tier II human health risk assessment (see Section 28). These include:

  Copper – Subsistence angler exposure to whole lobster (non-cancer risk)

  Mercury – Recreational angler exposure to lobster tail (non-cancer risk), and subsistence angler exposure to whole fish (non-cancer risk)

  PCBs – Recreational angler exposure to fish fillet (cancer and non-cancer risks) and lobster tail (cancer risk), and subsistence angler exposure to whole fish (cancer and non-cancer risks) and lobster (cancer and non-cancer risks)

- BAFs were calculated from pre-remedial data as the ratio of average site-wide tissue concentration (C) to SWAC for a given COC and tissue type:

$$\mathrm{BAF} = \frac{\mathrm{C}}{\mathrm{SWAC}}$$

  These BAFs are assumed to be constant over the concentration range between pre-remedial and post-remedial conditions.

- These BAFs were then used to estimate the post-remedial concentration of COCs in the relevant tissue types (C_{PR}) by multiplying the predicted post-remedial SWAC ($SWAC_{PR}$) and the BAF:

$$\mathrm{C}_{\mathrm{PR}} = SWAC_{PR} \times BAF$$

- Once the predicted post-remedial tissue concentration was calculated, the exposure models developed for the Tier II human health risk assessment were used to calculate residual post-remedial exposure, using the estimated C_{PR} values:

$$\text{Exposure (in mg/kg-day)} = \frac{(\mathrm{C}_{\mathrm{PR}} * \mathrm{CR} * \mathrm{FI} * \mathrm{ED})}{(\mathrm{BW} * \mathrm{AT} * \mathrm{CF})}$$

  where:

C_{PR}	=	post-remedial tissue concentration in spotted sand bass or spiny lobster (µg/kg-wet weight)
CR	=	fish or lobster consumption rate (kg/day)
FI	=	fraction ingested from the site (unitless)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (years) - noncarcinogens: 30 years - carcinogens: 70 years

CF = conversion factor (1,000 µg/mg)

The resulting post-remedial exposure estimate was then evaluated for cancer risk and non-cancer risk in a manner consistent with the Tier II risk assessment.

- As a separate calculation, the edible tissue concentrations associated with a desired threshold exposure point (TEP) were calculated. The first step in this process is to calculate a TEP associated with a risk threshold of interest (i.e., 10^{-5} cancer probability or HI = 1.0)

$$\mathbf{TEP} = \frac{\mathbf{Risk}}{\mathbf{CSF}}$$

where:

TEP = threshold exposure point for carcinogenic exposure (mg/kg-day)
Risk = cancer probability (e.g., 0.0001)
CSF = oral carcinogenic slope factor (risk/(mg/kg-day))

$$\mathbf{TEP} = RfD$$

where:

TEP = threshold exposure point for non-carcinogenic exposure (mg/kg-day)
RfD = oral reference dose (mg/kg-day)

- Once TEP values are known, acceptable tissue concentrations in biota can be calculated using the equation below:

$$C_{TEP} = TEP \left(\frac{BW * AT * CF}{CR * FI * ED} \right)$$

where:

C_{TEP} = tissue concentration at TEP (µg/kg)
TEP = threshold exposure point (mg/kg-day)
BW = body weight (kg)
AT = averaging time (years)
CR = consumption rate (kg/day)
FI = fraction ingested from the site (unitless)
ED = exposure duration (years)
CF = conversion factor (1000 µg/mg)

- Using the constant BAFs described above, C_{TEP} can be used to calculate a SWAC that will result in the associated risk threshold ($SWAC_{TEP}$):

$$SWAC_{TEP} = \frac{C_{TEP}}{BAF}$$

Calculations and the results for PCBs, mercury, and copper are shown below. Calculations for all human health risk drivers are provided in the Appendix for Section 32 and are summarized in Table 32-16. For scenarios where post-remedial risk was calculated to remain above the target risk threshold at a fractional intake (FI) of 100 percent, the FI necessary to fully protect the beneficial use was calculated. Exposure and risk are reduced in a linear fashion with FI. Therefore, risk at FI = 50 percent would be exactly half the risk at 100 percent.

The cleanup remedy is expected to result in a post-remedial sediment SWAC of approximately 194 µg/kg for PCBs, 0.68 mg/kg for mercury, and 159 mg/kg for copper. Although BAFs may vary in part due to changes in sediment concentration, it is assumed that BAFs for organisms exposed to these ranges of sediment concentration (194 to 309 µg/kg, 0.75 to 0.68 mg/kg, and 187 to 159 mg/kg) are constant. These BAFs were used to predict concentration in fish and lobster (C_{PR} values) by multiplying the SWAC and the BAF, as shown in Table 32-9 below.

Table 32-9 Estimated Post-Remedial PCB, Mercury, and Copper Tissue Concentrations

COC	Scenario	Species	Tissue	$SWAC_{PR}$ (µg/kg for PCB, mg/kg for metals)	BAF	C_{PR} (µg/kg for PCB, mg/kg for metals)
PCB	recreational	sand bass	fillet	194	0.346	67
PCB	subsistence	sand bass	whole	194	1.85	359
PCB	recreational	lobster	edible	194	0.0256	5
PCB	subsistence	lobster	whole	194	0.142	28
Mercury	recreational	lobster	edible	0.68	0.20	0.14
Mercury	subsistence	sand bass	whole	0.68	0.19	0.13
Copper	subsistence	lobster	whole	159	0.28	44

Note: See Appendix for Section 32 for supporting calculations.

The cancer and non-cancer exposure models described above can then be used to predict risk under post-remedial conditions (see Appendix for Section 32 for supporting calculations). These calculations assume the theoretical worst case scenario where fractional intake of fish from the site is 100 percent (entire fish or lobster diet is caught at the Shipyard Sediment Site).

Post-remedial SWACs should not pose an unreasonable risk to human health if the cancer risks posed by the SWACs should fall within the range of 1×10^{-6} to 1×10^{-4} and non-cancer risks do not exceed 1.0. For remedial decision making, cancer risks that fall within this range are acceptable pursuant to applicable state and federal regulatory requirements under Title 40 Code of Federal Regulations, Part 300 and OEHHA (2008).

The equations for calculating cancer and non-cancer risk are the same with the exception of the calculation of the exposure. Differences in these exposure calculations (Threshold Exposure Point variable) are described in the Carcinogenic Exposure Equation and the Non-carcinogenic Exposure Equation, below.

Equation for Threshold Exposure Point for Carcinogenic Exposure

$$\mathbf{TEP} = \frac{\mathbf{Risk}}{\mathbf{CSF}}$$

Where:

TEP	=	threshold exposure point (mg/kg-day)
Risk	=	0.00001
CSF	=	oral carcinogenic slope factor (risk/(mg/kg-day))

Equation for Threshold Exposure Point for Non-Carcinogenic Exposure

$$\mathbf{TEP} = RfD$$

Where:

TEP	=	threshold exposure point (mg/kg-day)
RfD	=	oral reference dose (mg/kg-day)

The CSF for PCBs is 2 mg/kg-day resulting in a cancer TEP of 0.000005 mg/kg-day and the RfD and, therefore, non-cancer TEP is 0.00002 mg/kg-day. The mercury and copper RfD (TEP) values used in the assessment are 0.0001 and 0.037 mg/kg-day, respectively.

Equation for Acceptable Tissue Concentrations in Biota

$$C_{TEP} = TEP\left(\frac{BW * AT * CF}{CR * FI * ED}\right)$$

Where:

C_{TEP}	=	tissue concentration at TEP (µg/kg)
TEP	=	threshold exposure point (mg/kg-day)
BW	=	body weight (kg)
AT	=	averaging time (years)
CR	=	consumption rate (kg/day)
FI	=	fraction ingested from the site (unitless)

ED = exposure duration (years)
CF = conversion factor (1000 µg/mg)

The variable values are specified in Table 32-10 and the tissue concentrations protective of recreational and subsistence exposure scenarios evaluated are presented in Table 32-11.

Table 32-10 Variable Values for Risk Scenarios

Variable	Scenario	Value
BW	All	70 kg
AT	Cancer	70 years
	Non-cancer	30 years
CR	Recreational	0.02104 kg/day
	Subsistence	0.161kg/day
FI	All	1.0
ED	All	30 years

Table 32-11 Tissue Concentrations (Threshold Exposure Point)

COC	Scenario	C_{TEP} (mg/kg)[1]
PCB	Recreational fish or lobster consumption cancer risk	0.0388
PCB	Recreational fish or lobster consumption non-cancer risk	0.0665
PCB	Subsistence fish or lobster consumption cancer risk	0.0051
PCB	Subsistence fish or lobster consumption non-cancer risk	0.0087
Mercury	Recreational lobster consumption non-cancer risk	0.3
Mercury	Subsistence fish consumption non-cancer risk	0.04
Copper	Subsistence lobster consumption non-cancer risk	16.1

Note: See Appendix for Section 32 for supporting calculations.

1. Wet weight

Once tissue concentrations have been calculated, acceptable SWAC concentrations can be determined using the BAFs presented in Table 32-12 and by rearranging the BAF equation to solve for SWAC.

$$SWAC_{TEP} = \frac{C_{TEP}}{BAF}$$

Where:

C_{TEP}	=	tissue concentration at TEP (µg/kg)
BAF	=	bioaccumulation factor calculated from pre-remedial data as the ratio of average site-wide tissue concentration (C) to SWAC for a given COC and tissue type

Acceptable SWACs for specific TEP values and exposure scenarios are presented in Table 32-13.

Table 32-12 Biota Accumulation Factors

COC	Scenario	Species	Tissue	Tissue Concentration (µg/kg for PCB, mg/kg for metals)	Pre-Remedial Sediment SWAC (µg/kg for PCB, mg/kg for metals)	BAF
PCB	recreational	sand bass	fillet	106.7	308	0.346
PCB	subsistence	sand bass	whole	569.5	308	1.85
PCB	recreational	lobster	edible	7.9	308	0.0256
PCB	subsistence	lobster	whole	43.6	308	0.142
Mercury	subsistence	sand bass	whole	0.14	0.75	0.19
Mercury	recreational	lobster	edible	0.153	0.75	0.20
Copper	subsistence	lobster	whole	57	187	0.28

Note: See Appendix for Section 32 for supporting calculations.

Table 32-13 SWACs Protective of Human Health at FI=100%

COC	Scenario	$SWAC_{TEP}$ (µg/kg for PCB, mg/kg for metals)					
		Post Remedial SWAC	Back-ground	Cancer (1×10^{-4})	Cancer (1×10^{-5})	Cancer (1×10^{-6})	Non-cancer (HI < 1)
PCB	Recreational consumption of bass fillets	194	84	1,123	112.3	11.2	192.4
PCB	Subsistence consumption of whole bass			27	2.7	0.27	4.7
PCB	Recreational consumption of edible lobster			15,162	1,516.2	151.6	2,599.2
PCB	Subsistence consumption of whole lobster			358	35.8	3.6	61.4
Mercury	Subsistence consumption of whole bass	0.68	0.57	NA	NA	NA	0.2

COC	Scenario	SWAC$_{TEP}$ (µg/kg for PCB, mg/kg for metals)					
		Post Remedial SWAC	Back-ground	Cancer (1×10^{-4})	Cancer (1×10^{-5})	Cancer (1×10^{-6})	Non-cancer (HI < 1)
Mercury	Recreational consumption of edible lobster			NA	NA	NA	1.6
Copper	Subsistence consumption of whole lobster	159	121	NA	NA	NA	57.9

Note: See Appendix for Section 32 for supporting calculations.
NA: Not applicable.

To assure adequacy of the cleanup, results in Table 32-13 were compared to the projected post-remedial SWACs. The table demonstrates that the post-remedial SWACs for PCBs is protective for recreational anglers (risk in the range of 10^{-4} to 10^{-6} or less, and non-cancer risk Hazard Index (HI) of less than 1). The PCB post-remedial SWAC is not fully protective of cancer or non-cancer risk to subsistence anglers that consume whole bass or lobster. The post-remedial SWAC for mercury is protective of recreational consumers of lobster, but is not protective of subsistence anglers that consume whole bass. The post-remedial SWAC for copper is not protective of subsistence consumers of lobster. Acceptable risk levels for subsistence anglers of whole bass would not be obtained even if the Site was cleaned up to background levels for mercury or PCBs. Acceptable risk levels for subsistence consumers of lobster would not be obtained even if the Site was cleaned up to background levels for copper and PCBs.

The above analysis is based on a fractional intake (FI) of 100 percent, which assumes the angler intake is entirely from the Shipyard Sediment Site. In addition, these results evaluate a cancer risk in the range of 10^{-4} to 10^{-6}, which is consistent with the U.S. EPA, regulations under the National Contingency Plan (U.S. EPA, 1990) and OEHHA (2008) fish tissue advisory guidance.

Various SWACs for recreational anglers were evaluated by varying the fractional intake to identify the post-remedial SWACs for PCBs associated with three different cancer risk levels and the non-cancer risk level in Table 32-14. The bolded cells indicate where the post-remedial SWAC is below the calculated “acceptable” SWAC associated with that fractional intake and cancer risk level where the cancer risk falls within the acceptable range (noted in the preceding paragraph) and the non-cancer risk level (HI) is less than 1.

Table 32-14 Acceptable Total PCB SWACs for Recreational Anglers Assuming Varying Risk Levels and Fractional Intake

Fractional Intake (%)	PCBs SWAC (µg/kg)									
	Background	Post-Remedial SWAC	Cancer Risk Level						Non-cancer Risk Level	
			10^{-6}		10^{-5}		10^{-4}		HI < 1	
			Fish	Lobster	Fish	Lobster	Fish	Lobster	Fish	Lobster
25	84	194	44.9	**606.5**	**448.7**	**6,064.8**	**4,487**	**60,648**	**768**	**10,396**
40			28.1	**379.1**	**280.5**	**3,790.5**	**2,805**	**37,905**	**480**	**6,498**
75			15.0	**202.2**	149.6	**2,021.6**	**1,496**	**20,216**	**256**	**3,465**
100			11.2	151.6	112.3	**1,516.2**	**1,123**	**15,162**	192	**2,599**

Note: Bolded values indicate where the projected post-remedy SWAC is acceptable.
See Appendix for Section 32 for supporting calculations.

Various acceptable SWACs for recreational and subsistence anglers were evaluated by varying the fractional intake to identify the post-remedial SWACs for mercury and copper associated with three different cancer risk levels and the non-cancer risk level in Table 32-15. The bolded cells indicate where the post-remedial SWAC is below the calculated acceptable SWAC associated with that fractional intake and non-cancer risk level.

Table 32-15 Acceptable Copper and Mercury SWACs for Recreational and Subsistence Anglers Assuming Varying Risk Levels and Fractional Intake

FI (%)	SWAC (mg/kg)				
	COC	Scenario	Background	Post-Remedial SWAC	Non-cancer Risk Level HI < 1 Lobster
25	Mercury	Subsistence consumption of whole bass	0.57	0.68	0.92
40					0.58
75					0.31
100					0.23
25	Mercury	Recreational consumption of edible lobster			6.4
40					4.0
75					2.1
100					1.6
25	Copper	Subsistence consumption of edible lobster	121	159	232
40					145
75					77
100					58

Notes: FI = Fractional Intake
Bolded values indicate where the projected post-remedy SWAC is acceptable.
See Appendix for Section 32 for supporting calculations.

Results for the post-remedial SWACs are summarized in Table 32-16.

Table 32-16 Protectiveness of the Human Health Beneficial Uses of Post-Remedial SWACs

COC	Scenario	Fractional Intake Protected by Post-Remedial SWACs (%)		
		Post Remedial SWAC	**Cancer Risk (< 1 x 10^{-4} to 1 x 10^{-6} Range)**	**Non-cancer Risk (HI < 1)**
PCB	Recreational consumption of bass fillets	194 µg/kg	100%	**99%** (Background = 100%)[1]
PCB	Subsistence consumption of whole bass		**14%** (Background = 33%)[1]	**2%** (Background = 6%)[1]
PCB	Recreational consumption of edible lobster		100%	100%
PCB	Subsistence consumption of whole lobster		100%	**32%** [2] (Background = 73%)[1]
Mercury	Recreational consumption of bass fillets	0.68 mg/kg	NA	100%
Mercury	Subsistence consumption of whole bass		NA	**34%** [2] (Background = 41%)[1]
Mercury	Recreational consumption of edible lobster		NA	100%
Mercury	Subsistence consumption of whole lobster		NA	100%
Copper	Recreational consumption of bass fillets	159 mg/kg	NA	100%
Copper	Subsistence consumption of whole bass		NA	100%
Copper	Recreational consumption of edible lobster		NA	100%
Copper	Subsistence consumption of whole lobster		NA	**36%** [2] (Background = 48%)[1]
HPAHs	All Scenarios	2,451 µg/kg	NA	100%
TBT	All Scenarios	110 µg/kg	NA	100%

Note: See Appendix for Section 32 for supporting calculations for risk driver scenarios.
Scenarios in which 100% Fractional Intake is not protected by post-remedial SWACs are shown in bold.
NA: Not applicable.

1. Fractional Intake protected by background concentrations (as predicted by the model) is shown in parentheses in the six cases in which the post-remedial SWAC is not protective of 100% Fractional Intake. In five of the six cases, background conditions are also not expected to be protective of 100% Fractional Intake. In the sixth case, the SWAC is protective of 99% Fractional Intake (approximates 100%).
2. Post-remedial SWAC would be protective of this scenario at a 20% Fractional Intake for subsistence fishermen, equivalent to the 1 meal per week ingestion rate used to derive California fish consumption advisories by OEHHA (2008).

For PCBs, seafood consumption for recreational anglers would be limited to consumption of the edible portions of the lobster (at 100 percent consumption rate), while sand bass consumption would be limited to fish fillets (at an approximate 100 percent consumption rate). For mercury, consumers of lobster are protected at a 100 percent consumption rate. In general, SWACs are reasonably protective of the human health beneficial uses at this site because:

- The theoretical 100 percent consumption rate analyzed in this Technical Report represents a conservative evaluation criterion. All post-remedial SWACs approximated protection of recreational angler consumption at 100 percent consumption rates, although subsistence anglers would only be protected at lower consumption rates. In development of fish tissue advisory levels, OEHHA bases risk-based fish tissue advisory levels using a one-meal per week consumption rate (equivalent to 32 g/day; OEHHA, 2008). This is equivalent of a 20 percent fractional intake for subsistence fishermen. The PCB post-remedial SWAC for subsistence fishermen is not protective, although reference conditions are not protective of this PCB exposure route, reflecting the broad regional pattern of PCBs in Southern California.

- The PCB post-remedial SWAC is within the range of acceptable cancer risks ($1x10^{-4}$ to $1x10^{-6}$ cancer risk) that the U.S. EPA requires for remedial decision making (40 CFR Section 300). Furthermore, the PCB post-remedial SWAC is consistent with OEHHA fish tissue advisory levels. OEHHA bases fish tissue advisory levels on a maximum cancer risk of $1x10^{-4}$, and considers that this risk level appropriately balances cancer risk with the numerous known health benefits from eating fish, as their risk-based goal expands “beyond a simple risk paradigm in order to best promote the overall health of the fish consumer” (OEHHA, 2008).

- Target species consumed by recreational or subsistence anglers are known to forage over areas near or greater than the size of the Site, depending on the species. Fish and lobster do not limit their movement to the small area represented by a single sediment sample, but range among a much larger area and would be exposed to sediments of varying chemical concentrations throughout the Site and greater San Diego Bay.

- The amount of exposure sand bass would have to the chemicals at the Shipyard Sediment Site are expected to be less than 100 percent due to physical disturbances interfering with feeding and foraging activities. Thus, the sand bass caught by anglers may have less exposure and less accumulation of chemicals than a strict application of the calculated BAF would indicate.

- With respect to fish and lobster consumption, it is not likely that anglers will consume fish caught from the same location from within the site every day for 30 or more years since anglers are likely to utilize different fishing locations from time to time based on fish abundance, which can be seasonal or vary year to year.

- With respect to the carcinogenicity of PCBs, U.S. EPA (2000b) suggests that there is a level of great conservatism in its published cancer slope factors:

  > "PCB mixtures have been classified as probable human carcinogens (Group B2) (Appendix G) (IRIS, 1999; U.S. EPA, 1988a). PCB mixtures have been shown to cause adverse developmental effects in experimental animals (ATSDR, 1998b). Data are inconclusive in regard to developmental effects in humans. Several studies in humans have suggested that PCB exposure may cause adverse developmental effects in children and in developing fetuses (ATSDR, 1998b) These include lower IQ scores (Jacobson and Jacobson, 1996), low birth weight (Rylander et al., 1998), and lower behavior assessment scores (Lonky et al., 1996). However, study limitations, including lack of control for confounding variables, deficiencies in the general areas of exposure assessment, selection of exposed and control subjects, and the comparability of exposed and control samples obscured interpretation of these results (ATSDR, 1998b)." (U.S. EPA 2000b, page 4-48).

  Human epidemiological studies of PCBs have not yielded conclusive results (Silberhorn et al., 1990). There is some suggestive evidence that xenoestrogens, including PCBs, may play a role in breast cancer induction (ATSDR, 1998c). Some studies have indicated an excess risk of several cancers, including: liver, biliary tract, gallbladder, gastrointestinal tract, pancreas, melanoma, and non-Hodgkin's lymphoma (IRIS, 1999, ATSDR, 1998c). As with all epidemiological studies, it is very difficult to obtain unequivocal results because of the long latency period required for cancer induction and the multiple confounders arising from concurrent exposures, lifestyle differences, and other factors. The currently available human evidence is considered inadequate but suggestive that PCBs may cause cancer in humans (IRIS, 1999).

- With respect to non-cancer health effects of PCBs, the RfD value, 2×10^{-5} mg/kg-day, is based on morphological and potential immunosuppressive effects of ocular exudate, inflamed Meibomian (tarsal) glands, distorted fingernail and toenail growth, and decreased antibody response to injected sheep erythrocytes in Rhesus monkeys exposed to PCBs (OEHHA, 2008). These morphological responses are considered to occur at or below the exposure levels causing developmental neurobehavioral effects, suggesting that the RfD is protective of a sensitive developing fetus (OEHHA, 2008). Data from human studies support the conservativeness of this RfD, as a NOAEL of 5×10^{-5} mg/kg-day (2-3 times less conservative than the RfD value used in this assessment) was found in studies summarized in ATSDR (2000).

- With respect to health effects of mercury, this assessment is conservative because the RfD value, 0.0001 mg/kg-day is protective of developmental neurological abnormalities in infants, and is considered to be protective of the sensitive subpopulation of infants and childbearing women (OEHHA, 2008). OEHHA (2008) specifically recommends that this RfD applies to women aged 18 to 45 years and children aged 1 to 17 years, and suggests application of an RfD three times higher (less conservative) to women over 45 years and men. If the RfD for the general population (i.e., 0.0003 mg/kg-day for men and non-childbearing women) is used in the above calculations, the cleanup would be protective of subsistence fishermen at a fractional intake of 100%.

- With respect to health effects of copper, this assessment is expected to be conservative. Copper is an essential nutrient and a necessary component of the human diet. Copper is not a typical chemical of concern monitored in regulatory fish advisories (in contrast to mercury and PCBs). In contrast to PCBs and mercury, copper accumulation is regulated in humans such that after nutritional requirements are met in the diet, there are several mechanisms that prevent copper overload (ATSDR, 2004). When a large excess of copper is consumed, one of the most commonly reported adverse health effect of copper is gastrointestinal distress; this symptom is not usually persistent and has not been linked with other adverse health effects (ATSDR, 2004).

32.5. Alternative Cleanup Levels to Protect Aquatic Life Beneficial Uses

The triad data evaluated in Section 18 to determine if sediment pollutant levels at the Shipyard Sediment Site were adversely affecting the health of the benthic community and a SWAC approach are not adequate to set cleanup levels for Aquatic Life beneficial uses. As part of the alternative cleanup level approach, an independent evaluation for protection of aquatic life beneficial uses was conducted. This approach included in the remedial footprint all areas with sediment quality related impacts to benthic communities. The approach utilized chemical and biological data available from the Shipyard Report (Exponent, 2003) and addressed two situations: the case where full Triad data were available (29 of 65 stations), and the case where only chemical and Sediment Profile Imaging (SPI) data were available (36 of 65 stations). In each case, the goal was to maximize the use of available data to determine which polygons had sediment pollutant levels likely to adversely affect the health of the benthic community and include those polygons in the remedial footprint.

32.5.1. Analysis for Aquatic Life at Triad Stations

For Triad stations, the assessment relied primarily on the weight of evidence analysis described in Section 18 of this Technical Report. For each Shipyard Sediment Site Triad station, the weight of evidence analysis determined one of three categories to describe the overall likelihood of impairment including: “Unlikely,” “Possibly,” and “Likely.” These categories were assigned to each Shipyard Sediment Site station based on the potential combinations of the three principal Triad lines of evidence as described in Section 18. Triad stations with conditions designated as “Unlikely” impaired were interpreted to not unreasonably affect aquatic life beneficial uses. Triad stations with conditions designated as “Likely” impaired were interpreted to have the potential to impact aquatic life beneficial uses and were targeted for remedial action. Triad stations with conditions designated as “Possibly” impaired were further evaluated using the following approaches:

1. While the Shipyard Sediment Site is explicitly exempt from regulation under the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Plan) SWRCB, 2009), the Plan's MLOE approach used to interpret the narrative SQO was used as a tool to evaluate whether or not further action was warranted at the "Possibly" impaired Triad stations. Two of 12 "Possibly" impaired stations were classified as "Likely Impacted" and none were classified as "Clearly Impacted" under the Plan's SQO's MLOE approach (Table 32-17). These two stations, NA11 and SW27, were targeted for further evaluation.

Table 32-17 Evaluation of Triad "Possibly" Impaired Stations Using MLOE Approach in the Bays and Estuaries Plan

Station ID	MLOE Result[1]	Station ID	MLOE Result[1]
SW08	likely unimpacted	NA09	possibly impacted
SW09	possibly impacted	NA11	likely impacted
SW15	likely unimpacted	NA12	possibly impacted
SW17	likely unimpacted	NA16	likely unimpacted
SW21	likely unimpacted	NA17	likely unimpacted
SW25	possibly impacted		
SW27	likely impacted		

1. SCCWRP evaluated a number of stations within San Diego Bay utilizing the MLOE approach in the Bays and Estuaries Plan. This evaluation included 27 stations at the Shipyard Sediment Site (Bay 2007 and 2009). The supporting calculations are provided in the Appendix for Section 32.
Source: Bay 2009

2. Shipyard Sediment Site stations designated as "Possibly" impaired represent areas of uncertainty in the weight of evidence analysis in Section 18 due to inconsistency among lines of evidence. The designation is based on two scenarios resulting from the weight of evidence analysis including: (1) "High" chemistry but "Low"[18] toxicity or benthic community effects relative to reference; or (2) "Moderate" chemistry and "Moderate" toxicity but "Low" benthic community effects. Both scenarios were considered and interpreted on the basis of the underlying data.

   Scenario 1 - High Chemistry with Low Toxicity and Low Benthic Community Effects. Stations with possible impairment under scenario 1 had high COC concentrations relative to reference and benchmarks, no significant toxicity relative to reference and controls, and benthic community conditions consistent with reference areas. Shipyard Sediment Site stations with this condition included NA17, SW02, SW08, SW09 and SW21. Because multiple biological tests showed no significant impact relative to reference, the interpretation for these stations is that COCs are not sufficiently bioavailable to benthic organisms to cause impairment significantly different from reference areas of the bay. The polygons associated with these stations, however, were

[18] The "Low" category for toxicity also includes a no significant toxicity relative to reference and control outcome.

ultimately included in the remedial footprint in order to achieve the post-remedial SWACs for human health and aquatic dependent wildlife protection (see Section 32.2).

Scenario 2 - Moderate Chemistry and Moderate Toxicity with Low Benthic Community Effects. Stations with “Possibly” impairment under scenario 2 had moderate COC concentrations relative to reference and benchmarks, a designation of moderate toxicity based on comparison to reference and control conditions, and benthic community conditions consistent with reference areas. Shipyard Sediment Site stations with this condition included NA09, NA11, NA12, NA16, SW15, SW17, SW25, and SW27. Results for the testing at these stations were further reviewed. Further examination of the biological testing results indicated that in every case, of the seven biological metrics assessed under the toxicity and benthic community lines of evidence, no more than one metric per station exceeded reference conditions (Table 32-18). In every case, the benthic community results indicated communities comparable to reference conditions. Because the predominance of biological tests showed no significant impact relative to reference, the interpretation for these stations is that, even though limited effects were observed in a single toxicity test, healthy benthic community suggests that COC concentrations are not high enough to drive site-specific impairment. Additionally, remediation of NA11 polygon is technologically infeasible due to stability concerns about the slope near the floating dry dock sump. Any dredging in this area of NA11 polygon would drastically undermine the slope. The polygons associated with stations NA09 and SW27, however, were ultimately included in the remedial footprint in order to achieve the post-remedial SWACs for human health and aquatic dependent wildlife protection (see Section 32.2).

Table 32-18 Summary of Biological Line-Of-Evidence Results for Toxicity and Benthic Community Endpoints for the Triad Stations Classified as Possibly Impaired Under Scenario 2

Triad WOE “Possibly” Station	Toxicity Relative to Reference			Benthic Community Impact Relative to Reference			
	Amphipod Survival	Urchin Fertilization	Bivalve Development	BRI	Abundance	# Taxa	S-W Diversity
NA09	No	No	Yes	No	No	No	No
NA11	Yes	No	No	No	No	No	No
NA12	No	No	Yes	No	No	No	No
NA16	No	No	Yes	No	No	No	No
SW15	No	No	Yes	No	No	No	No
SW17	No	No	Yes	No	No	No	No
SW25	No	No	Yes	No	No	No	No
SW27	No	No	Yes	No	No	No	No

32.5.2. Analysis for Aquatic Life at Non-Triad Stations

For non-Triad stations only limited data were available to assess potential impacts to aquatic life beneficial uses. This does not indicate a shortcoming of the study, but rather reflects the goal of the data collection at these stations which was primarily to help delineate the nature and extent of contamination. The available data at non-Triad stations generally included surface sediment COC concentrations, and proximate Sediment Profile Image (SPI) analysis of benthic community successional stage. The analysis relied upon these available data and site specific chemical thresholds that were developed from the Triad station in the Shipyard Report (Exponent, 2003). Chemical thresholds included site-specific Lowest Apparent Effects Thresholds (LAETs) for individual COCs, and a Site-Specific Median Effects Quotient (SS-MEQ) to address combined effects of multiple COCs.

The Apparent Effects Threshold (AET) is a tool for identifying concentrations of a pollutant in sediment above which adverse biological effects are always expected. When multiple site-specific effects endpoints are measured, several AET values can be combined to derive a single set of AET values by conservatively applying the lowest of any of the individual AET values for each chemical. This is known as the lowest AET or LAET. The methodology for calculating the site-specific LAETs is described in additional detail in the Shipyard Report (Exponent, 2003). To provide an additional margin of protection, the LAETs derived from the site-specific Triad data were reduced to 60 percent of the calculated value (60%LAETs), and these 60%LAETs were used to assess individual chemicals at the non-Triad stations. The 60%LAET threshold values are shown in Table 32-19. All non-triad stations exceeding the 60% LAET were designated for remediation (Table 32-23).

Table 32-19 60% LAET Values for Primary COCs

Primary COCs	60%LAET Values
Copper	552 mg/kg
Mercury	2.67 mg/kg
HPAH	15.3 mg/kg
PCBs	3,270 μg/kg
TBT	1,110 μg/kg

Note: See Appendix for Section 32 for supporting calculations.

To address potential combined impacts of chemicals, an SS-MEQ was also developed from the Triad data available in the Shipyard Report (Exponent, 2003). The SS-MEQ was derived by calculating the median concentration of individual COCs at 6 of the 30 Triad stations (Table 32-20). Three of the six included stations identified as likely impaired under the weight of evidence analysis described in Section 18 of this Technical Report (NA22, SW04, and SW13). Three possibly-impaired stations with the highest potential for chemically-associated effects (among possibly-impaired stations) were also included in SS-MEQ derivation (NA19, SW22, and SW23). These stations exhibited both "Moderate" toxicity and chemical concentrations just below levels indicative of the "High" LOE category by the Triad sediment chemistry ranking criteria (Table 18-1). The SS-MEQ threshold was then established by conservatively optimizing the performance of the quotient in predicting likely effects or the three most chemically-impaired possible stations (true positives) while minimizing false negatives. The optimal threshold was found to be an SS-MEQ of 0.9. The overall reliability for the available data was 73 percent. The term "overall reliability" is defined as the percentage of SS-MEQ predictions that agree with the Triad weight of evidence categories for the stations. The only false negative was at NA22 which had significant evidence of non-COC related impacts from physical disturbance. Performance metrics for this threshold are summarized in Table 32-21.

$$\mathrm{SS} \bullet \mathrm{MEQ} = \frac{1}{5}\left[\frac{[Cu]}{ME_{Cu}} + \frac{[Hg]}{ME_{Hg}} + \frac{[HPAH]}{ME_{HPAH}} + \frac{[TPCB]}{ME_{TPCB}} + \frac{[TBT]}{ME_{TBT}}\right]$$

For the non-Triad stations, the SS-MEQ threshold of 0.9 was conservatively assumed to be predictive of "Likely" impairment. The SS-MEQ was calculated for all non-Triad stations as where the values in the numerator (e.g. [Cu], [Hg], etc.) are the non-Triad station sediment concentration for that COC, and the values in the denominator (e.g. ME_{Cu}, ME_{Hg}, etc.) are the site-specific median effects levels as shown in Table 32-20. All non-triad stations exceeding the SS-MEQ threshold were designated for remediation (Table 32-23).

Table 32-20 Data from Triad Stations at the Shipyard Sediment Site Used to Develop the SS-MEQ

Station	Sediment COC Concentration				
	Cu mg/kg	Hg mg/kg	HPAH µg/kg	PCB µg/kg	TBT µg/kg
NA19	270	0.78	3,000	990	570
NA22[1]	150	0.38	3,600	180	120
SW04	1,500	1.75	14,000	4,000	3,250
SW13	800	0.86	12,000	490	790
SW22	260	1.1	12,000	900	190
SW23	280	1	11,000	1,000	210
SS-Median	275	0.93	11,500	945	390

Note: See Appendix for Section 32 for supporting calculations.

1. NA22 is not included in the remedial footprint, and is being addressed separately in the TMDL for the mouth of Chollas Creek.

Table 32-21 Performance Summary for the SS-MEQ

Total Stations	30
Threshold	0.90
Reliability	70%
True Positives	5
True Negatives	16
False Positives	8
False Negatives	1

Note: See Appendix for Section 32 for supporting calculations.

In order to confirm that the SS-MEQ/60%LAET approach was protective of the health of the benthic community in polygons with only sediment chemistry data, a supplemental Triad study was conducted at the Shipyard Sediment Site in July 2009. The purpose of the study was to determine if the 60%LAET and SS-MEQ thresholds could reliably predict the likelihood of sediment quality impacts to the benthic community. Sampling and full triad analyses were conducted at five stations and the results compared to the 60%LAET and SS-MEQs for those stations to see if the 60%LAET and SS-MEQ thresholds could reliably predict a “Likely” impaired triad result. Five stations (NA23, NA24, SW06, SW19, and SW30) were selected for inclusion in the study, based on the following criteria:

1. They were not included in the Phase 1 sediment investigation Triad study, conducted in 2001.

2. Station locations were outside of the proposed remedial footprint (see Figure 32-1).

3. These stations had relatively high primary COC concentrations compared to other stations outside the remedial footprint.

The sediment chemistry, toxicity, and benthic community data from these five stations were evaluated in a manner consistent with that described in Section 18. The study depicted that, while 4 of the 5 stations had moderately elevated chemistry (SW19 was low), all had low toxicity. Benthic community disturbance was found to be low at three of the five stations, and moderate at NA23 and NA24. The results in the pre-remediation monitoring are shown in Table 32-22.

Table 32-22 Supplemental Triad Analysis Results and SS-MEQ/60%LAET Predictions

Station ID	Sediment Chemistry	Toxicity	Benthic Community	Triad Analysis Result	SS-MEQ/60%LAET Prediction	Accurate SS-MEQ/ 60%LAET Prediction?
SW06	Moderate	Low	Low	Unlikely	Unlikely or Possible	Yes
SW19	Low	Low	Low	Unlikely	Unlikely or Possible	Yes
SW30	Moderate	Low	Low	Unlikely	Unlikely or Possible	Yes
NA23	Moderate	Low	Moderate	Possible	Unlikely or Possible	Yes
NA24	Moderate	Low	Moderate	Possible	Unlikely or Possible	Yes

Note: See Appendix for Section 32 for supporting calculations.

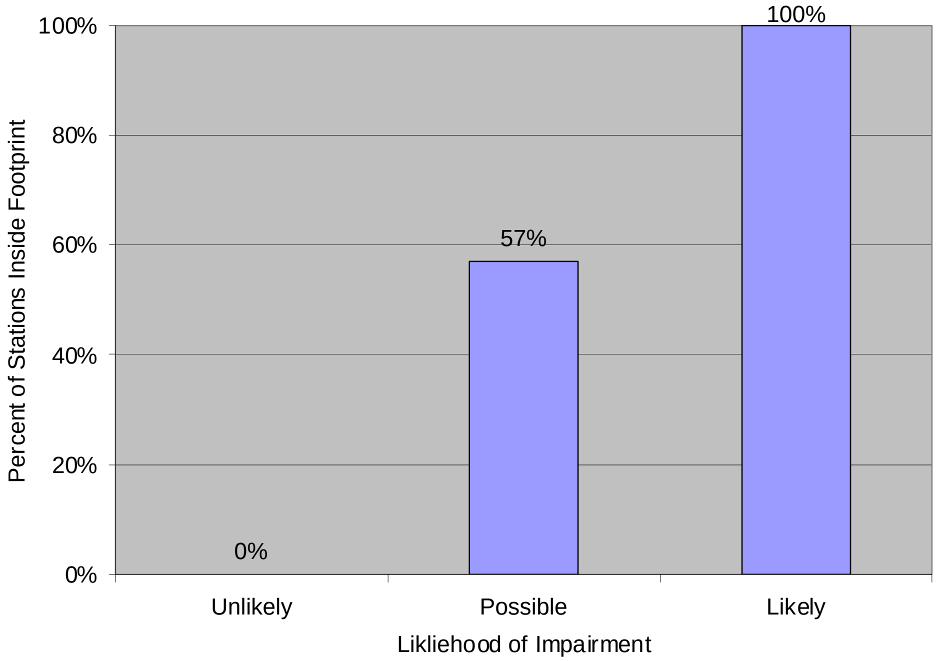
These findings indicated that no benthic community impacts are the result of elevated COCs in the sediments at these locations. None of the stations assessed were deemed “Likely” impaired (although some benthic impacts are likely in some areas due to physical disturbance from shipyard activities, such as ship movements and dry dock operations). At all five stations, the SS-MEQ/60%LAET thresholds successfully predicted the absence of “Likely” benthic community impacts. Based on the preceding evidence, the SS-MEQ and 60%LAET approach appears to be a reliable predictor of likely benthic impairment at other locations at the Shipyard Sediment Site.

32.6. Alternative Cleanup Levels Protect Aquatic Life Beneficial Uses

An analysis of ecological, toxicological, and chemical lines of evidence confirmed that alternative cleanup levels will be protective of aquatic life beneficial uses at the Shipyard Sediment Site.

For polygons with Triad data at the Shipyard Sediment Site, all polygons with a Triad station identified as “Likely” impaired under the weight of evidence analysis in Section 18 were designated for remediation (Figure 32-2). The majority of the polygons with “Possibly” impaired stations, and all of the polygons with “Possibly” impaired stations with “High” chemistry were designated for remediation (Figure 32-2). Of the remaining polygons with “Possibly” impaired stations, all have healthy benthic communities comparable to reference conditions, and showed biological effects in a maximum of one metric out of the seven that were assessed. With respect to the Triad stations, the proposed remedial design targets all of the “Likely” areas of impairment and the majority of areas of “Possible” impairment for remedial action.

Figure 32-2 Percent of Stations Targeted for Remediation as a Function of the Weight-Of-Evidence Category for Aquatic Life Impairment



For polygons with only sediment chemistry data, all exceeding the SS-MEQ or 60%LAET thresholds were designated for remediation (Table 32-23).

Table 32-23 Site-Specific 60%LAET and SS-MEQ Threshold Exceedences SPI Successional Stage, and Remedial Designations at the Shipyard Sediment Site Non-Triad Stations

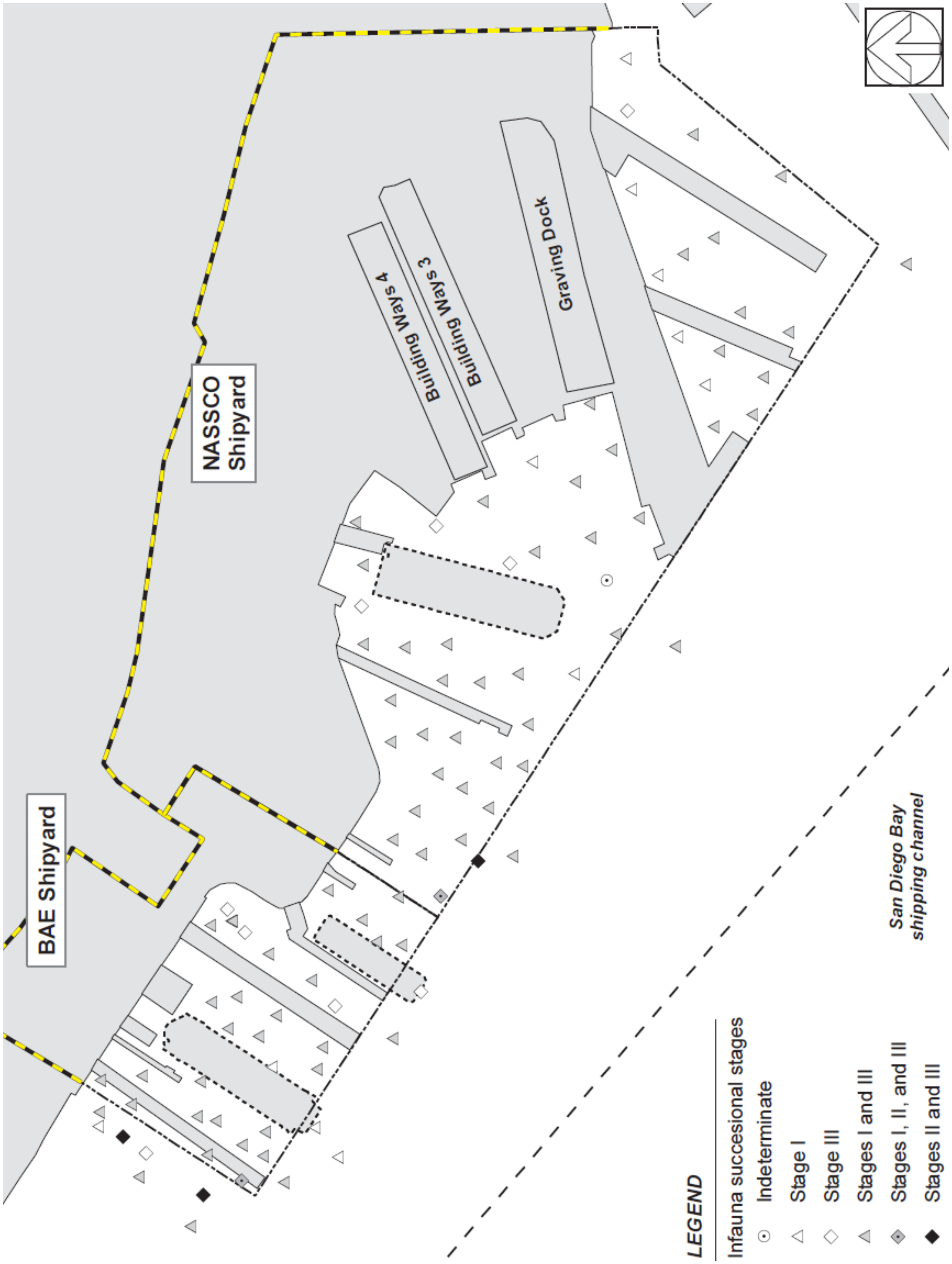
Non-Triad Station	Exceeds 60%LAET Threshold	Exceeds SS-MEQ Threshold	SPI Successional Stage	Designated for Remediation
NA02	No	No	Stage I & III	No
NA08	No	No	Stage I & III*	No
NA10	No	No	Stage I & III	No
NA13	No	No	Stage I & III	No
NA14	No	No	NA	No
NA18	No	No	Stage I & III*	No
NA21	No	No	Stage I & III*	No
NA23	No	No	Stage I & III*	No
NA24	No	No	Stage I & III*	No
NA25	No	No	NA	No
NA26	No	No	NA	No

Non-Triad Station	Exceeds 60%LAET Threshold	Exceeds SS-MEQ Threshold	SPI Successional Stage	Designated for Remediation
NA27	No	No	NA	No
NA28	No	No	NA	No
NA29	No	No	NA	No
NA30	No	No	NA	No
NA31	No	No	NA	No
SW01	No	Yes	Stage I	Yes
SW05	No	Yes	Stage III*	Yes
SW06	No	No	Stage I and III	No
SW07	No	No	Stage I, II & III	No
SW10	Yes	No	Stage I & III	Yes
SW12	No	No	Stage I & III	No
SW14	No	No	Stage I & III*	Yes
SW16	No	Yes	Stage I & III*	Yes
SW19	No	No	NA	No
SW20	No	Yes	Stage I & III	Yes
SW24	Yes	Yes	Stage I & III*	Yes
SW26	No	No	Stage I & III	No
SW28	Yes	Yes	Stage I & III*	Yes
SW29	No	No	NA	Yes (partial)
SW30	No	No	NA	No
SW31	No	No	Stage III*	No
SW32	No	No	NA	No
SW33	No	No	NA	No
SW34	No	No	NA	No
SW36	No	No	Stage I & III	No

Note: Successional stage marked with * indicates condition taken from an SPI location in proximity to the non-Triad station. NA indicates that there was no available SPI station in proximity to the non-Triad station. All other SPI stations were co-located with non-Triad stations.

To further verify protection of aquatic life beneficial uses at non-Triad stations, the available SPI data were also evaluated. These results are described in detail in the Shipyard Report (Exponent, 2003). SPI data were not always specifically co-located with non-Triad chemistry data, but a large number of sampling stations were assessed and thus, if not co-located, SPI stations were generally in close proximity to non-Triad stations, and the SPI data provide the best available generalized assessment of the benthic community health in areas where detailed benthic community assessment was not carried out. While SPI analysis yields a range of metrics, the most relevant measure for this assessment is the infaunal successional stage. Briefly, successional stage measures the degree of development or recolonization of a benthic community following disturbance (physical or chemical). The evolving succession is described in three stages. Stage I occurs soon after sediment has been disturbed and is characterized by colonization of small tube-dwelling polychaetes that feed at the sediment surface. Stage II is characterized by organisms that burrow shallowly into the sediment but nevertheless feed at or near the sediment surface. Stage III is characterized by organisms that burrow well into the anaerobic sediment and feed at depth off of organic matter and microbial decomposers. The three characteristic benthic successional stages can be identified in SPI photographs through the structures that the organisms create (tubes, burrows) and through the modifications they induce in sediment properties. SPI analysis showed that mature Stage III communities are present throughout both shipyards (Figure 32-3). In some limited areas of known physical disturbance only Stage I communities were observed such as the engine test area between Piers 4 and 5, near the southeast end of the NASSCO shipyard. With these exceptions, the SPI analysis generally indicates that healthy Stage III benthic communities are present at Shipyard Sediment Site stations with COC concentrations below the 60%LAET or SS-MEQ thresholds (Table 32-23).

Figure 32-3 Distribution of Benthic Infuana Successional Stage at the Shipyard Sediment Site (Figure 8-1; Exponent, 2003)



In conclusion, under the analysis, all Triad stations at the Shipyard Sediment Site identified as likely impaired under the weight of evidence analysis were designated for remediation. The majority of the possibly impaired stations, and all of the possibly impaired Triad stations with high chemistry were designated for remediation. Of the remaining possibly impaired stations, all have healthy benthic communities comparable to reference conditions, and showed biological effects in a maximum of one metric out of the seven that were assessed. All non-Triad stations exceeding the 60%LAET or SS-MEQ were designated for remediation. The SPI analysis generally indicates that healthy stage III benthic communities are present at Shipyard Sediment Site non-Triad stations with COC concentrations below the 60%LAET or SS-MEQ thresholds.

Table 32-24 Summary of Aquatic Life Beneficial Use Protection Analysis

<table>
<tr><th colspan="3">Beneficial Use</th><th>COC</th><th>Condition</th><th>Basis</th></tr>
<tr><td rowspan="8">Aquatic Life (Benthos)</td><td colspan="2">Triad Stations</td><td>Weight of Evidence Category</td><td>No “Likely” Impacted Stations</td><td>• Cleanup all areas designated as “Likely” impacted or above under the weight of evidence analysis in the Section 18.</td></tr>
<tr><td rowspan="7">Non-Triad Stations</td><td>SS-MEQ</td><td>Quotient of 5 COCs</td><td>0.9</td><td>• Protective of benthic communities consistent with “Likely” stations (Section 18).</td></tr>
<tr><td rowspan="5">60%LAET</td><td>Cu (mg/kg)</td><td>552</td><td rowspan="5">• Protective of benthic communities consistent with Site-specific Lowest Apparent Effects Threshold (LAET)
• Significant margin of safety</td></tr>
<tr><td>Hg (mg/kg)</td><td>2.67</td></tr>
<tr><td>HPAH (µg/kg)</td><td>15,300</td></tr>
<tr><td>PCB (µg/kg)</td><td>3,270</td></tr>
<tr><td>TBT (µg/kg)</td><td>1,110</td></tr>
<tr><td>SPI</td><td>NA</td><td>Presence of Stage 3 Community</td><td>• Supporting line of evidence</td></tr>
</table>

32.7. Other Considerations Regarding Resolution No. 92-49

The alternative cleanup levels must also comply with the provisions of Resolution No. 92-49. This Resolution requires that alternative cleanup levels less stringent than background levels be:

1. The lowest chemical concentrations that are technologically and economically achievable
2. Consistent with maximum benefit to the people of the state, and
3. Not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards.

32.7.1. Technological and Economical Feasibility

In prescribing any alternative cleanup levels less stringent than background the San Diego Water Board must apply section 2550.4 of Title 23 of the California Code of Regulations Pursuant to Resolution No. 92-49, the San Diego Water Board may not set alternative cleanup levels for chemicals of concern more stringent than “the lowest concentration that the discharger demonstrates and the San Diego Water Board finds is technologically and economically achievable.”[19] This regulation establishes a “ceiling” for proposed concentration limits for chemicals of concern in cleanup and abatement actions.

As demonstrated in Section 31 above, it is not economically feasible to remediate the Shipyard Sediment Site to background sediment-quality levels. Comparing incremental costs of remediation to incremental exposure reduction values, the highest net benefit per remedial dollar spent occurs for the first $33 million (18 polygons), based on the fact that initial exposure reduction is above 12 percent per $10 million spent. Beyond $33 million, however, exposure reduction drops consistently as the cost of remediation increases. Exposure reduction drops below 7 percent per $10 million spent after $33 million, below 4 percent after $45 million, and drops to zero at $185 million.

Based on this comparison of incremental costs versus incremental benefit, the San Diego Water Board cannot require remediation to background sediment-quality levels because doing so would establish alternative cleanup levels that are not economically feasible and, therefore, are above the “ceiling” permitted by section 2550.4(e).

The total cost of the cleanup is estimated to be $58 million (see Appendix for Section 32).[20] Cleaning up additional areas beyond the proposed remedial footprint would yield about 4 percent additional exposure reduction per $10 million spent. Accordingly, the alternative cleanup levels established for the Shipyard Sediment Site are the lowest levels that are technologically and economically achievable, as required under section 2550.4(e).

32.7.2. Maximum Benefit to the People of the State

Resolution No. 92-49 requires that an alternative cleanup level be consistent with maximum benefit to the people of the State of California. When considering an alternative cleanup level under Resolution No. 92-49, a regional water board must consider: “all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible.” Moreover, a Regional Water Board must consider the total values involved in the light of “current, planned, or future land use, social, and economic impacts to the surrounding community, including property owners other than the discharger.” The proposed alternative cleanup levels are judged to be consistent with maximum benefit to the people of the State based on the San Diego Bay resource protection, mass removal and source control, and economic considerations provided below.

---

[19] See Title 23 CCR section 2550.4(e).

[20] The actual cost of cleanup can vary significantly from the estimate due to a number of factors including variability regarding the estimated volume, and dredging subcontractor, transportation, and disposal costs.

San Diego Bay Resource Protection Considerations

The Shipyard Sediment Site pollution is located in San Diego Bay, one of the finest natural harbors in the world. San Diego Bay is an important and valuable resource to San Diego and the Southern California Region. The Bay provides habitat for fish and wildlife, extensive commercial and industrial economic benefits, and recreational opportunities to citizens and visitors. The Bay is a key element for the military security of the United States.

San Diego Bay is of significant economic value to California and the Nation. The Bay is a major tourist and convention destination, international shipping center, plays a key role in the national defense, and has many other recreational, industrial, and commercial uses. Most of these uses rely on a healthy Bay. Shipping, shipbuilding, boat repair, tourism, and other industries are either directly dependent on, or otherwise benefit from, the Bay. Because of its beauty and availability as a recreational resource, San Diego Bay is a major draw for the tourist industry. In 1997, tourism in the greater San Diego area accounted for 14 million overnight visitors and $4.4 billion in income. Much of this activity occurred around San Diego Bay and downtown San Diego where the hotels and San Diego Convention Center are located.

San Diego Bay is designated as a State Estuary under Section 1, Division 18 (commencing with section 28000) of the Public Resources Code. A State Estuary is defined as a California saltwater bay or body of water, receiving freshwater stream 5 flows, which supports human beneficial uses and wildlife and merits high priority action for preservation.

San Diego Bay is bordered by the cities of San Diego, National City, Chula Vista and Coronado, with an estimated population of approximately 1.65 million persons. San Diego County has a population of over 3 million and is growing at a rate of about 50,000 per year; most of these residents are located in the in the metropolitan western portion of the county.

The proposed alternative cleanup levels are judged to be consistent with maximum benefit to the people of the State because:

1. Remediated areas will approach reference area sediment concentrations for most COCs,
2. All areas identified with “Likely” impacts to benthic beneficial use will be remediated,
3. Adverse impacts to benthic communities from dredging will be temporary, with stasis expected within approximately three years,
4. The alternative cleanup levels support human health, aquatic dependent wildlife, and aquatic life beneficial uses,
5. Impacts on local communities associated with remedial activities are temporary and will be mitigated where feasible,
6. Remedial activities will cause no adverse effects to sport or commercial angling, or to contact or non-contact water recreation beneficial uses because they will take place inside the shipyard security boom, and

7. Adverse effects to eelgrass beds from dredging will be mitigated to levels of insignificance following remediation.

Compared to cleaning up to background cleanup levels, cleaning up to the alternative cleanup levels will cause less diesel emission, less greenhouse gas emission, less noise, less truck traffic, have a lower potential for accidents, and less disruption to the local community. Achieving the alternative cleanup levels also requires less barge and crane movement on San Diego Bay, has a lower risk of re-suspension of contaminated sediments, and reduces the amount of landfill capacity required to dispose of the sediment wastes.

Mass Removal and Source Control Considerations

The alternative cleanup levels also maximize benefit to the people of the State by effectuating source control at the dischargers' storm water facilities, and by causing significant contaminant mass removal from San Diego Bay. The City of San Diego will take protective measures to remove potential contaminants and prevent their discharge to the Bay from its storm drains and storm water collection system in the areas upland of the shipyards, including cleaning sediments out of the catch basins and conveyances, repairing the system where it is damaged, installing filters, and implementing other BMPs.

Preliminary contaminant mass removal estimates based on data from the Shipyard Report are set forth in Table 32-25, below.

Table 32-25 Preliminary Contaminant Mass Removal/Containment Estimates

COC	Estimated Mass Removed (Kg)	Estimated Mass Contained (Kg)	Total Estimated Mass Removed and/or Contained (Kg)
Arsenic	2,200	230	2,400
Cadmium	170	13	180
Chromium	8,700	640	9,300
Copper*	52,000	6,100	58,000
HPAH*	1,300	130	1,400
Lead	15,000	1,500	17,000
Mercury*	230	22	250
PCBs*	190	32	220
Tributyltin*	95	15	110
Zinc	61,000	5,600	67,000
Total All Chemicals	141,000	14,000	156,000

*Primary COC

Notes: See Appendix for Section 32 for supporting calculations.
Total for All Chemicals rounded to nearest thousand.

Assumptions:

1. Concentrations at depths where no data exist are assumed to be the same as the concentrations at the nearest depth interval where data exist within a station bore.

2. Areas being dredged are to be over-dredged 1 foot. The concentrations in this 1 foot over-dredge depth are assumed to be the same as the interval above that depth.
3. Depth of chemicals in under pier areas are assumed to be the same as in the adjacent areas being dredged represented by the same sampling station data inclusive of the 1 foot over-dredged area.
4. NA22 not included in the analysis.
5. The PCBs value is comprised of the 41 congeners. Non-detected congeners are assumed to be at the reporting limit for those congeners.
6. Non detects for all other chemicals are assumed to be at ½ the reporting limit for those chemicals, including HPAH congeners.
7. Where multiple samples exist, averaging was performed as follows:
   - Splits were averaged.
   - The average split sample results were then averaged with samples collected from the same station and depth interval conducted on different dates.
   - All sediment results collected were included in the average data sets from a location, including the solid sediment concentrations measured during the pore water study.
8. All analytical results were assumed to be dry weight.
9. Dry bulk density of the sediments is estimated to be the average of the values found in the Exponent report where dry bulk density is the Total Solids (dry weight as a percent of bulk weight) times the specific gravity values (averages of each).
10. Thiessen polygons approximate dredge and under-pier areas for Sediment Management Units (SMUs).
11. Concentrations in a SMU or polygon are assumed to be constant throughout the SMU or polygon and the same as the concentrations in the sample bore that represents the SMU or polygon. There is one sample bore per SMU or polygon.
12. Dredge depth is based on concentrations detected above background in sediment cores. Where the bottom sample of a core had concentrations above background, additional depths for dredging were assumed based on activities at that location, elevation of the sediment surface, and resulting expectations of contamination at depth due to those activities and elevations.
13. Each SMU is represented by one Thiessen polygon.
14. Data is from Exponent (2003).

Economic Considerations

City of San Diego

There are also significant benefits of the economic and public service activities of the City of San Diego. The City provides numerous public services that contribute to an extraordinarily high quality of life, including law enforcement, fire protection, public safety, administration of justice, road and traffic management, potable water collection treatment and distribution, wastewater collection and treatment, flood protection, planning, zoning and development administration, parks, beaches and recreation, public library services, storm water quality management, among many other public services.

This municipality provides a home to numerous industries including several high technology and innovative industries with global reach. This creates an economic powerhouse that fuels the overall state economy, particularly in the sectors of wireless telecommunications and biotechnology, for which San Diego maintains a world-class reputation that attracts talent and capital from around the world. Maintaining this economic powerhouse requires striking a delicate balance of governance that allows this economic activity to thrive while maintaining an environment that top global talent is attracted to and wants to live in.

This cleanup represents the essence of that balance and improves the environmental conditions of San Diego Bay in balance with ensuring that vital City services can also be maintained so that crime should not increase, fire protection should be sufficient, and a host of other City services should not decline and impair the City's economy and vibrancy.

Shipyards

Despite not having an unreasonable affect on beneficial uses in San Diego Bay, achieving the alternative cleanup levels will result in no long-term loss of use of the Shipyard Sediment Site, thereby furthering continued operation of the shipyards, including vessel construction, maintenance and repair, and the concomitant employment of persons in the San Diego region.

The Shipyards provide significant economic benefit to the San Diego community. NASSCO is the only major construction shipyard on the West Coast. BAE Systems and NASSCO provide essential repairs and maintenance on U.S. Navy vessels. The two Shipyards have repaired more than 250 U.S. Navy vessels this decade. The two Shipyards directly employ approximately 5,800 skilled trade persons while providing work for another 1,100 subcontractors and other companies. The Shipyards are the largest minority employers in San Diego, and continue to provide more manufacturing jobs in San Diego than any other company.

The Shipyards in conjunction with the remaining working waterfront have an estimated $3.5 billion impact in the local community surrounding the Shipyards. BAE Systems alone has spent or invested about $500 million in the community over the course of the last two years.

The Shipyards have heavily invested to eliminate environmental discharges to San Diego Bay. NASSCO and BAE Systems have both set a "zero discharge" goal for their facilities.

32.7.3. Water Quality Control Plans

The Water Quality Control Plans that apply to the alternative cleanup levels are the Basin Plan and State Water Quality Control Plan for Enclosed Bays and Estuaries (Bays and Estuaries Plan). The Basin Plan contains a narrative water quality objective for toxicity that states in relevant part:

> "All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the San Diego Water Board."

The Bays and Estuaries Plan contains narrative sediment quality objectives for the protection of aquatic life and human health. These objectives are as follows:

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.

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.

The alternative cleanup levels comply with the Basin Plan and Bays and Estuaries Plan narrative water quality objectives because, as discussed in the previous section, human health, aquatic-dependent wildlife, and aquatic life beneficial uses will not be unreasonably affected by the post-cleanup sediment chemistry concentrations. Regarding aquatic life objectives, polygons associated with Triad stations characterized as “Likely” impacted are included in the cleanup footprint. Furthermore, polygons without a Triad station, but with sediment chemistry that exceeds 60%LAET, or the SS-MEQ thresholds are included in the cleanup footprint (see Section 32.5.2). The alternative cleanup levels comply with the human health and aquatic dependent wildlife objectives as shown by the risk assessments for the alternative cleanup levels discussed in Sections 32.3 and 32.4.

33. Finding 33: Proposed Remedial Footprint and Preliminary Remedial Design

Finding 33 of CAO No. R9-2011-0001 states:

Polygonal areas were developed around the sampling stations at the Shipyard Sediment Site using the Thiessen Polygon method to facilitate the development of the remedial footprint. The polygons targeted for remediation are shown in red and green in Attachment 2. The red areas are where the proposed remedial action is dredging. The areas shown in green represent inaccessible or under-pier areas that will be remediated by one or more methods other than dredging. Portions of polygons NA20, NA21, and NA22 as shown in Attachment 2 were omitted from this analysis because it falls within an area that is being evaluated as part of the TMDLs for Toxic Pollutants in Sediment at the Mouth of Chollas Creek TMDL and is not considered part of the Shipyard Sediment Site for purposes of the CAO.

The polygons were ranked based on a number of factors including likely impaired stations, composite surface-area weighted average concentration for the five primary COCs, Site-Specific Median Effects Quotient (SS-MEQ)[21] for non-Triad stations, and highest concentration of individual primary COCs. Based on these rankings, polygons were selected for remediation on a "worst first" basis.

In recognition of the methodologies and limitations of traditional mechanical dredging, the irregular polygons were converted into uniform dredge units. Each dredge unit (sediment management unit or "SMU") was then used to develop the dredge footprint. The conversion from irregular polygons to SMUs is shown in Attachments 3 and 4. These attachments show the remedial footprint, inclusive of areas to be dredged ("dredge remedial area," in red) and under-pier areas ("under-pier remedial area," in green) to be remediated by other means, most likely by sand cover. Together, the dredge remedial area and the under-pier remedial area constitute the remedial footprint.

Upland source control measures in the watershed of municipal separate storm sewer system outfall SW-4 are also needed to eliminate ongoing contamination from this source, if any, and ensure that recontamination of cleaned up areas of the Shipyard Sediment Site from this source does not occur.

---

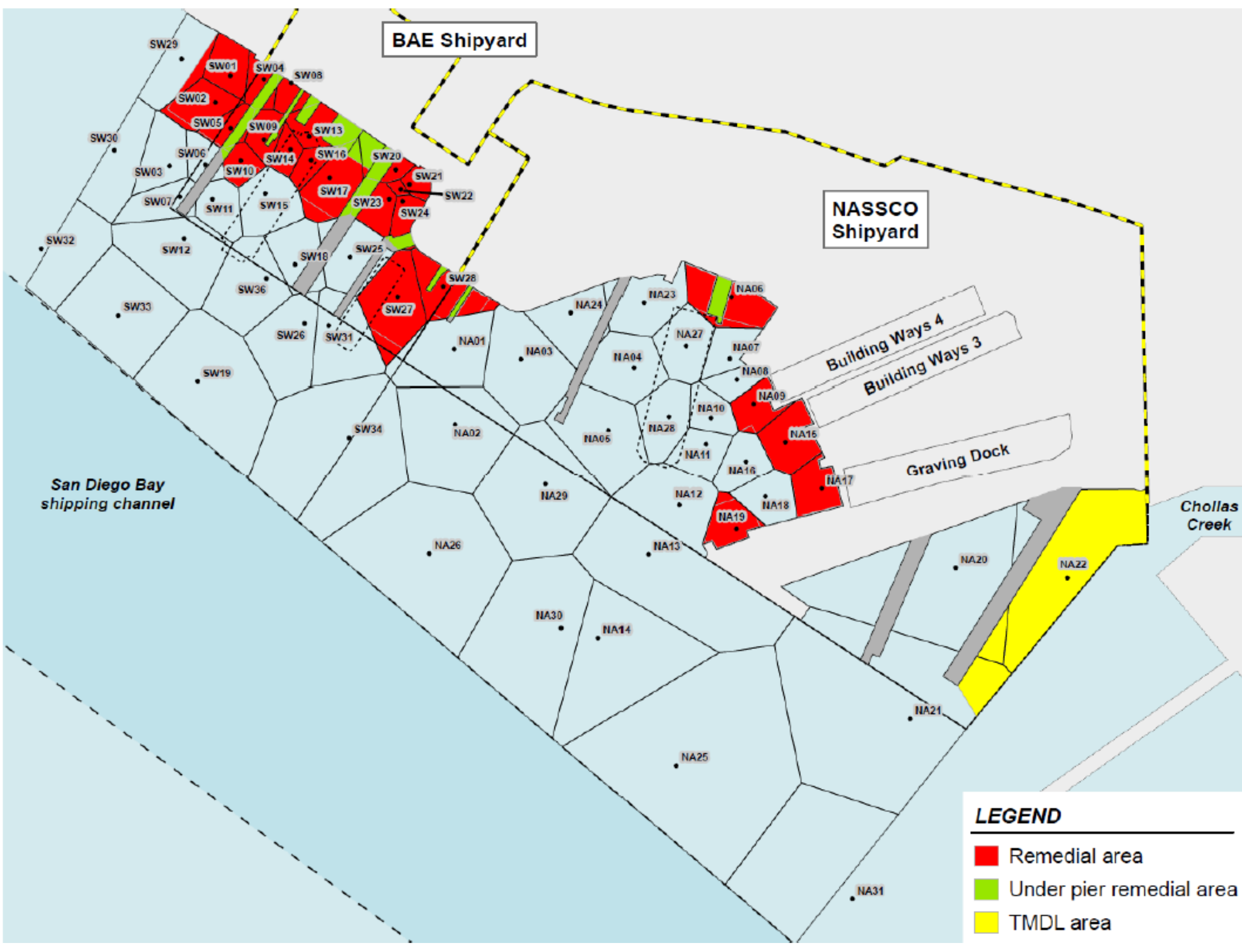
[21] The SS-MEQ is a threshold developed to predict likely benthic community impairments based on sediment chemistry at the Shipyard Sediment Site. The development, validation, and application of the SS-MEQ is described in Section 32.5.2 of the Technical Report.

33.1. Proposed Remedial Footprint

The proposed remedial footprint was developed based on the Thiessen Polygons determined to require remediation, as presented in Section 32. These polygons were used to associate a specific area (the area within a polygon) with the sediment chemistry, toxicity, and benthic sampling within the polygon. The sediment chemistry, toxicity, and benthic community data at the sampling station were assumed to be constant over the entire area of the polygon. The sediment chemistry concentrations at depth for each polygon targeted for remediation were then evaluated to determine the depth necessary to remediate each of those selected polygons to background sediment levels. Once remediation is completed, the SWAC within the remedial footprint is expected to be at or below background levels.

The polygons targeted for remediation are shown in red and green in Figure 33-1. The red areas are where the proposed remedial action is dredging. The areas shown in green represent inaccessible or under-pier areas that will be remediated by one or more methods other than dredging, as described in Section 30 Technological Feasibility Considerations.

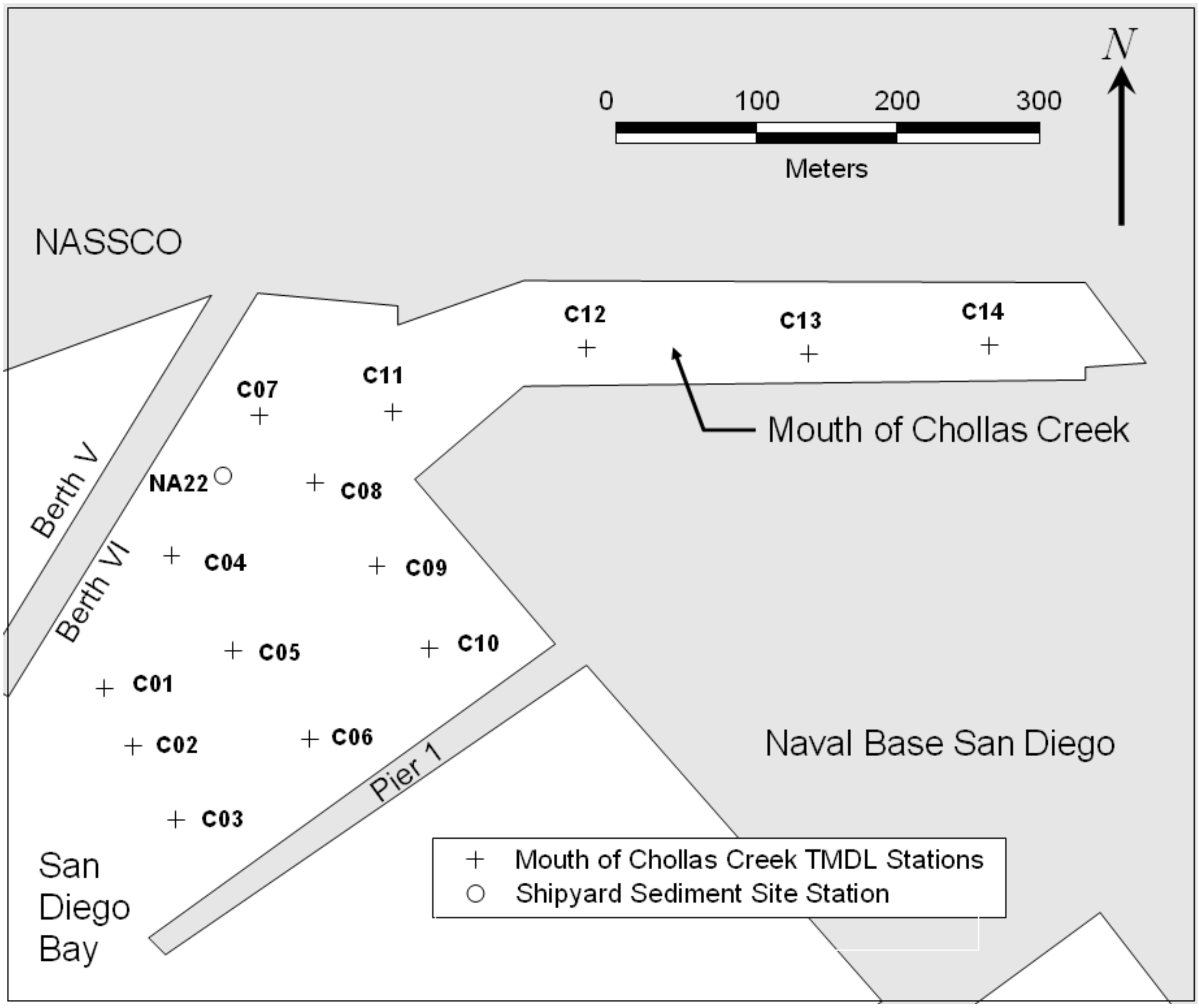
Figure 33-1 Polygons Targeted for Remediation



33.1.1. Exclusion of Station NA22 from the Remedial Footprint

The polygon for station NA22 is excluded from the remediation footprint. A Total Maximum Daily Load (TMDL) is being developed for the mouth of Chollas Creek, which encompasses one station (NA22) of the Shipyard Sediment Site study area. This TMDL will apply to sediments in the mouth of Chollas Creek. Figure 33-2 shows the Chollas Creek Mouth study area and the location of the NA22 sample station.

Figure 33-2 Chollas Creek Mouth Study Area and Shipyard Sediment Site Study Area Sample Location, NA22



During the TMDL study, over a dozen sediment samples were collected in the mouth of Chollas Creek (sample locations notated by a cross in Figure 33-2). These samples have been analyzed for physical parameters, chemistry, toxicity, and benthic communities. There is substantially more data collected in the Chollas Creek Mouth area as part of the TMDL than was collected during the Shipyards sediment study, in which one sample was collected at Station NA22. Therefore, substantially more data is available for decision making in the mouth of Chollas Creek at the completion of the TMDL than is available now.

The triad analysis weight-of-evidence category for Station NA 22, the station in the Chollas Creek Mouth area, was "Likely" impaired based on "Moderate" sediment chemistry, "Moderate" toxicity, and "Moderate" benthic community results for the three legs of the triad (see Table 18-1). NA22 is in an area where propeller testing occurs routinely, suggesting that physical impacts could be causing the impaired benthic condition. The additional samples from the TMDL will allow a better assessment of the causes of potential impairment in the mouth of Chollas Creek area, which will allow a more effective decision to be made. Therefore, the polygon represented by the station NA22 is excluded from the remediation footprint.

33.1.2. Remedial Footprint Stations Ranked by SWAC

The composite surface-area weighted average concentrations (composite SWACs) for all 5 COCs for each polygon was given a value and ranked to identify which polygons should be removed on a "worst-first" basis. The composite value accounts for all the COC concentrations at the station. The values and ranking are shown in Table 33-1, which includes the polygons within the remedial footprint.

Table 33-1 Remedial Footprint Polygons Ranked by SWAC

Polygon	Composite SWAC Ranking Value	Numerical Ranking
SW04	46.6	1
SW08	33.0	2
SW02	31.8	3
SW24	23.1	4
SW09	17.4	5
SW28	15.1	6
SW13	15.1	7
SW01	14.9	8
SW21	14.8	9
NA17	14.5	10
SW16	13.2	11
SW20	12.0	12
SW05	11.1	13
SW23	10.5	14
SW22	10.3	15
SW17	10.0	16
NA19	9.9	17
NA06	9.7	19
SW10	9.7	20
SW14	9.2	21
NA15	8.7	22
SW27	7.6	23
NA09	5.5	38

Note: See Appendix for Section 33 for supporting calculations.

33.1.3. Remedial Footprint Polygons Ranked by SS-MEQ

Each polygon without full Triad data (i.e., chemistry data only) was evaluated using the SS-MEQ threshold value of 0.9 to predict "Likely" impacted stations. This ranking also was ordered "worst-first," as identified in Table 33-2. There are more non-Triad polygons proposed for remediation than would otherwise be targeted using SS-MEQ alone, as five of the polygons had SS-MEQ values less than the 0.9 threshold (Table 33-2).

Table 33-2 Remedial Footprint Polygons Ranked by SS-MEQ

Polygon	SS-MEQ	Ranking
SW04	4.22	1
SW08	2.99	2
SW02	2.87	3
SW24	1.82	4
SW09	1.60	5
SW13	1.48	6
NA17	1.41	7
SW01	1.42	8
SW16	1.28	9
SW21	1.25	10
SW28	1.20	11
NA06	1.11	12
SW20	1.02	13
SW05	0.94	14
SW23	0.93	15
SW22	0.92	16
SW17	0.92	17
NA19	0.92	18
SW14	0.88	20
NA15	0.87	21
SW10	0.78	22
SW27	0.68	30
NA09	0.62	37

Note: See Appendix for Section 33 for supporting calculations.

33.1.4. Remedial Footprint Generally Includes Areas with Highest Concentrations of COCs

To ensure that the polygons with the highest individual COC concentration are remediated, each polygon was rank-ordered independently for each of the COCs. This rank order is presented in Tables 33-3 through 0.

Table 33-3 Polygons with Highest Individual COCs

Polygon	Total HPAH
SW24	52,000
SW08	25,500
SW09	17,000
SW28	17,000
SW10	16,000
NA07*	15,850
SW02	14,500
SW04	14,000
SW05	13,000
SW22	12,000

Polygon	PCB Congeners
SW02	5,450
SW04	4,000
SW21	2,400
SW08	2,100
SW28	2,100
SW20	1,600
SW01	1,600
SW05	1,200
SW23	1,000
NA19	990

Polygon	Tributyltin
SW04	3,250
SW08	1,850
NA17	1,350
SW16	1,100
SW09	910
SW13	790
NA15	670
NA19	570
SW14	450
SW01	450

Table 33-4 Polygons with Highest Individual COCs

Polygon	Copper
SW04	1,500
SW08	920
SW13	800
SW09	660
SW02	580
SW01	560
NA17	510
SW16	430
NA06	395
NA27*	390

Polygon	Mercury
SW02	4.5
NA06	2.4
SW08	2.3
SW19*	2.1
SW24	1.9
SW04	1.8
SW01	1.5
NA07*	1.5
SW21	1.4
NA09	1.2

Polygon	Lead
SW04	430
SW08	225
SW09	220
SW02	170
SW01	145
NA06	130
NA23*	120
SW05	120
SW21	120
NA17	115

Table 33-5 Polygons with Highest Individual COCs

Polygon	Arsenic
SW04	73
SW09	27
SW08	24
NA08*	18
SW13	15
SW06*	15
SW23	15
NA17	15
SW28	14
SW20	14

Polygon	Zinc
SW04	3,450
SW09	1,200
SW08	830
NA17	620
SW02	585
SW13	580
SW01	520
NA27*	500
NA19	450
NA23	430

Polygon	Cadmium
SW02	3.2
SW04	2.0
SW09	1.1
SW10	0.9
SW05	0.9
SW06*	0.9
SW08	0.7
SW03*	0.7
SW16	0.7
SW13	0.4

*Polygons not within the remedial footprint

Each of the polygons excluded from the remedial footprint, as identified Table 33-3, was independently evaluated to determine consistency with the SWAC and SS-MEQ ranking of stations. Table 33-6 identifies the rational for exclusion of these seven polygons from the remedial footprint.

Table 33-6 Rationale for Exclusion of Polygon from Remedial Footprint

Polygon	Rationale for Exclusion
NA07	• Triad station – not "Likely" impaired • All COCs below 60%LAET values • Low toxicity and low benthic impacts • Technical infeasibility
NA08	• All COCs below 60%LAET and SS-MEQ values • Technical infeasibility
NA23	• All COCs below 60%LAET and SS-MEQ values • Technical infeasibility
NA27	• All COCs below 60%LAET and SS-MEQ values • Technical infeasibility
SW03	• Triad station - Low toxicity and low benthic impacts • All COCs below 60%LAET and SS-MEQ values • Cd not a cleanup driver
SW06	• All COCs below 60%LAET and SS-MEQ values • Triad analysis – not "Likely" impaired
SW19	• All COCs below 60%LAET and SS-MEQ values • Triad analysis – not "Likely" impaired

The NA07, NA08, NA23, and NA27 polygons all had technical infeasibility problems associated with dredging. The NA07 polygon is technically infeasible to dredge due to stability concerns about the sheetpile bulkhead on the shoreline and slope near the floating dry dock sump. Any dredging in this area would drastically undermine the slope as well as impacting the sheetpile bulkhead on the east side.

The NA08 polygon is technically infeasible to dredge due to stability concerns about the sheetpile bulkhead on the shoreline and slope near the floating dry dock sump. Any dredging in this area would drastically undermine the slope as well as impacting the sheetpile bulkhead on the east side. The east side of NA08 also supports the structure of the gate at Ways 4. Any dredging in this area would drastically undermine the slope as well as impacting the sheetpile bulkhead on the east side.

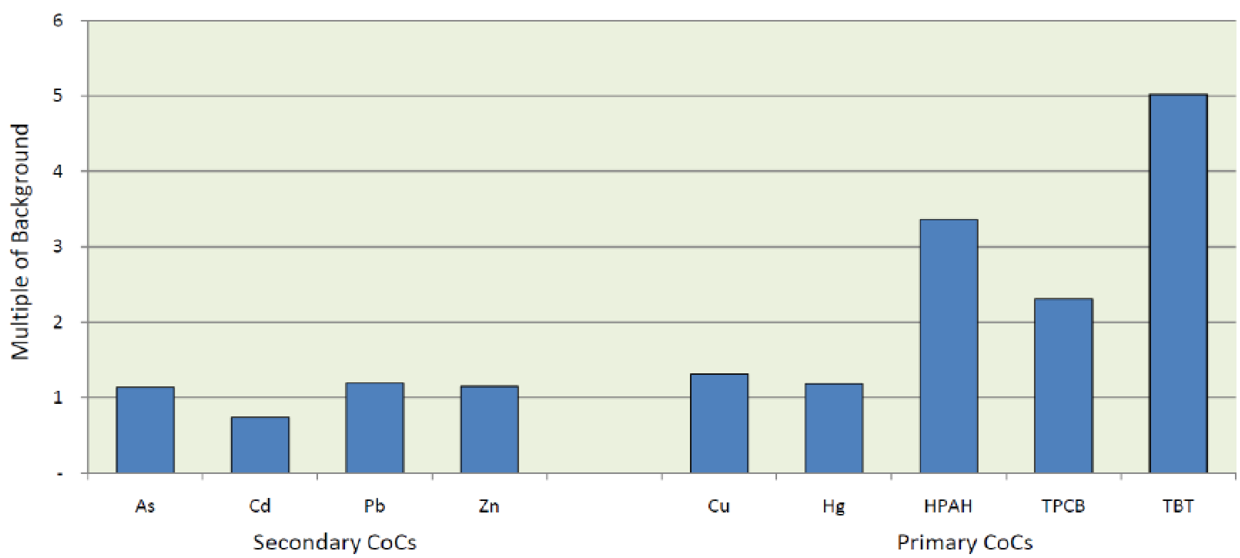
The NA23 polygon is technically infeasible to dredge because dredging would affect Pier 12, the tug boat pier, the rip-rap shoreline, as well as undermining the sediment slope for the floating dry dock sump.

The NA27 polygon is technically infeasible to dredge because the polygon is entirely within the footprint of the floating dry dock sump. Dredging would significantly undermine the slope.

33.2. Evaluation of Estimated Post-Remedial SWACs Relative to Background Sediment Chemistry Levels

Following remediation of all areas identified above, the estimated post-remedial SWAC concentrations in sediment at the site compared to background sediment chemistry levels (see Section 29) are shown in Figure 33-3. The SWAC for cadmium will be below the estimate background concentration, while the SWACs for arsenic, lead, zinc, copper, and mercury will be less than 1.5 times background.

Figure 33-3 Comparison of Post-Remedial SWACs to Background Sediment Chemistry Levels



33.3. Preliminary Remedial Design

In recognition of the methodologies and limitations of traditional mechanical dredging, the irregular polygons were converted into uniform dredge units. Uniform dredge units allow the dredge operator to develop transects of linear, but regular, proportions, e.g., straight lines and 90 degree angles. As a practical matter, uniform dredge units also allow planners to create dredge boxes (units) that contain the same volume of dredge material represented by a given polygon. Each dredge box (sediment management unit or "SMU") is then used to develop the dredge footprint. The details of the area and volume of dredging and under pier areas are identified in Table 33-7.

Table 33-7 Remedial Footprint Details

Activity	North	South
Dredge Remedial Area (Square Feet)	438,300	217,800
Under Pier Remedial Area (Square Feet)	89,980	13,725
Total Remedial Area (Square Feet)	528,295	231,495
Dredge Volume (Cubic Yards)	90,800	52,600

Note: See Appendix for Section 33 for supporting calculations.

The conversion from irregular polygons to SMUs is shown in Figures 33-4 and 33-5. These figures show the proposed remedial footprint, inclusive of areas to be dredged (red areas) and under-pier areas to be remediated by other means (green areas).

Figure 33-4 "North" Dredge Footprint based on SMUs

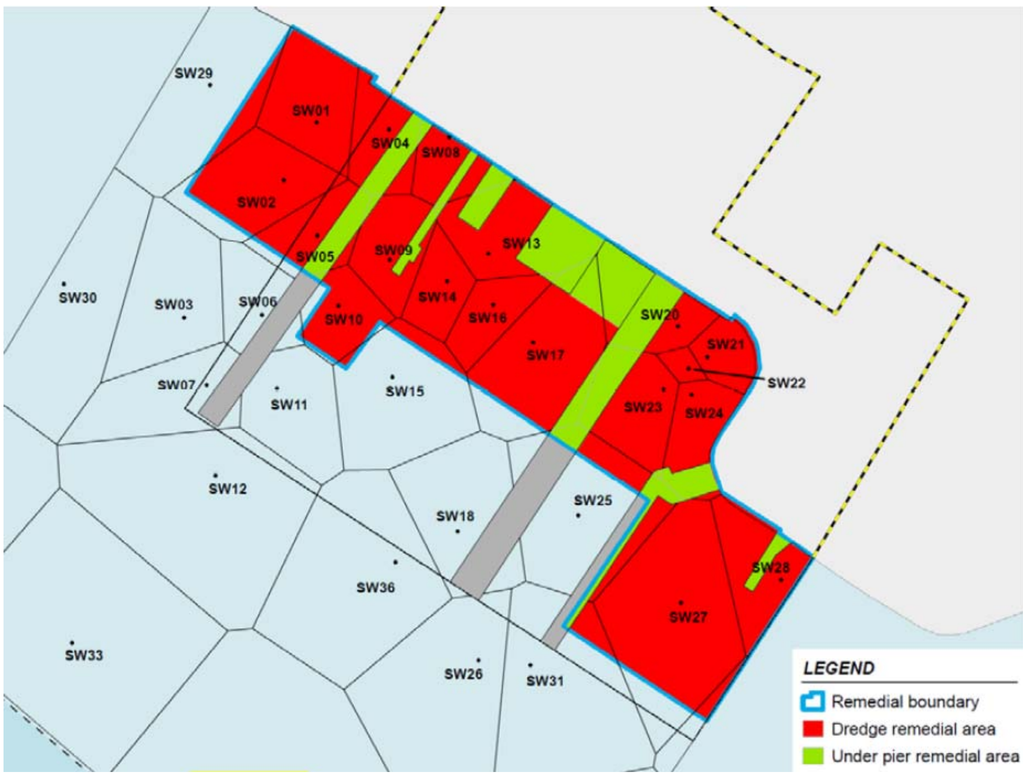
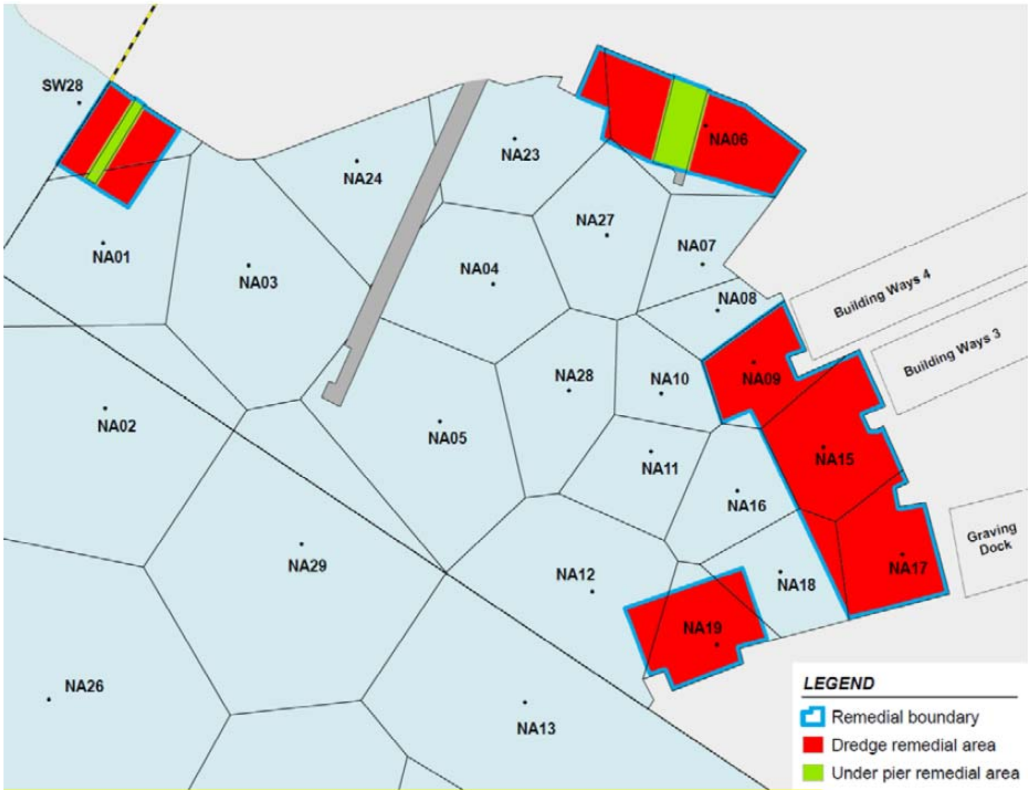


Figure 33-5 "South" Dredge Footprint based upon SMUs



As discussed in Section 30, remedial measures may include dredging (with or without backfill), capping, and thin-layer covers. The presumed remedial measure in accessible areas is dredging. For under-pier areas and other locations, where significant impacts to infrastructure (e.g., piers, wharves and bulkheads) are likely, alternatives to dredging are proposed.

Sand capping is proposed in areas immediately adjacent to sheet pile bulkheads and beneath piers, and is expected to result in achievement of target SWAC concentrations and aquatic life beneficial use concerns. Where necessary, rock or gravel may also be used to fortify or stabilize the sand capping in these set-back areas. Inaccessible areas under piers will be remediated using technically feasible techniques such as placement of a sand layer, nominally 1 to 2 feet in thickness, on top of existing sediment. Design details of the remedial action will be specified in the Remedial Action Plan (RAP) required by CAO No. R9-2011-0001.

Dredge material is currently proposed for upland landfill as daily cover or fill. Local landfills have accepted dredge material for use in daily cover from other dredge projects in San Diego Bay where ocean disposal or beneficial reuse was not appropriate. Alternatives for local landfill disposal include other landfill locations in Southern California or out of state disposal. Upland disposal requires that dredge material be dewatered prior to disposal. This is necessary for at least two reasons. First, California landfills will not accept waste that exceeds a specific moisture content. Generally this includes passing a "paint filter test." Second, transportation of excessively moist material can cause spillage or leaks during transportation. Currently, no site has been identified for off-loading, drying, stockpiling, and loading for transportation of dredged sediment. In addition to identifying a site for sediment management, there are logistical impacts related to traffic, as well as concerns by the local community who may be impacted by the significant number of trucks that would be required to transport the dredged sediment to its ultimate disposal location.

Alternatives to upland disposal, as identified in Section 30 include in-Bay confined aquatic disposal (CAD) or near-shore confined disposal facility (CDF). While these alternatives themselves have many challenges, they should be considered as alternatives to upland disposal as part of the RAP.

33.3.1. Proposed Remedial Footprint Characteristics

The proposed remedial footprint has the following characteristics:

- Total of 23 Polygons
- Captures 100 percent of Triad "Likely" and 69 percent of Triad "Possibly" impacted stations
- Captures all non-Triad stations with COC concentrations above the 60%LAET and SS-MEQ thresholds
- Total Remedial Surface Area (including under piers) = 764,034 ft^2
- Under-pier Remedial Surface Area = 102,202 ft^2
- Dredge Volume = 143,400 $yards^3$
- Achieves SWAC for protection of human health and wildlife
- SWACs are at or near background for 6 out of 9 COCs

The estimated post-remedial SWACs are compared to the current or pre-remediation SWACs in Table 33-8. The pre- and post-remediation station maximum SS-MEQ is also shown.

Table 33-8 Comparison of Pre- and Post-Remedial SWACs

COCs	Background	Pre-Remedy		Post Remedy	
		SWAC	Station Maximum	SWAC	Station Maximum
Primary COCs					
Cu (mg/kg)	121	187	1,500	159	320
Hg (mg/kg)	0.57	0.75	4.5	0.68	2.1
HPAH (µg/kg)	663	3,509	52,000	2,451	15,850
PCB (µg/kg)	84	308	5,450	194	495
TBT (µg/kg)	22	162	3,250	110	410
Secondary COCs					
As (mg/kg)	7.5	9.4	73	8.7	18
Cd (mg/kg)	0.33	0.28	3.2	0.2	0.46
Pb (mg/kg)	53	73	430	66	100
Zn (mg/kg)	192	252	3,450	221	390

Note: See Appendix for Section 32 for Primary COC supporting calculations. See Appendix for Section 33 for Secondary COC supporting calculations.

While the above information, in conjunction with Triad and Non-Triad data evaluations, was used to develop the remedial footprint and anticipated strategy for implementation, the final engineering details necessary to execute the remedial action will require the responsible parties to submit for review and approval a Remedial Act Plan that provides the level of detail necessary to ensure the targeted remedial action will be successful. Many of those details, such as selection of an on-shore dredge material handling site, upland sediment disposal site(s), and alternatives to upland disposal, simply cannot be determined without more extensive engineering assessment and public comment.

33.4. Upland Source Control in Watershed of MS4 Outfall SW-4

Storm water runoff from the shipyards is controlled and monitored in both the BAE Systems and NASSCO NPDES permits. Also, the City of San Diego MS4 outfall located at the foot of Sampson Street discharges at outfall SW4 within the BAE Systems facility. To reduce the risks of ongoing contamination and recontamination post-cleanup from potential pollutant sources in the watershed that drains to MS4 outfall SW-4, several activities will be completed in the watershed of the SW-4 outfall (shown in Figure 33-6) as part of the remedy. These activities include:

- Investigate the storm drain and surrounding environs to identify sources of pollutants to the storm drain.
- Clean out residual sediments in the storm drain.
- Place structural treatment control Best Management Practices (BMPs), where feasible, in the storm drain system to mitigate entry of pollutants into the storm drain to the maximum extent practicable.
- Maintain BMPs, as necessary, to prevent significant degradation in their performance.

Figure 33-6 Map of Watershed that Drains to MS4 Outfall SW-4

34. Finding 34: Remedial Monitoring Program

Finding 34 of CAO No. R9-2011-0001 states:

Monitoring during remediation activities is needed to document that remedial actions have not caused water quality standards to be violated outside of the remedial footprint, that the target cleanup levels have been reached within the remedial footprint, and to assess sediment for appropriate disposal. This monitoring should include water quality monitoring, sediment monitoring, and disposal monitoring.

Post-remediation monitoring is needed to verify that remaining pollutant concentrations in the sediments will not unreasonably affect San Diego Bay beneficial uses. Post-remediation monitoring should be initiated two years after remedy implementation has been completed and continue for a period of up to 10 years after remediation. For human health and aquatic dependent wildlife beneficial uses, post-remediation monitoring should include sediment chemistry monitoring to ensure that post-remediation SWACs are maintained at the site following cleanup. A subset of samples should undergo bioaccumulation testing using *Macoma*. For aquatic life beneficial uses, post-remediation monitoring should include sediment chemistry, and toxicity bioassays to verify that post-remedial conditions have the potential to support a healthy benthic community. In addition, post-remediation monitoring should include benthic community condition assessments to evaluate the overall impact of remediation on the benthic community re-colonization activities.

Environmental data has natural variability which does not represent a true difference from expected values. Therefore, if remedial monitoring results are within an acceptable range of the expected outcome, the remedial actions will be considered successful.

34.1. Remediation Monitoring

Remediation monitoring is the monitoring phase conducted during remedy implementation and consists of three components: 1) water quality monitoring, 2) sediment monitoring, and 3) disposal monitoring. The objectives of this monitoring are to document that cleanup activities have not caused water quality standards to be violated outside of the remedial footprint, that the target cleanup levels have been reached within the remedial footprint, and to assess sediment for appropriate disposal. If the monitoring shows that any of these objectives are not being met, then action will be taken to bring the remedy implementation into compliance. Monitoring decision rules which specify when an action should occur and the type of action that should occur are also discussed in this section. At a minimum, the remediation monitoring provisions described below should be included in the waste discharge requirements issued by the San Diego Water Board for dredging activities which may have additional dredging and monitoring requirements.

34.1.1. Water Quality

The goal of water quality monitoring during active remediation is to demonstrate that remedy implementation does not result in violations of water quality standards outside the construction area, specifically at a distance of 500 feet from the dredging activity as the point of compliance. Measures of turbidity and dissolved oxygen (DO) will be used to assess compliance with water quality monitoring goals. One of two methods will be employed:

1. Prior to remedy implementation, a model of turbidity and synoptic water quality measures will be developed for ambient conditions. This model will be used to determine if monitored turbidity would likely result in unacceptable water quality. Turbidity measures will be monitored from four samples each on two arcs outside of the construction area: one arc at 250 feet and one arc at 500 feet. Samples will be collected from a depth of 10 feet below the water surface. Monitored turbidity measures will be compared to synoptic "ambient" measurements outside the construction area, including Bay conditions and effects of non-remedial shipyard activities. The samples collected from the 250 foot arc are intended to warn of potential problems with the point of compliance at the 500 foot arc.

2. Real time monitoring of turbidity and DO readings will be taken synoptically at locations 250 feet from the dredge zone, 500 feet from the dredge zone, and at ambient locations. The 250 and 500 feet measurements will be compared to real time ambient readings taken by the same type of meters. If turbidity exceeds the ambient concentration by more than the error rate of the monitors' measurement ability, then appropriate corrective action will be taken in the dredge area. As in the prior option the 250 foot arc will warn of potential problems and the 500 foot arc will be the point of compliance.

The frequency of water quality monitoring may be reduced if three days of daily monitoring (performed at the start of dredging activities) shows that no samples exceed water quality targets. In this event, water quality monitoring will be reduced from daily to weekly. Monitoring frequency will return to daily if a significant change in operations occurs. Monitoring frequency can again be reduced to weekly if three days of monitoring show that there are no exceedances.

With respect to water quality, if turbidity or DO are not compliant at 250 feet, the construction activities will be adjusted to reduce turbidity and raise DO to achieve compliance. If turbidity or DO problems are found at 500 feet from the construction area, then remediation activities will be halted while best management practices (BMPs) and alternate remedial methods (i.e., equipment) are evaluated.

34.1.2. Sediment Conditions

Sediment monitoring during dredging activities is intended to confirm that remediation has achieved target cleanup levels within the remedial footprint. This confirmation sampling is necessary because sediment resuspension and chemical release are unavoidable during dredging (U.S. ACE 2008b). Resuspended particulate material will be re-deposited and some resuspended contaminants may also dissolve into the water column and be available for uptake by biota.

Sediments are resuspended not only from the dredge bucket, but also by other mechanisms associated with dredging such as spillage, prop wash, and anchor systems. Chemical release can occur when bed sediments are suspended in the water column and increased turbidity can itself degrade acceptable levels of habitat quality for organisms in the water column. Re-deposition may occur near the dredge area or, depending on the environmental conditions and controls, resuspended sediment may be transported to other locations in the water body. Further, sediment dredging activities are planned such that a sufficient volume of contaminated sediment is removed; however, removing all particles of contaminated sediment is neither practical nor feasible.

Sediment monitoring will occur in footprint polygons and will be implemented immediately after the dredging contractor has confirmed that dredge depths within the footprint area have been achieved. Dredge depths are confirmed using multibeam dual frequency sonar coupled to differential Global Positioning System (dGPS) equipment. Confirmation sediment sampling will consist of core sediment sample collection in each footprint polygon. Sediment concentrations in a horizon that represents the first undisturbed depth beneath the dredge depth will be measured. This will be determined based on the accuracy to which the dredge operator can guarantee the depth to which they dredge. Samples will be collected from beneath this elevation using appropriate sampling techniques. Sample cores will be just deep enough to collect sufficient sample for analysis. COCs that will be monitored and compared to background sediment chemistry levels include PCBs, copper, HPAHs, TBT, and mercury. The background sediment chemistry levels can be found in Section 29, Table 29-1.

With respect to determining sediment remediation success, there will be natural variability in the sediment chemistry data collected, which does not represent a true difference from the expected value. Natural variability can be attributed to random error in laboratory instrument outputs, sample collection and handling techniques, grain size distribution variance in sediment samples, or other random non-systematic differences that cannot be measured or specifically accounted for. Furthermore, sediment cannot be dredged at depths of 10 centimeters or less. Therefore, dredging success will be evaluated based on the following decision rules applied to subsurface monitored sediment:

- If concentrations of COCs in subsurface sediments (deeper than the upper 10 cm) are above 120 percent of background sediment chemistry levels,[22] then additional sediments will be dredged by performing an additional "pass" with the equipment.

- If concentrations of COCs in subsurface sediments are below 120 percent of background concentrations, then dredging is sufficient and will stop. A sand cover cap will be placed on the sediment surface, if necessary.

- If no sample can be collected because the equipment cannot penetrate a hard substrate, than this area will be evaluated to determine whether sand cover is required.

---

[22] See Table 29-1 for background concentrations of COCs.

34.1.3. Disposal

When dredging sediments, waste characterization of the dredged sediments is necessary to identify the disposal options which include landfills, confined aquatic disposal facilities (CDFs), uplands re-use, or open water disposal. Disposal options for dredged sediments are typically based on an array of tests which are dictated by the disposal facility. The testing of dredged sediments at this site will occur in a two-tiered approach.

Tier 1 evaluation will be based on existing data. Results will be compared to federal and state disposal criteria, as well as disposal facility specific requirements. The sediments in San Diego Bay have been adequately characterized to facilitate preliminary and conditional approval for identifying general disposal options which include hazardous and non-hazardous wastes landfills.

Tier II testing will occur when specific landfills have been selected for disposal. For uplands disposal, the dredged sediments typically shall require stockpiling and de-watering prior to disposal. Most uplands landfills require leaching tests for specific chemicals prior to final disposal and these can be performed on the stockpiled sediments after de-watering has occurred. Concentrations of chemicals in the leachate are compared to limit values allowing the dredged material to be characterized as non hazardous or hazardous, allowing disposal of the sediments in the appropriate type of landfill. Moisture content will be necessary as well as potentially other physical property measurements for upland disposal or re-use options. Development and placement of materials in CDFs is often preferred to uplands disposal as it minimizes the amount of distance and associated risks with transporting materials. Requirements of CDFs typically include data to show the sediments do not contain free oil, are not designated as hazardous waste, and do not exceed limits on TPH concentrations. Additionally, the geotechnical properties and leachability of the sediments must be shown to be protective of human health and the environment when allowances are made for mixing and natural attenuation. If a CDF in San Diego Bay is determined to be a viable option, Tier II testing to evaluate geotechnical properties associated with the sediments will be completed prior to the start of the sediment dredging activity.

Specific requirements for waste characterization will be developed once a disposal facility or option is developed as these options will dictate the extent and type of characterization required.

34.2. Post-Remediation Monitoring

The objective with post-remedy implementation monitoring is to verify that remaining pollutant concentrations in the sediments will not unreasonably affect San Diego Bay beneficial uses. These long-term beneficial uses include shellfish harvesting (SHELL), commercial and sport fishing (COMM), contact water recreation (REC-1), non-contact water recreations (REC-2), estuarine habitat (EST), marine habitat (MAR), wildlife habitat (WILD), and migration of aquatic organisms (MIGR). The sediment monitoring program will be based upon a conceptual model of the site that identifies the physical and chemical factors that control the fate and transport of pollutants and receptors that could be exposed to pollutants in the sediment.

Post-remediation monitoring will be initiated two years after remedy implementation has been completed and will continue for a period of up to 10 years after remediation.

34.2.1. Human Health and Aquatic-Dependent Wildlife

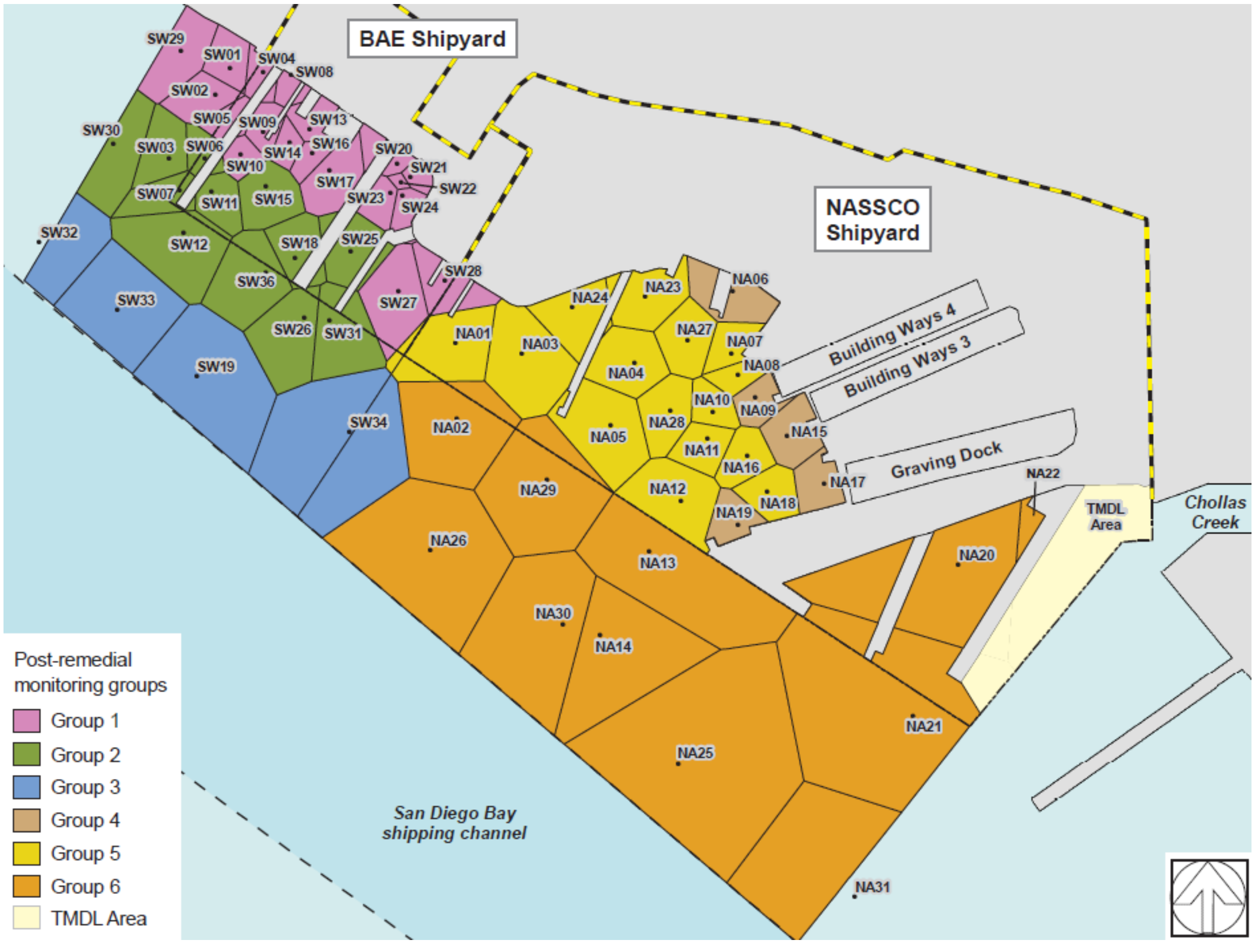
Post-remediation monitoring is intended to verify that remediation was effective in reducing and maintaining pollutants in sediments at levels that do not unreasonably impact human health and aquatic-dependent wildlife. To achieve these goals, composite surface sediment samples will be collected from six polygon groups comprising sub-regions of the site. The six groups are described below and shown in Figure 34-1:

Group 1. Northern half of the site inside the remedial footprint
Group 2. Northern half of the site outside the remedial footprint – smaller polygons
Group 3. Northern half of the site outside the remedial footprint – larger polygons
Group 4. Southern half of the site inside the remedial footprint
Group 5. Southern half of the site outside the remedial footprint – smaller polygons
Group 6. Southern half of the site outside the remedial footprint – larger polygons

To prepare the composite samples, the 65 station locations within the six polygon groups will be sampled. The volume of the sample at each station will be proportional to the area of the polygon the station represents. These samples will be collected from the 0-2 cm interval. Two (2) grab samples will be composited in the field at each station. The composite samples will be separated into six (6) pools and composited into six (6) composite samples representing the areas noted above. Three (3) replicates will be taken from each of these six (6) composite samples and analyzed for the COCs. The average concentration of each of the six (6) composites will be calculated from the analytical results of the replicates for each COC. The average concentrations represent SWACs for each of the six (6) polygon groups. The site-wide SWAC calculated from the average COC concentrations of the six (6) composite sample results is consistent with the SWAC method discussed in this Technical Report. The three replicate sub-samples of composite samples provide an estimate of variances in the compositing process. Sample material from the 65 station-specific composite samples will be archived for potential future analysis.

Analyses of surface sediment samples will include sediment bulk chemistry of the parameters PCBs, copper, mercury, HPAHs, and TBT, and sediment conventional parameters (e.g., grain size and TOC). Nine (9) sediment samples will undergo bioaccumulation testing using the 28-day *macoma* test. The samples selected for bioaccumulation testing will be from the same stations that underwent bioaccumulation testing in the Shipyard Report (Exponent, 2003). These stations are SW04, SW08, SW13, SW21, SW28, and NA06, NA11, NA12, and NA20.

Figure 34-1 Polygon Groups for Composite Sampling



The frequency of sediment sampling and analyses (chemical, physical, and bioaccumulation) will occur at two and five years post-remediation and, depending on the results at year five post-remediation, may also occur at ten years post remediation.

The goals of the sediment chemistry monitoring are to demonstrate that the post-remedial site-wide SWACs are at or below threshold target levels for specific COCs. The goals of bioaccumulation testing are to show decreasing bioaccumulation over time such that at two years post-remediation, the average of stations sampled shows bioaccumulation levels below what was measured in the Shipyard Report (Exponent, 2003) and that this decreasing trend continues at year five post-remediation and, if determined necessary, at year ten post-remediation.

34.2.2. Post-Remediation SWAC Trigger Concentrations

When collecting environmental data, there is natural variability in the data collected, which does not represent a true difference from the expected value. Natural variability can be attributed to random error in laboratory instrument outputs, sample collection and handling techniques, grain size distribution variance in sediment samples, or other random non-systematic differences that cannot be measured or specifically accounted for. Therefore, if the measured SWAC is within a range of the expected SWAC, then it can be stated with statistical significance that the expected

SWAC was achieved. This is accounted for with statistically calculated confidence limits that describe the amount that the measured SWAC can vary from the expected SWAC and still be considered to be the same as the expected SWAC due to random error in the sampling or analytical techniques. The 95 percent Upper Confidence Limit (UCL) is typically employed in environmental sampling programs to determine if a measured set of values are significantly different from the expected set of values.

SWAC trigger concentrations will be used to evaluate whether SWAC cleanup levels have been met, or whether further action is needed. These concentrations represent the surface-area weighted average concentration expected after cleanup, accounting for the variability in measured concentrations throughout the area. If the SWAC after remediation is below the trigger concentration then remediation will be considered successful. Exceedance of the trigger concentration will result in further evaluation of the site-specific conditions to determine if the remedy was successful. For these post-remedial comparisons, it is critical to account for the natural variability of the predicted post-remedial SWAC.

The trigger levels for each primary COC was set at the upper 95 percent confidence limit (UCL) on the estimated post-remediation SWAC. The post-remediation SWAC is based on measured concentrations in non-remediated areas and background concentrations in the areas to be remediated. Calculation of the UCL requires an estimate of the variability in concentrations following remedial activities. The UCL trigger concentrations assumed that remediated areas have the same variability as non-remediated areas. This variability was estimated based on the area-weighted variability of the measured concentrations in the non-remediated areas. Specifics regarding the area-weighted variability estimate and the resulting UCL calculation can be found in Bevington and Robinson (1992).

The trigger concentrations for the primary COCs are listed in Table 34-1, below.

Table 34-1 Trigger Concentrations for Primary COCs

Primary COCs	Trigger Concentrations
Copper	185 mg/kg
Mercury	0.78 mg/kg
HPAHs	3,208 µg/kg
PCBs	253 µg/kg
TBT	156 µg/kg

Note: See Appendix for Section 34 for supporting calculations.

34.2.3. Benthic Community Conditions

The purpose of assessing benthic community conditions as part of post-remedy monitoring is to demonstrate the remediation will successfully create conditions that would be expected to promote re-colonization of a healthy benthic community. This objective will be evaluated by collecting surface sediment samples (0-2 cm interval) from selected stations within the remedial footprint where pre-remedial Triad analyses showed likely effects on benthic receptors. Chemistry and toxicity tests will be performed on these samples to determine if they are likely to have effects on benthic receptors.

Surface sediment samples will be collected at five stations within the footprint area: NA19, SW04, SW13, SW22, and SW23. The frequency of sediment sampling and analyses (chemical, physical, and bioassay testing) will occur at two and five years post-remediation and, depending on the results at year five post-remediation, may also occur at ten years post remediation.

Sediments will be analyzed for sediment conventional parameters (e.g., grain size, TOC, ammonia) and the following: arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, TBT, PCBs, and PAHs.[23] Additionally, sediments will be evaluated using two types of sediment toxicity tests in accordance with protocols recommended by the San Diego Water Board: (1) 10-day amphipod survival test using *Eohaustorius estuarius* exposed to whole sediment, and (2) 48 hour bivalve larva development test using the mussel *Mytilus galloprovincialis* exposed to whole sediment at the sediment-water interface.

Results from the chemical analyses and bioassays will be evaluated in accordance with the flow diagrams in Figures 34-2 and 34-3 to determine if further evaluation or action is necessary based on benthic effects indicators.[24]

[23] See Appendix for Section 34 for list of PCBs and PAHs.

[24] The 2005 Final Reference Pool shall be used for this evaluation (see Section 17).

Figure 34-2 Flow Diagram for the Sediment Chemistry Ranking Criteria (Low, Moderate, and High)

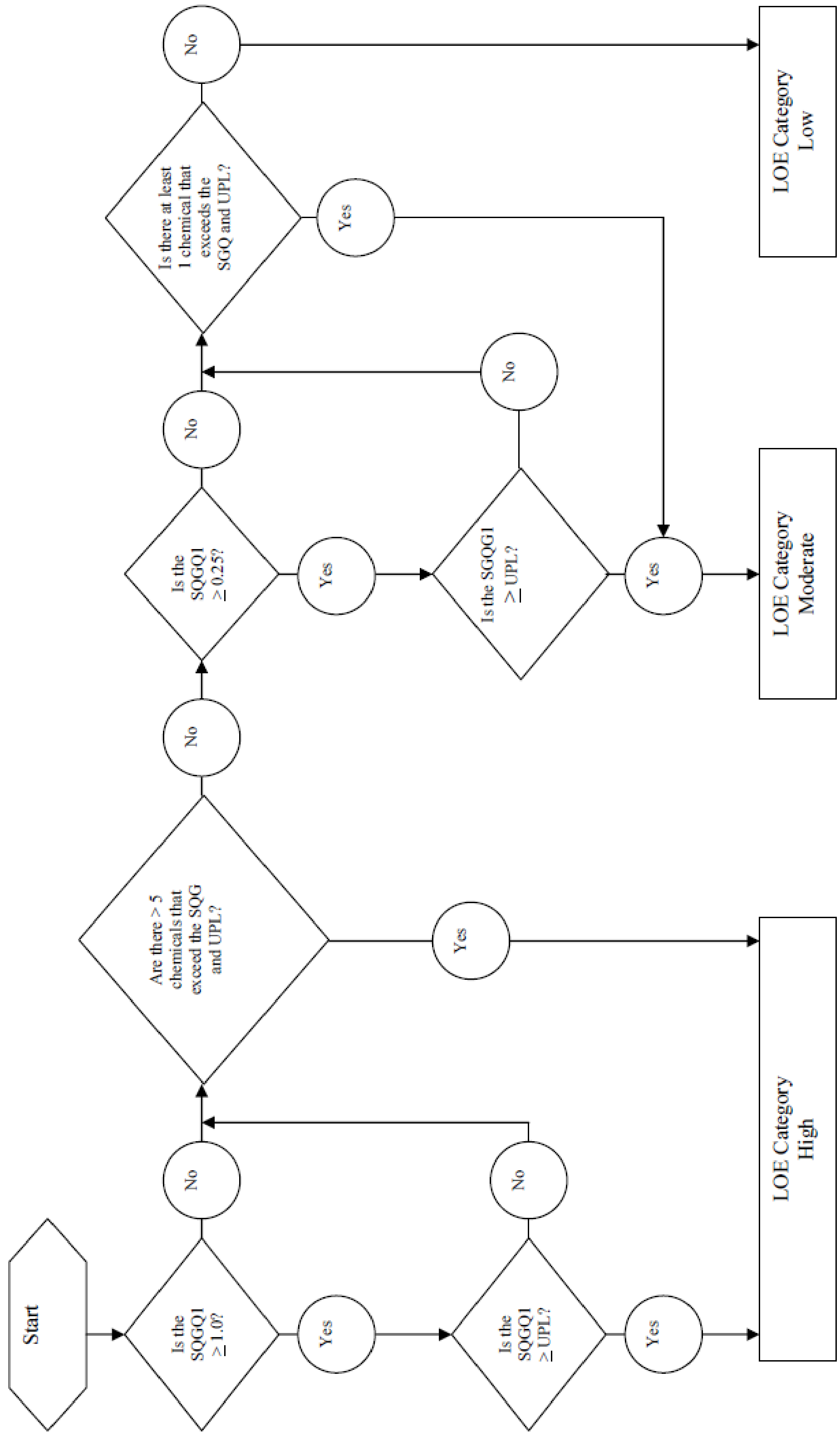
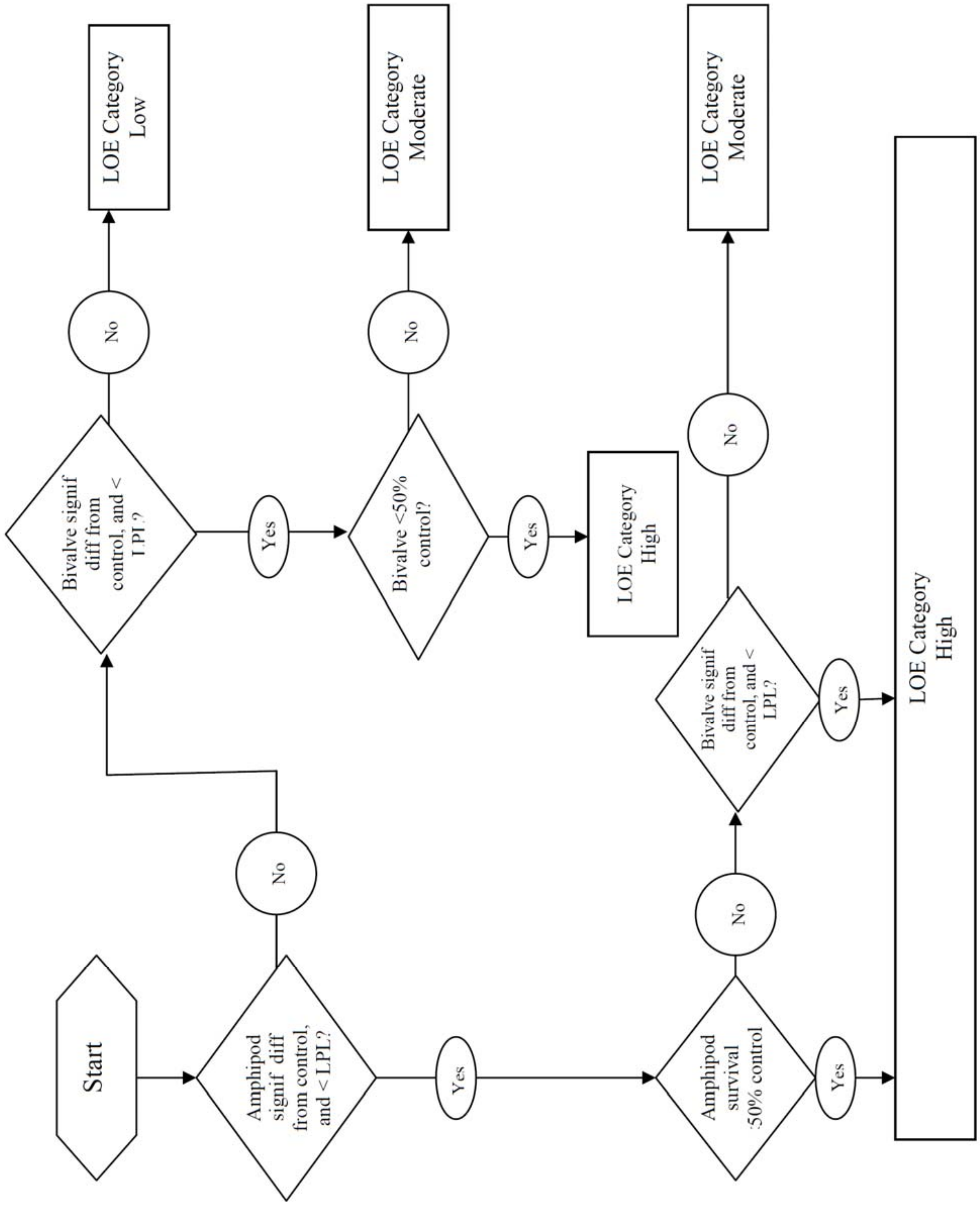


Figure 34-3 Flow Diagram for the Toxicity Ranking Criteria (Low, Moderate, and High)



34.2.4. Benthic Community Development

The purpose of assessing benthic community development as part of post-remedy monitoring is to determine how the benthic community develops within the footprint following remediation. Note that dredging temporarily destroys the benthic community. The intent of these benthic community measurements is to track the degree to which the benthic community re-colonizes the area and will not be used to evaluate the success of the remedy. Benthic community analyses will consist of full taxonomic analyses at five randomly selected sample locations from within the remedial footprint. The random samples will be stratified to assure two to three samples are collected from each of the two shipyard areas, and that sample locations for chemistry, toxicity, and bioaccumulation are avoided as they could potentially be disturbed by sampling activities. Further, to also avoid potential benthic community disturbances from sediment sampling, benthic community development will be assessed on years three and four post-remediation, alternate from sediment sampling years.

The goal of monitoring benthic community development is to observe the nature and extent (e.g., species composition, abundance, and diversity) of re-colonization over time after remediation. All benthic invertebrates in the screened sample shall be identified to the lowest possible taxon and counted. This information will be used to measure the benthic community re-colonization and will be used to assist with remedial decision making elsewhere in San Diego Bay.

35. Finding 35: Remedial Action Implementation Schedule

Finding 35 of CAO No. R9-2011-0001 states:

The dischargers have proposed a remedial action implementation schedule and a description of specific remedial actions they intend to undertake to comply with this CAO. The remedial action implementation schedule will begin with the adoption of this CAO and end with the submission of final reports documenting that the alternative sediment cleanup levels have been met. From start to finish, remedial action implementation is expected to take approximately 5 years to complete.

The proposed remedial actions have a substantial likelihood to achieve compliance with the requirements of this CAO within a reasonable time frame. The proposed schedule is as short as possible, given 1) the scope, size, complexity, and cost of the remediation, 2) industry experience with the time typically required to implement similar remedial actions, 3) the time needed to secure other regulatory agency approvals and permits before remediation can start, and 4) the need to conduct dredging in a phased manner to prevent or reduce adverse effects to the endangered California Least Tern. Therefore, the remedial action implementation schedule proposed by the dischargers is consistent with the provisions in Resolution No. 92-49 for schedules for cleanup and abatement.

35.1. Resolution No. 92-49 Requirements

Resolution No. 92-49 requires the San Diego Water Board to determine schedules for cleanup and abatement taking into consideration:

a. The degree of threat or impact of the discharge on water quality and beneficial uses;

b. The obligation to achieve timely compliance with cleanup and abatement goals and objectives that implement the applicable Water Quality Control Policies adopted by the Water Boards;

c. The financial and technical resources available to the discharger; and

d. Minimizing the likelihood of imposing a burden on the people of the state with the expense of cleanup and abatement, where feasible.

Under Water Code section 13360, the San Diego Water Board may not specify the "design, location, type of construction, or particular manner" of compliance with cleanup and abatement orders and dischargers can comply in any lawful manner. This restriction serves as a shield against unwarranted interference with the ingenuity of the party subject to the cleanup and abatement order who can elect between available strategies to comply with cleanup objectives and other standards stipulated in a cleanup and abatement order.

The Responsible Parties have provided a remedial action implementation schedule and a description of specific remedial actions they intend to undertake to comply with the CAO. The proposed remedial actions have a substantial likelihood to achieve compliance with the requirements of the CAO within a reasonable time frame. The proposed schedule is as short as possible, given 1) the scope, size, complexity, and cost of the remediation, 2) industry experience with the time typically required to implement similar remedial actions, 3) the time needed to secure other regulatory agency approvals and permits before remediation can start, and 4) the need to conduct dredging in a phased manner to prevent or reduce adverse effects to the endangered California Least Tern.

The remedial action implementation schedule proposed by the Responsible Parties is consistent with the provisions in Resolution No. 92-49 for schedules for cleanup and abatement. The cleanup and abatement actions and milestone dates stipulated in the directives of the CAO, therefore, are based on this remedial action implementation schedule. The schedule, and the remedial actions proposed by the dischargers are discussed in further detail below.

35.2. Remedial Action Implementation Schedule

The remedial action implementation schedule will begin with the adoption of CAO No. R9-2011-0001 and end with the submission of final reports documenting that the alternative sediment cleanup levels have been met. This would mark the start of the Post-remedial Monitoring Phase of the cleanup. From start to finish, remedial action implementation is expected to take 5 years to complete. The schedule is constrained by the limited dredging window of September 15 through March 31 to protect the endangered California Least Tern. Because of the limited dredging window, three annual dredging episodes will be needed to complete the proposed dredging activities.

Following is a list of the major tasks to be carried out during the remedial action implementation time frame:

a. Establish framework for funding with a funding mechanism based on an allocation share ratio agreed upon by the Responsible Parties.

b. Bid and select the remedial action project management firm.

c. Design and submit the remedial action plan (RAP).

d. Prepare environmental document, most likely an Environmental Impact Report (EIR).

e. Secure all needed permits from permitting agencies. These permits are likely to include a Clean Water Act Section 401 Water Quality Certification, a Coastal Development Permit, a Rivers and Harbors Act Section 10 Permit, and a Clean Water Act Section 404 Permit.

f. Establish sediment management areas.

g. Implement the selected remedial actions.

h. Conduct final confirmation monitoring.

i. Terminate permits and submit final reports.

A timeline showing when these tasks are expected to occur is shown in Figure 35-1. The timeline is based on implementation schedule running from the final issuance of the CAO by the San Diego Water Board.

35.3. Remedial Actions

The remedial actions that can be used in the different areas of the Shipyard Sediment Site are constrained by both operations at the site, such as vessel and dry dock operations, and physical conditions such as near-shore obstructions and piers. For this reason a variety of remedial techniques are necessary to achieve remedial action objectives. The selected techniques include removing the sediments from the aquatic environment by dredging, capping[25] contaminated sediments with clean material, source control, and relying on natural processes while monitoring the sediments to ensure that contaminant levels are not increasing. These techniques differ in complexity and cost; dredging is the most complex and expensive, and monitoring without active remediation is the least difficult and least expensive.

Vessel and dry-dock operation areas are likely to be prioritized for dredging first because their limited open berth space time requires these areas to be dredged quickly. Near-shore areas present challenges for dredging because of the limited room in these areas for the dredge and barge, and the difficulty maneuvering the dredge and barge in these areas. Land-based excavation/dredging may be an option in these areas. Under-pier areas will be dredged where possible. Where dredging is impossible under the piers, sand capping will be used to cover and contain contaminated sediment. Unconstrained open areas are the easiest to dredge. These areas will be scheduled for dredging around the more difficult areas such as piers, berths, and dry docks.

Structures such as pile bulkheads, rock reveted slopes, piers, and pilings will need to be protected during dredging operations. Protection and/or support will be installed iteratively during remedial activities.

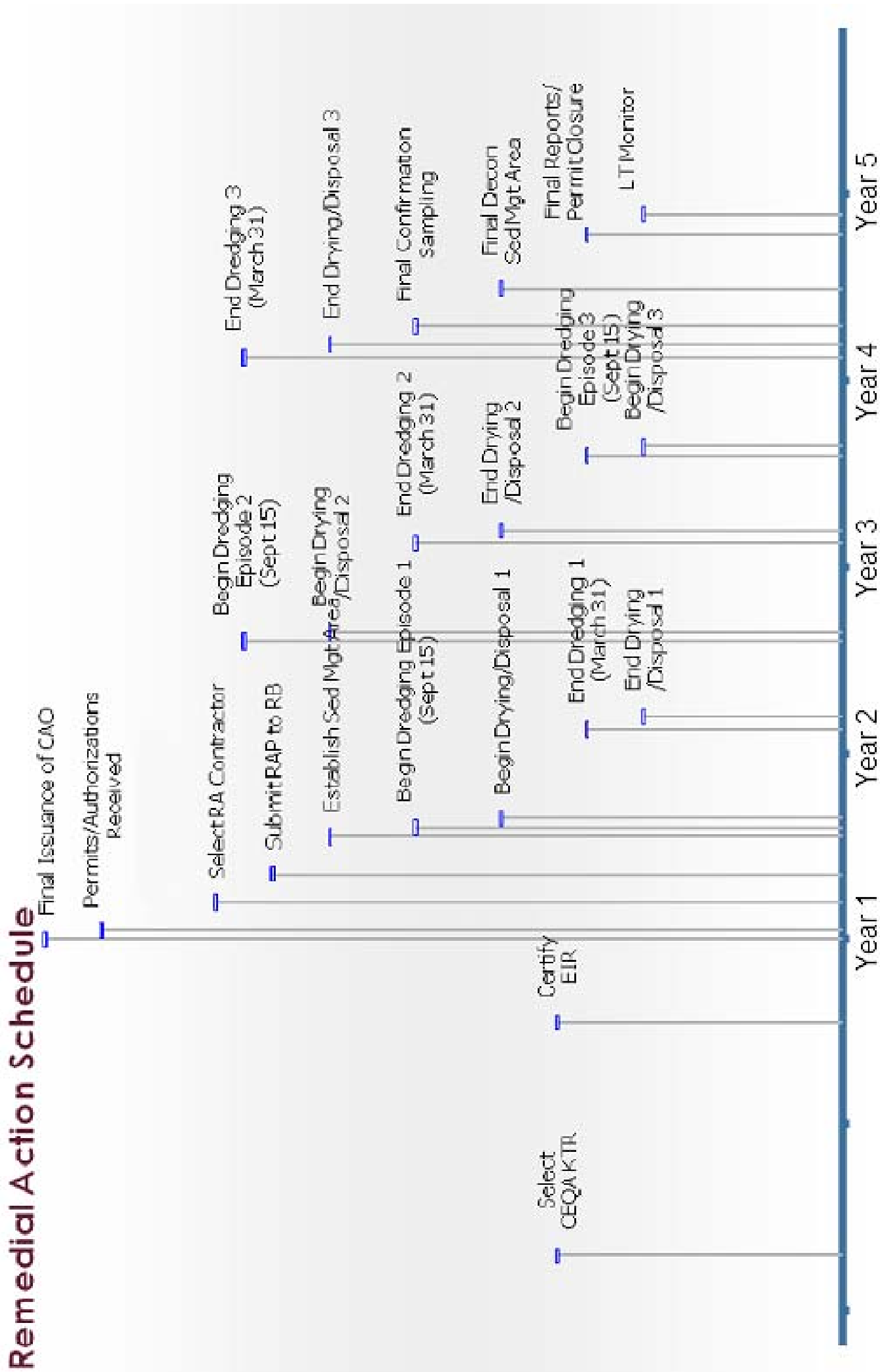
Sand capping will be used to manage residual contamination at depth that may be exposed by dredging. Clean sand will be applied in these areas to a depth that will ensure that the bioactive zone does not extend into residually contaminated areas.

Source control measures will be implemented to ensure that recontamination of the site from storm drain discharges does not occur. These measures include identifying storm drains that are sources of sediment discharge to the Shipyard Sediment Site, cleaning sediment from those

[25] Capping refers broadly to the placement of a layer of uncontaminated material over material with elevated concentrations to contain contaminated sediment.

storm drains, repairing them if damaged, installing filter best management practices within storm drains, and verifying that the storm drains remain clean and in good repair through closed circuit television inspections.

Figure 35-1 Remedial Action Implementation Schedule



36. Finding 36: Legal and Regulatory Authority

Finding 36 of CAO No. R9-2011-0001 states:

This Order is based on (1) section 13267 and Chapter 5, Enforcement, of the Porter-Cologne Water Quality Control Act (Division 7 of the Water Code, commencing with section 13000), commencing with section 13300; (2) applicable state and federal regulations; (3) all applicable provisions of statewide Water Quality Control Plans adopted by the State Water Resources Control Board and the *Water Quality Control Plan for the San Diego Basin* (Basin Plan) adopted by the San Diego Water Board including beneficial uses, water quality objectives, and implementation plans; (4) State Water Board policies for water quality control, including State Water Board Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California* and Resolution No. 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code section 13304*; and (5) relevant standards, criteria, and advisories adopted by other state and federal agencies.

36.1. Porter-Cologne Water Quality Control Act Jurisdiction

The Porter-Cologne Water Quality Control Act (Division 7 of the Water Code, commencing with section 13000) is replete with provisions intended to protect beneficial uses from impacts from contaminated sediment. Porter-Cologne jurisdiction extends beyond water column effects to require the reasonable protection of beneficial uses from discharges of waste to waters of the state. Legislative history of the Porter-Cologne Act states in commentary on the definition of "pollution" that "it is the unreasonable effect upon beneficial uses of water, caused by waste, that constitutes pollution."[26] This history expresses the intent that if a person discharges waste into waters of the state and beneficial uses of the water are thereby harmed – then pollution exists even if water column concentrations are not effected by wastes that have settled in sediment.

36.1.1. Water Code Section 13267

Water Code section 13267 provides that the San Diego Water Board can require any person who has discharged, discharges, proposes to discharge or is suspected of discharging waste to investigate, monitor, and report information. The only restriction is that the burden of preparing the reports bears a reasonable relationship to the need for and the benefits to be obtained from the reports.

---

[26] Final Report of the Study Panel to the California State Water Resources Control Board, 1969, p. 30.

36.1.2. Water Code Section 13304

Water Code section 13304 contains the cleanup and abatement authority of the San Diego Water Board. Section 13304(a) provides that any person who has discharged or discharges waste[27] into waters of the state in violation of any waste discharge requirement[28] or other order or prohibition issued by a Regional Water Board or the State Water Board or who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution[29] or nuisance[30] may be required to clean up the discharge and abate the effects thereof. This Section authorizes Regional Water Boards to require complete cleanup of all waste discharged and restoration of affected water to background conditions (i.e., the water quality that existed before the discharge).

36.2. Applicable Federal Regulations

U.S. Code of Federal Regulations (CFR). Title 40: Protection of Environment, Part 300 – National Oil And Hazardous Substances Pollution Contingency Plan (NCP), Section 300.430, Remedial Investigation/Feasibility Study and Selection of Remedy

The National Oil and Hazardous Substance Pollution Contingency Plan (NCP) in Title 40 Code of Federal Regulations, Part 300 (40 CFR 300) implements the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Oil Pollution Act. CERCLA is a federal law enacted in 1980 and amended in 1986 to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. CERCLA established a “Superfund” to be used by the U.S. EPA to respond to releases of hazardous wastes at certain sites. Under CERCLA, remedial actions selected by U.S. EPA or other delegated federal agencies for “Superfund” cleanup sites must be protective of human health and the environment.

---

[27] “Waste” is very broadly defined in Water Code section 13050(d) and includes sewage and any and all other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, processing operation, including waste placed within containers of whatever nature prior to, and for purposes of, disposal.

[28] The term waste discharge requirements include those, which implement the National Pollutant Discharge Elimination System.

[29] Pollution” is defined in Water Code section 13050 (1) as “an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either of the following: (A) the waters for beneficial uses, (B) Facilities which serve these beneficial uses.” Pollution” may include “contamination.”

[30] Nuisance is defined in Water Code section 13050(m) “... anything which: (1) is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, and (2) affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal, and (3) occurs during or as a result of the treatment or disposal of wastes.”

If CERCLA hazardous substances remain on-site after cleanup, the cleanup levels or remedial action must also attain "legally" applicable or relevant and appropriate requirements (ARARs).[31] ARARs are defined in CERCLA as standards, requirements, criteria, or limitations of federal environmental laws and any more stringent standards, requirements, criteria, or limitations of state environmental or facility sitting laws.[32] To qualify as a state ARAR, the requirement must be a state environmental or facility siting law, not a local law. The requirement must be promulgated (legally enforceable and of general applicability), and more stringent than the federal requirement.[33] The State Water Board's, Resolution No. 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code section 13304*, is an example of a state ARAR that would apply to the setting of cleanup levels at CERCLA sites in California.[34]

The NCP described in 40 CFR 300 provides the USEPA's organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants. The NCP is required by section 105 of CERCLA and by section 311 of the Clean Water Act and addresses CERCLA's requirements and goals concerning clean-up levels.

Although the Shipyard Sediment Site remediation is not a "Superfund" remediation site subject to the requirements of CERCLA or its implementing regulations, the San Diego Water Board did consider guidance provided in 40 CFR 300.430 clarifying flexibility in the use of baseline risk assessments and acceptable exposure levels in selecting appropriate cleanup levels at CERCLA sites. Based on the considerations provided below the alternative cleanup levels for the Shipyard Sediment Site prescribed in Section 32 are consistent with the requirements of 40 CFR 300.430 pertaining to the protection of human health and the environment and acceptable exposure levels.

Subpart E of 40 CFR 300, Hazardous Substance Response, beginning with 40 CFR 300.430 contains regulations pertaining to the remedy selection process for CERCLA cleanup sites to ensure remedies are implemented 1) that are protective of human health and the environment, 2) that maintain protection over time, and 3) that minimize untreated waste. The NCP provides that remediation goals at CERCLA cleanup sites shall establish acceptable exposure levels that are protective of human health and the environment.[35] Exposures are evaluated based on the potential risk for developing cancer and the potential for non-cancer health hazards.

---

[31] CERCLA section 121(d)(2)(A), 42 U.S.C. 69621(6)(2)(A).

[32] CERCLA section 121(d)(2), 42 U.S.C. 9621(d)(2).

[33] CERCLA section 121(d)(4).

[34] January 3, 1996 letter from Francis McChesney, Staff Counsel, State Water Resources Control Board to Rex Callaway, Counsel, Department of the Navy, Southwest Division, Naval Facilities Engineering Command, Subject: Resolution No. 92-49.

[35] 40 CFR 300.430(e)(2)(i).

Risk estimates for non-cancer health effects are expressed as hazard quotients (HQs) and hazard indices (HIs). An RfD is the intake level that represents a threshold below which it is unlikely that even sensitive individuals, such as children, will experience adverse health effects following a chronic exposure. An HQ is the ratio of a specified intake relative to an acceptable intake (i.e., the RfD). If the average daily intake exceeds the RfD (i.e., if the HQ exceeds 1), then there may be cause for concern. The HQ for each contaminant of concern are summed to yield a Hazard Index (HI) to integrate non-cancer hazards from multiple chemicals. The assumption of additive health effects inherent in the HI is most appropriate for substances that induce a common adverse effect by a shared mechanism. Similarly, hazards from exposure to multiple COPCs from multiple pathways are characterized by adding HIs from the relevant pathways to calculate an integrative HI. If the HI is less than or equal to one, then multiple-pathway exposures to contaminants of concern at the site are considered unlikely to result in an adverse effect. Thus remediation goals at CERCLA cleanup sites achieving HQs less than or equal to one for chemical specific hazards and HIs less than or equal to one for multiple-pathway exposures can be considered protective for non-cancer human health effects.[36,37] Alternative cleanup levels for the Shipyard Sediment Site, were set consistent with the requirements of Resolution No. 92-49, to achieve HQs less than or equal to one for chemical specific hazards and HIs less than or equal to one to address non-cancer health effects. These criteria are consistent with the requirements of 40 CFR 300.430.

Cancer risk is expressed as an excess probability of developing cancer over a lifetime (i.e., an increased risk of developing cancer attributable to exposures to site-related contaminants). For example, a 10^{-4} cancer risk means a “one in 10,000 excess cancer risk,” or an increased risk of an individual developing cancer of one in 10,000 as a result of exposure to site contaminants under the conditions used in the baseline risk assessment. The NCP provides that for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6} (1 in 10,000 to 1 in 1,000,000) using U.S. EPA information on the relationship between dose and response.[38] At CERCLA sites cancer risks below 10^{-6} are considered acceptable and cancer risks above 10^{-4} are considered unacceptable. Thus cleanup levels at CERCLA cleanup sites achieving exposure levels within the 10^{-4} to 10^{-6} cancer risk range for known or suspected carcinogens can be considered protective of human health.

---

[36] 1986. Guidelines for Health Risk Assessment of Chemical Mixtures. 51 Federal Register 34014. EPA: Washington, D.C. September 24.

[37] 1989. Risk Assessment Guidance for Superfund Human Health Evaluation Manual Part A. Interim Final. Office of Solid Waste and Emergency Response: Washington, D.C. 9285.701A. July. http://www.epa.gov/superfund/programs/risk/ragsa/index.htm

[38] 40 CFR 300.430(e)(2)(i)(A)(2).

The NCP does establish a preference that cleanup levels be set for the more protective end of the range at 10^{-6} when ARARS are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.[39] However, cleanup levels can be revised to attain a different risk level within the range of 10^{-4} to 10^{-6} based on the balancing of site-specific factors including, but not limited to exposure factors, uncertainty factors, technical factors, and the cost of remediation. In California ARARS are available for setting contaminated sediment cleanup levels at CERCLA sites including the State Water Board's, Resolution No. 92-49. Thus setting alternative cleanup levels for the Shipyard Sediment Site, consistent with the requirements of Resolution No. 92-49, to achieve exposure levels anywhere in the 10^{-4} to 10^{-6} cancer risk range would also be consistent with the requirements of 40 CFR 300.430.

U.S. Code of Federal Regulations (CFR). Title 40: Protection of Environment, Part 131 – Water Quality Standards, Section 131.38, Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California

U.S. EPA promulgated a final rule prescribing water quality criteria for toxic pollutants in inland surface waters, enclosed bays, and estuaries in California in 2000 (The California Toxics Rule or "CTR."[40] CTR criteria constitute applicable water quality objectives in California. In addition to the CTR, certain criteria for toxic pollutants in the National Toxics Rule (NTR) [40 CFR 131.36] constitute applicable water quality objectives in California as well.

---

[39] 40 CFR 300.430(e)(2)(i)(A)(2).

[40] The California Toxics Rule (CTR) was finalized by the U.S. EPA in the Federal Register (65 Fed. Register 31682-31719), adding Section 131.38 to Title 40 of the Code of Federal Regulations on May 18, 2000. The full text of the CTR is available at the following web address: http://www.epa.gov/OST/standards/ctrindex.html.

36.3. Water Quality Control Plan for the San Diego Basin (Basin Plan)

The San Diego Water Board's Water Quality Control Plan for the San Diego Basin (Basin Plan) designates 12 beneficial uses[41] for San Diego Bay[42] that may be adversely affected by contaminated sediment. These beneficial uses fall into four broad categories called target receptors, as shown below:

TARGET RECEPTORS	AQUATIC LIFE	AQUATIC - DEPENDENT WILDLIFE	HUMAN HEALTH	NAVIGATION AND SHIPPING
BENEFICIAL USES	Estuarine Habitat (EST)	Wildlife Habitat (WILD)	Contact Water Recreation (REC1)	Navigation (NAV)
	Marine Habitat (MAR)	Preservation of Biological Habitats of Special Significance (BIOL)	Non Contact Water Recreation (REC2)	
	Migration of Aquatic Organisms (MIGR)	Rare, Threatened or Endangered Species (RARE)	Shellfish Harvesting (SHELL)	
	Preservation of Biological Habitats of Special Significance (BIOL)		Commercial and Sport Fishing (COMM)	

[41] See Water Code section 13050(f). "Beneficial uses" of the waters of the state that may be protected against quality degradation include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

[42] Basin Plan, Table 2-3, Beneficial Uses of Coastal Waters at page 2-47. Specific definitions of the beneficial uses are provided in the Basin Plan at pages 2-3 and 2-4.

The Basin Plan also contains a narrative water quality objective[43] for toxicity[44] applicable to San Diego Bay as follows:

> *"All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Board.*
>
> *'The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with requirements specified in US EPA, State Water Resources Control Board or other protocol authorized by the Regional Board. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour acute bioassay.*
>
> *'In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged."*

36.4. Resolution No. 92-49

State Water Board Resolution No. 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code section 13304* describes the policies and procedures that apply to the cleanup and abatement of all types of discharges subject to Water Code section 13304. These include discharges, or threatened discharges, to surface and groundwater. The Resolution requires dischargers to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality or the best water quality that is reasonable if background levels of water quality cannot be restored, considering economic and other factors. In approving any alternative cleanup levels less stringent than background, Regional Water Boards must apply section 2550.4 of Title 23 of the California Code of Regulations.[45] Section 2550.4 provides that a Regional Water Board can only approve cleanup levels less stringent than background if the Regional Water Board finds that it is technologically or economically infeasible to achieve background. Resolution No. 92-49 further requires that any alternative cleanup level shall: (1) be consistent with maximum benefit to the people of the state; (2) not unreasonably affect present and anticipated beneficial uses of such water; and

---

[43] "Water quality objectives" are defined in Water Code section 13050(h) as "the limits or levels water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area."

[44] Basin Plan, Chapter 3. Water Quality Objectives, Page 3-15.

[45] Resolution No. 92-49, Section III.G.

(3) not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards.[46]

Resolution No. 92-49 is applicable to establishing cleanup levels at the Shipyard Sediment Site. The State Water Board's Office of Chief Counsel (hereinafter Office of Chief Counsel) fully supports this position. A Regional Water Board must apply Resolution No. 92-49 when setting cleanup levels for contaminated sediment if such sediment threatens beneficial uses of the waters of the state, and the contamination or pollution is the result of a discharge of waste. Contaminated sediment must be cleaned up to background sediment quality unless it would be technologically or economically infeasible to do so (Wilson, 2002).

36.5. Resolution No. 68-16

Resolution No. 92-49 specifies that cleanup and abatement actions must conform to State Water Board Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California*. Resolution No. 68-16 is a state policy that establishes the requirement that discharges to waters of the state shall be regulated to achieve the highest water quality with maximum benefit to the people of the state. Resolution No. 68-16 also establishes the intent where the waters of the state are of higher quality than required by state policies, including Water Quality Control Plans, such higher quality "shall be maintained to the maximum extent possible" consistent with the maximum benefit to the people of the state.

36.6. Policy for Implementation of Toxics Standards

The State Water Board *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (State Implementation Policy, or "SIP") provides that mixing zones shall not result in "objectionable bottom deposits." This term is defined as "an accumulation of materials … on or near the bottom of a water body which creates conditions that adversely impact aquatic life, human health, beneficial uses, or aesthetics. These conditions include, but are not limited to, the accumulation of pollutants in the sediment (SIP at Appendix 4).

[46] *Id.*

36.7. Environmental Justice

Environmental justice is defined in California law[47] as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." The California Environmental Protection Agency (Cal EPA), and its Boards, Departments, and Offices, which include the State and Regional Water Boards, are charged[48] with conducting its programs, policies, and activities in a manner that ensures the fair treatment of people of all races, cultures, and income levels, including minority populations and low-income populations of the state.

Cal EPA's stated mission, as described in its 2004 Intra-Agency Environmental Justice Strategy, is to accord the highest respect and value to every individual and community, by developing and conducting our public health and environmental protection programs, policies, and activities in a manner that promotes equity and affords fair treatment, accessibility, and protection for all Californians, regardless of race, age, culture, income, or geographic location. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

---

[47] Government Code section 65040.12(e).

[48] Public Resources Code sections 71110 – 71113.

37. Finding 37: CEQA Review

Finding 37 of CAO No. R9-2011-0001 states:

In many cases, an enforcement action such as this could be exempt from the provisions of the California Environmental Quality Act ("CEQA"; Public Resources Code, section 21000 et seq.), because it would fall within Classes 7, 8, and 21 of the categorical exemptions for projects that have been determined not to have a significant effect on the environment under section 21084 of CEQA.[49] In Resolution No. R9-2010-0115 adopted on September 8, 2010, the San Diego Water Board found that because the tentative CAO presents unusual circumstances and there is a reasonable possibility of a significant effect on the environment due to the unusual circumstances, the tentative CAO is not exempt from CEQA and that an EIR analyzing the potential environmental effects of the tentative CAO should be prepared.

As the lead agency for the tentative CAO, the San Diego Water Board prepared an EIR that complies with CEQA. The San Diego Water Board has reviewed and considered the information in the EIR.

37.1. Guiding Principles for Determination of CEQA Applicability

The California Environmental Quality Act (CEQA)[50] requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. CEQA applies to certain activities of state and local public agencies. A public agency must comply with CEQA when it undertakes an activity defined by CEQA as a "project." A project is an activity undertaken by a public agency or a private activity which must receive some discretionary approval (meaning that the agency has the authority to deny the requested permit or approval) from a government agency which may cause either a direct physical change in the environment or a reasonably foreseeable indirect change in the environment.[51]

When more than one public agency is involved, a "Lead Agency" is the public agency that has the primary responsibility for approving a project that may have a significant impact upon the environment.[52] A "lead agency" must complete the environmental review process required by CEQA. The most basic steps of the environmental review process are:

---

[49] Title 14 CCR sections 15307, 15308, and 15321.

[50] Public Resources Code section 21000 et seq.

[51] Public Resources Code section 21065.

[52] Public Resources Code section 21067.

1. Determine if the activity is a “project” subject to CEQA;
2. Determine if the “project” is “exempt”[53] from CEQA;
3. Perform an Initial Study to identify the environmental impacts of the project and determine whether the identified impacts are “significant.” Based on its findings of “significance,” the lead agency prepares one of the following environmental review documents:
    a) Negative Declaration if it finds no “significant” impacts;[54]
    b) Mitigated Negative Declaration if it finds “significant” impacts but revises the project to avoid or mitigate those significant impacts;[55]
    c) Environmental Impact Report (EIR) if it finds “significant” impacts.[56]

While there is no ironclad definition of “significance,” the State CEQA Guidelines provides criteria to lead agencies in determining whether a project may have significant effects.[57]

CEQA requires an Evironmental Impact Report to be prepared whenever it can be fairly argued on the basis of substantial evidence in the record that a project may have a significant effect on the environment.[58] The purpose of an EIR is to provide State and local agencies and the general public with detailed information on the potentially significant environmental effects which a proposed project is likely to have and to list ways which the significant environmental effects may be minimized and indicate alternatives to the project.

CEQA authorizes the Secretary of Resources to develop a list of classes of projects that are to be categorically exempt from the requirement to prepare environmental documents under CEQA after a determination that such classes of projects ordinarily will not have a significant effect on the environment.[59] The Secretary’s list includes, in pertinent part: (1) actions by regulatory agencies for the protection of natural resources; (2) actions by regulatory agencies for the protection of the environment; and (3) enforcement actions by regulatory agencies.[60] The San Diego Water Board has routinely used these categorical exemptions when taking regulatory enforcement actions, including when it issues cleanup and abatement orders in past years. However, a lead agency may not use a categorical exemption if there is a reasonable possibility

---

53 Public Resources Code sections 21080 - 21080.33.

54 Public Resources Code section 21064.

55 Public Resources Code section 21064.5.

56 Public Resources Code section 21064.5.

57 Title 17 CCR sections 15060 – 15065.

58 See *No Oil, Inc. v. City of Los Angeles* (1974) 13 Cal.3d 68, 75.

59 Public Resources Code section 21084(a).

60 Title 14 CCR sections 15307, 15308, 15321, respectively.

that the project will have a significant effect on the environment due to unusual circumstances.[61] The two-part test for when a categorical exemption may not be is whether the circumstances of a particular project differ from the general circumstances of the projects covered by a particular categorical exemption, and whether those circumstances create an environmental risk that does not exist for the general class of exempt projects.[62]

37.2. Cleanup and Abatement Order Project Description

The Shipyard Sediment Site Cleanup and Abatement Order Project (the CAO Project) requires that remedial actions be implemented within the Shipyard Sediment Site which may include dredging, capping, and/or natural recovery depending upon a number of factors, including levels of contamination in sediment and site accessibility. Under the terms of the CAO, dredging and disposal of sediments is the proposed remedy for approximately 15.2 acres, (661,832 square feet) of the Site. Dredging of these 15.2 acres is expected to generate approximately 143,400 cubic yards of marine sediment that would require transport to shore, on-shore dewatering and possible treatment, and transport of the dewatered dredge spoil to an appropriate landfill disposal site. If cleanup criteria for chemical constituents of concern in the sediments cannot be attained by dredging (for example, contaminants extend more deeply than anticipated or there is equipment refusal due to a hard substrate) some dredge areas may be capped with sand. In addition to the 15.2 acres targeted for dredging, approximately 2.3 acres of the project site are inaccessible or under-pier areas that will be remediated by one or more methods other than dredging, most likely by sand capping. Sand capping would involve the transport of capping material to the site (possibly via truck or barge) and placement of the materials over contaminated sediment.

The specific actions to be taken by the responsible parties for cleanup will be described in a Remedial Action Plan (RAP) that is to be prepared and submitted to the San Diego Water Board within 90 days of adoption of the CAO. The remedial action is expected to take 5 years to complete and would be followed by a period of post-remedial monitoring.

This type of physical disturbance to the environment includes, but is not limited to, sediment movement, air quality impacts from diesel emissions from dredging equipment, and potential impacts to traffic patterns and noise from equipment operations in the area where the sediment will be dewatered and from which it will be transported. Because of the proposed remedial design, this CAO differs considerably from the typical agency enforcement action, or action to protect natural resources or the environment. The CAO is considerably different in scope and detail, and the potential for significant impacts to the physical environment from the proposed remedial design is manifest. Because the CAO Project presents unusual circumstances both with respect to its scope and unique characteristics, and because substantial evidence in the record indicates the CAO Project may cause potentially-significant adverse environmental impacts, it is not categorically exempt from CEQA.

---

[61] 14 CCR section 15300.2(c); *Azusa Land Reclamation Co. v. Main San Gabriel Basin Watermaster* (1997) 52 Cal.App.4th 1165, 1198-1199.

[62] *Id.*, at 1207.

On July 23, 2010, NASSCO submitted a motion requesting that the San Diego Water Board determine that the tentative CAO is exempt from CEQA such that no EIR would be required if the San Diego Water Board were to approve the tentative CAO. In Resolution No. R9-2010-0115 adopted on September 8, 2010, the San Diego Water Board found that because the tentative CAO presents unusual circumstances and there is a reasonable possibility of a significant effect on the environment due to the unusual circumstances, the tentative CAO is not exempt from CEQA and that an EIR analyzing the potential environmental effects of the tentative CAO should be prepared.

37.3. CEQA Process to Date

The San Diego Water Board is the lead agency under CEQA for the CAO Project. The San Diego Water Board initiated the environmental review process for the CAO Project on November 25, 2009, with the issuance of a Notice of Preparation. On December 22, 2009, the San Diego Water Board Water Board released for public review an Initial Study for the CAO Project which concluded that the CAO Project may have a significant effect on the environment and that an Environmental Impact Report was required. The Initial Study was posted on the San Diego Water Board's website for a 30-day public review period. At the end of the review period, on January 21, 2010, a CEQA scoping meeting was held at the Water Board's office to receive comments on the Initial Study and the scope of the environmental issues to be addressed in the EIR.

The Initial Study identified three topics for further study in a focused EIR — air quality, geology/soils, and transportation — either by explicitly stating that the issue will be addressed in the EIR in response to a checklist question (air quality and transportation) or by checking the box for that issue at the beginning of the Initial Study, thereby indicating that the topic is a "potentially significant impact" (air quality and geology/soils). Comments received on the Initial Study raised additional concerns with regard to impacts to Air Quality, Marine Biological Resources, Noise, Hazards and Hazardous Materials, Hydrology and Water Quality, and Environmental Justice. Based on these considerations the San Diego Water Board is currently proceeding with the development of an EIR for the CAO Project. The EIR for the CAO Project will include the analysis of the environmental impacts of sediment management, including the impacts of the proposed dredging activities, handling of the dredged material, dewatering and potential treatment of the dredged material, and transport to the disposal site. These effects may include but not be limited to the potential for release of contaminants into the water and air as a result of the sediment management activities, air quality impacts from the equipment emissions and vehicular trips associated with the dredge activity, and short-term noise from truck trips traveling to and from the project site/shore to the freeway.

38. Finding 38: Public Notice

Finding 38 of CAO No. R9-2011-0001 states:

The San Diego Water Board has notified all known interested persons and the public of its intent to adopt this CAO, and has provided them with an opportunity to submit written comments and recommendations.

38.1. Public Review Process to Date

The San Diego Water Board is considering development and issuance of a cleanup and abatement order for discharges of metals and other pollutant wastes to San Diego Bay marine sediment and waters at the Shipyard Sediment Site. On April 29, 2005 the San Diego Water Board circulated for public review and comment an initial tentative version of the cleanup and abatement order (see tentative CAO No. R9-2005-0126). A revised CAO was released in April 2008 (see tentative CAO No. R9-2005-0126 issued on April 4, 2008).

On June 9, 2008, the San Diego Water Board's Presiding Officer in this matter, David King, referred the CAO proceedings to confidential mediation. The Mediation Parties, which included the San Diego Water Board Cleanup Team (Cleanup Team) and other Parties to whom the tentative CAO is directed, through the course of mediation, reached agreement on appropriate cleanup levels, the preliminary remedial design, remediation and post-remediation monitoring requirements, and a remedial action implementation schedule. Those agreements are contained in tentative CAO No. R9-2010-0002, which was released for public review on December 22, 2009.

On September 15, 2010 the San Diego Water Board released a revised version of the tentative CAO (see tentative CAO No. R9-2011-0001. This version will update and clarify the tentative CAO which was previously released on December 22, 2010. This release of a preliminary tentative CAO and draft DTR is not intended to fulfill the San Diego Water Board's formal procedures for adopting a CAO in this matter under the Porter-Cologne Water Quality Control Act. A public hearing schedule and deadline for public comments on a finalized tentative CAO and draft DTR will be established in a future ruling by the San Diego Water Board's Presiding Officer in this matter.

Prior to the issuance of a final CAO and Technical Report in this matter, the San Diego Water Board will first release a public hearing notice and a final tentative CAO, a draft Technical Report (DTR), and a draft Environmental Impact Report (EIR) for public review and comment. The San Diego Water Board will provide an opportunity for all Parties to whom the CAO is directed or otherwise designated, and interested persons to comment on issues pertaining to the tentative CAO, DTR, draft EIR and other cleanup issues described in the hearing notice. The San Diego Water Board's consideration of testimony and written submittals by Parties and interested persons may result in revisions to the tentative CAO and the supporting draft DTR and draft EIR during the course of the hearing proceedings. Thus the finalized version of the tentative CAO that is ultimately considered for adoption by the San Diego Water Board at the conclusion of the proceedings may differ from the current preliminary version of the tentative CAO issued on September 15, 2010.

39. Finding 39: Public Hearing

Finding 39 of CAO No. R9-2011-0001 states:

The San Diego Water Board has considered all comments pertaining to this CAO submitted to the San Diego Water Board in writing, or by oral presentations at the public hearing held on [date(s) to be inserted]. Responses to relevant comments have been incorporated into the Technical Report for this CAO. In the event that the San Diego Water Board proposes any changes to the Tentative CAO deemed material by the Dischargers, the Dischargers reserve their right to complete the administrative process delineated in the Final Discovery Plan and Second Amended Order of Proceedings, including the rights to conduct discovery, to cross–examine witnesses, and to submit rebuttal evidence, comments and initial and final briefs, subject to revised deadlines to be set by the San Diego Water Board or its designated Presiding Officer.

39.1. Public Hearing

See discussion in Section 38 of this Technical Report on the public participation process.

40. References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Division of Toxicology/Toxicology Information Branch, Atlanta, GA. November 2000.

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Copper. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Division of Toxicology/Toxicology Information Branch, Atlanta, GA. September 2004.

American Society for Testing and Materials (ASTM). 2001. Standard Guide for Determination of the Bioaccumulation of Sediment-Associated Contaminants by Benthic Invertebrates. Method E1688-00a. In Annual Book of ASTM Standards, Vol 11.05. Philadelphia, PA, pp 1039-1092. American Society for Testing and Materials.

Barrick, R., S. Becker, L. Brown, H. Beller, and R. Pastorok. 1988. Volume 1. Sediment Quality Values Refinement: 1988 Update and Evaluation of Puget Sound AET. EPA Contract No. 68-01-4341. PTI Environmental Services, Bellevue, WA, 144 pp.

Bay, Steve. 2007. Email to Craig Carlisle, San Diego Regional Water Quality Control Board. "Subject: Data Request." Including Excel file attachment "TriadData_SDBay.xls." Southern California Coastal Water Research Project, Costa Mesa, CA. December 18, 2007.

Bay, Steve. 2009. Email to Tom Alo, San Diego Regional Water Quality Control Board. "Subject: SD Bay Database." Southern California Coastal Water Research Project, Costa Mesa, CA. May 20, 2008

Bevington, P.R. and D.K. Robinson. 1992. Data Reduction and Error Analysis for the Physical Sciences. Second Edition. McGraw-Hill Inc., U.S. 328 pp. (Third Edition published in 2002.)

Bjorndal, K.A. 1980. Nutrition And Grazing Behavior Of The Green Turtle (*Chelonia mydas*). Mar. Biol. 56:147-154.

Brodberg, R. K., and G. A. Pollock. 1999. Prevalence of Selected Target Chemical Contaminants in Sport Fish from Two California Lakes: Public Health Designed Screening Study, Final Project Report. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Section, Sacramento, CA. June 1999.

Brodberg, R. 2004. Memorandum to T. Alo, San Diego Water Board, regarding "Review of the Exponent, NASSCO, and Southwest Marine Detailed Sediment Investigation." California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Section, Sacramento, CA. April 29, 2004.

Brown, J.S., and S. A. Steinert. 2004. DNA Damage and Biliary PAH Metabolites in Flatfish from Southern California Bays and Harbors, and Channel Islands. Ecological Indicators, Vol. 3, Issue 4, pp. 263-274. January 2004.

Buchman, M.F. 1999. NOAA Screening Quick Reference Tables. NOAA HAZMAT Report 99-1. National Oceanic and Atmospheric Administration, Coastal Protection and Restoration Division, Seattle, WA. September 1999.

Bermudez, H. 2005. E-mail to C. Gorham-Test, San Diego Water Board, regarding "RE: Mouth of Chollas, Paleta, and Switzer Creek Stakeholder Work Group Meeting." National Steel and Shipbuilding Company, San Diego, CA. December 15, 2005.

California Code of Regulations, Title 22, Chapter 11, Section 66261.24. Characteristic of Toxicity.

California Environmental Protection Agency (Cal EPA). 2004. Intra-Agency Environmental Justice Strategy. State of California, California Environmental Protection Agency. August 2004. http://www.calepa.ca.gov/EnvJustice/Documents/2004/Strategy/Final.pdf

Calscience Environmental Laboratories (CEL). 2005. Analytical Report for City of San Diego – Sampson St. (cover letter and analytical reports). Garden Grove, CA. October 12, 2005.

Carlin, E. 2003. Letter to T. Alo and A. Monji, San Diego Water Board, regarding "Selecting a Pool of Reference Stations for San Diego Bay." Prepared for the San Diego Bay Council, San Diego, CA. April 30, 2003.

Chadwick, B., J. Leather, K. Richter, S. Apitz, D. Lapota, D. Duckwork, C. Katz, V. Kirtay, B. Davidson, A. Patterson, P. Wang, S. Curtis. 1999. Sediment Quality Characterization Naval Station San Diego: Final Summary Report. U.S. Navy and SPAWAR Systems Center San Diego. Technical Report No. 1777. SSC San Diego, San Diego, CA. January 1999.

Chapman, P.M., F. Wang, J.D. Germano, and G. Batley. 2001. Pore Water Testing and Analysis: The Good, The Bad, And The Ugly. Marine Pollution Bulletin, Article No. 1773. October 6, 2001.

Chee, M. 2004. E-mail to T. Alo, San Diego Water Board, regarding "RE: Maintenance Dredging at NASSCO and SWM." National Steel and Shipbuilding Company, San Diego, CA. January 7, 2004.

Chevron. 2005. Preliminary Comments of Chevron U.S.A., Inc. on Tentative Cleanup and Abatement Order No. R9-2005-0126. Submitted for Public Workshop on June 29, 2005. Submitted by C.J. McNevin of Pilsbury, Winthrop, Shaw, Pittman LLP, Los Angeles, CA. June 15, 2005.

Chichester, R. 2006. E-mail to L. Walsh, San Diego Water Board, regarding "Storm Drain Outfalls Chollas Creek." U.S. Navy, Command Navy Region Southwest, Environmental Department, San Diego, CA. February 21, 2006.

City of San Diego. 2004a. Report for the Investigation of Exceedances of the Sediment Quality Objective at National Steel and Shipbuilding Company. Prepared for Regional Water Quality Control Board, San Diego, CA. City of San Diego Storm Water Pollution Prevention Program, San Diego, CA. July 15, 2004.

City of San Diego. 2004b. Report for the Investigation of Exceedances of the Sediment Quality Objectives at Southwest Marine. Prepared for Regional Water Quality Control Board, San Diego, CA. City of San Diego Storm Water Pollution Prevention Program, San Diego, CA. July 15, 2004.

Cornelius, S.E. 1986. The Sea Turtles of Santa Rosa National Park. M.V. Garcia (ed). Fundacion de Parques Nacionales, Costa Rica.

County of San Diego. 1990. San Diego Bay Health Risk Study. San Diego County Department of Health Services, Environmental Health Services. Prepared for the Port of San Diego. San Diego, CA. June 12, 1990.

DTSC. 1996. Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities. Part A: Overview. California Department of Toxic Substances Control, Human and Ecological Risk Division. July 4, 1996.

DTSC. 2000. HERD Ecological Risk Assessment (ERA) Note Number 4. California Department of Toxic Substances Control, Human and Ecological Risk Division. Sacramento, CA. December 8, 2000.

Dunning, Jr., J.B. (ed). 1993. CRC Handbook Of Avian Body Masses. CRC Press, Boca Raton, FL.

Eisler, R. 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Biological Report 85(1.11). Contaminant Hazard Reviews Report No. 11. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Lauren, MD.

ENV America. 2004a. Site Assessment Report Landside Tidelands Lease Area Silver Gate Power Plant. Prepared for San Diego Gas and Electric Company, San Diego, CA. ENV America Inc., San Diego, CA. July 14, 2004.

ENV America. 2004b. Technical Report for RWQCB Investigation Order R9-2004-026. Prepared for San Diego Gas and Electric Company, San Diego, CA. ENV America Inc., San Diego, CA. July 14, 2004.

Environmental Health Coalition (EHC). 2005. Survey of Fishers on Piers in San Diego Bay, Results and Conclusions. San Diego, CA. March 2005. http://www.environmentalhealth.org/CBCPierFishersSurveyReport.htm

Exponent. 2001a. Work Plan for the NASSCO and Southwest Marine Detailed Sediment Investigation. Prepared for NASSCO and Southwest Marine. Exponent, Bellevue, WA. July 2001.

Exponent. 2001b. Technical Memorandum 1: Phase 1 Sediment Chemistry Data for the NASSCO and Southwest Marine Detailed Sediment Investigation. Prepared for Regional Water Quality Control Board, San Diego, CA. Exponent, Bellevue, WA. October 2001.

Exponent. 2002. Technical Memorandum 4, Phase 1 Bioaccumulation Data, Ecological Receptor Species, and Receptor Parameters for the NASSCO and Southwest Marine Detailed Sediment Investigation. Prepared for NASSCO and Southwest Marine by Exponent, Bellevue, WA. January 2002.

Exponent. 2003. NASSCO and Southwest Marine Detailed Sediment Investigation Volumes I, II, and III. Prepared for NASSCO and Southwest Marine, San Diego, CA. Exponent, Bellevue, WA. October 2003.

Exponent. 2004. Letter to T. Alo, San Diego Water Board, regarding the “Responses to NOAA Comments of the NASSCO and Southwest Marine Sediment Investigation Report Project No. 8601718.002 and 8601731.002.” Prepared for Regional Water Quality Control Board, San Diego, CA. by Exponent, Bellevue, WA. June 11, 2004.

Exponent. 2005. External Memorandum from D. Nielsen (Exponent) to S. Halvax (Southwest Marine) and M. Chee (NASSCO) regarding “Responses to Tom Alo’s Questions on Pore Water Regressions.” Exponent, Bellevue, WA. February 1, 2005.

Fairey, R., C. Bretz, S. Lamerdin, J. Hunt, B. Anderson, S. Tudor, C. Wilson, F. La Caro, M. Stephenson, M. Puckett, and E. Long. 1996. Chemistry, Toxicity, and Benthic Community Conditions in Sediments of the San Diego Bay Region, Final Report. California State Water Quality Control Board, Sacramento, Ca. September 1996.

Fairey, R., E.R. Long, C.A. Roberts, B.A. Anderson, B.M. Phillips, J.W. Hunt, H.R. Puckett, and C.W. Wilson. 2001. An Evaluation of Methods for Calculating Mean Sediment Quality Guideline Quotients as Indicators of Contamination and Acute Toxicity to Amphipods by Chemical Mixtures. Environmental Toxicology and Chemistry, Vol. 20, No. 10, pp. 2276-2286. October 2001.

GlobalSecurity.org. 2005. Military Paint. Web page last modified April 27, 2005. http://www.globalsecurity.org/military/systems/ship/systems/paint.htm

Gonzales, V. 2005. Letter to J. Robertus, San Diego Water Board, regarding “Tentative Cleanup & Abatement Order No. R9-2005-0126 Issued by the San Diego Regional Water Quality Control Board ("RWQCB"), on April 29, 2005 ("Order").” Sempra Energy, Los Angeles, CA. June 15, 2005.

Greenstein, D., S. Bay, and D. Young. 2005. Sediment Toxicity Identification Evaluation for the Mouths of Chollas and Paleta Creeks, San Diego, Draft Report. Southern California Coastal Water Research Project, Westminster, CA. September 2005.

Haddad, R.I. 2005. Forensic Geochemical Analysis of TPH and PAH Data Collected from Sediments at Southwest Marine, Inc., San Diego, CA. Prepared for BP West Coast Products, LLC. Prepared by Applied Geochemical Strategies, Inc., Arroyo Grande, CA.

Halvax, S. 2004. E-mail to T. Alo, San Diego Water Board, regarding "RE: Maintenance Dredging at NASSCO and SWM." BAE Systems, Inc., San Diego, CA. January 7, 2004.

Haumschilt, Lynwood P. 1991. Letter to San Diego Water Board regarding NPDES Permit No. CA0107671, Order No. 85-05. NASSCO, San Diego, CA. December 18, 1991.

International Agency for Research on Cancer (IARC). 1989. Diesel Fuels. IARC Summary & Evaluations, Volume 45. http://www.inchem.org/pages/iarc.html

IT Corporation. 2000. Draft Corrective Measures Implementation Report, Building 6 Sump. Prepared for NASSCO, San Diego, CA. IT Corporation.

Jamieson, Jon. 2002. Raw Sewage to Reclaimed Water, The History of Sewerage Systems in the Metropolitan San Diego – Tijuana Region. Nimbus Press, Chapters 5 and 6. March 2002.

Johnson, L. 2000. An Analysis in Support of Sediment Quality Thresholds for Polycyclic Aromatic Hydrocarbons (PAHs) to Protect Estuarine Fish. National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center, Seattle, WA. July 24, 2000.

Katz, C.N., A. Carlson-Blake, and D.B. Chadwick. 2003. Spatial and Temporal Evolution of Storm Water Plumes Impacting San Diego Bay. Poster presented at the Estuarine Research Federation National Conference in 2003 at St. Pete's Beach, FL. Marine Environmental Quality Branch, SPAWAR Systems Center, San Diego, CA. April 8, 2003.

Klimas, D. 2004. Letter to T. Alo, San Diego Water Board, regarding comments on "Necropsy and Histopathology of Spotted Sea Bass Sampled from San Diego Harbor" (Marty, 2003) and Sections 8.2 and 8.3 of the "NASSCO and Southwest Marine Detailed Sediment Investigation" (Exponent, 2003). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response & Restoration, Coastal Protection and Restoration Division, Sacramento, CA. April 20, 2004.

Kolb, R. 2005a. E-mail to L. Honma, San Diego Water Board, regarding "Re: Questions regarding catch basin near SWM." City of San Diego, Department of General Services, Storm Water Pollution Prevention Program, San Diego, CA. November 21, 2005.

Kolb, R. 2005b. Fax to C. Carlisle, San Diego Water Board, regarding "Sampson Street Investigation" (Map and Field Notes). City of San Diego, Department of General Services, Storm Water Pollution Prevention Program, San Diego, CA. November 22, 2005.

List, E.J. 2005. Evaluation of Polycyclic Aromatic Hydrocarbons and Metals in the San Diego Shipyard Site Sediments. Prepared for Chevron by Flow Science Incorporated, Pasadena, CA. Report No. FSI SC054052.

Long, E. R. 1989. The Use of the Sediment Quality Triad in Classification of Sediment Contamination. As published in National Research Council, Commission on Engineering and Technical Systems, Marine Board, Committee on Contaminated Marine Sediments, Report on Contaminated Marine Sediments – Assessment and Remediation. National Academy Press, Washington, D.C. Pp. 78-99.

Long, E.R. and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Seattle, Washington. March 1990.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management, Vol. 19, No. 1, pp. 81-97.

Long, E.R., L.J. Field, and D.D. MacDonald. 1998. Predicting Toxicity in Marine Sediments with Numerical Sediment Quality Guidelines. Environmental Toxicology and Chemistry, Vol. 17, No. 4, pp. 714-727. April 1998.

LFR Levine-Fricke. 2004. Technical Data Report Chevron San Diego Terminal. Prepared for Chevron Products Company and Chevron, San Diego, CA. LRF Levine-Fricke, Costa Mesa, CA. July 13, 2004.

MacDonald, D.D., L.M. DiPinto, J. Field, C.G. Ingersoll, E.R. Long, and R.C. Swartz. 2000. Development and Evaluation of Consensus-based Sediment Effect Concentrations for Polychlorinated Biphenyls. Environmental Toxicology and Chemistry, Vol. 19, No. 5, pp. 1403-1413. May 2000.

MacDonald, D. 2005. E-mail to C. Carlisle regarding “Post-Remed Area Wt Averages” with attachment AreaWtAvgSummarySF.xls. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response & Restoration, Coastal Protection and Restoration Division, Seattle, WA. June 2, 2005.

MacDonald, D. 2005. E-mail to C. Carlisle, San Diego Water Board, regarding “Re: Shipyard Cleanup” with attachment BAPScenarios072105.pdf. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response & Restoration, Coastal Protection and Restoration Division, Seattle, WA. July 21, 2005.

MacDonald, D. 2006. Ambient Concentrations of Select Metals in the Surficial Sediment of San Diego Bay. Poster presented at the Society of Environmental Toxicology and Chemistry conference. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response & Restoration, Coastal Protection and Restoration Division, Seattle, WA, 2006.

MacDonald, D., and D. Klimas. 2003. An Approach for Selecting a San Diego Bay Reference Envelope to Evaluate Site-Specific Reference Stations. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response & Restoration, Coastal Protection and Restoration Division, Sacramento, CA. January 16, 2003.

MacDonald, D. and B. Shorr. 2005. Memorandum to T. Alo and C. Carlisle, San Diego Water Board, regarding “Calculation of Dredging Volumes at the NASSCO and Southwest Marine Shipyards for Alternative Remedial Scenarios.” U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response & Restoration, Coastal Protection and Restoration Division, Seattle, WA. February 23, 2005.

Magar, V. and Wenning, R.J. 2006. The Role of Monitored Natural Recovery in Sediment Remediation. Integr. Environ. Assess. Manage. 2006, 2 (1), pp. 66-74.

Magar, V.S., D.B. Chadwick, T.S. Bridges, P.C. Fuchsman, J.M. Conder, T.J. Dekker, J.A. Steevens, K.E. Gustavson, and M.A. Mills. 2009. Technical Guide: Monitored Natural Recovery at Contaminated Sediment Sites. ESTCP Project ER-0622. U.S. Department of Defense, Environmental Security Technology Certification Program, May 2009.

Marty, G.D. 2003. Necropsy and Histopathology of Spotted Sea Bass Sampled from San Diego Harbor in September 2002 – Final Report. Fish Pathology Services, Davis, CA. March 25, 2003.

Meador, James P., 2000. An Analysis in Support of Tissue and Sediment Based Threshold Concentrations of Polychlorinated Biphenyls (PCBs) to Protect Juvenile Salmonids Listed by the Endangered Species Act. Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration. October 13, 2000.

Myers, S. M., C. M. Stehr, P. Olson, L. L. Johnson, B. B. McCain, S. Chan, and U. Varanasi. 1994. Relationships between Toxicopathic Hepatic Lesions and Exposure to Chemical Contaminants in English Sole (*Pleuronectes vetulus*), Starry Flounder (*Platichthys stellatus*), and White Croaker (*Genyonemus lineatus*). Environmental Health Perspectives, Vol. 102, No. 2, pp. 200-215. February 1994.

Myers, S. M., L.L. Johnson, P. Olson, C.M. Stehr, B.H. Horness, T. Collier, and B.B. McCain. 1998. Toxicopathic Hepatic Lesions as Biomarkers of Chemical Contaminant Exposure and Effects in Marine Bottomfish Species from the Northeast and Pacific Coasts, USA. Marine Pollution Bulletin, Vol. 37, No. 1-2, pp. 92-113. January-February 1998.

Nagy, K.A., I.A. Gierard, and T.K. Brown. 1999. Energetics of Free-Ranging Mammals, Reptiles, and Birds. Ann. Rev. Nutr. 19:247-277.

Nagpal, N.K. 1993. Ambient Water Quality Criteria for Polycyclic Aromatic Hydrocarbons (PAHs). Government of British Columbia, Canada, Ministry of Environment, Lands and Parks, Environmental Protection Division. August 13, 1993. http://www.env.gov.bc.ca/wat/wq/BCguidelines/pahs/pahs_over.html

National Marine Fisheries Service (NMFS). 2005. Southern California Eelgrass Mitigation Policy (revision 11). National Marine Fisheries Service, Southwest Regional Office, Long Beach, CA. Adopted on July 31, 1991, Last Revised on August 30, 2005. http://swr.nmfs.noaa.gov/hcd/policies/EELPOLrev11_final.pdf

National Oceanic and Atmospheric Administration (NOAA). 1999. Sediment Quality Guidelines Developed for the National Status and Trends Program. National Oceanic and Atmospheric Administration, Office of Response and Restoration. June 12, 1999. http://response.restoration.noaa.gov.

National Research Council (NRC). 1997. Contaminated Sediments in Ports and Waterways, Cleanup Strategies and Technologies. National Research Council, Commission on Engineering and Technical Systems, Marine Board, Committee on Contaminated Marine Sediments. National Academy Press, Washington, D.C.

NRC. 2001. A Risk-Management Stractegy for PCB-Contaminated Sediments. National Research Council. National Academy Press, Washington, D.C. **Not relied upon.**

NRC. 2007. Sediment Dredging at Superfund Megasites. Assessing the Effectiveness. Committee on Dredging at Superfund Megasites, National Research Council of the National Academies. National Academy Press, Washington, D.C.

Office of Environmental Health Hazard Assessment (OEHHA). 2001. Chemicals in Fish: Consumption of fish and shellfish in California and the United States, Final Report. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Section, Oakland, CA. October 2001.

OEHHA. 2003. Methylmercury in Sport Fish: Information for Fish Consumers. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Section, Oakland, CA. June 2003. http://www.oehha.ca.gov/fish/hg/index.html

OEHHA. 2006. PCBs in Sport Fish: Answers to Questions on Health Effects. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Sacramento, CA. Downloaded on February 14, 2006 from the following website: http://www.oehha.ca.gov/fish/pcb/index.html

OEHHA. 2008. Development of fish contamination goals and advisory tissue levels for common contaminants in California sport fish: Chlordane, DDTs, Dieldrin, methylmercury, PCBs, selenium, and Toxaphene. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Branch. June 2008. http://www.oehha.ca.gov/fish/gtlsv/pdf/FCGsATLs27June2008.pdf.

Palermo, M.R., J.E. Clausner, M.P. Rollings, G.L. Williams, T.E. Myers, T.J. Fredette, and R.E. Randall. 1998. Guidance for Subaqueous Dredged Material Capping, US Army Corps of Engineers, Technical Report DOER-1. U.S. Army Corps of Engineers, Waterways Experiment Station, Dredging Operations and Environmental Research Program, Washington, D.C., June 1998. http://el.erdc.usace.army.mil/elpubs/pdf/trdoer1.pdf

Peng, J., E. Zeng, T-L Ku, and S Luo. 2003. Significance of Sediment Resuspension and Tidal Exchange to Reduction of Polychlorinated Biphenyl Mass in San Diego Bay. Pp 101-109. In: Southern California Coastal Research Project Biennial Report 2001-2002. First edition. Southern California Coastal Water Research Project Authority.

Peterson, J., M. MacDonell, L. Haroun, and F. Monette. 2005. Radiological and Chemical Fact Sheets to Support Health Risk Analyses for Contaminated Areas. U.S. Department of Energy, Argonne National Laboratory, Environmental Science Division, DuPage County, IL. August 2005. http://www.ead.anl.gov/pub/dsp_detail.cfm?PubID=1472

Phillips, B.M., J.W. Hunt, B.S. Anderson, H.M. Puckett, R. Fairey, C.J. Wilson, and R. Tjeerdema. 2001. Statistical Significance of Sediment Toxicity Test Results: Threshold Values Derived by the Detectable Significance Approach. Environmental Toxicology and Chemistry, Vol. 20, No. 2, pp. 371-3733. February 2001.

Ranasinghe, A.J., D.E. Montagne, R.W. Smith, T.K. Mikel, S.B. Weisberg, D.B. Cadien, R.G. Velarde, and A. Dalkey. 2003. Southern California Bight 1998 Regional Monitoring Program, Benthic Macrofauna, Volume VII. Southern California Coastal Water Research Project, Westminster, CA. March 2003.

Rand, G.M., 1995. Fundamentals of Aquatic Toxicology, Effects, Environmental Fate, and Risk Assessment, Second Edition. Taylor and Francis, Washington, D.C., pp. 38-39.

Regional Water Quality Control Board (RWQCB). 1972. Wastes Associated with Shipbuilding and Repair Facilities in San Diego Bay. State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA. June 1972.

RWQCB. 1976a. Letter to Gary Higgins of San Diego Marine Construction Corporation regarding delay of Water Pollution Control Plan implementation. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA. November 23, 1976.

RWQCB. 1976b. Letter to Gary Higgins of San Diego Marine Construction Corporation regarding delay of Water Pollution Control Plan implementation. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA. December 29, 1976.

RWQCB. 1985. Order No. 85-05, NPDES Permit No. CAO107671, Waste Discharge Requirements for NASSCO Shipyard, San Diego County. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1987a. Inspection Form for BAE Systems – Industrial Discharger dated March 3, 1987. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1987b. Note to BAE Systems File dated March 18, 1987. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1988a. Inspection Form for BAE Systems – Industrial Discharger dated November 9, 1988. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1988b. Inspection Form for BAE Systems – Industrial Discharger dated November 15, 1988. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1989a. Inspection Form – Industrial Discharger dated August 1989. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1989b. Addendum No. 1 to Order No. 85-05. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1989c. Inspection Form for BAE Systems – Industrial Discharger dated February 27, 1989. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1989d. Inspection Form for BAE Systems – Industrial Discharger dated August 18, 1989. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1991. Facilities Inspection Report. Inspection date October 16, 1991. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 1994. Water Quality Control Plan for the San Diego Basin. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA. September 8, 1994.

RWQCB. 1997. Order No. 97-36, NPDES Permit No. CAG039001, Waste Discharge Requirements for Discharges from Ship Construction, Modification, Repair, and Maintenance Facilities and Activities Located in the San Diego Region. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 2001a. Guidelines for Assessment and Remediation of Contaminated Sediments in San Diego Bay at NASSCO & Southwest Marine Shipyards. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA. June 1, 2001.

RWQCB. 2001b. Municipal Stormwater Permit Order No. 2001-01. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 2002a. Letter to M. Chee (NASSCO) and S. Halvax (Southwest Marine) regarding "Assessment of Bioaccumulation and Risk to Fish Health from Sediment Contaminants at NASSCO and Southwest Marine Shipyards." California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA. July 16, 2002.

RWQCB. 2002b. NPDES PERMIT NO. CA0109151, Waste Discharge Requirements for Southwest Marine, Order No. 2002-0161. California Environmental Protection Agency, State

Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 2003a. A Compilation of Water Quality Goals. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, Central Valley Region, Sacramento, CA. August 2003. http://www.waterboards.ca.gov/centralvalley/available_documents/wq_goals/wq_goals_2003.pdf

RWQCB. 2003b. Letter to M. Chee (NASSCO), S. Halvax (BAE Systems), B. Chadwick (SPAWAR), and S. Bay (SCCWRP) regarding "Regional Board Final Position on a Reference Pool for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel Sediment Investigations." California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA. June 9, 2003

RWQCB. 2003c. Waste Discharge Requirements for NASSCO, Order No. 2003-005. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, San Diego Region, San Diego, CA.

RWQCB. 2005. Total Maximum Daily Loads for Toxic Pollutants in Ballona Creek Estuary. California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Board, Los Angeles Region, Los Angeles, CA. July 7, 2005.

San Diego Unified Port District (SDUPD). 2004. Historical Study, San Diego Bay Waterfront, Sampson Street to 28th Street, San Diego, California. Document by S. E. Booth in response to RWQCB Investigation Order Nos. R9-2004-0026 and 0027 on behalf of the San Diego Unified Port District. San Diego Unified Port District, San Diego, CA. June 30, 2004.

Savard, J. P., D. Bordage, and A. Reed. 1998. Surf Scoter (*Melaniita perspicillata*). In: The Birds of North America, No. 363. A. Poole and F. Gill (eds). The Birds of North America, Inc., Philadelphia, PA.

Southern California Coastal Water Research Project (SCCWRP). 2003. Southern California Bight 1998 Regional Monitoring Program. Southern California Coastal Water Research Project, Westminster, CA. March 2003.

SCCWRP and MBC. 1994. Santa Monica Bay Seafood Consumption Study: Final Report. Southern California Coastal Water Research Project, Westminster, CA and MBC Applied Environmental Sciences, Costa Mesa, CA. June 1994.

SCCWRP and U.S. Navy. 2004. Sediment Assessment at the Mouths of Chollas Creek and Paleta Creek, Phase 1 Results, Powerpoint presentation to the Regional Board. Southern California Coastal Water Research Project, Westminster, CA and U.S. Navy Region Southwest, San Diego, CA. May 11, 2004.

SCCWRP and U.S. Navy. 2005a. Sediment Assessment Study for the Mouths of Chollas and Paleta Creek, Phase 1 Results, PowerPoint presentation to the Regional Board. Southern

California Coastal Water Research Project, Westminster, CA and U.S. Navy Region Southwest, San Diego, CA. January 18, 2005.

SCCWRP and U.S. Navy. 2005b. Sediment Assessment Study for the Mouths of Chollas and Paleta Creek, San Diego, Phase 1 Final Report. Southern California Coastal Water Research Project, Westminster, CA and Space and Naval Warfare Systems Center, U.S. Navy, San Diego, CA. May 2005.

Schiff, K., S. Bay, and D. Diehl. 2003. Stormwater Toxicity in Chollas Creek and San Diego Bay, California. Environmental Monitoring and Assessment, Vol. 81, pp. 119-132.

SECOR. 2004. Historical Site Assessment Report Atlantic Richfield Facility No. 33-T. Prepared for ARCO, La Palma, CA. SECOR, San Diego, CA. July 16, 2007.

Snider, Thomas. 1992. Letter regarding Regional Board Inspection of February 27, 1992. NASSCO, San Diego, CA. May 1, 1992.

Storer, R.W. and G.L. Nuechterlein. 1992. Western and Clark's grebe. In: The Birds of North America, No. 26. A. Poole, P. Stettenheim, and F. Gill (eds). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, DC.

State Water Resources Control Board (SWRCB). 1968. Resolution No. 68-16 – Statement of Policy with Respect to Maintaining High Quality of Waters in California. California Environmental Protection Agency, State Water Resources Control Board, Sacramento, CA. October 28, 1968.

SWRCB. 1996. Resolution No. 92-49 - Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304 (As Amended on April 21, 1994 and October 2, 1996). California Environmental Protection Agency, State Water Resources Control Board, Sacramento, CA. October 2, 1996.

SWRCB. 1997. Water Quality Control Plan: Ocean Waters of California. California Environmental Protection Agency, State Water Resources Control Board, Sacramento, CA.

SWRCB. 2001. California Ocean Plan. California Environmental Protection Agency, State Water Resources Control Board, Sacramento, CA.

SWRCB. 2005. Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California. California Environmental Protection Agency, State Water Resources Control Board, Sacramento, CA.

SWRCB. 2008. Draft Staff Report – Water Quality Control Plan for Enclosed Bays and Estuaries, Part 1. Sediment Quality. CA Environmental Protection Agency, State Water Resources Control Board, Sacramento, CA. July 18, 2008.

SWRCB. 2009. Water Quality Control Plan for Enclosed Bays and Estuaries, Part 1. Sediment Quality. CA Environmental Protection Agency, State Water Resources Control Board, Sacramento, CA. August 25, 2009.

Swartz, R.C. 1999. Consensus Sediment Quality Guidelines for Polycyclic Aromatic Hydrocarbon Mixtures. Environmental Toxicology and Chemistry, Vol. 18, No. 4, pp. 780-787. April 1999.

TAMS/Gradient Corporation. 2000. Phase 2 Report, Further Site Characterization and Analysis, Volume 2F – Revised Human Health Risk Assessment, Hudson River PCBs Reassessment RI/FS. TAMS Consultants, Inc. and Gradient Corporation.

Thompson, B.C., J.A. Jackson, J. Burger, L.A. Hill, E.M. Kirsh, and J.L. Atwood. 1997. Least Tern (*Sterna antillarum*). In: The Birds of North America, No. 290. A. Poole and F. Gill (eds). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Thursby, G.B., J. Heltshe, and K. J. Scott. 1997. Revised Approach to Toxicity Test Acceptability Criteria Using a Statistical Performance Assessment. Environmental Toxicology and Chemistry, Vol. 16, No. 6, pp. 1322-1329. June 1997.

TN & Associates, Inc. 2006. Underground Storage Tank Closure Report, Silvergate Power Plant, 1348 Sampson Street, San Diego, California 92113. TN & Associates, Inc. November 13, 2006.

U.S. Army Corps of Engineers (U.S. ACE). 2008a. Technical Guidelines for Environmental Dredging of Contaminated Sediments. U.S. Army Corps of Engineers Environmental Laboratory, Vicksburg, MS. ERDC/EL TR-08-29 September 2008. Available on the web at http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/dredging_guidance.pdf

U.S. ACE, 2008b. The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk. U.S. Army Corps of Engineers. Engineer Research and Development Center, Vicksburg, MS. ERDC/EL TR-08-4, February, 2008. Available on the web at http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/summaryreport.pdf

U.S. Code of Federal Regulations (CFR). Title 40: Protection of Environment, Part 300 – National Oil And Hazardous Substances Pollution Contingency Plan (NCP), Section 300.430, Remedial Investigation/Feasibility Study and Selection of Remedy.

U.S. Environmental Protection Agency (U.S. EPA). 1989a. EPA Superfund Record of Decision: Commencement Bay, Near Shore/Tide Flats. EPA/ROD/R10-89/020. U.S. Environmental Protection Agency, Region X, Seattle, WA. September 30, 1989.

U.S. EPA. 1989b. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA-540-1-89-002. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. December 1989.

U.S. EPA. 1992a. Sediment Classification Methods Compendium. EPA-823-R-92-006. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C. September 1992.

U.S. EPA. 1992b. Proceedings of EPA's Contaminated Marine Sediment Management Strategy Forums. EPA-823-R-92-007. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C. September 1992.

U.S. EPA. 1993a. Wildlife Exposures Factors Handbook, Volumes 1 and 2. EPA-600-R-93-187a. U.S. Environmental Protection Agency, Office of Research and Development, Office of Health and Environmental Assessment, Washington, DC. December 1993.

U.S. EPA. 1993b. Selecting Remediation Techniques for Contaminated Sediment. EPA-823-B93-001. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C. and Office of Research and Development, Cincinnati, OH. June 1993.

U.S. EPA. 1994a. Assessment and Remediation of Contaminated Sediment (ARCS) Program, Assessment Guidance Document. EPA-905-B94-002. U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, Ill. July 1994.

U.S. EPA. 1994b. Selecting and Using Reference Information in Superfund Ecological Risk Assessments. EPA 540-F-94-050. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response Hazardous Site Evaluation Division (5204G). September 1994.

U.S. EPA. 1995. National Primary Drinking Water Regulations, Copper. Consumer Version. EPA 811-F-95-002i-C. U.S. Environmental Protection Agency, Office of Water. October 1995. The information contained in the above reference was found at the following webpage, updated on February 28, 2006: http://www.epa.gov/safewater/dwh/c-ioc/copper.html

U.S. EPA. 1997a. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. EPA 540-R-97-006, OSWER 9285.7-25, PB97-963211. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. June 1997.

U.S. EPA. 1997b. EPA Superfund Explanation of Significant Differences: Commencement Bay, Near Shore/Tide Flats. EPA/ESD/R10-97/059. U.S. Environmental Protection Agency, Region X, Seattle, WA. July 28, 1997.

U.S. EPA. 1997c. Profile of the Shipbuilding and Repair Industry. EPA-310-R-97-008. U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance, Washington, D.C. September 1997. Compliance Assistance Web Page at http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/ship.html

U.S. EPA. 1997d. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1, National Sediment Quality Survey. EPA-823-R-98-006. U.S. Environmental Protection Agency, Office of Science and Technology, Washington, D.C. September 1997.

U.S. EPA. 1997e. Mercury Study Report to Congress, Volume V: Health Effects of Mercury and Mercury Compounds. EPA-452-R-97-007. U.S. Environmental Protection Agency, Office of Air Quality Planning & Standards, Research Triangle Park, NC and Office of Research and

Development Cincinnati, OH. December 1997. The report was found at the following webpage: http://www.epa.gov/mercury/report.htm

U.S. EPA. 1998a. Methods for Assessing Sediment Bioaccumulation in Marine/Estuarine Benthic Organisms. National Sediment Bioaccumulation Conference Proceedings, September 11-13, 1996, Bethesda, MD. EPA-823-R-98-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. February 1998.

U.S. EPA. 1998b. Guidelines for Ecological Risk Assessment. EPA-630-R-95-002F. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, D.C. May 14, 1998.

U.S. EPA. 1998c. Assessment and Remediation of Contaminated Sediment (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments http://www.epa.gov/glnpo/sediment/iscmain

U.S. EPA. 2000a. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. 40 CFR Part 131. U.S. Environmental Protection Agency, Region IX, Water Division, San Francisco, CA. May 18, 2000.

U.S. EPA. 2000b. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition. EPA 823-B-00-008. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C. November 2000.

U.S. EPA. 2000c. Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance. EPA-822-B-00-024. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. December 2000.

U.S. EPA. 2000d. Development of a Framework for Evaluating Numerical Sediment Quality Targets and Sediment Contamination in the St Louis River Area of Concern. EPA-905-R-00-008. U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, IL. December 2000.

U.S. EPA. 2000e. EPA Superfund Record of Decision: Puget Sound Naval Shipyard Complex EPA ID: WA2170023418 OU 2. Bremerton, WA. U.S. Environmental Protection Agency. EPA/ROD/R10-00/516.

U.S. EPA. 2001a. Draft Implementation Framework for the Use of Equilibrium Partitioning Sediment Guidelines. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C. February 2001.

U.S. EPA. 2001b. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA-823-B-01-002. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C. October 2001.

U.S. EPA. 2003a. Integrated Risk Information System (IRIS). All searches conducted in online through Toxnet beginning in 2003. Database developed and maintained by U.S. Environmental

Protection Agency, Office of Research and Development, National Center for Environmental Assessment. Available at: www.epa.gov/iris/.

U.S. EPA. 2003b. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C. November 2003.

U.S. EPA. 2004a. What You Need to Know About Mercury in Fish and Shellfish, 2004 EPA and FDA Advice For: Women Who Might Become Pregnant, Women Who are Pregnant, Nursing Mothers, and Young Children. U.S. Department of Human Health Services and U.S. Environmental Protection Agency. EPA-823-R-04-005. March 2004. http://www.cfsan.fda.gov/~dms/admehg3.html

U.S. EPA. 2004b. Technical Memorandum – Origin of 1 Meal/Week Noncommercial Fish Consumption Rate in National Advisory for Mercury. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. March 11, 2004.

U.S. EPA. 2005a. Contaminated Sediments in Superfund. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Webpage can be found at: http://www.epa.gov/superfund/resources/sediment.

U.S. EPA. 2005b. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc). EPA-600-R-02-011. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C. January 2005.

U.S. EPA. 2006. Background Information on PCB Sources and Regulations. U.S. Environmental Protection Agency, Great Lakes Pollution Prevention and Toxics Reduction. Webpage can be found at: http://www.epa.gov/glnpo/bnsdocs/pcbsrce/pcbsrce.html

U.S. EPA. 2010. Contaminated sediment in Superfund: List of Sediment Sites with Substantial Contamination. Webpage last updated on June 28, 2010. Webpage accessed on June 28, 2010: http://www.epa.gov/superfund/health/conmedia/sediment/sites.htm

U.S. Food and Drug Administration (U.S. FDA). 2004. Mercury Levels in Commercial Fish and Shellfish. U.S. Food and Drug Administration, Department of Health and Human Services, Rockville, MD. March 19, 2004. Downloaded on May 12, 2004 at the following website: http://www.cfsan.fda.gov/seafood1.html.

U.S. Geological Survey. 2000. Mercury in the Environment, Fact Sheet 146-00. U.S. Department of the Interior, U.S. Geological Survey, Denver, CO. October 2000. Webpage last modified September 26, 2002, found at: http://www.usgs.gov/themes/factsheet/146-00/

U.S. Naval Seas Systems Command. 1984. Fleetwide Use of Organotin Antifouling Paint. Washington, D.C. December 1984.

U.S. Navy. 2000. Toxic Hot Spot Assessment Study At Chollas Creek and Paleta Creek, Historical Data Review. U.S. Navy, Navy Region Southwest, SPAWAR Systems Center San Diego, San Diego, CA, pp. 23-27. August 2000.

U.S. Navy. 2004. Historical Naval Activities at National Steel and Shipbuilding Company Shipyard. Prepared for Investigation Order No. R9-2004-0027 for Regional Water Quality Control Board, San Diego, CA. US Navy, San Diego, CA., July 2004.

Vidal, D.E. and S. M. Bay. 2005. Comparative Sediment Quality Guideline Performance For Predicting Sediment Toxicity In Southern California. Southern California Coastal Water Research Project, Westminster, CA. June 2005.

Washington State Department of Ecology (WDOE). 1997. Developing Health-Based Sediment Quality Criteria for Cleanup Sites: A Case Study Report. Ecology Publication No. 97-114. Washington State Department of Ecology.

Whitaker, J.O., Jr. 1997. National Audubon Society Field Guide to North American Mammals. Alfred A. Knopf (Ed.), New York, NY, pp. 937.

Wilson, C. M. 2002. Memorandum to J. Robertus, San Diego Water Board, regarding "Applicability of State Board Resolution 92-49 in Setting Sediment Cleanup Levels." State Water Resources Control Board, Office of Chief Counsel, Sacramento, CA. February 22, 2002.

Woodward-Clyde. 1995. Historical Occupancy Search Southwest Marine, Foot of Sampson Street, San Diego California. Prepared for Southwest Marine, Inc, San Diego, CA. Woodward-Clyde, San Diego, CA.

Zeeman, C.Q.T. 2004. Ecological Risk-Based Screening Levels for Contaminants in Sediments of San Diego Bay Sediments, Technical Memorandum CFWO-EC-TM-04-01. U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Environmental Contaminants Division, Carlsbad, CA. December 8, 2004.

Zirkle, C. 2005a. Letter to T. Sanger, SDG&E, regarding "Unauthorized Discharge of Toxic Pollutants into the Municipal Storm Drain System." City of San Diego, Department of General Services, Storm Water Pollution Prevention Program, San Diego, CA. October 14, 2005.

Zirkle, C. 2005b. Letter to K. Rowland, SDG&E, regarding "Extension of Notice of Violation Number 5408 Regarding Unauthorized Discharge of Toxic Pollutants into the Municipal Storm Drain System." City of San Diego, Department of General Services, Storm Water Pollution Prevention Program, San Diego, CA. November 8, 2005.

Zirkle, C. 2006. Letter to J. Robertus, San Diego Water Board Executive Officer, regarding "Comments on the Total Maximum Daily Load for Indicator Bacteria, Project I – Beaches and Creeks in San Diego Region." City of San Diego, Department of General Services, Storm Water Pollution Prevention Program, San Diego, CA. Page 9. February 3, 2006.