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I declare under penalty of perjury according to the laws of the State of California that the above is true and correct. Executed on February 11, 2011, at San Diego, California.

Shelley R. Campbell

LATHAM & WATKINS LLP
Robert M. Howard (SB No. 145870)
Kelly E. Richardson (SB No. 210511)
Jeffrey P. Carlin (SB No. 227539)
Ryan R. Waterman (SB No. 229485)
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San Diego, California 92101-3375
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Facsimile: (619) 696-7419

Attorneys for Designated Party
National Steel and Shipbuilding Company

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

SAN DIEGO REGION

IN THE MATTER OF:	NASSCO'S FIRST AMENDED NOTICE OF VIDEOTAPED DEPOSITION OF SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD CLEANUP TEAM'S PERSON(S) MOST KNOWLEDGEABLE FOR DESIGNATED SUBJECT MATTERS
TENTATIVE CLEANUP AND ABATEMENT ORDER NO. R9-2011-0001	Date: March 1 - 3, 2011 Time: 9:00 a.m. Place: Latham & Watkins LLP 600 West Broadway, Suite 1800 San Diego, CA 92101-3375

TO ALL PARTIES AND THEIR COUNSEL OF RECORD:

NOTICE IS HEREBY GIVEN, pursuant to the Presiding Officer's Order Issuing Final Discovery Plan dated February 18, 2010, and the Presiding Officer's October 27, 2010 Discovery Order, that on March 1 through 3, 2011, at 9:00 a.m., National Steel and Shipbuilding Company ("NASSCO") will take the deposition of the Person(s) Most Knowledgeable of the Cleanup Team of the San Diego Regional Water Quality Control Board ("Cleanup Team") for Designated Subject Matters. This deposition will take place at the law offices of Latham & Watkins LLP, 600 West Broadway, Suite 1800, San Diego, California, 92101, upon oral examination before a Certified Shorthand Reporter duly authorized to administer oaths, and will continue from day to day, Saturdays, Sundays and holidays excepted, until completed.

PLEASE TAKE FURTHER NOTICE that the deposition may also be videotaped, stenographically recorded, and recorded through such means as to provide the instant display of the testimony. NASSCO reserves the right to use any videotaped portion of the deposition testimony at a hearing in this matter.

PLEASE TAKE FURTHER NOTICE THAT the Cleanup Team is required to designate and produce those of its officers, staff, managing agents, employees, or agents who are the most qualified to testify on its behalf as to the subject matters set forth below:

1. Sediment/Site Investigation
2. Bioavailability/Bioaccumulation
3. Technological Feasibility
4. Economic Feasibility
5. Alternative Cleanup Levels
6. Alternative Remedies (including monitored natural attenuation, dredging, capping and aquatic disposal)
7. Other sediment remediations (in San Diego and California)
8. Shipyard Administrative Record
9. Remedial Footprint

DOCUMENTS AND ITEMS TO BE PRODUCED

San Diego Regional Water Quality Control Board's Person(s) Most Knowledgeable is required to produce the following items:

DEFINITIONS

The following definitions shall apply to each category of documents set forth below:

1. "COMMUNICATIONS" shall mean and refer to the written or verbal exchange of information by any means, including, without limitation, telephone, telecopy, facsimile, or other electronic medium (including e-mail), letter, memorandum, notes or other writing method, meeting, discussion, conversation or other form of verbal expression.

2. "DOCUMENT(S)" shall mean and refer to any and all written, printed,

typewritten, photographic, graphic, or recorded materials (by tape, video or otherwise), however produced or reproduced, including data stored in a computer, data stored on removable magnetic and optical media (e.g., magnetic tape, floppy disks, and recordable optical disks), e-mail, and voice mail, which relate or pertain in any way to the subject matter to which the Interrogatory refers. "DOCUMENT(S)" shall further include, without limitation, all preliminary, intermediate and final drafts or versions of any DOCUMENT, as well as any notes, comments, and marginalia appearing on any DOCUMENT, and shall not be limited in any way with respect to the process by which any DOCUMENT was created, generated, or reproduced, or with respect to the medium in which the document is embodied. DOCUMENT(S) shall include all "writing" and tangible forms of expression falling within the scope of California Evidence Code § 250, within YOUR custody, possession or control.

3. "PERSON(S)" shall mean and refer to any natural person, proprietorship, public or private corporation, limited or general partnership, trust, joint venture, firm, association, organization, board, authority, governmental entity, or any other entity, including a representative of such PERSON(S).

4. "RELATING TO" shall mean and refer to relating to, pertaining to, referring to, evidencing, in connection with, reflecting, respecting, concerning, based upon, stating, showing, establishing, supporting, bolstering, contradicting, refuting, diminishing, constituting, describing, recording, noting, embodying, memorializing, containing, mentioning, studying, analyzing, discussing, specifying, identifying, or in any other way bearing on the matter addressed in the request, in whole or in part.

5. "REGIONAL BOARD" shall mean and refer to the California Regional Water Quality Control Board, San Diego Region.

6. "SHIPYARD ADMINISTRATIVE RECORD" refers to the compilation of indexed electronic documents distributed by the REGIONAL BOARD on April 4, 2008 in the San Diego Bay sediments cleanup proceedings regarding Tentative Cleanup and Abatement Order No. R9-2005-0126, and any subsequent additions thereto in connection with the TENTATIVE ORDER.

7. "SITE" shall mean and refer to the Shipyard Sediment Site, as described in the TENTATIVE ORDER and TECHNICAL REPORT.

8. "TECHNICAL REPORT" shall mean and refer to the Draft Technical Report for the TENTATIVE ORDER, publicly released on September 15, 2010, including but not limited to the prior drafts released publicly on December 22, 2009, August 24, 2007, and April 4, 2008.

9. "TENTATIVE ORDER" shall mean and refer to Tentative Cleanup and Abatement Order R9-2011-0001, publicly released on September 15, 2010, including but not limited to the prior drafts released publicly on December 22, 2009, April 29, 2005, August 24, 2007, and April 4, 2008.

10. "YOU" or "YOUR" or "CLEANUP TEAM" shall mean and refer to the Cleanup Team of the California Regional Water Quality Control Board, San Diego Region, formed in connection with the investigation of the Shipyard Sediment Site in San Diego Bay, and its agents, employees, consultants, attorneys, investigators, affiliates, or anyone else acting on its behalf.

DOCUMENT REQUESTS

1. All DOCUMENTS RELATING TO the subject matter(s) for which the person most knowledgeable shall testify, and which the person most knowledgeable relied upon in connection with any work performed or conclusions reached in connection with the subject matter(s).

2. All DOCUMENTS RELATING TO the subject matter(s) for which the person most knowledgeable shall testify which are not part of the SHIPYARD ADMINISTRATIVE RECORD.

Dated: February 15, 2011

LATHAM & WATKINS LLP

By _____
Jeffrey P. Carlin
Attorneys for Designated Party
National Steel and Shipbuilding Company

PROOF OF SERVICE

I am a resident of the State of California, over the age of eighteen years, and not a party to the within action. My business address is Latham & Watkins, 600 West Broadway, Suite 1800, San Diego, California 92101. On February 15, 2011, I served the within document(s):

NASSCO'S FIRST AMENDED NOTICE OF VIDEOTAPED DEPOSITION OF SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD CLEANUP TEAM'S PERSON(S) MOST KNOWLEDGEABLE

☒ **BY E-MAIL:** I caused the above-referenced documents to be converted in digital format (.pdf) and served by electronic mail to the addresses listed below.

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I declare under penalty of perjury according to the laws of the State of California that the above is true and correct. Executed on February 15, 2011, at San Diego, California.

Shelley R. Campbell

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

In the matter of Tentative Cleanup and Abatement Order No. R9-2011-0001 (Shipyard Sediment Cleanup)	San Diego Water Board Cleanup Team's Amended Witness Designations

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TO ALL PARTIES AND TO THEIR ATTORNEYS OF RECORD HEREIN;

PLEASE TAKE NOTICE that, pursuant to the Presiding Officer's February 18, 2010 Order Issuing Final Discovery Plan Etc., and all applicable Orders in the above-referenced proceeding, Designated Party the California Regional Water Quality Control Board, San Diego Region Cleanup Team ("Cleanup Team") hereby designates the following witness who may testify in the above-referenced proceeding.

- David Gibson – Executive Officer, Former Branch Chief of the Water Quality Restoration Standards Branch and an Environmental Program Manager 1.
- David Barker – Branch Chief of the Surface Waters Basins Branch and a Supervising Water Resource Control Engineer.
- Julie Chan – Branch Chief of the Ground Water Basins Branch and a Supervising Engineering Geologist.
- Craig Carlisle – Senior Engineering Geologist.
- Tom Alo – Water Resource Control Engineer.

- Vicente Rodriguez – Water Resource Control Engineer.

- All persons designated as witnesses by any other Designated Party under the Presiding Officer's February 18, 2010 Order Issuing Final Discovery Plan, Etc. and all applicable Orders.

PLEASE TAKE FURTHER NOTICE that Alan Monji, Cynthia Gorham-Test, Benjamin Tobler and Peter Peuron, all of whom were previously designated as potential witnesses by the Cleanup Team will not testify.

Each of the specifically-identified above-referenced witnesses may testify regarding some or all aspects of Cleanup and Abatement Order No. R9-2011-0001 and/or the contents of the accompanying Draft Technical Report, has agreed to testify in this proceeding, and is sufficiently familiar with this proceeding to submit to an oral deposition concerning his or her specific testimony, but none will be paid a fee for his or her testimony.

Each of the specifically-identified above-referenced witnesses may testify as a percipient witness, and/or, with the exception of Vicente Rodriguez, may offer an expert opinion within the scope of his or her expertise as an employee of the San Diego Water Board.

The address for all of the specifically-identified witness above is 9174 Sky Park Court, Suite 100, San Diego, CA 92123-4353.

Dated: January 18, 2011

Respectfully submitted,

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, SAN DIEGO REGION CLEANUP TEAM

By: _____

Christian Carrigan

TENTATIVE

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

RESOLUTION NO. 2001-02

A RESOLUTION REQUIRING SEDIMENT STUDIES FOR ESTABLISHING SHIPYARD SEDIMENT CLEANUP LEVELS FOR NATIONAL STEEL AND SHIPBUILDING COMPANY SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board), finds that:

1. The Regional Board must establish final sediment cleanup levels for National Steel and Shipbuilding Company (NASSCO) in accordance with State Water Resources Control Board – Resolution No. 92-49, *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304*.

2. Elevated levels of pollutants exist in the San Diego Bay sediment adjacent to NASSCO. The concentration of these pollutants causes or threatens to cause a condition of pollution that harms the beneficial uses designated for San Diego Bay.

3. On March 10, 1999, the Regional Board adopted Resolution No. 99-20 establishing interim sediment cleanup levels for NASSCO. The interim cleanup levels were derived from the AET cleanup levels for Campbell Shipyard and Shelter Island Boatyard.

4. On March 10, 1999, the Regional directed the Executive Officer to establish an informal peer review panel to determine the appropriateness of using the Campbell Shipyard AET cleanup levels at NASSCO.

5. NASSCO has performed assessment activities to delineate the extent of these pollutants adjacent to its facility. Four remediation areas were identified which contained copper, zinc, and mercury concentrations that exceeded the Campbell Shipyard and Shelter Island Boatyard AET cleanup levels.

6. Six cleanup level options have been selected for establishing final sediment cleanup levels at NASSCO. The six options consist of the following:

   Option 1 – Background Reference Station
   Option 2 – Effects Range Median
   Option 3 – Campbell Shipyard & Shelter Island Boatyard AET Levels – 20% Safety Factor (Pre-Sampling Program)

Option 4 - Campbell Shipyard & Shelter Island Boatyard AET Levels (Pre-Sampling Program)
Option 5 – Site-Specific AET Levels (Comprehensive Chemical Analysis)
Option 6 – No Action

These options have been considered and evaluated in the February 16, 2001, *Final-Regional Board Report, Shipyard Sediment Cleanup Levels, NASSCO & Southwest Marine Shipyards, San Diego Bay* and *Response to Comments, Regional Board Report, Shipyard Sediment Cleanup Levels, NASSCO & Southwest Marine Shipyards, San Diego Bay.*

7. There are a variety of complimentary approaches available to derive cleanup levels (e.g. Apparent Effects Threshold (AET), Equilibrium Partitioning, Spiked Sediment Toxicity, human health risk assessment) which taken together, can provide a firm foundation for a site specific cleanup level at NASSCO that would be fully protective of beneficial uses.

8. The Regional Board has notified the discharger and all known interested parties of its intent to establish final sediment cleanup levels for NASSCO.

9. The San Diego Unified Port District (Port District) owns the land where NASSCO is located. The Port District has been notified of this proposed Regional Board action and has been provided with the opportunity to participate pursuant to Water Code Section 13307.

10. This action is exempt from the requirements of the California Environmental Quality Act (Public Resources Code 21000 et seq.) in accordance with Title 14, California Code of Regulations, Chapter 3, Section 15270.

11. The Regional Board, in public meetings on October 11, 2000 and February 21, 2001, heard and considered all comments pertaining to the proposed action.

NOW THEREFORE BE IT RESOLVED THAT,

1. The Executive Officer shall issue a Water Code Section 13267 letters to NASSCO requiring the submission of a site-specific study by June 21, 2001 to develop sediment cleanup levels and identify sediment cleanup alternatives. The Site Specific Study should include at a minimum the information described below.

   a) Site Specific Study to Develop Cleanup Levels

      i) NASSCO shall submit a work plan and time schedule to complete a site assessment; develop sediment cleanup levels, including an adequate margin of safety, for constituents of concern identified through on-site chemical screening.

      ii) NASSCO shall develop cleanup alternatives with projected cleanup costs.

      iii) NASSCO shall determine cleanup level(s) through scientifically defensible methods and designed to provide adequate protection for the most sensitive beneficial use of San Diego Bay. This requires that an extremely broad group of organisms that are affected by water quality conditions be considered. These include benthic (living in sediments) and epibenthic (living on the surface of sediments) organisms, organisms living in the water, waterfowl and shorebirds, and terrestrial animals (including humans) which eat aquatic organisms.

      iv) NASSCO shall determine cleanup levels for each constituent of concern by several complimentary methods as determined by Regional Board staff. There is no single method that measures the effects of contaminated sediments at all times and to all organisms. The selection of complementary allow for the integration of empirical data developed for Apparent Effects Thresholds (AET), theoretical information used in Equilibrium Partitioning (EqP), and cause and effect relationships established by spiked bioassays. The methods used to determine cleanup levels shall at minimum include the following:

         (1) Equilibrium Partitioning (EqP) Approach – Cleanup levels will be established at chemical concentrations in sediment that ensure interstitial water concentrations do not exceed adopted water quality objectives or USEPA water quality criteria (in the absence of adopted water quality objectives)

         (2) Apparent Effects Threshold - The Apparent Effects Threshold (AET) approach is the sediment concentration of a contaminant above which statistically significant biological effects (e.g. amphipod mortality in bioassays, depressions in the abundance of benthic infauna) would always be expected. The method applies the triad of chemical, toxicological, and

benthic community field survey measures to determine a concentration in sediments above which adverse effects are always expected.

(3) Spiked Sediment Toxicity – Dose response measurements are established by exposing test organisms to sediments that have been spiked with known amounts of chemicals or mixtures of chemicals.

v) NASSCO shall assess ~~access~~ the potential health risk to humans from exposure to pollutants through the food chain attributable to the contaminated sediment. If preliminary screening indicates an unacceptable risk to human health, a detailed human health risk assessment shall be conducted.

vi) NASSCO shall submit other additional information on cleanup costs, alternatives and methods as determined by Regional board staff. In determining this information staff will review and update the August 3, 1995 letter from the Regional Board to NASSCO and describing the minimum criteria for contaminated sediment assessment.

2. REF-03, as described on Page 29 of the February 16, 2001 staff report titled "Final Regional Board Report, Shipyard Sediment Cleanup Levels: NASSCO & Southwest Marine Shipyards, San Diego Bay," shall serve as the "Background Reference Station" representing background sediment conditions that existed before the discharge at NASSCO and Southwest Marine. The background sediment chemical concentrations at REF-03 for the chemicals of concern at NASSCO include:

Constituent	Background Reference Station Dry Weight (mg/kg)
Copper	87.5
Zinc	139
Lead	41
PCBs	0.12
Mercury	0.57

The Executive Officer may modify the sediment chemical concentrations if new information indicates a change is appropriate.

I, John H. Robertus, Executive Officer, do hereby certify the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Diego Region, on February 21, 2001.

TENTATIVE

JOHN H. ROBERTUS
Executive Officer

California Regional Water Quality Control Board

San Diego Region

Winston H. Hickox
Secretary for Environmental Protection

Internet Address: http://www.swrcb.ca.gov/rwqcb9
9771 Clairemont Mesa Boulevard, Suite A, San Diego, California 92124-1324
Phone (858) 467-2952 • FAX (858) 571-6972

Gray Davis
Governor

June 1, 2001

CERTIFIED-RETURN RECEIPT REQUESTED
7000 1530 0002 7651 1684

Mr. Mike Chee
National Steel and Shipbuilding Company
Harbor Drive and 28th Street
San Diego, CA 92113

Dear Mr. Chee:

ASSESSMENT AND REMEDIATION OF CONTAMINATED SEDIMENTS IN SAN DIEGO BAY AT NASSCO AND SOUTHWEST MARINE SHIPYARDS

On February 21, 2001, the Regional Board adopted Resolution No. 2001-02, *A RESOLUTION REQUIRING SEDIMENT STUDIES FOR ESTABLISHING SHIPYARD SEDIMENT CLEANUP LEVELS FOR NATIONAL STEEL AND SHIPBUILDING COMPANY, SAN DIEGO COUNTY.* As you know, Resolution 2001-02 directs me to issue a Water Code Section 13267 letter to NASSCO requiring the submission of a site-specific study to develop sediment cleanup levels and identify sediment cleanup alternatives.

Accordingly, pursuant to California Water Code (CWC) Section 13267, I hereby direct NASSCO to conduct a site-specific study in accordance with the attached document, *GUIDELINES FOR ASSESSMENT AND REMEDIATION OF CONTAMINATED SEDIMENTS IN SAN DIEGO BAY AT NASSCO AND SOUTHWEST MARINE SHIPYARDS, June 1, 2001.* As a first step, Southwest Marine shall develop and submit to the Regional Board by June 25, 2001, a workplan and time schedule for development of the site assessment, sediment cleanup levels, sediment cleanup alternatives, and cleanup costs as described in the attached guidelines.

Under CWC Section 13268, any person failing or refusing to furnish information requested under the authority of CWC Section 13267 is guilty of a misdemeanor and may be subject to civil liability. Civil liability may be imposed administratively by the Regional Board in an amount not to exceed $1,000 per day per violation.

If you have any questions, or require additional assistance, please contact either Mr. Tom Alo of my staff at (858) 636-3154 or Ms. Keri Cole of my staff at (858) 467-2798.

Sincerely,

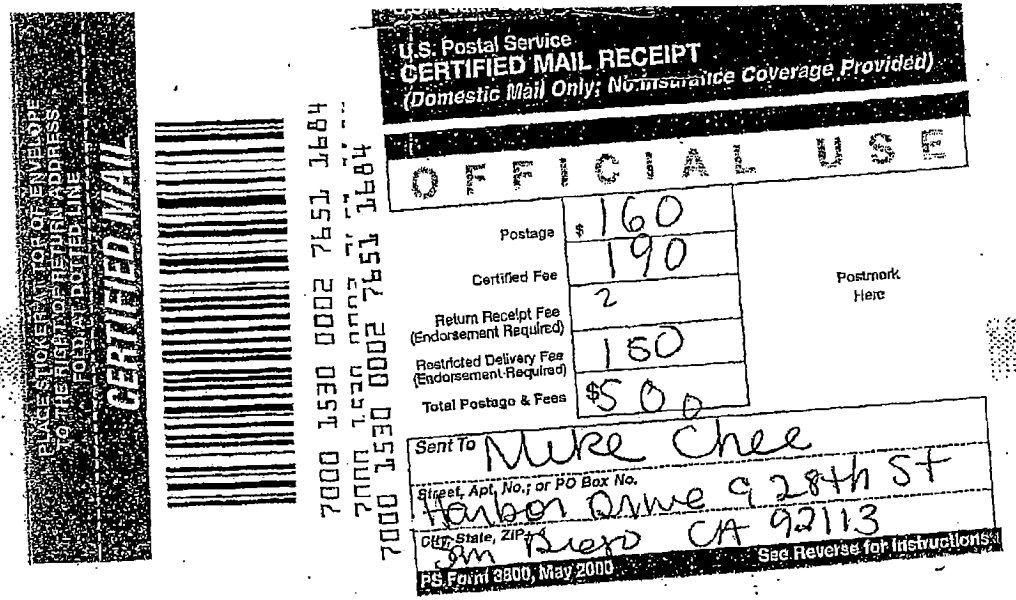
JOHN H. ROBERTUS
Executive Officer

JHR:dtb:tca

Enclosure: Guidelines for Assessment and Remediation of Contaminated Sediments in San Diego Bay at NASSCO and Southwest Marine Shipyards, June 1, 2001

NASSCO File No.: 03-0066.05

NASSCO 13267 Letter - Assessment and Remediation.doc



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Mr. Mike Chee
National Steel & Shipbuilding Co
Harbor Drive & 28th St
San Diego, CA 92113

4a. Article Number
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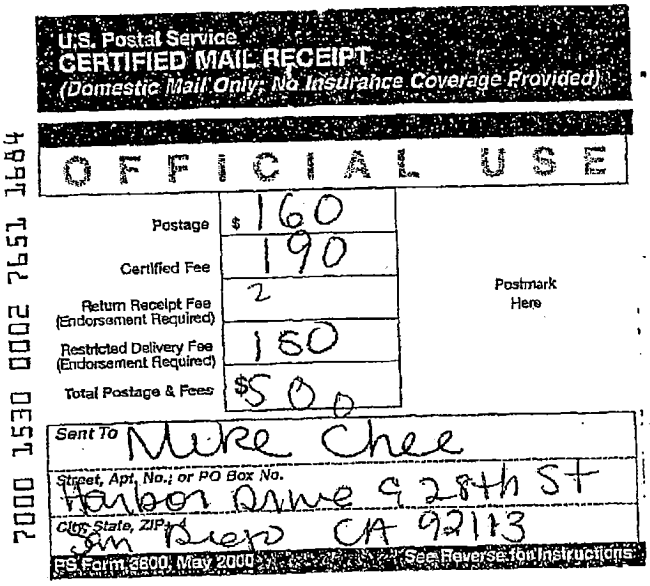

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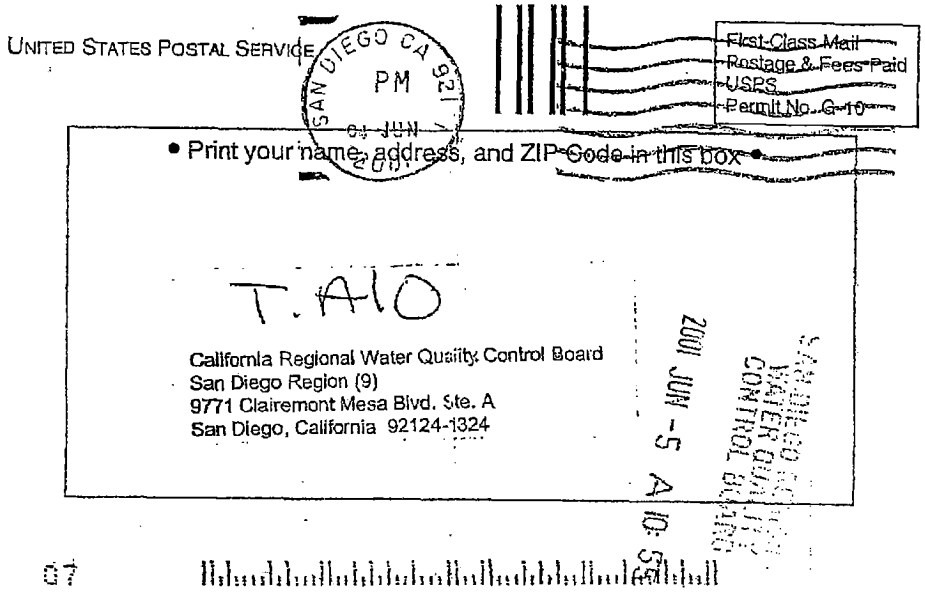
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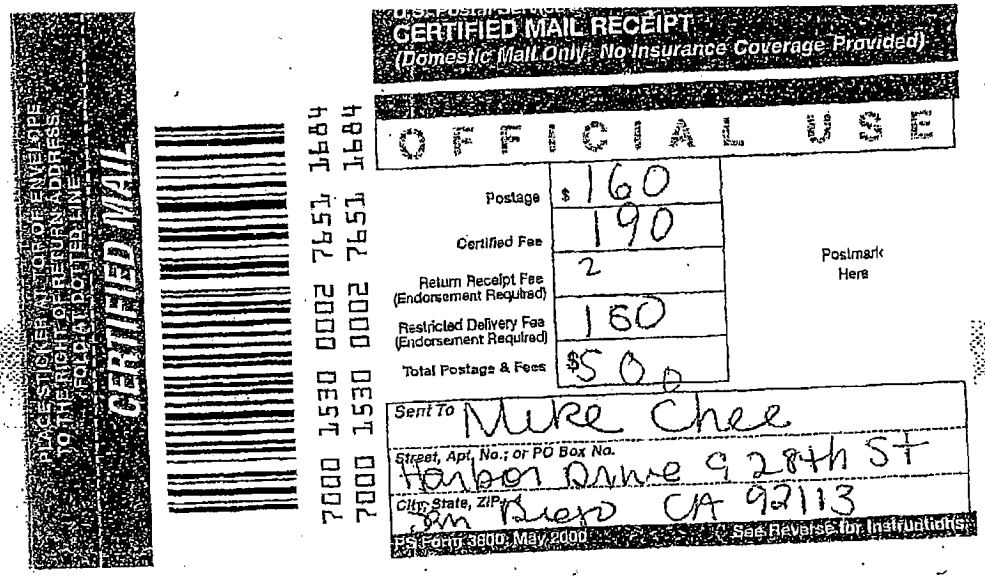

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

GUIDELINES FOR ASSESSMENT AND REMEDIATION OF CONTAMINATED SEDIMENTS IN SAN DIEGO BAY AT NASSCO AND SOUTHWEST MARINE SHIPYARDS

June 1, 2001

TABLE OF CONTENTS

APPENDICES LIST

LIST OF ACRONYMS AND ABBREVIATIONS

AET	Apparent Effects Threshold
AQUA	Aquaculture Beneficial Use
AVS/SEM	Acid Volatile Sulfide / Simultaneously Extracted Metals
Bight 98	Southern California Bight 1998 Regional Marine Monitoring Survey
BIOL	Preservation of Biological Habitats of Special Significance
BSAFs	Biota-to-Sediment Accumulation Factors
CTR	California Toxics Rule
COMM	Commercial and Sport Fishing Beneficial Use
EC_{50}	Median Effective Concentration
EqP	Equilibrium Partitioning Approach
EST	Estuarine Habitat Beneficial Use
Kp	Partition Coefficients
LAET	Lowest Apparent Effects Threshold
LC_{50}	Median Lethal Concentration
MAR	Marine Habitat Beneficial Use
MIGR	Migration of Aquatic Organisms Beneficial Use
NAV	Navigation Beneficial Use
NASSCO	National Steel and Shipbuilding Company
OHHEA	Office of Environmental Health and Hazard Assessment
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCTs	Polychlorinated Triphenyls
RARE	Rare, Threatened or Endangered Species Beneficial Use
REC1	Contact Water Recreation Beneficial Use
REC2	Non Contact Water Recreation Beneficial Use
REF-03	Reference Station 3
SCCWRP	Southern California Coastal Water Research Project
SHELL	Shellfish Harvesting Beneficial Use
SPWN	Spawning Habitat Beneficial Use
SSDTT	Sediment Serial Dilution Toxicity Test
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TR	Tissue Residue (biota-water-sediment equilibrium partitioning approach)
TRGs	Tissue Residue Guidelines
Triad Approach	Sediment Quality Triad Approach
WILD	Wildlife Habitat Beneficial Use

DEFINITIONS

Acute Toxicity - The immediate or short-term response of an organism to a chemical substance. Lethality is the response that is most commonly measured in acute toxicity tests.

Benthic Invertebrate Community – The assemblage of various species of sediment dwelling organisms that are found within an aquatic ecosystem.

Bioaccumulation – The net accumulation of a chemical substance by an organism as a result of uptake from all environmental sources.

Bioaccumulative Substances – The chemicals that tend to accumulate in the tissues of aquatic organisms.

Bioavailability - The fraction of a chemical present in the sediment that is available for uptake by organisms

Bulk Sediment – Sediment and associated porewater.

Chronic Toxicity – The response of an organism to long-term exposure to a chemical substance. Among others, the responses that are typically measured in chronic toxicity tests include lethality, decreased growth and impaired reproduction.

EC_{50} - Concentration of a toxicant predicted to cause a sublethal effect in 50% of test organisms over the course of an exposure period.

Endpoint – The response measured in a toxicity test.

LC_{50} – Concentration of a toxicant predicted to cause a lethal effect in 50% of test organisms over the course of an exposure period.

Porewater – The water that occupies the spaces between sediment particles.

Sediment – Particulate material that usually lies below water.

Toxicity Test - A laboratory experiment that measure the response (e.g., survival, growth, or reproduction) of an organism following exposure to a sample suspected of containing harmful substances.

Wildlife – The reptiles, amphibians, birds, and mammals that are associated with aquatic ecosystems [e.g., piscivorous (fish eating) wildlife].

I INTRODUCTION

Elevated levels of pollutants exist in the bay bottom sediments adjacent to NASSCO and Southwest Marine shipyards. The concentrations of these pollutants cause or threaten to cause a condition of pollution that harms aquatic life beneficial uses designated for San Diego Bay. The concentrations of these pollutants may also present aquatic-dependent wildlife and human health risks from exposure to pollutants through the food chain attributable to the contaminated sediment.

The purpose of this document is to provide guidelines for the assessment and remediation of contaminated sediments in San Diego Bay at NASSCO and Southwest Marine shipyards. The Regional Board is requiring NASSCO and Southwest Marine shipyards to perform an investigation to determine: (1) The nature and extent of the waste discharges, (2) The biological effects and human health risk associated with bay sediments containing pollutants resulting from the discharges, and (3) Appropriate cleanup and abatement measures.

II REGIONAL BOARD MANDATE

The Regional Board designates cleanup levels for contaminated bay sediment sites in accordance with the enclosed State Water Resources Control Board Resolution No. 92-49, POLICIES AND PROCEDURES FOR INVESTIGATION AND CLEANUP AND ABATEMENT OF DISCHARGES UNDER WATER CODE SECTION 13304. Resolution No. 92-49 is a state policy that establishes policies and procedures for investigation and cleanup and abatement under Water Code, Section 13304. The Resolution establishes the basis for determining cleanup levels of waters of the State and sediments that impact waters of the State.

Resolution No. 92-49 provides that dischargers are required to cleanup and abate the effects of discharges..... "in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored...". Alternative cleanup levels less stringent than background must, among other things, not unreasonably affect present and anticipated beneficial uses of waters of the State. The Resolution also includes procedures to investigate the nature and horizontal and vertical extent of a discharge and procedures to determine appropriate cleanup and abatement measures.

III PRESUMPTIVE CLEANUP GOAL

Under the terms of Resolution No. 92-49, the Regional Board is obligated to have a presumptive cleanup goal to require cleanup to attain background water quality conditions. The Regional Board will establish a cleanup level above background water quality conditions, only if the Board determines that it is technologically or economically infeasible to achieve background water quality conditions. If the Regional Board makes such a determination, the Board will then select a cleanup level that is based on the lowest levels which are technologically or economically

achievable and that will not unreasonably affect present and anticipated beneficial uses of waters of the Region. This approach provides for determining and establishing a level of water quality protection which is reasonable without allowing or causing an unreasonable effect on water quality.

IV BENEFICIAL USES TO BE PROTECTED

The Basin Plan designates 12 beneficial uses for San Diego Bay that may be adversely affected by the contaminated sediment. Contaminated bay bottom sediments may adversely affect eleven of the beneficial uses. These beneficial uses fall into four broad categories as shown below:

AQUATIC LIFE BENEFICAL USES	AQUATIC -DEPENDENT WILDLIFE BENEFICAL USES	HUMAN HEALTH BENEFICIAL USE	NAVIGATION AND SHIPPING BENEFICICAL 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)	

The environmental threat associated with contaminated sediments is caused by the tendency of many chemical substances discharged into marine waters to attach to sediment particles and thus accumulate to high concentrations in the bay bottom sediments. The bottom sediments support biological communities of benthic or bottom dwelling organisms, (e.g., worms, clams, bottom feeding fish), that live in and eat marine sediment. The marine sediments may also serve as a spawning habitat for many pelagic species that inhabit the water column (e.g., invertebrates and fish). The elevated concentrations of chemicals in the sediment may cause acute mortality or can affect the reproductive behavior, egg hatching characteristics, and the early life development of these organisms. In addition to acute mortality and abnormal development phenomena, contaminated sediments can also lead to the accumulation of contaminants in organisms due to the effects of bioaccumulation. In addition, biomagnification of the contaminants can occur in the food chain when smaller contaminated organisms are consumed by higher trophic level species, including humans. The primary and by far the most significant threat to the public health are the consumption of fish and shellfish contaminated by chemicals in the sediment.

Shipping, travel or transportation by private, military or commercial vessels is an

important beneficial use in San Diego Bay. The protection of this beneficial use is dependent upon maintaining appropriate depths in shipping channels and vessel berthing areas by carrying out maintenance dredging. The Navigation (NAV) beneficial use can be adversely affected when maintenance-dredging projects are stymied due to water quality problems associated with the resuspension and migration of contaminants from contaminated bay sediments to previously uncontaminated areas. The Navigation beneficial use can also be affected when contaminants in bay sediments complicate the disposal of dredged sediment by exceeding criteria for the ocean disposal of dredged sediment or the beneficial reuse of dredged sediment (e.g. beach replenishment) from maintenance dredging projects.

NASSCO's and Southwest Marine's investigation must address the development of cleanup levels to protect the aquatic life, aquatic-dependent wildlife, human health and navigation and shipping categories of beneficial uses. The Regional Board is making the assumption that: (1) The benthic community (covered under the marine habitat beneficial use), (2) Aquatic-dependent wildlife (e.g., birds, mammals, and reptiles) consumption of fish and other aquatic organisms (covered under the Wildlife Habitat beneficial use), and (3) The human consumption of fish and shellfish (covered under the Commercial and Sport Fishing and Shellfish Harvesting beneficial uses) represent the most sensitive beneficial uses needing protection from contaminated sediment at NASSCO and Southwest Marine shipyards.

V SITE REMEDIATION CLEANUP GOALS

The Regional Board is mandated under Resolution 92-49 to require cleanup to either: (1) Attain sediment chemistry background conditions, or (2) if background conditions cannot be achieved , attain sediment chemistry conditions as close to background as possible that will protect beneficial uses. There are three categories of beneficial uses requiring protection: aquatic life beneficial uses, aquatic-dependent wildlife beneficial uses, and human health beneficial uses.

Accordingly four broad investigations are required to develop: (1) Cleanup levels to attain background conditions or as close to background conditions as possible; (2) Cleanup levels to protect aquatic life beneficial uses; (3) Cleanup levels to protect aquatic-dependent wildlife beneficial uses; and (4) Cleanup levels to protect human health. The work activities required and the associated sequence of these work activities are illustrated in the following figures in Appendix A :

- Figure 1 - NASSCO & Southwest Marine Shipyards Cleanup Level Methodology Selection
- Figure 2 - Sediment Cleanup Levels to Protect Aquatic Life
- Figure 3 - Sediment Cleanup Levels to Protect Aquatic-Dependent Wildlife
- Figure 4 - Sediment Cleanup Levels to Protect Human Health.

VI SITE REMEDIATION WORKPLAN

A. NASSCO and Southwest Marine shipyards shall develop and submit to

the Regional Board by June 25, 2001, a workplan and time schedule for development of the site assessment, sediment cleanup levels, sediment cleanup alternatives, and cleanup costs associated with the following: (1) Sediment cleanup levels to attain background conditions or as close to background conditions as possible; (2) Sediment cleanup levels to protect aquatic life beneficial uses; (3) Sediment cleanup levels to protect aquatic-dependent wildlife beneficial uses; and (4) Sediment cleanup levels to protect human health. The workplan shall conform to the guidelines contained in this document and be subject to the approval of the Regional Board Executive Officer.

B. The workplan shall contain the following main elements describing the work to be done in conformance with the guidelines contained in this document.

1. *Spatial Site Assessment*: The workplan shall include a detailed description of the study design to define and analyze the extent and magnitude of sediment contaminants and associated biological effects related to shipbuilding and repair activities.

2. *Spatial Data Analysis*: The workplan shall include a conceptual framework for assessing sediment quality and the potential for impairment of aquatic life, aquatic-dependent wildlife, and human health beneficial uses. Additionally, the workplan shall include a detailed description of the maps that will be developed to depict the areas where there is a potential for beneficial use impairment.

3. *Numerical Data Analysis to Determine Sediment Cleanup Levels*: The workplan shall provide a description of the methodologies to be used for developing sediment cleanup levels to protect aquatic life, aquatic-dependent wildlife, and human health beneficial uses. Additionally, the workplan shall provide a detailed description of the maps that will be developed to depict the areas exceeding the sediment cleanup levels.

4. *Cleanup Alternatives Analyses*: The workplan shall include a description of the methodologies to be used for developing technological and economic feasibility analyses for each of the sediment cleanup levels and applicable cleanup methodologies, including an evaluation of the potential benefits and adverse effects associated with each strategy.

5. *Selection of Target Cleanup Level*: The workplan shall include a description of the methodologies to be used for selection of the final cleanup level. If the final recommended cleanup level does not attain background levels, the final report must include justification for an alternative cleanup level which is as close to background as possible based on the technological and economic feasibility

analyses for each of the cleanup levels and cleanup methodologies.

6. *Logistics and time schedule:* The workplan shall describe the overall field and laboratory logistics for the site investigation and remediation. The time schedule shall include dates for completing all major tasks in an expedited time frame.

7. *Information Management:* In order to facilitate data sharing, NASSCO and Southwest Marine shipyards shall enter data into a data management system consistent with the standardized data transfer format protocols established by the Southern California Bight 1998 Regional Marine Monitoring Survey (Bight 98) Steering Committee, Southern California Coastal Water Research Project (SCCWRP). Data collected from the project shall be provided to the Regional Board in electronic and paper format.

8. *Quality Assurance and Quality Control:* The Quality Assurance Plan, including field and laboratory methods, shall be modeled on the Quality Assurance Manuals prepared for the Bight 98 Steering Committee, Southern California Coastal Water Research Project. The Quality Assurance Plan shall include provisions for notifying Regional Board staff of sampling activities and provisions for a split-sampling program with the Regional Board.

9. *Project Management:* Each component of the site remediation investigation shall be conducted under the direction of appropriately qualified professionals, licensed where applicable, and competent and proficient in the fields pertinent to the issue of sediment cleanup. A statement of qualifications of the responsible lead professionals shall be included in all plans and reports submitted by NASSCO and Southwest Marine shipyards.

VII SPATIAL SITE ASSESSMENT

NASSCO and Southwest Marine shipyards shall define and analyze the extent and magnitude of sediment contaminants and associated biological effects related to shipbuilding and repair activities within and adjacent to their leaseholds. The site assessment shall include sufficient detail and address all necessary factors to develop: (1) Sediment cleanup levels to attain background conditions or as close to background conditions as possible; (2) Sediment cleanup levels to protect aquatic life beneficial uses; (3) Sediment cleanup levels to protect aquatic-dependent wildlife beneficial uses; and (4) Sediment cleanup levels to protect human health beneficial uses.

A. General Spatial Site Assessment Guidelines

1. *Sampling Locations:* NASSCO and Southwest Marine shipyards shall specify the number and locations of sampling stations within and adjacent to the shipyard leaseholds. The station selection shall facilitate producing maps that illustrate areas where there is a potential for beneficial use impairment and facilitate the development of sediment cleanup levels that protect aquatic life, aquatic-dependent wildlife, and human health beneficial uses.

2. *Reference Stations:* NASSCO and Southwest Marine shipyards shall specify the number and location of offsite reference stations to evaluate statistically significant differences between reference conditions and site conditions with respect to sediment chemistry, toxicity, benthic community structure, and bioaccumulation. The reference stations should be representative of current water quality conditions of San Diego Bay, including bay-wide urban anthropogenic sources of pollutants (at concentrations that are nontoxic) and excluding sources of pollutants associated with shipbuilding and repair activities. These sites shall have similar physical characteristics (e.g. grain size, water depth, and total organic carbon [TOC]) as compared to the NASSCO and Southwest Marine shipyard sediment conditions.

3. *Sediment and Pore Water Chemistry:* The list of contaminants to be measured include metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc), butyltin species, polychlorinated biphenyls (PCBs)/ polychlorinated triphenyls (PCTs), polynuclear aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), and any other chemical constituent associated with shipbuilding and repair activities believed to be present in bay sediment.

4. *Pollution Sources:* NASSCO and Southwest Marine shipyards shall determine and describe the sources of pollution, which caused the contaminated sediment to exist. Both shipyard and non-shipyard sources shall be evaluated for current and/or historic activities that may have contributed contaminants to San Diego Bay.

B. Background Conditions Spatial Site Assessment Guidelines

1. NASSCO and Southwest Marine shipyards shall determine the vertical and horizontal extent of sediment contaminants associated with shipbuilding and repair activities that are present in bay sediment in excess of background concentrations, within and adjacent to their leaseholds.

2. For the purposes of this assessment, background sediment chemical concentrations are defined as the current chemical concentrations in the sediment absent the existence of the shipyards (i.e., excluding the pollutant loading by NASSCO and Southwest Marine and considering urban storm water inputs only). The background sediment chemical concentrations are represented by the sediment pollutant concentrations found at Reference Station 3 (REF-03), as described on Page 29 of the February 16, 2001 staff report titled *Final Regional Board Report, Shipyard Sediment Cleanup Levels, NASSCO & Southwest Marine Shipyards, San Diego Bay)*. REF-03 is located on the northeast side of San Diego Bay at the end of Broadway Pier. The background sediment chemical concentrations at REF-03 for the chemicals of concern at NASSCO and Southwest Marine include:

Constituent	Background Reference Station Dry Weight (mg/kg)
Copper	87.5
Zinc	139
Lead	41
PCBs	0.12
Mercury	0.57

3. San Diego Bay water quality chemistry, toxicity and biological information will soon be available from Bight 98. Regional Board staff is working with SCCWRP to determine alternate background chemical concentrations for NASSCO and Southwest Marine using the Bight 98 data. Bight 98 sample stations will be identified based on the following criteria: (1) The stations should have similar physical characteristics as the shipyard sediments (e.g., grain size, water depth, and TOC), (2) The sediment is representative of urban watershed loading only, (3) The sediment is representative of non-toxic sediments in San Diego Bay and (4) The sediment contains a healthy benthos. The Regional Board may replace the REF-03 sediment chemical concentrations with the Bight 98 sediment chemical concentrations to define background concentrations at NASSCO and Southwest Marine.

C. Aquatic Life Investigation Spatial Site Assessment Guidelines

1. NASSCO and Southwest Marine shipyards shall specify the number and locations of sampling stations within and adjacent to their leaseholds to determine areas where there is a potential for aquatic life impairment and to facilitate the development of sediment cleanup levels that protect aquatic life (as defined in Section VIII, B. Aquatic Life Cleanup Level Guidelines.

2. The stations shall be assessed using the Sediment Quality Triad

Approach (Triad Approach). The Triad Approach consists of synoptic measures of sediment chemical contamination and biological effects. The three components of the Triad Approach are:

a) Sediment chemistry;

b) Sediment, sediment-water interface, and pore water toxicity (determined through bioassays); and

c) Benthic community structure (determined through taxonomic analyses of macrofauna).

Chemical analyses provide information on the mixtures and concentrations of contaminants in the sediments and pore water that may be harmful to marine biota. Bioassays provide information on the relative bioavailability and toxicity of sediment–sorbed contaminants under laboratory conditions where the effects of many natural environmental factors are controlled. The benthic community analyses provides corroborating evidence from resident biota regarding major compositional alterations to a component of the ecosystem under in situ conditions. The data from the three independent measures are complimentary and provide a preponderance of empirical evidence of both contamination and effects that can be used to classify the relative quality of sediments.

3. *Sediment Chemistry* - Sediment samples shall be measured for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc), butyltin species, PCBs/PCTs, PAHs, TPH, and any other chemical constituent associated with shipbuilding and repair activities believed to be present in bay sediment. Additionally, sediment grain size distribution and TOC shall be measured to help interpret the concentrations of sediment contaminants and toxicity results.

4. *Sediment Toxicity* - Sediment toxicity shall be evaluated using whole sediment samples, sediment-water interface samples, and interstitial water samples. Toxicity of whole sediments will be measured using a 10-day amphipod (*Eohaustorius estuarius*) survival test, toxicity at the sediment water interface will be measured using the bivalve (*Mytilus edulis*) development test, and toxicity of interstitial water will be measured using the sea urchin (*S. purpuratus*) fertilization test. The amphipod survival test and sea urchin fertilization test provide acute and critical life stage effects data, respectively, while the bivalve development test will provide sublethal data on the effects of contaminant diffusion from whole sediment into the water.

5. *Benthic Community* - Benthic community structure analyses shall include identifying and enumerating the invertebrate organisms living in the sediments. The community shall be described using a variety of metrics, including conventional parameters such as total abundance and abundance of individual species, species diversity, and numbers of indicator taxa. In addition, the Bay Protection and Toxic Cleanup Program and/or the Southern California Bight 1998 Benthic Response Index for Bays and Harbors shall be used to identify stations containing degraded benthos. It is anticipated that the Bight 98 index will be available for use by the end of December 2001.

6. *Pore Water* – NASSCO and Southwest Marine shall specify a subset of sampling stations from the overall number of stations proposed for the Triad Approach to derive empirical sediment partition coefficients for the Equilibrium Partitioning Approach (discussed in Section VIII.B.2.). Pore water samples shall be measured for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc), butyltin species, PCBs/PCTs, PAHs, TPH, and any other chemical constituent associated with shipbuilding and repair activities believed to be present in bay sediment. Additionally, the pore water samples shall be measured for ammonia to help interpret the concentrations of pore water contaminants and toxicity results. Sediment normalization shall also be conducted on the pore water samples to account for the bioavailability of the chemical of concern (e.g., TOC-normalization for nonionic organic chemicals and Acid Volatile Sulfide/Simultaneously Extracted Metals (AVS/SEM)-normalization for metals. Laboratory detection limits shall be established at or below California Toxics Rule (CTR) water quality criterion.

D. Aquatic-Dependent Wildlife and Human Health Investigation Spatial Site Assessment Guidelines

1. NASSCO and Southwest Marine shall review the sediment chemistry data collected from the site assessment and determine if contaminants listed in Appendix B, Table 1 are present in concentrations that have the potential to bioaccumulate in aquatic food webs. Appendix B, Table 1 is a listing of target analytes recommended by the EPA Fish Contaminant Workgroup ("*Guidance for Assessing Chemical Contaminant Data For Use in Fish Advisories*", Volume I – Fish Sampling and Analysis, Second Edition, September 1995, EPA 823-R-95-007). The target analytes consist of metals, organochlorine pesticides, organophosphate pesticides, chlorophenoxy herbicides, PAHs, PCBs, and dioxins/furans. NASSCO and Southwest Marine can exclude an analyte(s) from the recommended list if historic tissue or sediment data collected within their leaseholds indicate that an analyte(s) is not present at a level of concern to wildlife or human health, or if an

analyte(s) is not associated with shipbuilding and repair activities. Exclusion of any target analyte will require justification by NASSCO and Southwest Marine and approval from the Regional Board Executive Officer.

2. NASSCO and Southwest Marine shall identify and propose numerical fish/shellfish tissue residue guidelines (TRGs) for the protection of human health and aquatic-dependent wildlife. The TRGs shall be subject to the approval of the Regional Board Executive Officer. Current information indicates that the following guidelines can be used to evaluate the potential for the bioaccumulation of contaminants in aquatic food webs:

a) *TRGs for Human Health Protection* – The human health bioaccumulation tissue residue criteria established by the Office of Environmental Health Hazard Assessment (OHHEA).

b) *TRGs for Aquatic-Dependent Wildlife Protection* for aquatic-dependent wildlife protection - The wildlife bioaccumulation tissue residue criteria established by the New York State Department of Environmental Conservation, Division of Fish Wildlife, and Marine Resources.

3. NASSCO and Southwest Marine shipyards shall conduct 28-day sediment bioaccumulation tests using the burrowing clam, *Macoma nasuta* , for all contaminants identified as having potential to bioaccumulate in aquatic food webs to levels that would adversely affect aquatic-dependent wildlife or human health. *Macoma nasuta* is native to and widely distributed in San Diego Bay and actively ingest surface sediments. The shipyards shall specify the number and locations of sampling stations within and adjacent to their leaseholds to conduct the bioaccumulation tests.

4. NASSCO and Southwest Marine shall compare the tissue concentrations of the clams to: (1) Tissue residue guidelines described above, and (2) Tissue concentrations of clams exposed to reference sediments. The comparisons will be used to: (1) Evaluate the potential for contaminant uptake and subsequent food chain transfer of contaminants from the sediment, and (2) Determine the sediment areas where there is a potential for aquatic-dependent wildlife risks and human health risks associated with the contaminated sediment.

VIII SPATIAL DATA ANALYSIS

A. Conceptual Framework

1. NASSCO and Southwest Marine shall develop a conceptual framework for evaluating sediment quality within and adjacent to their leaseholds. The framework shall be consistent with the framework developed by EPA for the St. Louis River Area of Concern (*Development of a Framework for Evaluating Numerical Sediment Quality Targets and Sediment Contamination in the St. Louis River Area of Concern*, December 2000, EPA 905-R-00-008). The framework shall consist of: (1) Decision-making flow charts to evaluate each sample station for the following four indicators: sediment chemistry, toxicity (sediment, sediment-water interface, and pore water), benthic community structure, and bioaccumulation, and (2) A decision matrix based on the four indicators to assess the potential for impairment of aquatic life, aquatic-dependent wildlife, and human health beneficial uses.

2. Spatial Site Assessment Maps

a) *Modeling Program:* NASSCO and Southwest Marine shipyards shall illustrate the following using an appropriate modeling program:

(1) Horizontal and vertical distribution and magnitude of chemical contaminant concentrations for sediment areas containing contaminants exceeding background concentrations.

(2) Spatial distribution and magnitude of areas where there is a potential for aquatic life impairment (identified from the decision matrix).

(3) Spatial distribution and magnitude of areas where there is a potential for aquatic-dependent wildlife impairment (identified from the decision matrix).

(4) Spatial distribution and magnitude of areas where there is a potential for human health impairment (identified from the decision matrix).

b) *Thiessen Polygons:* The maps discussed above shall also be illustrated using Thiessen polygons or other equivalent methodology. Thiessen polygons are created by constructing straight lines from each station to every nearby selected station that can be reached without crossing any other straight line and then constructing the perpendicular bisector of each radius. Each Thiessen polygon will

represent the single station located within the polygon, and all points within a given Thiessen polygon are closer to that station than to any adjacent station. In complex, localized environments such as the shipyard sites, this method may be more accurate than contouring because of confounding interactions with boundary conditions (e.g., shoreline) and the patchy nature of elevated chemical concentrations.

IX NUMERCIAL DATA ANALYSIS TO DETERMINE SEDIMENT CLEANUP LEVELS

NASSCO and Southwest Marine shipyards shall develop sediment cleanup levels to protect aquatic life, aquatic-dependent wildlife and human health beneficial uses. The sediment cleanup levels that protect the aquatic life beneficial uses shall be developed based on the matched chemistry, toxicity and benthic community data generated during the spatial site assessment. The sediment cleanup levels that protect the aquatic-dependent wildlife and human health beneficial uses shall be developed based on a tiered bioaccumulation approach.

A. General Guidelines on Deriving Cleanup Levels

1. *Multiple Lines Of Evidence:* There are a variety of methods for assessing and classifying contaminated sediment for cleanup; each has its advantages and disadvantages. No single method can be used to derive cleanup levels because no single method measures all contaminated sediment impacts at all times and to all biological organisms. Accordingly the Regional Board is requiring the use of a "weight of evidence" approach incorporating multiple lines of evidence and the use of complimentary sediment classification methods to support the cleanup level decision making process. This approach will provide the Regional Board with a preponderance of evidence, developed through scientifically defensible methods, to establish sediment cleanup levels protecting the most sensitive beneficial use of San Diego Bay.

2. *Selection of Indicator Sediment Contaminants:* Based on the spatial data analysis results, NASSCO and Southwest Marine shipyards shall select a subset of chemicals for the development of site specific cleanup levels. These chemicals, termed "indicator pollutants" shall include and be representative of each of the major classes of sediment pollutants and sources (discharge pathways) occurring at the sites. NASSCO and Southwest Marine shipyards shall develop and document the rationale used in selecting the indicator pollutants.

B. Aquatic Life Cleanup Level Guidelines

NASSCO and Southwest Marine shipyards shall develop alternative

cleanup levels for each indicator pollutant using the Apparent Effects Threshold (AET) Approach and the Equilibrium Partitioning (EqP) Approach (See Appendix A, Figure 2). Other methodologies may be later specified by the Regional Board Executive Officer such as the Multivariate Data Analysis Approach to determine cleanup levels. Each cleanup level shall incorporate and describe an adequate margin of safety.

The use of the above methodologies provides multiple lines of evidence and allows for the integration of empirical data (from the AET approach) and theoretical/empirical information (from the EqP approach). The combination of these methodologies balances the uncertainties and limitations of any one method by incorporating the strengths of the other methods. Strong agreement in the results of each method will provide an independent validation of each method and a sound scientific basis to support the decision making process and final selected cleanup levels. Disagreement in the results of the methods will increase scientific uncertainty and indicate a need for caution in interpreting the data during the cleanup level decision making process.

1. *AET Approach:* By empirically determining the association between chemical contamination and adverse biological effects, predictions can be made regarding the levels of contamination that are always associated with adverse effects. The AET value for any given chemical is the concentration of that chemical, above which, statistically significant biological effects are always observed in the data set used to generate the AET. For any given chemical, sediment concentrations can be as high as the AET value and not be associated with statistically significant biological effects. If a chemical exceeds its AET for a particular biological indicator, then an adverse effect is predicted for that biological indicator.

a) *Number of Stations*: AETs can be expected to be most predictive of adverse biological effects associated with specific chemical concentrations when developed from a large database with wide ranges of chemical concentrations and a wide diversity of measured contaminants. Accordingly, NASSCO and Southwest Marine shipyards shall sample the triad of data (matched chemistry, toxicity, and benthic community structure) needed to develop the AET values from a sufficient number of stations. Available literature suggests that a minimum of 30-50 stations are required to develop AET cleanup levels. The shipyards shall propose the number of stations that will be used to develop AET cleanup levels for NASSCO and Southwest Marine and incorporate those stations into the spatial site assessment. The justification of the proposed number of stations shall be submitted and will be subject to the approval of the Regional Board Executive Officer.

b) *Range of Biological Effects:* NASSCO and Southwest Marine shipyards shall develop proposed cleanup levels using the AET approach for each indicator pollutant. The protectiveness of an AET can be ensured by evaluating organisms and biological responses with different degrees of sensitivity to chemical toxicity. Accordingly, the determination of the AET value for each indicator pollutant shall be based on the following suite of acute and sublethal biological effects (i.e. biological endpoints or indicators):

(1) Toxicity of bulk sediments will be measured using a 10-day amphipod (*E. estuarius*) survival test.

(2) Toxicity of interstitial water will be measured using the sea urchin (*S. purpuratus*) fertilization test.

(3) Toxicity of the sediment-water interface will be measured using the mussel (Mytilus edulis) development test.

(4) Benthic community degradation.

c) *Lowest Apparent Effects Threshold (LAET):* In order to provide confidence that the most sensitive aquatic organisms are reasonably protected the AET cleanup level(s) shall be defined by the LAET value for each indicator pollutant. By definition, the LAET cleanup level is expected to be protective of a wide range of adverse biological effects. Available literature indicates LAET values can be 90 to 94 percent sensitive in correctly predicting all known biological effects in the database used to generate the AET values.

2. *EqP Approach*: The EqP approach can be either an empirical or theoretical method that correlates interstitial water (pore water) concentrations of contaminants with bulk sediment chemical concentrations. Chemical concentrations in pore water can be most directly related to chemical concentrations in sediment either through: (1) Direct measurement of pore water and sediment concentrations (empirical), or (2) Chemical partitioning coefficients based on information from the scientific literature and measured sediment concentrations (theoretical).

In the EqP approach, water quality criteria developed for the protection of marine organisms are used as the basis for developing sediment quality criteria. As such, the water quality criteria formulated for the protection of water column species are assumed to be applicable to benthic organisms. The calculation procedure for establishing sediment quality criteria using the EqP approach consists of multiplying the partition coefficient, Kp, with

the water quality criteria for the chemical of interest. Hence, the sediment quality value is the sediment concentration that would correspond to a pore water concentration equivalent to the CTR water quality criterion.

a) NASSCO and Southwest Marine shall use the synoptic pore water chemistry and sediment chemistry data generated from the spatial site assessment to develop a wide range of empirically derived partition coefficients, Kp.

b) The proposed sediment cleanup levels shall be established at chemical concentrations that ensure pore water concentrations do not exceed water quality criteria as established in the CTR.

3. Validation of Aquatic Life Cleanup Levels

a) *Sensitivity and Reliability:* NASSCO and Southwest Marine shipyards shall assess the predictions made by the AET and EqP approaches (i.e., cleanup levels) by measuring their respective overall reliabilities. The overall reliability of any sediment quality approach addresses the following components:

(1) Sensitivity: Represents the ability of sediment quality values to correctly identify all stations in a data set that actually have biological impacts.

(2) Efficiency: Represents the ability of sediment quality values to identify only stations that actually have biological impacts.

The overall reliability measure is defined as the proportion of all stations for which correct predictions were made for either the presence or absence of adverse biological effects:

Overall Reliability = [All stations correctly predicted as impacted + All stations correctly predicted as nonimpacted] / [Total number of stations evaluated]

b) *Sediment Serial Dilution Toxicity Tests.* The Sediment Serial Dilution Toxicity Test (SSDTT) approach involves exposing test organisms to whole sediment or pore water that have exhibited toxicity in previous testing and serial diluting the sample by 50 percent to establish a cause and effect relationship between chemicals in the sediment or pore water and adverse biological responses. This approach can be used to confirm the biological effects of contaminants in sediment and pore water. This approach

can also be used to provide experimental validation of cleanup levels generated by the AET and EqP approaches. The concentration of sample sediment to clean reference station sediment will be 0 (control) 12.5, 25, 50, and 100 percent.

(1) The biological test organisms used should be the amphipod (*E. estuarius*) and the sea urchin (*S. purpuratus*).

(2) Biological and chemical data from the serial diluted sediments shall be statistically compared with reference station data to determine the occurrence of biological effects. The Median Lethal Concentration (LC_{50}) values, Median Effective Concentration (EC_{50}) values, lowest observable effect concentrations and no-effect concentrations shall be determined for each indicator pollutant.

(3) Data correlating observed biological effects with chemical concentrations in the serial diluted sediment should be used to calculate probit curves for deriving biological effect sediment contaminant values.

(4) The results of the SSDTT approach shall be compared with the results of cleanup levels generated by the AET and EqP approaches. A determination shall be made on whether the results of the SSDTT approach validate the cleanup levels derived through the AET and EqP approaches.

C. Aquatic-Dependent Wildlife Cleanup Level Guidelines

NASSCO and Southwest Marine shipyards shall develop cleanup levels for each contaminant associated with contaminant concentrations harmful to aquatic-dependent wildlife in the food web. NASSCO and Southwest Marine shall use a tiered methodology based on the Tissue Residue Approach (TRA) to assess the potential for impairment to the aquatic-dependent wildlife beneficial uses (See Appendix A, Figure 3). Each cleanup level shall incorporate and describe an adequate margin of safety.

1. *Tissue Residue Approach:* The TR approach (which is also known as the biota-water-sediment equilibrium partitioning approach) is premised on the fact that sediments represent important sources of bioaccumulative contaminants in aquatic food webs. For this reason, it is necessary that the sediment contaminant concentrations remain below the levels that bioaccumulate to harmful levels in the food web. Therefore, the TR approach establishes safe sediment concentrations for individual chemicals or classes of chemicals by determining the chemical

concentrations in sediments that are predicted to result in acceptable tissue residues.

Derivation of numerical cleanup levels using the TR approach involves several steps. As a first step, the contaminants for which cleanup levels are to be derived are selected based on their potential to accumulate in aquatic food webs. Next, numerical TRGs are identified for these contaminants. While most of the available TRGs are intended to provide protection for human health, it is also important to obtain TRGs that are explicitly designed to protect piscivorus wildlife species. Following the selection of TRGs, biota-to-sediment accumulation factors (BSAFs) are determined for each of the substances of concern. Such BSAFs can be determined from the results of bioaccumulation assessments, from matching sediment chemistry and tissue residue data, or from the results of bioaccumulation models.

Numerical cleanup levels are subsequently derived using the equation: *Numerical cleanup level = TRG ÷ BSAF*

a) If there is a potential for aquatic-dependent wildlife impairment based on the 28-day sediment bioaccumulation tests, as discussed in Section VI.D.4. then NASSCO and Southwest Marine Shipyards shall directly measure tissue concentrations in resident biota (fish and/or shellfish) and compare the contaminant concentrations in the tissue to the tissue residue guidelines.

b) NASSCO and Southwest Marine shipyards shall propose target species for measuring tissue contaminant concentrations and determining the rate of contaminant uptake. If practicable and appropriate, the target species provided in Appendix C, Table 1 shall be used. Appendix C, Table 1 is a list of target species for use in southern California estuaries and marine waters recommended by the EPA Fish Contaminant Workgroup ("Guidance for Assessing Chemical Contaminant Data For Use in Fish Advisories", Volume I – Fish Sampling and Analysis, Second Edition, September 1995, EPA 823-R-95-007).

c) NASSCO and Southwest Marine shipyards shall identify and propose numerical TRGs for the protection of aquatic-dependent wildlife. The TRGs shall be subject to the approval of the Regional Board Executive Officer. Current information indicates that the wildlife bioaccumulation tissue residue criteria established by the New York State Department of Environmental Conservation, Division of Fish Wildlife, and Marine Resources can be used to evaluate the potential for the bioaccumulation of contaminants in aquatic

food webs.

d) NASSCO and Southwest Marine shipyards shall develop cleanup levels using BSAFs if the contaminant concentrations in the sampled tissue exceed the tissue residue guidelines. The cleanup levels shall assure that the concentrations of contaminants in the sediment remain below the levels that are associated with the bioaccumulation of such contaminants to harmful levels in the food web.

D. Human Health Risk Cleanup Level Guidelines

NASSCO and Southwest Marine shipyards shall develop cleanup levels for each contaminant associated with contaminant concentrations harmful to human health in the food web. NASSCO and Southwest Marine shall use a tiered methodology based on the TR Approach (described above) to assess the potential for impairment to human health beneficial uses (See Appendix A, Figure 4). Each cleanup level shall incorporate and describe an adequate margin of safety.

1. If there is a potential for human health impairment based on the 28-day sediment bioaccumulation tests, as discussed in Section VI.D.4. (4), then the Shipyards shall directly measure tissue concentrations in the resident biota (fish and shellfish) and compare the contaminant concentrations in the tissue to the tissue residue guidelines.

2. NASSCO and Southwest Marine shipyards shall propose target species for measuring tissue contaminant concentrations and determining the rate of contaminant uptake. The target species shall be subject to the approval of the Regional Board Executive Officer. If practicable and appropriate, the target species provided in Appendix C shall be used. Appendix C is a list of target species for use in southern California estuaries and marine waters recommended by the EPA Fish Contaminant Workgroup ("Guidance for Assessing Chemical Contaminant Data For Use in Fish Advisories", Volume I – Fish Sampling and Analysis, Second Edition, September 1995, EPA 823-R-95-007).

3. The shipyards shall identify and propose numerical tissue residue guidelines for the protection human health. The tissue residue guidelines shall be subject to the approval of the Regional Board Executive Officer. Current information indicates that the human health bioaccumulation tissue residue criteria established by the OEHHA can be used to evaluate the potential for the bioaccumulation of contaminants in aquatic food webs.

4. NASSCO and Southwest Marine shipyards shall develop cleanup levels using BSAFs if the contaminant concentrations in the sampled tissue exceed the tissue residue guidelines. The cleanup levels shall assure that the concentrations of contaminants in the sediment remain below the levels that are associated with the bioaccumulation of such contaminants to harmful levels in the aquatic food web.

E. Sediment Cleanup Level Maps

1. *Modeling Program:* NASSCO and Southwest Marine shipyards shall illustrate the following using an appropriate modeling program:

a) Sediment areas containing contaminants exceeding LAET cleanup levels;

b) Sediment areas containing contaminants exceeding EqP cleanup levels;

c) Sediment areas containing contaminants exceeding other criteria that may be later specified by the Regional Board Executive Officer such as the multivariate data analysis;

d) Sediment areas containing contaminants exceeding the Aquatic-Dependent Wildlife cleanup levels; and

e) Sediment areas containing contaminants exceeding the Human Health cleanup levels.

2. *Thiessen Polygons:* The maps discussed above shall also be illustrated using Thiessen polygons or other equivalent methodology. Thiessen polygons are created by constructing straight lines from each station to every nearby selected station that can be reached without crossing any other straight line and then constructing the perpendicular bisector of each radius. Each Thiessen polygon will represent the single station located within the polygon, and all points within a given Thiessen polygon are closer to that station than to any adjacent station. In complex, localized environments such as the shipyard sites, this method may be more accurate than contouring because of confounding interactions with boundary conditions (e.g., shoreline) and the patchy nature of elevated chemical concentrations.

X CLEANUP ALTERNATIVES ANALYSES

NASSCO and Southwest Marine shipyards shall evaluate the technological and economic feasibility of a cleanup strategy to attain each of the sediment cleanup levels established under the preceding Section I VIII including: (1) Sediment

cleanup levels to attain background conditions or levels as close to background as possible; (2) Sediment cleanup levels to protect aquatic life beneficial uses; (3) Sediment cleanup levels to protect aquatic-dependent wildlife beneficial uses and (4) Sediment cleanup levels to protect human health beneficial uses.

A. Technical feasibility shall be determined by assessing the technologies which are effective in reducing the contaminant concentrations to the established cleanup levels. The USEPA Report Selecting Remediation Techniques for Contaminated Sediment (EPA-823-B-93-001) provides a more detailed explanation of these cleanup alternatives. NASSCO and Southwest Marine shipyards shall document their selection rationale and justification as to the applicability or inapplicability or practicality of the various technologies. The following cleanup and abatement methods, or combinations thereof, shall be reviewed and considered for each alternative cleanup level to the extent that the methods are applicable to the contaminated sediment site(s).

- Dredging w/disposal or reuse of dredged material
- Subaqueous Capping
- Treatment
- No Action

The criteria to be considered for each alternative cleanup and abatement method are described below.

1. Dredging

a) There is no single dredge technology that is the universal solution for cleanup of contaminated sediment. Typical dredging methods include mechanical or hydraulic dredging. The following factors should be considered in the selection of the dredging process:

- Physical characteristics of the contaminated sediment to be dredged.
- Quantity of contaminated sediment to be dredged.
- Depth of water overlying the contaminated sediment.
- Temporary storage or staging of the material, the ultimate. disposal site for the material once it is removed, and the distance to an authorized contaminated sediment disposal area.
- Concentration of contaminants in the sediment to be dredged.
- Mobility of contaminants in the sediment and containment capability of the methods employed.
- Method of disposal for the dredged material.
- Types of dredging equipment available.
- Currents and waves.

- Access to the site.

b) The dredging process can disturb bottom sediments leading to the release of contaminants into the water column by resuspension of contaminated sediment particles, dispersal of interstitial water in the sediment pores and desorption of contaminants from the contaminated sediment. It is critical that the dredging process be designed to limit sediment resuspension. This will reduce the potential for release of contaminants to the water column during the dredging process and reduce the possibility that the contaminants will spread to previously uncontaminated sediment areas. Technologies to reduce resuspension and potential recontamination shall be utilized. Examples of such technologies include silt curtains constructed of geotextile fabrics.

c) Potential alternatives for the disposal of dredged material from San Diego Bay include:

- Incineration;
- Upland disposal without treatment;
- Upland disposal with treatment; or
- Confined aquatic disposal.

d) Reuse of remediated material may include:

- Beach replenishment;
- Habitat restoration/ enhancement;
- Ocean disposal; or
- Reuse sites such as capping.

Most of these items are further discussed in the section titled Disposal of Dredged Material in the San Diego Region Basin Plan, Chapter Four.

e) Removal often involves consolidation using a diked structure which retains the dredged material. Considerations include:

- Construction of the dike or containment structure to assure that contaminants do not migrate,
- The period of time for consolidation of the sediments,
- Staging or holding structures or settling ponds,
- De-watering issues, including treatment and discharge of wastewater,
- Transportation of dredged material, i.e., pipeline, barge, rail, truck,

- Regulatory constraints.

2. Subaqueous Capping

a) Subaqueous capping refers to the placement of a clean material over the contaminated sediment. Capping may be the preferred alternative where the costs and environmental effects of moving or treating the contaminated sediments are too great. The cover material must minimize the migration of contaminants from the sediment to the water column. Subaqueous capping requires long-term monitoring to measure changes in cap thickness, erosion around cap boundaries, and possible leakage of contaminants through the cap.

b) The following criteria must be satisfied to allow implementation of a subaqueous cap:

(1) All point and non-point source discharges to the cap area must be identified and terminated.

(2) The cap must provide adequate coverage of contaminated sediments. The capping materials must be suitable for easy and accurate placement.

(3) The cap design must inhibit burrowing organisms from penetrating the cap and re-exposing contaminated sediments (bioturbation).

(4) The contaminated sediments must have the ability to support the cap (i.e. the cap will not cause settlement or loading).

(5) During seismic events, the bottom topography must not allow sloping or slumping of the capped sediments. The seismic design of the cap should be conducted as required by California Code of Regulations Title 23, Division 3, Chapter 15 (Chapter 15). Section 2547 of Chapter 15 requires Class I and II waste management units to be designed to withstand the Maximum Credible Earthquake and Class III waste management units to be designed to withstand the Maximum Probable Earthquake.

(6) Hydrologic conditions must not disturb the site, and natural or human activities must not compromise the integrity of the cap. The cap area must be protected against erosion or disruption by currents, waves, propeller wash, or ship hulls.

(7) The potential of shipping channels, channel maintenance dredging, or other present and future harbor

development projects to disrupt the integrity of the cap must be considered.

(8) The capped area must be noted on appropriate maps, charts, and deeds to document the exact location of the site. Section 2511 (d) of the California Code of Regulations Title 23, Division 3, Chapter 15 regulations (Chapter 15) provides that remedial actions intended to contain waste at the point of release, such as a subaqueous cap, must conform to applicable provisions of the Chapter 15 regulations to the extent feasible. Recognition is made that many of the Chapter 15 regulations pertaining to liners, subsurface barriers, geologic criteria, ground water monitoring, precipitation and drainage controls etc. are obviously not applicable to a subaqueous cap. However, there are some Chapter 15 regulations which are applicable.

3. Treatment

a) Site treatment involves the physical or contaminant alteration of the sediment. The treatment must reduce or eliminate the toxicity, mobility, or volume of contaminated material such that compliance with State Board Resolution 92-49 is achieved. Treatment may be either in-situ or ex-situ. In-situ and ex-situ treatment requires uniform treatment and documentation of effectiveness. Ex-situ treatment generally requires a dedicated treatment area.

b) Types of treatment may include:

- biological,
- dechlorination,
- soil washing,
- solvent extraction,
- solidification,
- incineration,
- thermal desorption, and
- contaminant fixation

c) Appropriate treatment methods depend upon the contaminant characteristics, as well as physical characteristics of the sediments (e.g. clay content, organic carbon content, salinity, and water content). Some treatment options produce by-products which require further handling. Although the above technologies are currently being employed for soils, their effectiveness for use in marine sediments should be thoroughly evaluated. Bench tests and pilot projects should be performed to document the efficacy of the treatment method if the effectiveness of the

treatment method is not well documented.

4. No action

a) The "no action" alternative involves reliance upon natural processes for managing contaminated sediment. Examples of the natural processes include:

- Burial of the contaminated sediment by natural sedimentation
- Dispersal of contaminants by natural processes
- Natural detoxification of contaminated sediments

b) The no action alternative may include posting of warning signs, restricting access to the site, and monitoring of water, sediments, or organisms.

c) If a no-action alternative is recommended, the following information must be submitted: 1) compelling evidence must be provided that no remediation technologies should be applied and only the no-action alternative is feasible at the site, and 2) a cleanup cost comparison of all other remediation technologies versus the no-action alternative, and a detailed proposed monitoring program. The monitoring program should be designed to measure changes in discharge rates from the site and to show whether rates of contaminant release and the area of influence of the contaminants are accelerating. The duration of the monitoring and all organizations which will implement the monitoring shall be identified.

d) The Regional Board will require NASSCO and Southwest Marine shipyards to demonstrate some or all of the following items before consideration of the no-action alternative:

(1) All contaminant discharges from all sources have been halted;

(2) The costs and environmental effects of moving and treating contaminated sediment are outweigh the costs and environmental effects of leaving the material in-place;

(3) Hydrologic conditions will not disturb the site;

(4) The contaminated sediment will not be re-mobilized by human or natural activities, such as by shipping activity or bioturbation;

(5) The contaminated sediments at the site will not spread;

(6) Burial or dilution processes are rapid;

(7) Uncontaminated sediments will integrate with contaminated sediments through a combination of dispersion, mixing, burial, and/or biological degradation;

(8) Notices to abandon the site including a list of all contaminants known or suspected, concentrations of contaminants, estimate of the total amount of contaminants, potential hazards to human health, toxicity and bioaccumulation potential in sport or commercial fish and shellfish will be issued to appropriate federal, state, and local agencies and to the public including the US Army Corps of Engineers, US Coast Guard, local harbor authorities, county health officer, California Coastal Commission, State Lands Commission, State and federal fish and wildlife agencies, local environmental groups, and local water user groups; and

(9) The exact location and depth of the site, with a list of contaminants and their quantities, will be noted on appropriate deeds, maps, and navigational charts such as those prepared by the US Army Corps of Engineers, US Coast Guard, National Oceanographic and Atmospheric Administration, Coastal Commission, State Lands Commission, and harbor authorities.

B. Economic feasibility refers to the objective balancing of the incremental benefit of attaining more stringent cleanup levels compared with the incremental cost of achieving those levels. Economic feasibility does not refer to the subjective measurement of the shipyards' ability to pay the costs.

1. NASSCO and Southwest Marine shipyards shall provide a cost and feasibility analysis for each applicable cleanup and abatement methodology described above to achieve each of the various cleanup levels.

2. NASSCO and Southwest Marine shipyards shall obtain at least two direct cost quotes from reliable companies for each applicable cleanup alternative. Obtaining direct quotes assures that all aspects of the project are included in the final estimate. These will also help refine the remedial design and the selection of the technology, for instance, selecting the appropriate type of dredging method, designing the appropriate type of containment structure, determining the method for transport of dredged sediments, or selecting the type of pretreatment or effluent treatment methods. Include the following, where applicable for each:

- Assumptions,
- Capital costs,

- Operation and Maintenance Costs,
- Unit costs with subtotals, and
- Sources of cost estimates.

3. In evaluating the economic feasibility of the strategies, NASSCO and Southwest Marine shipyards shall consider the factors described in Water Code Section 13000 and Resolution 92-49, Directive III.G. including all demands being made and to be made on San Diego Bay waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible. The factors to be considered shall also include the following beneficial effects and potential adverse effects of remediating contaminated sediments:

Beneficial Effects of Sediment Cleanup	Values Quantifying These Beneficial Uses	Beneficial Use Affected
Lower toxicity in planktonic and benthic organisms	Greater survival of organisms in toxicity tests.	MAR, EST
Undegraded benthic community	Species diversity and abundance characteristic of undegraded conditions.	MAR, EST
Lower concentrations of pollutants in water	Water column chemical concentration that will not contribute to possible human health impacts.	MIGR, SPWN, EST, MAR, REC 1, REC 2
Lower concentrations of pollutants in fish and shellfish tissue	Lower tissue concentrations of chemicals that could contribute to possible human health and ecological impacts.	MAR, EST, REC 1, COMM
Area can be used for sport and commercial fishing	Anglers catch more fish. Impact on catches and net revenues of fishing operations increase.	REC 1, COMM
Area can be used for shellfish harvesting or aquaculture	Jobs and production generated by these activities increase. Net revenues from these activities are enhanced.	SHELL, AQUA
Improved conditions for seabirds and other predators	Increase in populations. Value to public of more abundant wildlife.	WILD, MIGR, RARE
More abundant fish populations	Increase in populations. Value to public of more abundant wildlife.	MAR, EST
Commercial catches increase	Impact on catches and net revenues of fishing operations	COMM
Recreational catches increase, more opportunities for angling	Increased catches and recreational visitor-days.	REC 1

Beneficial Effects of Sediment Cleanup	Values Quantifying These Beneficial Uses	Beneficial Use Affected
Improved ecosystem conditions	Species diversity and abundance characteristic of undegraded conditions.	EST, MAR
Improved aesthetics	Value to public of improved aesthetics. In some cases, estimates of the value to the public of improved conditions may be available from surveys.	REC 2
More abundant wildlife, more opportunities for wildlife viewing	Impact on wildlife populations. Impact on recreational visitor-days.	MAR, WILD, RARE, REC 2

Potential Adverse Effects of Sediment Cleanup	Environmental Factor Affected
Emissions from dredging, excavation, transport, disposal and capping equipment	Air Quality
Odor from dredged material if reused	Air Quality
Short-term impacts on aquatic resources from high chemical concentrations of turbidity	Surface Water Column and Sediments
Runoff from excavated or disposed material	Surface Water Column and Sediments
Leaching of pollutants from capped area into surface water & sediment	Surface Water Column and Sediments
Alterations of currents or course of water movement	Geology and groundwater
Destabilization of channel slopes and undermining pilings	Geology and groundwater
Destabilization of sediments under cap	Sediments, geology and groundwater
Turbidity disrupting sensitive spawning or migrating fish species	Biological resources
Sensitive species displacement by removal of habitat or burial or contamination of sensitive habitats due to excessive turbidity	Biological resources
Access to berths by ships or recreational boating could be altered	Transportation

XI SELECTION OF TARGET CLEANUP LEVEL

Under the terms of Resolution No. 92-49, the Regional Board is obligated to have a presumptive goal of cleanup to attain background water quality conditions. If, based on the technological and economic feasibility analyses for the cleanup levels and methodologies previously discussed, the shipyards determine that cleanup to background is not feasible, they shall propose cleanup levels that are as close to background conditions as possible and do not unreasonably affect present and anticipated beneficial uses of San Diego Bay.

The Regional Board may accept a cleanup level above background water quality conditions, only if the Board reviews the shipyards' justifications for proposing an

alternative cleanup level and determines that it is technologically or economically infeasible to achieve background water quality conditions. If the Regional Board makes such a determination, the Board will then select a cleanup level that is based on the lowest levels which are technologically or economically achievable and that will not unreasonably affect present and anticipated beneficial uses of waters of the Region.

APPENDIX A

PROCESS ACTIVITES TO DETERMINE SEDIMENT CLEANUP LEVELS

FIGURE 1 - NASSCO & Southwest Marine Shipyards Cleanup Level & Methodolgy Selection

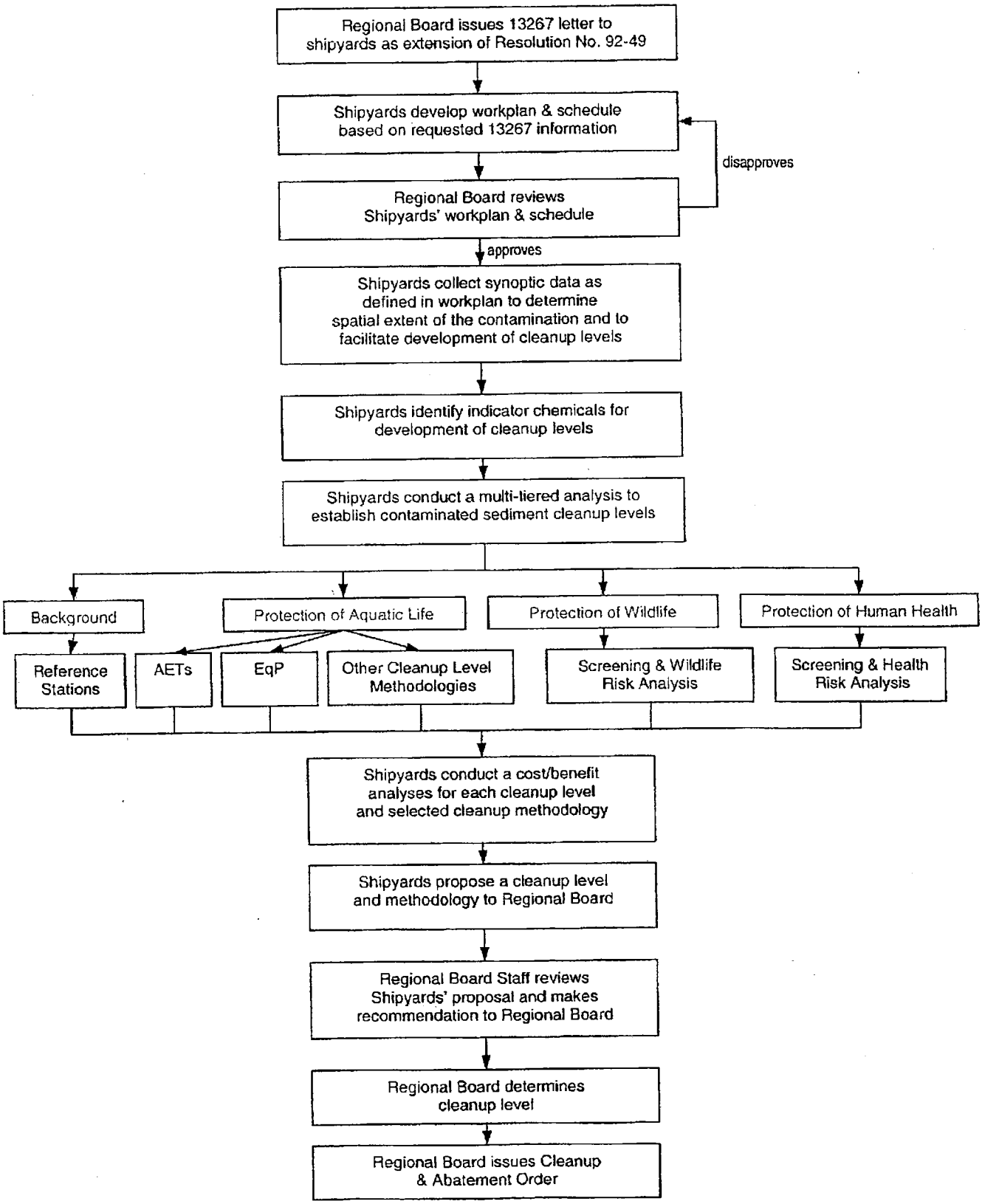


FIGURE 2 - Sediment Cleanup Levels to Protect Aquatic Life

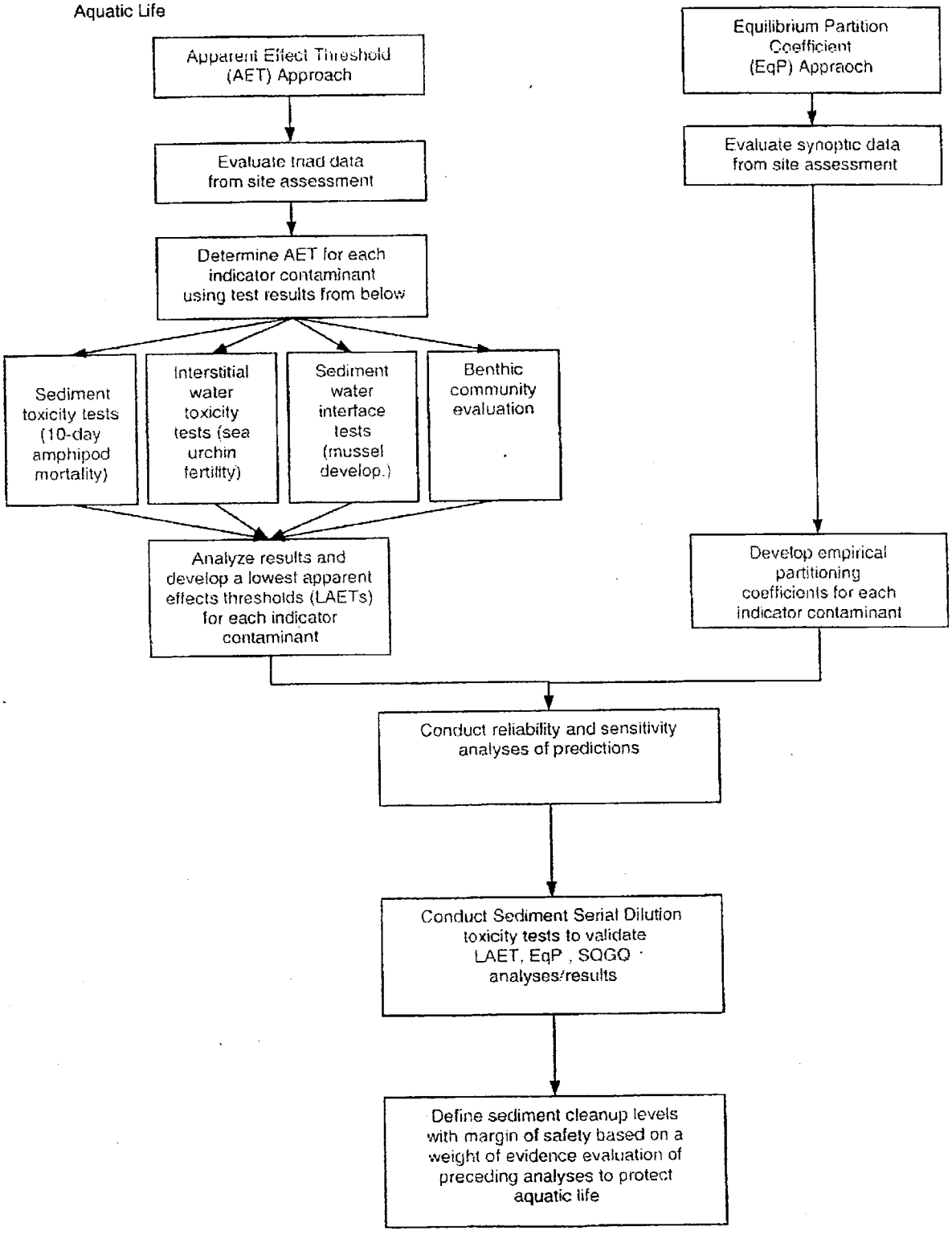


FIGURE 3 - Sediment Cleanup Levels to Protect Aquatic-Dependent Wildlife

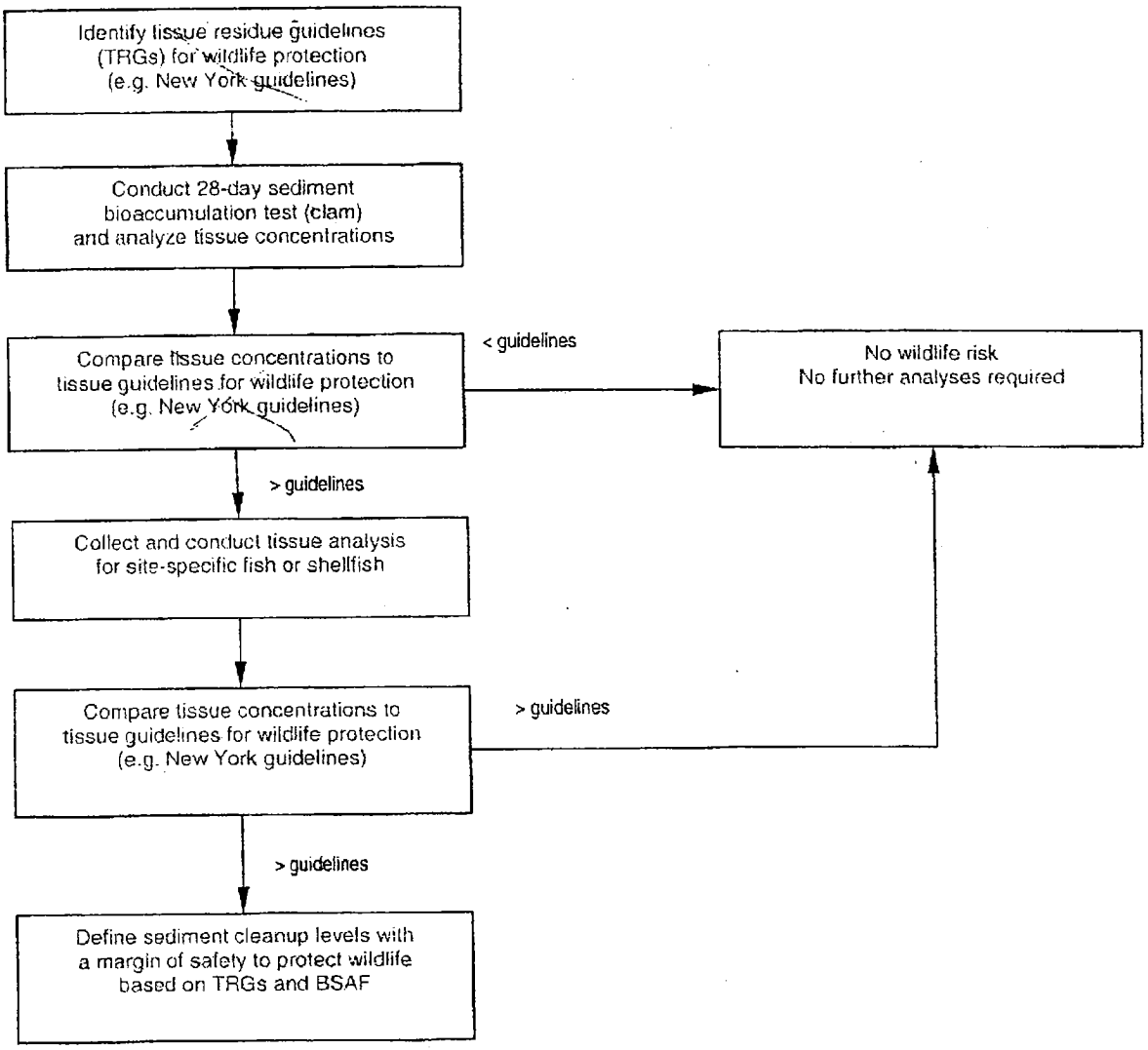
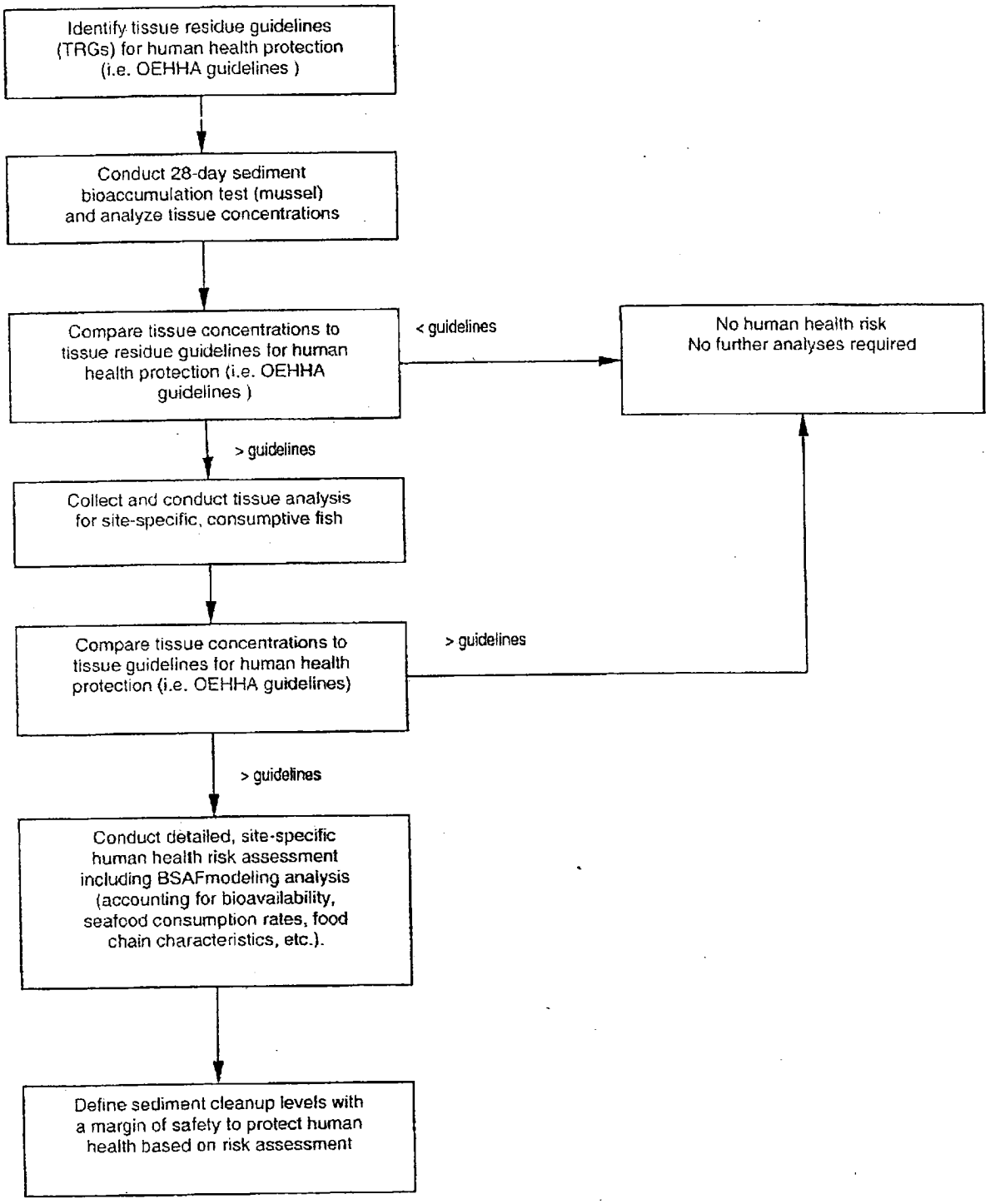


Figure 4 - Sediment Cleanup Levels to Protect Human Health



APPENDIX B

EPA RECOMMENDED TARGET ANALYTES FOR FISH AND SHELLFISH

Table 1. Recommended Target Analytes[a]

Metals	Organophosphate Pesticides[e]
Arsenic (inorganic)	Chlorpyrifos
Cadmium	Diazinon
Mercury	Disulfoton
Selenium	Ethion
Tributyltin	Terbufos
Organochlorine Pesticides	**Chlorophenoxy Herbicides**
Chlordane, total (cis- and trans-chlordane, cis- and trans-nonachlor, oxychlordane)	Oxyfluorfen
DDT, total (2,4'-DDD, 4,4'-DDD, 2,4'-DDE, 4,4'-DDE, 2,4'-DDT, 4,4'-DDT	**PAHs[f]**
Dicofol	**PCBs**
Dieldrin	Total Aroclors[g]
Endosulfan (I and II)	**Dioxins / furans [h, i]**
Endrin	
Heptachlor epoxide[b]	
Hexachlorobenzene	
Lindane (γ-hexachlorocyclohexane; γ-HCl)[c]	
Mirex[d]	
Toxaphene	

PAHs = Polycyclic aromatic hydrocarbons
PCBs = Polychlorinated biphenyls

[a] States should include all recommended target analytes in screening studies, if resources allow, unless historic tissue or sediment data indicate that an analyte is not present at a level of concern for human health. Additional target analytes should be included in screening studies if States have site-specific information (e.g. historic tissue or sediment data, discharge monitoring reports from municipal and industrial sources, pesticide use application information) that these chemicals may be present at levels of concern for human health.

[b] Heptachlor epoxide is not a pesticide but is a metabolite of the pesticide heptachlor.

[c] Also known as γ-benzene hexachloride (γ-BHC).

[d] Mirex should be regarded primarily as a regional target analyte in the southeast and Great Lakes States, unless historic tissue, sediment, or discharge data indicate the likelihood of its presence in other areas.

[e] The reader should note that carbophenothion was included on the original list of target analytes. Because the registrant did not support reregistration for this chemical, it will not longer be used. For this reason and because of its use profile, carbophenothion was removed from the recommended list of target analytes.

[f] It is recommended that, in both screening and intensive studies, tissue samples be analyzed for benzo[a]pyrene, benz[*a*]-anthracene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, chrysene, dibenz[*a,h*]anthracene, and indeno [*1,2,3-cd*]pyrene, and that the order-of-magnitude relative potencies given for PAHs in the EPA provisional guidance for quantitative risk assessment of PAHs (U.S. EPA, 1993c) be used to calculate a potency equivalency concentration (PEC) for each sample for comparison with the recommended SV for benzo[a]pyrene (see Section 5.3.2.3). At this time, EPA's recommendation for risk assessment of PAHs (U.S. EPA, 1993c) is considered provisional because quantitative risk assessment data are not available of all PAHs. This approach is under Agency review and over the next year will be evaluated as new health effects benchmark values are developed. Therefore, the method provided in this guidance document is subject to change pending results of the Agency's reevaluation.

[g] Analysis of total PCBs, as the sum of Arochlor equivalents, is recommended in both screening and intensive studies because of the lack of adequate toxicologic data to develop screening values (SVs) for individual PCB congeners (see Section 4.3.5). However, because of the wide range of toxicities among different PCB congeners and the effects of metabolism and degradation on Aroclor composition in the environment, congener analysis is deemed to be a more scientifically sound and accurate method for determining total PCB concentrations. Consequently, States that currently do congener-specific PCB analyses should continue to do so. Other States are encouraged to develop the capability to conduct PCB congener analysis.

[h] Note: The EPA Office of Research and Development is currently reassessing the human health effects of dioxins / furans.

[i] Dixons / furans should be considered for analysis primarily at sites of pulp and paper mills using a chlorine bleaching process and at industrial sites where the following organic compounds are formulated: herbicides (containing 2,4,5-trichlorophyoxy acids and 2,4,5-trichlorophenol), hexachlorophene, pentachlorophenol, and PCBs (U.S. EPA 1987d). It is recommended that the 2,3,7,8-substituted tetra- through octa-chlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) be determined and a toxicity-weighted total concentration calculated for each sample (Barnes and Bellin, 1989; U.S. EPA, 1987d) (see Section 5.3.2.4). If resources are limited, 2,3,7,8-TCDD and 2,3,7,8-TCDF should be determined at a minimum.

APPENDIX C

TARGET SPECIES FOR USE IN SOUTHERN CALIFORNIA ESTUARIES AND MARINE WATERS RECOMMENDED BY THE EPA FISH CONTAMINANT WORKGROUP ("GUIDANCE FOR ASSESSING CHEMICAL CONTAMINANT DATA FOR USE IN FISH ADVISORIES", VOLUME I – FISH SAMPLING AND ANALYSIS, SECOND EDITION, SEPTEMBER 1995, EPA 823-R-95-007)

Table 1. Recommended Target Species for Southern California Estuaries and Marine Waters (Santa Monica Bay to Tijuana Estuary)

Family name	Common name	Scientific name
Finfish Species		
Serranidae	Kelp bass	*Paralabrax clathratus*
	Barred sand bass	*Paralabrax nebulifer*
Sciaenidae	White croaker	*Genyonemus lineatus*
	Corbina	*Menticirrhus undulatus*
Embiotocidae	Black perch	*Embiotoca jacksoni*
	Walleye surf perch	*Hyperprosopan argenteum*
	Barred surf perch	*Amphistichus argenteus*
Scorpaenidae	California scorpionfish	*Scorpaena guttata*
	Widow rockfish	*Sebastes entomelas*
	Blue rockfish	*Sebastes mystinus*
	Bocaccio	*Sebastes paucispinis*
Pleuronectidae	Diamond turbot	*Hypsopetta guttulata*
	Dover sole	*Microstomus pacificus*
Shellfish Species		
Bivalves	Blue mussel	*Mytilus edulis*
	California mussel	*Mytilus californianus*
	Pacific littleneck clam	*Protothaca staminea*
Crustaceans	Pacific rock crab	*Cancer antennarius*
	Red crab	*Cancer productus*
	California rock lobster	*Panulirus interruptus*

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Presentation and interpretation of Sediment Quality Triad data

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Updated guidance is provided for presenting and interpreting individual Sediment Quality Triad components (Triad: chemistry, toxicity and community structure), and for the integration of all components. Three separate methods are identified: summary indices, tabular decision matrices, and multivariate analyses. Indices, an early method, are of limited usefulness. General guidance regarding decision matrices and multivariate analyses (in particular, statistical criteria for the combined Triad components) is provided, in a manner intended not to exclude future new techniques or approaches.

Keywords: Sediment Quality Triad; toxicity; sediments; integrated analyses.

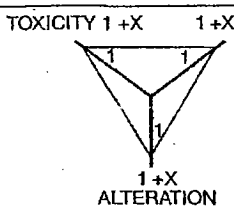
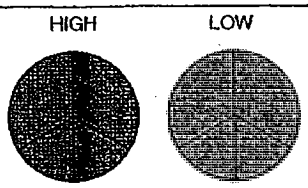
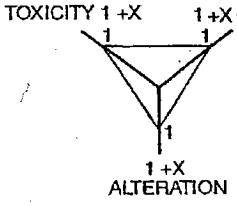
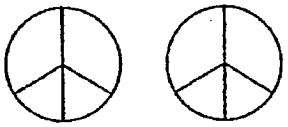
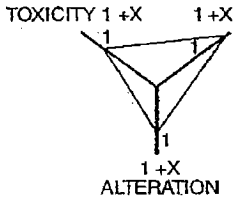
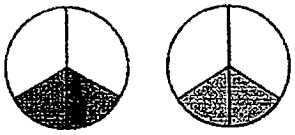
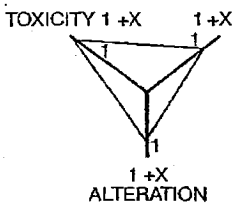
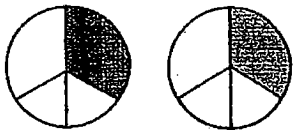
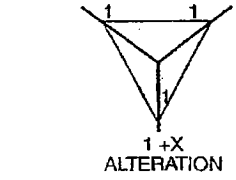
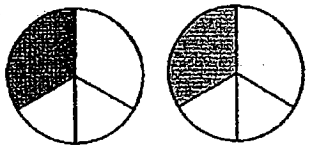
Introduction

The Sediment Quality Triad (Triad) comprises one approach to integrate environmental chemistry, biological observation and biological experimentation to determine pollution-induced degradation (Chapman *et al.*, 1987; Long, 1989). Specifically, it involves three separate components, each of which can comprise one or more measurement end points: sediment chemistry analyses which measure contamination, laboratory toxicity tests which measure effects under standardized conditions (experimentation), and assessments of resident community alteration (generally the benthic infauna) which measure field conditions (observation). Thus, the Triad incorporates field validation to the extent appropriate (Chapman, 1995). The rationale for this approach is provided in Chapman (1990, 1992a) and Chapman *et al.* (1991a,b). Chapman (1992a) reviews studies which have applied this approach. Current available methods for Triad data analysis and presentation are discussed, including additional guidance (both statistical and non-statistical) for interpreting Triad results.

Interpreting and presenting triad results

Interpretation of the integrated Triad components ultimately depends upon 'weight of evidence', which can be defined as drawing conclusions based upon all available information, in particular interrelationships: 'The separate lines of evidence must be evaluated, organized in some coherent fashion, and explained . . . so that a weight-of-evidence evaluation can be made' (Suter, 1993). Because the Triad will, by definition, include cases of competing or contradictory lines of evidence (Table 1), a coherent

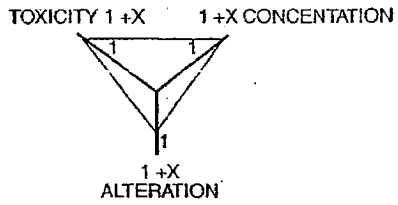
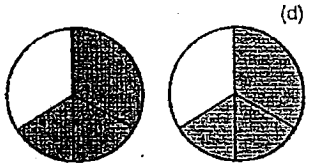
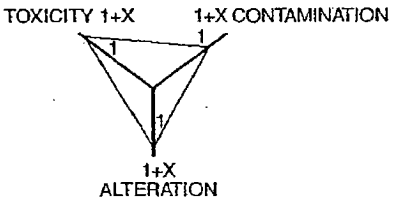
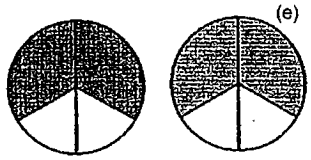
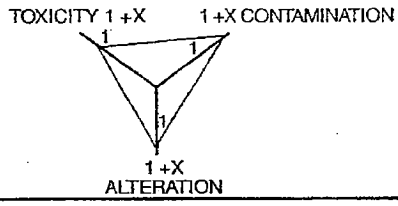
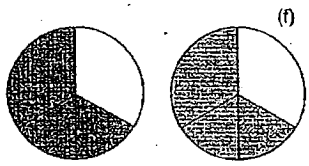
Table I. Methods of Triad Analysis/Presentation. Note that the three method examples may not necessarily be the only methods in future

Possible Outcome	Method Example: Summary Indices[a]	Method Example: Multivariate Analyses[b]
1		
2		
3		
4		
5		

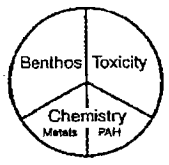
Method: Tabular Decision Matrix[9]

Contamination	Toxicity	Alteration	Possible Conclusions	Possible Actions/Decisions
+	+	+	Strong evidence for pollution-induced degradation.	Treat/remediate dependent on degree of degradation and chemical(s) responsible. Sediment toxicity identification evaluation (TIE) can identify contaminants of concern.
–	–	–	Strong evidence against pollution-induced degradation.	No action(s) necessary.
+	–	–	Contaminant(s) are not bioavailable.	No action(s) necessary.
–	+	–	Unmeasured contaminant(s) or condition(s) have the potential to cause degradation.	(1) Recheck chemical analyses; verify toxicity test results, ensure not due to modifying factors (e.g., grain size effects). (2) Conduct further, focused studies (e.g., TIE) if toxicity results confirmed. (3) Action(s) or lack thereof dependent on the above.
–	–	+	Alteration is not due to toxic contamination.	No action(s) necessary due to toxic chemicals (action may be necessary for other reasons, e.g., physical habitat changes).

Table 1. Continued

Possible Outcome	Method Example: Summary Indices[a]	Method Example: Multivariate Analyses[b]
6		
7		
8		

(a) Toxicity, contamination, and alteration are shown normalized to Ratio-to-Reference values as described by Chapman (1990), 1.0 = reference conditions. Note that the exact symmetry in these examples would not be routinely expected in actual studies.

(b) 

Example data presentation following multivariate analyses based on Chapman *et al.* (1996). Toxicity (based on a representative toxicity test), significantly different or not than control; Benthos (benthic community structure), Eucledian distance matrices, all taxon abundances relative to reference stations; Metals (based on copper), relative concentrations; Polyaromatic Hydrocarbons (PAH, based on fluoranthene), relative concentrations. If more possibilities than "high" or "low" are included, the number of possible combinations increases accordingly.

(c) Plus two intermediate possibilities (metals and PAH show different patterns).

(d) Plus six intermediate possibilities (mixtures of high and low).

(e) Plus two intermediate possibilities (mixtures of high and low).

(f) Plus six intermediate possibilities (mixtures of high and low).

(g) Adapted from Chapman (1990).

framework is needed for evaluating and integrating the results of each of the three Triad components. Such a framework should be established *a priori*, as part of the study design. There are presently three different means to assess weight of evidence which are not mutually exclusive: summary indices, tabular decision matrices, and multivariate analyses. All require an appropriate reference station (or group of stations).

Method: Tabular Decision Matrix[g]

Contamination	Toxicity	Alteration	Possible Conclusions	Possible Actions/Decisions
+	+	−	Toxic contaminants are bioavailable but *in situ* effects are not demonstrable.	(1) Recheck results from benthic analyses, consider additional data analyses. (2) If recheck indicates benthic alteration, treat/remediate (see Possible Outcome 1). (3) If recheck confirms no benthic alteration, minimize or reduce inputs to prevent future alteration.
−	+	+	Unmeasured toxic contaminants are causing degradation.	(1) Recheck chemical analyses, consider additional analyses and/or TIE; ensure toxicity and alteration not due to modifying factors (e.g., grain size effects). (2) Any action(s) dependent on the above.
+	−	+	Contaminants are not bioavailable, alteration not due to toxic chemicals.	(1) Confirm/verify lack of toxicity, investigate reason(s) for alteration. (2) Any action(s) dependent on the above.

Summary indices

Initial attempts to analyse and present Triad results in a meaningful way involved simple bar graphs (Long and Chapman, 1985). Subsequent attempts involved the determination of summary indices (i.e. ratios) for each of the three components, normalized to a reference value (called a ratio-to-reference [RTR] determination), followed by

presentation of the data in a triangular format, with differences in shape indicating different conclusions related to the eight possible combinations of results (hit/no hit) of the three separate Triad components (Chapman, 1990, 1992a; Table 1). Alden (1992) describes a method to derive confidence limits for this approach.

There are two main problems with this approach. First, substantial loss of information occurs during the conversion of multivariate data into single proportional indices, including spatial relational information. Second, the significance of any spatial impacts cannot be statistically determined. However, such indices have provided useful information in the past and continue to do so, provided that their limitations are recognized.

For example, Canfield *et al.* (1994) applied the Triad to the Upper Clark Fork River in Montana. This approach allowed them to recognize that increased numbers of chironomids and oligochaetes, a predominance of metal-tolerant species in metal-contaminated sediments suggested an imbalanced benthic community, but factors such as differences in habitat and, perhaps, intermittent disturbance could also account for the community structure observed. Canfield *et al.* (in press) have similarly applied the Triad to the Great Lakes.

Summary indices in triangular format provide a simple and highly visual data presentation which can be explained to and understood by non-scientists (which is not true of much scientific data analyses). Further, such data reduction can be a useful way, in time-series monitoring, of summarizing changes by time and location. However, this format generally assumes equality among the different Triad components, i.e. there is no weighting involved. Weighting is possible but of questionable value. For instance, it does not appear reasonable to weight certain chemical contaminants as more important than others (the ultimate criterion for significance is whether or not they cause any type of adverse effect). Similarly, it is not clear how (or if) to weight acute versus chronic effects. Chemical analyses, toxicity tests and measures of resident community alteration all represent (in terms of sediment ecological risk assessment) measurement end points which must be judged relative to the ultimate assessment end point(s), with any weighting done only in this latter context.

Tabular decision matrices

Tabular interpretation of hit/no hit alternatives formatted for decision-making (e.g. Chapman, 1992b; Chapman *et al.*, 1996) is neither new nor complex, but does form one of the few existing frameworks by which weight of evidence can be applied (Suter, in press). A principle limitation of this approach as initially proposed (Chapman, 1990) is that it does not explicitly incorporate variance in the quality of the lines of evidence (Suter, in press). The assumption is that the data from each Triad component are appropriate. For example, if chemicals are not measured at toxic concentrations and toxicity tests are negative but the community is altered (possible outcome 5, Table 1), there are two possibilities: (i) alteration is not due to toxic contamination, or (ii) the chemical analyses and/or toxicity tests may be inappropriate. Provided that the possibility of spatial differences was accounted for in the study design, the conclusion is that alteration is not due to toxic contamination. The assumption of appropriate tests and analyses is considered reasonable when, as in this case, contamination and toxicity converge to indicate that there is no problem. Similarly (possible outcome 3, Table 1),

lack of toxicity and of alteration does not require rechecking chemical analyses even where contamination is indicated because there is no biological reason for concern (provided tests and sampling design were appropriate). However, in any case where toxicity is indicated, either alone or in combination with another measure (i.e. possible outcomes 4, 6, 7 and 8 – Table 1), rechecking/verification is recommended because of the possibility that toxicity is providing 'worst case', proactive information which should be considered in decision-making (Chapman, 1995).

Some form of ranking may be done, including numerical scores. This can be done from the decision matrix (e.g. numerical scores reflecting the rank order of the verbally stated relative values) or before the decision matrix. For example, Carr (1993) and Carr *et al.* (in press) ranked chemistry, toxicity and benthos data by station, calculated a scaled rank sum (range 0–99) to facilitate comparisons among stations, then used this information in a tabular decision matrix to suggest where actions might or might not be needed to improve sediment quality in Galveston Bay, Texas. Canfield *et al.* (1994) used a similar ranking and scaling procedure in the Clark Fork River. Such ranks can be compared using Kendall's coefficient of concordance (Zar, 1984) to determine whether components are changing in the same direction or not (i.e. improving or degrading). Multivariate analyses can also be used as the basis for a decision matrix. For example, Chapman *et al.* (1996) used multivariate analyses to derive a final tabular decision matrix related to the need (or not) to treat sewage discharged to the marine environment.

Multivariate analyses

Multivariate analyses of the Triad (i.e. those which retain the multivariate properties of such data) have been conducted by various authors (e.g. Green, 1993; Green *et al.*, 1993, 1995; Chapman *et al.*, 1996; Kennicutt, 1995). The following comprises a general example of how Triad data might be analysed by multivariate techniques (adapted from Chapman *et al.*, 1996 and Paine *et al.*, in press). However, under no circumstances should this example be considered the *only* such method for multivariate analyses. As noted by Green (1993): 'There is no one "right" way to relate sets of variables'.

Multivariate analyses begin with independent analyses of individual Triad components (i.e. chemistry, toxicity, community structure data). This can be done using ANOVA (which can also be used to compare indices or tabular decision matrices) and a set of *a priori* contrasts, to determine spatial trends and statistically significant differences among stations or logically chosen groups of stations. Ideally such contrasts should be considered when the study is designed. Pseudoreplication is avoided by taking multiple samples for each component from each station. Testing should include: differences between impact and reference stations; differences among reference stations; differences among impact stations. The latter could, in the case of a point source, include comparison of the station nearest the source with all other stations, determination of any effect of direction and determination of any effect of distance from the point source.

Prior to ANOVA testing, Principal Components Analysis (PCA) can be employed where necessary and appropriate to reduce the multidimensionality of the data sets (Zar, 1984). Specific parameters, transformations and data manipulations employed for ANOVA testing on the different Triad components will vary depending on the specific

nature of the data. However, the following have proven useful. For sediment chemistry, calculate concentrations of all contaminants normalized to percent fines, and concentrations of organic contaminants normalized to total organic carbon (TOC). It may also be useful to normalize concentrations of appropriate metals to acid volatile sulfides (DiToro *et al.*, 1990). Where there are some data below detection limits, an appropriate transformation is log (reported value + a constant equal to the lowest measured non-zero value for that contaminant). PCA analyses allow selection of the principal components (PC) accounting for the most data variability, for use in subsequent ANOVA. Non-normal distribution or heterogeneity of variance will require normalization (e.g. ranks – Conover, 1982) to meet the assumptions of the ANOVA.

For sediment toxicity, paired comparisons should be conducted with both the control and reference responses for all end points tested following the statistical comparisons which accompany the specific test method. Then conduct between-station differences in mean response using ANOVA and *a priori* contrasts. For tests which may be affected by factors other than chemical contamination (e.g. grain size), comparisons using such factors as a covariate in ANCOVA may be appropriate.

For benthic infaunal data, calculated parameters can include: taxa richness, total abundance, numerical dominance, mean abundances of all species of major taxa. Data dimensionality can be reduced by PCA; subsequent ANOVAs can be used to reveal station differences related to the above four parameters. Data may require transformation prior to analysis; log-transformation is appropriate. Data sets containing zero values can be transformed using $\log(K+1)$.

Correspondence among Triad components can be evaluated statistically using Mantel's Test (Mantel, 1967), which is a randomization procedure that calculates the probability that two distance matrices are more similar than would be expected by chance alone (e.g. Jackson and Sommers, 1989). The randomization procedure avoids spurious correlations in assessing the relationship between two distance matrices. A measure of similarity such as pairwise Spearman rank correlations should then be used. The Spearman measure calculates all possible correlations generated by the randomization to calculate the probability of observing a higher correlation (Carr *et al.*, in press). Tests can be performed on Euclidean distance matrices generated using the different component data sets. To control for experiment-wise error, a Bonferroni procedure involving a significance level of $p = 0.017$ rather than $p = 0.05$ is appropriate (Legendre and Fortin, 1989). Initially all possible pairwise comparisons on selected stations data matrices (see descriptions of individual component analyses) should be conducted, then comparisons can be made between selected component groupings, based on the results of the initial within-component comparisons.

Rank correlations between each pair of distance matrices can be calculated using the Euclidean distances by site. Randomization procedures (Mantel's test) are appropriate since the distance matrices are not independent of each other. The Mantel program randomly selects a number of elements from the total set of Euclidean distances and calculates the rank correlation. This correlation can then be compared to the correlation from the original correlation matrix. The program can be specified to generate and make comparisons based on 10 runs of 1000 iterations each (i.e. randomly selected sets of Euclidean distances). The program estimates the p value as the number of times a randomly chosen set of observations yields a higher correlation than the total correlation (r), divided by the number of iterations (i.e. 1000).

The multivariate analyses described can be used to provide highly effective visual data presentations, and avoid some of the problems inherent in only using summary indices. The spatial correspondence among Triad components can be shown based on representative parameters derived from the multivariate analyses. The key to producing such a synoptic or summary map from a larger array of multidimensional data types and sets lies in choosing the appropriate data reduction techniques. Table 1 illustrates a pie diagram format used by Chapman *et al.* (1996). Due to high correlations, copper concentrations were used to represent total metal and non-PAH organic concentrations, PAH concentrations were represented by fluoranthene, a single toxicity test end point represented all toxicity tests and end points, and benthos data were reduced by creating Euclidean distance matrices between stations based on taxon abundances related to combined reference station data. The results of such analyses can also be used in tabular decision matrices. Although significant associations do not indicate cause-and-effect, as noted in Kennicutt (1995): 'An integration of results demonstrating coherence ... provides strong circumstantial evidence of effect or impact'. Note that separating metals and PAH into two separate categories does not imply a doubling of the weight of the chemical data compared to the individual biological measures (toxicity, benthos alteration); such only occurs where such separation is used in a relative ranking scheme (e.g. Carr *et al.*, in press).

Green (1993) and Green *et al.* (1993) also describe multivariate methods for analysing Triad data (including physical sediment characteristics), and similarly favour Mantel's test, which they follow with ordination. Kennicutt (1995) and Green *et al.* (1995) describe application of these methods to document chronic sublethal effects due to oil and gas operations in the Gulf of Mexico. High correlations were noted among all Triad components, the results were internally consistent, and the interpretation was that sediment contamination and toxicity exist and are forcing biological responses (modest biological effects close to the platforms resulting from organic enrichment and metal toxicity in the sediment).

Other methods of multivariate analyses could include other options, only a few of which are mentioned (not to exclude other possibilities or to specifically recommend these options – the methods used should be appropriate to the study design and ultimate purpose of the work). Kennicutt (1995) calculated correlations among components, tested the relationship among the three Triad components using Bartlett's sphericity test, provided information on significance on the sides of a triangle representing the Triad, then used PCA to evaluate the correlation matrix for structural relationships among the three Triad components. Cluster analyses can be conducted with 'boot strapping' techniques (Nemec and Brinkhurst, 1988a,b) to test for significance between clusters (i.e. dendrograms) produced by community classification analyses (e.g. Schlekat *et al.*, 1994) or contingency table analysis (Green *et al.*, 1993). Canonical correlation analysis (CCA) is another possibility. However, Green *et al.* (1993) caution that CCA may not be appropriate due mainly to the sensitivity of this analysis to non-linear between-sets relationships (within-set relationships are assumed to be linear). Canonical correspondence analysis (CANOCO) could be more appropriate as it can deal with non-linear responses, but Green (personal communication, 1995) cautions that CANOCO has algorithmic and theoretical problems and does not advise using the detrending option. Further useful discussion of multivariate analyses is provided by Green *et al.* (1993) and Landis *et al.* (1994).

Phasing/tiering

The strength of the Triad lies in obtaining matching chemistry, toxicity and benthos data. Collection of samples at different times may result in artifacts due to spatial or temporal variability and is not recommended. The Triad can however, if necessary, be conducted in a phased (or tiered) approach if data are collected appropriately. Specifically, synoptic sampling is required for chemistry and toxicity, and toxicity samples cannot be archived. Thus, phasing can involve testing toxicity and archiving samples for chemistry analyses, but not the reverse. Benthic community structure is coincident rather than synoptic, because complete sediment grab samples are required for these analyses (Chapman, 1990). Unlike toxicity samples, benthos samples can be archived. Thus, provided field conditions do not change, and precise station repositioning can be accomplished, benthic samples can be collected separately. Consequently, two possibilities exist for phased studies: (i) conduct benthic studies first, then collect samples for chemistry and toxicity but archive the chemistry; (ii) collect samples for chemistry and toxicity, but archive the chemistry samples, then either analyse the chemistry or collect samples for benthos (Fig. 1). Note that such phasing will not fit a scheme (e.g. sediment ecological risk analysis) where acute tests are conducted prior to chronic tests unless sample holding times (up to 8 weeks; EPA/ACOE, 1995) can be met.

Reynoldson *et al.* (1995) developed an inferential approach which basically involves a phased Triad beginning with the benthos. Their approach creates a model, based on reference conditions, that uses conservative physical and chemical variables to predict the community structure of macroinvertebrates in lakes and rivers. Predicted community structure at a site is then compared to actual benthic communities at the site. The distance between the two conditions indicates their similarity or dissimilarity. This model does not identify what has caused the benthic invertebrate community to deviate from reference conditions. This information must come from smaller-scale investigative work (e.g. laboratory toxicity tests, chemical analyses). This approach has not been (but probably can be) applied to marine and estuarine sites.

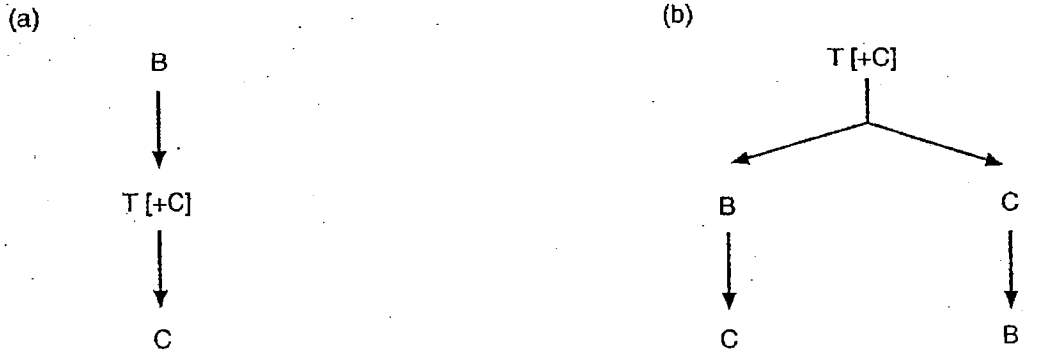


Fig. 1. Possible phased approaches to the Triad. B = benthos; T = toxicity; C = chemistry; [] collect but archive. Approach (a) is exampled by Engle *et al.* (1994) and Reynoldson *et al.* (1995). Approach (b) is exampled by EPA/ACOE (1995) and Paine *et al.* (in press).

Conclusion

The Triad is a very simple but holistic concept, basically just common sense, which appears to be useful. It will not be useful if future researchers are limited by either the concept or by how it has been used in the past (e.g. summary indices as opposed to multivariate analyses). Hopefully future researchers will improve on the Triad in all aspects, even replacing it if appropriate. For example, Engle *et al.* (1994) have proposed, for Gulf of Mexico benthos, an index incorporating selected components of higher-taxon community structure, which can then be coupled with investigative (i.e. experimental) studies such as sediment toxicity tests and measures of chemical contamination in a phased Triad. Future variations based on the Triad are expected.

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STATE WATER RESOURCES CONTROL BOARD

RESOLUTION NO. 92-49

File Number: 03-0284.051

(As Amended on April 21, 1994 and October 2, 1996)

POLICIES AND PROCEDURES FOR INVESTIGATION AND CLEANUP AND ABATEMENT OF DISCHARGES UNDER WATER CODE SECTION 13304

WHEREAS:

1. California Water Code (WC) Section 13001 provides that it is the intent of the Legislature that the State Water Resources Control Board (State Water Board) and each Regional Water Quality Control Board (Regional Water Board) shall be the principal state agencies with primary responsibility for the coordination and control of water quality. The State and Regional Water Boards shall conform to and implement the policies of the Porter-Cologne Water Quality Control Act (Division 7, commencing with WC Section 13000) and shall coordinate their respective activities so as to achieve a unified and effective water quality control program in the state;

2. WC Section 13140 provides that the State Water Board shall formulate and adopt State Policy for Water Quality Control;

3. WC Section 13240 provides that Water Quality Control Plans shall conform to any State Policy for Water Quality Control;

4. WC Section 13304 requires that any person who has discharged or discharges waste into waters of the state in violation of any waste discharge requirement 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 or nuisance 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). The term waste discharge requirements includes those which implement the National Pollutant Discharge Elimination System;

5. WC Section 13307 provides that the State Water Board shall establish policies and procedures that its representatives and the representatives of the Regional Water Boards shall follow for the oversight of investigations and cleanup and abatement activities resulting from discharges of hazardous substances, including:

a. The procedures the State Water Board and the Regional Water Boards will follow in making decisions as to when a person may be required to undertake an investigation to determine if an unauthorized hazardous substance discharge has occurred;

b. Policies for carrying out a phased, step-by-step investigation to determine the nature and extent of possible soil and ground water contamination or pollution at a site;

c. Procedures for identifying and utilizing the most cost-effective methods for detecting contamination or pollution and cleaning up or abating the effects of contamination or pollution;

d. Policies for determining reasonable schedules for investigation and cleanup, abatement, or other remedial action at a site. The policies shall recognize the danger to public health and the waters of the state posed by an unauthorized discharge and the need to mitigate those dangers while at the same time taking into account, to the extent possible, the resources, both financial and technical, available to the person responsible for the discharge;

6. "Waters of the state" include both ground water and surface water;

7. Regardless of the type of discharge, procedures and policies applicable to investigations, and cleanup and abatement activities are similar. It is in the best interest of the people of the state for the State Water Board to provide consistent guidance for Regional Water Boards to apply to investigation, and cleanup and abatement;

8. WC Section 13260 requires any person discharging or proposing to discharge waste that could affect waters of the state, or proposing to change the character, location, or volume of a discharge to file a report with and receive requirements from the Regional Water Board;

9. WC Section 13267 provides that the Regional Water Board may require dischargers, past dischargers, or suspected dischargers to furnish those technical or monitoring reports as the Regional Water Board may specify, provided that the burden, including costs, of these reports, shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports;

10. WC Section 13300 states that the Regional Water Board may require a discharger to submit a time schedule of specific actions the discharger shall take in order to correct or prevent a violation of requirements prescribed by the Regional Water Board or the State Water Board;

11. California Health and Safety Code (HSC) Section 25356.1 requires the Department of Toxic Substances Control (DTSC) or, if appropriate, the Regional Water Board to prepare or approve remedial action plans for sites where hazardous substances were released to the environment if the sites have been listed pursuant to HSC Section 25356 (state "Superfund" priority list for cleanup of sites);

12. Coordination with the U.S. Environmental Protection Agency (USEPA), state agencies within the California Environmental Protection Agency (Cal/EPA) (e.g., DTSC, Air Resources Control Board), air pollution control districts, local environmental health agencies, and other responsible federal, state, and local agencies: (l) promotes effective protection of water quality, human health, and the environment and (2) is in the best interest of the people of the state. The principles of coordination are embodied in many statutes, regulations, and

interagency memoranda of understanding (MOU) or agreement which affect the State and Regional Water Boards and these agencies;

13. In order to clean up and abate the effects of a discharge or threat of a discharge, a discharger may be required to perform an investigation to define the nature and extent of the discharge or threatened discharge and to develop appropriate cleanup and abatement measures;

14. Investigations that were not properly planned have resulted in increases in overall costs and, in some cases, environmental damage. Overall costs have increased when original corrective actions were later found to have had no positive effect or to have exacerbated the pollution. Environmental damage may increase when a poorly conceived investigation or cleanup and abatement program allows pollutants to spread to previously unaffected waters of the state;

15. A phased approach to site investigation should facilitate adequate delineation of the nature and extent of the pollution, and may reduce overall costs and environmental damage, because: (1) investigations inherently build on information previously gained; (2) often data are dependent on seasonal and other temporal variations; and (3) adverse consequences of greater cost or increased environmental damage can result from improperly planned investigations and the lack of consultation and coordination with the Regional Water Board. However, there are circumstances under which a phased, iterative approach may not be necessary to protect water quality, and there are other circumstances under which phases may need to be compressed or combined to expedite cleanup and abatement;

16. Preparation of written workplans prior to initiation of significant elements or phases of investigation, and cleanup and abatement generally saves Regional Water Board and discharger resources. Results are superior, and the overall cost-effectiveness is enhanced;

17. Discharger reliance on qualified professionals promotes proper planning, implementation, and long-term cost-effectiveness of investigation, and cleanup and abatement activities. Professionals should be qualified, licensed where applicable, and competent and proficient in the fields pertinent to the required activities. California Business and Professions Code Sections 6735, 7835, and 7835.1 require that engineering and geologic evaluations and judgements be performed by or under the direction of registered professionals;

18. WC Section 13360 prohibits the Regional Water Boards from specifying, but not from suggesting, methods that a discharger may use to achieve compliance with requirements or orders. It is the responsibility of the discharger to propose methods for Regional Water Board review and concurrence to achieve compliance with requirements or orders;

19. The USEPA, California state agencies, the American Society for Testing and Materials, and similar organizations have developed or identified methods successful in particular applications. Reliance on established, appropriate methods can reduce costs of investigation, and cleanup and abatement;

20. The basis for Regional Water Board decisions regarding investigation, and cleanup and

abatement includes: (1) site-specific characteristics; (2) applicable state and federal statutes and regulations; (3) applicable water quality control plans adopted by the State Water Board and Regional Water Boards, including beneficial uses, water quality objectives, and implementation plans; (4) State Water Board and Regional Water Board policies, including State Water Board Resolutions No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California) and No. 88-63 (Sources of Drinking Water); and (5) relevant standards, criteria, and advisories adopted by other state and federal agencies;

21. Discharges subject to WC Section 13304 may include discharges of waste to land; such discharges may cause, or threaten to cause, conditions of soil or water pollution or nuisance that are analogous to conditions associated with migration of waste or fluid from a waste management unit;

22. The State Water Board has adopted regulations governing discharges of waste to land (California Code of Regulations (CCR), Title 23, Division 3, Chapter 15);

23. State Water Board regulations governing site investigation and corrective action at underground storage tank unauthorized release sites are found in 23 CCR Division 3, Chapter 16, in particular Article 11 commencing with Section 2720;

24. It is the responsibility of the Regional Water Board to make decisions regarding cleanup and abatement goals and objectives for the protection of water quality and the beneficial uses of waters of the state within each Region;

25. Cleanup and abatement alternatives that entail discharge of residual wastes to waters of the state, discharges to regulated waste management units, or leaving wastes in place, create additional regulatory constraints and long-term liability, which must be considered in any evaluation of cost-effectiveness;

26. It is not the intent of the State or Regional Water Boards to allow dischargers, whose actions have caused, permitted, or threaten to cause or permit conditions of pollution, to avoid responsibilities for cleanup. However, in some cases, attainment of applicable water quality objectives for ground water cannot reasonably be achieved. In these cases, the State Water Board determines that establishment of a containment zone is appropriate and consistent with the maximum benefit to the people of the State if applicable requirements contained in the Policy are satisfied. The establishment of a containment zone does not limit or supersede obligations or liabilities that may arise under other laws;

27. The Porter-Cologne Water Quality Control Act allows Regional Water Boards to impose more stringent requirements on discharges of waste than any statewide requirements promulgated by the State Water Board (e.g., in this Policy) or than water quality objectives established in statewide or regional water quality control plans as needed to protect water quality and to reflect regional and site-specific conditions; and

28. Pursuant to Section 13320 of the Water Code, aggrieved persons may petition the State Water Board to review any decisions made under this policy.

THEREFORE BE IT RESOLVED:

These policies and procedures apply to all investigations, and cleanup and abatement activities, for all types of discharges subject to Section 13304 of the WC.

I. The Regional Water Board shall apply the following procedures in determining whether a person shall be required to investigate a discharge under WC Section 13267, or to clean up waste and abate the effects of a discharge or a threat of a discharge under WC Section 13304. The Regional Water Board shall:

A. Use any relevant evidence, whether direct or circumstantial, including, but not limited to, evidence in the following categories:

1. Documentation of historical or current activities, waste characteristics, chemical use, storage or disposal information, as documented by public records, responses to questionnaires, or other sources of information;

2. Site characteristics and location in relation to other potential sources of a discharge;

3. Hydrologic and hydrogeologic information, such as differences in upgradient and downgradient water quality;

4. Industry-wide operational practices that historically have led to discharges, such as leakage of pollutants from wastewater collection and conveyance systems, sumps, storage tanks, landfills, and clarifiers;

5. Evidence of poor management of materials or wastes, such as improper storage practices or inability to reconcile inventories;

6. Lack of documentation of responsible management of materials or wastes, such as lack of manifests or lack of documentation of proper disposal;

7. Physical evidence, such as analytical data, soil or pavement staining, distressed vegetation, or unusual odor or appearance;

8. Reports and complaints;

9. Other agencies' records of possible or known discharge; and

10. Refusal or failure to respond to Regional Water Board inquiries;

B. Make a reasonable effort to identify the dischargers associated with the discharge. It is not necessary to identify all dischargers for the Regional Water Board to proceed with requirements for a discharger to investigate and clean up;

C. Require one or more persons identified as a discharger associated with a discharge or

threatened discharge subject to WC Section 13304 to undertake an investigation, based on findings of I.A and I.B above;

D. Notify appropriate federal, state, and local agencies regarding discharges subject to WC Section 13304 and coordinate with these agencies on investigation, and cleanup and abatement activities.

II. The Regional Water Board shall apply the following policies in overseeing: (a) investigations to determine the nature and horizontal and vertical extent of a discharge and (b) appropriate cleanup and abatement measures.

A. The Regional Water Board shall:

1. Require the discharger to conduct investigation, and cleanup and abatement, in a progressive sequence ordinarily consisting of the following phases, provided that the sequence shall be adjusted to accommodate site-specific circumstances, if necessary:

a. Preliminary site assessment (to confirm the discharge and the identity of the discharg- ers; to identify affected or threatened waters of the state and their beneficial uses; and to develop preliminary information on the nature, and vertical and horizontal extent, of the discharge);

b. Soil and water investigation (to determine the source, nature and extent of the discharge with sufficient detail to provide the basis for decisions regarding subsequent cleanup and abatement actions, if any are determined by the Regional Water Board to be necessary);

c. Proposal and selection of cleanup and abatement action (to evaluate feasible and effective cleanup and abatement actions, and to develop preferred cleanup and abatement alternatives);

d. Implementation of cleanup and abatement action (to implement the selected alternative, and to monitor in order to verify progress);

e. Monitoring (to confirm short- and long-term effectiveness of cleanup and abatement);

2. Consider, where necessary to protect water quality, approval of plans for investigation, or cleanup and abatement, that proceed concurrently rather than sequentially, provided that overall cleanup and abatement goals and objectives are not compromised, under the following conditions:

a. Emergency situations involving acute pollution or contamination affecting present uses of waters of the state;

b. Imminent threat of pollution;

c. Protracted investigations resulting in unreasonable delay of cleanup and abatement; or

d. Discharges of limited extent which can be effectively investigated and cleaned up within a

short time;

3. Require the discharger to extend the investigation, and cleanup and abatement, to any location affected by the discharge or threatened discharge;

4. Where necessary to protect water quality, name other persons as dischargers, to the extent permitted by law;

5. Require the discharger to submit written workplans for elements and phases of the investigation, and cleanup and abatement, whenever practicable;

6. Review and concur with adequate workplans prior to initiation of investigations, to the extent practicable. The Regional Water Board may give verbal concurrence for investigations to proceed, with written follow-up. An adequate workplan should include or reference, at least, a comprehensive description of proposed investigative, cleanup, and abatement activities, a sampling and analysis plan, a quality assurance project plan, a health and safety plan, and a commitment to implement the workplan;

7. Require the discharger to submit reports on results of all phases of investigations, and cleanup and abatement actions, regardless of degree of oversight by the Regional Water Board;

8. Require the discharger to provide documentation that plans and reports are prepared by professionals qualified to prepare such reports, and that each component of investigative and cleanup and abatement actions is conducted under the direction of appropriately qualified professionals. A statement of qualifications of the responsible lead professionals shall be included in all plans and reports submitted by the discharger;

9. Prescribe cleanup levels which are consistent with appropriate levels set by the Regional Water Board for analogous discharges that involve similar wastes, site characteristics, and water quality considerations;

B. The Regional Water Board may identify investigative and cleanup and abatement activities that the discharger could undertake without Regional Water Board oversight, provided that these investigations and cleanup and abatement activities shall be consistent with the policies and procedures established herein.

III. The Regional Water Board shall implement the following procedures to ensure that dischargers shall have the opportunity to select cost-effective methods for detecting discharges or threatened discharges and methods for cleaning up or abating the effects thereof. The Regional Water Board shall:

A. Concur with any investigative and cleanup and abatement proposal which the discharger demonstrates and the Regional Water Board finds to have a substantial likelihood to achieve compliance, within a reasonable time frame, with cleanup goals and objectives that implement the applicable Water Quality Control Plans and Policies adopted by the State Water Board and Regional Water Boards, and which implement permanent cleanup and abatement solutions

which do not require ongoing maintenance, wherever feasible;

B. Consider whether the burden, including costs, of reports required of the discharger during the investigation and cleanup and abatement of a discharge bears a reasonable relationship to the need for the reports and the benefits to be obtained from the reports;

C. Require the discharger to consider the effectiveness, feasibility, and relative costs of applicable alternative methods for investigation, and cleanup and abatement. Such comparison may rely on previous analysis of analogous sites, and shall include supporting rationale for the selected methods;

D. Ensure that the discharger is aware of and considers techniques which provide a cost-effective basis for initial assessment of a discharge.

1. The following techniques may be applicable:

a. Use of available current and historical photographs and site records to focus investigative activities on locations and wastes or materials handled at the site;

b. Soil gas surveys;

c. Shallow geophysical surveys;

d. Remote sensing techniques;

2. The above techniques are in addition to the standard site assessment techniques, which include:

a. Inventory and sampling and analysis of materials or wastes;

b. Sampling and analysis of surface water;

c. Sampling and analysis of sediment and aquatic biota;

d. Sampling and analysis of ground water;

e. Sampling and analysis of soil and soil pore moisture;

f. Hydrogeologic investigation;

E. Ensure that the discharger is aware of and considers the following cleanup and abatement methods or combinations thereof, to the extent that they may be applicable to the discharge or threat thereof:

1. Source removal and/or isolation;

2. In-place treatment of soil or water:

a. Bioremediation;

b. Aeration;

c. Fixation;

3. Excavation or extraction of soil, water, or gas for on-site or off-site treatment by the following techniques:

a. Bioremediation;

b. Thermal destruction;

c. Aeration;

d. Sorption;

e. Precipitation, flocculation, and sedimentation;

f. Filtration;

g. Fixation;

h. Evaporation;

4. Excavation or extraction of soil, water, or gas for appropriate recycling, re-use, or disposal;

F. Require actions for cleanup and abatement to:

1. Conform to the provisions of Resolution No. 68-16 of the State Water Board, and the Water Quality Control Plans of the State and Regional Water Boards, provided that under no circumstances shall these provisions be interpreted to require cleanup and abatement which achieves water quality conditions that are better than background conditions;

2. Implement the provisions of Chapter 15 that are applicable to cleanup and abatement, as follows:

a. If cleanup and abatement involves corrective action at a waste management unit regulated by waste discharge requirements issued under Chapter 15, the Regional Water Board shall implement the provisions of that chapter;

b. If cleanup and abatement involves removal of waste from the immediate place of release and discharge of the waste to land for treatment, storage, or disposal, the Regional Water Board shall regulate the discharge of the waste through waste discharge requirements issued under Chapter 15, provided that the Regional Water Board may waive waste discharge requirements under WC Section 13269 if the waiver is not against the public interest (e.g., if the discharge is for short-term treatment or storage, and if the temporary waste management

unit is equipped with features that will ensure full and complete containment of the waste for the treatment or storage period); and

c. If cleanup and abatement involves actions other than removal of the waste, such as containment of waste in soil or ground water by physical or hydrological barriers to migration (natural or engineered), or in-situ treatment (e.g., chemical or thermal fixation, or bioremediation), the Regional Water Board shall apply the applicable provisions of Chapter 15, to the extent that it is technologically and economically feasible to do so; and

3. Implement the applicable provisions of Chapter 16 for investigations and cleanup and abatement of discharges of hazardous substances from underground storage tanks;

G. Ensure that dischargers are required 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 which is reasonable if background levels of water quality cannot be restored, considering 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; in approving any alternative cleanup levels less stringent than background, apply Section 2550.4 of Chapter 15, or, for cleanup and abatement associated with underground storage tanks, apply Section 2725 of Chapter 16, provided that the Regional Water Board considers the conditions set forth in Section 2550.4 of Chapter 15 in setting alternative cleanup levels pursuant to Section 2725 of Chapter 16; any such alternative cleanup level shall:

1. Be consistent with maximum benefit to the people of the state;

2. Not unreasonably affect present and anticipated beneficial use 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; and

H. Consider the designation of containment zones notwithstanding any other provision of this or other policies or regulations which require cleanup to water quality objectives. A containment zone is defined as a specific portion of a water bearing unit where the Regional Water Board finds, pursuant to Section III.H. of this policy, it is unreasonable to remediate to the level that achieves water quality objectives. The discharger is required to take all actions necessary to prevent the migration of pollutants beyond the boundaries of the containment zone in concentrations which exceed water quality objectives. The discharger must verify containment with an approved monitoring program and must provide reasonable mitigation measures to compensate for any significant adverse environmental impacts attributable to the discharge. Examples of sites which may qualify for containment zone designation include, but are not limited to, sites where either strong sorption of pollutants on soils, pollutant entrapment (e.g. dense non-aqueous phase liquids [DNAPLS]), or complex geology due to heterogeneity or fractures indicate that cleanup to applicable water quality objectives cannot reasonably be achieved. In establishing a containment zone, the following procedures, conditions, and restrictions must be met:

1. The Regional Water Board shall determine whether water quality objectives can reasonably

be achieved within a reasonable period by considering what is technologically and economically feasible and shall take into account environmental characteristics of the hydrogeologic unit under consideration and the degree of impact of any remaining pollutants pursuant to Section III.H.3. The Regional Water Board shall evaluate information provided by the discharger and any other information available to it:

a. Technological feasibility is determined by assessing available technologies, which have been shown to be effective under similar hydrogeologic conditions in reducing the concentration of the constituents of concern. Bench-scale or pilot-scale studies may be necessary to make this feasibility assessment;

b. Economic feasibility is an objective balancing of the incremental benefit of attaining further reductions in the concentrations of constituents of concern as compared with the incremental cost of achieving those reductions. The evaluation of economic feasibility will include consideration of current, planned, or future land use, social, and economic impacts to the surrounding community including property owners other than the discharger. Economic feasibility, in this Policy, does not refer to the discharger's ability to finance cleanup. Availability of financial resources should be considered in the establishment of reasonable compliance schedules;

c. The Regional Water Board may make determinations of technological or economic infeasibility after a discharger either implements a cleanup program pursuant to III.G. which cannot reasonably attain cleanup objectives, or demonstrates that it is unreasonable to cleanup to water quality objectives, and may make determinations on the basis of projection, modeling, or other analysis of site-specific data without necessarily requiring that remedial measures be first constructed or installed and operated and their performance reviewed over time unless such projection, modeling, or other analysis is insufficient or inadequate to make such determinations;

2. The following conditions shall be met for all containment zone designations:

a. The discharger or a group of dischargers is responsible for submitting an application for designation of a containment zone. Where the application does not have sufficient information for the Regional Water Board to make the requisite findings, the Regional Water Board shall request the discharger(s) to develop and submit the necessary information. Information requirements are listed in the Appendix to this section;

b. Containment and storage vessels that have caused, are causing, or are likely to cause ground water degradation must be removed or repaired, or closed in accordance with applicable regulations. Floating free product must be removed to the extent practicable. If necessary, as determined by the Regional Water Board, to prevent further water degradation, other sources (e.g., soils, nonfloating free product) must be either removed, isolated, or managed. The significance and approach to be taken regarding these sources must be addressed in the management plan developed under H.2.d.;

c. Where reasonable, removal of pollutant mass from ground water within the containment zone may be required, if it will significantly reduce the concentration of pollutants within the

containment zone, the volume of the containment zone, or the level of maintenance required for containment. The degree of removal which may be required will be determined by the Regional Water Board in the process of evaluating the proposal for designation of a containment zone. The determination of the extent of mass removal required will include consideration of the incremental cost of mass removal, the incremental benefit of mass removal, and the availability of funds to implement the provisions in the management plan for as long as water quality objectives are exceeded within the containment zone;

d. The discharger or a group of dischargers must propose and agree to implement a management plan to assess, cleanup, abate, manage, monitor, and mitigate the remaining significant human health, water quality, and environmental impacts to the satisfaction of the Regional Water Board. Impacts will be evaluated in accordance with Section III.H.3. The management plan may include management measures, such as land use controls(footnote 1), engineering controls(footnote 2), and agreements with other landowners or agreements with the landlord or lessor where the discharger is a tenant or lessee(footnote 3). The contents of the management plan shall be dependent upon the specific characteristics of the proposed containment zone and must include a requirement that the Regional Water Board be notified of any transfer of affected property to a new owner(s);

e. The proposed management plan must provide reasonable mitigation measures to substantially lessen or avoid any significant adverse environmental impacts attributable to he discharge. At a minimum, the plan must provide for control of pollutants within the containment zone such that water quality objectives are not exceeded outside the containment zone as a result of the discharge. The plan must also provide, if appropriate, for equivalent alternative water supplies, reimbursement for increased water treatment costs to affected users, and increased costs associated with well modifications. Additional mitigation measures may be proposed by the discharger based on the specific characteristics of the proposed containment zone. Such measures must assist in water quality improvement efforts within the ground water basin and may include participating in regional ground water monitoring, contributing to ground water basin cleanup or management programs, or contributing to research projects which are publicly accessible (i.e., not protected by patents and licenses) and aimed at developing remedial technologies that would be used in the ground water basin. Proposals for off-site cleanup projects may be considered by the Regional Water Board as a mitigation measure under the following criteria:

1. Off-site cleanup projects must be located in the same ground water basin as the proposed containment zone, and

2. Implementation of an off-site project must result in an improvement in the basin's water quality or protect the basin's water quality from pollution, and

3. Off-site projects must include source removal or other elements for which water quality benefits or water quality protection can be easily demonstrated, and

4. Off-site projects may be proposed independently by the discharger or taken from projects identified as acceptable by the Regional Water Board through a clearinghouse process, or

5. In lieu of choosing to finance a specific off-site project, the discharger may contribute moneys to the SWRCB's Cleanup and Abatement Account (Account) or other funding source. Use of such contributions to the Account or other source will be limited to cleanup projects or water quality protection projects for the basin in which the containment zone is designated. Contributions are not to exceed ten percent of the savings in continued active remediation that discharger will accrue over a ten-year period due to designation of a containment zone (less any additional costs of containment zone designation during this period, e.g., additional monitoring requirements, Regional Water Board application costs, etc.). Contributions of less than ten percent must be accompanied by a detailed justification as to why a lesser contribution would provide adequate mitigation.

Except where prohibited by Federal law, Federal agencies may be required, based on specific site conditions, to implement mitigation measures;

f. The proposed management plan must include a detailed description of the proposed monitoring program, including the location and construction of monitoring points, a list of proposed monitoring parameters, a detailed description of sampling protocols, the monitoring frequency, and the reporting requirements and frequency. The monitoring points must be at or as close as reasonable to the boundary of the containment zone so as to clearly demonstrate containment such that water quality objectives outside the containment zone are not violated as the result of the discharge. Specific monitoring points must be defined on a case-by-case basis by determining what is necessary to demonstrate containment, horizontally and vertically. All technical or monitoring program requirements and requirements for access shall be designated pursuant to WC Section 13267. The monitoring program may be modified with the approval of the Regional Water Board s Executive Officer based on an evaluation of monitoring data;

g. The management plan must include a detailed description of the method to be used by the discharger to evaluate monitoring data and a specific protocol for actions to be taken in response to evidence that water quality objectives have been exceeded outside the containment zone as a result of the migration of pollutants from within the containment zone;

3. In order for a containment zone to be designated, it shall be limited in vertical and lateral extent; as protective as reasonably possible of human health and safety and the environment; and should not result in violation of water quality objectives outside the containment zone. The following factors must be considered by the Regional Water Board in making such findings:

a. The size of a containment zone shall be no larger than necessary based on the facts of the individual designation. In no event shall the size of a containment zone or the cumulative effect of containment zones cause a substantial decline in the overall yield, storage, or transport capacity of a ground water basin;

b. Evaluation of potentially significant impacts to water quality, human health, and the environment, shall take into consideration the following, as applicable to the specific factual situation:

1. The physical and chemical characteristics of the discharge, including its potential for migration;

2. The hydrogeological characteristics of the site and surrounding land;

3. The quantity of ground water and surface water and the direction of ground water flow;

4. The proximity and withdrawal rates of ground water users;

5. The patterns of rainfall in the region and the proximity of the site to surface waters;

6. The present and probable future uses of ground water and surface water in the area;

7. The existing quality of ground water and surface water, including other sources of pollution and their cumulative impact on water quality;

8. The potential for health impacts caused by human exposure to waste constituents;

9. The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents;

10. The persistence and permanence of any potential adverse effects;

11. Exposure to human or other biological receptors from the aggregate of hazardous constituents in the environment;

12. The potential for the pollutants to attenuate or degrade and the nature of the breakdown products; and

13. Potential adverse effects on approved local development plans, including plans approved by redevelopment agencies or the California Coastal Commission.

c. No provision of this Policy shall be interpreted to allow exposure levels of constituents of concern that could have a significant adverse effect on human health or the environment;

d. A containment zone shall not be designated in a critical recharge area. A critical recharge area is an artificial recharge area or an area determined by the Regional Water Board to be a critical recharge area after the consultation process required by Section III.H.9. Further, a containment zone shall not be designated if it would be inconsistent with a local ground water management plan developed pursuant to Part 2.75 of Division 6 of the WC (commencing at Section 10750) or other provisions of law or court order, judgment or decree;

4. After designation, no further action to reduce pollutant levels, beyond that which is specified in the management plan, will be required within a containment zone unless the Regional Water Board finds that the discharger(s) has failed to fully implement the required management plan or that violation of water quality objectives has occurred beyond the containment zone, as a result of migration of chemicals from inside the containment zone. If

the required tasks contained in the approved management plan are not implemented, or appropriate access is not granted by the discharger to the Regional Water Board for purposes of compliance inspection, or violation of water quality objectives occurs outside the containment zone and that violation is attributable to the discharge in the containment zone, the Regional Water Board, after 45 days public notice, shall promptly revoke the zone's containment status and shall take appropriate enforcement action against the discharger;

5. The designation of a containment zone shall be accomplished through the adoption of a cleanup and abatement order as authorized by WC Section 13304. The Regional Water Board shall make a finding of fact with regard to each of the conditions which serve as a prerequisite for containment zone designation in the cleanup and abatement order. All applicable criteria of Section III.H. must be met as a prerequisite to designation. The Regional Water Board may reject an application for designation of a containment zone for failure to meet any applicable criteria without having to make findings with regard to each prerequisite. Such orders shall be adopted by the Regional Water Boards themselves and not issued by the Executive Officers of the Regional Water Boards. These orders shall ensure compliance with all procedures, conditions, and restrictions set forth in Section III.H. As authorized by WC Section 13308, time schedules issued as part of the establishment of a containment zone may prescribe a civil penalty which shall become due if compliance is not achieved in accordance with that time schedule;

6. A containment zone shall be implemented only with the written agreement of all fee interest owners of the parcel(s) of property containing the containment zone. Exceptions may be allowed by the Regional Water Board where opposition is found to be unreasonable. In such cases, the Regional Water Board may use the authority of WC Section 13267 to assure access to property overlying the containment zone;

7. Local agencies which are supervising cleanup under contract with the State Water Board or by agreement with the Regional Water Board pursuant to provisions of the Underground Storage Tank Program may propose containment zones for consideration by the Regional Water Board. The local agency will forward its files and proposal to the Regional Water Board for consideration. Regional Water Boards shall use the same procedures, processes, public notice, and criteria that are noted elsewhere in this policy. Approval of Technical Impracticability Waivers by the Department of Toxic Substances Control or the United States Environmental Protection Agency under the requirements of the Federal Resource Conservation and Recovery Act or the Comprehensive Environmental Response, Compensation, and Liability Act are deemed to be equivalent to the actions outlined in Section H. of this Policy if :

a. the substantive provisions of Sections III.H.2.b., e., f., and g. are met;

b. interested parties described in III.H.8.a. are included in the public participation process; and

c. site information is forwarded from the approving agency to the Regional Water Board so that sites for which Technical Impracticability Waivers have been approved can be included in the master listings described in Section III.H.10.;

8. The Regional Water Board shall comply with the following public participation requirements, in addition to any other legal requirements for notice and public participation, prior to the designation of a containment zone:

a. Public notice of an intention to designate a containment zone shall be provided to all known interested persons, including the owner of the affected property(s), owners and residents of properties adjacent to the containment zone, and agencies identified in Section III.H.9, at least 45 days prior to the proposed designation of a containment zone;

b. Interested persons shall be given the opportunity to review the application, including the proposed management plan, and any other available materials and to comment on any proposed designation of a containment zone. These materials, which contain information upon which the proposed designation of a containment zone is based, must be available for review at least 45 days prior to the proposed designation of a containment zone;

c. The proposed designation of a containment zone shall be placed on the agenda for consideration at a Regional Water Board meeting;

9. At least 45 days prior to the proposed designation of a containment zone, the Regional Water Board shall invite a technical advisory committee to review any proposed designation and shall meet as a committee at the request of any committee member. The committee or any committee member shall provide advice to the Regional Water Board as to the appropriateness of the requested designation and such designation will become part of the public record. No person or agency shall be made a member of the committee who is employed by or has a financial interest with the discharger seeking the designation. The following agencies shall be invited to participate in the advisory committee:

a. The California Department of Toxic Substances Control;

b. The California Department of Health Services, Drinking Water Branch;

c. The California Department of Fish and Game;

d. The local health authority;

e. The local water purveyor, in the event ground water is used or planned to be used as a source of water supply;

f. Any local ground water management agency including an appointed water master;

g. The United States Environmental Protection Agency; and

h. The California Coastal Commission if the site is located within the coastal zone of California.

10. The Regional Water Boards shall keep a master listing of all designated containment zones. The master listing shall describe the location and physical boundaries of the containment zone, the pollutants which exceed applicable water quality objectives, and any

land use controls associated with the containment zone designation. The Regional Water Board shall forward the information on the master list to the State Water Board and to the local well permitting agency whenever a new containment zone is designated. The State Water Board will compile the lists from the Regional Water Boards into a comprehensive master list;

11. To assure consistency of application of this Policy, the State Water Board will designate a Containment Zone Review Committee consisting of staff from the State Water Board and each of the Regional Water Boards. This review committee shall meet quarterly for two years and review all designation actions taken. The committee shall review problems and issues and make recommendations for consistency and improved procedures. In any event the State Water Board shall review the containment zone issue not later than five years after the adoption of Section III.H... and periodically thereafter. Such review shall take place in a public proceeding;

12. In the event that a Regional Water Board finds that water quality objectives within the containment zone have been met, after public notice, the Regional Water Board will rescind the designation of the containment zone and issue a closure letter; and

13. The Regional Water Board s cost associated with review of applications for containment zone designation will be recoverable pursuant to Section 13304 of the Water Code, provided a separate source of funding has not been provided by the discharger.

14. Designation of a containment zone shall have no impact on a Regional Water Board s discretion to take appropriate enforcement actions except for the provisions of Section III.H.4.

IV. The Regional Water Board shall determine schedules for investigation, and cleanup and abatement, taking into account the following factors:

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 Plans and Policies adopted by the State Water Board and Regional 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.

V. The State and Regional Water Boards shall develop an expedited technical conflict resolution process so when disagreements occur, a prompt appeal and resolution of the conflict is accomplished.

Appendix to Section III.H.

Application for a Containment Zone Designation

The discharger is responsible for submitting an application for designation of a containment zone. Supporting information which is readily available to the Regional Water Board and which would be cumbersome or costly to reproduce can be included in the application by reference. In order to facilitate the preparation of an acceptable application, the discharger may request that the Regional Water Board provide a preliminary review of a partial application. The partial application should be detailed enough to allow the Regional Water Board to determine if the site passes the threshold criteria for establishment of a containment zone (e.g., it is not reasonable to achieve water quality objectives at that site, plume management measures are likely to be effective, etc.). As appropriate, the application shall include:

a) Background information (location, site history, regulatory history);

b) Site characterization information, including a description of the nature and extent of the discharge. Hydrogeologic characterization must be adequate for making the determinations necessary for a containment zone designation;

c) An inventory of all wells (including abandoned wells and exploratory boreholes) that could affect or be affected by the containment zone;

d) A demonstration that it is not reasonable to achieve water quality objectives;

e) A discussion of completed source removal and identification of any additional sources that will be addressed during implementation of the management plan;

f) A discussion of the extent to which pollutant mass has been reduced in the aquifer and identification of any additional mass removal that will be addressed during implementation of the management plan;

g) If necessary, information related to the availability of funds to implement the provisions of the management plan throughout the expected duration of the containment zone designation;

h) The proposed boundaries for the proposed containment zone pursuant to Section III.H.3.a.;

i) An evaluation of potential impacts to water quality, human health and the environment pursuant to Sections III.H.3.b. and c.;

j) A statement that the discharger believes that the site is not located in a critical recharge area, as required by Section III.H.3.d.;

k) Copies of maps and cross sections that clearly show the boundaries of the proposed containment zone and that show the locations where land use restrictions will apply. Maps must include at least four points of reference near the map corners. Reference points must be identified by latitude and longitude (accurate to within 50 feet), as appropriate for possible inclusion in a geographic information system (GIS) database; and

l) A management plan for review and approval. The management plan must contain provisions for:

1) source removal as appropriate;

2) pollutant mass removal from the aquifer as appropriate;

3) land use or engineering controls necessary to prevent the migration of pollution, including the proper abandonment of any wells within the vicinity of the containment zone that could provide a conduit for pollution migration beyond the containment zone boundary;

4) land use or engineering controls necessary to prevent water quality impacts and risks to human health and the environment;

5) mitigation measures, an implementation schedule for mitigation, and reporting requirements for compliance with mitigation measures;

6) a detailed description of the proposed monitoring program;

7) a detailed description of the method to be used by the discharger to evaluate monitoring data;

8) a specific protocol for actions to be taken if there is evidence that water quality objectives have been exceeded outside the containment zone as a result of the migration of pollutants from within the containment zone;

9) a detailed description of the frequency and content of reports to be submitted to the Regional Water Board;

10) detailed procedures and designs for well maintenance, replacement and decommissioning;

11) a protocol for submittal to and approval by the Executive Officer of minor modifications to the management plan as necessary to optimize monitoring and containment; and

12) a description of file and database maintenance requirements.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 18, 1992, and amended at meetings of the State Water Resources Control Board held on April 21, 1994, and October 2, 1996.

/s/

Maureen Marché

Administrative Assistant to the Board

FOOTNOTES:

1. For the purposes of this section, "land use controls" means recorded instruments, proposed by the discharger and agreed to by the owner of the affected property, restructing the present and future uses of the affected property, including, but not limited to, recorded easements, convenants, restrictions or servitudes, or any combination thereof, as appropriate. Land use controls shall run with the land from the date of recordation, shall bind all of the owners of the land, and their heirs, successors, and assignees, and the agents, employees, and lessees of the owners, heirs, successors, and assignees. Such instruments shall provide for (a) amendment or rescission of the restruction upon application of the holder of fee interest in the property and upon the approval of the Regional Water Board if warranted by changed circumstances (e.g., new information demonstrates that a modification to land use restriction is appropriate, the containment zone designation has been rescinded because water quality objectives have been attained throughout the containment zone, etc.), and (b) except for the restriction contained in the instrument, the establishment of a containment zone shall not prohibit the full use of enjoyment of the property.

2. For the purposes of this section, "engineering controls" means measures to prevent migration of pollutants and to prevent, minimize or mitigate environmental damage which may otherwise result from a release of threatened release, including, but not limited to , caps, covers, dikes, trenches, leachate collection systems, treatment systems, and ground water containment systems or procedures and decomissioning of wells.

3. For the purposes of this section, these agreements could be formal, private agreements between parties related to the property use, existing or potential water use, etc.

ADDITIONAL INFORMATION RELATED TO ADOPTION OF CONTAINMENT ZONE POLICY

1. ADDITIONAL PROVISIONS OF RESOLUTION NO. 96-079

State Water Resources Control Board (SWRCB) Resolution No. 96-079, which adopted the Containment Zone Policy Amendment to Resolution No. 92-49, also:

o Directs the Containment Zone Review Committee established pursuant to Section III.H.11. of the amendment to review the implementation of this policy and the incorporation of risk assessment into this policy and provide recommendations to the SWRCB by May 1, 1997, on any further adjustments to the policy.

o Expands the Containment Zone Review Committee to include other public officials and private individuals as determined by the State Board.

2. ANTICIPATED FUTURE MINOR CHANGES TO BE MADE TO CONTAINMENT ZONE PROVISIONS OF RESOLUTION NO. 92-49

On October 2, 1996, the SWRCB adopted Resolution No. 96-079 which amended SWRCB

Resolution No. 92-49 to include provisions for a containment zone policy.

Pursuant to Government Code Section 11355, this amendment was submitted to the Office of Administrative Law (OAL) for review and approval. Staff of OAL approved this amendment on January 13, 1997 and brought to our attention two minor matters which need correction. In the first sentence of Section III.H.4., the word "pollutant" should be substitued for the word "chemical". In the second sentence of Section III.H.9. the word "advice" should be substituted for the word "designation".

These minor changes will be corrected the next time Resolution No. 92-49 is revised.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

CLEANUP AND ABATEMENT ORDER NO. 95-21

CAMPBELL INDUSTRIES
MARINE CONSTRUCTION AND DESIGN COMPANY

CAMPBELL SHIPYARDS
501 EAST HARBOR DRIVE
SAN DIEGO, CALIFORNIA

SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board) finds that:

NPDES PERMIT STATUS

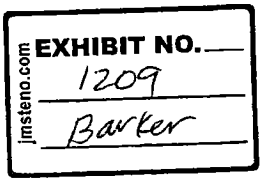
1. On April 22, 1985, the Regional Board adopted Order No. 85-01, NPDES Permit No. CA0107646, Waste Discharge Requirements for Campbell Industries, San Diego County. Order No. 85-01 established waste discharge requirements for a the threatened discharge of pollutants from a ship construction and repair facility to San Diego Bay, a water of the United States.

2. On October 23, 1989 the Regional Board adopted Addendum No. 1 to Order No. 85-01. The addendum modifies Monitoring and Reporting Program No. 85-01 to include sediment monitoring requirements and adds the San Diego Unified Port District as a secondary liable responsible party for purposes of compliance with Order No. 85-01, if Campbell Industries fails to comply with the Order and Addenda thereto.

3. Order No. 85-01 contains an expiration date of April 22, 1990. The Regional Board can enforce the terms and conditions of an expired permit under the authority of California Code of Regulations, Title 23, Section 2235.4. Section 2235.4 provides that the terms and conditions of expired NPDES permits are automatically continued if the discharger submits a complete application for permit renewal, prior to permit expiration. On October 19, 1989 Campbell Industries submitted a timely application for renewal of Order No. 85-01. Order No. 85-01 is enforceable pursuant to the provisions of Section 2235.4.

SITE LOCATION AND HISTORY

4. Campbell Shipyards (hereinafter Campbell) is located on the northeastern shore of San Diego Bay at 501 East Harbor Drive in the City of San Diego. The site is leased by Campbell Industries from the San Diego Unified Port District.



5. Campbell Industries, operator of Campbell Shipyards, was started by the Campbell Brothers in 1906. Campbell Industries began operation of Campbell Shipyards at its current location adjacent to San Diego Bay in 1926. Campbell Industries primary business has historically been the construction of commercial fishing vessels. Campbell Industries entered the Naval ship repair business in the early 1980's due to a decline in commercial fishing vessel orders.

6. A diesel and gasoline tank farm facility, owned and operated by General Petroleum Company, occupied the south parking lot of the Campbell site from at least 1939 to 1956. There is an abandoned diesel pipeline that runs along the southern portion of the Campbell site that may have been connected to the tank farm.

7. A San Diego Gas & Electric (SDG&E) facility is located approximately two blocks northeast of the Campbell Shipyards site. Campbell reports that this facility is a likely offsite source of petroleum-contaminated ground water. Petroleum production activities occurred at this site from 1888 through 1984, beginning with the production of oil gas from crude petroleum (in 1888), and followed by the generation of coal gas and oil gas. SDG&E switched from oil gas to natural gas in 1932.

8. Campbell Industries' predecessor, Campbell Machine Company, had facility structures that occupied the east parking lot area from the early 1900s to the 1930s. A number of other facilities owned by other entities have occupied all or parts of the east parking lot area, including an ice skating rink, a City of San Diego garbage disposal plant, other machining companies, and truck repair facilities. San Diego Unified Port District (SDUPD) owns and operates a maintenance facility adjacent to the east parking lot.

9. Campbell Industries is currently a California Corporation that is a wholly owned subsidiary of Marine Construction and Design Company Holding, Inc. of Seattle (MARCO), located at 2300 West Commodore Way, Seattle, Washington, 98199.

10. Campbell Industries proposes to redevelop the current leasehold. Under the proposed redevelopment plan, the shipyard activities at the site will cease entirely and the site will be converted to a public and commercial

recreational area. Campbell Industries has conducted a site investigation to identify polluted soils, ground water and bay sediment and determine appropriate remedial actions in order to expedite and facilitate the closure of the shipyard site.

DISCHARGERS NAMED IN THIS ORDER

11. The following parties are named as "dischargers" in this cleanup and abatement order pursuant to Water Code Section 13304:

a) Campbell Industries in their capacity as the operators of Campbell Shipyards at the time when the unauthorized discharges occurred.

b) MARCO Seattle in their capacity as the parent company to the operators of Campbell Shipyards.

SHIPBUILDING AND REPAIR SITE OPERATIONS

12. Shipbuilding and repair operations at Campbell Shipyards historically encompassed a large number and variety of activities and industrial processes including, but not limited to, formation and assembly of steel hulls; application of paint systems; installation and repair of a large variety of mechanical, electrical, and hydraulic systems and equipment; repair of damaged vessels; removal and replacement of expended/failed paint systems; and provision of entire utility/support systems to ships (and crew) during repair.

13. There were three major types of building/repair facilities at Campbell Shipyards, which, together with cranes, enabled ships to be assembled, launched, or repaired. These facilities were floating drydocks, marine railways, and berths/piers. With the exception of berths and piers, the basic purpose of each facility was to separate the vessel from the bay and provide access to parts of the ship normally underwater. Campbell Shipyards had three floating drydocks and three sets of marine railways of varying lengths and capacities. Campbell Shipyards also had five (5) berths. The berths and piers were overwater structures to which vessels were tied during repair or construction activities. Because drydock space was limited and expensive, many operations were conducted pierside. For example, after painting the parts of a ship normally

underwater, the ship was moved from the drydock to a berth where the remainder of the painting would be completed.

14. The primary activities at Campbell Shipyards involved a multitude of industrial processes, many of which were conducted over San Diego Bay waters or very close to the waterfront. As a result of these processes, an assortment of wastes were generated. The industrial processes at Campbell Shipyards included the following:

a) SURFACE PREPARATION AND PAINT REMOVAL Methods of surface preparation and paint removal included dry abrasive blasting, wet abrasive or slurry blasting, hydroblasting, and chemical paint stripping.

b) PAINT APPLICATION After preparation, surfaces were painted. Most painting occurred in a drydock and involved the ship hull and internal tanks. Painting was also conducted in other locations throughout the shipyard including piers and berths. Paint application was accomplished by way of air or airless spraying equipment and was a major activity at Campbell Shipyards.

c) TANK CLEANING Tank cleaning operations used steam to remove dirt and sludges from internal tanks, particularly fuel tanks and bilges. Detergents, cleaners, and hot water may be injected into the steam supply hoses. Campbell reports that wastewater generated has typically been removed and disposed of by outside subcontractors.

d) MECHANICAL REPAIR/MAINTENANCE/INSTALLATION A variety of mechanical systems and machinery required repair, maintenance, and installation.

e) STRUCTURAL REPAIR/ALTERATION/ASSEMBLY Structural repair, alteration, and assembly generally involved welding, cutting, and fastening of steel plates or assembly blocks and other industrial processes.

f) INTEGRITY/HYDROSTATIC TESTING Hydrostatic or strength testing (flushing) was conducted on hull, tanks, or pipe repairs. Integrity testing was also conducted on new systems during ship construction phases.

q) REFURBISHING/MODERNIZATION/CLEANING Refurbishing, modernization, and cleaning of ships processes were conducted at Campbell Shipyards.

r) AIR CONDITIONING/REFRIGERATION REPAIR Campbell reports that refrigeration repair was done almost exclusively on tuna vessels utilizing ammonia as a refrigerant.

MATERIALS USED

15. Materials commonly used at Campbell Shipyards are summarized below beginning with those utilized during floating drydock operations. Although a few specific materials are included, the list consists primarily of major categories.

a) ABRASIVE GRIT Typically slag was collected from coalfired boilers and consisting principally of iron, aluminum, silicon, and calcium oxides. Trace elements such as copper, zinc and titanium were also present. Sand, cast iron, or steel shot were also used as abrasives. Enormous amounts of abrasive were needed to remove paint to bare metal; removing paint from a 15,000 square foot hull can take up to 6 days and consume 87 tons of grit. Grit was needed in all dry and wet (slurry) abrasive blasting.

b) PAINT Paints contained copper, zinc, chromium, and lead as well as hydrocarbons. Two major types of paints were used on ship hulls:

(1) Anticorrosive Paints (primers) Vinyl, vinyl-lead, or epoxy based coatings were used. Others contain zinc chromate and lead oxide.

(2) Antifouling Paints were used to prevent growth and attachment of marine organisms by continuously releasing toxic substances into the water. Cuprous oxide and tributyltin fluoride or tributyltin oxide were the principal toxicants in copper-based and organotin-based paints, respectively.

c) Miscellaneous materials included the following: Oils (engine, cutting, and hydraulic); Lubricants, Grease; Fuels; Weld; Detergents, Cleaners; Rust Inhibitors; Paint Thinners; Hydrocarbon and Chlorinated

g) PAINT EQUIPMENT CLEANING All air and airless paint spraying equipment was generally cleaned following use. Paint equipment cleaning was a major producer of waste, including solvents, thinners, and paint wastes, and sludges

h) ENGINE REPAIR/MAINTENANCE/INSTALLATION Automotive repair, ship engine repair, maintenance, and installation generated waste oils, solvents, fuels, batteries, and filters.

i) STEEL FABRICATION AND MACHINING Fabrication of engine and ship parts occurred at Campbell Shipyards. Cutting oils, fluids, and solvents were used extensively including acetone, methyl ethyl ketone (MEK) and chlorinated solvents.

j) ELECTRICAL REPAIR/MAINTENANCE/INSTALLATION The repair, maintenance, and installation of electrical systems involved the use of numerous hazardous materials including trichlorethylene, trichloroethane, methylene chloride, and acetone.

k) HYDRAULIC REPAIR/MAINTENANCE/INSTALLATION The repair, maintenance, and installation of hydraulic systems involved the replacement of spent hydraulic oils.

l) TANK EMPTYING Bilge, fuel, and ballast tanks were typically emptied prior to ship repair activities.

m) FUELING Fueling operations occurred at Campbell Shipyards.

n) SHIPFITTING Shipfitting was conducted at Campbell Shipyards, and is defined as the forming of ship plates and shapes, etc. according to plans, patterns, or molds.

o) BOILER CLEANING Campbell reports that the vessels built and repaired, were primarily diesel vessels. Campbell reports that a few cases involving small auxiliary boiler cleaning on vessels were accomplished by sub-contractors who were required to carry away any spoils.

p) CARPENTRY Woodworking was conducted at Campbell Shipyards.

Solvents; Degreasers; Acids; Caustics; Resins; Adhesives/Cement/Sealants; and Chlorine.

WASTE GENERATED

16. Categories of wastes commonly generated by Campbell Shipyards industrial processes included but were not limited to those listed below.

a) ABRASIVE BLAST WASTE: SPENT GRIT, SPENT PAINT, MARINE ORGANISMS, RUST Abrasive blast waste, consisting of spent grit, spent paint, marine organisms, and rust was generated in significant quantities during all dry or wet abrasive blasting procedures. The constituent of greatest concern with regard to toxicity was the spent paint, particularly the copper and tributyltin antifouling components, which were designed to be toxic and designed to continuously leach into the water column. Other pollutants in paint included zinc, chromium, and lead. Abrasive blast waste can be conveyed by water flows, become airborne (especially during dry blasting), or fall directly into receiving waters.

b) FRESH PAINT Losses occurred when paint ended up somewhere other than its intended location (e.g., drydock floor, bay, worker's clothing). These losses were results from spills, drips, and overspray. Typical overspray losses were estimated at approximately 5% for air spraying; and 1-2% for airless spraying.

c) BILGE WASTE/OTHER OILY WASTEWATER This waste was generated during tank emptying, leakages, and cleaning operations (bilge, ballast, fuel tanks). In addition to petroleum products (fuel, oil), tank washwater also contained detergents or cleaners (nitrogen and phosphorus compounds) and was generated in large quantities. Campbell reports that for many years these wastes were disposed of off-site by sub-contractors.

d) BLAST WASTEWATER Hydroblasting generated large quantities of wastewater. In addition to suspended and settleable solids (spent abrasive, paint, rust, marine organisms) and water, blast wastewater also contained rust inhibitors such as diammonium phosphate and sodium nitrite.

e) OILS (engine, cutting, and hydraulic) In addition to spent products, fresh oils, lubricants, and fuels were released as a result of spills and leaks from ship or drydock equipment, machinery, and tanks (especially during cleaning and refueling).

f) WASTE PAINTS/SLUDGES/SOLVENTS/THINNERS These wastes were generated from cleaning paint equipment.

g) CONSTRUCTION/REPAIR WASTES AND TRASH These wastes included scrap metal, welding rods, slag (from arc welding), wood, rags, plastics, cans, paper, bottles, packaging materials, etc.

h) MISCELLANEOUS WASTES These wastes included lubricants, Grease; Fuels; Sewage (black and grey water from vessels or docks); Boiler Blowdown, Condensate, Discard; Acid Wastes; Caustic Wastes; Aqueous Wastes (with and without metals).

WASTE AND WATER DISCHARGES TO SAN DIEGO BAY

17. Actual and potential waste discharges to San Diego Bay from Campbell are described below. The discharges listed below were either the direct result of an industrial process (drydock, marine railway, or berth operations) or, more commonly, the result of water coming into contact with wastes, typically spent abrasive blast waste. There were numerous sources of waste discharge at Campbell Shipyards including industrial processes; building or repair facilities (e.g., floating drydock); vessels under repair (e.g., cooling water); bay water (e.g., due to tidal influence or wave action); storm water; or other sources.

a) FLOATING DRYDOCK DEBALLASTING (tanks) This discharge occurred when the ballast tanks were flooded with San Diego Bay water to lower the drydock and then emptied to raise the drydock. A floating drydock was typically submerged and raised twice for each ship docked.

b) FLOATING DRYDOCK SUBMERGENCE/EMERGENCE (platform) This discharge occurred when bay water flowed over the drydock platform each time the dock was sunk. Water was discharged over the ends of the platform and through sally ports and other openings each time the dock was raised. Sinking and raising typically

occurred twice for each ship docked. Campbell reports that in recent years, it has damned the deck of the drydock and is collecting the runoff water, pumping it into tanks, analyzing it and then disposing of it. Campbell also reports that the deck of the drydock is swept clean before submergence.

c) FIRE PROTECTION SYSTEM DISCHARGE Campbell Shipyards had a fire protection system on the drydock, graving dock, berth, or pier. The system, which was in operation at all times when a ship was docked, consisted of constantly circulating bay water. Campbell reports that chemicals were not added to the system to prevent fouling.

d) COOLING WATER Cooling water was generated from vessels under repair, drydock equipment, pumps, etc.

e) Miscellaneous discharges or spills occurred during Floating Drydock Operations; Marine Railway Operations; Berth and Pier Operations; Storm water; Boiler Feedwater.

NPDES PERMIT VIOLATIONS

18. NPDES permits in the San Diego Region currently require shipyard and boatyard operators to follow best management practices (BMP) plans to prevent the discharge of substances such as refuse, rubbish, spent abrasive, paint, paint chips, and marine fouling organisms cleaned from ship or boat hulls. The operator of Campbell Shipyards, Campbell Industries, was required to submit a best management practices plan as part of the report of waste discharge for Order No. 85-01. The best management practices plan identified various measures that Campbell Industries would undertake to prevent the discharge of pollutants to San Diego Bay. The best management practices plan was accepted by the Regional Board and is summarized in Findings 8 and 9 of Order No. 85-01.

19. Order No. 85-01 contains the following applicable terms and conditions:

a) Prohibitions A.2: "The deposition or discharge of refuse, rubbish, materials of petroleum origin, spent abrasives (including old primer and antifouling paint), paint, paint chips, or marine fouling organisms into

San Diego Bay or at any place where they would be eventually transported to San Diego Bay is prohibited."

b) Discharge Specification B.3: "The discharger shall comply with the Water Pollution Control Plan described in Finding No. 9 (of Order No. 85-01) "

c) Provision D.1: "Neither the treatment nor the discharge of pollutants shall create a pollution, contamination, or nuisance as defined by Section 13050 of the California Water Code."

d) Provision D.11: "The discharger shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with the conditions of the Order."

20. Violations noted by Regional Board staff during compliance inspections of Campbell Shipyards from November 20, 1986 to July 31, 1992 are summarized below. This listing is not intended to be a complete listing of all Campbell Industries violations of Order No. 85-01 and prior NPDES permits. This violation listing is intended to illustrate some of the activities at Campbell Shipyards, which resulted in illicit waste discharges to San Diego Bay.

Inspection Violations

Date	Incident	Provision Violated
11/20/86	Navy ship undergoing repair at Pier 1 did not have boom extended far enough to catch floating waste material. This resulted in floating waste material in bay not being contained by booms. Sandblasting waste grit stockpiled in yard. Facility does not have berm around transformer containing PCBs, which is a violation of properly operating and maintaining all facilities and systems of treatment and control which are installed or used by the discharger to achieve compliance.	A.2, B.3 D.11

Inspection Violations (continued)

Date	Incident	Provision Violated
7/2/87	Dust, Paint, and Oil attributable to Campbell Shipyard operations was found floating in San Diego Bay near the dry dock.	A.2, B.3, D.11
11/20/87	Sandblast abrasive was discharged to San Diego Bay.	A.2, B.3, D.11
8/15/89	Sandblast waste entered bay from three drydocks, a marine railway and several piers. The storm drain had sandblast waste in it. The blasting area's wall is allowing sandblasting waste to go into San Diego Bay.	A.2, B.3, D.11
7/31/90	Blast material was apparent in various areas of the facility. Compressor was leaking oil into nearby San Diego Bay.	A.2, B.3, D.11
11/15/91	Discharger is deficient in controlling illicit waste dischargers to yard areas subject to surface flows, where it could be eventually transported to San Diego Bay.	A.2, B.3, D.11
4/29/92	Test Results of grit samples, from boat works area under the cradle which may be subject to tidal action where it could be eventually transported to San Diego Bay, show significant & hazardous levels of heavy metals.	A.2, B.3, D.1, D.11
7/31/92	Inadequate implementation of Best Management Practices on dry dock number two. Grit was apparent on the bay surface surrounding dock area.	A.2, B.3, D.11

BENEFICIAL USES

21. The "Water Quality Control Plan, San Diego Basin (9)" (hereinafter Basin Plan) was adopted by the Regional Board on September 8, 1994 and approved by the State Water Resources Control Board (State Board) on December 13, 1994. Subsequent revisions to the Basin Plan have also been adopted by the Regional Board and approved by the State Board.

22. The site described in this Order, 501 East Harbor Drive, San Diego, is located in the Lindbergh Hydrologic Subarea (908.21) of the San Diego Mesa Hydrologic Area (908.20) of the Pueblo San Diego Hydrologic Unit (908) as described in the Basin Plan.

23. The Basin Plan establishes no designated beneficial uses for ground waters in the San Diego Mesa Hydrologic Area.

24. The Basin Plan establishes the following designated beneficial uses for waters of San Diego Bay:

a) Industrial Service Supply
b) Navigation
c) Water Contact Recreation
d) Non-Contact Water Recreation
e) Ocean Commercial and Sport Fishing
f) Saline Water Habitat
g) Wildlife Habitat
h) Preservation of Rare and Endangered Species
i) Marine Habitat
j) Fish Migration
k) Shellfish Harvesting

WATER QUALITY GOALS FOR SAN DIEGO BAY

25. The following are water quality goals for San Diego Bay, based on the best professional judgement of the Regional Board.

Water Quality Goals for San Diego Bay	
Copper	2.9 µg/l
Lead	5.6 µg/l
Zinc	86 µg/l
TBT	0.005 µg/l

Water Quality Goals for San Diego Bay (continued)	
PCBs	0.00007 µg/l
PAHs	0.031 µg/l
Benzene	21 µg/l
Toluene	300 mg/l
Ethylbenzene	29 mg/l
Fluoranthene	42 µg/l

NPDES MONITORING PROGRAM

26. Campbell's NPDES permit monitoring program requires sediment monitoring at three (3) Remote Reference Stations. The purpose of these reference stations is to ascertain background chemical constituent concentrations for the purposes of evaluating incremental increases in sediment pollutant concentrations. Reference Station Number 3 is the closest of the three Reference Stations to Campbell Shipyards. Like the monitoring stations at Campbell Shipyards, the Reference Station is subject to many common sources of bay pollutants such as heavy boat or ship traffic and storm drain runoff. The important and obvious distinction between the Reference Station and the Campbell Shipyards monitoring stations, is that the Reference Station is not subject to the discharge of wastes from any shipyard, boatyard or Naval facility operations. A partial summary of the Reference Station Number 3 values from the report titled "Campbell Marine, NPDES Permit, Marine Sediment Monitoring and Reporting, Fourth Semi-Annual Report, June 1994" is presented below. This report was prepared for Campbell Marine by Ecosystems Mgt. Assoc. Inc. and submitted to the Regional Board on June 29, 1994.

Summary of Reference Station No. 3

Constituent	Average Values (mg/kg)
Arsenic	6.18
Cadmium	0.238*
Chromium	34.5
Copper	80.6
Lead	33.8
Mercury	0.354*
Nickel	9.97
LPAH	3.74*
HPAH	6.44*
PCB	0.0724*
PCT	4.61*

Summary of Reference Station No. 3 (continued)

Constituent	Average Values (mg/kg)
TBT	0.005*
TPH (Total)	41.9*
Silver	0.618*
Zinc	147

*Calculated average values include some sample results that were below the detection level; one-half the detection level sample result was used in the calculation.

The Regional Board believes it is reasonable to use the average values for Reference Station No. 3 summarized above, for the purposes of evaluating incremental increases in bay sediment pollutant concentrations at Campbell Shipyards.

27. Campbell's NPDES permit also requires sediment monitoring of eleven (11) Stations in San Diego Bay at Campbell Shipyards (CMB01-11), and four stations, CMB-STD 01, 02, 03, and 04 each located at the outlet of four storm drains which are tributary to the San Diego Bay at the Campbell Shipyard site. One storm drain outfall is located in Campbell's immediate area (CMB-STD-03), and three storm drain outfalls are located outside of Campbell's immediate area (CMB-STD 01,02,04). Below is a partial summary of the average values of these monitoring Stations for the period December 1992 to June 1994.

Summary of Campbell Stations CMB 01-11

Constituent	Average Values (mg/kg)
Arsenic	22.9
Cadmium	1.12
Chromium	143
Copper	961
Lead	238
Mercury	1.944
Nickel	24.6
LPAH	3.31*
HPAH	13.04*
PCB	0.6072*
PCT	0.79*
TBT	1.201
TPH (Total)	99.1
Silver	1.10*
Zinc	1015

*Data available only from stations CMB 01,04,08.
*Calculated average values include some sample results that were below the detection level; one-half the detection level sample result was used in the calculation.

Summary of Storm Drain Stations-Average Values (mg/kg)

Constituent	CMB-STD-03	CMB-STD-01,02,04
Arsenic	20.9	6.12
Cadmium	1.55	0.472
Chromium	162.5	28.5
Copper	722	119
Lead	283	110
Mercury	0.783	0.466
Nickel	37.2	5.91*
LPAH	no data	0.17'
HPAH	no data	1.05'
PCB	no data	0.0245'
PCT	no data	7.83'
TBT	0.061	0.045
TPH (Total)	no data	36.4'
Silver	1.1*	0.259*
Zinc	1372	264

'Data available only from station CMB-STD-01
*Calculated average values include some sample results that were below the detection level; one-half the detection level sample result was used in the calculation.

The NPDES monitoring data shows that all average constituent concentrations at Stations CMB 01-11 exceed the designated average background concentrations for Reference Station No. 3 except for low molecular weight PAHs. Storm Drains 1, 2 and 4 are tributary to the Campbell shipyard site but have a discharge point outside of the main area where major shipyard activities occurred. The outlet of Storm Drain 3 is located directly adjacent to areas where shipyard activities were conducted. The data indicates that constituent concentrations are significantly higher at Storm Drain 3 as compared to the other storm drains. The data indicates that the average constituent concentrations at Storm Drains 1, 2, and 4 exceed background values for cadmium, copper, lead, PCT, TBT and zinc. Average constituent concentrations markedly exceed background values at Storm Drain 3 for all constituent values. The higher concentrations at storm drain 3 are indicative of Campbell Shipyard activities and not storm water influence.

PTI TECHNICAL REPORTS

28. PTI Environmental Services prepared the following reports on behalf of Campbell Industries to determine appropriate remedial actions at the site:

a) "Study Proposal Campbell Shipyards Sediment Characterization - Phase 2" dated **July 1990** was submitted to the Regional Board by Campbell Industries on July 16, 1990. This Study Proposal contains sediment data from samples taken by the Regional Board in 1989 and a 1989 Campbell Industries study.

b) "Data Report, Campbell Shipyards, Sediment Characterization - Phase 2" Volumes 1 and 2 dated **June 1991**, for MARCO Seattle was submitted to the Regional Board by Campbell Industries on July 1, 1991. This Data Report summarizes additional sediment data collected during Phase 2 at Campbell Shipyards.

c) "Campbell Shipyards Remedial Action Alternatives Analysis Report" (**RAAAR**) dated October 1993, for MARCO Seattle was submitted to the Regional Board by Campbell Industries on November 15, 1993. The purpose of the RAAAR is to summarize the results of the sediment studies referenced above and to identify and evaluate whether sediment remediation would be warranted prior to redevelopment of the site, also included are Remedial Alternatives.

d) On October 13, 1994, Campbell Industries submitted a report entitled "Campbell Shipyards, Site Investigation and Corrective Action Report, Soil and Groundwater (**SI/CAR**)" dated October 1994, prepared by PTI Environmental Services. The purpose of the SI/CAR is to summarize the results of the soil and groundwater studies conducted at Campbell Shipyards and to identify and evaluate candidate remedial alternatives for the site prior to redevelopment.

PTI BAY SEDIMENT DATA

29. Below is a partial summary of the San Diego Bay sediment data contained in the **July 1990** PTI report:

Summary of Sediment Data Collected by San Diego Regional Water Quality Control Board, 1989

Constituents	Concentration Range (mg/kg)	Constituents	Concentration Range (mg/kg)
TOC[1]	9,380 - 66,100	Lead	30.1 - 231
PCB[2]	0.17 - 3.3	Mercury	<0.763 - 2.62
Arsenic	4.50 - 29.0	Nickel	8.60 - 20.9
Cadmium	<0.486 - 2.14	Silver	1.37 - 7.26
Chromium	40.2 - 257	Zinc	245 - 902
Copper	194 - 1,190	TBT[3]	1.2 - 13

Summary of Sediment Data Collected by CAMPBELL SHIPYARDS, 1989

Constituents	Concentration Range (mg/kg)	Constituents	Concentration Range (mg/kg)
Arsenic	7.30 - 107	Silver	< 1.00 - 4.90
Cadmium	2.60 - 23.4	Zinc	68.4 - 2,870
Chromium	6.00 - 369		
Copper	28.8 - 2,010	TBT[3]	< 0.006 - 0.99
Lead	11.7 - 399	TPH[4]	73 - 5,000
Mercury	< 0.280 - 3.90	LPAH[5]	0.340 - 7.70
Manganese	54.6 - 1,570	HPAH[6]	0.250 - 74.0
Nickel	6.30 - 41.5	PCB[2]	0.053 - 7.10

< = Undetected at level shown
[1]TOC = Total Organic Carbon
[2]PCB = Total Polychlorinated Biphenyls
[3]TBT = Tributyltin
[4]TPH = Total Petroleum Hydrocarbons
[5]LPAH = Total Low Molecular Weight Polycyclic Aromatic Hydrocarbons
[6]HPAH = Total High Molecular Weight Polycyclic Aromatic Hydrocarbons

30. San Diego Bay sediment samples from the **June 1991** PTI report are summarized below:

BAY SEDIMENT SAMPLES

Constituent	CONCENTRATION RANGE at Reference Stations	CONCENTRATION RANGE at Site Stations
Arsenic	7.2 - 80.4 mg/kg	11.5 - 66.6 mg/kg
Cadmium	0.30 - 0.80 mg/kg	0.02 - 2.3 mg/kg
Chromium(total)	43.0 - 142 mg/kg	35.0 - 480 mg/kg
Copper	55.0 - 179 mg/kg	75.0 - 2,500 mg/kg
Lead	27.1 - 128 mg/kg	60.9 - 1,100 mg/kg

BAY SEDIMENT SAMPLES (continued)

Constituent	CONCENTRATION RANGE at Reference Stations	CONCENTRATION RANGE at Site Stations
Mercury	0.18 - 0.74 mg/kg	0.11 - 3.05 mg/kg
Nickel	14.0 - 25.0 mg/kg	14.0 - 70.0 mg/kg
Silver	0.50 - 1.60 mg/kg	0.40 - 28.0 mg/kg
Zinc	150 - 304 mg/kg	168 - 2,600 mg/kg
Monobutyltin	17.8 - 96.9 µg/kg	7.56 - 537 µg/kg
Dibutyltin	14.2 - 29.1 µg/kg	4.79 - 454 µg/kg
Tributyltin	51.5 - 124 µg/kg	52.9 - 16,300 µg/kg
Tetrabutyltin	4.44 - 22.0 µg/kg	0.969 - 7.5 µg/kg
LPAH[1]	990 - 5,200 µg/kg	21 - 16,000 µg/kg
HPAH[2]	146 - 19,000 µg/kg	330 - 96,000 µg/kg
Diesel fuel	18 - 28 mg/kg	17 - 130 mg/kg
Petroleum oil	870 - 1,800 mg/kg	620 - 4,400 mg/kg
Total PCBs[3]	8.9 - 880 µg/kg	17 - 8,100 µg/kg
Total PCTs[4]	89 - 1,200 µg/kg	110 - 3,400 µg/kg

[1]LPAH = Total Low Molecular Weight Polycyclic Aromatic Hydrocarbons
[2]HPAH = Total High Molecular Weight Polycyclic Aromatic Hydrocarbons
[3]PCB = Total Polychlorinated Biphenyls
[4]PCT = Total Polychlorinated Terphenyls

31. The data listed in the two preceding findings show that a large majority of the constituent concentrations at the site exceed background levels at the NPDES monitoring program reference station No. 3.

32. The PTI **RAAAR** report states that petroleum hydrocarbon and polynuclear aromatic hydrocarbon contamination along the shoreline in the vicinity of Dry Docks 1 and 2, particularly the presence of oil and PCBs, suggests that oil underlying the site, and possibly deriving from the oil production and storage facilities located upland of the Campbell Shipyards facility, has leaked through the bulkhead and infiltrated the adjacent sediments.

PTI SEDIMENT QUALITY OBJECTIVES

33. There are currently no sediment quality objectives established for use in California. Sediment quality objectives are currently under development by the State Board pursuant to Chapter 5.6 Section 13390 et. seq. of the California Water Code. In the absence of such objectives,

site-specific sediment quality objectives were developed by PTI, using the following methods:

a) WATER QUALITY OBJECTIVES - Determination of the limiting sediment concentration that would not cause California Enclosed Bays and Estuaries Plan water quality objectives to be exceeded. (Note - In 1994, the Bays and Estuaries Plan was rescinded, and is currently being redrafted by the California State Water Resource Control Board.)

b) TOXICITY - Determination of site specific advanced effects threshold (AET) sediment toxicity values. AET is defined as the sediment concentration of a contaminant above which statistically significant ($P<0.05$) adverse effects for a particular biological indicator are always expected relative to appropriate reference conditions. Sediment concentrations in excess of AET values may be indicative of historical and/or current shipyard waste discharges and may also adversely affect the water quality and beneficial uses of the water.

34. PTI's development of sediment quality objectives, based on conformance to the Bays and Estuaries Plan, required the determination of the relationship between the concentration of the chemical in water and the concentration of the chemical in sediments. Chemical concentrations in pore water were directly related to chemical concentrations in sediment, by the following two methods:

a) The direct measurement approach - This approach was applied to copper, lead, zinc, and TBT. PTI reported that sediment/water concentration ratios varied at the different sampling stations, probably because the behavior of metals is controlled by complex set of processes, including complexation with dissolved ligands, varying affinities of different chemicals for different particle types and surfaces, and oxidation/reduction reactions. PTI also reports it is likely the measured pore metal water concentrations for copper, lead, zinc, and TBT are overestimates of actual concentrations because clean techniques were not used (or required) at the time samples were collected. Recent guidance from EPA recommends that clean sample handling techniques be used for metal levels in the low µg/l range. Otherwise, substantial contamination can

occur resulting in measured concentrations that are higher than actual concentrations. This guidance was not in place at the time the samples were collected.

b) Derived partition coefficient - Sediment quality, for organic chemicals, used partition coefficient values derived from the scientific literature. These partition coefficients, and estimated sediment quality objectives are summarized below:

SEDIMENT QUALITY OBJECTIVES ESTIMATED FROM CALIFORNIA ENCLOSED BAYS AND ESTUARIES PLAN WATER QUALITY OBJECTIVES

Chemical	California Enclosed Bays and Estuaries Plan Water Quality Objectives (µg/L)	Partition Coefficient (L/kg sediment)	Estimated Sediment Quality Objective (mg/kg dry weight)
Copper	3.9	2.4×10^3	990
Lead	5.6	2.3×10^5	13,000
Zinc	86	6.6×10^3	5,700
TBT	0.005	7.2×10^3	0.033

		L/kg Organic Carbon (K_{oc})	Organic Carbon (mg/kg)	Dry Weight (mg/kg)
PAH	0.031	6.3×10^4	1.9	0.039
PCB	0.00007	4.0×10^5	0.03	0.0007

35. PTI's development of AET site-specific sediment quality objectives, presented below, were derived from observed relationships between biological data (i.e., sediment toxicity tests and in situ benthic infauna assessed and integrated into sediment quality objectives to define site-specific cleanup levels.

Summary of AET Site-specific values
(mg/kg dry weight)

Chemical	Site Specific Sediment Quality Obj.
Copper	810
Lead	231
Zinc	820
Tributyltin	5.75
High molecular weight polycyclic aromatic hydrocarbon	44
Polychlorinated biphenyls	0.95
Total petroleum hydrocarbons	4,300

REGIONAL BOARD BAY SEDIMENT DATA CONCLUSIONS

36. Based on the PTI RAAAR report and Campbell Shipyard sediment data and reports described in previous findings the Regional Board concludes the following:

a) Copper and zinc share similar distribution patterns with elevated concentrations along the shoreline and adjacent to the dry docks. Concentrations decrease rapidly with increased distance from the site and typically reach background or near background levels just bayward of the docks and piers. The majority of copper and zinc in the bay sediments was caused by Campbell's shipbuilding and repair activities. Copper and zinc are key constituent of the paints used ion ship construction. Copper is also present at elevated concentrations in the blasting slag used in this construction and repair.

b) The concentration of lead in bay sediments is elevated with respect to background levels. Lead concentrations adjacent to the four storm drains at the site suggest that these storm drains may contribute lead to bay sediments. Discharges from the Campbell site have also contributed to elevated lead concentrations in bay sediments. Lead was a common constituent of paint used at the site. In addition, lead is present at elevated concentrations in upland soils at the site.

c) Mercury distribution patterns are similar to those of copper and zinc, but display a much narrower range of concentrations. The highest concentrations are observed along the shoreline and adjacent to the dry docks. Concentrations of mercury decrease to near background levels just bayward of the piers and dry docks. Discharges from the Campbell site have contributed to elevated mercury concentrations in bay sediments. Mercury is not contained in any of the paint currently used at the site; however, it has been used historically in antifouling paints. Mercury concentrations adjacent to Storm drains 2 and 4 indicate that these storm found in bay sediments at the site.

d) The distribution pattern of TBT is similar to that of copper and zinc. The highest concentrations are found immediately adjacent to the dry docks, with some elevated concentration extending bayward of the site. The majority of TBT in the bay sediments was caused by Campbell's shipbuilding and repair activities. Discharges from the Campbell site have contributed to elevated TBT concentrations in bay sediments. TBT was present as a copolymer in the antifouling paint used at the site.

e) Polynuclear Aromatic Hydrocarbons are present in crude oil, fuel oils, and crankcase oil. Combustion of this fuel creates contaminated particulates (soot) which falls back on land and may eventually be washed into the bay by storm runoff. Oil spills in San Diego Bay also contribute to elevated concentrations of PAH's in San Diego bay sediments. In general, elevated concentrations of Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAH) and High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAH) are more localized than those of metals and are elevated along the Campbell site shoreline. LPAH concentrations are generally below background throughout the site with the exception of two locations, one location adjacent to the storm drain near the northern end of the Campbell shoreline and another location in the vicinity of the outlet of the large dry dock. HPAH elevated concentrations are generally located along the shipyard shoreline. The LPAH and HPAH concentrations along the shoreline in the vicinity of Dry Docks 1 and 2,

suggests that oil underlying the site has leaked through the bulkhead and infiltrated the adjacent bay sediments. Wastes generated at the site included bilge waste/ other oily wastewater, oils, lubricants, grease, and fuels. LPAH and HPAH concentrations adjacent to the storm drains indicate that these storm drains have not contributed significantly to LPAH and HPAH concentrations in the bay sediment.

f) Concentrations of PCBs in bay sediments are above background levels along the Campbell shoreline. The higher PCB sediment concentrations (value grater than 1 mg/kg) were generally located in the area where shipyard activities were conducted. Ship hydraulic system and repair and paint application activities were conducted at Campbell. Wastes generated at the site included fresh and spent paint - sludges/ solvents/ thinners, and waste hydraulic oils. These wastes may have contained PCB's in the past. The PCBs may also have originated from the San Diego Gas and Electric facility described in Finding 7. PCB concentrations adjacent to the storm drains at the site indicate that these storm drains did not contribute significantly to PCB concentrations in the bay sediment.

g) Total petroleum hydrocarbons (TPH) are elevated above background in the bay sediment along the Campbell site shoreline. Concentrations of TPH decrease to near background levels just bayward of the piers and dry docks. The sources of TPH are the same as described for PAH's.

h) Waste discharges from Campbell Shipyards to San Diego Bay have occurred in violation of Order No. 85-01. It appears that the Best Management Practices plans employed by Campbell Industries were either inadequate or were being ineffectively implemented to prevent waste discharges to San Diego Bay.

i) The contaminated bay sediments present at Campbell Shipyards have caused or threaten to cause a condition of pollution as described in California Water Code Section 13050. Bay sediment concentrations of copper, zinc, lead, tributyltin, high molecular weight polynuclear aromatic hydrocarbons (HPAH),polychlorinated biphenyls (PCB), and total petroleum hydrocarbons (TPH) exceed site specific AET

values and thus may adversely affect San Diego Bay beneficial uses.

PTI SOIL AND GROUND WATER DATA

37. Chemical concentrations in soil reported by PTI in the SI/CAR report are summarized below:

Chemical Concentrations in Soil

Chemical	Detection Frequency	Concentration Range	Units	Location of Maximum Concentration: Station	Location of Maximum Concentration: Depth Horizon (ft bgs)
TRPH	63/91	5.1 - 57,000	mg/kg	B-6	1-1.5
TPH	56/74	0.5 U - 9,000	mg/kg	B-25	3-3.5
Naphthalene	10/26	500 U 5,800,000	µg/kg	B-31-P	3-3.5
Benzo[a]pyrene	16/26	170 U - 530,00	µg/kg	B-31-P	3-3.5
Benzene	1/55	500 U - 1,300	µg/kg	MW-5	7-7.5
Toluene	7/55	5 U - 47000	µg/kg	MW-5	7-7.5
Ethylbenzene	4/55	5 U - 350	µg/kg	MW-5	7-7.5
Xylene	5/56	10 U - 3,100	µg/kg	MW-5	7-7.5
1,2 - Dichlorethane	1/48	5 U - 6.1	µg/kg	MW-1-M	6-6.5
Tetra-chloroethylene	1/48	5 U - 140	µg/kg	B-13	3-3.5
PCBs	3/14	50 U - 1,900	µg/kg	B-31	3-3.5
Lead	72/89	0.05 U - 6,300	mg/kg	B-30-P	5-5.5
Copper	57/58	0.1 U - 1,200	mg/kg	B-38	1-1.5
Zinc	54/54	3.2 - 4,300	mg/kg	B-27	1-1.5

U - Undetected at levels shown

38. The PTI SI/CAR report identified seven major soil contamination areas:

a) The south parking lot had total petroleum hydrocarbon soil contamination greater than 1,000 mg/kg at borings B-24, B-25, B-25-P, B-26, and B-42. The vertical extent of elevated petroleum hydrocarbon concentrations extends from the ground surface down to the shallow groundwater surface. The soils in the south parking

lot and near MW-5 had detectable concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds. PTI reports that the south parking lot was a former tank farm facility owned by General Petroleum Company from at least 1939 to 1956. The tank farm may have been the source of this contamination.

b) The east parking lot had total petroleum hydrocarbon soil contamination greater than 1,000 mg/kg at borings B-31-P, B-32-P, and well MW-1-N. This area also had detectable concentrations of PAHs. Naphthalene, a PAH, was detected as high as 5,800,000 µg/kg at boring B-31-P. PAHs were also detected at Boring B-42. 1,2-Dichloroethane was detected in MW-1-N soils at 6.1 µg\kg. Possible sources of PAH's in this area include the City of San Diego garbage disposal plant, other machining companies, and truck repair facilities. Campbell Machine Company, had facility structures that occupied the east parking lot area from the early 1900s to the 1930s. San Diego Unified Port District (SDUPD) owns and operates a maintenance facility adjacent to the east parking lot.

c) The paint shop/sand blasting area had total petroleum hydrocarbon soil contamination greater than 1,000 mg/kg at boring B-19. PCB was detected in two boreholes near a transformer substation. Soils at B-35 near an electrical and telephone vault and weld shop and B-31 near the paint shop sand blasting area had PCB concentrations of 470 µg/kg and 1800 µg/kg respectively. Tetrachloroethylene was detected in B-19 soils at 140 µg/kg.

d) A site near the Coast Guard recovery well had total petroleum hydrocarbon soil contamination greater than 1,000 mg/kg at borings B-15 and B-17.

e) A site along the seawall near the pipe shop area had total petroleum hydrocarbon soil contamination greater than 1,000 mg/kg at borings B-6 and B-37.

f) A site in the vicinity of well MW-5 had total petroleum hydrocarbon soil contamination greater than 1,000 mg/kg at borings B-29.

g) A site near the parts warehouse along Harbor Street had total petroleum hydrocarbon soil contamination greater

than 1,000 mg/kg at borings B-6-P and CS21. Lead, copper, and zinc were found at elevated concentrations in the shallow soils beneath and northwest of the parts warehouse. Campbell reports that lead affected soils may be due to historical uses, including spreading ash from a City of San Diego incinerator that operated in this area.

39. The concentrations of all metals that exceeded background and all organic compounds were compared by PTI with risk-based concentrations for industrial soils derived using USEPA methods. PTI found that six of the carcinogenic PAH compounds in soil exceeded the risk based concentration level. PAH compounds are known toxic constituents of total petroleum hydrocarbons. Based on a review of the soil TPH data, the hydrocarbon identification analysis, risk based soil PAH concentrations, and site characteristics, the following site-specific cleanup levels were proposed by PTI:

a) PAHs - 3.9 mg/kg for toxic equivalent concentrations (TECs) of benzo[a]pyrene.

b) Total petroleum hydrocarbons - 1000 mg/kg.

40. The PTI SI/CAR report summarized the nature and extent of the site ground water contamination as follows:

a) Petroleum hydrocarbons - PTI reports that Ninyo & Moore performed an investigation of the Campbell shipyards site in 1989. According to this investigation total petroleum hydrocarbons (TPH) concentrations in ground water samples from monitoring wells on the neighboring San Diego Unified Port District (SDUPD) maintenance shop had TPH concentrations ranging from undetected (at 50 µg/l) to 1,560 µg/l in MW-9-N immediately upgradient of the east parking lot. Later investigations by Thorne (1990) and Park (1991) indicated that none of the wells they sampled had detectable quantities of petroleum hydrocarbons. TPH was not analyzed during PTI's resampling of site wells in 1993.

b) PAH - During the December 1993 sampling by PTI, PAHs were detected in three wells at or near the East parking lot. On the Campbell site the two wells were MW-1-N (Naphthalene 600 µg/l, Acenaphthene 15 µg/l, and Acenaphthylene 40 µg/l) and MW-2-N (Naphthalene 34 µg/kg). Adjacent to the east parking lot on the SDUPD

maintenance shop the third well with PAHs was MW-9-N (Acenaphthene 20 µg/l, Fluoranthene 25 µg/l, Pyrene 35 µg/l, Benzo [b,k], fluoranthene 11 µg/l, and Benzo [g,h,i], perylene 10 µg/l).

c) BTEX and VOCs - During the December 1993 sampling by PTI, seven wells had detectable concentrations of BTEX compounds; four of these wells are on the Campbell Shipyards site. MW-1-P, MW-2-N, and MW-6 had benzene concentrations of 660 µg/l, 4 µg/l, and 2 µg/l, respectively, and MW-1-P had ethylbenzene concentration of 47 µg/l. In addition, cis-1,2-dichloroethene was detected in MW-8-N, MW-1-P, MW-2-N, and MW-1 at concentrations ranging from 5 to 78 µg/l. Chlorobenzene was detected in MW-6 at 14 µg/l and 1,2-dichlorethane was detected in two offsite wells, MW-3-N and MW-9-N, at 1 µg/l.

d) Pesticides/PCBs - Pesticides and PCBs were not detected in ground water by Park in 1991.

e) Metals - Samples from wells MW-8-N, MW-3, and MW-4 were analyzed for dissolved lead, copper, and zinc by PTI in 1993. None of the metals were detected (at a detection limit of 0.5 mg/l) during this round of sampling.

f) Free product - Floating petroleum product was measured in two site wells MW-5 and the Coast Guard recovery well. Floating product samples were analyzed for hydrocarbon identification, BTEX, VOCs, and semivolatile organic compounds (SVOCs). The results of the hydrocarbon identification indicated that 94 percent of the MW-5 sample and 25 percent of the Coast Guard recovery well sample were diesel-range hydrocarbons. No gasoline or heavier oil-range hydrocarbons were identified in the samples.

REGIONAL BOARD GROUND WATER AND SOIL DATA CONCLUSIONS

41. Based on review of the PTI, Regional Board and Campbell Shipyard soil and ground water data and reports described in previous findings the Regional Board finds and concludes the following:

a) Elevated concentration of total petroleum hydrocarbon (TPH) and polynuclear aromatic hydrocarbons (PAHs) in soil and ground water indicate that historic activities

in the east parking lot by Campbell Machine Company, the adjacent San Diego Unified Port District (SDUPD) maintenance facility, a City of San Diego garbage disposal plant, other machining companies, and truck repair facilities may have contaminated ground water under the east parking lot of the site.

b) On-site data indicate that soil contaminants in the east parking lot are degrading and not migrating toward the bay.

c) The soils in the south parking lot had elevated concentrations of BTEX compounds, PAHs and TPH. Activities at a former tank farm owned by General Petroleum Company from at least 1939 to 1956 may have contaminated soils in the south parking lot.

d) Two site wells along the seawall, MW-5 and the Coast Guard recovery well, contain floating product. Adjacent wells within 200 feet along the seawall do not contain floating product, suggesting that the two areas are localized and that floating product is not a site-wide problem. Analyses of floating product in the two wells indicate that the product is primarily diesel fuel with some probable mixing with a heavier hydrocarbon fuel, especially in the Coast Guard recovery well. Analytical results also suggest that some degradation of the diesel fuel has occurred in both areas. Most of the diesel-type fuels in these wells may have come from abandoned diesel pipelines that cross the site. The floating product in the recovery well may also be a mixture of other hydrocarbons that have migrated from the former General Petroleum Company tank farm area (the south parking lot), Campbell Shipyard on-site activities involving use of fuel products, or from other sources that could not be identified from the available historical data.

e) The contaminated soil and ground water present at Campbell Shipyards have caused or threaten to cause a condition of pollution as described in California Water Code Section 13050 because:

(1) Floating product on the shallow ground water surface is a potential ongoing source of dissolved or pure-phase releases of petroleum hydrocarbon contamination to the bay if left in place.

(2) Contaminated soils and ground water containing TPH, PAHs, and BTEX compounds near the bulkhead threaten to cause applicable bay water quality target values to be exceeded. The contaminated soil and ground water has also contributed to elevated concentration of TPH and PAHs in bay sediments adjacent to the shoreline.

(3) The maximum detected concentrations for six of the carcinogenic PAHs (benzo[a]pyrene, benz[a]anthracene, benzo[b]fluoranthene, chrysene, dibenzo[a,h]anthracene, and indeno[1,2,3-cd]pyrene) were higher than the human health risk-based concentrations for contaminated soil ingestion and dermal exposure developed by US EPA.

ALTERNATIVE CLEANUP LEVELS

42. Several alternative bay sediment cleanup levels for the site were evaluated by PTI including (1) no cleanup (with reliance upon natural recovery processes), (2) cleanup to background levels, (3) cleanup to site specific levels, (4) two intermediate cleanup levels between background and the site specific AET objective, and (5) cleanup to levels to conform with Bays and Estuaries water quality objectives. The specific alternative cleanup levels are summarized below.

Alternative Sediment Cleanup Levels (mg/kg)

Con-stituent	Regional Board Background	Mid Level Cleanup Obj.	PTI LAET* Site-Specific Obj. with safety factor	PTI LAET Site-Specific Obj.	PTI LAET Mid Level Site-Specific Obj.	PTI 2nd LAET Site-Specific Obj.
Copper	81	445.3	729	810	1,130	1,450
Zinc	147	483.5	738	820	1,460	2,100
TBT	0.005	2.88	5.18	5.75	--	--
Mercury	0.35	-	-	-	--	--
Lead	34	132.4	207.9	231	365	500
PAH	-	-	39.6	44	--	--
PCB	0.07	0.51	0.855	0.95	--	--
TPH	42	2170.95	3870	4300	--	--

*PTI LAET - Lowest apparent effects threshold developed by PTI.

43. PTI considered several alternatives for attaining the various alternative cleanup levels. Offsite confined aquatic disposal was rejected because it was considered highly unlikely that a suitable location would be found within San Diego Bay, and the costs associated with transporting the sediment to the open ocean would be excessive. The natural recovery alternative was rejected by the Regional Board because several of the sediment contaminants at the site are metals and do not biodegrade. These alternatives and costs are summarized below:

SUMMARY OF ESTIMATED REMEDIAL ACTION COST (in Million $)

Alternative		Cleanup to: Regional Board Background	Mid Level Cleanup Obj.	PTI LAET* Site-Specific Obj. with Safety Factor	PTI LAET Site-Specific Obj.	PTI LAET Mid Level Site-Specific Obj.	PTI 2nd LAET Site-Specific Obj.
A	Natural Recovery	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
B	Cap in Place	$6.7	$4.5	$1.7	$1..	$0.38	$0.36
C	Hydraulic Dredging	$27	$19	$7.6	$4.6	$1.13	$0.95
D	Mechanical Dredging	$24	$17	$6.7	$4.1	$1.01	$0.85
E	Stabilization with Offsite Disposal	$38	$27	$11	$6.4	$1.56	$1.3

*PTI LAET - Lowest apparent effects threshold developed by PTI.

The estimated area and volume of contaminated sediment are described below;

AREA AND VOLUME ESTIMATES FOR CANDIDATE CLEANUP SCENARIOS

Cleanup Scenario	Area (acres)	Volume (cubic yards)
1. Background	32	100,000
2. Mid-level	20	73,000
3. PTI LAET* with Safety	8.8	28,000
4. PTI LAET	4.2	17,000
5. PTI LAET Mid-level	1.1	3,700
6. PTI 2nd LAET	0.9	3,000

*PTI LAET - Lowest apparent effects threshold developed by PTI.

44. Several alternative upland soil and ground water cleanup levels for the site were evaluated by PTI including (1) no action (2) cleanup to background levels, (3) cleanup to Bays and Estuaries water quality objectives and (4) an intermediate cleanup level between background and Bays and Estuaries water quality objectives. The PTI SI/CAR report considers six alternatives for the remediation of the contaminated soil and five alternatives for the remediation of the contaminated ground water for various levels. On May 2, 1995 PTI submitted supplemental data for remedial actions for cleanup to background, water quality objectives and a level in between background and water quality objectives. These alternatives and costs are summarized below:

SUMMARY OF ESTIMATED REMEDIAL ACTION COSTS

SOIL

Alternative		Cost ($in millions) Background	Mid - Level	Water Quality Obj.	Human Health
S5 -	Removal and Offsite Disposal	$7.9	$7.9	$7.9	$1.5
S6 - .	Thermal Desorption	$5.82	$5.82	$5.82	$1.1

GROUNDWATER

Alternative		Cost ($in millions) Background	Mid - Level	Water Quality Obj.	Free product removal
GW4-	Soil Excavation/ Removal of Floating Product	--	--	--	$0.015
GW5-	Recovery Wells and Soil Excavation/ Removal of Floating Product	--	--	--	$0.055
GW5A-	Ground water extraction and treatment	$4.83	$2.68	$1.75	--
GW5B-	Ground water and NAPL extraction and treatment	$5.47	$3.07	$2.02	--

45. The PTI SI/CAR report recommended a method for treatment and disposal of the contamination at the site based on SI/CAR Alternative S6 and Alternative GW4. This recommended alternative has several components:

a) Removal and Treatment of Floating Product - Floating product in wells adjacent to the seawall will be removed either using recovery wells or by excavating pits to the ground water table and skimming the floating product off the ground water surface. The recovered product will be transported offsite to a treatment/recycling facility.

b) Removal and Treatment of Soil - Soil containing elevated levels of TPH in the south parking lot and in the vicinity of the seawall will be excavated and treated by thermal desorption to remove petroleum hydrocarbons. The diesel pipelines underlying the site will also be removed, and associated TPH affected soil exceeding the remediation level will be treated.

c) Capping of the East Parking Lot - Soil in the east parking lot contains elevated concentrations of TPH and PAHs; however, migration of TPH constituents (including PAHs and VOCs) in the direction of San Diego Bay via ground water was demonstrated to be negligible. The east parking lot will be capped with paving, structures, and landscaping during redevelopment and will not require additional remedial action.

d) Installation of a New Seawall/Bulkhead - A new seawall/bulkhead will be installed to replace the existing seawall. To the extent possible, this construction effort will be coordinated with the removal of the diesel pipelines, floating product, and TPH affected soil in the vicinity of the existing seawall.

e) Monitoring - Monitoring will be conducted during remediation to ensure that no unacceptable adverse human health or environmental effects occur. Confirmational monitoring will be conducted following completion of remediation to ensure that remedial action objectives have been met.

REGIONAL BOARD SELECTED CLEANUP LEVELS

46. In setting cleanup levels at any site the Regional Board must consider the terms and conditions of State Board Resolution No. 92-49 (Polices and Procedures For Investigation and Cleanup and Abatement of Discharges), under Water Code Section 13304. These conditions includes 1) site-specific characteristics; 2) applicable state and federal statutes and regulations; 3) the Basin Plan; and 4) State Board Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality Waters in California). The Regional Board has selected the following cleanup levels for San Diego Bay sediments, ground water, and soil at the Campbell Shipyard site in conformance with the requirements of State Board Resolution No. 92-49:

a) San Diego Bay **sediments** at the Campbell Shipyards site.

Constituent	Level (mg/kg dry wt.)
Copper	810
Zinc	820
Lead	231
Total Petroleum Hydrocarbons	4300
HPAHs	44
PCBs	0.95
Tributyltin	5.75

b) **Ground water** along the seawall as described in Figure 5 of the May 1995 PTI Supplemental Soil and Ground Water report.

Constituent	Level (mg/l)
PAHs	0.000031
Benzene	0.021
Toluene	300
Ethylbenzene	29
Fluoranthene	0.042
Free Product	Recover all free product from the affected ground water zone.

c) Soil at the Campbell Shipyards site. No cleanup required for soil at the East Parking Lot provided Parking Lot Cap conditions exist.

Constituent	Level (mg/kg)
PAHs	3.9
TPH	1000

47. The cleanup levels for soil, ground water and bay sediment are based on the following considerations:

a) Ensuring that the dischargers are required to cleanup the site to levels as close to background conditions as is technically or economically feasible;

b) The need to provide assimilative capacity for possible future waste discharges;

c) PTI's bay sediment toxicity data on amphipod mortality, polychaete growth depressions, depression in total benthic infauna abundance and depression in amphipod abundance;

d) PTI's bay sediment pore water and partition coefficient data;

e) The pattern of higher mercury concentrations in bay sediments lie within the cleanup area defined by the copper cleanup level;

f) PTI's analysis of risk based concentrations for soil and ground water contaminants; and

g) The need to prevent exceedances of San Diego Bay water quality goals due to migration of contaminants from soil, ground water, and bay sediments.

CEQA EXEMPTION

48. This enforcement action is exempt from the provisions of the California Environmental Quality Act (Public Resources Code. Section 21000 et. seq.) in accordance with Section 15321, Chapter 3, Title 14, California Code of Regulations.

IT IS HEREBY ORDERED, that pursuant to Section 13304 of the California Water Code, Campbell Industries and Marine Construction and Design Company Holding, Inc. of Seattle (hereinafter dischargers) shall comply with the following directives:

1. The dischargers shall forthwith achieve and maintain compliance with Prohibition A.2, Discharge Specifications B.3, and Provisions D.1 and D.11 of Order No. 85-01.

2. The dischargers shall submit a technical report by September 1, 1995 demonstrating, to the satisfaction of the Regional Board Executive Officer, that the best management practices plan currently used at Campbell Shipyards is in full conformance with the requirements set forth in "Title 40, Code of Federal Regulations, Part 125, Subpart K-Criteria and Standards for Best Management Practices Authorized Under Section 304(e) of the Clean Water Act". If the best management practices plan is not in conformance with 40 CFR 125, the technical report shall identify any changes needed to the best management practices plan to achieve conformance.

3. The dischargers shall cleanup contaminated bay sediment at the Campbell Shipyards site to the levels specified below:

CONSTITUENT	BAY SEDIMENT (mg/kg) Dry Weight
Copper	810
Zinc	820
Lead	231
Tributyltin (TBT)	5.75
HPAH'S	44
PCB's	0.95
Total Petroleum Hydrocarbons	4300

4. The dischargers shall cleanup contaminated soils in the upland portion of the site as summarized on page 6-13 of the SI/CAR report and Finding 45 of this Order in all areas except the east parking lot area. Contaminated soils shall be cleaned to the levels specified below:

CONSTITUENT	UPLAND SOILS (mg/kg) (Dry Weight)
Polynuclear Aromatic Hydrocarbons	1.9
Total Petroleum Hydrocarbons (TPH)	1000

5. The dischargers shall cleanup soils at the east parking lot portion of the site as summarized on page 6-13 of the PTI's SI/CAR Report and Finding 45 of this Order.

6. The dischargers shall cleanup ground water, adjacent to the seawall as described in Figure 5 of the May 1995 PTI Supplemental Soil and Ground Water report, to the levels specified below:

CONSTITUENT	Ground Water (mg/l)
Polynuclear Aromatic Hydrocarbons	0.000031
Benzene	0.021
Toluene	300
Ethylbenzene	29
Fluoranthene	0.042
Free Product	Recover all free product

7. The dischargers shall achieve compliance with directives 3,4,5, and 6 in accordance with the following schedule and prior to initiation of construction of any portion of the proposed site redevelopment project:

	Task	Date of Compliance
a)	Submit a preliminary design plan including a description of all remediation activities to be conducted, a map depicting the area to be cleaned up, the permits and other governmental approvals needed, and a time schedule for completion of each task.	October 1, 1995
b)	Complete ground water cleanup in conformance with Directive No 6.	June 1, 1996
c)	Submit all necessary applications for permits and other governmental approvals necessary to complete the cleanup project.	February 1, 1998
d)	Submit a final design plan for the cleanup project.	March 1, 1998
e)	Submit a post cleanup sampling plan to verify conformance with the cleanup levels required in Directives 3, 4, and 5.	May 1, 1998
f)	Complete bidding and award of a contract for the cleanup project.	September 1, 1998
g)	Complete cleanup of the site in conformance with Directives 3, 4, and 5.	June 1, 1999
h)	Submit the results of a post cleanup sampling plan.	July 1, 1999

8. The dischargers shall submit a technical report by October 1, 1995 comparing soil leachate concentration values for copper, lead, and zinc in the area south of Gull street with the following water quality goals for San Diego Bay (see Finding 25):

Copper	2.9 µg/l
Lead	5.6 µg/l
Zinc	86 µg/l

If the soil leachate values exceed the above water quality goals for San Diego Bay, additional information should be provided describing the degree of expected attenuation at the site. The attenuation must be sufficient to ensure that constituents from the site will not ultimately migrate to ground water in amounts sufficient to cause or contribute to an exceedance of the water quality goals. Appropriate attenuation factors to be considered include processes such as absorption of constituents to clay particles and organic material in the soil, ionic or covalent binding of the constituents to soil components, filtration of larger constituents by fine grained soils, and chemical or biochemical degradation. These attenuation processes may be enhanced by an engineered impervious cap.

If analysis of the soil leachate shows that the soluble constituent concentrations are equal or greater than the quantity (environmental attenuation factor) x (water quality goals) mg/l, constituents migrating from the soil will not receive sufficient attenuation as they migrate to ground water and the resulting concentration in ground water may exceed the water quality goals.

Based upon the information described above the Regional Board Executive Officer may amend this cleanup and abatement order to require soil remediation for copper, lead, and zinc in the area south of Gull Street.

9. The dischargers shall submit a technical report by July 10, 1995 demonstrating that no significant migration of contaminants from soil or ground water in the east parking lot area of the site to San Diego Bay will occur. The report shall include the following information:

a) An analysis based on technically sound principles demonstrating that soil fuel product contaminants will be reduced by natural biodegradation over time. This

analysis shall also include actual on - site sample data verifying that the natural degradation processes are occurring.

b) An analysis based on technically sound principles demonstrating that soil fuel product contaminants will not generate free product due to ambient, or anticipated fluctuations in, ground water elevations at the site;

c) An analysis demonstrating that no significant migration of contaminants to San Diego Bay will occur due to hydrogeological or chemical characteristics. The demonstration shall be based on aquifer characteristics, fate and transport characteristics, soil leachability analysis or other technically sound principles.

10. The discharger shall submit quarterly progress reports on the cleanup to the Regional Board in accordance with the following reporting schedule:

Reporting Period	Report Due
January, February, March	April 30
April, May, June	July 30
July, August, September	October 30
October, November, December	January 30

11. The dischargers shall dispose of contaminated bay sediment, soil and ground water in accordance with applicable federal, state, and local regulations. Prior to disposal in California of contaminated bay sediments and soils, the discharger shall submit a Report of Waste Discharge (RWD) to the Executive Officer pursuant to California Code of Regulations, Title 23, Division 3, Chapter 15. Upon determining the RWD to be complete, the Regional Board may issue either waste discharge requirements (WDRs) or a waiver of WDRs.

12. The dischargers shall ensure that:

a) All reports required by this cleanup and abatement order are prepared by professionals qualified to prepare such reports. Professionals should be qualified, licensed where applicable, and competent and proficient in the fields pertinent to the required activities. California Business and Professions Code

Sections 6735, 7835, and 7835.1 require that engineering and geologic evaluations and judgements be performed by or under the direction of registered professionals.

b) All components of investigative and cleanup and abatement actions required under this order are conducted under the direction of appropriately qualified professionals.

c) A statement of qualifications of the responsible lead professionals shall be included in all plans and reports submitted to the Regional Board. Plans and reports which do not contain this statement will be deemed incomplete by the Regional Board Executive Officer for the purpose of compliance with this cleanup and abatement order.

PROVISIONS

1. Failure to submit technical reports required under this Cleanup and Abatement Order may result in the imposition of civil liabilities, under California Water Code section 13350(f), in an amount not to exceed ten thousand dollars ($10,000) for each day in which the violation occurs.

2. The cleanup levels in this order are applicable for cleanup at the Campbell Shipyard site and shall not be construed to be applicable or transferable to any other location.

ARTHUR L. JOE
Executive Officer

Date Order No. 95-21 issued: May 24, 1995

Revised at Regional Board meeting
June 8, 1995

Campbell\CAO\95-21-1.U95

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

In the matter of Tentative Cleanup and Abatement Order No. R9-2011-0001 (Formerly R9-2010-0002) Shipyard Sediment Cleanup	Regional Board Cleanup Team's Responses & Objections to Designated Party NASSCO's Second Set of Special Interrogatories

Propounding Party: National Steel and Shipbuilding Company ("NASSCO")

Responding Party: California Regional Water Quality Control Board, San Diego Region Cleanup Team

Set Number: Two (2)

Pursuant to the Presiding Officer's February 18, 2010 Order Issuing Final Discovery Plan for Tentative Cleanup and Abatement Order No. R9-2010-0002 and Associated Draft Technical Report, the Parties' August 9, 2010 Stipulation Regarding Discovery Extension and all applicable law, Designated Party the San Diego Water Board Cleanup Team ("Cleanup Team"), hereby responds and objects to NASSCO's Second Set of Special Interrogatories (the "Interrogatories") as follows:

GENERAL STATEMENT OF OBJECTIONS

The Cleanup Team makes the following general objections, whether or not separately set forth in response to each Interrogatory, to each and every Interrogatory propounded by NASSCO, all as set forth herein and incorporated specifically into each of the responses below:

1. Privilege Objection. The Cleanup Team objects to each Interrogatory to the extent it requests information protected by the attorney-client privilege, joint prosecution privilege, common interest privilege, settlement communication privilege, mediation privilege or deliberative process privilege, and to the extent it requests information subject to the work-product exemption, collectively referred to herein as the "privilege" or "privileged." The Cleanup Team contends that all information exchanged between it and its counsel is privileged. The Cleanup Team objects to identifying or producing any and all products of investigations or inquiry conducted by, or pursuant to the direction of counsel, including, but not limited to, all products of investigation or inquiry prepared by the Cleanup Team in anticipation of this proceeding, based on the attorney-client privilege and/or the work-product doctrine. The Cleanup Team further objects to identifying information subject to or protected by any other privilege, including, but not limited to, settlement communications, the joint prosecution privilege, the common interest privilege, the mediation privilege and/or the deliberative process privilege. Inadvertent production of privileged documents shall not constitute a waiver of said privileges.
2. Scope of Discovery Objection. The Cleanup Team objects to each Interrogatory to the extent it purports to impose any requirement or discovery obligation other than as set forth in Title 23 of the California Code of Regulations, sections 648 et seq., the California Government Code, sections 11400 et seq. and/or applicable stipulations, agreements and/or orders governing this proceeding.

3. Irrelevant Information Objection. The Cleanup Team objects to the Interrogatories to the extent they are overbroad and/or seek information that is not relevant to the claims or defenses asserted in this proceeding and are not reasonably calculated to lead to the discovery of admissible evidence.
4. Burdensome and Oppressive Objection. The Cleanup Team objects to each Interrogatory to the extent that it seeks the identification of documents that have already been produced, or that otherwise are equally available to NASSCO, or are already in NASSCO's possession, custody or control, which renders the Interrogatory unduly burdensome and oppressive. The Cleanup Team has already provided NASSCO with a copy of the electronic, text searchable administrative record for this matter. Therefore, the burden of identifying documents that are equally accessible to NASSCO is no greater on NASSCO than it would be on the Cleanup Team, and the Cleanup Team will not create a compilation or index of documents that NASSCO could create itself with equal or less burden.
5. Overbroad Objection. The Cleanup Team objects that certain Interrogatories are overbroad, and are framed in a manner that prevents any reasonable ability to search for and locate all responsive information. Such Interrogatories create an unreasonable risk of inadvertent noncompliance as framed.
6. Cleanup and Abatement Order Proceeding is Ongoing. The instant Cleanup and Abatement Order proceeding is ongoing, and the Cleanup Team expects that additional evidence will be provided by the Designated Parties hereto in accordance with governing statutes, regulation and applicable hearing procedures. While the Cleanup

Team's response to each of these Interrogatories is based on a reasonable investigation and search for the information requested as of this date, additional information may be made available to the Cleanup Team subsequent to the date of this response. These responses are provided without prejudice to the Cleanup Team's right to supplement these Responses, or to use in this proceeding any testimonial, documentary, or other form of evidence or facts yet to be discovered, unintentionally omitted, or within the scope of the objections set forth herein.

OBJECTIONS TO DEFINITIONS

1. The Cleanup Team objects to the defined term "DOCUMENTS" on the ground and to the extent that it seeks information protected by settlement confidentiality rules, the attorney-client privilege, the joint prosecution privilege, the work product doctrine, the mediation privilege, the common interest privilege, the deliberative process privilege, and/or any other privilege or confidentiality protection.
2. The Cleanup Team objects to the defined terms "YOU" and "YOUR" on the grounds that they are overbroad, and that they are vague, ambiguous and unintelligible. For purposes of this Response, the Cleanup Team shall use the term REGIONAL BOARD as if it means all persons employed by the California Regional Water Quality Control Board, San Diego Region, other than the ADVISORY TEAM.
3. The Cleanup Team objects to the defined term "COMMUNICATIONS" on the ground and to the extent that it seeks information protected by the attorney-client privilege, the joint prosecution privilege, the work product doctrine, the common interest

privilege, the mediation privilege, the deliberative process privilege, and/or any other privilege or confidentiality protection.

RESPONSES TO SPECIAL INTERROGATORIES

INTERROGATORY NO. 1:

For each response to a Request in NASSCO's Second Set of Requests for Admission:

a. State the number of the Request;

b. State all facts supporting your response;

c. IDENTIFY each PERSON who has knowledge RELATING TO the facts; and

d. IDENTIFY all DOCUMENTS that RELATE TO YOUR response.

RESPONSE TO INTERROGATORY NO. 1.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to this Interrogatory as overbroad, and unduly burdensome and harassing. The Interrogatory is improperly disguised as a single interrogatory, when, in fact, it constitutes 84 distinct interrogatories (4 x 21 Requests for Admissions). All facts supporting and Response by the Cleanup Team to NASSCO's Second Set of Requests for Admission that are denials are set forth specifically in the individual Request and these facts are equally available to NASSCO in the electronic, text searchable administrative record and/or the CAO, the Draft Technical Report and/or the appendices. The persons with knowledge relating to the facts set forth in the electronic, text searchable administrative record include the persons identified therein, David Barker, Julie Chan, David Gibson, Tom Alo, Craig Carlisle, and unknown members of the named Dischargers and their agents, consultants and employees. All documents that relate to the Cleanup Team's responses have already been provided to and are equally available to NASSCO in either the Draft Technical Report or electronic, text searchable administrative record, and the Cleanup Team will not prepare a compilation or abstract of those documents since the burden of doing so is equal or less for NASSCO than it is for the Cleanup Team.

INTERROGATORY NO. 2:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of the human health risk assessment utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 2.

Tom Alo

David Barker

Craig Carlisle

Julie Chan

INTERROGATORY NO. 3:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of the ecological risk assessment utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 3.

Tom Alo

David Barker

Craig Carlisle

Julie Chan

David Gibson

INTERROGATORY NO. 4:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of the economic feasibility analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 4.

David Barker

Julie Chan

Craig Carlisle

INTERROGATORY NO. 5:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of the technological feasibility analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 5.

David Barker

Julie Chan

Craig Carlisle

INTERROGATORY NO. 6:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of any cost analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 6.

David Barker

Julie Chan

Craig Carlisle

INTERROGATORY NO. 7:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of any remedy selection alternatives analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 7.

David Barker

Julie Chan

David Gibson

Craig Carlisle

INTERROGATORY NO. 8:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of any aquatic life impairment analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 9.

Tom Alo

David Barker

Julie Chan

Craig Carlisle

David Gibson

INTERROGATORY NO. 9:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of any aquatic-dependent wildlife impairment analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 9.

Tom Alo

David Barker

Julie Chan

Craig Carlisle

David Gibson

INTERROGATORY NO. 10:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of any bioavailability analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 10.

Tom Alo

David Barker

David Gibson

Julie Chan

Craig Carlisle

INTERROGATORY NO. 11:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of any alternative sediment cleanup levels analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 11.

David Barker

Julie Chan

David Gibson

Craig Carlisle

Tom Alo

INTERROGATORY NO. 12:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of any remedial monitoring analysis utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 12.

David Gibson

David Barker

Julie Chan

Tom Alo

Craig Carlisle

INTERROGATORY NO. 13:

IDENTIFY the CLEANUP TEAM staff primarily responsible for preparation of the analysis regarding the contribution of stormwater to sediment contamination in the San Diego Bay, utilized in connection with proposed cleanup levels and remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 13.

Tom Alo

David Barker

Julie Chan

Craig Carlisle

David Gibson

INTERROGATORY NO. 14:

IDENTIFY all site(s) in San Diego Bay where contaminated sediment has been remediated, the remedy selected, and the starting and ending dates of such remediation, including but not limited to the Campbell Shipyard Site, Paco Terminals, Commercial Basin and Convair Lagoon.

RESPONSE TO INTERROGATORY NO. 14.

1. Paco Terminals Inc
2. Teledyne Ryan (Convair Lagoon)
3. Bay City Marine (Americas Cup Harbor)
4. Driscoll Boatyard (Americas Cup Harbor)
5. Kettenburg Marine (Americas Cup Harbor)
6. Koehler Kraft (Americas Cup Harbor)
7. Mauricio and Sons (Americas Cup Harbor)
8. Campbell Industries Shipyard
9. BF Goodrich (Upland Tidal Marsh)

(See Exhibit A attached hereto for additional responsive information.)

INTERROGATORY NO. 15:

For any sites identified in response to the preceding Special Interrogatory, IDENTIFY the constituents of concern that were remediated and the cleanup levels that were set for those constituents.

RESPONSE TO INTERROGATORY NO. 15.

Responsive information is attached on Exhibit A.

INTERROGATORY NO. 16:

IDENTIFY all site(s) within the REGIONAL BOARD'S jurisdiction, other than San Diego Bay, where sediment contamination has been remediated in rivers, bays, estuaries, ocean, wetlands, or any other surface water body, and the starting and ending dates of such remediation.

RESPONSE TO INTERROGATORY NO. 16.

There are no sites within the Regional Board's jurisdiction, other than those identified in Response to Interrogatory No. 15, where sediment contamination has been remediated in rivers, bays, estuaries, ocean, wetlands, or any other surface water body.

INTERROGATORY NO. 17:

For any sites identified in response to the preceding Special Interrogatory, IDENTIFY the constituents of concern that were remediated and the cleanup levels that were imposed for those constituents.

RESPONSE TO INTERROGATORY NO. 17.

There are no sites within the Regional Board's jurisdiction, other than those identified in Response to Interrogatory No. 15, where sediment contamination has been remediated in rivers, bays, estuaries, ocean, wetlands, or any other surface water body.

INTERROGATORY NO. 18:

IDENTIFY all site(s) within the State of California where sediment contamination in rivers, bays, estuaries, ocean, wetlands, or any other surface water body has been remediated, and the starting and ending dates of such remediation.

RESPONSE TO INTERROGATORY NO. 18.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to this Interrogatory as burdensome and harassing to the extent it seeks information about sites outside the jurisdiction of the San Diego Water Board on the ground and to the extent that the information sought is not known by the Cleanup Team and is equally available to NASSCO. The Cleanup Team further objects to this Interrogatory on the ground that it is not reasonably calculated to lead to the discovery of admissible evidence because, on its face, it seeks information about cleanups over which the San Diego Water Board has no jurisdiction.

INTERROGATORY NO. 19:

For any sites identified in response to the preceding Special Interrogatory, IDENTIFY the constituents of concern that were remediated and the cleanup levels that were imposed for those constituents.

RESPONSE TO INTERROGATORY NO. 19.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to this Interrogatory as burdensome and harassing to the extent it seeks information about sites outside the jurisdiction of the San Diego Water Board on the ground and to the extent that the information sought is not known by the Cleanup Team and is equally available to NASSCO. The Cleanup Team further objects to this Interrogatory on the ground that it is not reasonably calculated to lead to the discovery of admissible evidence because, on its face, it seeks information about cleanups over which the San Diego Water Board has no jurisdiction

INTERROGATORY NO. 20:

IDENTIFY any alternative cleanup methodologies YOU considered in connection with the remediation of the SITE.

RESPONSE TO INTERROGATORY NO. 20.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to the Interrogatory as vague and ambiguous with respect to "alternative cleanup methodologies." Subject to and without waiving the foregoing

objections, the Cleanup Team considered natural attenuation, monitored attenuation, cleanup to background, and cleanup to various multiples of background all as set forth in detail in the CAO, the supporting DTR and/or the appendices.

INTERROGATORY NO. 21:

IDENTIFY all COMMUNICATIONS between YOU and ENVIRONMENTAL GROUPS RELATING TO the TENTATIVE ORDER or TECHNICAL REPORT.

RESPONSE TO INTERROGATORY NO. 21.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. Subject to and without waiving these objections, the Cleanup Team responds as follows: After reasonable investigation, the Cleanup Team was unable to identify any non-privileged communications between the Cleanup Team or San Diego Water Board staff and environmental groups relating to the tentative order that were not already produced or otherwise provided to NASSCO. Because of the ambiguous definition of "YOU," the Cleanup Team clarifies that it does not have access to ADVISORY TEAM COMMUNICATIONS that were not otherwise made to all parties.

INTERROGATORY NO. 22:

IDENTIFY all COMMUNICATIONS between YOU and any PERSON RELATING TO the TENTATIVE ORDER or TECHNICAL REPORT.

RESPONSE TO INTERROGATORY NO. 22.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to this Interrogatory as overbroad, and unduly burdensome and harassing. Subject to and without waiving these objections, the Cleanup Team responds as follows: After reasonable investigation, the Cleanup Team was unable to identify any non-privileged communications between the Cleanup Team or San Diego Water Board staff and any other person relating to the tentative order that were not already produced or otherwise provided to NASSCO. Because of the ambiguous definition of "YOU," the Cleanup Team clarifies that it does not have access to ADVISORY TEAM COMMUNICATIONS that were not otherwise made to all parties.

INTERROGATORY NO. 23:

IDENTIFY all COMMUNICATIONS between YOU and any local, state or federal agency RELATING TO the TENTATIVE ORDER or TECHNICAL REPORT.

RESPONSE TO INTERROGATORY NO. 23.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to this Interrogatory as overbroad, and unduly burdensome and harassing. Subject to and without waiving these objections, the Cleanup Team responds as follows: After reasonable investigation, the Cleanup Team was unable to identify

any communications between the Cleanup Team or San Diego Water Board staff and any local, state or federal agency relating to the tentative order that were not already produced or otherwise provided to NASSCO. Because of the ambiguous definition of "YOU," the Cleanup Team clarifies that it does not have access to ADVISORY TEAM COMMUNICATIONS that were not otherwise made to all parties.

INTERROGATORY NO. 24:

IDENTIFY all COMMUNICATIONS between YOU and any PERSON RELATING TO YOUR dismissal of natural attenuation as a preferred remedy for the SITE.

RESPONSE TO INTERROGATORY NO. 24.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to this Interrogatory as overbroad, and unduly burdensome and harassing. Subject to and without waiving these objections, the Cleanup Team responds as follows: After reasonable investigation, the Cleanup Team was unable to identify any non-privileged communications between the Cleanup Team or San Diego Water Board staff and any other person relating to its rejection of natural attenuation as a preferred remedy for the site. Because of the ambiguous definition of "YOU," the Cleanup Team clarifies that it does not have access to ADVISORY TEAM COMMUNICATIONS that were not otherwise made to all parties.

INTERROGATORY NO. 25:

IDENTIFY all COMMUNICATIONS between YOU and any PERSON RELATING TO the results and findings of the June 2009 sediment quality testing performed by Exponent at the SITE.

RESPONSE TO INTERROGATORY NO. 26.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. Subject to and without waiving these objections, the Cleanup Team responds as follows: After reasonable investigation, the Cleanup Team was unable to identify any non-privileged communications between the Cleanup Team or San Diego Water Board staff and any other person relating to the results and finding of the June 2009 sediment quality testing performed by Exponent at the site. Because of the ambiguous definition of "YOU," the Cleanup Team clarifies that it does not have access to ADVISORY TEAM COMMUNICATIONS that were not otherwise made to all parties.

INTERROGATORY NO. 26:

IDENTIFY all COMMUNICATIONS between YOU and any PERSON RELATING TO any alternative cleanup methodologies YOU considered for the remediation of the SITE, including but not limited to Lowest Apparent Effects Thresholds ("LAETs").

RESPONSE TO INTERROGATORY NO. 26.

The Cleanup Team incorporates each of the General Objections set forth above as if set forth in full herein. The Cleanup Team further objects to this Interrogatory as overbroad, and unduly burdensome and harassing. Subject to and without waiving these objections, the Cleanup Team responds as follows: After reasonable investigation, the Cleanup Team was unable to identify any non-privileged communications between the Cleanup Team or San Diego Water Board staff and any other person relating to the alternative cleanup methodologies the Cleanup Team considered for remediation of the site, including LAETs, that were not already produced or otherwise provided to NASSCO. Because of the ambiguous definition of "YOU," the Cleanup Team clarifies that it does not have access to ADVISORY TEAM COMMUNICATIONS that were not otherwise made to all parties.

Dated: October 4, 2010

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, SAN DIEGO REGION, CLEANUP TEAM

By: _____

Christian Carrigan

NASSCO WRITTEN DISCOVERY VERIFICATION

I, David Barker, declare:

I am the Branch Chief of the Surface Waters Basins Branch and a Supervising Water Resource Control Engineer at the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board). I am the designated manager of the Cleanup Team for the San Diego Water Board's proceedings to consider the development and issuance of a cleanup and abatement order for discharges of metals and other pollutant wastes to San Diego Bay marine sediments and waters at a Site referred to as the Shipyard Sediment Site. I am authorized to make this verification on behalf of the San Diego Water Board.

I have read the foregoing Regional Board Cleanup Team's Responses & Objections to Designated Party NASSCO's Second Set of Requests for Admissions, Regional Board Cleanup Team's Responses & Objections to Designated Party NASSCO's Second Set of Requests for Production of Documents, and Regional Board Cleanup Team's Responses & Objections to Designated Party NASSCO's Second Set of Special Interrogatories, and know their contents. I am informed and believe that the matters stated therein are true and on that ground certify or declare under penalty of perjury under the laws of the State of California that the same are true and correct.

Dated: October 7, 2010

David Barker

Exhibit A to Cleanup Team's Responses to NASSCO's Special Interrogatory and BAE Systems' Special Interrogatory

Cleanup Site	Paco Terminals, Inc.	Teledyne Ryan (Convair Lagoon)	Eichenlaub Marine	Shelter Island Boatyard	Bay City Marine	Driscoll Boatyard	Kettenburg Marine	Koehler Kraft	Mauricio and Sons	Campbell Industries Shipyard		BF Goodrich (Upland Tidal Marsh)	Shipyard Sediment Site	
										Campbell Industries CAO	Campbell Industries (CAP As Constructed Design)			
Order No.	CAO No.85-91	CAO No. 86-92	CAO	CAO	CAO No.88-79	CAO No. 89-31	CAO No. 88-78	CAO No. 89-32	CAO No. 88-86	CAO No. 95-21	WDR R9-2004-0295	CAO No. 98-08	Tentative CAO No. R9-2011-0001	
Year Order Issued	1985	1986	1988	1988	1988	1989	1988	1988	1988	1995	2004	1998	2010 (Latest Draft)	
No. of Responsible Parties	2	1	1	1	2	1	2	1	1	1		1	8	
Year Cleanup Level Set by San Diego Water Board	1991	1991	12/9/1991	10/28/1991	10/28/1991	10/28/1991	10/28/1991	10/28/1991	10/28/1991	1995	2004	2004		
Cleanup Remedial Action Completion	12/16/1994	5/15/1998	12/9/1991	10/28/1991	7/30/1998	8/15/2001	8/15/2001	1/27/1995	8/15/2001	6/30/2008		10/15/2004		
Cleanup Level Threshold	Copper Ocean Plan Water Quality Objective (water column)	USFDA Shellfish Standard	No Cleanup Required	No Cleanup Required	Apparent Effects Threshold (AET)	Apparent Effects Threshold (AET)	Apparent Effects Threshold (AET)	Apparent Effects Threshold (AET)	Apparent Effects Threshold (AET)	Apparent Effects Threshold (AET)		NOAA Effects Range Low (ERLs)	Multiple lines of evidence for benthic community protection. Human health and aquatic dependent wildlife risk assessment.	
Cleanup Level Metric	Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration			Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration	Site-wide Maximum not to be Exceeded Concentration	Post Remedial Surface-Area Weighted Average Concentrations	Post-Remedial Dredge Area Concentrations (Background Levels)
Pollutants of Concern	Copper Ore	PCBs	Copper, Mercury, TBT	Copper, Mercury, TBT	Copper, Mercury, TBT	Copper, Mercury, TBT	Copper, Mercury, TBT	Copper, Mercury, TBT	Copper, Mercury, TBT	Copper, Lead, Zinc, Mercury, TBT, TPH, HPAH and PCBs	Copper, Lead, Zinc, Mercury, TBT, TPH, HPAH and PCBs	Antimony, Arsenic, Cadmium, Copper, Mercury, Lead, Nickel, Silver, Zinc, PAHs, and PCBs	Primary CoC - Copper, Mercury, HPAH, PCBs and TBT. Secondary CoC - Arsenic, Cadmium, Lead and Zinc.	
Arsenic												8.2 mg/kg		
Cadmium												1.2 mg/kg		
Chromium														
Copper	1000 mg/kg				530 mg/kg	530 mg/kg	530 mg/kg	530 mg/kg	530 mg/kg	810 mg/kg	264 mg/kg	34 mg/kg	159 mg/kg	121 mg/kg
Lead										231 mg/kg	88 mg/kg	46.7 mg/kg		
Mercury					4.8 mg/kg	4.8 mg/kg	4.8 mg/kg	4.8 mg/kg	4.8 mg/kg			0.15 mg/kg	0.66 mg/kg	0.57 mg/kg
Nickel												20.9 mg/kg		
Silver												1 mg/kg		
Zinc										820 mg/kg	410 mg/kg	150 mg/kg		
TBT					Natural Degradation	Natural Degradation	Natural Degradation	Natural Degradation	Natural Degradation	5.75 mg/kg	0.121 mg/kg		110 ug/kg	22 ug/kg
TPH										4300 mg/kg	<14 mg/kg			
LPAH												552 ug/kg		
HPAH										44 mg/kg	3.47 mg/kg	1700 ug/kg	2451 ug/kg	663 ug/kg
Benzo[a]pyrene												430 ug/kg		
PCBs		4.8 mg/kg								0.95 mg/kg	0.11 mg/kg	22.7 ug/kg	194 ug/kg	84 ug/kg
Cleanup to Background Evaluated	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Alternative Cleanup levels greater than background approved by San Diego Water Board	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes		Yes	San Diego Water Board Approval Pending	
Benthic Community Effects Evaluated	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Aquatic Dependent Wildlife Risk Evaluated										Yes		Yes	Yes	
Human Health Risk Evaluated		Yes								Yes			Yes	
Cleanup Method	Dredging	Capping			Dredging	Dredging	Dredging	Dredging	Dredging	Capping/ Dredging		Dredging	Dredging/Sand Covering	
Sediment Dredge Disposal	Bay- side landfill, Part of dredged material recycled to copper mine in Arizona for copper ore recovery. Copper ore recovered was exported to Japan.	-			Landfill	Landfill	Landfill	Landfill	Landfill	Landfill		Landfill	To be determined.	
Dredge Volume (Cubic Yards)	20,926		0	0	17,250	700	8,799	300	1,845	41,000		795	143,400	
Capped Volume (Cubic Yards)		112,933								135,000				
Remediation Monitoring	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Post Remediation Monitoring		Yes								Yes			Yes	

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

CLEANUP AND ABATEMENT ORDER NO. 86-92
FOR
TELEDYNE RYAN AERONAUTICAL
NEAR LINDBERGH FIELD
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board), finds that:

1. Teledyne Ryan Aeronautical is a major aircraft manufacturing company in the City of San Diego. In 1969, Teledyne Ryan Aeronautical became a division of Teledyne Industries, Inc. The Teledyne Ryan Aeronautical plant is located on a 44-acre site at 1701 Harbor Drive, which is adjacent to the San Diego International Airport. Teledyne Ryan Aeronautical is located in an area in which other industries and facilities are located. The facilities at this site include engineering departments, manufacturing and production areas, research and testing laboratories, and office space. The facilities cover approximately 1.1 million square feet of floor space.

2. Teledyne Ryan Aeronautical's primary operations include fabrication and assembly of airframes for various types of aircraft. Various plant operations at Teledyne Ryan Aeronautical use cutting oils, lubricants, and a variety of cleaning solvents. Such substances as lead, copper, chromium, and zinc are elements of materials used in priming, painting, and metal working operations at the plant. Teledyne Ryan Aeronautical also uses electrical transformers and capacitors which use fluids containing polychlorinated biphenyls (PCBs). Various industrial organic compounds are also used at the Teledyne Ryan Aeronautical facility. Other facilities located in the area of Teledyne Ryan Aeronautical may also use these same substances.

3. The *Comprehensive Water Quality Control Plan Report, San Diego Basin (9)* (Basin Plan) was adopted by this Regional Board on March 17, 1975; approved by the State Water Resources Control Board on March 20, 1975; and updated by the Regional Board on February 27, 1978; March 23, 1981; January 24 and October 3, 1983; and August 27, 1984. The 1978, 1981, 1983 and 1984 updates were subsequently approved by the State Board.

4. The Basin Plan establishes the following prohibitions on waste discharges to coastal surface waters subject to tidal action, which includes San Diego Bay;

   a. "The discharge of industrial wastewaters exclusive of cooling water, clear brine or other waters which are essentially chemically unchanged, into waters subject to tidal action is prohibited."

   b. "The dumping or deposition of chemical wastes, chemical agents or explosives into water subject to tidal action is prohibited."

5. The Basin Plan also establishes the following beneficial uses for waters of the San Diego Bay:

   a. Industrial Service Supply
   b. Navigation
   c. Water Contact Recreation
   d. Noncontact Water Recreation
   e. Ocean Commercial and Sport Fishing
   f. Saline Water Habitat
   g. Preservation of Rare and Endangered Species
   h. Marine Habitat
   i. Fish Migration
   j. Shellfish Harvesting

6. California Water Code Section 13050 defines pollution as an alteration of the quality of the waters of the State by waste to a degree which unreasonably affects (1) such waters for beneficial uses, or (2) facilities which serve such beneficial uses.

7. Storm runoff from the Teledyne Ryan Aeronautical facility flows into five separate storm drain systems. One of these storm drain systems, which is referred to as the 15-inch storm drain system, collects stormwater runoff from the eastern portion of Teledyne Ryan Aeronautical property, and discharges into the San Diego Bay east of Convair Lagoon. Three of the storm drain systems, one 30-inch diameter drain, one 54-inch diameter drain, and one 60-inch diameter drain discharge into the Convair Lagoon portion of San Diego Bay. Two of these storm drain systems, the 54-inch and 60-inch diameter storm drains, originate beyond the limits of and upgradient from the Teledyne Ryan Aeronautical plant site and receive storm runoff from other sources including the General Dynamics, Convair Division plant and the San Diego International Airport - Lindbergh Field. The 30-inch diameter drain originates at the Teledyne Ryan Aeronautical plant site. The 30-inch storm drain system receives storm runoff from the Teledyne Ryan Aeronautical plant site and, according to Teledyne Ryan Aeronautical personnel, also receives storm runoff from the adjacent Lindbergh Field. The previously mentioned 30-inch, 54-inch and 60-inch diameter storm drain systems discharge into the Convair Lagoon portion of San Diego Bay. Several additional storm drain pipes which do not receive storm runoff from Teledyne Ryan Aeronautical also discharge into the Convair Lagoon portion of San Diego Bay. In addition, Convair Lagoon has been used for many years as a dumping ground for derelict boats.

8. On February 28, March 29, May 31, and October 11, 1985, Regional Board staff conducted a comprehensive sampling study of the storm drains located on Teledyne Ryan Aeronautical property. Regional Board staff collected sediment and water samples from storm drain sumps for heavy metals, PCBs, and volatile organic compounds. The results of these analyses revealed that PCBs, some metals, and certain volatile organic compounds, were present in the Teledyne Ryan Aeronautical storm drain sumps. The Regional Board staff sampling data is contained in the Regional Board files.

9. Monitoring performed by Regional Board staff on June 13, 1983, June 28, 1984 and May 2-3, 1985 at locations in Convair Lagoon adjacent to the 30-inch, 54-inch, and 60-inch storm drain outlets which discharge into the Convair Lagoon portion of San Diego Bay shows elevated levels of PCBs in the San Diego Bay sediments. The San Diego Bay sediment sample results are contained in the Regional Board files.

10. Further evidence of elevated concentrations of PCBs in Convair Lagoon was obtained by the California State Mussel Watch Program. The California State Mussel Watch Report for 1984-85 states that dry, wet and lipid weight levels of PCB's in mussel tissue planted in Convair Lagoon have consistently been the highest ever measured in the history of the State Mussel Watch Program. The wet weight total PCB level of 2.4 mg/kg detected by the State Mussel Watch Program in 1984/85 exceeds the United States Food and Drug Administration tolerance level of 2.0 mg/kg, wet weight for PCB's in fish and shellfish. As a result the County of San Diego, Department of Health Services has posted Convair Lagoon to restrict the collection and consumption of mussels from the area. Prior to 1985 the tolerance level for total PCB's was set at 5.0 mg/kg wet weight. As a result previously high levels of total PCB's in the Convair Lagoon mussel tissue had not exceeded the pre-1985 USFDA tolerance level. However, the 3.79 mg/kg wet weight of total PCB's measured by the State Mussel Watch Program in 1982-83 and the 2.01 mg/kg of total PCB's measured in 1983-84 provide confirmation that the 1984-85 PCB results are not isolated measurements.

11. As shown in previous findings, Regional Board staff sampling to date has detected PCBs in the sediment contained in storm drain sumps on Teledyne Ryan Aeronautical property. The highest concentrations of PCBs were found in the 30-inch diameter storm drain system which flows to the Convair Lagoon portion of San Diego Bay. The Regional Board believes that the data collected to date provides ample evidence that PCB contaminated sediment was carried into San Diego Bay by storm water runoff. Therefore, the Regional Board concludes that the PCB contaminated sediment in the 30-inch storm drain system has, at a minimum, contributed to the elevated PCB concentrations found in the sediment of Convair Lagoon. Furthermore, the PCBs found in the 30-inch diameter storm drain sumps located on Teledyne Ryan Aeronautical property at present would also be discharged into Convair Lagoon during future rainfall events.

12. Regional Board staff has initiated an expanded investigation to attempt to identify other possible contributors to the PCB contamination problem in Convair Lagoon.

13. The discharge of PCB's from the 30-inch diameter storm drain system located on Teledyne Ryan Aeronautical property into Convair Lagoon has, at a minimum, contributed to the creation of a condition of pollution in Convair Lagoon in accordance with the following rationale:

    a. State Mussel Watch sampling of Convair Lagoon in 1982/83,1983/84 and 1984/85 revealed PCB concentrations in mussel tissue of 3.79 mg/kg (wet weight), 2.01 mg/kg (wet weight) and 2.4 mg/kg (wet weight) respectively. These values exceed the current U.S. Food and Drug

Administration tolerance level of 2 mg/kg (wet weight) which was established in 1985. As a result, the San Diego County Health Department has quarantined the Convair Lagoon portion of San Diego Bay to prevent the collection of shellfish for human consumption.

b. As stated in previous findings, the Basin Plan establishes one beneficial use of San Diego Bay to be shellfish harvesting, which includes the collection of clams, oysters, abalone, shrimp, crab and lobster for either commercial or sport purposes. The discharge of PCBs into Convair Lagoon has resulted in the impairment of the shellfish harvesting beneficial use of the Convair Lagoon portion of San Diego Bay.

c. Discharges of PCBs into San Diego Bay also threaten to impair other beneficial uses of the waters in San Diego Bay. These include Water Contact Recreation, Ocean Commercial and Sport Fishing, Saline Water Habitat, and Marine Habitat. The presence of PCBs in the environment at certain concentrations have been found to cause toxic effects in man and animals, particularly if repeated exposures occur.

d. The impairment of beneficial uses in the Convair Lagoon portion of San Diego Bay by elevated levels of PCBs has created a condition of pollution, as defined by the California Water Code and stated in Finding No. 6. Therefore, the discharge of PCBs into Convair Lagoon from the 30-inch storm drain system located on Teledyne Ryan Aeronautical property has contributed to the pollution in Convair Lagoon.

14. As stated in previous findings, Regional Board staff sampling to date has detected the presence of PCBs and other chemicals in the storm drain system at Teledyne Ryan Aeronautical which flows to the Convair Lagoon portion of San Diego Bay. During rainfall events, contaminated sediment and other waste material present in the storm drain system are carried by stormwater runoff into San Diego Bay. These waste discharges into San Diego Bay constitute violations and threatened violations of the Basin Plan prohibitions as stated in Finding No. 4.

15. On September 19, 1986, Teledyne Ryan Aeronautical voluntarily submitted to Regional Board staff a report dated September, 1986 entitled *Proposed Storm Drain Sediment Removal and Catch Basin Sediment Sampling Methodology.* By letter dated September 25, 1986, Teledyne Ryan Aeronautical transmitted copies of revised pages for this report. The aforementioned report and revisions is hereinafter referred to as the TRA Proposal. The TRA proposal outlines the steps which Teledyne Ryan Aeronautical proposes to take to remove contaminated sediment from portions of the storm drain system on its property. In addition, the proposal discusses procedures for sample collection, worker health and safety, and sample collection and analyses. A map showing the location of storm drains on Teledyne Ryan Aeronautical property was also included with the cleanup proposal. This map contains a detailed numbering system which assigns a different number to each storm drain sump entering the storm drain system. These sump numbers will be used in this Order to identify particular sumps on Teledyne Ryan Aeronautical property.

16. Procedures for removing contaminated sediment from the 30-inch storm drain system as described in the TRA Proposal and modified by the Regional Board are outlined below:

    a. Separate Department of Transportation-approved drums will be marked with the catch basin number for each of the basins within the system (140-154). In catch basins which contain free water, the water will be removed first and absorbed by vermiculite in a 55 gallon drum. In catch basins containing a depth of six inches (6") or more of sedimentary material, one sample shall be collected of each six inch (6") depth of sediment starting from the sediment surface. The bottommost vertical sediment portion, if less than six inches (6") shall also be sampled where, in the opinion of Regional Board staff, a sufficient sample size can be collected. All sedimentary materials will then be shovelled out of each catch basin and placed into the designated drum. Loose materials will be vacuumed from the catch basin using a large industrial vacuum. All vacuum exhaust air will pass through a high-efficiency particle absorption (HEPA) filter. Subsequently, the interconnecting lines will be cleaned as outlined below. When line cleaning has been completed and the cleaning materials and sediment have been collected, all drop box walls and floors will be cleaned with a rotating wire brush. All loose materials will be removed with the vacuum described above. Once all cleaning has been completed, the walls and floors of each drop box will be cleaned with cotton pads saturated with a strongly alkaline (pH approximately 13) surfactant. This material has been repeatedly shown to be effective in PCB removal from floor slabs, walls, and other concrete structures.

    b. All collected sediment materials stored in drums will be thoroughly mixed and retained in separate drums for a period of at least 60 days. The sediment materials in those drums as well as the sediment samples collected in place shall be subsequently analyzed for PCB's and heavy metals. Teledyne Ryan Aeronautical will notify Regional Board staff of the date that the samples will be collected in place from each sump or mixed and collected from each drum in advance of such activities so that splits can be collected if desired or Regional Board staff may witness the proceeding. At the time of sample collection, three split samples will be prepared. One set of samples will be provided to the Regional Board and the other two sets of samples will be transported to an EPA certified and DOHS certified laboratory retained by Teledyne Ryan Aeronautical. At the laboratory, one set of samples will be prepared for heavy metals and PCBs analyses. Fifty percent (50%) of sample extract for PCBs will be analyzed immediately and the remainder will be held for the maximum holding period of 30 days from date of sample collection for subsequent analysis if required. Similarly, the extract for samples digested for heavy metals analyses will be held for the maximum holding period of 30 days for later analysis if required. The second set of samples will be held indefinitely by the laboratory.

c. The 30-inch storm drain system interconnecting lines between sumps 140 and 154 will be cleaned using dry steam at 360°F, at a pressure of up to 1700 pounds per square inch (psi), and at a water flow rate not-to-exceed 1 gallon per minute (gpm). Unlike hydroblasting, which typically is carried out at high pressures in the range of 2000-10000 psi, the dry steam proposed for this activity will be used under the lowest pressure feasible to dislodge sediment and other materials adhering to pipe bores and the low flow water feed rate will be adjusted to allow resultant water flow to carry sediment and other cleaned materials out of the pipe and into the next receiving basin for collection and solidification. This proposed process will generate approximately one gallon per minute whereas a technique such as hydroblasting generates up to 10 gallons per minute and could force PCBs, if any, into the concrete due to extremely high operating pressures.

17. The Teledyne Ryan Aeronautical proposal as modified by the Regional Board, describes the following methodology for sediment removal from sumps 56, 57, 58, 66 and 67 on the 54-inch storm drain system and sumps 92, 130, and 133 on the 60-inch storm drain system:

a. In catch basins which contain free water, the water will be removed first and absorbed by vermiculite in a 55 gallon drum. With the exception of sump 58, an in place sediment sample shall be collected from each catch basin. In catch basins containing a depth of six inches (6") or more of sedimentary material, one sample shall be collected of each six inch (6") depth of sediment starting from the sediment surface. The bottommost vertical sediment portion, if less than six inches (6") shall also be sampled where, in the opinion of Regional Board staff, a sufficient sample size can be collected. All sedimentary materials will then be shovelled out of each catch basin and placed into a double polyethylene-lined waste bin for storage. Subsequently, all drop box walls and floors will be cleaned with a rotating wire brush. All loose materials will be removed with a large industrial vacuum. Exhaust air from the vacuum will pass through a high efficiency particle absorption (HEPA) filter. Vacuumed materials will be added to the sediment stores in the waste storage bin.

b. All collected sediment materials stored in drums will be thoroughly mixed and retained in separate drums for a period of at least 60 days. The sediment materials in those drums as well as the sediment samples collected in place shall be subsequently analyzed for PCB's and heavy metals. Teledyne Ryan Aeronautical will notify Regional Board staff of the date that the samples will be collected in place from each sump or mixed and collected from each drum in advance of such activities so that splits can be collected if desired or Regional Board staff may witness the proceeding. At the time of sample collection, three split samples will be prepared. One set of samples will be provided to the Regional Board and the other two sets of samples will be transported to an EPA certified and DOHS certified laboratory retained by Teledyne Ryan Aeronautical. At the laboratory, one set of samples will be prepared for heavy metals and PCBs

analyses. Fifty percent (50%) of sample extract for PCBs will be analyzed immediately and the remainder will be held for the maximum holding period of 30 days from date of sample collection for subse quent analysis if required. Similarly, the extract for samples digested for heavy metals analyses will be held for the maximum holding period of 30 days for later analysis if required. The second set of samples will be held indefinitely by the laboratory.

18. Additional sampling is necessary to determine whether additional cleanup is required of storm drain sumps and pipe sections that comprise the 54-inch, 60-inch and 15-inch diameter storm drain systems. In the report submitted in September, 1986, Teledyne Ryan Aeronautical proposed a plan for additional sampling, which included heavy metal analysis of sediment from four storm drain sumps on the 54-inch storm drain systems and three on the 60-inch storm drain system. Upon review of the proposed storm drain sampling program, Regional Board staff concluded that additional storm drain sump sampling is necessary to ascertain the possible presence of contaminants in the 54-inch, 60-inch and 15-inch diameter storm drain systems.

19. This enforcement action is exempt from the provisions of the California Environmental Quality Act in accordance with Section 15321, Chapter 3, Title 14, of the California Administrative Code.

20. Teledyne Ryan Aeronautical has cooperated fully with the Regional Board staff in its Convair Lagoon investigation. Teledyne Ryan Aeronautical desires to resolve this matter in an expeditious manner and therefore has consented to the issuance and entry of this Order and agrees to be bound by the provisions, terms and conditions of this Order. By consenting to this Order, Teledyne Ryan Aeronautical does not admit the validity of any claim or admit any liability arising under Federal, State, or local law from any conditions present at its facility or in Convair Lagoon, nor does it admit any issue of law or fact other than its obligation to comply with this Order.

IT IS HEREBY ORDERED, That pursuant to Section 13304 of the California Water Code, Teledyne Ryan Aeronautical shall comply with the following directives:

1. By December 15, 1986, Teledyne Ryan Aeronautical shall submit to the Regional Board a report containing a detailed description of all cleaning, maintenance and construction activities carried out on storm drains traversing Teledyne Ryan Aeronautical property from January 1, 1980 to the present.

2. By November 1, 1986, Teledyne Ryan Aeronautical shall remove all contaminated sediment and other wastes from the sumps and interconnecting storm drain lines of the 30-inch storm drain system located on Teledyne Ryan Aeronautical property which includes sumps and interconnecting pipes from sump 140 through sump 154. Removal of sediment from this storm drain system shall be in accordance with the procedures described in Finding No. 16 of this Order. Sediment samples collected from each sump shall be

analyzed for PCB's and heavy metals. For each sample, concentrations of individual PCB species shall be reported as well as the total PCB concentration.

3. By November 1, 1986, Teledyne Ryan Aeronautical shall remove all contaminated material and other wastes from sumps 56, 57, 58, 66 and 67 on the 54-inch storm drain system and sumps 92, 130, and 133 on the 60-inch storm drain system located on Teledyne property. Removal of wastes from these sumps shall be in accordance with the procedures outlined in Finding No. 17 of this Order. Samples of the sediment removed from each individual storm drain sump shall be analyzed for heavy metals and PCBs. For each sample, concentrations of individual PCB species shall be reported as well as the total PCB concentration.

4. By November 1, 1986, Teledyne Ryan Aeronautical shall collect sediment samples from storm drain sumps 21, 43, 45, 47, 55, 64, 91, 102, 124, 132, 173, and 181. An in place sediment sample shall be collected from each catch basin. In catch basins containing a depth of six inches (6") or more of sedimentary material, one sample shall be collected of each six inch (6") depth of sediment starting from the sediment surface. The bottommost vertical sediment portion, if less than six inches (6") shall also be sampled where, in the opinion of Regional Board staff, a sufficient sample size can be collected. Samples of the sediment removed from each individual storm drain sump shall be analyzed for heavy metals and PCBs. For each sample, concentrations of individual PCB species shall be reported as well as the total PCB concentration. If no sample can be collected from any one of these sumps, Teledyne Ryan Aeronautical may, upon approval from Regional Board staff, collect a sample from an alternative sump.

5. Selection, transport and analyses of sediment samples shall be in accordance with the procedures contained in 40 CFR Part 261, Identification and Listing of Hazardous Waste and as set forth in Appendix B of the TRA Proposal. Teledyne Ryan Aeronautical shall consult with the Regional Board Executive Officer for the procedures to be used for collection of vertical sediment samples.

6. The removal of contaminated sediment from storm drain sumps and interconnecting lines on Teledyne Ryan Aeronautical property shall not cause any wastes to be discharged into San Diego Bay.

7. All waste removed from storm drain sumps and interconnecting lines on Teledyne Ryan Aeronautical property shall be disposed of in conformance with federal, state and local laws and regulations.

8. By December 15, 1986, Teledyne Ryan Aeronautical shall submit an application for a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES application shall include a best management practices (BMP) plan which complies with the regulations specified in 40 CFR, Part 131, Subpart K, *Criteria and Standards for Best Management Practices Authorized Under Section 304(e) of the Act.* The purpose of the BMP plan is to prevent, or minimize the potential for, the release of toxic substances from ancillary activities to the waters of the United States

through plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. More specifically, the BMP plan shall:

a. Be documented in narrative form, and shall include any necessary plot plans, drawings or maps.

b. Establish specific objectives for the control of toxic and hazardous pollutants.

(1) Each facility component or system shall be examined for its potential for causing a release of significant amounts of toxic or hazardous pollutants to waters of the United States due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc.

(2) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g., precipitation), or other circumstances to result in significant amounts of toxic or hazardous pollutants reaching surface waters, the plan should include a prediction of the direction, rate of flow and total quantity of toxic or hazardous pollutants which could be discharged from the facility as a result of each condition or circumstance.

c. Establish specific Best Management Practices to meet the objectives identified under Paragraph b of this section, addressing each component or system capable of causing a release of significant amounts of toxic or hazardous pollutants to the waters of the United States.

d. Be reviewed by plant engineering staff and the plant manager; and

e. Include the following elements:

(1) BMP Committee
(2) Reporting of BMP Incidents
(3) Risk Identification and Assessment
(4) Employee Training
(5) Inspections and Records
(6) Preventive Maintenance
(7) Good Housekeeping
(8) Materials Compatibility
(9) Security

9. Teledyne Ryan Aeronautical shall obtain approval from the Regional Board staff for any proposed modifications of the cleanup and sampling plan outlined in this Order prior to implementing such modifications.

10. If, for any reason, Teledyne Ryan Aeronautical is unable to perform any activity or submit any document in compliance with the schedule set forth herein or in compliance with any work schedule submitted pursuant to this Order and approved by the Regional Board, or new information indicates

that revisions to this Order are appropriate, Teledyne Ryan Aeronautical may request, in writing, an extension of the time specified or other appropriate revisions to this Order. The request shall include a justification for the extension or other revision. If the Regional Board is convinced that an extension or other revision of this Order is appropriate it will revise the Order accordingly. The discharger shall comply with the revised Order.

Ladin H. Delaney

LADIN H. DELANEY
Executive Officer

Date: October 17, 1986

DTB:rs

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

ADDENDUM NO. 1 TO
CLEANUP AND ABATEMENT ORDER NO. 86-92
FOR
TELEDYNE RYAN AERONAUTICAL
NEAR LINDBERGH FIELD
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board), finds that:

1. On October 17, 1986, the Regional Board Executive Officer issued *Cleanup and Abatement Order No. 86-92 For Teledyne Ryan Aeronautical Near Lindbergh Field, San Diego County* for violations of the *Comprehensive Water Quality Control Plan for the San Diego Basin* (Basin Plan), and for contributing to the condition of pollution in the Convair Lagoon portion of San Diego Bay. These violations pertain to the discharge of waste containing Polychlorinated Biphenyls (PCBs), some metals, and volatile organic compounds to the storm drains on Teledyne Ryan Aeronautical property and to the Convair Lagoon portion of San Diego Bay.

2. Cleanup and Abatement Order No. 86-92 directed Teledyne Ryan Aeronautical to perform the following tasks at the Teledyne Ryan Aeronautical facility by November 1, 1986:

   a. Remove all contaminated material and other wastes from sumps and interconnecting storm drain lines of the 30-inch storm drain system, which includes sumps and interconnecting pipes from sump 140 through sump 154.

   b. Remove all contaminated material and other wastes from sumps 56, 57, 58, 66, and 67 on the 54-inch storm drain system and sumps 92, 130, and 133 on the 60-inch storm drain system.

   c. Collect in-place sediment samples from storm drain sumps 21, 43, 45, 47, 55, 64, 91, 102, 124, 132, 173, and 181, and analyze these samples for PCBs and heavy metals.

   The purpose of the above directives was to (1) clean storm drain sumps and lines which were previously identified as containing PCBs and other contaminants, and (2) collect samples from storm drain sumps not previously sampled to determine whether additional sampling and cleanup would be necessary.

The above tasks were completed by Teledyne Ryan Aeronautical prior to the November 1, 1986 deadline date.

3. On November 30 and December 1, 1987, Teledyne Ryan Aeronautical, in the presence of Regional Board staff, removed contaminated sediment and other wastes from the following sumps located on Teledyne Ryan Aeronautical property: VLTI (located in San Diego Gas and Electric Power Vault #1), 102, 91, 172, and 64.

4. By letter dated February 19, 1987, the Regional Board Executive Officer requested that Teledyne Ryan Aeronautical submit to the Regional Board by March 6, 1987, the results of analyses of samples collected under the directives of Cleanup and Abatement Order No. 86-92 and any other additional samples collected from the storm drains or other in-plant sumps located on Teledyne Ryan Aeronautical property since January 1, 1984. Upon request from Teledyne Ryan Aeronautical, Regional Board staff granted an extension of the due date for submission of sample results from March 6, 1987 to April 1, 1987. In response to Regional Board staff's request for sample results, Teledyne Ryan submitted, on April 6, 1987, the document entitled *Teledyne Ryan Aeronautical Analytical Data Sets, January 1, 1984 to Present.* Upon review of the data contained in this document, data obtained by Regional Board staff, and data obtained by the U.S. Environmental Protection Agency, Regional Board staff has determined that additional sampling of storm drains on Teledyne Ryan Aeronautical property is necessary. The above described data is contained in the Regional Board's files.

5. The sample results described in the previous finding provide further evidence that Teledyne Ryan Aeronautical has discharged PCBs and other contaminants to the storm drain systems tributary to San Diego Bay. These discharges have, at a minimum, contributed to the creation of a condition of pollution, as defined by California Water Code Section 13050, in the Convair Lagoon portion of San Diego Bay as stated in the findings of Cleanup and Abatement Order No. 86-92. Furthermore, these discharges have caused violations of the Basin Plan prohibitions as stated in Finding No. 4 of Cleanup and Abatement Order No. 86-92.

6. This enforcement action is exempt from the provisions of the California Environmental Quality Act in accordance with Section 15321, Chapter 3, Title 14, of the California Administrative Code.

IT IS HEREBY ORDERED, That pursuant to Section 13304 of the California Water Code, Teledyne Ryan Aeronautical shall comply with the following directives:

1. Teledyne Ryan Aeronautical shall collect an in-place sediment sample from each storm drain sump identified below by August 15, 1987:

   a. Sumps 20, trench adjacent to Building 513, 22, 23, 44, 45, 48, 49, 54, 63, 65, 68, 69, 70, 75, 76, 77, 82, and 83 on the 54-inch storm drain system;

b. Sumps 88, 89, 90, 94, 95, 96, 97, 98, 99, 100, 103, 104, 105, 123, and 134 on the 60-inch storm drain system;

c. Sumps 166, trench adjacent to 167, 168, 169, 170, 171, 173, 180, and 182 on the 15-inch/24-inch/30-inch storm drain system.

Each sediment sample shall be collected prior to the removal of sediment and other contaminated material. In sumps or trenches containing a depth of six inches or more of sedimentary material, one sample shall be collected from each six inch (6") depth of sediment starting from the sediment surface. The bottommost vertical sediment portion, if less than six inches (6") shall also be sampled where, in the opinion of Regional Board staff, a sufficient sample size can be collected. Each sediment sample shall be analyzed for heavy metals and PCBs. For each sample, concentrations of individual PCB species shall be reported as well as the total PCB concentration. Teledyne Ryan Aeronautical shall notify Regional Board staff of the date and time that samples will be collected in advance of such sampling activities so that Regional Board staff may witness the proceedings and collect split samples at each location. The Executive Officer, or his duly authorized representative, may waive the requirement to collect an in-place sediment sample upon request by Teledyne Ryan Aeronautical.

2. Selection, transport and analyses of sediment samples shall be in accordance with the procedures contained in 40 CFR Part 261, Identification and Listing of Hazardous Waste.

3. Teledyne Ryan Aeronautical shall submit to the Regional Board by July 15, 1987 a storm drain sediment sampling plan containing a description of the sediment sampling procedures to be used in complying with Directives 1 and 2 above.

4. Teledyne Ryan Aeronautical shall not alter in any way the contents of storm drains located on Teledyne Ryan Aeronautical property without prior approval from the Regional Board Executive Officer.

5. Teledyne Ryan Aeronautical shall submit to the Regional Board by September 15, 1987, the results of analyses of samples collected per Directive Nos. 1 and 2 above. Each sample result submitted to the Regional Board shall contain the following information:

   a. Sample type;
   b. Sample location;
   c. Date and time of sampling;
   d. Method of sample collection;
   e. Sample analysis method;
   f. Method of sample preservation; and
   g. Laboratory used to analyze sample.

6. Upon analysis of the sample results described in Directive No. 5, the Regional Board Executive Officer will make a determination of the additional storm drain sumps, lines, and trenches on Teledyne Ryan

Aeronautical property which will require cleanup of sediment and/or other waste materials. Teledyne Ryan Aeronautical shall, within 15 days of the Executive Officer's determination, submit a storm drain cleanup plan describing the procedures to be used in removing sediment and other contaminated materials from the storm drain sumps, trenches and interconnecting lines identified by the Executive Officer. This cleanup plan shall also include a post-cleanup monitoring program to determine the overall effectiveness of the cleanup method used. Upon approval of the cleanup plan by the Executive Officer, Teledyne Ryan Aeronautical shall implement the cleanup plan as approved and complete all cleanup activities within 30 days of the cleanup plan approval date. Results of the post-cleanup monitoring program shall be submitted within 60 days following the completion of cleanup activities described in the approved cleanup plan.

7. The removal of contaminated sediment from storm drain sumps, interconnecting lines and trenches on Teledyne Ryan Aeronautical property shall not cause any wastes to be discharged into San Diego Bay.

8. All waste removed from storm drain sumps and interconnecting lines on Teledyne Ryan Aeronautical property shall be disposed of in conformance with federal, state and local laws and regulations.

9. Teledyne Ryan Aeronautical shall submit by August 1, 1987 any results of analyses performed on post-cleanup samples collected from storm drains which have been cleaned of contamination since September, 1986. Each sample result shall contain the information listed in Directive No. 5 above.

10. Teledyne Ryan Aeronautical shall submit by August 1, 1987 copies of all field notes taken by Teledyne Ryan Aeronautical staff and/or consultants pertaining to sampling and cleanup activities conducted on site from September, 1986 to the present.

11. Teledyne Ryan Aeronautical shall submit a detailed description, including sump numbers, of all cleaning, maintenance and construction activities carried out on storm drains traversing Teledyne Ryan Aeronautical property from December 22, 1986 to the present.

Ordered by Ladin H. Delaney
LADIN H. DELANEY
Executive Officer

Date: July 2, 1987

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

ADDENDUM NO. 2 TO
CLEANUP AND ABATEMENT ORDER NO. 86-92
FOR
TELEDYNE RYAN AERONAUTICAL
NEAR LINDBERGH FIELD
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board), finds that:

1. On October 17, 1986, the Regional Board Executive Officer issued *Cleanup and Abatement Order No. 86-92 For Teledyne Ryan Aeronautical Near Lindbergh Field, San Diego County* for violations of the *Comprehensive Water Quality Control Plan for the San Diego Basin* (Basin Plan), and for contributing to the condition of pollution in the Convair Lagoon portion of San Diego Bay. These violations pertain to the discharge of waste containing polychlorinated biphenyls (PCBs), some metals, and volatile organic compounds to the storm drains on Teledyne Ryan Aeronautical property and to the Convair Lagoon portion of San Diego Bay. Cleanup and Abatement Order No. 86-92 required cleanup and sampling of certain storm drain lines and sumps located on Teledyne Ryan Aeronautical property.

2. On July 2, 1987, the Regional Board Executive Officer issued *Addendum No. 1 to Cleanup and Abatement Order No. 86-92 For Teledyne Ryan Aeronautical Near Lindbergh Field, San Diego County*. Addendum No. 1 required additional sampling of storm drain sumps at Teledyne Ryan Aeronautical not previously sampled.

3. By letter dated October 23, 1986, Regional Board staff requested that Teledyne Ryan Aeronautical submit by January 1, 1987 a plan of study for characterizing the vertical and horizontal extent, and potential sources of contaminated sediments in the Convair Lagoon portion of San Diego Bay. Upon request by Teledyne Ryan Aeronautical, the due date for submission of this plan was extended from January 1 to February 1, 1987.

4. Teledyne Ryan Aeronautical submitted the plan described in Finding No. 3, entitled, *Plan of Study For Characterizing the Extent and Potential Sources of Contaminated Sediments in Convair Lagoon, San Diego Bay*, dated January 30, 1987. Upon review of this report, Regional Board staff determined that revisions were necessary prior to its implementation. By letter dated September 21, 1987, Regional Board staff requested that Teledyne Ryan Aeronautical submit by November 1, 1987 a revised plan of study for characterizing the extent of contaminated sediments in the Convair Lagoon portion of San Diego Bay. At a meeting with Regional Board staff on October 21, 1987, Teledyne Ryan Aeronautical requested a two week extension of the due date for submission of this revised plan. Regional Board staff granted the extension and notified Teledyne Ryan Aeronautical by letter dated October 22, 1987.

5. On November 16, 1987, Teledyne Ryan Aeronautical submitted a revised plan of study for characterizing the extent of contaminated sediments in Convair Lagoon, as described in the previous finding. The revised plan proposes a two-phased plan for determining the

extent of contamination. Phase I consists of the collection of sediment core samples up to a maximum depth of 8 feet to determine the vertical distribution of contaminants. These core samples are to be collected at 10 separate sites along two transects in the Convair Lagoon area of San Diego Bay. One transect originates at the sea wall near the 60-inch storm drain outfall, crosses the lagoon to the south and terminates directly east of the entrance to Harbor Island East Basin. Seven core samples will be collected along this transect at distances of 20, 60, 120, 240, 500, 750, and 1000 feet southerly of the sea wall. Three additional core samples will be collected along a second transect located across the entrance to Convair Lagoon, approximately perpendicular to the first transect. A diagram of the proposed sample locations is contained on page 2-2 of the revised plan of study.

6. The revised plan of study described in the previous finding contains the following description of the sample collection and analysis procedures to be employed during Phase I for each core sample:

   a. One complete sediment core, 4 inches in diameter, will be collected at each station to a depth of approximately 8 feet. Each core sample will be subdivided and labeled in the field into upper, mid, and lower sections to facilitate satisfactory preservation. The upper section will be 2 feet in length. The mid and lower sections will divide the remainder of the core in half, and result in two sections each approximately 3 feet in length.

   b. In the laboratory, each core will be examined, and prominent sedimentary stratification identified, described, and photographed.

   c. A subsample 3-inches in diameter and approximately 8 inches in length (depth) will be taken from the longitudinal axis of each prominent sediment layer. At a minimum, the top of the upper and mid sections and the bottom of the lower section will be sampled. Each individual subsample will be homogenized and divided into two discreet split samples, including a split sample for the Regional Board.

7. The revised plan also states that upon completion of Phase I sampling, the results will be submitted to the Regional Board for review prior to initiating Phase II. Phase II will consist of a determination of the horizontal distribution of contaminants and will be based on the data obtained during Phase I.

8. Regional Board staff has reviewed the revised plan of study for characterizing the extent of contaminated sediments in Convair Lagoon, as summarized in previous findings, and determined that certain modifications are necessary prior to the implementation of Phase I. These modifications are included in the directives of this Addendum.

9. This enforcement action is exempt from the provisions of the California Environmental Quality Act in accordance with Section 15321, Chapter 3, Title 14, of the California Administrative Code.

IT IS HEREBY ORDERED, That pursuant to Section 13304 of the California Water Code, Teledyne Ryan Aeronautical shall comply with the following directives:

1. Teledyne Ryan Aeronautical shall submit by April 1, 1988 the Phase I sampling results and the proposed Phase II sampling plan as described in the document entitled, *Plan of Study for Characterizing the Extent of Contaminated Sediments in Convair Lagoon, San Diego Bay*, dated November 13, 1987 (revised plan), as summarized in Finding Nos. 5, 6, and 7 above. Phase I sampling and analytical procedures shall be in accordance with those stated in the revised plan with the following modifications:

   a. Two additional sediment core samples shall be collected to a depth of 8 feet: one sample at a distance of 20 feet from the outlet of the 30 inch storm drain and one sample at a distance of 20 feet from the outlet of the 54 inch storm drain in Convair Lagoon.

   b. All sediment core samples shall be sampled for PCBs and heavy metals at 1-foot intervals starting from the top of the core. This procedure may be modified upon approval by Regional Board staff depending on the specific stratification of each core. Teledyne Ryan Aeronautical shall provide Regional Board staff with at least five days notification of the date and time that core samples will be collected and/or split samples will be prepared in the laboratory so that Regional Board staff may witness the proceedings and obtain split samples as described in the revised plan and summarized in Finding No. 6.c.

   Each sample result submitted to the Regional Board shall contain the following information at a minimum:

   a. Sample type
   b. Sample location, including depth
   c. Date and time of sampling
   d. Method of sample collection
   e. Sample analysis method
   f. Method of sample preservation
   g. Laboratory used to analyze sample

   Teledyne Ryan Aeronautical shall also submit all field notes and logs prepared during the collection of samples and all laboratory records describing the stratification of core samples.

2. Selection, transport, and analysis of all sediment samples shall be in accordance with the procedures contained in 40 CFR Part 261, Identification and Listing of Hazardous Waste.

3. Teledyne Ryan Aeronautical shall obtain approval from the Regional Board Executive Officer prior to initiating Phase II of the revised sampling plan as stated in Finding No. 7 of this addendum.

Ordered by Ladin H. Delaney

Ladin H. Delaney
Executive Officer

Date: December 7, 1987

BDK

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

ADDENDUM NO. 3 TO
CLEANUP AND ABATEMENT ORDER NO. 86-92
FOR
TELEDYNE RYAN AERONAUTICAL
NEAR LINDBERGH FIELD
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board), finds that:

1. On October 17, 1986, the Regional Board Executive Officer issued "Cleanup and Abatement Order No. 86-92 For Teledyne Ryan Aeronautical Near Lindbergh Field, San Diego County" for violations of the "Comprehensive Water Quality Control Plan for the San Diego Basin" (Basin Plan), and for contributing to the condition of pollution in the Convair Lagoon portion of San Diego Bay. These violations pertain to the discharge of waste containing polychlorinated biphenyls (PCBs), some metals, and volatile organic compounds to the storm drains on Teledyne Ryan Aeronautical property and to the Convair Lagoon portion of San Diego Bay. Cleanup and Abatement Order No. 86-92 required cleanup and sampling of certain storm drain lines and sumps located on Teledyne Ryan Aeronautical property.

2. On July 2, 1987, the Regional Board Executive Officer issued "Addendum No. 1 to Cleanup and Abatement Order No. 86-92 For Teledyne Ryan Aeronautical Near Lindbergh Field, San Diego County." Addendum No. 1 required additional sampling of storm drain sumps at Teledyne Ryan Aeronautical not previously sampled.

3. On December 7, 1987, the Regional Board Executive Officer issued "Addendum No. 2 to Cleanup and Abatement Order No. 86-92 for Teledyne Ryan Aeronautical Near Lindbergh Field, San Diego County." Addendum No. 2 required Teledyne Ryan Aeronautical to complete the Phase I sampling plan to determine the vertical extent of contaminated sediment in the Convair Lagoon portion of San Diego Bay. Directive No. 3 of Addendum No. 2 requires Teledyne Ryan Aeronautical to obtain approval from the Regional Board Executive Officer prior to initiating Phase II of the sampling plan. Phase II will consist of a determination of the lateral distribution of contaminants and will be developed using the information obtained during Phase I.

4. On April 27, 1988, Teledyne Ryan Aeronautical submitted a two-volume report entitled, "Characterization of the Vertical Extent of Contaminated Sediments in Convair Lagoon, San Diego Bay." This report contains the sample results obtained upon completion of the Phase I sampling plan.

5. Upon review of the data contained in the report identified in Finding No. 4, Regional Board staff has concluded that PCB contaminated sediments are confined to an area north of Transect B, as shown on page 2-2 of the report. However, in order to completely characterize the contaminated sediments within this area, it is necessary to complete Phase II of the proposed sampling plan.

6. In a meeting with Teledyne Ryan Aeronautical representatives on August 10, 1988, Regional Board staff discussed the items which, at a minimum, should be addressed in a Phase II sampling plan.

7. This enforcement action is exempt from the provisions of the California Environmental Quality Act in accordance with Section 15321, Chapter 3, Title 14, of the California Administrative Code.

IT IS HEREBY ORDERED, That pursuant to Section 13304 of the California Water Code, Teledyne Ryan Aeronautical shall comply with the following directives:

1. Teledyne Ryan Aeronautical shall submit by November 1, 1988 a Phase II sampling plan designed to completely characterize the extent of contaminated sediments within the area of Convair Lagoon bounded by the shoreline and the B transect, as described in Finding No. 5 of this Addendum. The Phase II sampling plan shall contain, at a minimum, a detailed description of the sampling procedures to be used during sample collection and analysis and the location and depth of sample cores. All assumptions which are used to formulate the sampling plan shall be clearly defined. A time schedule with dates for completing the tasks contained in the Phase II sampling plan shall be included.

2. Upon approval by the Executive Officer of the Phase II sampling plan, as described in Directive No. 1, Teledyne Ryan Aeronautical shall implement the plan as approved in accordance with the time schedule contained in the approved plan.

3. Selection, transport, and analysis of all sediment samples shall be in accordance with the procedures contained in 40 CFR Part 261, Identification and Listing of Hazardous Waste.

4. Teledyne Ryan Aeronautical shall submit by March 1, 1989 a report which fully characterizes the extent of contaminated sediments within the area defined in Directive No. 1 above. This report shall contain a complete characterization of both the presence of contamination and the probable environmental impact of the contamination. All data shall be plotted, and clarified by isocons, to support all narrative conclusions regarding contaminant distribution. Any narrative description of similarities or differences in any data sets shall be supported by appropriate statistical analyses of these relationships. The report shall contain a complete record of all data which was collected as part of the Phase II sampling plan. Each sample result submitted to the Regional Board shall contain the following information at a minimum:

   a. Sample type
   b. Sample location, including depth
   c. Date and time of sampling
   d. Method of sample collection
   e. Sample analysis method
   f. Method of sample preservation
   g. Laboratory used to analyze sample
   h. Units (expressed in both dry weight and wet weight)

   Teledyne Ryan Aeronautical shall also submit all field notes and logs prepared during the collection of samples and all laboratory records which provide a description of the core material.

Ladin H. Delaney

LADIN H. DELANEY
Executive Officer

Date: September 16, 1988

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

CLEANUP AND ABATEMENT ORDER NO. 89-18 2/22/89

EICHENLAUB MARINE
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board) finds that:

1. Mr. Carl M. Eichenlaub Jr. owns and operates a boat repair facility named Eichenlaub Marine. The facility is located on the shoreline of the Commercial Basin portion of San Diego Bay at 2606 Shelter Island Drive on land owned by the San Diego Unified Port District. Boat work performed at Eichenlaub Marine includes vessel repairs and modifications, vessel cleaning, sanding and painting, and vessel washing to remove loose paint and fouling organisms.

2. Eichenlaub Marine is alleged to have, in violation of discharge prohibitions adopted by the Regional Board pursuant to Section 13243 of the California Water Code, discharged waste, or caused or permitted waste to be deposited where it was discharged, into waters of the State and created a condition of pollution.

3. The Comprehensive Water Quality Control Plan, San Diego Basin (9) (Basin Plan), adopted by the Regional Board on March 17, 1975, contains the following prohibitions applicable to waters subject to tidal actions, including the waters of San Diego Bay:

   a) "Discharge of industrial wastewaters exclusive of cooling water, clear brine or other waters which are essentially chemically unchanged, into waters subject to tidal action is prohibited."

   b) "The dumping or deposition of chemical wastes, chemical agents or explosives into waters subject to tidal action is prohibited."

4. The Basin Plan establishes the following beneficial uses for waters of San Diego Bay including Commercial Basin:

   Industrial Service Supply
   Navigation
   Water Contact Recreation
   Ocean Commercial and Sport Fishing
   Saline Water Habitat
   Preservation of Rare and Endangered Species
   Marine Habitat
   Fish Migration
   Shellfish Harvesting;

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5. The Water Quality Control Policy for the Enclosed Bays and Estuaries of California, 1974 (hereinafter referred to as the Bays and Estuaries Policy) adopted by the State Water Resources Control Board on May 16, 1974, contains water quality standards applicable to waste discharges to enclosed bays and estuaries such as San Diego Bay. The Bays and Estuaries Policy does not contain numerical water quality objectives for waste discharges to bays and estuaries. The Bays and Estuaries Policy requires that discharges of municipal wastewater and industrial process wastewaters to enclosed bays and estuaries be phased out at the earliest practicable date. On June 16, 1988 the State Board found in Order No. 88-4 that miscellaneous water flows from boatyards containing pollutants such as dry paints and sandblasting abrasives did not qualify as a industrial process wastewater under the Bays and Estuaries policy. Thus the Regional Board is not prohibited from granting waste discharge requirements for discharges such as those described in Order No. 88-4.

6. On November 17, 1983 the State Water Resources Control Board adopted the Water Quality Control Plan, Ocean Waters of California, 1983 (hereinafter Ocean Plan). The Ocean Plan contains the following applicable water quality objectives for copper and mercury:

Constituent	6-Month Median	Daily Maximum	Instantaneous Maximum
Copper	5 µg/l	20 µg/l	50 µg/l
Mercury	0.14 µg/l	0.56 µg/l	1.4 µg/l

7. In the findings and directives of this cleanup and abatement order, effluent limitations and water quality objectives contained in the Ocean Plan are used as a baseline to determine the potential effects of waste discharges from Eichenlaub Marina on the water quality and beneficial uses of San Diego Bay as well as appropriate cleanup levels. The Ocean Plan is applicable to point source discharges of waste to ocean waters; however the Ocean Plan is not applicable to waste discharges to enclosed bays such as San Diego Bay. The beneficial uses of San Diego Bay are identical to those of the ocean. San Diego Bay waters are in hydrologic continuity to waters of the open ocean; however, the bay waters are subject to less dilution than ocean waters. Thus the water quality standard to protect the beneficial uses of San Diego Bay waters should be at least as stringent as the standards in the Ocean Plan which provide for the protection of open ocean waters. Accordingly the Regional Board finds that, in the absence of numerical water quality standards specifically applicable to San Diego Bay, the numerical water quality standards contained in the Ocean Plan should be used to protect the beneficial uses of San Diego Bay.

8. By letter dated May 20, 1988 the Regional Board Executive Officer requested Eichenlaub Marina to submit a complete NPDES permit application to the Regional Board by November 15, 1988. On August 26, 1988, Regional Board staff conducted an inspection of Eichenlaub Marina. During the inspection Regional Board staff collected a sample of a water flow discharged from a work area to an exposed yard drain and ultimately to San Diego Bay. Partial results of the sample analysis are summarized below and compared with Ocean Plan water quality objectives:

Ocean Plan Objectives

Constituent	Waste Discharge Concentration	Ocean Plan Standards	Ocean Plan Standard Type
Copper	67,700 µg/l	5 µg/L	Water Quality Objective
Mercury	2.0 µg/l	0.14 µg/l	Water Quality Objective

The copper and mercury concentration in the discharge greatly exceeds the six month median water quality objective for copper (5 µg/l) and mercury (0.14 µg/l) contained in the Ocean Plan. The waste flow characteristics of the discharge were such that little or no initial dilution as defined in the Ocean Plan was achieved in the receiving water. Accordingly, the Regional Board believes that the discharge caused the Ocean Plan water quality objectives to be exceeded in the receiving water. By letter dated December 23, 1988, Mr. Wayne T. Morrison, Eichenlaub Marina reported that the boatyard had no drainage into the bay and that the Port District had graded the property to drain rainwater into the street.

9. On February 2, 1988 Regional Board staff and California Department of Fish and Game staff collected sediment samples from the Commercial Basin portion of San Diego Bay at the station locations shown in Figure 1. Five of the sediment samples collected on February 2, 1988 were from a portion of Commercial Basin directly fronting Eichenlaub Marina at Stations AQ, AR, AS, AT and AU. The sample results are summarized below:

Constituent	Range of Dry Weight Concentration	Number of Samples
Copper	315-634 mg/kg	5
Tributyltin	827-12,910 ng/g	5
Mercury	3.81-8.76 mg/kg	5

As shown in Figures 2 and 3 concentrations of copper and tributyltin decrease markedly with distance from the Eichenlaub Marina facility. Although concentrations of mercury found at these stations are all above levels considered to be background, the lowest values are found closest to the shoreline (Figure 4). The distribution of mercury may differ from that of copper and tributyltin because it probably represents historic rather than recent discharges.

10. Sediment samples were also collected at Stations A, B, CC, and CD on February 2, 1988. Because of their locations these four stations are expected to be least influenced by Commercial Basin boatyard activities (See Area II in Figures 1 through 4). These stations had markedly lower concentrations of copper, tributyltin, and mercury than the stations fronting the Eichenlaub Marina. The sample results for these stations are summarized below:

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Constituent	Range of Dry Weight Concentration		Number Of Samples	Mean Dry Weight Concentration	
Copper	49-77	mg/kg	4	63	mg/kg
Tributyltin	83-240	ng/g	4	193	ng/g
Mercury	0.53-1.26	mg/kg	4	0.81	mg/kg

For purposes of evaluating the environmental effects of boatyard activities in Commercial Basin, the Regional Board believes it is reasonable to use the sediment quality at Stations A, B, CC, and CD to represent "background conditions".

11. Cuprous oxide, other copper compounds and tributyltin are antifouling agents commonly used in vessel paints to inhibit the growth of marine organisms on hull bottoms. Mercury and mercuric salts were extensively used in antifouling marine paints as an antifouling agent prior to 1970. In 1970 the use of mercury and mercuric salts in antifouling marine paints was discontinued.

12. The background concentration of tributyltin in the sediments and water column of San Diego Bay can also be influenced by the continuous leaching of tributyltin from the hulls of vessels moored in the bay in addition to waste discharges from boatyards/shipyards. In order to estimate the tributyltin contribution from moored vessels, Regional Board and the Department of Fish and Game staff collected 3 sediment samples for tributyltin analysis from the Shelter Island Yacht Basin portion of San Diego Bay on May 10, 1988. Shelter Island Yacht Basin receives no boatyard discharges but has extensive marine facilities. The tributyltin concentration in these sediment samples ranged from 138 to 231 ng/g, with a mean concentration of 195 ng/g. Since there are no direct discharges of waste from boatyard facilities into Shelter Island Yacht Basin, the Regional Board believes that the existing concentrations of tributyltin in Shelter Island Yacht Basin sediments results from the leaching of tributyltin from antifouling marine paints on vessel hulls. The 195 ng/g tributyltin concentration found in Shelter Island Yacht Basin is essentially equal to the 193 ng/g concentration cited in Finding 10 as representing "background conditions" in Commercial Basin. For this reason the Regional Board believes that the 193 ng/g tributyltin concentration found at the "background" stations of Commercial Basin incorporates the contribution of tributyltin which can be expected from the leaching from vessel hulls alone.

13. Eichenlaub Marine has two exposed yard drains which receive runoff from storm events as well as miscellaneous water flows from the work area. Water and vessel waste collected in the exposed yard drains is discharged to San Diego Bay. In order to obtain a chemical analysis of paint chips that may have been discharged by Eichenlaub Marine, Regional Board staff collected a sample of the waste deposits in the two exposed yard drains on August 26, 1988. The sample results are as follows:

Constituent	Range of Dry Weight Concentration	Number Of Samples	Mean Dry Weight Concentration
Copper	33,000-134,000 mg/kg	2	83,500 mg/kg
Mercury	0.191-1.81 mg/kg	2	1.00 mg/kg

14. Several conclusions can be drawn from the data which has been obtained in Commercial Basin. The bay sediment data discussed in Findings 9 and 10 shows that concentrations of copper, mercury, and tributyltin at Stations AQ, AR, AS, AT and AU are very elevated with respect to the background concentrations. Furthermore, the bay sediment data collected by Regional Board staff on February 2, 1988 shows that sediment concentrations of copper, mercury, and tributyltin in bay sediment decrease markedly with distance from the Eichenlaub Marine facility. The paint composition data cited in Finding 11 shows that copper and tributyltin are used in marine anti-fouling paints. (Mercury is also present in marine antifouling paints in use prior to 1970.) The samples results of waste collected from the Eichenlaub Marine surface yard drains cited in Finding 13 shows that copper and mercury were present in elevated concentrations. Discharges of miscellaneous water flows from the work area through the copper yard drains into San Diego Bay cited in Finding 6 contained elevated concentrations of copper and mercury. Based on the foregoing the Regional Board finds and concludes that the elevated concentrations of copper, mercury, and tributyltin in the bay sediment at Stations AQ, AR, AS, AT and AU resulted from discharges of paint chips and other waste from Eichenlaub Marine into San Diego Bay. These waste discharges constitute a violation of the Basin Plan prohibitions cited in Finding 3. These waste discharges also show that Eichenlaub Marine is discharging pollutants into San Diego Bay, a navigable water of the United States. Accordingly Eichenlaub Marine must file an NPDES permit application containing the items described in the Regional Board's letter dated May 20, 1988.

15. In September, 1995 a report titled Development of Sediment Quality Values for Puget Sound was published as a joint effort of the Puget Sound Estuary Program and the Puget Sound Dredged Disposal Analysis. The work was performed by Tetra Tech, Inc. with funding and support from the U. S. Environmental Protection Agency, the U. S. Army Corps of Engineers and the State of Washington Departments of Ecology and Natural Resources. The report evaluates options for sediment management and identifies numerical values for concentrations of chemicals in sediments that appear to be associated with adverse biological effects in Puget Sound. One methodology discussed in the report for determining limiting sediment concentrations is the Apparent Effects Threshold (AET) approach. The determination of AET sediment values for various chemicals was based on oyster bioassays, amphipod bioassays and abundance of benthic infauna. The AET sediment concentration for a given chemical is defined as the sediment concentration of a chemical, above which, statistically significant biological effects (eg., mortality in amphipod bioassays, depressions in the abundance of benthic infauna) could always be expected to occur. The lower limit AET sediment concentrations in dry weight for copper and mercury concentrations (AET values for tributyltin have not been developed) in sediment are listed below:

Chemical	Amphipod AET Value	Oyster AET Value	Benthic AET Value
Copper	310.0 mg/kg	290.0 mg/kg	170.0 mg/kg
Mercury	1.7 mg/kg	0.49 mg/kg	0.52 mg/kg

The discharges of waste from Eichenlaub Marine cited in previous findings have caused bay

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sediment concentrations of mercury and copper in the vicinity of Elchemlab Marine to exceed the AET sediment concentration criteria cited above.

16. Currently there are no sediment quality values specifically established for San Diego Bay. Although there are limitations that are inherent in the use of the AET sediment quality standards for a particular body of water, the Puget Sound AET values still provide useful guidance in predicting the environmental consequences of the sediment quality in Chemical Basin. There are several similarities in the environmental conditions which are present in Puget Sound and San Diego Bay. The potential sources of both copper and mercury contaminants are believed to be similar in Puget Sound and San Diego Bay. Both water bodies have extensive areas of boat and ship repair facilities. Although the natural biota may be somewhat different between the two areas, it is unlikely that San Diego Bay organisms would be significantly more tolerant to heavy metal contamination than the organisms found in Puget Sound. The Regional Board finds and concludes that, in this instance, the Puget Sound AET values represent the best information available on the sediment pollutant concentrations for copper and mercury which could adversely affect the beneficial uses of San Diego Bay.

17. As previously stated in Finding 11, tributyltin is a biocide used in antifouling vessel paints. The antifouling paint prevents the fouling of the vessel hull by releasing tributyltin into the surrounding water. Depending on environmental conditions, tributyltin is eventually degraded into dibutyltin, monobutyltin, and ultimately to elemental tin. Tributyltin is one to two orders of magnitude more toxic than dibutyltin, which is more toxic than monobutyltin. Tributyltin is lipophilic, rapidly adsorbs to marine sediments, and can penetrate biological membranes. Sensitivity to tributyltin varies among aquatic species. Gastropods and bivalves are the most susceptible organisms affected at tributyltin water concentrations as low as 0.02 to 0.14 µg/l, followed by crustaceans at 0.09 to 0.14 µg/l, algae at 0.1 to 0.35 µg/l, and fishes at concentrations of 0.2 µg/l or greater. Sublethal effects on marine biota caused by tributyltin include reproductive abnormalities, growth retardation, anatomical abnormalities, bioaccumulation, and behavior changes.

18. Tributyltin has been investigated by the State Water Resources Control Board's Priority Chemicals Program. By memorandum dated December 30, 1987 State Board staff presented a summary of the findings and recommendations contained in the forthcoming report **Tributyltin in California Waters**. In this report State Board staff recommended a water quality criteria of 6 ng/l for tributyltin in seawater to protect aquatic life. State Board staff also recommended that this criteria serve as the basis for adoption of water quality objectives in the California Ocean Plan and basin plans. In the absence of a standard for tributyltin in San Diego Bay, the State Board's recommended criteria of 6 ng/l will be applied for purposes of establishing sediment cleanup levels. Water quality objectives for tributyltin in marine sediments have not been established.

19. Regional Board and Department of Fish and Game staff conducted a sampling survey of tributyltin water column concentrations throughout San Diego Bay on August 19, 1987. The tributyltin water column sample results are contained in the Department of Fish and Game's draft report, **Preliminary Data Report on Tributyltin and PCBs in San Diego Harbor, March 30, 1988** and are summarized below:

Location	Station	Range of Tributyltin Concentrations	Number of Samples	Mean Tributyltin Concentrations
Bay Entrance	1-4	<7-36 ng/l	4	22 ng/l
Shelter Is Yacht Bn	5-6	210 ng/l	1	210 ng/l
Commercial Basin	7-9	75-420 ng/l	3	262 ng/l
Harbor Island South	10	24 ng/l	1	24 ng/l
Harbor Island West	11-13	160 ng/l	1	160 ng/l
Harbor Island East	16-22	10-28 ng/l	2	19 ng/l
Navy Channel	14-15	34-56 ng/l	2	45 ng/l
Glorietta Bay	23-25	98 ng/l	1	98 ng/l
7th Street	26-27	<7 ng/l	1	<7 ng/l
Sweetwater	28-32	18-21 ng/l	2	20 ng/l

As shown in the table above the mean tributyltin concentrations in bay waters ranged from a low of <7 ng/l at the 7th Street station to a high of 262 ng/l in Commercial Basin. The mean concentration of tributyltin in Commercial Basin, based on the August 19 sample data, exceeded the mean tributyltin concentrations in all other areas of San Diego Bay. The mean tributyltin concentration of 262 ng/l in Commercial Basin is in excess of concentrations known to cause adverse effects on marine biota and is over 43 times greater than the State Board's Water Quality Criteria of 6 ng/l. As discussed in Findings 9 and 10, the discharge of paint chips significantly contributed to the elevated concentrations of tributyltin in the sediment fronting Eichenlaub Marine. These sediment concentrations in turn contributed to the elevated tributyltin concentrations found in the water column of Commercial Basin. The Regional Board recognizes that the leaching of tributyltin from boat hulls is also a major source of tributyltin in San Diego Bay. As a consequence of such boat hull leaching, other areas of San Diego Bay not subject to waste discharges from boatyards/shipyards were also found to contain tributyltin concentrations in excess of the State Board's 6 ng/l water quality criteria.

20. Oysters from Humboldt Bay were transplanted to numerous locations throughout San Diego Bay by Regional Board and Department of Fish and Game staff in order to evaluate the biological effects of tributyltin. The oysters were deployed in August, 1987 and collected in December, 1987. The most notable effects are growth reduction and a characteristic shell thickening response known as chambering. Chambering in oysters occurs at tributyltin concentrations as low as 0.15 ug/l and is believed to be a specific biological indicator of elevated concentrations of tributyltin. Because of the enormous amount of biological energy devoted to shell chambering, the edible muscle tissue remains small and the oysters are rendered commercially non-viable. Chambering oysters which are subsequently transplanted to clean waters resume normal growth. The shell thickness index is defined as the ratio of shell length to width and is a measure of the degree of chambering. A low index indicates a high degree of chambering; conversely, a high index indicates a lack of chambering. Upon collection, the oyster shells were measured and the edible tissue extracted and weighed. The results of the study are contained in the Department of Fish and Game's draft report and are summarized below:

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Location	Station	Mean Shell Thickness Index		Tissue Weight	
Bay Entrance	1-4	4.55-11.84	mm	0.91-7.02	grams
Station Island	5-6	4.64	mm	0.37	grams
Commercial Basin	7-9	3.65-6.59	mm	0.25-0.65	grams
Harbor Island South	10	4.04	mm	0.45	grams
Harbor Island West	11-13	3.64-5.50	mm	0.14-0.33	grams
Harbor Island East	16-22	4.31-5.39	mm	0.30-0.68	grams
Navy Channel	14-15	4.79-4.91	mm	0.62-1.30	grams
Eichenlaub Bay	23-25	3.94-5.28	mm	0.31-1.03	grams
7th Street	26-27	6.60-11.18	mm	0.80-2.0	grams
Shoreline	28-32	6.71-9.13	mm	1.56-4.79	grams

21. The data cited in Finding 20 shows that the 11.84, 11.18, and 9.13 mm shell thickness indices at Stations 1, 27, and 30 in bay areas less influenced by tributyltin were markedly higher than the 3.65, 5.62, and 6.59 mm shell thickness indices found at Stations 7, 8, and 9 in Commercial Basin. The low shell thickness indices found in the Commercial Basin oysters indicates a high degree of chambering and is a direct result of the elevated tributyltin concentrations found in Commercial Basin. The Commercial Basin oysters also exhibited high mortality and apparently reduced edible tissue weights. Oysters transplanted to other areas of the bay having elevated tributyltin levels in the water column, for example in marinas, exhibited adverse biological effects similar to those observed in Commercial Basin. The Regional Board believes that the waste discharges from Eichenlaub Marina did contribute to the adverse biological effects observed in oysters transplanted to Commercial Basin. However the extent to which the adverse biological effects were caused by the waste discharges, as opposed to the leaching of tributyltin from boat hulls, is not known.

22. Biologists from the Moss Landing Marine Laboratory are currently evaluating the impact of boats on biological communities in San Diego Bay. The preliminary data (contained in the Preliminary Data Report on Tributyltin and PCBs in San Diego Harbor, March 30, 1988) reveal general patterns and show that dramatic biological changes have occurred in portions of San Diego Bay where boats are most numerous. In general, areas with high densities of boats such as Commercial Basin, are characterized by the lack of species diversification. Benthic fauna in Commercial Basin is dominated by serpulid tube worms, while other groups of organisms are reduced or absent. Overall, biomass is low and bare substrate is common. While the major emphasis of the study is on the effects of boat densities, with the concomitant leaching of antifouling agents into the bay, the Regional Board believes that the waste discharges containing tributyltin, copper and mercury from Eichenlaub Marina contributed to the adverse biological effects cited in this study.

23. The Eichenlaub Marina waste discharges caused the bay sediment concentrations of mercury and copper in the vicinity of Eichenlaub Marina to exceed the AET sediment concentration criteria cited in Finding 15. The Eichenlaub Marina waste discharges have also contributed to tributyltin concentrations in the water column of Commercial Basin exceeding the State Board's Water Quality Criteria of 6 ng/l. The Eichenlaub Marina waste discharges have also contributed to increased chambering and reduced edible tissue weight in oysters transplanted to Commercial

Basin. Furthermore the Eichenlaub Marina waste discharges have contributed to substantial degradation in the biological communities of Commercial Basin. The Eichenlaub Marina waste discharges have impaired the marine habitat and shellfish harvesting beneficial uses of the Commercial Basin portion of San Diego Bay. Based on the foregoing, the Regional Board finds and concludes that the waste discharges from Eichenlaub Marina have caused a condition of pollution as defined in Water Code Section 13050 in the Commercial Basin portion of San Diego Bay.

24. This enforcement action is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000, et seq.) in accordance with Section 15321, Chapter 3, Title 14, California Administrative Code.

IT IS HEREBY ORDERED, THAT in accordance with California Water Code Section 13304, Eichenlaub Marina shall comply with the following directives:

1. Eichenlaub Marina shall forthwith terminate all waste discharges to San Diego Bay.

2. Eichenlaub Marina shall, no later than April 3, 1989, submit an NPDES permit application containing the items listed in the Regional Board's May 20, 1988 letter to Eichenlaub Marina.

3. Eichenlaub Marina shall submit a report to the Regional Board no later than June 30, 1989 (May 3, 1989 if Eichenlaub Marina elects to follow the time schedule described in directive 4(b) below) identifying a range of remedial action alternatives to cleanup contaminated bay sediment resulting from the discharge of waste from Eichenlaub Marina. The report shall, at a minimum, contain a detailed analysis of the cost, feasibility, and lateral and vertical extent of contaminated sediment associated with cleanup strategies a), b), and c) described below. In addition to the evaluation of these cleanup strategies Eichenlaub Marina may propose an alternate cleanup strategy by evaluating the criteria described in Item d) below. The Regional Board will evaluate the information submitted in the report and select a cleanup level for the contaminated sediment.

   a) Removal and/or treatment of the contaminated sediment to attain the following background concentrations of mercury, copper, and tributyltin in the bay sediment described in Finding 10:

Constituent	Dry Weight Concentration
Mercury	0.81 mg/kg
Copper	63 mg/kg
Tributyltin	193 ng/g

   b) Removal and/or treatment of the contaminated sediment to attain the following Apparent Effects Threshold (AET) dry weight sediment concentrations for copper and mercury described in Finding 15 and the State Water Resources Control Board's proposed water quality criteria for tributyltin described in Finding 18:

Constituent	Concentration
Mercury	0.49 mg/kg
Copper	170 mg/kg
Tributyltin	6 ng/l

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Under this alternative it will be necessary to ascertain the degree of tributyltin migration from the sediments to the water column that will occur and to demonstrate that any tributyltin migration will not cause the 6 ng/l water quality criteria to be exceeded in either the water column or the interstitial water found within the sediment.

c) Removal and/or treatment of contaminated sediment to attain the following Ocean Plan water quality objectives for copper and mercury described in Finding 5 and the State Water Resources Control Board's proposed water quality criteria for tributyltin described in Finding 10 in the water column and interstitial water:

Constituent	Concentration
Mercury	0.14 µg/l
Copper	5 µg/l
Tributyltin	6 ng/l

Under this alternative it will be necessary to ascertain the degree of copper, mercury, and tributyltin migration from the sediments to the water column that will occur and to demonstrate that any copper, mercury, and tributyltin migration will not cause the above concentrations to be exceeded in either the water column or the interstitial water found within the sediment.

d) Any remedial action alternative proposing the attainment of copper, mercury, and tributyltin concentrations in the sediment, water column and interstitial water that would comply with the following criteria:

1. The proposed copper, mercury, and tributyltin concentrations to be attained in the affected San Diego Bay sediment contamination zone will not alter the quality of San Diego Bay waters to a degree which unreasonably affects the beneficial uses of San Diego Bay.

2. The proposed copper, mercury, and tributyltin concentrations to be attained in the sediment contamination zone will be consistent with the maximum benefit to the people of the state.

3. The proposed copper, mercury, and tributyltin concentrations to be attained in the sediment contamination zone will not result in water quality less than prescribed in the Basin Plan, Ocean Plan or other prescribed policies.

4. The remedial action alternative analysis report described in Directive No. 3 shall be prepared and submitted in accordance with the following alternative time schedule and criteria:

(c) Eichenlaub Marina may participate in the cleanup project being undertaken by Mauricio and Sons Inc., Bay City Marina, and Kettenburg Marina in accordance with the following time schedule:

(1) Eichenlaub Marina shall complete collection of the Phase 1 samples described in **Commercial Basin Boatyards Sediment Sampling Plan, San Diego California, Woodward Clyde Consultants** by February 24, 1989. All Phase 1 samples shall be taken to a depth of 6 inches.

(2) Elchenlaub Marina shall submit a report by March 24, 1989, which describes the ... of sampling performed in accordance with Directive 4(a)(1) of this Order. The ... shall include a discussion of the procedures which will be used to collect and ... samples for Phase 2. The report shall also include a discussion of the locations ... for the collection of samples and the constituents for which the samples will be ...

(3) Upon approval of the Phase 2 sampling plan by the Regional Board Executive ... Elchenlaub Marina shall complete collection of samples as described in Directive 4(a)(2) of this Order no later than May 1, 1989.

(4) Elchenlaub Marina shall submit a report by June 15, 1989, which describes ... of sampling performed in accordance with Directive No. 4 (a)(3) of this Order.

(b) Elchenlaub Marina may as an alternative to Directive 4(a) of this Order comply with ... following time schedule for submission of sample data:

(1) Elchenlaub Marina shall submit a sampling plan by March 3, 1989, to determine ... vertical and horizontal extent of the bay sediment contamination resulting from ... discharges of waste by Elchenlaub Marina.

(2) Upon approval of the sampling plan by the Regional Board Executive Officer, ... Marina shall complete sampling and submit the sample results to the Regional ... April 3, 1989.

(3) Elchenlaub Marina shall submit the remedial action alternatives analysis ... in Directive No. 3 no later than May 3, 1989.

5. Elchenlaub Marina shall no later than November 1, 1989 cleanup the contaminated bay sediment to the level prescribed by the Regional Board under Directive 3 of this order.

6. Elchenlaub Marina shall no later than February 1, 1990 submit a post-cleanup sampling plan to verify the attainment of the prescribed cleanup standards in the area of sediment contamination defined under Directive 3 of this order. Upon the approval of the sampling plan by the Regional Board Executive Officer, Elchenlaub Marina shall collect and analyze the samples prescribed in the sampling plan. The post cleanup sampling results shall be submitted to the Regional Board no later than May 1, 1990.

7. Elchenlaub Marina shall upon implementation of the selected cleanup alternative, submit cleanup progress reports to the Regional Board on a quarterly basis, until in the opinion of the Regional Board Executive Officer, the cleanup of the contaminated sediment has been completed. The reports shall contain information discussing the progress made toward attaining the final selected cleanup criteria for the bay sediment. Specific information included in the quarterly progress reports will be determined by the Regional Board Executive Officer upon the selection of the sediment cleanup standard. The reports shall be submitted in accordance with the following reporting schedule:

Reporting Schedule	Report Due
January, February, March	April 30
April, May, June	July 30
July, August, September	October 30
October, November, December	January 30

c. Eichenlaub Marina shall dispose of all contaminated sediment in accordance with all applicable state and federal regulations.

Provisions

1. Eichenlaub Marina is located on lands owned by the San Diego Unified Port District. The Port District is a governmental agency. In addition the current lease for Eichenlaub Marina requires that the Eichenlaub Marina comply with any applicable laws of the State of California. Thus under Water Code Section 13304, the Regional Board may name the Port District as a responsible party for the purposes of compliance with this order. The Regional Board will amend this order to include the Port District as a responsible party only if Eichenlaub Marina fails to comply with the terms and conditions of this cleanup and abatement order and the Port District fails to promptly use its governmental powers to achieve compliance with this cleanup and abatement order.

2. Eichenlaub Marina shall provide Regional Board staff with a schedule of sampling activities as it becomes available to enable the Regional Board to witness sampling activities and obtain split samples. Each sample result submitted to the Regional Board shall, as a minimum, contain the following information:

   a) The date, location, and time of sampling;
   b) Sample sediment depth;
   c) The individual(s) who performed each sampling or measurement;
   d) The date(s) analyses were performed;
   e) The laboratory and the name of each individual who performed each analyses;
   f) The analytical techniques or methods used including preservation techniques
   g) The number of samples composited to represent the concentration at each point;
   h) The results of such analyses. Sediment sample results shall be reported in terms of dry weight.

3. Eichenlaub Marina shall submit copies of all field notes and sample logs prepared during the collection of samples.

4. Sample results shall be submitted both in tabular form and plotted on a map of the sampling area with lines of equal concentration included.

5. Collection, transport and analysis of sediment samples (excluding analysis of sediment samples for tributyltin) shall be in accordance with procedures contained in 40 CFR Part 261, Identification

Estimated Monitoring Costs

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and Listing of [illegible] Waste Collection, transport and analysis of water samples (excluding analysis of water samples for tributyltin) shall be in accordance with procedures contained in 40 CFR 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act. Analysis of sediment and water samples for tributyltin shall be in accordance with procedures employed by the California Department of Fish and Game contained in Organic Ca EDT to San Diego Harbor, California Department of Fish and Game, Marine Pollution Studies Laboratory, August 1988.

Ordered by _____
Lodin H. Delaney
Executive Officer

Dated: February 16, 1989

JBM:DSJ:DTB

2/21/89

and Listing of Hazardous Waste. Collection, transport and analysis of water samples (excluding analysis of water samples for tributyltin) shall be in accordance with procedures contained in 40 CFR 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act. Analysis of sediment and water samples for tributyltin shall be in accordance with procedures employed by the California Department of Fish and Game in its [illegible] on TBT in San Diego Harbor, [illegible] Department of Fish and Game, [illegible] Marine Laboratory, August [illegible].

Ordered by ______________________
Ladin H. Delaney
Executive Officer

Dated: February 16, 1989

JBM:DSJ:DTB

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

ORDER NO. 91-91
RESCINDING
CLEANUP AND ABATEMENT ORDER NO. 88-70
FOR
SHELTER ISLAND BOATYARD
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board) finds that:

1. On June 30, 1988, the Regional Board Executive Officer issued Cleanup and Abatement Order No. 88-70 for Shelter Island Boatyard. Cleanup and Abatement Order No. 88-70 contains findings alleging that boat repair and maintenance activities at Shelter Island Boatyard have resulted in waste discharges to Commercial Basin in San Diego Bay. These waste discharges are alleged to have created a condition of pollution. The waste discharges were violations of requirements contained in Order No. 83-25, NPDES No. CA0108049, "Waste Discharge Requirements for Shelter Island Boatyard, San Diego County."

2. On December 1, 1988, the Regional Board Executive Officer issued Addendum No. 1 to Cleanup and Abatement Order No. 88-70. This addendum revised the compliance dates and directives contained in the cleanup and abatement order.

3. On February 2, 1989, the Regional Board Executive Officer issued Addendum No. 2 to Cleanup and Abatement Order No. 88-70. This addendum revised the compliance dates and directives contained in the cleanup and abatement order.

4. Cleanup and abatement orders were issued to seven boatyards in Commercial Basin in the period from June, 1988 to March, 1989, for the discharge of boatyard waste causing elevated levels of copper, mercury and tributyltin (TBT) in Commercial Basin sediment. The seven boatyards were Bay City Marine, Driscoll Custom Boats, Eichenlaub Marine, Kettenburg Marine, Koehler Kraft, Mauricio and Sons, and Shelter Island Boatyard. Each boatyard was required, by the cleanup and abatement orders, to prepare a remedial action alternatives analysis report (RAAAR) to evaluate a range of sediment cleanup levels and to recommend a cleanup alternative. Final RAAARs were submitted by October, 1990, which presented information on the extent of contaminated sediment in Commercial Basin and possible cleanup levels. The table below indicates when each report was submitted and

Shelter Island Boatyard's 12 stations in Commercial Basin. Using the information in the ERCE study of Shelter Island Yacht Basin (see Finding 7 above), the Regional Board concludes that the background sediment concentration for Commercial Basin should be 96.3 mg/kg (dry weight) for copper, 0.64 mg/kg (dry weight) for mercury, and 52.5 ug/kg (dry weight) for TBT.

TRIBUTYLTIN (TBT) STUDY RESULTS

12. The Naval Ocean Systems Center (NOSC) has been conducting a large scale series of studies on tributyltin (TBT) contamination and potential environmental impacts associated with TBT in San Diego Bay.

13. One of the reports discussed in the Woodward-Clyde RAAAR is the NOSC report titled, Ecological Evaluation of Organotin-Contaminated Sediment, July 1985, which evaluates the prospects of ocean disposal for organotin-contaminated sediment. The test sediment sample was collected in Commercial Basin off the Shelter Island Boatyard docks. Particulate-phase tests were conducted with the species Acanthomysis sculpta (mysid), Citharichthys stigmaeus (flatfish), and Acartia tonsa (copepod). Solid-phase tests were conducted with the species Acanthomysis sculpta (mysid), Macoma nasuta (clam), and Neanthes arenaceodentata (polychaete worm). These tests all had high survival rates for Commercial Basin sediment containing 780 ug/kg TBT, 210 mg/kg copper, and 2.7 mg/kg mercury. These tests also showed significant bioaccumulation for TBT and copper but not for mercury. The report stated that the environmental significance of the bioaccumulation estimate is unclear, and therefore, concluded that this Commercial Basin sediment should not have significant impact on the marine environment if discharged into ocean waters.

14. The NOSC report titled, Utility of Mussel Growth in Assessing the Environmental Effects of Tributyltin, April 1990, discusses a series of seven juvenile mussel field transplant experiments conducted in San Diego Bay from 1987 through 1989. One site in Shelter Island Yacht Basin and one site in Commercial Basin were among the locations studied. The results at these two sites showed higher mean seawater TBT concentrations in surface waters than in deeper waters. Mussel bioaccumulation of TBT was also greater and growth rates lower for these sites in surface water when compared to deeper water. The data also indicate a decrease in mean seawater TBT concentrations in Shelter Island Yacht Basin from 530 ng/l in 1987 to 59 ng/l in 1989. Limited data on Commercial Basin appears to indicate the same

decreasing trend in mean seawater TBT concentration. The Commercial Basin mean seawater TBT concentration for deeper water was reported as 32 ng/l for August through October, 1989.

15. The California Department of Food and Agriculture adopted regulations for TBT in January of 1988. The California regulations require 1) the use of TBT paints with release rates of 5 ug/cm^2/day or less, 2) the application of TBT paints by certified commercial applicators and 3) the application of TBT paints only on vessels at least 25 meters (82 feet) in length and on aluminum hulls and vessel parts. Federal legislation and regulations came out in June of 1988, and September of 1988 respectively. Federal regulations limit TBT release rates to 4 ug/cm^2/day and the application of TBT antifouling paints to vessels 25 meters (82 feet) in length or larger.

16. The State Water Resources Control Board (State Board) issued a report titled "Tributyltin, a California Water Quality Assessment," dated December 1988. This report quoted studies which showed the TBT half life to be as short as 4 to 20 days in salt water, and 100-200 days in marine sediment. The report also established a water quality criteria of 6 ng/l in the marine water column.

17. TBT levels in Commercial Basin sediments appear to have decreased markedly from February of 1988 when the Regional Board sampled the sediment until the time the boatyards sampled the sediment in early 1989 through early 1990, as shown in the following table.

BOATYARD	REGIONAL BOARD SAMPLE TBT RESULTS (ug/kg)	DATES	BOATYARD SAMPLE TBT RESULTS (ug/kg)	DATES
Shelter Island	273 - 6,187	2-2-88	3.1-7.4	2-89,4-89
Koehler Kraft	70 - 1,752	2-2-88	38-434	2-90
Bay City Marine	375 - 6,029	2-2-88	0.9-22	2-89,4-89
Eichenlaub Marine	827 - 12,910	2-2-88	0.9-1.5	2-89,4-89
Kettenburg Marine	1,102 - 7,177	2-2-88	1.0-11	2-89,4-89
Mauricio & Sons	958 - 9,607	2-2-88	0.7-19	2-89,4-89
Driscoll Custom	907 - 9,871	2-2-88	4.6-590	10-89,11-89

18. Regional Board staff believes that this apparent reduction in TBT concentrations in the sediment is due to the following factors:

    a. The application of TBT antifouling paints on boats under 25 meters (82 feet) is now prohibited. A large proportion of the boats found in Commercial Basin are

under 25 meters (82 feet) and are prohibited from using TBT antifouling paints. These small boats should not be releasing TBT into the water through leaching, underwater hull cleaning, or other maintenance activities on these boats. Therefore, a large source of TBT has been eliminated from Commercial Basin.

b. TBT undergoes rapid natural degradation in the environment. Depending on environmental conditions, tributyltin is eventually degraded into dibutyltin, monobutyltin, and ultimately to elemental tin. The half life of TBT has been shown to be as short as 4 to 20 days in salt water, and 100-200 days in marine sediment. Tributyltin is one to two orders of magnitude more toxic than dibutyltin, which is more toxic than monobutyltin. With the prohibition of the use of TBT antifouling paints on small boats, it is believed that natural degradation will reduce TBT levels to acceptable levels in a relatively short period of time.

c. NOSC data indicate that a decrease has occurred in mean seawater TBT concentrations in Shelter Island Yacht Basin from 530 ng/l in 1987 to 59 ng/l in 1989. Limited data on Commercial Basin appears to indicate the same decreasing trend in mean seawater TBT concentration.

19. The Regional Board believes that the TBT contamination in the Commercial Basin sediments has been greatly reduced due to natural degradation processes and the elimination of the use of TBT in paint for small boats such as the size found in Commercial Basin. The water column TBT concentration in Commercial Basin is expected to be below the level which would adversely affect the beneficial uses. The Regional Board believes that it is not necessary to establish a cleanup level for TBT in Commercial Basin.

COPPER AND MERCURY STUDY RESULTS

20. The Woodward-Clyde RAAAR contained a sediment biological effects study prepared by Kinnetic Laboratories, Inc. One sediment station at each client boatyard (Bay City Marine, Kettenburg Marine, Eichenlaub Marine, and Mauricio and Sons Marine) and one reference station in the center of the basin were used in this study. Benthic infaunal counts, an amphipod sediment toxicity test, and a bivalve larvae sediment elutriate test were performed for each station. The amphipod 10-day survival and reburial test used the species Grandidierella japonica following the test

procedures described in Swartz et al. (1985). The 48-hour bivalve larvae survival and shell abnormality test used a 1:4 sediment to water elutriate mixture as described in ASTM Test Method E-724-80. The sediment biological effects study prepared for the Woodward-Clyde RAAAR concluded that there were no significant adverse biological effects associated with sediment containing 530 mg/kg (dry weight) of copper and 4.8 mg/kg (dry weight) of mercury.

21. PTI's RAAAR for Shelter Island Boatyard also performed a sediment biological effects study. PTI's RAAAR used eleven sample stations. A benthic infaunal count, and an amphipod sediment toxicity test were performed for each station. The 10-day survival, avoidance, and reburial test used the species Rhepoxynius abronius following the test procedures described in Swartz et al. (1985) as amended by Chapman and Becker (1986). Only two stations, far removed from the greatest boatyard activities, exhibited any chronic effects in the amphipod tests. Two additional stations exhibited depressed infaunal diversity and numbers near the boatyard activities. The copper and mercury concentrations of the four stations which showed adverse test results are lower than the concentrations at one station which showed no adverse results. It appears that the adverse test results were not caused by copper and mercury concentrations, but resulted from high sand content, low organic content, or other pollutants. PTI's RAAAR reported that high amphipod survival and no depression in infaunal assemblage were found in the sediment from the area adjacent to Shelter Island Boatyard with the sediment metal concentrations of 275 mg/kg (dry weight) for copper, 4.2 mg/kg (dry weight) for mercury, and 23 ug/kg (dry weight) for TBT.

22. The Woodward-Clyde RAAAR addressed bioaccumulation in one water column bivalve, four species of benthic invertebrates, two species of water column fish, and three species of bottom dwelling fish. Specimens were collected at each client boatyard (Bay City Marine, Kettenburg Marine, Eichenlaub Marine, and Mauricio and Sons Marine) and one reference station in the center of the basin. Tissues were then analyzed for copper and mercury. Bioaccumulation of copper was found to be significant only in the bubble snail, but an adverse effect level for tissue burden was not defined. An action level for copper has not been developed by the U.S. Food and Drug Administration (FDA), but the FDA action level for mercury in oysters of 1.0 mg/kg was not exceeded in any of the organisms sampled in Commercial Basin. The major food items of brown pelicans, topsmelt and anchovies, had no detectable levels of mercury in their tissue and appear to pose little if any risk of bioaccumulation of mercury to these birds. The study

concluded that there is little if any risk of copper and mercury bioaccumulation from the Commercial Basin sediments.

23. The ERCE RAAAR for Driscoll Custom Boats analyzed State of California Mussel Watch data from Commercial Basin and Shelter Island Yacht Basin collected from 1977 through 1988. Mussel watch data was then compared to sediment contaminant concentrations. Sediment in Commercial Basin near the mussel watch stations averaged 947 mg/kg copper and 6.75 mg/kg mercury. Sediment in Shelter Island Yacht Basin averaged 96.3 mg/kg copper and 0.64 mg/kg mercury. The report concluded that mussels exposed in Commercial Basin and in Shelter Island Yacht Basin contained similar tissue concentrations of metals despite the much higher sediment metals concentrations in Commercial Basin.

WATER QUALITY STANDARDS

24. Several of the RAAARs examined the sediment concentrations which would not cause the following concentrations to be exceeded in the water column; 3 ug/l for copper, 0.04 ug/l for mercury, and 6 ng/l for TBT. At the time of these reports there were no applicable numerical water quality standards for enclosed bays such as San Diego Bay. Therefore, these water quality standards were taken from the "Water Pollution Control Plan, Ocean Waters of California, 1988" and from the report titled, "Tributyltin a California Water Quality Assessment," December 1988.

25. The State Board adopted the "1991, California Enclosed Bays and Estuaries Plan, Water Quality Control Plan for Enclosed Bays and Estuaries of California" (Enclosed Bays and Estuaries Plan) on April 11, 1991. This Enclosed Bays and Estuaries Plan contains numerical water quality standards which are applicable to San Diego Bay; a 1-hour average of 2.9 ug/l for copper, a 1-hour average of 2.1 ug/l for mercury, a 30-day average of 25 ng/l for mercury, and a 30-day average of 5 ng/l for TBT.

26. The Woodward-Clyde RAAAR, Driscoll Custom Boats RAAAR, and the Shelter Island RAAAR attempted to define a relationship between sediment concentrations and interstitial water concentrations. The results of these analyses are summarized in the table below. Woodward-Clyde and Driscoll Custom Boats developed vastly different numbers for the copper relationship. Woodward-Clyde developed the only mercury relationship, because all of the interstitial water samples for Driscoll Custom Boats were below the detection limit for mercury. The Shelter Island Boatyard RAAAR reported that, due to the uncertainties and number of

variables, a relationship between sediment concentration and interstitial water concentration could not accurately be developed for metals such as copper and mercury. The variables and factors involved in the metal sorption process in sediments are quite complex, and are not entirely understood at this time. The Regional Board believes that an accurate relationship was not developed between sediment concentration and interstitial water concentration for copper or mercury.

	Woodward-Clyde		Driscoll Boats		Shelter Island	
	Sediment mg/kg	Water ug/l	Sediment mg/kg	Water ug/l	Sediment mg/kg	Water ug/l
Copper	378	3	.849	3	none	3
Mercury	3.5	0.04	none	0.04	none	0.04
TBT	none	0.006	0.01	0.006	0.01-0.0229	0.006

APPARENT EFFECTS THRESHOLD (AET)

27. In September of 1988, a report titled "Sediment Quality Values Refinement: Volume I; 1988 Update and Evaluation of Puget Sound AET" was published for the Puget Sound Estuary Program, U.S. Environmental Protection Agency. The report was prepared by PTI Environmental Services with funding from the National Estuary Program, U.S. Environmental Protection Agency. The 1988 AET sediment concentrations in dry weight for copper and mercury are listed below. An AET for TBT was not developed in this report.

Chemical	Amphipod AET Values	Oyster AET Values	Benthic AET Values
Copper	1,300 mg/kg	390 mg/kg	530 mg/kg
Mercury	2.1 mg/kg	0.59 mg/kg	2.1 mg/kg

28. California AETs have now been developed for the State Board and published in a report titled "Evaluation of the AET Approach for Assessing Contamination in Marine Sediments in California, November 1989." These numbers were derived on an experimental basis and have not been adopted by the State Board. Three data sets were used to develop three sets of AET values for 1) "All of California," 2) "Southern California," and 3) "Northern California." Reliability was used in the report to measure the suitability of the AET values with respect to correctly predicting biologically impacted and non-impacted stations. Reliability for the "All of California" AET was relatively high for the amphipod and bivalve AET, but only moderate for the benthic AET.

Reliability for the "Southern California" Benthic AET was relatively low, and reliability for "Southern California" amphipod values could not be determined because all values are preliminary. The "All of California" and the "Southern California" AET sediment concentrations in dry weight for copper and mercury, based on dry weight normalization, are listed below.

SOUTHERN CALIFORNIA

Chemical	Amphipod AET Values	Bivalve* AET Values	Benthic AET Values
Copper	>690 mg/kg	---	310 mg/kg
Mercury	---	---	---

ALL OF CALIFORNIA

Chemical	Amphipod AET Values	Bivalve* AET Values	Benthic AET Values
Copper	>690 mg/kg	66 mg/kg	310 mg/kg
Mercury	1.2 mg/kg	0.51 mg/kg	0.51 mg/kg

* Bivalve AET could be calculated only from data collected in Northern California.

"---" indicates AET data could not be calculated with available data.

DETERMINATION OF CLEANUP LEVELS

29. The Regional Board, in determining the appropriate level of cleanup in this matter, is guided by the State Water Resources Control Board's Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California." This policy provides that existing water quality be maintained when it is reasonable to do so. This policy further provides that any change in water quality 1)be consistent with maximum public benefit, 2)will not unreasonably affect beneficial uses, and 3)will not result in water quality less than that prescribed in the policies. The Regional Board has determined that discharges of copper, mercury, and TBT from the seven Commercial Basin Boatyards have resulted in a change in water quality in the affected portion of San Diego Bay; the change in water quality threatens to adversely affect the marine habitat beneficial use of San Diego Bay.

30. The Regional Board, based on the available information, is directing the seven boatyards in Commercial Basin to reduce the sediment copper and mercury concentrations in the affected portion of the San Diego Bay to a sediment copper concentration less than 530 mg/kg (dry weight) and to

sediment mercury concentration less than 4.8 mg/kg (dry weight) as recommended by the sediment toxicity and infaunal studies performed for the Woodward-Clyde RAAAR. This cleanup level represents less than 100 percent removal of the affected sediment. The Regional Board has determined that this cleanup level is reasonable, consistent with the maximum public benefit, and should not unreasonably affect beneficial uses. It was not possible to fully determine if these cleanup levels will result in water quality less than that prescribed in the Enclosed Bays and Estuaries Plan. However, these cleanup levels were chosen using biological effects data. The Regional Board believes that the beneficial uses will be protected by these cleanup levels. Post-cleanup sampling is designed to confirm that the beneficial uses will be protected.

31. The Regional Board is also guided by the Environmental Protection Agency's antidegradation policy contained in 40 CFR 131.12. The federal antidegradation policy requires that changes in water quality be consistent with the following three part test:

    a. Existing instream water uses and level of water quality necessary to protect the existing uses shall be maintained and protected.

    b. Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, the quality shall be maintained and protected unless the State finds ... that allowing the lower water quality is necessary to accommodate important economic or social development....

    c. Where high quality waters constitute an outstanding National resource ... that water quality shall be maintained and protected."

    The Regional Board has determined that 1) the cleanup levels established in this order will protect and maintain existing instream water uses, 2) the water quality will not exceed levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water, and 3) the water quality in the affected area will be improved upon implementation of these cleanup levels.

32. The PTI RAAAR reported that the sediment adjacent to Shelter Island Boatyard contained no copper and mercury above the cleanup levels of 530 mg/kg (dry weight) copper and 4.8 mg/kg (dry weight) mercury. The highest concentrations reported by the PTI RAAAR were 315 mg/kg (dry weight) copper

and 4.2 mg/kg (dry weight) mercury. The sediment concentrations adjacent to Shelter Island Boatyard are elevated above background concentrations, and are indicative of waste discharges by Shelter Island Boatyard. However, these elevated concentrations are below the cleanup levels as shown in the table below. Therefore, the Regional Board is rescinding Cleanup and Abatement Order No. 88-70 for Shelter Island Boatyard.

	COPPER dry weight mg/kg	MERCURY dry weight mg/kg
CLEANUP LEVELS	530	4.8
REPORTED LEVELS	315	4.2
BACKGROUND LEVELS	96.3	0.64

IT IS HEREBY ORDERED that:

1. Cleanup and Abatement Order No. 88-70 is hereby rescinded.

I, Arthur L. Coe, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Diego Region, on October 28, 1991.

ARTHUR L. COE
Executive Officer

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

CLEANUP AND ABATEMENT ORDER NO. 88-79

BAY CITY MARINE, INC.
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board) finds that:

1. On June 1, 1981 this Regional Board adopted Order No. 81-24 (NPDES NO. CA0108006, **Waste Discharge Requirements for the Harbor Boat and Yacht Company, San Diego County**. Order No. 81-24 established waste discharge requirements prohibiting the discharge of various boat repair wastes to San Diego Bay. The facility is located on the shoreline of the Commercial Basin portion of San Diego Bay at 4960 Harbor Drive in San Diego on land owned by the San Diego Unified Port District. On November 10, 1984 this Regional Board adopted Addendum No. 1 to Order No. 81-24, modifying the requirements of Order No. 81-24 to reflect a change of ownership for the Harbor Boat and Yacht Company to Bay City Marine, Inc..

2. On May 4, 1987, this Regional Board adopted Order No. 87-49, NPDES No. CA0108006, **Waste Discharge Requirements for the Bay City Marine Incorporated, San Diego County**. Order No. 87-49 renewed the waste discharge requirements contained in Order No. 81-24 and established additional waste discharge requirements prohibiting the discharge of various boat repair wastes to San Diego Bay.

3. NPDES permits in the San Diego Region currently require shipyard and boatyard operators to follow best management practices plans to prevent the discharge of substances such as refuse, rubbish, spent abrasives, paint, paint chips, and marine fouling organisms cleaned from vessel hulls. Bay City Marine, Inc. was required to submit a best management practices plan as part of the report of waste discharge for Order No. 87-49. The best management practices plan identified various measures that Bay City Marine, Inc. would undertake to prevent the discharge of pollutants to San Diego Bay. The best management practices plan was accepted by the Regional Board and incorporated into Discharge Specification B.2 of Order No. 87-49.

4. Order No. 87-49 contains the following applicable terms and conditions:

   a) Prohibition A.2: "The deposition or discharge of refuse, rubbish, materials of petroleum origin, spent abrasives (including old primer and antifouling paint), paint, paint chips, or marine fouling organisms into San Diego Bay or at any place where they would be eventually transported to San Diego Bay is prohibited."

   b) Discharge Specification B.1: "Effluent discharged to San Diego Bay must be essentially free of....:

      b) "Settleable material or substances that form sediments which degrade benthic communities or other aquatic life."

c) "Substances toxic to marine life due to increases in concentrations in marine waters or sediments."

c) Discharge Specification B.2: "The discharger shall implement best management practices[4] which prevent or minimize the potential for release of toxic or hazardous pollutants from Bay City Marine, Inc. to San Diego Bay in accordance with the Best Management Practices Plan attached as Appendix A to this NPDES permit. The discharger shall amend its Best Management Practices Plan in accordance with 40 CFR Sections 125.100 - 125.104 whenever there is a change in design, construction, operation, or maintenance which materially affects the potential for discharge of significant amounts of hazardous or toxic pollutants into the waters of the United States. All changes in the Best Management Practices Plan shall be reported to the Executive Officer.

4 Best Management Practices means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to event or reduce the pollution of waters of the United States.

d) Provision D.1: "Neither the treatment nor the discharge of pollutants shall create a pollution, contamination, or nuisance as defined by Section 13050 of the California Water Code."

e) Provision D.12: "The discharger shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with the conditions of this Order. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this Order."

5. The **Water Quality Control Policy for the Enclosed Bays and Estuaries of California, 1974** (hereinafter referred to as the Bays and Estuaries Policy) adopted by the State Water Resources Control Board on May 16, 1974, contains water quality standards applicable to waste discharges to enclosed bays and estuaries such as San Diego Bay. The Bays and Estuaries Policy does not contain numerical water quality objectives for waste discharges to bays and estuaries. The Bays and Estuaries Policy requires that discharges of municipal wastewater and industrial process wastewaters to enclosed bays and estuaries be phased out at the earliest practicable date. On June 16, 1988 the State Board found in Order No. 88-4 that miscellaneous water flows from boatyards containing pollutants such as dry paints and sandblasting abrasives did not qualify as a industrial process wastewater under the Bays and Estuaries policy. Thus the Regional Board is not prohibited from granting waste discharge requirements for discharges such as those described in Order No. 88-4.

6. On November 17, 1983 the State Water Resources Control Board adopted the **Water Quality Control Plan, Ocean Waters of California, 1983** (hereinafter referred to as the Ocean

Plan). The Ocean Plan contains the following applicable water quality objectives for copper and mercury:

Constituent	6-Month Median	Daily Maximum	Instantaneous Maximum
Copper	5 µg/l	20 µg/l	50 µg/l
Mercury	0.14 µg/l	0.56 µg/l	1.4 µg/l

7. In the findings and directives of this cleanup and abatement order, effluent limitations and water quality objectives contained in the Ocean Plan are used as a baseline to determine the potential effects of waste discharges from Bay City Marine on the water quality and beneficial uses of San Diego Bay as well as appropriate cleanup levels. The Ocean Plan is applicable to point source discharges of waste to ocean waters; however,the Ocean Plan is not applicable to waste discharges to enclosed bays such as San Diego Bay. The beneficial uses of San Diego Bay are identical to those of the ocean. San Diego Bay waters are in hydrologic continuity to waters of the open ocean; however, the bay waters are subject to less dilution than ocean waters. Thus the water quality standard to protect the beneficial uses of San Diego Bay waters should be at least as stringent as the standards in the Ocean Plan which provide for the protection of open ocean waters. Accordingly the Regional Board finds that, in the absence of numerical water quality standards specifically applicable to San Diego Bay, the numerical water quality standards contained in the Ocean Plan should be used to protect the beneficial uses of San Diego Bay

8. The **Comprehensive Water Quality Control Plan, San Diego Basin (9)** (Basin Plan) adopted by the Regional Board on March 17, 1975, established the following beneficial uses for the waters of San Diego Bay:

Industrial Service Supply
Navigation
Water Contact Recreation
Ocean Commercial and Sport Fishing
Saline Water Habitat
Preservation of Rare and Endangered Species
Marine Habitat
Fish Migration
Shellfish Harvesting

9. On February 2, 1988 Regional Board staff and California Department of Fish and Game staff collected sediment samples from the Commercial Basin portion of San Diego Bay at the station locations shown in Figure 1. Ten of the sediment samples collected on February 2, 1988 were from a portion of Commercial Basin directly fronting Bay City Marine at Stations BQ, BR, BS, BT, BU, BV, BW, and BX. The sample results are summarized below:

Constituent	Range of Dry Weight Concentration	Number of Samples
Copper	388-3528 mg/kg	10
Tributyltin	375-6029 ng/g	10
Mercury	2.83 - 18.45 mg/kg	10

As shown in Figures 2, 3, and 4 concentrations of copper, tributyltin, and mercury decrease markedly with distance from the Bay City Marine facility.

10. Sediment samples were also collected at Stations A, B, CC, and CD on February 2, 1988. Because of their locations these four stations are expected to be least influenced by Commercial Basin boatyard activities (See Area II in Figures 1 through 4). Theses stations had markedly lower concentrations of copper, tributyltin, and mercury than the stations fronting Bay City Marine. The sample results for these stations are summarized below:

Constituent	Range of Dry Weight Concentration	Number Of Samples	Mean Dry Weight Concentration
Copper	49-77 mg/kg	4	63 mg/kg
Tributyltin	83-240 ng/g	4	193 ng/g
Mercury	0.53-1.26 mg/kg	4	0.81 mg/kg

For purposes of evaluating the environmental effects of boatyard activities in Commercial Basin, the Regional Board believes it is reasonable to use the sediment quality at Stations A, B, CC, and CD to represent "background conditions".

11. Cuprous oxide, other copper compounds and tributyltin are antifouling agents commonly used in vessel paints to inhibit the growth of marine organisms on hull bottoms. Mercury and mercuric salts were extensively used in antifouling marine paints as an antifouling agent prior to 1970. In 1970 the use of mercury and mercuric salts in antifouling marine paints was discontinued.

12. The background concentration of tributyltin in the sediments and water column of San Diego Bay can also be influenced by the continuous leaching of tributyltin from the hulls of vessels moored in the bay in addition to waste discharges from boatyards/shipyards. In order to estimate the tributyltin contribution from moored vessels, Regional Board and the Department of Fish and Game staff collected 3 sediment samples for tributyltin analysis from the Shelter Island Yacht Basin portion of San Diego Bay on May 10, 1988. Shelter Island Yacht Basin receives no boatyard discharges but has extensive marina facilities. The tributyltin concentration in these sediment samples ranged from 138 to 231 ng/g, with a mean concentration of 195 ng/g. Since there are no direct discharges of waste from boatyard facilities into Shelter Island Yacht Basin, the Regional Board believes that the existing concentrations of tributyltin in Shelter Island Yacht Basin sediments results from the leaching of tributyltin from antifouling marine paints on vessel hulls. The 195 ng/g tributyltin concentration found in Shelter Island Yacht Basin is essentially equal to the 193 ng/g concentration cited in Finding 10 as representing "background

conditions" in Commercial Basin. For this reason the Regional Board believes that the 193 ng/g tributyltin concentration found at the "background" stations of Commercial Basin incorporates the contribution of tributyltin which can be expected from the leaching from vessel hulls alone.

13. Paint chips were extracted from additional sediment samples collected March 8, 1988 at twenty stations in Commercial Basin by Regional Board and Department of Fish and Game staff. The paint chips were quantified and analyzed for heavy metals and tributyltin and the sediment samples were analyzed for tributyltin. The paint chips were not analyzed for mercury due to insufficient sample size. Results of the paint chip and sediment analysis for Stations BV, BW, and BX in dry weight are as follows:

Station	Paint Chips[1]	Copper Paint Chip	Tributyltin Paint Chip	Tributyltin Sediment
BV	0.46 grams	300,000 mg/kg	829.842 mg/kg	4009 ng/g
BW	0.09 grams	150,000 mg/kg	-	103 ng/g
BX	0.02 grams	< 26 mg/kg	-	32 ng/g

1 Paint chip quantity extracted from approximately 3,500 grams (dry weight) of sediment.

A linear regression analysis of the sample results from the 20 stations done by the Department of Fish and Game shows that there is a statistically significant correlation between the concentration of paint chips and the tributyltin concentration in the sediment. The concentration of tributyltin in sediment increases as the concentration of paint chips in sediment increases. The 32-4009 ng/g range for tributyltin sediment concentration at Stations BV, BW, and BX is less than the 375-6029 ng/g range found on February 2, 1988 cited in Finding 9. The Regional Board believes that this apparent reduction in the concentration of tributyltin present at the Bay City Marine stations may be due to the combination of natural siltation processes and the inherent heterogeneous distribution of contaminents within the sediment.

14. Several conclusions can be drawn from the data which has been obtained in Commercial Basin. The bay sediment data discussed in Findings 9 and 10 shows that concentrations of copper, mercury, and tributyltin at Stations BQ, BR, BS, BT, BU, BB, BW, and BX are very elevated with respect to the background concentrations. Furthermore, the bay sediment data collected by Regional Board staff on February 2, 1988 shows that sediment concentrations of copper, mercury, and tributyltin in the bay sediment decrease markedly with distance from the Bay City Marine facility. The paint composition data cited in Finding 11 shows that copper and tributyltin are used in marine anti-fouling paints. (Mercury is also present in marine antifouling paints in use prior to 1970.) Analysis of paint chips segregated from the bay sediment at Stations BV, BW, and BX showed high concentrations of copper and tributyltin. Based on the foregoing the Regional Board finds and concludes that the elevated concentrations of copper, mercury, and tributyltin in the bay sediment at Stations BQ, BR, BS, BT, BU, BV, BW, and BX resulted from discharges of paint chips and other waste from Bay City Marine into San Diego Bay. These waste discharges constitute a violation of Prohibition A.2, Discharge Specifications B.2 and B.3 and Provisions D.1 and D.12 of Order No. 87-49.

15. In September, 1986 a report titled **Development of Sediment Quality Values for Puget**

Sound was published as a joint effort of the Puget Sound Estuary Program and the Puget Sound Dredged Disposal Analysis. The work was performed by Tetra Tech, Inc. with funding and support from the U. S. Environmental Protection Agency, the U. S. Army Corps of Engineers and the State of Washington Departments of Ecology and Natural Resources. The report evaluates options for sediment management and identifies numerical values for concentrations of chemicals in sediments that appear to be associated with adverse biological effects in Puget Sound. One methodology discussed in the report for determining limiting sediment concentrations is the Apparent Effects Threshold (AET) approach. The determination of AET sediment values for various chemicals was based on oyster bioassays, amphipod bioassays and abundance of benthic infauna. The AET sediment concentration for a given chemical is defined as the sediment concentration of a chemical, above which, statistically significant biological effects (eg., mortality in amphipod bioassays, depressions in the abundance of benthic infauna) could always be expected to occur. The lower limit AET sediment concentrations in dry weight for copper and mercury concentrations (AET values for tributyltin have not been developed) in sediment are listed below:

Chemical	Amphipod AET Value	Oyster AET Value	Benthic AET Value
Copper	310.0 mg/kg	290.0 mg/kg	170.0 mg/kg
Mercury	1.7 mg/kg	0.49 mg/kg	0.52 mg/kg

The discharges of waste from Bay City Marine cited in previous findings have caused bay sediment concentrations of mercury and copper in the vicinity of Bay City Marine to exceed the AET sediment concentration criteria cited above.

16. Currently there are no sediment quality values specifically established for San Diego Bay. Although there are limitations that are inherent in transferring AET sediment quality standards from one water body to another, the Puget Sound AET values still provide useful guidance in predicting the environmental consequences of the sediment quality in Commercial Basin. There are several similarities in the environmental conditions which are present in Puget Sound and San Diego Bay. The potential sources of both copper and mercury contaminants are believed to be similar in Puget Sound and San Diego Bay. Both water bodies have extensive areas of boat and ship repair facilities. Although the natural biota may be somewhat different between the two areas, it is unlikely that San Diego Bay organisms would be significantly more tolerant to heavy metal contamination than the organisms found in Puget Sound. The Regional Board finds and concludes that, in this instance, the Puget Sound AET values represent the best information available on the sediment pollutant concentrations for copper and mercury which could adversely affect the beneficial uses of San Diego Bay.

17. As previously stated in Finding 11, tributyltin is a biocide used in antifouling vessel paints. The antifouling paint prevents the fouling of the vessel hull by releasing tributyltin into the surrounding water. Depending on environmental conditions, tributyltin is eventually degraded into dibutyltin, monobutyltin, and ultimately to elemental tin. Tributyltin is one to two orders of magnitude more toxic than dibutyltin, which is more toxic than monobutyltin. Tributyltin is lipophilic, rapidly adsorbs to marine sediments, and can penetrate biological membranes. Sensitivity to tributyltin varies among aquatic species. Gastropods and bivalves are the most susceptible organisms affected at tributyltin water concentrations as low as 0.02 to 0.14 µg/l,

followed by crustaceans at 0.09 to 0.14 µg/l, algae at 0.1 to 0.35 µg/l, and fishes at concentrations of 0.2 µg/l or greater. Sublethal effects on marine biota caused by tributyltin include reproductive abnormalities, growth retardation, anatomical abnormalities, bioaccumulation, and behavior changes.

18. Tributyltin has been investigated by the State Water Resources Control Board's Priority Chemicals Program. By memorandum dated December 30, 1987 State Board staff presented a summary of the findings and recommendations contained in the forthcoming report **Tributyltin in California Waters.** In this report State Board staff recommended a water quality criteria of 6 ng/l for tributyltin in seawater to protect aquatic life. State Board staff also recommended that this criteria serve as the basis for adoption of water quality objectives in the California Ocean Plan and basin plans. In the absence of a standard for tributyltin in San Diego Bay, the State Board's recommended criteria of 6 ng/l will be applied for purposes of establishing sediment cleanup levels. Water quality objectives for tributyltin in marine sediments have not been established.

19. Regional Board and Department of Fish and Game staff conducted a sampling survey of tributyltin water column concentrations throughout San Diego Bay on August 19, 1987. The tributyltin water column sample results are contained in the Department of Fish and Game's draft report, **Preliminary Data Report on Tributyltin and PCBs in San Diego Harbor, March 30, 1988** and are summarized below:

Location	Station	Range of Tributyltin Concentrations	Number of Samples	Mean Tributyltin Concentrations
Bay Entrance	1-4	<7-36 ng/l	4	22 ng/l
Shelter Is Yacht Bn	5-6	210 ng/l	1	210 ng/l
Commercial Basin	7-9	75-420 ng/l	3	262 ng/l
Harbor Island South	10	24 ng/l	1	24 ng/l
Harbor Island West	11-13	160 ng/l	1	160 ng/l
Harbor Island East	16-22	10-28 ng/l	2	19 ng/l
Navy Channel	14-15	34-56 ng/l	2	45 ng/l
Glorietta Bay	23-25	98 ng/l	1	98 ng/l
7th Street	26-27	<7 ng/l	1	<7 ng/l
Sweetwater	28-32	18-21 ng/l	2	20 ng/l

As shown in the table above the mean tributyltin concentrations in bay waters ranged from a low of <7 ng/l at the 7th Street station to a high of 262 ng/l in Commercial Basin. The mean concentration of tributyltin in Commercial Basin, based on the August 19 sample data, exceeded the mean tributyltin concentrations in all other areas of San Diego Bay. The mean tributyltin concentration of 262 ng/l in Commercial Basin is in excess of concentrations known to cause adverse effects on marine biota and is over 43 times greater than the State Board's Water Quality Criteria of 6 ng/l. As discussed in Findings 9 and 10, the discharge of paint chips significantly contributed to the elevated concentrations of tributyltin in the sediment fronting Bay City Marine. These sediment concentrations in turn contributed to the elevated tributyltin concentrations found in the water column of Commercial Basin. The Regional Board recognizes