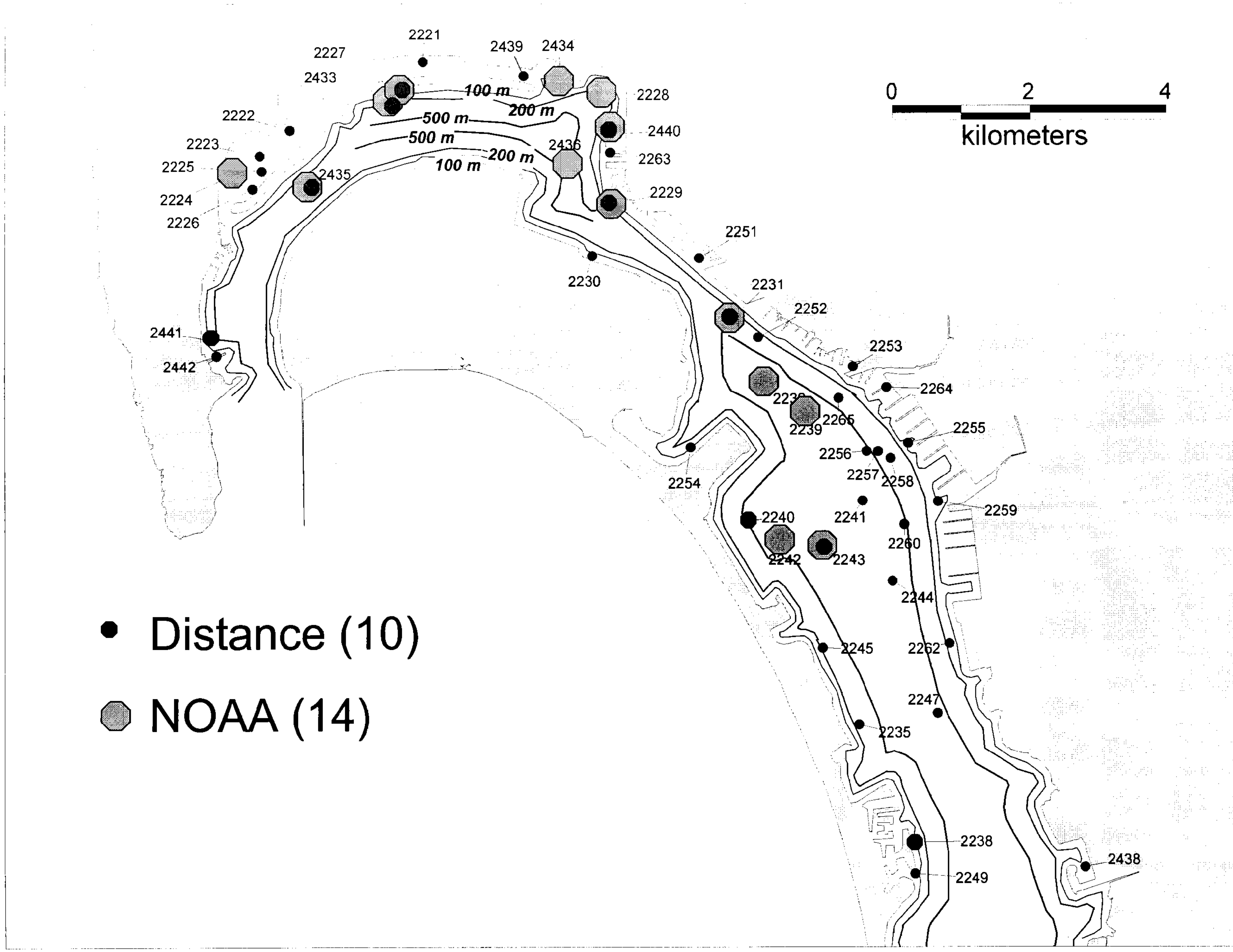
Comparison of Data Limits
10 Bight98 Stations

Bight'98 Station	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	LMWPAHs (ng/g)	HMWPAHs (ng/g)	PPPAHs (ng/g)	ERMq	Amphipod survival (% control)	Number of benthic species
N	10	10	10	10	10	10	10	10	10	10
Mean	52.6	0.226	19.5	102.6	169.5	287.5	576.4	0.07	95.1	58
Std Dev	13.9	0.054	4.8	24.0	88.8	281.7	457.6	0.02	5.7	13.4
Mean+1.64SD	75.3	0.3	27.4	141.9	315.1	749.4	1326.8	0.1		
Upper 95% PI NonAdj.	79.2	0.3	28.7	148.7	340.2	829.0	1456.2	0.1		
Upper 95% PI Adj.	99.8	0.4	35.8	184.3	472.1	1247.6	2136.1	0.1		
Mean-1.64SD									85.7	35.5
Lower 95% PI NonAdj.									84.1	31.7
Lower 95% PI Adj.									75.5	11.8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Laura Hunter

From: Steve Bay [steveb@sccwrp.org]
nt: Thursday, January 23, 2003 6:55 AM
o: Tom Alo; Brian Anderson; Laura Hunter
Subject: additional comparisons

OtherBight98Results.ppt

Tom, Brian, Laura,

I have attached some additional figures to help address the questions that were raised regarding the Bight'98 Benthic data, the different comparison limits (Prediction interval or standard deviation) and the relative locations of the sets of 10 and 14 candidate reference sites.

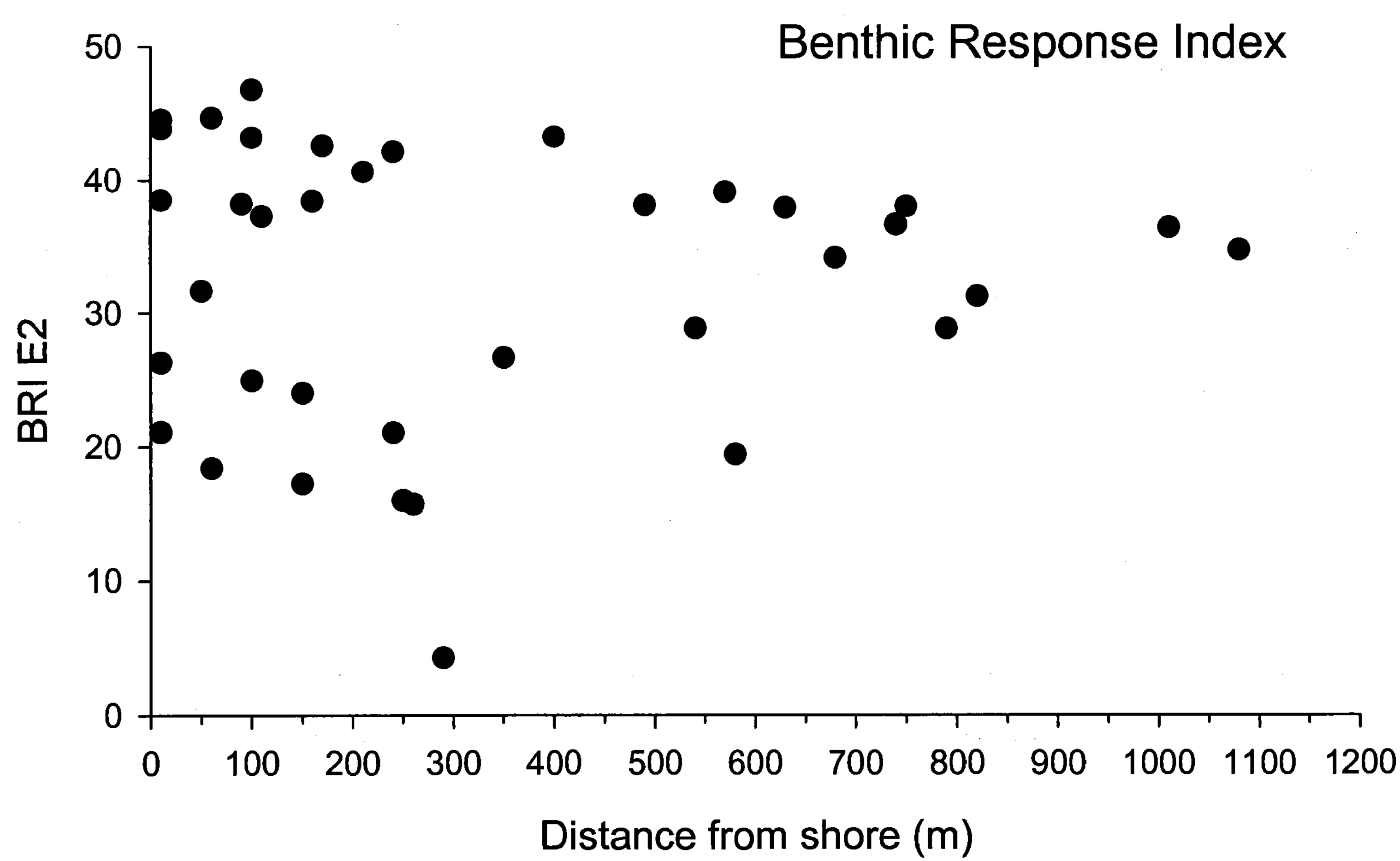
Steve

--

Steven Bay
Southern California Coastal Water Research Project
7171 Fenwick Lane
Westminster, CA 92683
714-372-9204 (ph)/ 714-894-9699 (fax)
steveb@sccwrp.org

EHC 001199

Bight'98 Data



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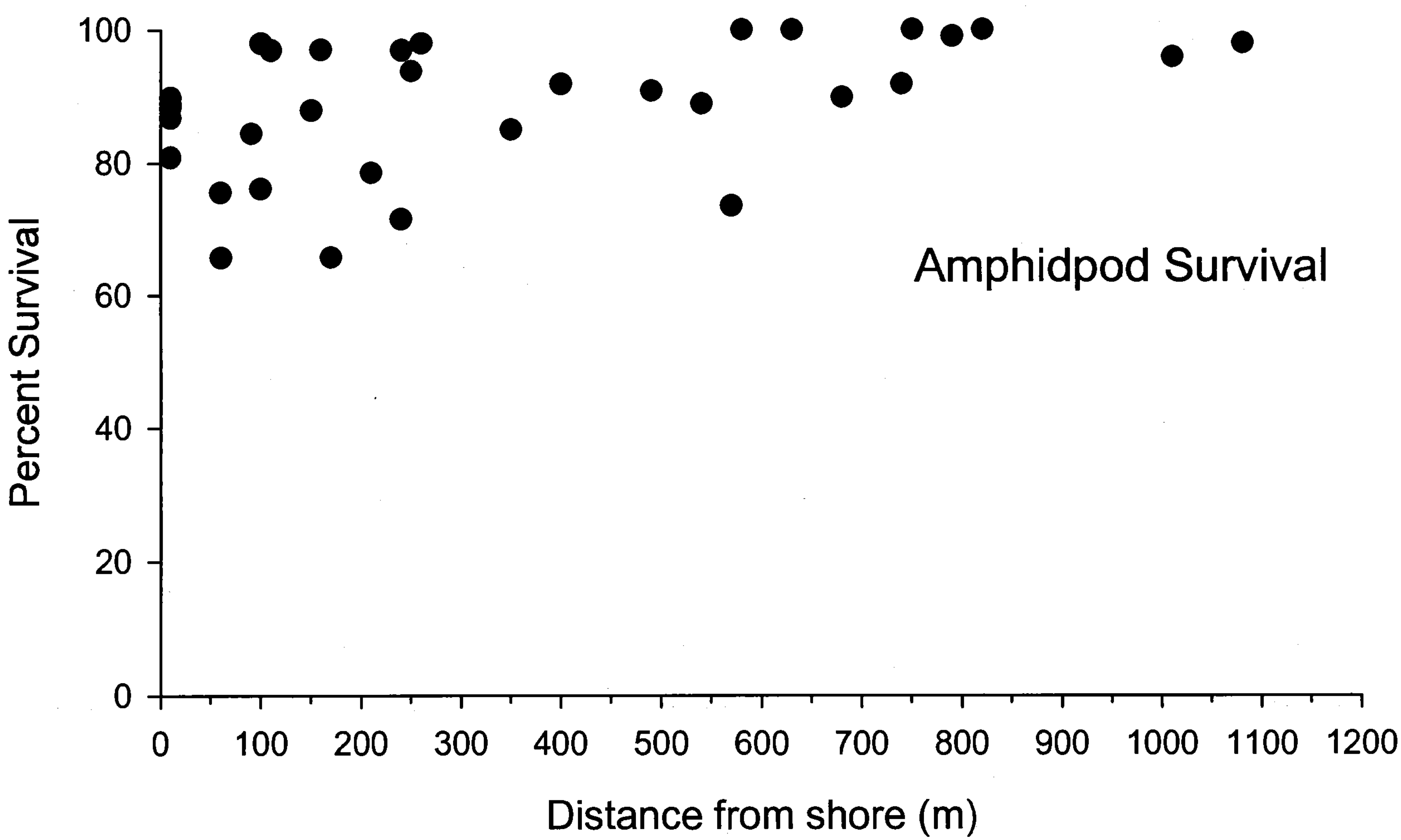

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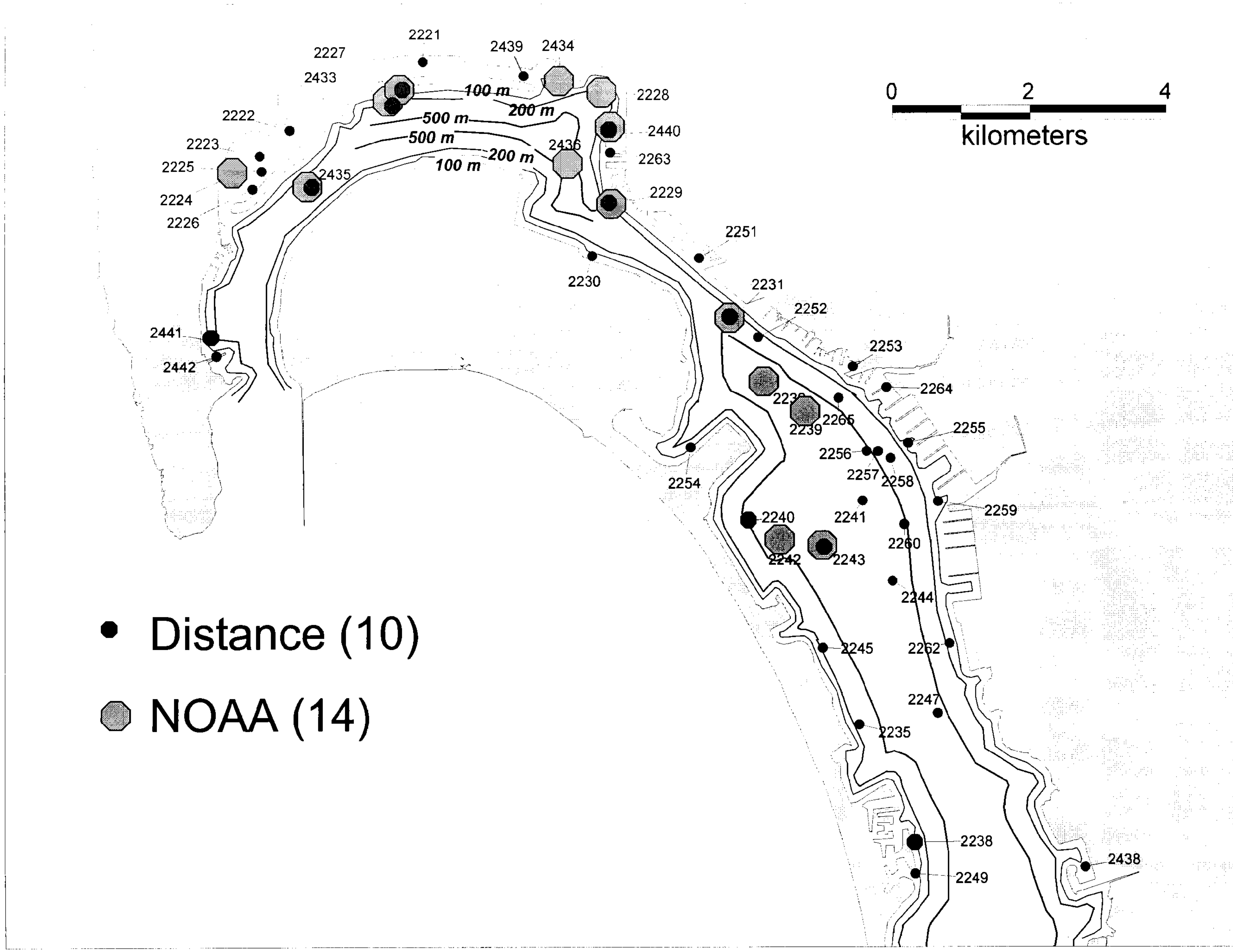

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2259
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Laura Hunter

From: Tom Alo [alot@rb9.swrcb.ca.gov]
Sent: Thursday, January 23, 2003 3:02 PM
To: morley.theresa.l@asw.enrsw.navy.mil; elainecarlin@att.net; emkimr@cts.com; underwoodpm@efdsw.navfac.navy.mil; Laura Hunter; nielsend@exponent.com; mchee@nassco.com; Denise.Klimas@noaa.gov; donald.macdonald@noaa.gov; Scott_Sobiech@r1.fws.gov; David Barker; Charles Cheng; Craig Carlisle; Alan Monji; Brennan Ott; Peter Peuron; steveb@sccwrp.org; chadwick@spawar.navy.mil; ckatz@spawar.navy.mil; Jallen@spawar.navy.mil; halvaxs@swmarine.com; anderson@ucdavis.edu
Cc: MMARTIN@OSPR.DFG.CA.GOV
Subject: EPA Document

All,

Here's the link for the EPA document that Michael Martin discussed at the Jan 22-23 meeting.

http://www.epa.gov/superfund/programs/risk/background.pdf

--Tom

Laura Hunter

From: Denise Klimas [Denise.Klimas@noaa.gov]
Sent: Friday, January 31, 2003 9:51 AM
To: Laura Hunter
Subject: [Fwd: Interesting research on SD Bay]

Laura,
Alan Monji sent me this article yesterday and here is my response back to him and his response to my comments. I am glad to see that the RWQCB is not agreeing with the statement in the City Lights article. BUT, I am concerned that this researcher dissed dredging. This is especially bad because at the sediment workshop last summer folks were telling the Board that dredging will create more problems than it will solve. In my opinion, that is wrong thinking, and this article just gives that credibility because it views things way too simplistically. Thanks for keeping me in the loop.

Did you get the fax I sent on PCBs dissolved in the water column in SD Bay? I sent to the RWQCB but have not heard a reaction from them. Spoke with Mike Martin and he says that Zeng does very good work so the data are accurate................
d

Alan Monji wrote:

> I agree, some of his statements are a bit shaky. I also think the
> sediment water interface tests we have conducted indicate there are
> impacts at the sediment surface to both bivalve and echinoderm larvae.
>
> >>> "Denise Klimas" <Denise.Klimas@noaa.gov> 01/30/03 04:37PM >>>
> Alan,
> Thanks for the article.
> I think the article does a good job of explaining water circulation
> and
> simple sediment chemistry. But, I have to comment on the last couple
> of
> paragraphs, which if one takes without caveats, could lead to the
> belief
> that everything is simple and linear, and dredging is bad. The reality
> is that the chemistry is very complex and doesn't lend itself to
> one-size-fits-all answers.
> I find it disturbing that Dr. Deheyn made the blanket statement that
> it
> is OK to have toxic concentrations of contams below the sediment
> surface
> and that organisms aren't exposed. Depending on the organisms that
> live
> in the sediments, you may not have a static, undisturbed situation.
> For
> SD Bay, I understand that burrowing shrimp (ghost shrimp, snapping
> shrimp, and mud shrimp) are resident throughout the bay. These shrimp
> can go down about a meter and can move great amounts of sediment up to
> the surface. There was a study done for the capping project at
> Convair
> Lagoon and I think that they found the burrowing shrimp in SDB did not
> go quite that deep.
> Anyway, the point is that it is much more complex (bioturbation,
> biomagnification, etc.) than the article leads you to believe. But, I
> am sure you already know this and I am preaching to the choir!
> Have a good weekend!
> d
>
> Alan Monji wrote:

Laura Hunter

From: Elaine Carlin [elainecarlin@worldnet.att.net]

Sent: Tuesday, March 11, 2003 9:16 AM

To: Laura Hunter

Subject: FW:

Here's my original message to Tom, which I forwarded to Denise

-----Original Message-----
From: Elaine Carlin [mailto:elainecarlin@worldnet.att.net]
Sent: Sunday, March 02, 2003 9:10 PM
To: 'alot@rb9.swrcb.ca.gov'
Cc: 'monja@rb9.swrcb.ca.gov'
Subject:

Hi Tom:

I need a bit more time to get comments to you on the various issues discussed at the last (2 day) meeting, including comments on the Phase 2 data. These comments bear directly on your choice of a set of reference stations to use to screen the Shipyard's reference stations, so I want to get them to you in time for you to consider, before you make this choice. How much time do I and the other participants have to get comments in?

Thanks,
Elaine

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Thanks,
Elaine

Laura Hunter

From: Steve Bay [steveb@sccwrp.org]
Sent: Monday, April 07, 2003 6:44 AM
To: Tom Alo
Cc: Denise.Klimas@noaa.gov; Laura Hunter; nielsend@exponent.com; scott_sobiech@fws.gov; mchee@nassco.com; Donald.Macdonald@noaa.gov; Mmartin@OSPR.DFG.CA.GOV; David Barker; Craig Carlisle; chadwick@spawar.navy.mil; ckatz@spawar.navy.mil; halvaxs@swmarine.com; elainecarlin@worldnet.att.net
Subject: Re: Results of steps 1-4?

Maria
235-8636

Tom and Denise,
We (SCCWRP, Navy, Exponent) are in the final stages of conducting the data evaluations that you mention in your email and the 4 pool evaluations described previously. It has taken a while to compile a standardized dataset of the data, resolve questions regarding detection limits and calculation formulas, and attain consensus regarding interpretation of the results.

Our analysis of the Bight'98 data indicated that arsenic and mercury were the only constituents for which a deviation from normality could be supported by statistical evaluation. We have log transformed these data in the final analyses.

A option! do not include any Bight '98 data b does

We plan to submit a summary of our analyses, which will include the prediction limit calculations and statistical summaries of the 1A, 1B, 2A, and 2B reference pools, by this Friday.

Steve

Tom Alo wrote:

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> Steve, Bart, Chuck, and Dreas are currently working on the action items
> listed in your email and we are expecting the results fairly soon:
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> upper (lower) one-tail 95% PI that is not adjusted for multiple
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> Please contact Steve directly regarding information on the Bight'98
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> Thanks Tom, and I look forward to hearing from you.
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--
Steven Bay
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Steven Bay
Southern California Coastal Water Research Project
7171 Fenwick Lane
Westminster, CA 92683
714-372-9204 (ph)/ 714-894-9699 (fax)
steveb@sccwrp.org

#2

Subject: **Re: Quick Question(s) on Reference Site Evaluation Results**
Date: Wed, 16 Apr 2003 14:16:18 -0700
From: "Peter Peuron" <peurp@rb9.swrcb.ca.gov>
To: "Tom Alo" <alot@rb9.swrcb.ca.gov>, <steveb@sccwrp.org>
CC: <nielsend@exponent.com>, "David Barker" <barkd@rb9.swrcb.ca.gov>, "Craig Carlisle" <craigc@rb9.swrcb.ca.gov>, "Alan Monji" <Monja@rb9.swrcb.ca.gov>, "Brennan Ott" <otbre@rb9.swrcb.ca.gov>, <chadwick@spawar.navy.mil>, <ckatz@spawar.navy.mil>

Steve, I don't remember there being an understanding that I would provide guidance on how to normalize chemical concentrations. I remember that I raised an objection to normalizing sets of data that consist of ratios of chemicals to fines content. The problem is that these ratios represent the slope of the normalization relationship and since confidence levels increase the magnitude of whatever data you are
evluating, you will simply increase the slope which represents the chemical to fines normalization. This tends to bias the data so that higher concentrations of chemicals would be allowed at higher fines content than lower contents (higher than the actual normalized relationship would justify using a standard predictive limit approach).
When I compared this effect with the 95% upper predictive limit of the Bight 98 data, I found significant differences between these upper limits. It seems to me that if there is a standard approach that consists of calculating an upper predictive limit on data that represents an established correlation between two parameters, that this
would be the preferred approach. This is what Steve Weisberg did in his
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If there is anything in the literature that backs up the alternative approach of calculating an upper predictive limit for individual ratios
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Pete Peuron

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Pete Peuron

CA Regional Water Quality Control Board
San Diego Region

B STREET / BROADWAY PIERS

DOWNTOWN ANCHORAGE

SWITZER CREEK

21 APRIL 2003 WORKSHOP

Craig L. Carlisle

- INTRODUCTIONS
- CONTAMINATED SEDIMENTS - OVERVIEW
- TMDLs:
  A NUMBER OR A PROCESS?

INTRODUCTIONS

- David Barker, Branch Chief
- Brennan Ott, Project Manager
- Alan Monji, Environmental Specialist
- Tom Alo, WRC Engineer
- Lisa Honma, Environmental Scientist
- Craig Carlisle, Engineering Geologist

INTRODUCTIONS

- Port of San Diego
- City of San Diego
- UC Davis
  Marine Pollution Studies Lab
- CSU San Jose Moss Landing
- SCCWRP, NOAA, and US Navy

CONTAMINATED SEDIMENTS - OVERVIEW

- Definition
- Why a concern ?
- Historical perspective
- Current and future projects

DEFINITION

"Sediments containing chemical concentrations that pose a known or suspected threat to human health or the environment."

WHY A CONCERN ?

- Benthic organisms
- Bioaccumulation
- Human food sources
- Re-suspension

HISTORICAL PERSPECTIVE

- 1985 copper ore clean-up
- Capping Convair Lagoon PCBs
- Commercial Basin boatyards

CURRENT AND FUTURE PROJECTS

- Campbell Shipyard
- Chollas Creek and 7th Street Channel
- Navy: Boat Channel & North Island
- NASSCO and Southwest Marine Shipyards

TMDL: A NUMBER OR A PROCESS?

- A TMDL is a number
- The term TMDL also is used to refer to a process or a project

Regional Sampling - Impairment Determined

↓

303d Listing - TMDL Required

↓

Site Assessment (Problem Identification)

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Analysis (TMDL Development)

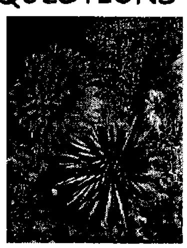
↓

Implementation (Source Control)

↓

Sediment Clean-up

QUESTIONS ?



EHC 000392

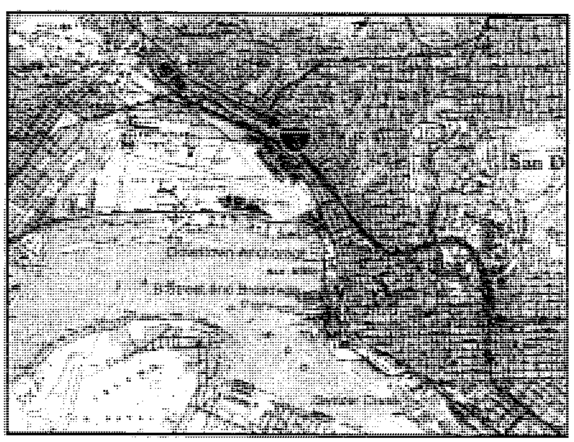
B Street / Broadway Piers, Downtown Anchorage, and Switzer Creek TMDLs

Public Workshop
& CEQA Scoping Meeting
April 21, 2003

Presented by Brennan Ott

Workshop Outline

- Introduction to Downtown Anchorage, Switzer Creek, and B Street / Broadway Piers TMDLs
- Sampling and Analysis (UC Davis)
- CEQA Scoping Meeting
- Questions and Comments



Site History

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- Downtown Anchorage and Switzer Creek identified as Toxic Hot Spots and listed on 303(d)
- B Street / Broadway Piers listed on 303(d)

Downtown Anchorage (Formerly Grape Street) BPTCP Results

Parameter	BPTCP Station 90002
Amphipod Toxicity	x
Benthic Community	x
Chlordane	x
Metals	x

Switzer Creek BPTCP Results

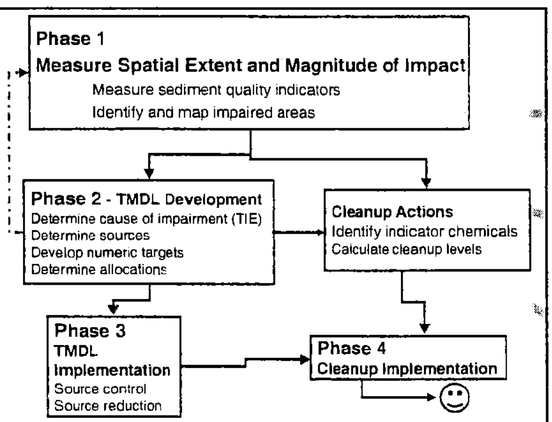
Parameter	BPTCP Station	
	90017	90039
Amphipod Toxicity		x
Benthic Community	x	x
Chlordane	x	x
Metals	x	x

B Street / Broadway Piers (Formerly Downtown Piers) BPTCP Results

Parameter	BPTCP Station		
	90003	93205	93206
Amphipod Toxicity			
Benthic Community	x	x	x
Chlordane	x		x
PAH	x	x	x

Beneficial Uses

Estuarine Habitat (EST)	Wildlife Habitat (WILD)	Shellfish Harvesting (SHELL)	Navigation (NAV)
Migration of Aquatic Organisms (MIGR)	Preservation of Biological Habitats of Special Significance (BIOL)	Contact Water Recreation (REC-1)	Industrial Service Supply (IND)
Marine Habitat (MAR)	Rare, Threatened or Endangered Species (RARE)	Non-Contact Water Recreation (REC-2)	
		Commercial and Sport Fishing (COMM)	



TMDL Elements

- Problem statement
- Numeric targets
- Source analysis
- Linkage analysis
- Margin of safety
- TMDL
- Allocations
- Implementation plan

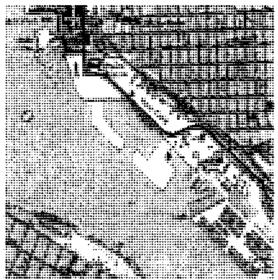
Site Assessment

- Data collection starting June 2003
- Sampling and analysis similar to Bight 98, Shipyard, and Chollas/Paleta studies
- Data needed
  - Sediment chemistry
  - Bioaccumulation
  - Toxicity
  - Benthic community
  - Toxicity Identification Evaluation (TIE)

Project Challenges

- Determining cleanup levels
- Identifying sources
- Controlling sources
- Evaluating cleanup alternatives
- Cleanup of sediments
- Re-suspension of sediment

Switzer Creek



Site specific issues
- Proposed Campbell shipyard cap
- Dredging at 10th Ave Marine Terminal
- Switzer Creek
- Ship activity

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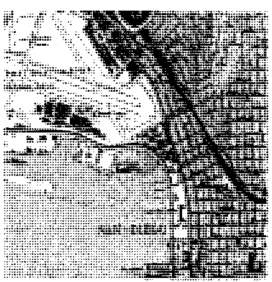
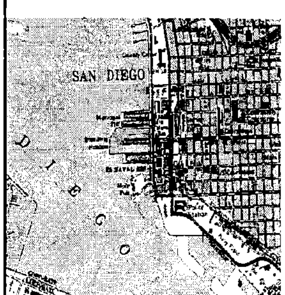


Site specific issues
- Other investigations
- Stormdrains

B Street / Broadway Piers



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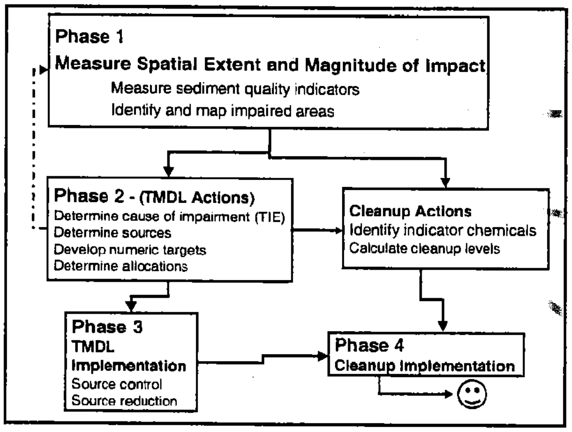
Target Schedule



Target Schedule

- Phase I - March 2004
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San Diego Bay TMDLs Working Group

- Committed group to advise the Regional Board and participate during the TMDL process
- Emphasis on implementation planning
- Key representatives from various stakeholder groups

Public Participation

- Subscription lists
- Web-site: www.swrcb.ca.gov/rb9
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California Environmental Quality Act (CEQA)

Purpose:

- High-quality environment
  - Identify significant impacts
  - Avoid where possible
  - Mitigate where possible
- Ensure public disclosure/participation

Application of CEQA

- "Projects" undertaken or requiring approval by State and local government agencies.
- "Projects" are activities which have the potential to have a physical impact on the environment

Basin Planning: Exempt from CEQA Requirements

- "Functionally equivalent" to the CEQA requirements for environmental documentation [CCR Title 14, § 15251(g)]
- "Functionally equivalent" documents include: written report, initial draft of Basin Plan amendment, CEQA checklist [23 CCR 3776]

CEQA Scoping Meeting

- Legislation requires lead agency to conduct meeting
- Purpose: gain public input on scope and content of functionally equivalent documents

Scope of Project

- Identify environmental impacts
- Identify mitigation measures
- Identify alternatives for achieving compliance with TMDL (i.e. reducing toxicity levels)

Anticipated Impacts

- Meet toxicity standards
- Healthy benthic community
- Others?

Concluding Remarks

- Thank you for participating
- Please remember to subscribe

CA Regional Water Quality Control Board
San Diego Region

B STREET / BROADWAY PIERS

DOWNTOWN ANCHORAGE

SWITZER CREEK

21 APRIL 2003 WORKSHOP

Craig L. Carlisle

- INTRODUCTIONS
- CONTAMINATED SEDIMENTS - OVERVIEW
- TMDLs:
  A NUMBER OR A PROCESS?

INTRODUCTIONS

- David Barker, Branch Chief
- Brennan Ott, Project Manager
- Alan Monji, Environmental Specialist
- Tom Alo, WRC Engineer
- Lisa Honma, Environmental Scientist
- Craig Carlisle, Engineering Geologist

INTRODUCTIONS

- Port of San Diego
- City of San Diego
- UC Davis
  Marine Pollution Studies Lab
- CSU San Jose Moss Landing
- SCCWRP, NOAA, and US Navy

CONTAMINATED SEDIMENTS - OVERVIEW

- Definition
- Why a concern ?
- Historical perspective
- Current and future projects

DEFINITION

"Sediments containing chemical concentrations that pose a known or suspected threat to human health or the environment."

WHY A CONCERN ?

- Benthic organisms
- Bioaccumulation
- Human food sources
- Re-suspension

HISTORICAL PERSPECTIVE

- 1985 copper ore clean-up
- Capping Convair Lagoon PCBs
- Commercial Basin boatyards

CURRENT AND FUTURE PROJECTS

- Campbell Shipyard
- Chollas Creek and 7th Street Channel
- Navy: Boat Channel & North Island
- NASSCO and Southwest Marine Shipyards

TMDL: A NUMBER OR A PROCESS?

- A TMDL is a number
- The term TMDL also is used to refer to a process or a project

Regional Sampling - Impairment Determined

↓

303d Listing - TMDL Required

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Site Assessment (Problem Identification)

↓

Analysis (TMDL Development)

↓

Implementation (Source Control)

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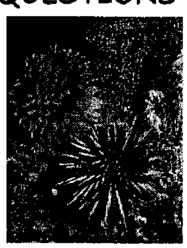

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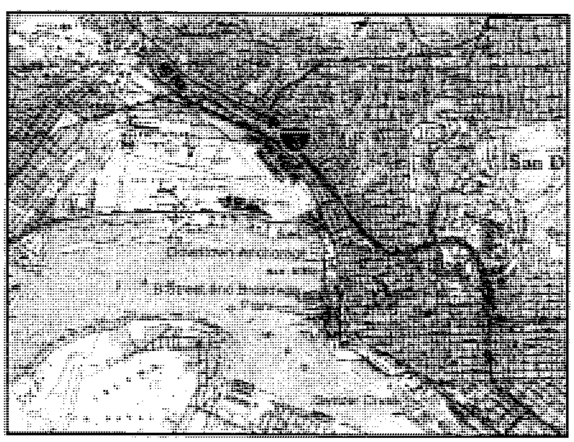

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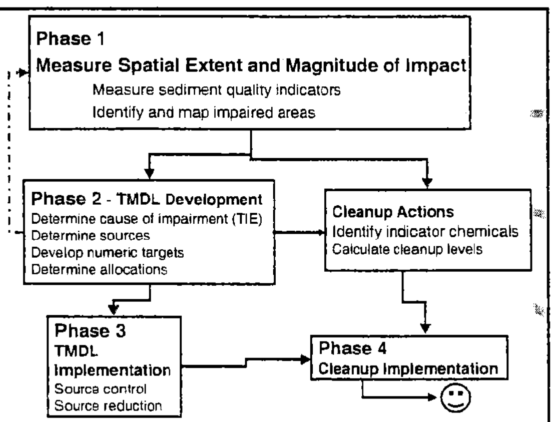

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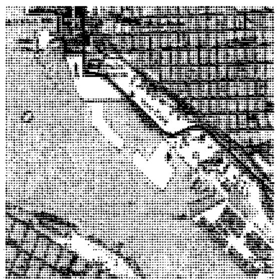

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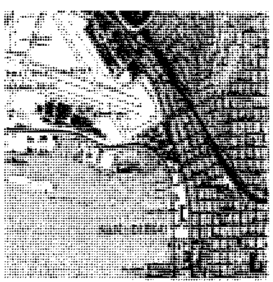

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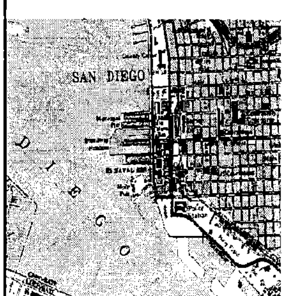

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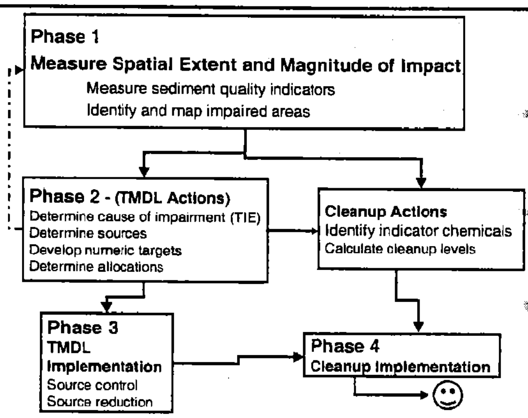

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Concluding Remarks

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Environmental Health Coalition

COALICION de SALUD AMBIENTAL

1717 Kettner Blvd., Suite 100 ◆ San Diego, CA 92101 ◆ (619) 235-0281 ◆ FAX: (619) 232-3670
ehc@environmentalhealth.org ◆ www.environmentalhealth.org

May 2, 2003

Mr. John Robertus
Mr. David Barker
Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Dear Messrs. Robertus and Barker:

As you know, the member organizations of the San Diego Bay Council are very concerned about, and involved in, the cleanup of contaminated sediments at the commercial shipyards in San Diego Bay. We have invested very significant time and resources in this effort, and we believe that the outcome of the Regional Board process, and the Board's ultimate decision, will set a very significant precedent for clean up, not only of San Diego Bay, but also for sediments in the rest of the State. Once again, we are proud that our Regional Board is finding itself on the leading edge of regulatory action in the name of protecting water quality, and we are very confident that you take this issue as seriously as we do. We thank the staff for your hard work on this.

One of the most critical steps – and the step that has held up progress toward cleanup of San Diego Bay - is *the selection of reference sites* for the Bay that will establish background levels, and thus, <u>determine how clean San Diego Bay will ever get</u>. There are EPA guidelines for this process that are readily achievable in San Diego Bay.

We wish to re-emphasize to you that these are widely accepted practices; the selection of reference sites is a relatively simple, straightforward exercise when executed properly. The real basis is simply common sense. Reference stations are those that represent relatively undisturbed conditions within the Bay or within a study area.

There have been at least two lengthy workshops held by staff to discuss the selection of reference sites, however, we have only been included in the second of these. As you remember, at the meeting agreement was reached on several overarching next steps. For example, it was agreed that a decision was needed on what data sets or combination of data sets would be used, what statistical methods would be used, and how the precautionary principle would be incorporated into the process. The original 10 reference stations selected at the beginning of the Chollas and Paleta Creek, and Shipyard studies were to be considered for use, as were the original 12 stations the Regional Board used to establish background levels in March 2002.

Our expectation was that these tasks would be carried out in a transparent manner with all participants informed, provided with the necessary data, and provided the opportunity to offer

input. We are very unclear as to the status of these overarching tasks and are concerned that decisions are being made with discharger input but not with the other interests represented. We understand that the scientists/consultants for the dischargers are working with you closely but the concept of a multi-stakeholder working group, such as was discussed at the TMDL meeting, is not being pursued. For example, the major proposal for a set of 14 reference stations offered by the National Oceanographic and Atmospheric Administration (NOAA) should be an agenda for such a working group meeting but has not been further discussed. *This is a proposal the majority of which we could have supported.*

Access to the data sets being used is critical for our meaningful participation. As you know, despite repeated requests for data – data that staff, the industry, and Navy have been using for quite some time - we were only provided access after the second meeting, in January of 2003. This has put us at a considerable disadvantage. We are concerned that it was indicated that the input we provided *before* we had access to the data, is what you are considering the full extent of our input. It is not.

To move the process forward, and because of profound concerns about how this selection process appears to be unfolding, (and now that we have the necessary data), we have identified a set of relatively clean sites, with relatively healthy benthic communities, to be used as a reference pool for the Bay (enclosed). We had the following purposes in mind as we proceeded:

- *Select a Pool of Reference Stations that will define background (ambient) conditions in San Diego Bay.*
- *This pool can be used for general assessments of whether areas of the Bay are degraded.*
- *This pool, or a subset of this Pool, can be used as reference for site-specific cleanups, including clean-up of the NASSCO and Southwest Marine Shipyards sites.*
- *Recommend that the stations that make up this pool be protected from degradation.*

The pool of reference sites that we have selected illustrates that:

- There are some relatively clean (and healthy) sites available to use as reference sites.
- It is not necessary to use more contaminated sites with marginal or disturbed benthic communities.
- Simple statistical methods that are readily understandable, and that keep the data transparent, are sufficient.
- It is possible to comply with EPA's guidance to select the least impaired sites.
- The Regional Board's approach and selection of a reference pool (described in their March 2002 letter) is a robust approach with comparable results.

We offer the attached proposal with a hope that it can be an approach that all entities that desire an equitable and protective cleanup can embrace.

To expedite action we request that the staff hold a full working group meeting to address the various proposals and the action items identified at the last work group meeting. We request that the Regional Board solicit and distribute written comments on the pool of reference stations we have proposed here as well as other proposals such as NOAA's 14 and the Regional Board's set

of 12 stations used to set background levels in March 2002 from the various entities and individuals participating in this process prior to the working group meeting.

Thank you for your attention to this important matter.

Sincerely,

Laura Hunter

Laura Hunter, Director
Environmental Health Coalition

Jim A. Peugh

Jim Peugh
San Diego Audubon

Marco Gonzalez

Marco Gonzalez
Surfrider Foundation, San Diego Chapter

Ed Kimura

Ed Kimura
Sierra Club

Bruce Reznik
San Diego Baykeeper

cc. (by email)
Elaine Carlin, consultant
Sandor Halvax
Mike Chee
Denise Klimas
Scott Sobiech
Michael Martin
Tom Alo
Bart Chadwick

Selecting a Pool of Reference Stations for San Diego Bay

Elaine M. Carlin, Scientific Consultant, San Diego Bay Council
elainecarlin@att.net; 202 607 4715

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- *Recommend that the stations that make up this pool be protected from degradation.*

Definition of Reference Conditions and Reference Sites

According to EPA:

> "Reference conditions are expectations of the status of biological communities in the absence of anthropogenic disturbances and pollution, and are usually based on the status of multiple reference sites."
>
> "Reference sites refer to locations within a [habitat] classification category at which data are collected to represent the most natural ambient conditions present."
>
> "The conditions at reference sites should represent the best range of minimally impaired conditions that can be achieved…"
>
> "The care that states use in selecting reference sites and developing reference condition parameters, together with their use of standard survey techniques, will directly influence the quality of the resulting water body assessment."
>
> "In practice, most reference sites will have some of these [human] impacts, however, the selection of reference sites is always made from those with the least anthropogenic influences."
>
> "Reference sites must be representative of the best quality of the estuaries and coastal marine waters under investigation; that is, they must exhibit conditions similar to what would be expected to be found in the region. They should not represent degraded conditions, even if such conditions are the most common."
>
> "It is advisable that the state make every effort, once reference sites are selected, to protect these areas from degradation."
>
> Source: U.S. Environmental Protection Agency, Office of Water. December 2000. *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance.* EPA–822–B–00–024.

Selection of Reference Pool

Bight 98 Data Set

A pool of minimally impaired stations was selected from the 46 stations of the Bight 98 San Diego Bay sampling program. Two approaches were taken; the first approach looks first for healthiest benthos, the second approach looks first for lowest chemical contamination. Both approaches ultimately rely on all available data, including chemical concentrations, toxicity data, and benthic community analyses (i.e., on all three legs of the triad). According to the California Regional Water Quality Control Board, San Diego Region:

> "Collection of synoptic measurements of sediment chemistry, toxicity, and benthic infauna (triad approach) is essential to assess the relative quality of sediments and to determine whether impacts are related to chemical contamination. Each component of the triad complements the other two and together all three components provides an integrated assessment of the quality of the sediment." (March 6, 2002 letter with attachment from John H. Robertus to Mike Chee and Sandor Halvax, re: Background Reference Conditions for Assessment and Remediation of Contaminated Sediments at NASSCO and Southwest Marine Shipyards, p.8-9.)

First Approach

The first approach begins with considering the benthic data. The benthic community is the best indicator available of ecosystem health, or lack thereof – the protection of the benthic community and ecosystem health is, after all, our ultimate goal. Benthic community information also gives us our only information about the impacts of the chronic stress of pollutants on marine life. In contrast, toxicity testing measures only acute stress.

The Benthic Response Index (BRI) identifies 16 of the 46 stations as "*Reference*" stations based on a healthy or relatively healthy benthos. The remainder of the stations were found to have either a marginal, or a degraded, benthos. These 16 sites include 9 of the 14 reference stations recommended by the National Oceanic and Atmospheric Administration (NOAA). The benthic community data was unavailable when NOAA made its selection - 5 of the NOAA set of 14 have a marginal BRI rating.

In addition to the BRI, the various other benthic endpoints and indexes were assessed in order to look for any problems not reflected in the BRI, and to see if certain of the 16 stations stand out as having the overall "healthiest" benthos. Three of the 16 stations were eliminated based on these benthic endpoints (Stations 2224, 2233, and 2240), and a fourth station was eliminated based on an anomalous benthic community (2231, based on Exponent sampling).

Sediment chemistry was next considered for the remaining 12 stations. First, the Mean ERM Quotient (minus DDT) data was reviewed, and revealed that only 2 of the 12 stations had values over 0.2 (0.273 and 0.210). Next, the individual ERM Quotients for each metal used in the mean quotient (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn) were reviewed for any values of 0.2 or above, i.e. for any metal concentrations that were 20 percent or more of the ERM value for that

chemical. For the organic chemicals, the PAH data was relied upon, because detection limit issues with the PCB data render this data basically unusable. A proposal for determining background levels for PCBs in light of this problem is offered below. PAH data requires further scrutiny in light of the number of nondetects.

Next, amphipod survival toxicity values were considered. These values are control-corrected. Four stations have percent survival values from 100 to 104. Three stations have percent survival values of 97 and 98. Four stations have values ranging from 81 to 88, and one station has a value of 66.

Reference stations were then selected based on all three legs of the triad, keeping in mind the need for a range of grain sizes, total organic carbon (TOC) values, and water depths representative of the various characteristics of the Bay. The following 7 stations provide a range of values for these physical characteristics, and represent the best available minimally-impaired sites from the Bight 98 data set, when all three legs of the triad are considered.

1 Station 2252. This station has a BRI of 4, a mean ERMQ of 0.067, chemistry is below 0.2 ERM for all nine metals, Total PAH (TPAH) is at 16 µg/kg (dry weight). Amphipod survival is 104%. Grain size, represented by the percent of fines, is16%.

(This station was not included NOAA's set of 14 sites because NOAA sorted for percent fines > 23.9%. Generally NOAA stays above 20% fines because normalization for grain size may result in high chemistry values (personal communication, D. MacDonald). For this station, chemistry is very low, so I have included it.)

2 Station 2435. This is a NOAA station, with a BRI of -1, and mean ERMQ of 0.077. Chemistry is below 0.2 ERM for all nine metals. TPAH is at 0 µg/kg. Amphipod survival is 102%. Percent fines is 49.

3 Station 2229, a NOAA station, has a BRI of 16, a mean ERMQ of 0.136, chemistry is above 0.2 ERM for Cu (0.218), Hg (0.444), and Zn (0.242). TPAH is at 687 µg/kg (ERL is 4022). Amphipod survival is 98%. Percent fines is 43.

4 Station 2433, a NOAA station and NASSCO/SWM Reference Station 2, has a BRI of 21 and a mean ERMQ of 0.155. Chemistry exceeds 0.2 ERM for Cu (0.265), Hg (0.370), Ni (0.289), and Zn (0.307). TPAH is at 284 µg/kg. Amphipod survival is at 97%. Percent fines is 71.

5 Station 2227, a NOAA station, has a BRI of 25 and a mean ERMQ of 0.128. Chemistry is equal to 0.2 ERM for Cu, and exceeds 0.2 ERM for Hg (0.333), Ni (0.215), and Zn (0.273). TPAH is at 305 µg/kg. Amphipod survival is 98%. Percent fines is 50.

6 Station 2434, a NOAA station, has a BRI of 24, and a mean ERMQ of 0.128. Chemistry exceeds 0.2 ERM for Cu (0.255), Ni (0.225), and Zn (0.322). TPAH is at 455 µg/kg. Amphipod survival is 101%. Percent fines is 45.

#7 Station 2441. This station has a BRI of 17, and a mean ERMQ of 0.144. Chemistry exceeds 0.2 ERM for Cu (0.266), Hg (0.268), Ni (0.322), and Zn (0.300). TPAH is at 1519 μg/kg. Amphipod survival is 88%. Percent fines is 79.

(This station is not included in the NOAA 14 because NOAA sorted for amphipod survival greater than 90%. To incorporate a higher-fines site, it was necessary to select this site even though the survival rate is significantly lower than the other selected stations. It is intended that this station be used as reference for similarly high-fines sites.)

These seven stations are located in Mid and North San Diego Bay. Grain size ranges from 16 percent fines to 79 percent fines. TOC values range from 0.6 to 2.0. Depths range from 3 to 16 meters.

Second Approach

The second approach begins with selection of the lowest chemical concentration sites. Fourteen sites were identified as having the lowest concentrations for several chemicals of concern and overall chemistry. The first two of these sites have concentrations for mercury, copper, zinc, the mean ERMQ, and total PAH that fall in the top 5 cleanest Bight stations. Amphipod survival rates are also in the top 5 highest survival rate stations. These are stations 2252 and 2435, two of the seven stations selected above, using the first approach.

The third site, 2265, also has concentrations for mercury, copper, zinc, mean ERMQ, and total PAH in the top 5, but amphipod survival is 85 percent. Thirty-three of the 46 Bight stations have higher than 85 percent survival. It would be appropriate to include this station based on its chemistry (and a healthy benthos rating), but not based on amphipod survival because this rate falls in the lower third of all sites, and suggests that an unknown factor is causing toxicity. As noted above, NOAA used 90 percent survival as its sorting criteria.

It is instructive to note at this point, if the reference pool is constructed based on chemistry alone, station 2265 (and other very low chemistry stations) would be selected, and background contaminant levels would be lower than those established by using all three legs of the triad

The fourth station, 2230, has two drawbacks. Despite very low chemistry for copper, zinc, and mean ERMQ, (and healthy benthos), mercury is at 0.5 ERM, and amphipod survival is very low, at 66 percent.

The next eight stations, 2243, 2244, 2440, 2260, 2247, 2231, 2242, and 2241, have disqualifying benthos, and four have amphipod survival rates that fall in the lower two thirds of the Bight stations. In addition, six of these stations have at least one chemical concentration for mercury, copper, zinc, mean ERMQ, or TPAH that falls below the top third of Bight stations for that chemical.

The last two of the 14 lowest overall chemical concentration sites each have at least two individual chemical concentrations that fall below the top third of stations for that chemical.

Both of these sites have a "reference" level BRI, but one site, 2240, was eliminated for other benthic endpoints. The second, 2229, was selected under the first approach, above.

Bay Protection and Toxic Cleanup Program Data Set

Description of Data Set

> This Data Set is part of the ongoing Bay Protection and Toxic Cleanup Program, a legislatively-mandated program with the mission of assessing chemical pollution and associated biological effects in California's bays and harbors. In the San Diego Bay region, 350 stations were sampled between October, 1992 and May, 1994.
>
> Random sampling of San Diego Bay was conducted as part of the Program. One hundred and twenty one (121) stations were randomly selected using a stratified sampling design. This stratified random design ensures that all areas of the Bay are covered in the sampling. Sampling designed to identify specific toxic hot spots was carried out at 229 additional stations.

Chemistry

For several chemicals of concern, the Bay Protection data set contains many stations with lower concentrations than the Bight data set. For example, the cleanest 10 percent of the Bay Protection stations for mercury – a total of 20 stations – have mercury ERM Quotients ranging from 0.053 to 0.156. The Bight data set contains only a few stations with ERM Quotients for mercury in this range.

As a result, if the reference pool is constructed using the cleanest stations when both data sets are considered, one would expect background levels to be lower, and possibly significantly lower, than those established using only the Bight data set. We propose that the cleanest 10 percent of the Bay Protection stations be considered for inclusion in the pool for at least two reasons: first, to comply with the guidance referenced above directing the selection of the least impaired sites for reference purposes; and second, to address the likelihood that chemical concentrations in the Bay have been increasing over time.

With the continuing loading of contaminants into the Bay environment from a variety of sources not yet controlled, and from known toxic hot spots and other contaminated areas of the Bay, chemical concentrations, toxicity and the degradation of benthos are expected to have increased over time. Thus, we find cleaner stations in the Bay Protection sampling time frame as compared to the Bight 98 sampling time frame. This increasing trend can only be expected to continue until these various sources of contamination are controlled or eliminated.

Approach to Determine Reference Concentrations for Total PCBs

A background level for PCBs should, in theory, be set at zero because there is no natural background level of this human-made contaminant. Because PCBs are pervasive in San Diego

Bay sediments, it may be necessary to set a background level slightly above zero, to represent PCB concentrations found in the cleanest parts of the Bay.

The PCB data from the Bight data set is basically unusable, due to detection limit issues. The set of PCB values from the 10 percent of the Bay Protection stations with the lowest PCB levels is proposed to be used to determine reference concentrations for PCBs. For total PCBs, these values range from 4.38 to 27.2 µg/kg.

This same approach can be used for other chemicals of concern that were not sampled in the Bight study, for example, the tributyltin chemicals, and PAHs depending on a final determination of the adequacy of the Bight 98 data for PAHs.

Background Values Based on Reference Station Pool

The average value for contaminants of concern was calculated using the proposed reference station pool. Non-detect values are treated as zero. Standard deviations and confidence intervals were also calculated (see Tables below, prepared by Ed Kimura).

Mean values calculated for the above 7 stations are relatively close to mean values for the 12 reference stations selected by the Regional Board to define background conditions for the NASSCO and Southwest Marine Shipyards Study (see March 2002 reference, above). In fact, results presented here confirm the overall robustness of the approach and results by Regional Board staff. Two different approaches, both relying on the best available triad data, produced comparable background values. As discussed above, if station 2265 (and other very low chemistry stations) are added to the pool, background contaminant levels would be even closer to the March 2002 values.

The following are the mean values for the 7 stations selected here (far left column), and for comparison purposes, the mean values for the 12 Regional Board stations selected in March, 2002 (second column). Also for comparison purposes, the third and fourth columns are the ERL and ERM values, respectively.

	PROPOSED POOL	RWQCB POOL	ERL	ERM	Units
Copper	55	46	34	270	(dry weight)
Zinc	103	87	150	410	mg/kg
Lead	20	19	46.7	218	
Mercury	0.18	0.20	0.15	0.71	
Arsenic	6.8	5.2	8.2	70	
Cadmium	0.16	0.08	1.2	9.6	
Chromium	32	25	81	370	
Nickel	11.1	7.9	20.9	51.6	
Silver	0.56	0.30	1.0	3.7	
Total PAH	467	240	4022	44792	µg/kg
Toxicity	98 %	89-96 %			

Selected Reference Stations:
Metals

StationID	STRATA	Units	Ag	ERMQ_Ag	As	ERMQ_As	Cd	ERMQ_Cd	Cr	EI
2252	sdport	mg/kg	0.204	0.055	4.34	0.062	0.041	0.004	14.8	
2435	sdother	mg/kg	0.185	0.050	5.06	0.072	0.136	0.014	20.6	
2229	sdother	mg/kg	0.413	0.112	5.36	0.077	0.085	0.009	31.6	
2433	sdother	mg/kg	0.499	0.135	8.32	0.119	0.245	0.026	34.5	
2227	sdmari	mg/kg	0.456	0.123	5.65	0.081	0.200	0.021	27.4	
2434	sdother	mg/kg	0.640	0.173	6.22	0.089	0.171	0.018	49.8	
2441	sdport	mg/kg	1.500	0.405	12.4	0.177	0.250	0.026	43.9	
Statistics for 7 Stations										
Average			0.557	0.150	6.76	0.097	0.161	0.017	31.8	
Max			1.500	0.405	12.40	0.177	0.250	0.026	49.8	
Min			0.185	0.050	4.34	0.062	0.041	0.004	14.8	
Stdev			0.446	0.121	2.78	0.040	0.079	0.008	12.3	
95% confidence			0.330	0.089	2.06	0.029	0.058	0.006	9.1	
upper limit			0.887	0.240	8.83	0.126	0.220	0.023	40.9	
lower limit			0.226	0.061	4.70	0.067	0.103	0.011	22.7	
use 1 Stdev:										
upper limit			1.003	0.271	9.547	0.136	0.240	0.025	44.1	
lower limit			0.111	0.030	3.981	0.057	0.082	0.009	1[illegible]	

Selected Reference Stations:
Metals

StationID	STRATA	Units	Hg	ERMQ_Hg	Ni	ERMQ_Ni	Pb	ERMQ_Pb	Zn
2252	sdport	mg/kg	0.113	0.158	4.2	0.081	13.8	0.063	64.2
2435	sdother	mg/kg	0.123	0.173	9.9	0.192	7.1	0.033	64.4
2229	sdother	mg/kg	0.316	0.444	9.3	0.180	24.5	0.112	99.3
2433	sdother	mg/kg	0.263	0.370	14.9	0.289	21	0.096	126.
2227	sdmari	mg/kg	0.234	0.330	11.1	0.215	17.9	0.082	112.
2434	sdother	mg/kg	0.015	0.021	11.6	0.225	31.6	0.145	132.
2441	sdport	mg/kg	0.191	0.268	16.6	0.322	21.9	0.100	123.
Statistics for 7 Stations									
Average			0.179	0.252	11.1	0.215	19.7	0.090	103.
Max			0.316	0.444	16.6	0.322	31.6	0.145	132.
Min			0.015	0.021	4.2	0.081	7.1	0.033	64.2
Stdev			0.103	0.145	4.0	0.078	7.8	0.036	28.5
95% confidence			0.076	0.107	3.0	0.058	5.8	0.027	21.1
upper limit			0.255	0.359	14.1	0.273	25.5	0.117	124.
lower limit			0.103	0.145	8.1	0.157	13.9	0.064	81.9
use 1 Stdev									
upper limit			0.282	0.397	15.1	0.293	27.5	0.126	131.
lower limit			0.076	0.108	7.1	0.137	11.9	0.054	74.5

Selected Reference Stations:
TPAH, % Fines and TOC

StationID	STRATA	Units	Total PAHs	ERMQ_PAH		%Fines	T(
2252	sdport	ug/kg	16.0	0.000		16	0.
2435	sdother	ug/kg	0.0	0.000		49	0.
2229	sdother	ug/kg	686.6	0.015		43	0.
2433	sdother	ug/kg	284.4	0.006		71	1.
2227	sdmari	ug/kg	305.4	0.007		50	0.
2434	sdother	ug/kg	455.4	0.010		45	0.
2441	sdport	ug/kg	1518.6	0.034		79	1.
Statistics for 7	Stations						
Average			466.6	0.010		50	0.
Max			1518.6	0.034		79	1.
Min			0.0	0.000		16	0.
Stdev			522.0	0.012		20	0.
95% confidence			387	0.009		15	0.
upper limit			853	0.019		66	1.
lower limit			80	0.002		35	0.
Use 1 stdev							
upper limit			989	0.022		71	1.
lower limit			<0	<0		30	0.

Environmental Health Coalition
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ehc@environmentalhealth.org ◆ www.environmentalhealth.org

May 2, 2003

Mr. John Robertus
Mr. David Barker
Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Dear Messrs. Robertus and Barker:

As you know, the member organizations of the San Diego Bay Council are very concerned about, and involved in, the cleanup of contaminated sediments at the commercial shipyards in San Diego Bay. We have invested very significant time and resources in this effort, and we believe that the outcome of the Regional Board process, and the Board's ultimate decision, will set a very significant precedent for clean up, not only of San Diego Bay, but also for sediments in the rest of the State. Once again, we are proud that our Regional Board is finding itself on the leading edge of regulatory action in the name of protecting water quality, and we are very confident that you take this issue as seriously as we do. We thank the staff for your hard work on this.

One of the most critical steps – and the step that has held up progress toward cleanup of San Diego Bay - is *the selection of reference sites* for the Bay that will establish background levels, and thus, <u>determine how clean San Diego Bay will ever get</u>. There are EPA guidelines for this process that are readily achievable in San Diego Bay.

We wish to re-emphasize to you that these are widely accepted practices; the selection of reference sites is a relatively simple, straightforward exercise when executed properly. The real basis is simply common sense. Reference stations are those that represent relatively undisturbed conditions within the Bay or within a study area.

There have been at least two lengthy workshops held by staff to discuss the selection of reference sites, however, we have only been included in the second of these. As you remember, at the meeting agreement was reached on several overarching next steps. For example, it was agreed that a decision was needed on what data sets or combination of data sets would be used, what statistical methods would be used, and how the precautionary principle would be incorporated into the process. The original 10 reference stations selected at the beginning of the Chollas and Paleta Creek, and Shipyard studies were to be considered for use, as were the original 12 stations the Regional Board used to establish background levels in March 2002.

Our expectation was that these tasks would be carried out in a transparent manner with all participants informed, provided with the necessary data, and provided the opportunity to offer

input. We are very unclear as to the status of these overarching tasks and are concerned that decisions are being made with discharger input but not with the other interests represented. We understand that the scientists/consultants for the dischargers are working with you closely but the concept of a multi-stakeholder working group, such as was discussed at the TMDL meeting, is not being pursued. For example, the major proposal for a set of 14 reference stations offered by the National Oceanographic and Atmospheric Administration (NOAA) should be an agenda for such a working group meeting but has not been further discussed. *This is a proposal the majority of which we could have supported.*

Access to the data sets being used is critical for our meaningful participation. As you know, despite repeated requests for data – data that staff, the industry, and Navy have been using for quite some time - we were only provided access after the second meeting, in January of 2003. This has put us at a considerable disadvantage. We are concerned that it was indicated that the input we provided *before* we had access to the data, is what you are considering the full extent of our input. It is not.

To move the process forward, and because of profound concerns about how this selection process appears to be unfolding, (and now that we have the necessary data), we have identified a set of relatively clean sites, with relatively healthy benthic communities, to be used as a reference pool for the Bay (enclosed). We had the following purposes in mind as we proceeded:

- *Select a Pool of Reference Stations that will define background (ambient) conditions in San Diego Bay.*
- *This pool can be used for general assessments of whether areas of the Bay are degraded.*
- *This pool, or a subset of this Pool, can be used as reference for site-specific cleanups, including clean-up of the NASSCO and Southwest Marine Shipyards sites.*
- *Recommend that the stations that make up this pool be protected from degradation.*

The pool of reference sites that we have selected illustrates that:

- There are some relatively clean (and healthy) sites available to use as reference sites.
- It is not necessary to use more contaminated sites with marginal or disturbed benthic communities.
- Simple statistical methods that are readily understandable, and that keep the data transparent, are sufficient.
- It is possible to comply with EPA's guidance to select the least impaired sites.
- The Regional Board's approach and selection of a reference pool (described in their March 2002 letter) is a robust approach with comparable results.

We offer the attached proposal with a hope that it can be an approach that all entities that desire an equitable and protective cleanup can embrace.

To expedite action we request that the staff hold a full working group meeting to address the various proposals and the action items identified at the last work group meeting. We request that the Regional Board solicit and distribute written comments on the pool of reference stations we have proposed here as well as other proposals such as NOAA's 14 and the Regional Board's set

of 12 stations used to set background levels in March 2002 from the various entities and individuals participating in this process prior to the working group meeting.

Thank you for your attention to this important matter.

Sincerely,

Laura Hunter, Director
Environmental Health Coalition

Jim Peugh
San Diego Audubon

Marco Gonzalez
Surfrider Foundation, San Diego Chapter

Ed Kimura
Sierra Club

Bruce Reznik
San Diego Baykeeper

cc. (by email)
Elaine Carlin, consultant
Sandor Halvax
Mike Chee
Denise Klimas
Scott Sobiech
Michael Martin
Tom Alo
Bart Chadwick

Selecting a Pool of Reference Stations for San Diego Bay

Elaine M. Carlin, Scientific Consultant, San Diego Bay Council
elainecarlin@att.net; 202 607 4715

Purposes:

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- *Recommend that the stations that make up this pool be protected from degradation.*

Definition of Reference Conditions and Reference Sites

According to EPA:

> "Reference conditions are expectations of the status of biological communities in the absence of anthropogenic disturbances and pollution, and are usually based on the status of multiple reference sites."
>
> "Reference sites refer to locations within a [habitat] classification category at which data are collected to represent the most natural ambient conditions present."
>
> "The conditions at reference sites should represent the best range of minimally impaired conditions that can be achieved..."
>
> "The care that states use in selecting reference sites and developing reference condition parameters, together with their use of standard survey techniques, will directly influence the quality of the resulting water body assessment."
>
> "In practice, most reference sites will have some of these [human] impacts, however, the selection of reference sites is always made from those with the least anthropogenic influences."
>
> "Reference sites must be representative of the best quality of the estuaries and coastal marine waters under investigation; that is, they must exhibit conditions similar to what would be expected to be found in the region. They should not represent degraded conditions, even if such conditions are the most common."
>
> "It is advisable that the state make every effort, once reference sites are selected, to protect these areas from degradation."
>
> Source: U.S. Environmental Protection Agency, Office of Water. December 2000. *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance.* EPA–822–B–00–024.

Selection of Reference Pool

Bight 98 Data Set

A pool of minimally impaired stations was selected from the 46 stations of the Bight 98 San Diego Bay sampling program. Two approaches were taken; the first approach looks first for healthiest benthos, the second approach looks first for lowest chemical contamination. Both approaches ultimately rely on all available data, including chemical concentrations, toxicity data, and benthic community analyses (i.e., on all three legs of the triad). According to the California Regional Water Quality Control Board, San Diego Region:

> "Collection of synoptic measurements of sediment chemistry, toxicity, and benthic infauna (triad approach) is essential to assess the relative quality of sediments and to determine whether impacts are related to chemical contamination. Each component of the triad complements the other two and together all three components provides an integrated assessment of the quality of the sediment." (March 6, 2002 letter with attachment from John H. Robertus to Mike Chee and Sandor Halvax, re: Background Reference Conditions for Assessment and Remediation of Contaminated Sediments at NASSCO and Southwest Marine Shipyards, p.8-9.)

First Approach

The first approach begins with considering the benthic data. The benthic community is the best indicator available of ecosystem health, or lack thereof – the protection of the benthic community and ecosystem health is, after all, our ultimate goal. Benthic community information also gives us our only information about the impacts of the chronic stress of pollutants on marine life. In contrast, toxicity testing measures only acute stress.

The Benthic Response Index (BRI) identifies 16 of the 46 stations as "*Reference*" stations based on a healthy or relatively healthy benthos. The remainder of the stations were found to have either a marginal, or a degraded, benthos. These 16 sites include 9 of the 14 reference stations recommended by the National Oceanic and Atmospheric Administration (NOAA). The benthic community data was unavailable when NOAA made its selection - 5 of the NOAA set of 14 have a marginal BRI rating.

In addition to the BRI, the various other benthic endpoints and indexes were assessed in order to look for any problems not reflected in the BRI, and to see if certain of the 16 stations stand out as having the overall "healthiest" benthos. Three of the 16 stations were eliminated based on these benthic endpoints (Stations 2224, 2233, and 2240), and a fourth station was eliminated based on an anomalous benthic community (2231, based on Exponent sampling).

Sediment chemistry was next considered for the remaining 12 stations. First, the Mean ERM Quotient (minus DDT) data was reviewed, and revealed that only 2 of the 12 stations had values over 0.2 (0.273 and 0.210). Next, the individual ERM Quotients for each metal used in the mean quotient (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn) were reviewed for any values of 0.2 or above, i.e. for any metal concentrations that were 20 percent or more of the ERM value for that

chemical. For the organic chemicals, the PAH data was relied upon, because detection limit issues with the PCB data render this data basically unusable. A proposal for determining background levels for PCBs in light of this problem is offered below. PAH data requires further scrutiny in light of the number of nondetects.

Next, amphipod survival toxicity values were considered. These values are control-corrected. Four stations have percent survival values from 100 to 104. Three stations have percent survival values of 97 and 98. Four stations have values ranging from 81 to 88, and one station has a value of 66.

Reference stations were then selected based on all three legs of the triad, keeping in mind the need for a range of grain sizes, total organic carbon (TOC) values, and water depths representative of the various characteristics of the Bay. The following 7 stations provide a range of values for these physical characteristics, and represent the best available minimally-impaired sites from the Bight 98 data set, when all three legs of the triad are considered.

1 Station 2252. This station has a BRI of 4, a mean ERMQ of 0.067, chemistry is below 0.2 ERM for all nine metals, Total PAH (TPAH) is at 16 µg/kg (dry weight). Amphipod survival is 104%. Grain size, represented by the percent of fines, is16%.

(This station was not included NOAA's set of 14 sites because NOAA sorted for percent fines > 23.9%. Generally NOAA stays above 20% fines because normalization for grain size may result in high chemistry values (personal communication, D. MacDonald). For this station, chemistry is very low, so I have included it.)

2 Station 2435. This is a NOAA station, with a BRI of -1, and mean ERMQ of 0.077. Chemistry is below 0.2 ERM for all nine metals. TPAH is at 0 µg/kg. Amphipod survival is 102%. Percent fines is 49.

3 Station 2229, a NOAA station, has a BRI of 16, a mean ERMQ of 0.136, chemistry is above 0.2 ERM for Cu (0.218), Hg (0.444), and Zn (0.242). TPAH is at 687 µg/kg (ERL is 4022). Amphipod survival is 98%. Percent fines is 43.

4 Station 2433, a NOAA station and NASSCO/SWM Reference Station 2, has a BRI of 21 and a mean ERMQ of 0.155. Chemistry exceeds 0.2 ERM for Cu (0.265), Hg (0.370), Ni (0.289), and Zn (0.307). TPAH is at 284 µg/kg. Amphipod survival is at 97%. Percent fines is 71.

5 Station 2227, a NOAA station, has a BRI of 25 and a mean ERMQ of 0.128. Chemistry is equal to 0.2 ERM for Cu, and exceeds 0.2 ERM for Hg (0.333), Ni (0.215), and Zn (0.273). TPAH is at 305 µg/kg. Amphipod survival is 98%. Percent fines is 50.

6 Station 2434, a NOAA station, has a BRI of 24, and a mean ERMQ of 0.128. Chemistry exceeds 0.2 ERM for Cu (0.255), Ni (0.225), and Zn (0.322). TPAH is at 455 µg/kg. Amphipod survival is 101%. Percent fines is 45.

#7 Station 2441. This station has a BRI of 17, and a mean ERMQ of 0.144. Chemistry exceeds 0.2 ERM for Cu (0.266), Hg (0.268), Ni (0.322), and Zn (0.300). TPAH is at 1519 µg/kg. Amphipod survival is 88%. Percent fines is 79.

(This station is not included in the NOAA 14 because NOAA sorted for amphipod survival greater than 90%. To incorporate a higher-fines site, it was necessary to select this site even though the survival rate is significantly lower than the other selected stations. It is intended that this station be used as reference for similarly high-fines sites.)

These seven stations are located in Mid and North San Diego Bay. Grain size ranges from 16 percent fines to 79 percent fines. TOC values range from 0.6 to 2.0. Depths range from 3 to 16 meters.

Second Approach

The second approach begins with selection of the lowest chemical concentration sites. Fourteen sites were identified as having the lowest concentrations for several chemicals of concern and overall chemistry. The first two of these sites have concentrations for mercury, copper, zinc, the mean ERMQ, and total PAH that fall in the top 5 cleanest Bight stations. Amphipod survival rates are also in the top 5 highest survival rate stations. These are stations 2252 and 2435, two of the seven stations selected above, using the first approach.

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The last two of the 14 lowest overall chemical concentration sites each have at least two individual chemical concentrations that fall below the top third of stations for that chemical.

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Bay sediments, it may be necessary to set a background level slightly above zero, to represent PCB concentrations found in the cleanest parts of the Bay.

The PCB data from the Bight data set is basically unusable, due to detection limit issues. The set of PCB values from the 10 percent of the Bay Protection stations with the lowest PCB levels is proposed to be used to determine reference concentrations for PCBs. For total PCBs, these values range from 4.38 to 27.2 µg/kg.

This same approach can be used for other chemicals of concern that were not sampled in the Bight study, for example, the tributyltin chemicals, and PAHs depending on a final determination of the adequacy of the Bight 98 data for PAHs.

Background Values Based on Reference Station Pool

The average value for contaminants of concern was calculated using the proposed reference station pool. Non-detect values are treated as zero. Standard deviations and confidence intervals were also calculated (see Tables below, prepared by Ed Kimura).

Mean values calculated for the above 7 stations are relatively close to mean values for the 12 reference stations selected by the Regional Board to define background conditions for the NASSCO and Southwest Marine Shipyards Study (see March 2002 reference, above). In fact, results presented here confirm the overall robustness of the approach and results by Regional Board staff. Two different approaches, both relying on the best available triad data, produced comparable background values. As discussed above, if station 2265 (and other very low chemistry stations) are added to the pool, background contaminant levels would be even closer to the March 2002 values.

The following are the mean values for the 7 stations selected here (far left column), and for comparison purposes, the mean values for the 12 Regional Board stations selected in March, 2002 (second column). Also for comparison purposes, the third and fourth columns are the ERL and ERM values, respectively.

	PROPOSED POOL	RWQCB POOL	ERL	ERM	Units
Copper	55	46	34	270	(dry weight)
Zinc	103	87	150	410	mg/kg
Lead	20	19	46.7	218	
Mercury	0.18	0.20	0.15	0.71	
Arsenic	6.8	5.2	8.2	70	
Cadmium	0.16	0.08	1.2	9.6	
Chromium	32	25	81	370	
Nickel	11.1	7.9	20.9	51.6	
Silver	0.56	0.30	1.0	3.7	
Total PAH	467	240	4022	44792	µg/kg
Toxicity	98 %	89-96 %			

Selected Reference Stations:
Metals

StationID	STRATA	Units	Ag	ERMQ_Ag	As	ERMQ_As	Cd	ERMQ_Cd	Cr	EI
2252	sdport	mg/kg	0.204	0.055	4.34	0.062	0.041	0.004	14.8	
2435	sdother	mg/kg	0.185	0.050	5.06	0.072	0.136	0.014	20.6	
2229	sdother	mg/kg	0.413	0.112	5.36	0.077	0.085	0.009	31.6	
2433	sdother	mg/kg	0.499	0.135	8.32	0.119	0.245	0.026	34.5	
2227	sdmari	mg/kg	0.456	0.123	5.65	0.081	0.200	0.021	27.4	
2434	sdother	mg/kg	0.640	0.173	6.22	0.089	0.171	0.018	49.8	
2441	sdport	mg/kg	1.500	0.405	12.4	0.177	0.250	0.026	43.9	
Statistics for 7 Stations										
Average			0.557	0.150	6.76	0.097	0.161	0.017	31.8	
Max			1.500	0.405	12.40	0.177	0.250	0.026	49.8	
Min			0.185	0.050	4.34	0.062	0.041	0.004	14.8	
Stdev			0.446	0.121	2.78	0.040	0.079	0.008	12.3	
95% confidence			0.330	0.089	2.06	0.029	0.058	0.006	9.1	
upper limit			0.887	0.240	8.83	0.126	0.220	0.023	40.9	
lower limit			0.226	0.061	4.70	0.067	0.103	0.011	22.7	
use 1 Stdev:										
upper limit			1.003	0.271	9.547	0.136	0.240	0.025	44.1	
lower limit			0.111	0.030	3.981	0.057	0.082	0.009	1[illegible]	

Selected Reference Stations:
Metals

StationID	STRATA	Units	Hg	ERMQ_Hg	Ni	ERMQ_Ni	Pb	ERMQ_Pb	Zn
2252	sdport	mg/kg	0.113	0.158	4.2	0.081	13.8	0.063	64.2
2435	sdother	mg/kg	0.123	0.173	9.9	0.192	7.1	0.033	64.4
2229	sdother	mg/kg	0.316	0.444	9.3	0.180	24.5	0.112	99.3
2433	sdother	mg/kg	0.263	0.370	14.9	0.289	21	0.096	126.
2227	sdmari	mg/kg	0.234	0.330	11.1	0.215	17.9	0.082	112.
2434	sdother	mg/kg	0.015	0.021	11.6	0.225	31.6	0.145	132.
2441	sdport	mg/kg	0.191	0.268	16.6	0.322	21.9	0.100	123.
Statistics for 7 Stations									
Average			0.179	0.252	11.1	0.215	19.7	0.090	103.
Max			0.316	0.444	16.6	0.322	31.6	0.145	132.
Min			0.015	0.021	4.2	0.081	7.1	0.033	64.2
Stdev			0.103	0.145	4.0	0.078	7.8	0.036	28.5
95% confidence			0.076	0.107	3.0	0.058	5.8	0.027	21.1
upper limit			0.255	0.359	14.1	0.273	25.5	0.117	124.
lower limit			0.103	0.145	8.1	0.157	13.9	0.064	81.9
use 1 Stdev									
upper limit			0.282	0.397	15.1	0.293	27.5	0.126	131.
lower limit			0.076	0.108	7.1	0.137	11.9	0.054	74.5

Selected Reference Stations:
TPAH, % Fines and TOC

StationID	STRATA	Units	Total PAHs	ERMQ_PAH		%Fines	T(
2252	sdport	ug/kg	16.0	0.000		16	0.
2435	sdother	ug/kg	0.0	0.000		49	0.
2229	sdother	ug/kg	686.6	0.015		43	0.
2433	sdother	ug/kg	284.4	0.006		71	1.
2227	sdmari	ug/kg	305.4	0.007		50	0.
2434	sdother	ug/kg	455.4	0.010		45	0.
2441	sdport	ug/kg	1518.6	0.034		79	1.
Statistics for 7	Stations						
Average			466.6	0.010		50	0.
Max			1518.6	0.034		79	1.
Min			0.0	0.000		16	0.
Stdev			522.0	0.012		20	0.
95% confidence			387	0.009		15	0.
upper limit			853	0.019		66	1.
lower limit			80	0.002		35	0.
Use 1 stdev							
upper limit			989	0.022		71	1.
lower limit			<0	<0		30	0.

San Diego Bay Council

A coalition of San Diego environmental organizations dedicated to protection and restoration of San Diego's coastal water resources

May 5, 2003

Mr. John Robertus
Mr. David Barker
Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Dear Messrs. Robertus and Barker:

As you know, the member organizations of the San Diego Bay Council are very concerned about, and involved in, the cleanup of contaminated sediments at the commercial shipyards in San Diego Bay. We have invested very significant time and resources in this effort, and we believe that the outcome of the Regional Board process, and the Board's ultimate decision, will set a very significant precedent for clean up, not only of San Diego Bay, but also for sediments in the rest of the State. Once again, we are proud that our Regional Board is finding itself on the leading edge of regulatory action in the name of protecting water quality, and we are very confident that you take this issue as seriously as we do. We thank the staff for your hard work on this.

One of the most critical steps – and the step that has held up progress toward cleanup of San Diego Bay - is *the selection of reference sites* for the Bay that will establish background levels, and thus, <u>determine how clean San Diego Bay will ever get</u>. There are EPA guidelines for this process that are readily achievable in San Diego Bay.

We wish to re-emphasize to you that these are widely accepted practices; the selection of reference sites is a relatively simple, straightforward exercise when executed properly. The real basis is simply common sense. Reference stations are those that represent relatively undisturbed conditions within the Bay or within a study area.

There have been at least two lengthy workshops held by staff to discuss the selection of reference sites, however, we have only been included in the second of these. As you remember, at the meeting agreement was reached on several overarching next steps. For example, it was agreed that a decision was needed on what data sets or combination of data sets would be used, what statistical methods would be used, and how the precautionary principle would be incorporated into the process. The original 10 reference stations selected at the beginning of the Chollas and Paleta Creek, and Shipyard studies were to be considered for use, as were the original 12 stations the Regional Board used to establish background levels in March 2002.

Our expectation was that these tasks would be carried out in a transparent manner with all participants informed, provided with the necessary data, and provided the opportunity to offer

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input. We are very unclear as to the status of these overarching tasks and are concerned that decisions are being made with discharger input but not with the other interests represented. We understand that the scientists/consultants for the dischargers are working with you closely but the concept of a multi-stakeholder working group, such as was discussed at the TMDL meeting, is not being pursued. For example, the major proposal for a set of 14 reference stations offered by the National Oceanographic and Atmospheric Administration (NOAA) should be an agenda for such a working group meeting but has not been further discussed. *This is a proposal the majority of which we could have supported.*

Access to the data sets being used is critical for our meaningful participation. As you know, despite repeated requests for data – data that staff, the industry, and Navy have been using for quite some time - we were only provided access after the second meeting, in January of 2003. This has put us at a considerable disadvantage. We are concerned that it was indicated that the input we provided *before* we had access to the data, is what you are considering the full extent of our input. It is not.

To move the process forward, and because of profound concerns about how this selection process appears to be unfolding, (and now that we have the necessary data), we have identified a set of relatively clean sites, with relatively healthy benthic communities, to be used as a reference pool for the Bay (enclosed). We had the following purposes in mind as we proceeded:

- *Select a Pool of Reference Stations that will define background (ambient) conditions in San Diego Bay.*
- *This pool can be used for general assessments of whether areas of the Bay are degraded.*
- *This pool, or a subset of this Pool, can be used as reference for site-specific cleanups, including clean-up of the NASSCO and Southwest Marine Shipyards sites.*
- *Recommend that the stations that make up this pool be protected from degradation.*

The pool of reference sites that we have selected illustrates that:

- There are some relatively clean (and healthy) sites available to use as reference sites.
- It is not necessary to use more contaminated sites with marginal or disturbed benthic communities.
- Simple statistical methods that are readily understandable, and that keep the data transparent, are sufficient.
- It is possible to comply with EPA's guidance to select the least impaired sites.
- The Regional Board's approach and selection of a reference pool (described in their March 2002 letter) is a robust approach with comparable results.

We offer the attached proposal with a hope that it can be an approach that all entities that desire an equitable and protective cleanup can embrace.

To expedite action we request that the staff hold a full working group meeting to address the various proposals and the action items identified at the last work group meeting. We request that the Regional Board solicit and distribute written comments on the pool of reference stations we have proposed here as well as other proposals such as NOAA's 14 and the Regional Board's set

Environmental Health Coalition

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May 2, 2003

Mr. John Robertus
Mr. David Barker
Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Dear Messrs. Robertus and Barker:

As you know, the member organizations of the San Diego Bay Council are very concerned about, and involved in, the cleanup of contaminated sediments at the commercial shipyards in San Diego Bay. We have invested very significant time and resources in this effort, and we believe that the outcome of the Regional Board process, and the Board's ultimate decision, will set a very significant precedent for clean up, not only of San Diego Bay, but also for sediments in the rest of the State. Once again, we are proud that our Regional Board is finding itself on the leading edge of regulatory action in the name of protecting water quality, and we are very confident that you take this issue as seriously as we do. We thank the staff for your hard work on this.

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Our expectation was that these tasks would be carried out in a transparent manner with all participants informed, provided with the necessary data, and provided the opportunity to offer

of 12 stations used to set background levels in March 2002 from the various entities and individuals participating in this process prior to the working group meeting.

Thank you for your attention to this important matter.

Sincerely,

Laura Hunter

Laura Hunter, Director
Environmental Health Coalition

Ed Kimura

Ed Kimura
Sierra Club

Jim A. Peugh

Jim Peugh
San Diego Audubon

Bruce Reznik
San Diego Baykeeper

Marco Gonzalez

Marco Gonzalez
Surfrider Foundation, San Diego Chapter

cc. (by email)
Elaine Carlin, consultant
Sandor Halvax
Mike Chee
Denise Klimas
Scott Sobiech
Michael Martin
Tom Alo
Bart Chadwick

Selecting a Pool of Reference Stations for San Diego Bay

Elaine M. Carlin, Scientific Consultant, San Diego Bay Council
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Purposes:

- *Select a Pool of Reference Stations that will define background (ambient) conditions in San Diego Bay.*
- *This pool can be used for general assessments of whether areas of the Bay are degraded.*
- *This pool, or a subset of this Pool, can be used as reference for site-specific cleanups, including clean-up of the NASSCO and Southwest Marine Shipyards sites.*
- *Recommend that the stations that make up this pool be protected from degradation.*

Definition of Reference Conditions and Reference Sites

According to EPA:

> "Reference conditions are expectations of the status of biological communities in the absence of anthropogenic disturbances and pollution, and are usually based on the status of multiple reference sites."
>
> "Reference sites refer to locations within a [habitat] classification category at which data are collected to represent the most natural ambient conditions present."
>
> "The conditions at reference sites should represent the best range of minimally impaired conditions that can be achieved..."
>
> "The care that states use in selecting reference sites and developing reference condition parameters, together with their use of standard survey techniques, will directly influence the quality of the resulting water body assessment."
>
> "In practice, most reference sites will have some of these [human] impacts, however, the selection of reference sites is always made from those with the least anthropogenic influences."
>
> "Reference sites must be representative of the best quality of the estuaries and coastal marine waters under investigation; that is, they must exhibit conditions similar to what would be expected to be found in the region. They should not represent degraded conditions, even if such conditions are the most common."
>
> "It is advisable that the state make every effort, once reference sites are selected, to protect these areas from degradation."
>
> Source: U.S. Environmental Protection Agency, Office of Water. December 2000. *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance.* EPA–822–B–00–024.

Selection of Reference Pool

Bight 98 Data Set

A pool of minimally impaired stations was selected from the 46 stations of the Bight 98 San Diego Bay sampling program. Two approaches were taken; the first approach looks first for healthiest benthos, the second approach looks first for lowest chemical contamination. Both approaches ultimately rely on all available data, including chemical concentrations, toxicity data, and benthic community analyses (i.e., on all three legs of the triad). According to the California Regional Water Quality Control Board, San Diego Region:

> "Collection of synoptic measurements of sediment chemistry, toxicity, and benthic infauna (triad approach) is essential to assess the relative quality of sediments and to determine whether impacts are related to chemical contamination. Each component of the triad complements the other two and together all three components provides an integrated assessment of the quality of the sediment." (March 6, 2002 letter with attachment from John H. Robertus to Mike Chee and Sandor Halvax, re: Background Reference Conditions for Assessment and Remediation of Contaminated Sediments at NASSCO and Southwest Marine Shipyards, p.8-9.)

First Approach

The first approach begins with considering the benthic data. The benthic community is the best indicator available of ecosystem health, or lack thereof – the protection of the benthic community and ecosystem health is, after all, our ultimate goal. Benthic community information also gives us our only information about the impacts of the chronic stress of pollutants on marine life. In contrast, toxicity testing measures only acute stress.

The Benthic Response Index (BRI) identifies 16 of the 46 stations as "*Reference*" stations based on a healthy or relatively healthy benthos. The remainder of the stations were found to have either a marginal, or a degraded, benthos. These 16 sites include 9 of the 14 reference stations recommended by the National Oceanic and Atmospheric Administration (NOAA). The benthic community data was unavailable when NOAA made its selection - 5 of the NOAA set of 14 have a marginal BRI rating.

In addition to the BRI, the various other benthic endpoints and indexes were assessed in order to look for any problems not reflected in the BRI, and to see if certain of the 16 stations stand out as having the overall "healthiest" benthos. Three of the 16 stations were eliminated based on these benthic endpoints (Stations 2224, 2233, and 2240), and a fourth station was eliminated based on an anomalous benthic community (2231, based on Exponent sampling).

Sediment chemistry was next considered for the remaining 12 stations. First, the Mean ERM Quotient (minus DDT) data was reviewed, and revealed that only 2 of the 12 stations had values over 0.2 (0.273 and 0.210). Next, the individual ERM Quotients for each metal used in the mean quotient (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn) were reviewed for any values of 0.2 or above, i.e. for any metal concentrations that were 20 percent or more of the ERM value for that

chemical. For the organic chemicals, the PAH data was relied upon, because detection limit issues with the PCB data render this data basically unusable. A proposal for determining background levels for PCBs in light of this problem is offered below. PAH data requires further scrutiny in light of the number of nondetects.

Next, amphipod survival toxicity values were considered. These values are control-corrected. Four stations have percent survival values from 100 to 104. Three stations have percent survival values of 97 and 98. Four stations have values ranging from 81 to 88, and one station has a value of 66.

Reference stations were then selected based on all three legs of the triad, keeping in mind the need for a range of grain sizes, total organic carbon (TOC) values, and water depths representative of the various characteristics of the Bay. The following 7 stations provide a range of values for these physical characteristics, and represent the best available minimally-impaired sites from the Bight 98 data set, when all three legs of the triad are considered.

1 Station 2252. This station has a BRI of 4, a mean ERMQ of 0.067, chemistry is below 0.2 ERM for all nine metals, Total PAH (TPAH) is at 16 μg/kg (dry weight). Amphipod survival is 104%. Grain size, represented by the percent of fines, is16%.

(This station was not included NOAA's set of 14 sites because NOAA sorted for percent fines > 23.9%. Generally NOAA stays above 20% fines because normalization for grain size may result in high chemistry values (personal communication, D. MacDonald). For this station, chemistry is very low, so I have included it.)

2 Station 2435. This is a NOAA station, with a BRI of -1, and mean ERMQ of 0.077. Chemistry is below 0.2 ERM for all nine metals. TPAH is at 0 μg/kg. Amphipod survival is 102%. Percent fines is 49.

3 Station 2229, a NOAA station, has a BRI of 16, a mean ERMQ of 0.136, chemistry is above 0.2 ERM for Cu (0.218), Hg (0.444), and Zn (0.242). TPAH is at 687 μg/kg (ERL is 4022). Amphipod survival is 98%. Percent fines is 43.

4 Station 2433, a NOAA station and NASSCO/SWM Reference Station 2, has a BRI of 21 and a mean ERMQ of 0.155. Chemistry exceeds 0.2 ERM for Cu (0.265), Hg (0.370), Ni (0.289), and Zn (0.307). TPAH is at 284 μg/kg. Amphipod survival is at 97%. Percent fines is 71.

5 Station 2227, a NOAA station, has a BRI of 25 and a mean ERMQ of 0.128. Chemistry is equal to 0.2 ERM for Cu, and exceeds 0.2 ERM for Hg (0.333), Ni (0.215), and Zn (0.273). TPAH is at 305 μg/kg. Amphipod survival is 98%. Percent fines is 50.

6 Station 2434, a NOAA station, has a BRI of 24, and a mean ERMQ of 0.128. Chemistry exceeds 0.2 ERM for Cu (0.255), Ni (0.225), and Zn (0.322). TPAH is at 455 μg/kg. Amphipod survival is 101%. Percent fines is 45.

#7 Station 2441. This station has a BRI of 17, and a mean ERMQ of 0.144. Chemistry exceeds 0.2 ERM for Cu (0.266), Hg (0.268), Ni (0.322), and Zn (0.300). TPAH is at 1519 μg/kg. Amphipod survival is 88%. Percent fines is 79.

(This station is not included in the NOAA 14 because NOAA sorted for amphipod survival greater than 90%. To incorporate a higher-fines site, it was necessary to select this site even though the survival rate is significantly lower than the other selected stations. It is intended that this station be used as reference for similarly high-fines sites.)

These seven stations are located in Mid and North San Diego Bay. Grain size ranges from 16 percent fines to 79 percent fines. TOC values range from 0.6 to 2.0. Depths range from 3 to 16 meters.

Second Approach

The second approach begins with selection of the lowest chemical concentration sites. Fourteen sites were identified as having the lowest concentrations for several chemicals of concern and overall chemistry. The first two of these sites have concentrations for mercury, copper, zinc, the mean ERMQ, and total PAH that fall in the top 5 cleanest Bight stations. Amphipod survival rates are also in the top 5 highest survival rate stations. These are stations 2252 and 2435, two of the seven stations selected above, using the first approach.

The third site, 2265, also has concentrations for mercury, copper, zinc, mean ERMQ, and total PAH in the top 5, but amphipod survival is 85 percent. Thirty-three of the 46 Bight stations have higher than 85 percent survival. It would be appropriate to include this station based on its chemistry (and a healthy benthos rating), but not based on amphipod survival because this rate falls in the lower third of all sites, and suggests that an unknown factor is causing toxicity. As noted above, NOAA used 90 percent survival as its sorting criteria.

It is instructive to note at this point, if the reference pool is constructed based on chemistry alone, station 2265 (and other very low chemistry stations) would be selected, and background contaminant levels would be lower than those established by using all three legs of the triad

The fourth station, 2230, has two drawbacks. Despite very low chemistry for copper, zinc, and mean ERMQ, (and healthy benthos), mercury is at 0.5 ERM, and amphipod survival is very low, at 66 percent.

The next eight stations, 2243, 2244, 2440, 2260, 2247, 2231, 2242, and 2241, have disqualifying benthos, and four have amphipod survival rates that fall in the lower two thirds of the Bight stations. In addition, six of these stations have at least one chemical concentration for mercury, copper, zinc, mean ERMQ, or TPAH that falls below the top third of Bight stations for that chemical.

The last two of the 14 lowest overall chemical concentration sites each have at least two individual chemical concentrations that fall below the top third of stations for that chemical.

Both of these sites have a "reference" level BRI, but one site, 2240, was eliminated for other benthic endpoints. The second, 2229, was selected under the first approach, above.

Bay Protection and Toxic Cleanup Program Data Set

Description of Data Set

> This Data Set is part of the ongoing Bay Protection and Toxic Cleanup Program, a legislatively-mandated program with the mission of assessing chemical pollution and associated biological effects in California's bays and harbors. In the San Diego Bay region, 350 stations were sampled between October, 1992 and May, 1994.
>
> Random sampling of San Diego Bay was conducted as part of the Program. One hundred and twenty one (121) stations were randomly selected using a stratified sampling design. This stratified random design ensures that all areas of the Bay are covered in the sampling. Sampling designed to identify specific toxic hot spots was carried out at 229 additional stations.

Chemistry

For several chemicals of concern, the Bay Protection data set contains many stations with lower concentrations than the Bight data set. For example, the cleanest 10 percent of the Bay Protection stations for mercury – a total of 20 stations – have mercury ERM Quotients ranging from 0.053 to 0.156. The Bight data set contains only a few stations with ERM Quotients for mercury in this range.

As a result, if the reference pool is constructed using the cleanest stations when both data sets are considered, one would expect background levels to be lower, and possibly significantly lower, than those established using only the Bight data set. We propose that the cleanest 10 percent of the Bay Protection stations be considered for inclusion in the pool for at least two reasons: first, to comply with the guidance referenced above directing the selection of the least impaired sites for reference purposes; and second, to address the likelihood that chemical concentrations in the Bay have been increasing over time.

With the continuing loading of contaminants into the Bay environment from a variety of sources not yet controlled, and from known toxic hot spots and other contaminated areas of the Bay, chemical concentrations, toxicity and the degradation of benthos are expected to have increased over time. Thus, we find cleaner stations in the Bay Protection sampling time frame as compared to the Bight 98 sampling time frame. This increasing trend can only be expected to continue until these various sources of contamination are controlled or eliminated.

Approach to Determine Reference Concentrations for Total PCBs

A background level for PCBs should, in theory, be set at zero because there is no natural background level of this human-made contaminant. Because PCBs are pervasive in San Diego

Bay sediments, it may be necessary to set a background level slightly above zero, to represent PCB concentrations found in the cleanest parts of the Bay.

The PCB data from the Bight data set is basically unusable, due to detection limit issues. The set of PCB values from the 10 percent of the Bay Protection stations with the lowest PCB levels is proposed to be used to determine reference concentrations for PCBs. For total PCBs, these values range from 4.38 to 27.2 µg/kg.

This same approach can be used for other chemicals of concern that were not sampled in the Bight study, for example, the tributyltin chemicals, and PAHs depending on a final determination of the adequacy of the Bight 98 data for PAHs.

Background Values Based on Reference Station Pool

The average value for contaminants of concern was calculated using the proposed reference station pool. Non-detect values are treated as zero. Standard deviations and confidence intervals were also calculated (see Tables below, prepared by Ed Kimura).

Mean values calculated for the above 7 stations are relatively close to mean values for the 12 reference stations selected by the Regional Board to define background conditions for the NASSCO and Southwest Marine Shipyards Study (see March 2002 reference, above). In fact, results presented here confirm the overall robustness of the approach and results by Regional Board staff. Two different approaches, both relying on the best available triad data, produced comparable background values. As discussed above, if station 2265 (and other very low chemistry stations) are added to the pool, background contaminant levels would be even closer to the March 2002 values.

The following are the mean values for the 7 stations selected here (far left column), and for comparison purposes, the mean values for the 12 Regional Board stations selected in March, 2002 (second column). Also for comparison purposes, the third and fourth columns are the ERL and ERM values, respectively.

	PROPOSED POOL	RWQCB POOL	ERL	ERM	Units
Copper	55	46	34	270	(dry weight)
Zinc	103	87	150	410	mg/kg
Lead	20	19	46.7	218	
Mercury	0.18	0.20	0.15	0.71	
Arsenic	6.8	5.2	8.2	70	
Cadmium	0.16	0.08	1.2	9.6	
Chromium	32	25	81	370	
Nickel	11.1	7.9	20.9	51.6	
Silver	0.56	0.30	1.0	3.7	
Total PAH	467	240	4022	44792	µg/kg
Toxicity	98 %	89-96 %			

Selected Reference Stations:
Metals

StationID	STRATA	Units	Ag	ERMQ_Ag	As	ERMQ_As	Cd	ERMQ_Cd	Cr	EI
2252	sdport	mg/kg	0.204	0.055	4.34	0.062	0.041	0.004	14.8	
2435	sdother	mg/kg	0.185	0.050	5.06	0.072	0.136	0.014	20.6	
2229	sdother	mg/kg	0.413	0.112	5.36	0.077	0.085	0.009	31.6	
2433	sdother	mg/kg	0.499	0.135	8.32	0.119	0.245	0.026	34.5	
2227	sdmari	mg/kg	0.456	0.123	5.65	0.081	0.200	0.021	27.4	
2434	sdother	mg/kg	0.640	0.173	6.22	0.089	0.171	0.018	49.8	
2441	sdport	mg/kg	1.500	0.405	12.4	0.177	0.250	0.026	43.9	
Statistics for 7 Stations										
Average			0.557	0.150	6.76	0.097	0.161	0.017	31.8	
Max			1.500	0.405	12.40	0.177	0.250	0.026	49.8	
Min			0.185	0.050	4.34	0.062	0.041	0.004	14.8	
Stdev			0.446	0.121	2.78	0.040	0.079	0.008	12.3	
95% confidence			0.330	0.089	2.06	0.029	0.058	0.006	9.1	
upper limit			0.887	0.240	8.83	0.126	0.220	0.023	40.9	
lower limit			0.226	0.061	4.70	0.067	0.103	0.011	22.7	
use 1 Stdev:										
upper limit			1.003	0.271	9.547	0.136	0.240	0.025	44.1	
lower limit			0.111	0.030	3.981	0.057	0.082	0.009	19	

Selected Reference Stations:
Metals

StationID	STRATA	Units	Hg	ERMQ_Hg	Ni	ERMQ_Ni	Pb	ERMQ_Pb	Zn
2252	sdport	mg/kg	0.113	0.158	4.2	0.081	13.8	0.063	64.2
2435	sdother	mg/kg	0.123	0.173	9.9	0.192	7.1	0.033	64.4
2229	sdother	mg/kg	0.316	0.444	9.3	0.180	24.5	0.112	99.3
2433	sdother	mg/kg	0.263	0.370	14.9	0.289	21	0.096	126.
2227	sdmari	mg/kg	0.234	0.330	11.1	0.215	17.9	0.082	112.
2434	sdother	mg/kg	0.015	0.021	11.6	0.225	31.6	0.145	132.
2441	sdport	mg/kg	0.191	0.268	16.6	0.322	21.9	0.100	123.
Statistics for 7 Stations									
Average			0.179	0.252	11.1	0.215	19.7	0.090	103.
Max			0.316	0.444	16.6	0.322	31.6	0.145	132.
Min			0.015	0.021	4.2	0.081	7.1	0.033	64.2
Stdev			0.103	0.145	4.0	0.078	7.8	0.036	28.5
95% confidence			0.076	0.107	3.0	0.058	5.8	0.027	21.1
upper limit			0.255	0.359	14.1	0.273	25.5	0.117	124.
lower limit			0.103	0.145	8.1	0.157	13.9	0.064	81.9
use 1 Stdev									
upper limit			0.282	0.397	15.1	0.293	27.5	0.126	131.
lower limit			0.076	0.108	7.1	0.137	11.9	0.054	74.5

Selected Reference Stations:
TPAH, % Fines and TOC

StationID	STRATA	Units	Total PAHs	ERMQ_PAH		%Fines	T(
2252	sdport	ug/kg	16.0	0.000		16	0.
2435	sdother	ug/kg	0.0	0.000		49	0.
2229	sdother	ug/kg	686.6	0.015		43	0.
2433	sdother	ug/kg	284.4	0.006		71	1.
2227	sdmari	ug/kg	305.4	0.007		50	0.
2434	sdother	ug/kg	455.4	0.010		45	0.
2441	sdport	ug/kg	1518.6	0.034		79	1.
Statistics for 7	Stations						
Average			466.6	0.010		50	0.
Max			1518.6	0.034		79	1.
Min			0.0	0.000		16	0.
Stdev			522.0	0.012		20	0.
95% confidence			387	0.009		15	0.
upper limit			853	0.019		66	1.
lower limit			80	0.002		35	0.
Use 1 stdev							
upper limit			989	0.022		71	1.
lower limit			<0	<0		30	0.

Laura Hunter

From: Elaine Carlin [elainecarlin@worldnet.att.net]
Sent: Thursday, May 15, 2003 9:21 AM
To: Laura Hunter; scott_sobiech@r1.fws.gov; emkimr@cts.com; bbet461@ecy.wa.gov; fairey@mlml.calstate.edu; denise.klimas@noaa.gov; donald.macdonald@noaa.gov; mmartin@OSPR.DFG.CA.GOV; rfford34@earthlink.net
Subject: Orders of magnitude differences between field versus lab bioaccumulation values

Rio Tinto

Here is the paper discussed by William Adams of Rio Tinto (but unavailable) at the sediments conference that references the difference in bioaccumulation values between field and lab studies - in the case of HCB, bioaccumulation values from the field were from 2 to 3.5 orders of magnitude greater than values from lab studies - see p. 1020. Also see p. 1031 re need to discriminate between lab and field exposures (mercury). Of course these differences depend in part on the extent to which lab studies mimic natural conditions, including if animals are fed and what they are fed.

I also noted in this paper that field exposure values can be underestimates if equilibrium has not been reached.

Enjoy!
Elaine

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INVERSE RELATIONSHIP BETWEEN BIOCONCENTRATION FACTOR AND EXPOSURE CONCENTRATION FOR METALS: IMPLICATIONS FOR HAZARD ASSESSMENT OF METALS IN THE AQUATIC ENVIRONMENT

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Abstract—The bioconcentration factor (BCF) and bioaccumulation factor (BAF) are used as the criteria for bioaccumulation in the context of identifying and classifying substances that are hazardous to the aquatic environment. The BCF/BAF criteria, while developed as surrogates for chronic toxicity and/or biomagnification of anthropogenic organic substances, are applied to all substances including metals. This work examines the theoretical and experimental basis for the use of BCF/BAF in the hazard assessment of Zn, Cd, Cu, Pb, Ni, and Ag. As well, BCF/BAFs for Hg (methyl and inorganic forms) and hexachlorobenzene (HCB) were evaluated. The BCF/BAF data for Zn, Cd, Cu, Pb, Ni, and Ag were characterized by extreme variability in mean BCF/BAF values and a clear inverse relationship between BCF/BAF and aqueous exposure. The high variability persisted when even when data were limited to an exposure range where chronic toxicity would be expected. Mean BCF/BAF values for Hg were also variable, but the inverse relationship was equivocal, in contrast with HCB, which conformed to the BCF model. This study illustrates that the BCF/BAF criteria, as currently applied, are inappropriate for the hazard identification and classification of metals. Furthermore, using BCF and BAF data leads to conclusions that are inconsistent with the toxicological data, as values are highest (indicating hazard) at low exposure concentrations and are lowest (indicating no hazard) at high exposure concentrations, where impacts are likely. Bioconcentration and bioaccumulation factors do not distinguish between essential mineral nutrient, normal background metal bioaccumulation, the adaptive capabilities of animals to vary uptake and elimination within the spectrum of exposure regimes, nor the specific ability to sequester, detoxify, and store internalized metal from metal uptake that results in adverse effect. An alternative to BCF, the accumulation factor (ACF), for metals was assessed and, while providing an improvement, it did not provide a complete solution. A bioaccumulation criterion for the hazard identification of metals is required, and work directed at linking chronic toxicity and bioaccumulation may provide some solutions.

Keywords—Metals Bioconcentration factor Hazard assessment Bioaccumulation Toxicity

INTRODUCTION

Bioaccumulation, along with persistence and acute toxicity, is used for aquatic environmental hazard identification to determine the potential for adverse effects to biota. Hazard identification is the determination of the adverse effects that a substance has an inherent capacity to cause and is based on its intrinsic properties [1]. Because it is based on a substance's fundamental and inherent properties, hazard identification criteria should be independent of exposure conditions. Specific issues and such as those that may be encountered locally and regionally are not considered in hazard identification but rather are dealt with in risk assessment, which integrates hazard identification, dose–response assessment, and exposure assessment.

In addition to its use as a criterion for hazard identification, bioaccumulation can also be a component of other regulatory toolboxes and is used in many jurisdictions for prioritization and risk assessment [2–4]. For example, aquatic toxicity, bioaccumulation, and persistence are applied in the internationally harmonized system for hazard classification of chemical substances, based on hazard identification, that has been developed within the framework of the Organization for Economic Cooperation and Development (Paris, France) [1]. Bioaccumulation is also used for categorization of substances in Canada, in life-cycle impact assessment models [5], and in screening-level risk assessment evaluations [6]. The criteria used to evaluate bioaccumulation in these contexts are the bioconcentration factor (BCF) and the bioaccumulation factor (BAF). For hazard classification, the BCF/BAF criterion is usually applied as a threshold, above which a substance is deemed bioaccumulative and therefore possessing the potential for long-term environmental impacts. The threshold BCF/BAF values used to classify substances typically range between 500 and 5,000, depending on the jurisdiction [1,7]. The criterion is generally applied to all substances including metals and metal compounds.

The BAF and BCF represent one of the most simplified models for bioaccumulation [8,9]. It is a single-compartment model that predicts partitioning between exposure medium (water in this study, but also soil or sediment) and biota. Both BCF and BAF are generally calculated as the ratio, at equi-

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librium, of internal biota concentration to exposure concentration. Although the calculation of BAF and BCF are usually the same (e.g., see [7]), the interpretations are slightly different, with accumulation in organisms arising from water only for BCF and from water and dietary sources for BAF. Therefore, in general, BAF is derived from measurements in natural environments and BCF is more readily measured under laboratory conditions.

In general, bioaccumulation of substances is widely accepted as one of the key factors in understanding and identifying their potential environmental hazard. To produce adverse effects, metals must bioaccumulate (where uptake exceeds elimination) in excess of a threshold concentration at the specific site of action. The BCF/BAF criterion is the only bioaccumulation model considered for hazard identification in spite of the fact that there are other models available. For example, some recent metal-specific bioaccumulation models include McGeer et al. [10], DiToro et al. [11], and Santore et al. [12], although it must be recognized that these are metal specific and not designed or easily adaptable for hazard identification. An important feature of these metal-specific models is validation, specifically, linking bioaccumulation to adverse impact. In terms of environmental protection, the issue of validation is important because, as noted by Beyer [13], an overemphasis on bioaccumulation potential as an independent endpoint often diverts attention and resources from the more important concern of whether metal concentrations in the environment result in impacts.

A number of recent studies have questioned whether use of the BCF/BAF model is appropriate for describing the relationship between bioaccumulation and the potential effects for naturally occurring inorganic substances such as metals [2,3,8,14–17]. These criticisms were based on the argument that the BCF/BAF model was originally developed and validated for a fairly limited number of neutral, lipophilic, synthetic organic substances with narcosis as the mode of toxic action. Additionally, those works argue that the simple ratio of internal concentration to external exposure (i.e., the BCF or the BAF) does not recognize the complex internal metal dynamics of uptake, internal sequestration, storage, active elimination, and nutrient essentiality or the potential for adverse effects.

The purpose of our study was to provide a detailed examination of the bioaccumulation of some metals in relation to the BCF, BAF, and hazard identification principles. We considered inorganic metal substances and compounds and excluded organometallic compounds with the exception of methylmercury. We focused efforts on two aspects, one being the theoretical underpinnings of the BCF/BAF model in relation to the state of the science on bioaccumulation of metals in aquatic organisms. The other aspect was an assessment of some of the bioaccumulation data available in terms of the practical implications of using BCF and BAF as criteria for aquatic hazard identification. While the bioaccumulation of metals from environmental media other than the aquatic medium can also lead to impacts, we chose to focus on the aquatic because of the volume of data available and the fact that metal BCFs and BAFs derived from soil and sediments studies tend to be orders of magnitude lower that those from aquatic (data not shown). In addition, much of the regulatory concern for metals in the context of environmental hazard classification is in relation to the aquatic medium [1,7].

THEORETICAL BASIS OF THE BCF/BAF MODEL

The use of BCF and BAF, subsequently referred to as BCF for simplicity, as quantitative measures that indicate the potential toxicological impact of substances [4,18] was developed and validated for neutral hydrophobic organic substances [4,19–27]. This development as an indicator of the long-term hazard potential was due to the limited data on the chronic toxicity of these substances. As such, BCF is of most value when little or no long-term toxicological data are available [1].

One of the most important theoretical conditions of the BCF model in terms of its applicability to hazard identification of chemical substances is that BCFs should be independent of exposure. In other words, hazard identification is based on the intrinsic properties of substances [1], and for BCF to be considered as an intrinsic property, it should remain constant over a range of conditions. Meeting this condition means that differences in BCFs among substances are related to variations in bioaccumulation, which includes uptake and elimination as well as metabolic and natural degradation/depuration [21,23,28].

Diffusion is the mechanism of uptake and accumulation for neutral organic substances in biota and is the key aspect of their bioaccumulation that ensures that BCFs are independent of exposure. Neutral organic substances, because they are intrinsically lipophilic and hydrophobic, accumulate in biota via simple passive diffusion across the lipid bilayer of biological membranes as predicted by Fick's Law [29]. Because lipid solubility is directly related to biological membrane permeability [9,30], uptake of neutral organic substances is driven by the thermochemical partitioning between the water phase of the environmental medium and the lipid phase of the animal. Uptake into biota by passive diffusion satisfies the assumption that BCF be independent of exposure. Therefore, the validation of the BCF model as an indicator of the bioaccumulative nature of neutral organic substances is related to their intrinsic hydrophobic and lipophilic chemical properties.

The fact that the BCF model is essentially a hydrophobicity model [26] has been exploited to derive even more simplified estimates of bioaccumulation potential. Studies have illustrated a direct relationship between the octanol-to-water partition coefficient (K_{ow}) of a substance and its BCF [20,23,25,27,31,32]. This BCF to K_{ow} relationship results from the link between K_{ow} and cell membrane permeability [33]. In addition, studies have shown an inverse relationship between BCF and water solubility [25,31,34,35]. Furthermore, the theoretical physiochemical basis of the experimental associations between BCF, K_{ow}, and water solubility for lipid-soluble organic compounds is based on fugacity, and this has been derived and discussed by Mackay [28], McCarty and Mackay [36], and Newman [9].

APPLICATION OF THE BCF MODEL TO METALS

The BCF model has been derived and validated, both experimentally and theoretically, but only for a limited number of lipophilic, nonionic synthetic organic substances that undergo minimal metabolism within an organism [4]. The fundamental differences that exist between the physical, chemical, and toxicological properties of organic and inorganic substances would indicate that this model might not apply to the latter and has been reviewed [2,26,36]. These fundamental physicochemical differences between organic and inorganic substances are carried over to their mechanisms of uptake by biota. Lipophilicity, K_{ow}, and fugacity, while key correlates for bioaccumulation of organic substances, are generally considered irrelevant and unrelated to accumulation of metals [1,9,29,37,38]. One of the important assumptions of the BCF model is that it reflects equilibrium conditions between exposure and tissue concentrations. While this equilibrium can be verified for lab-based exposures (BCFs), organisms sampled from natural conditions (BAFs) may not fulfill this assumption. Often there is not enough information given to assess whether or not equilibrium has been achieved, and if it has not, BAF values would be underestimates of real values.

Bioaccumulation of naturally occurring substances occurs along a continuum of exposure, and trace amounts of metals, both essential and nonessential, can be found in all biota [39,40]. These two studies demonstrate that, while it is possible to calculate BCFs from accumulations that occur under natural conditions, these values can be as high as 300,000 and are generally meaningless in terms of evaluating the potential for toxicity or environmental hazard [14,41]. In addition to background accumulation, aquatic biota are also able to regulate internal concentrations of metals through active regulation, storage, or a combination of these two [42–49]. Furthermore, the degree of uptake and ultimate internal fate of metals in aquatic biota is strongly influenced by availability and/or transfer processes such as ligand binding and receptor site competitive interactions. These bioaccumulation-controlling processes act at the level of the aquatic medium (e.g., geochemical speciation), the biological membranes (e.g., cationic competition), the vascular and intercellular transfer mechanisms, and the intracellular matrix [14,37,38,50–58]. While diffusional uptake of neutral inorganic complexes can occur [59,60], uptake of ions via physiological mechanisms that exhibit saturable kinetics is much more common and toxicologically relevant [9,29,33,61–63]. Similarly, physiological processes, usually renal, biliary, or branchial, generally control elimination. Additionally, sequestering, detoxification, and storage occurs [55,61] (also see below). As a result of these physiological processes, biota often actively regulate metal bioaccumulation via dynamic feedback systems that respond to environmental loading and maintain homeostasis [51,57,63]. These physiological processes have evolved over time because of the natural occurrence of metals, allowing biota to adapt with excesses and to accumulate because of nutritional dependency. As a result of the host of factors that influence metal uptake and accumulation, BCF values for metals are likely not to be independent of exposure. The independence between BCF values and exposure is a central feature of the BCF model and its use in hazard classification.

Because of active regulation and homeostatic control of metal bioaccumulation, the BCF model is problematic in terms of how it can be applied to metals and inorganic metal substances. Physiological control over accumulation suggests that bioaccumulation will vary with exposure, thus potentially invalidating BCF as a hazard criterion. Additionally, with respect to bioaccumulation from natural background levels and nutritionally essential elements, some degree of accumulation is normal and/or essential and completely unrelated to potential impact of anthropogenic releases to the environment (the focus of hazard identification of substances). The BCF is an aggregate measure of all these sources and does not distinguish between different forms of bioaccumulated metal. These issues do not arise in the hazard identification of the purely anthropogenic neutral organic substances that form the basis of the BCF model.

A further complicating factor in the application of BCF to metals is the fact that many aquatic organisms store metals in detoxified forms, such as in inorganic granules or bound to metallothionein-like proteins [64–67]. The use of granules as a storage mechanism is of particular note in the context of BCFs because extremely high tissue concentrations are often associated with this storage mechanism but unrelated to adverse impact. For example, two types of granules are known in mollusks. One of these is calcium phosphate based, capable of storing Cd, Cu, Co, Fe, Mn, Ni, and Zn [55,68] and rendering these metals nonbioavailable to both the mollusk and organisms that consume them [69–71]. Another granule type is derived from Cu-S complexes that appear to be products of normal lysosomal breakdown of metallo-sulfur proteins such as metallothioneins [72]. These granules have been shown to not only complex Cu but also Cd and Ag [68], with the end result that the metal is either excreted, recycled, or permanently stored. While sequestered and stored metal may not result in direct impacts on the organism itself, there exists the potential for impacts in predators through dietary uptake.

In summary, based on the assumptions underlying the BCF model and on the naturally occurring background concentrations of the elements in biota, it would appear that the theoretical basis for applying BCF to the hazard identification of metals is problematic. Complicating factors include the fundamental physicochemical differences between organic and inorganic substances and how these relate to the complexity and diversity of mechanisms for metal uptake, accumulation of essential and nonessential elements from natural background, homeostatic control of accumulation, and internal detoxification and storage. However, none of these issues diminishes the importance of bioaccumulation as a factor in assessing the environmental hazard associated with metals. To correctly assess potential hazards, it would be necessary to distinguish between essential nutritional accumulation, that which is sequestering and stored, and accumulation that causes adverse effects. Because BCFs are based on the whole-body concentration, the BCF model does not distinguish between these different forms of bioaccumulation and therefore it would seem unlikely that the criterion would be correlated to adverse effects such as chronic toxicity.

APPLICATION OF BCF TO METAL BIOACCUMULATION DATA

Methods

In this work, we have reviewed literature data to evaluate the relationships between chronic exposure and metal bioaccumulation in aquatic biota in terms of both whole-body metal concentration and BCF. The goal was to assess practical aspects of using BCFs as a criterion for hazard identification. Although BCFs are sometimes provided in the literature, many metal-exposure studies reporting whole-body concentrations do not include calculated BCF values. However, it is often possible to calculate BCF from whole-body concentration data and exposure or body concentration from BCF and exposure data. The data we reviewed were available from experimental exposures (BCF) and reports of samplings from natural environments (BAF). Because BCFs and BAFs are calculated in an identical manner [7] and are considered similarly in the regulatory context, we did not distinguish between these two types of data sources except in a few specific cases where an in-depth attempt was made to explain anomalous and/or variable data.

We collected and evaluated waterborne-exposure data on Zn, Cd, Cu, Pb, Ni, Ag, Hg, and hexachlorobenzene (HCB; $C_6H_4Cl_2O$). These substances were chosen for practical as well as theoretical reasons with the availability of reasonable amounts of suitable information as the primary consideration. Data were collected from the primary literature with the help of common sources such as the AQUIRE database [73] as well as Jarvinen and Ankley [74] being used to identify additional studies. Zn, Cd, Cu, Pb, Ni, and Ag were included in this study because these represent metals of general concern in terms of environmental protection and they span the continuum from nutritionally essential, such as Zn, Cu, and Ni, to nonessential, such as Pb and Ag. We included Hg for comparative purposes, as it can occur in the organic methylmercury form, with potentially different bioaccumulation trends from the other metals. Data for Hg were subdivided into studies where biota were exposed to methylmercury and those where they were exposed to inorganic Hg, usually as a chloride or nitrate salt. Hexachlorobenzene was also added to the comparative list as a synthetic organic pollutant. As such, HCB was chosen as an ideal substance, one for which BCF values could be assumed to accurately describe its bioaccumulative nature.

As prerequisites for data suitability, we required exposure and whole-body metal levels measured by accepted analytical techniques and an assessment of exposure in the context of guidelines associated with standard BCF test methodologies [75,76]. In this respect, we considered experimental exposure data to be acceptable only when whole-body concentration data were available and when the exposure duration was at least 28 d for fish and 14 d for invertebrates and plants or shorter periods if equilibrium had been demonstrated. The metal concentrations from biota sampled from natural environments (BAF) were assumed to be at equilibrium, although it must be recognized that often not enough information is given to assess whether or not this has been achieved. When data were available on a dry-weight basis, it was converted to wet weight for BCF calculations with dry-to-wet conversion ratios of 0.1 for algae, plants, and mollusks and 0.2 for arthropods, annelids, and fish [74]. When a range of exposure concentrations was given, the average was used. In a few cases, control exposure levels were reported as below a quantified detection limit, and exposure value at or slightly less than the reported limit of detection was used. A full listing of the data used in this study is presented in tabular format in the Appendix (See SETAC Supplementary Data Archive, Item ETC-22-05-001; http://etc.allenpress.com).

We have analyzed the data to show the relationships between exposure concentration and bioaccumulation in terms of whole-body metal concentration and BCF. To enable comparisons and because of the volume of information, data were sorted into 11 different species groups following the approach used by Jarvinen and Ankley [74], which were aquatic microphytes and algae (designated as algae), annelids, arthropods (other than insects), insects, mollusks, salmons, centrarchids, cyprinids, sticklebacks, killifish, and other fish species. For each metal, the species represented in these groups varied with the information available. For example, when one of the fish species groups, e.g., cyprinids, consisted of a small number of observations, the cyprinids were included in the other fish grouping. Additionally, in a few cases, data for specific metals and species groups were further subdivided to better understand patterns of bioaccumulation. Linear regression of log-transformed data was used to determine the slope and intercept of the best-fit line and to test the slope for significance from zero. For each metal, regression analysis was done within each species group and for all data combined.

The mean BCF value for each metal and associated coefficient of variations (CV) was calculated using all available data. To illustrate the effect of outliers, mean BCF and CV values were also recalculated for some metals after removal of extremely high or low data points. Data for potential exclusion in recalculations were identified as values greater or less than 3 SD from the mean as well as by visual assessment and these data points were clearly identified in the appropriate figure and discussed in the text. Mean BCF values were also calculated over a narrowed exposure range. The narrowed range was chosen to limit the amount of data by approximately 50 to 75% and to bracket the chronic water-quality guidelines and criteria [77–85]. The restricted-range mean BCF values were calculated to evaluate the possibility of linking BCF to an exposure range over which chronic effects would be expected to occur (i.e., environmentally relevant exposure conditions). These restricted exposure conditions were selected to include a concentration range spanning from just below the water-quality or guideline values to just above, and for each metal, the actual range depended on the amount of data available.

As an alternative to BCF, we derived accumulation factors as a parallel measure but calculated as the increase in concentration that results from an increase in exposure [86]. The only data available to calculate these values were studies with two or more exposure concentrations. Hence, the lowest exposure concentration (usually controls) and its associated whole-body concentration were subtracted from higher exposure and concentration values (respectively). The ACF is analogous to a BCF but represents the additional accumulation that results from incremental exposure. As with BCF values, it was assumed that tissue concentrations had reached equilibrium. There were sufficient data to calculate a database of ACF values for Zn, Cd, Cu, and Pb.

HCB accumulation and BCF

The mean BCF of 69,796 for HCB was significantly higher and the CV of 36% was significantly less than for the metals examined (see Table 1). The mean derived from all the data was heavily influence by six data points from the study of Baturo and Lagadic [87], where BCF values were as high as 1,533,000 and all but one of the values was higher than 3 SD above the mean. The exclusion of these six data points reduced the mean BCF by 74% to 18,391 and the CV to only 14%. Limiting the data to the range of 0.1 to 1 μg/L resulted in a 29% increase in the mean BCF to 23,667, but CV remained unchanged at 15% (Table 1).

Bioaccumulation data for HCB clearly showed that, as exposure concentrations increased, body concentrations increased (Fig. 1A, C, and E). Data for mollusks were split into two subgroups, namely those from field studies and those from laboratory studies, the former exhibiting HCB concentrations that were between 2 and 3.5 orders of magnitude greater (Fig. 1A, open squares) than those from laboratory studies (Fig. 1A, filled squares). The concentration-to-exposure relationship for mollusk field studies yielded a slope of 1.71 ± 0.29 ($p < 0.05$, $n = 6$; Fig. 1A), while that of lab studies was 0.68 ± 0.15 ($p < 0.05$, $n = 9$, Fig. 1A). Therefore, both within species groups and overall, the whole-body concentration to exposure relationship was significant (Table 2).

Table 1. Mean bioconcentration factor and bioaccumulation factor (BCF) values and associated standard deviation for seven metals and hexachlorobenzene (HCB). The data for mercury were separated into exposures using methylmercury and those where the exposure substance was an inorganic salt of mercury. Values are shown using all the available data and, for some substances, the effect of outlier data is illustrated by recalculating means with data from specific studies removed. Additionally, the BCF mean values were calculated over a limited range of exposure concentrations, and for each substance, this limited range was chosen to encompass concentrations where chronic toxicity might be expected to occur (based on water-quality guidelines/criteria). The accumulation factor (ACF) is also shown for those metals with sufficient data; standard deviation (SD)

Substance/metal	Variable	Mean	SD	*n*
HCB	BCF: all exposures	69,796	24,888	82
	BCF: all exposures[a]	18,391	2,595	76
	BCF: 0.1–1 μg/L[a]	23,667	3,660	42
Zinc	BCF: all data	3,957	8,771	143
	BCF: all data[b]	3,394	8,216	133
	BCF: 10–110 μg/L	2,941	6,006	45
	BCF: 10–110 μg/L[b]	1,852	3,237	43
	ACF: all data[b]	326	1,462	68
	ACF: all data[bc]	158	233	67
Cadmium	BCF: all data	1,866	4,844	226
	BCF: 0.1–3 μg/L	2,623	6,009	52
	ACF	600	2,510	97
	ACF[d]	352	615	96
Copper	BCF: all data	1,854	4,465	128
	BCF: all data[e]	1,144	1,720	122
	BCF: 1–10 μg/L	1,224	1,835	50
	ACF[e]	660	865	52
	ACF[ef]	456	659	46
Lead	BCF: all data	598	1,102	66
	BCF: 1–15 μg/L	410	647	14
	ACF	350	431	33
Nickel	BCF: all data	1,613	8,411	52
	BCF: all data[g]	157	135	49
	BCF: 5–50 μg/L[g]	106	53	27
	ACF[g]	39	112	6
Silver	BCF: all data	1,233	2,338	29
	BCF: 0.4–5 μg/L	884	484	17
Mercury, inorganic	BCF: all data	4,955	10,109	60
	BCF: 0.1–1 μg/L	14,550	15,859	15
Mercury, methyl	BCF: all data	8,952	24,675	53
	BCF: 0.1–1 μg/L	9,023	25,929	39

[a] Data from Baturo and Lagadic [87] removed.
[b] Outliers from Shuster and Pringle [89] as well as Mirenda [90] removed; see Figure 2 and text.
[c] Extreme value of Burbidge [160] removed.
[d] Extreme value of Pesch and Stewart [161] removed.
[e] Outliers from Shuster and Pringle [89] as well as Winner [117] removed; see Figure 4 and text.
[f] Data from McLusky and Phillips [119] removed.
[g] Data from Wilson [140] removed.

The BCF data revealed a relationship to exposure that was generally invariant (Fig. 1, Table 2). Arthropods were the only species group to show a significant BCF versus exposure slope, and this was a positive relationship. Overall, when all the data were pooled, the regression analysis revealed significant positive slope to the relationship between BCF and exposure concentration (Table 2).

Hexachlorobenzene was included in our assessment as typical of the neutral and lipid-soluble organic substances that fulfill the theoretical context of the BCF model. The organochlorine, which was used as a fungicide and chemical feedstock in manufacturing, is recognized as a persistent and bioaccumulative substance with the potential to biomagnify [88]. Based on these properties, the relatively low variability in the mean BCF, the elevated values of that mean, and the general lack of correlation between exposure concentration and BCF, it is reasonable to suggest that the BCFs illustrate the inherent bioaccumulative nature of HCB and are indicative of the hazard associated with HCB. This illustrates that the BCF model does apply to the substances for which it was designed.

Zinc accumulation and BCF

One of the most notable features of the mean for Zn BCF was the variability (Table 1) as typified by a CV of 223%. Recalculation of the mean with the values of Shuster and Pringle [89] and Mirenda [90] (Fig. 2A and C, open squares) not included resulted in a 14% reduction in BCF for Zn but little change in data variability (CV 242%; Table 1). The data of Shuster and Pringle [89] were not included as they was characterized by extremely high tissue concentrations relative to the exposure concentration. The data of Mirenda [90] had very low tissue concentrations (and consequently low BCF values, ranging from 0.5 to 1.3) for exposure concentrations up to 130,000 μg/L, and some of these data points are off the axis scale of Figure 2A. When the range of exposure values was limited to 10 to 110 μg Zn/L, the range where chronic effects are predicted to begin, the mean BCF value was slightly reduced, to a value of 2,941. Within the reduced exposure range, removal of the outlier data as described above (two data points from Shuster and Pringle [89]) decreased the mean BCF by

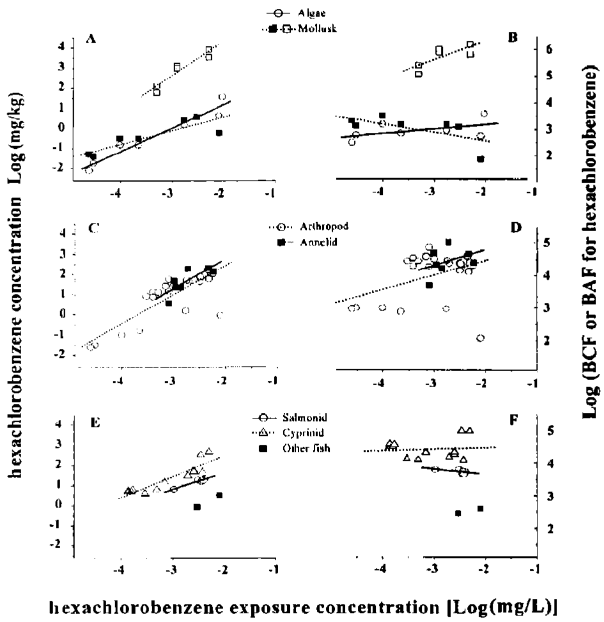

Fig. 1. Effect of chronic hexachlorobenzene (HCB) exposure on HCB content in aquatic biota (**A**, **C**, **E**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for HCB (**B**, **D**, **F**). Data are on a log-log basis and the best fit line from the linear regression analysis is shown for each species group. The regression variables are given in Table 2. Note that, due to distinct differences in tissue concentration, data for the mollusk species group were separated into two groups, and these are shown in **A** and **B** as open and filled squares (see text for details). As well, regression lines are not provided for the group designated as other fish.

37%, but the CV nonetheless remained elevated at 175% (Table 1).

The accumulation of Zn by eight species groups is shown in Figure 2A, C, E, and G, and the associated regression variables are given in Table 3. The data clearly illustrate that internal Zn content is well regulated. All eight species groups exhibited very slight increases in whole-body concentration over a dramatic increase in exposure concentration. Only arthropods and cyprinid species showed significant increases in whole-body Zn concentration with increasing exposure level (Table 3 and Fig. 2A, C, E, and G). When all data were pooled across the eight species groups, the overall concentration-to-exposure relationship showed a slight accumulation (Table 3) over the range of exposures, although the coefficient of determination (r^2) was low. From data for all species and all exposures except Shuster [89], the mean Zn content was 46.2 ± 50.7 μg Zn/g tissue (mean ± SD, n = 137, CV of 110%). Therefore, the carcass concentration data illustrate clearly that Zn does bioaccumulate in aquatic biota, but there is an inconsistent relationship between exposure concentration and whole-body concentration of Zn. In fact, most species did not show significant increases in Zn accumulation when exposure levels increased, even when exposure concentrations reached those that would be predicted to cause chronic effects. This suggests that adverse effects related to Zn exposure are independent of whole-body accumulation, as recently discussed by Alsop et al. [91].

Due to the general lack of increased whole-body and tissue concentrations at higher Zn exposure levels, the Zn BCF data showed an inverse relationship to exposure concentration (Fig. 2B, D, F, and H and Table 3). The highest BCF values for Zn were at low and naturally occurring exposure concentrations, while the lowest BCF values were at elevated Zn exposure

Table 2. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne hexachlorobenzene (HCB) exposure concentration to HCB content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for HCB ($\log_{10} : \log_{10}$ basis). Data are grouped by species as shown in Figure 1, where the associated best fit lines are shown. Overall relationships for slope and intercept are given as either the mean of species groups or the linear regression when all data are pooled. The number of observations is shown for each relationship, and * indicates that the slope or intercept are significantly different ($p < 0.05$) from zero as determined by the regression analysis

		Regression variables					
Variable	Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	n
BCF/BAF versus exposure							
By species	Algae	0.17	0.10	3.53*	0.36	0.31	9
	Arthropods	0.44*	0.18	5.35*	0.57	0.18	29
	Annelids	0.49	0.52	5.77*	1.43	0.15	7
	Mollusk[a]	0.19	0.22	4.84	0.69		15
	Salmonids	−0.16	0.10	3.33*	0.26	0.34	7
	Cyprinids	0.04	0.15	4.56*	0.46	0.01	13
Overall	Species mean[a]	0.20	0.14	4.60	0.72		6
	All data	0.35*	0.13	5.03*	0.41	0.08	82
Content versus exposure							
By species	Algae	1.17	0.10	3.53	0.35	0.96	9
	Arthropods	1.44*	0.18	5.35*	0.57	0.71	29
	Annelids	1.49*	0.52	5.77*	1.43	0.62	7
	Mollusk[a]	1.19	0.22	4.84	0.69		15
	Salmonids	0.84*	0.10	3.33*	0.26	0.92	7
	Cyprinids	1.04*	0.15	4.56*	0.46	0.83	13
Overall	Species mean[a]	1.20	0.14	7.60	0.71		6
	All data	1.35*	0.13	5.03*	0.41	0.58	82

[a] Statistical significance of the mean of species was not assessed.

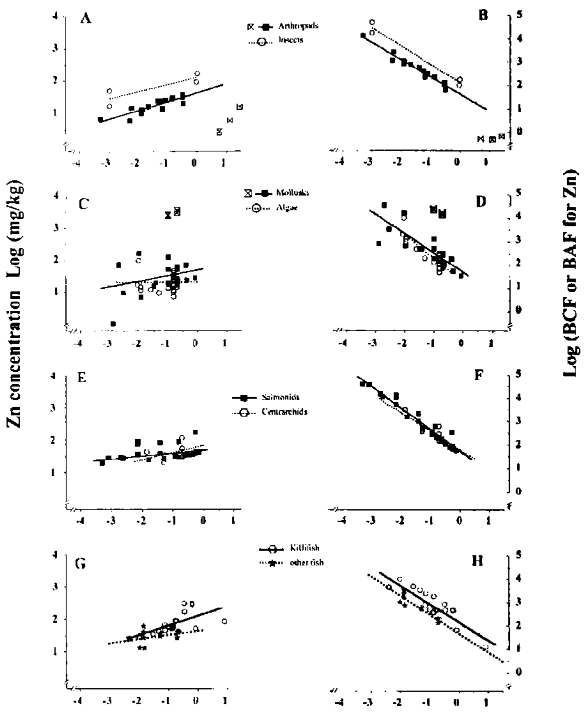

Fig. 2. Effect of chronic Zn exposure on Zn content in aquatic biota (**A**, **C**, **E**, **G**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Zn (**B**, **D**, **F**, **H**). Data are on a log-log basis and the best fit line from the linear regression analysis is shown for each species group. The regression variables are given in Table 3. Note that regression lines are not provided for the group designated as other fish and open symbols filled with an X are outliers that were not included in the regression analysis (see text for details).

levels. In all cases, the relationship of BCF to exposure was significant and negative. Therefore, while bioaccumulation of Zn occurs, the BCF for Zn should not be considered as a measure that describes this Zn bioaccumulation. In fact, Zn BCF values are much more closely correlated to Zn exposure concentration than they are with bioaccumulation (see coefficients of determination; Table 3). In terms of aquatic hazard classification, neither BCF nor body concentration seem to be reliable indicators of the potential for adverse effects. This is in agreement with both Alsop et al. [91] and Galvez et al. [92], who concluded that regulatory strategies based on total tissue Zn concentrations would not be successful. Taken together, the variability in mean Zn BCF values and the inverse relationship indicate that Zn BCF is not an intrinsic property of Zn.

The Zn data illustrate that, when BCF criteria are applied as threshold values for hazard identification, it may lead to conclusions that are inconsistent with toxicological data. In this context, the inverse relationship of BCF to exposure erroneously suggests that hazard is less at elevated exposure concentrations. However, water-quality guidelines and criteria [78,85] provide for waterborne Zn concentrations above which adverse impacts on aquatic biota can be expected and therefore increasing exposure results in increased hazard. This is supported by data showing tissue accumulation as exposure concentration increases. Thus, the conclusions drawn from the measured toxicological data as well as tissue concentrations and those derived from the application of BCF threshold criteria values are inconsistent.

The physiological basis for the inverse relationship of BCF to Zn exposure concentration arises from Zn uptake and control mechanisms. At low environmental Zn levels, animals are able to sequester and retain Zn in tissues for essential functions [93]. When Zn exposure levels are chronically elevated, aquatic animals are able to control bioaccumulation. There is clear evidence that many species actively regulate their body Zn concentrations, including Crustacea, such as *Homarus gammarus*, *Carcinus maenas*, *Maia squinado*, *Crangon crangon*, *Palaemon elegans*, *P. serratus* [94], and *Austropotamobius pallipes* [95,96]; the oligochaetes *Lumbriculus variegatus* and *Neries diversicolor* [96]; mussels such as *Mytilus edulis*, *Dreissena polymorpha*, *Unio pictorum*, and *Velesunio ambiguus* [96–98]; the gastropod *Nucella reticulatus* [99]; as well as *Oncorhynchus mykiss* [91,100]. As it does with Cu, the amphipod *Echinogammarus pirloti* does not actively excrete excess Zn but takes it up at a low net rate relative to its body growth rate [94], thus illustrating another burden control strategy. Detoxification both through binding to proteins such as metallothionein [44,69] and storing as Zn phosphate granules [94,101,102] has also been discussed. While the chironomids *Chironomus riparius* and *Stictochironomus histrio* do not appear to actively regulate their zinc body concentrations, Zn is lost with each cast exuvium [103]. This process may effectively reduce body concentrations but possibly only on an intermittent basis under an ongoing exposure and may also occur for other biota that molt.

Although total Zn carcass concentration is not well correlated with Zn exposure, radiotracer studies in rainbow trout have shown that chronic waterborne Zn^{2+} exposure results in dramatic and complex alterations in gill uptake kinetics [104] and that these are linked to Ca^{2+} dynamics [105]. Included in the changes are a decreased affinity and an increase in the total number of binding sites [104]. While these changes appear to be reliable indicators of exposure, it is unclear how they can be exploited for environmental hazard classification and therefore further development is required.

There is little evidence to suggest that metals such as Zn biomagnify in aquatic food webs. For example, Leland and Kuwabara [106] state that the classic idea of biomagnification, developed from studies of DDT, does not hold for most metals. Absorption of metals from food is highly variable because of the variety of free and bound forms of the ions that are possible in food [107]. In addition, competition between related elements for active transport sites is also variable. Although there is no evidence that zinc biomagnifies in aquatic systems, it is an essential element that many organisms accumulate to high levels and elevated accumulation rates may sometimes be mistaken as trophic transfer [108].

Cadmium accumulation and BCF

At 1,866, the mean BCF for Cd was lower than that of Zn (at 3,957), although it was similar with respect to variability (CV of 265%). Limiting the range of exposure values to 0.1 to 3 μg Cd/L increased the mean BCF to about 2,600 and the SD to about 6,000 (CV = 230%; Table 1). Whether the full data set or the limited-exposure range data was used, high variability was a key feature of the mean BCF values for Cd.

An increase in whole-body Cd concentration was apparent in most of the species examined (Fig. 3A, C, E, and G). Anal-

Table 3. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne Zn exposure concentration to Zn content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Zn ($\log_{10}:\log_{10}$ basis). Data are grouped by species as shown in Figure 2, where the associated best fit lines are shown. Overall relationships for slope and intercept are given as either the mean of species groups or the linear regression when all data were pooled. The number of observations is shown for each relationship, and * indicates that the slope or intercept are significantly different ($p < 0.05$) from zero as determined by the regression analysis

		Regression variables					
Variable	Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	*n*
BCF/BAF versus exposure							
By species	Algae	−1.00*	0.12	1.31*	0.14	0.74	24
	Insects	−0.79*	0.09	2.11*	0.19	0.98	4
	Arthropods[a]	−0.73*	0.04	1.64*	0.07	0.96	17
	Mollusks[a]	−0.83*	0.13	1.70*	0.19	0.71	20
	Salmonids	−0.92*	0.04	1.73*	0.06	0.96	29
	Centrarchids	−0.80*	0.20	1.78*	0.24	0.69	9
	Killifish	−0.84*	0.10	2.14*	0.12	0.78	20
	Other fish	−0.87*	0.16	1.63*	0.26	0.80	9
Overall	Species mean[b]	−0.85	0.03	1.76	0.09		8
	All data[a]	−0.84*	0.03	1.74*	0.06	0.77	132
Content versus exposure							
By species	Algae	0.002	0.12	1.31*	0.14	0.00001	24
	Insects	0.21	0.09	2.11*	0.19	0.76	4
	Arthropods[a]	0.27*	0.04	1.64*	0.07	0.74	17
	Mollusks[a]	0.17	0.13	1.70*	0.19	0.10	20
	Salmonids	0.07	0.04	1.71*	0.07	0.12	29
	Centrarchids	0.20	0.20	1.78*	0.24	0.12	9
	Killifish	0.30*	0.08	2.10*	0.09	0.45	20
	Other fish	0.13	0.16	1.63*	0.26	0.08	9
Overall	Species mean[b]	0.17	0.04	1.75	0.09		8
	All data[a]	0.17*	0.04	1.72*	0.05	0.14	132

[a] Outlier data points were not included in the regression analysis; see Figure 2 and text.
[b] Statistical significance of the mean of species was not assessed.

ysis of the trends was complicated by the variation in the data, particularly for fish groups such as salmonids (Fig. 3E) and sticklebacks (Fig. 3G), where a significant accumulation was absent and coefficients of determination were low (Table 4). Killifish and aquatic insects showed the highest accumulation as exposure concentration increased (Fig. 3G and A, respectively).

In spite of significant increases in body concentration over the range of exposure concentrations for a number of species groups, the relationship of Cd BCF to Cd exposure concentration was negatively correlated (Fig. 3B, D, F, and H and Table 4) except for killifish. This negative relationship between BCF and exposure was generally lower than for Zn but was nonetheless significant. The highest BCF values for Cd were at low and naturally occurring exposure concentrations. The inverse BCF to exposure relationship illustrates that, although Cd concentration increases with exposure, internal accumulation does not rise as quickly as exposure levels and therefore indicates a significant degree of control over Cd accumulation. Therefore, bioaccumulation of Cd does occur, but as with Zn, the high variability of the mean BCF values and the negative correlation between exposure and BCF indicates that BCF for Cd is neither an intrinsic property nor an optimum descriptor of Cd bioaccumulation.

It is generally agreed that the bioaccumulation of Cd does not serve a nutritional purpose, although recently this notion has been challenged for some marine organisms [109]. As seen from the relative differences in the scales of Zn and Cd body concentration axes in Figures 2 and 3, accumulations of Cd tend to be much lower than those of nutritionally essential elements such as Zn. Although there is little evidence of active regulation of internal Cd concentrations, it is clear from the inverse BCF-to-exposure relationship that some physiological control over Cd accumulation can be achieved. For example, reduced branchial uptake in response to exposure has been demonstrated in rainbow trout [110–112]. As well, growth dilution of Cd stores in decapods shows that a form of regulation is possible [102]. Detoxification of accumulated Cd is also common. For example, binding of Cd to low molecular weight proteins such as metallothionein occurs in many animals [55], including the rainbow trout [111], the barnacle *Semibalanus balanoides* [102], the scallop *Mizuhopecten yessoensis* [113], the marine gastropod *Nassarius reticulatus* [99], and possibly *Daphnia magna* [114]. An example of an animal with tissue-specific granule storage of Cd is the marine isopod *Idotea baltica*, in which granules are stored in the hepatopancreas [115]. Storage of Cd as granules in the kidney is also common in vertebrates. These studies illustrate that carcass concentrations of Cd significantly above normal levels can be tolerated and physiological processes adapted to result in acclimation. A mechanistic understanding of chronic bioaccumulation control mechanisms for Cd is incomplete and, as such, how this information might be included in a model for hazard classification is not clear. However, it is deserving of further efforts.

As discussed in the review by Suedel et al. [108], there is little evidence to suggest that cadmium biomagnifies in aquatic systems. For example, Ferard et al. [116] examined the transfer

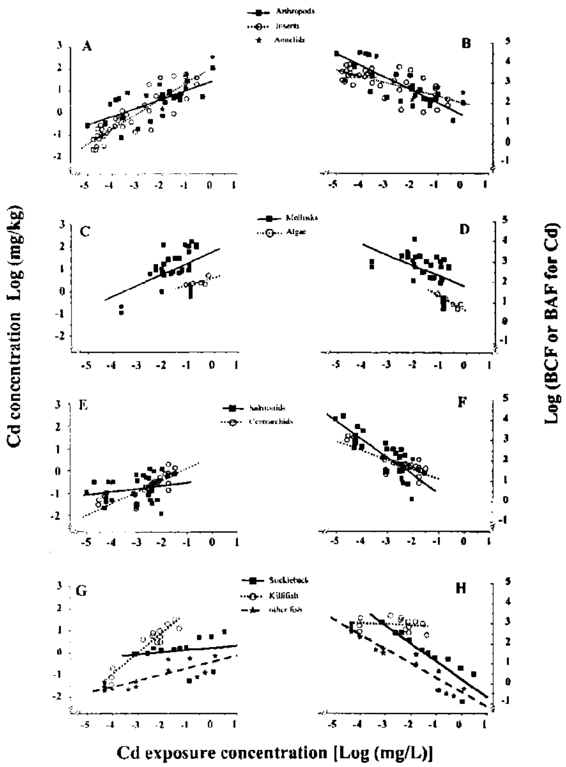

Fig. 3. Effect of chronic Cd exposure on Cd content in aquatic biota (**A**, **C**, **E**, **G**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Cd (**B**, **D**, **F**, **H**). Data are on a log-log basis and the best fit line from the linear regression analysis is shown for each species group. The regression variables are given in Table 4.

of cadmium in an experimental food chain consisting of algae (*Chlorella vulgaris*), zooplankton (*Daphnia magna*), and fish (*Leucaspias delineatus*) and illustrated that Cd concentrations decreased with increasing trophic level.

Copper accumulation and BCF

The mean BCF value for Cu was similar to that of Cd (Table 1), and again, the variability of the BCF data was very high (CV = 241%). Within the data set, the study of Shuster and Pringle [89] provided four relatively high BCF values (Fig. 4C and D, open triangle), while two very low BCF values came from the study of Winner [117] (both values <1.0). Note that the body burden data from this latter study are shown in Figure 4A (open circles marked with an x), but the corresponding BCF values were off the scale of the axis in Figure 4B. The removal of these six data points reduced the mean BCF by 39% and associated variability by 62% (Table 1, CV = 152%). Selecting BCFs from Cu exposures over the limited concentration range of 1 to 10 μg/L did not result in a change in either the mean or the variability (CV = 150%).

The accumulation data (Fig. 4A, C, E, and G and Table 5) for Cu illustrate that, except for the algae and other fish groups, all species groups experienced a generalized increase in carcass concentration as exposure levels of Cu increased. The accumulation trend for Cu in algae was not significant, but the range of exposure concentrations was limited and data were edited for an outlier (Fig. 4G). The data point not included in the analysis for algae (labeled as algae but including diatoms, macrophytes, and other plants) was for the aquatic moss *Rhychostegium riparioides* from the study of Mersch et al. [118]. The data on Cu tissue concentrations in mollusks required an in-depth examination primarily due to the values for the oyster *Crassostrea virginica* reported by Shuster and Pringle [89]. These values (Fig. 4C, open triangles) were omitted from the regression analysis (Table 5) because they were ninefold higher than the next highest value and almost 50 times above the mean body concentration for other mollusks of 14.5 ± 17.8 mg/kg ($n = 30$). As this was the only datum we had from *C. virginica* in our database, it is not known if the Cu hyperaccumulation observed in the Shuster and Pringle [89] study is a species-specific trait. A detailed examination of Cu accumulation with supplemental data from, e.g., estuarine monitoring programs may shed light on differences between this species and other mollusks.

To explain the variability in the remaining mollusk data for Cu concentration, it was further subdivided to show mussels (*Mytilus edulis* and *Dreissena polymorpha*; Fig. 4C, filled squares) as distinct from other mollusk species (Fig. 4C, open circles). The log-log concentration to exposure relationship for the mussel subgroup had a slope and intercept of 0.79 ± 0.24 and 2.60 ± 0.40 (for both, $p < 0.05$, $n = 13$; Fig. 4C, solid line), respectively, while that of the remaining mollusks was 0.76 ± 0.20 and 1.95 ± 0.46 (for both, $p < 0.05$, $n = 17$; Fig. 4C, dotted line). Although data are limited, mussel species may have a relatively lower Cu body concentration compared with other mollusk species. However, in terms of bioaccumulation during exposure, the similarity of the slope values indicates that uptake patterns are similar. For this reason, the regression data reported in Table 5 are for all mollusk data except for Shuster and Pringle [89].

As with the mollusk data, the annelid species group had two distinct data clusters for Cu body concentrations that were further subdivided into a high accumulation group and a lower accumulation group (Fig. 4A). The high accumulation group was dominated by the study of McLusky and Phillips [119] (Fig. 4A, filled squares). Data for a lower accumulating group were from three studies, Young et al. [120] (Fig. 4A, filled triangles), Pesch and Morgan [121], and Milanovich et al. [122] (these latter two studies shown as filled stars in Fig. 4A). After examining the available information, we conducted regression analyses on individual studies as opposed to grouped data. The McLusky and Phillips [119] study provided data on *Phyllodoce maculata* and yielded a concentration-to-exposure relationship with a slope of 0.62 ± 0.10 ($p < 0.05$, $n = 7$). The data of Young et al. [120] for *Eudistylia vancouveri* provided a slope of 0.36 ± 0.12 (not significant, $n = 4$). Note that the analysis of the arthropod data did not include the Winner [117] data, which were characterized by very low Cu concentrations in *Daphnia magna* in spite of relatively high exposure levels (Fig. 4A, open symbols marked with an X). The study of Winner [117] demonstrated the ability of dissolved organic carbon to reduce the bioavailability of Cu, perhaps explaining the low body concentrations.

The BCF values for Cu are shown in Figure 4B, D, F, and H and the associated regression analysis variables are given in Table 5. Algae (Fig. 4H), arthropods (Fig. 4B), and salmonids (Fig. 4F) each showed a significant and negative slope for the BCF-to-exposure relationship (Table 5). The mollusk and the other fish species groups (Fig. 4D and H, respectively) had negative BCF versus concentration slopes but, due to the variability in the data, these were not significant. For the an-

Table 4. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne Cd exposure concentration to Cd content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Cd ($\log_{10}:\log_{10}$ basis). Data are grouped by species as shown in Figure 3, where the associated best fit lines are shown. Overall relationships for slope and intercept are given as either the mean of species groups or the linear regression when all data were pooled. The number of observations is shown for each relationship, and * indicates that the slope or intercept are significantly different ($p < 0.05$) from zero as determined by the regression analysis

	Regression variables						
Variable	Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	*n*
BCF/BAF versus exposure							
	Algae	−0.72*	0.20	0.59*	0.14	0.81	5
	Insects	−0.32*	0.06	2.06*	0.19	0.46	40
	Arthropods	−0.61*	0.07	1.43*	0.19	0.74	31
	Mollusks	−0.50*	0.17	1.79*	0.29	0.21	36
	Salmonids	−0.87*	0.11	−0.40	0.36	0.69	29
	Centrarchids	−0.47*	0.08	0.64*	0.22	0.59	26
	Sticklebacks	−0.90*	0.17	0.23	0.28	0.73	12
	Killifish	−0.05	0.10	2.81*	0.26	0.03	13
By species	Other fish	−0.72*	0.06	−0.40*	0.17	0.93	13
	Species mean[a]	−0.57	0.09	0.97	0.37		9
Overall	All data	−0.49*	0.04	1.25*	0.12	0.38	209
Content versus exposure							
	Algae	0.28	0.20	0.59*	0.14	0.41	5
	Insects	0.68*	0.06	2.06*	0.19	0.79	40
	Arthropods	0.39*	0.07	1.43*	0.19	0.53	31
	Mollusks	0.50*	0.17	1.79*	0.29	0.21	36
	Salmonids	0.13	0.11	−0.40	0.36	0.05	29
	Centrarchids	0.53*	0.08	0.64*	0.22	0.64	26
	Sticklebacks	0.10	0.17	0.23	0.28	0.03	12
	Killifish	0.94*	0.10	2.81*	0.26	0.90	13
By species	Other fish	0.28*	0.06	−0.40*	0.17	0.66	13
	Species mean[a]	0.43	0.09	0.97	0.37		9
Overall	All data	0.51*	0.04	1.25*	0.12	0.41	209

[a] Statistical significance of the mean of species was not assessed.

nelid species group, data were split (described above; see Fig. 4B) into that for *P. maculata* and *E. vancouveri* and the slopes of the BCF versus exposure concentration relationship for both species was significant at -0.38 ± 0.10 ($p < 0.05$, $n = 7$) and -0.64 ± 0.12 ($p < 0.05$, $n = 4$), respectively. The mean of these two values is presented in Table 5.

The Cu accumulation and BCF data clearly show that aquatic animals are able to modulate Cu bioaccumulation, as would be expected from a nutritionally required element. Although Cu accumulated as exposure concentration increased, for most species groups, the increase in concentration was proportionally less than that of exposure, thus illustrating an ability to regulate and producing a negative relationship between exposure and BCF. The ability to regulate internal Cu concentrations has been demonstrated in a wide variety of aquatic organisms, including marine species such as *Palaemon elegans*, *Crangon crangon*, *Homarus gammarus*, *Carcinus maenas*, and *Echinogammarus pirloti*, as reviewed by Rainbow [94], as well as *Neanthes arenaceodentata* [121] and *Eudistylia vancouveri* [120]. It has also been shown that freshwater fish such as the rainbow trout actively regulate Cu via sequestering into the liver and elimination via the bile, a process that involves Cu-specific transport mechanisms [123,124]. Detoxification of Cu through binding to metallothionein-like proteins has also been shown to be of significance in both marine and freshwater organisms [44,55,61,102]. In addition, detoxification and storage of Cu in granules has been shown [102,125], and this may explain the relatively shallow slope of BCF versus exposure relationship for mussels and other mollusks (Fig. 4D). As noted earlier, the BCF measure does not distinguish among physiologically essential Cu, internally stored and detoxified Cu, and excess accumulation that can produce adverse effects. As with Zn and Cd, the variability of mean BCF values and the negative correlation between BCF and exposure concentration indicates that BCF is not an intrinsic property of Cu.

There is no evidence that copper biomagnifies in aquatic systems, although it does appear to be transferred through food chains [108]. As reviewed by Lewis and Cave [126], copper accumulation in aquatic organisms at different trophic levels varies considerably and depends on several factors, including the physiological requirements of the organism, the source of copper, exposure duration, migration patterns, and chemical speciation.

Lead accumulation and BCF

The mean BCF for Pb was the lowest of all the metals on which we collected data (Table 1). As with the other metals, there was considerable variation around the mean with a CV of 184%. Narrowing the range of exposure values to from 1 to 15 μg Pb/L decreased the mean BCF value by about 30%, and variation was approximately the same (CV of 158%; Table 1).

All species groups displayed increases in body concentrations for Pb as exposure levels increased (Fig. 5). The regression analysis (Table 6) showed a distinct variation in ac-

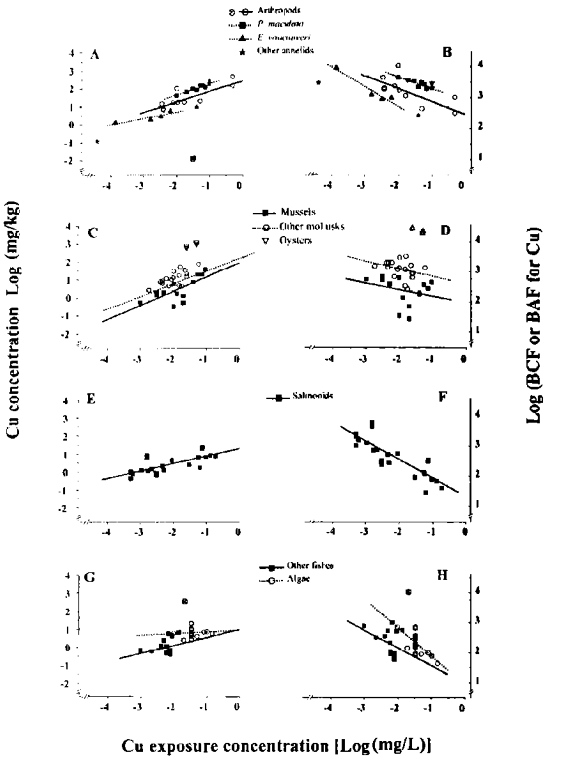

Fig. 4. Effect of chronic Cu exposure on Cu content in aquatic biota (**A**, **C**, **E**, **G**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Cu (**B**, **D**, **F**, **H**). Data are on a log-log basis and the best fit line from the linear regression analysis is shown for each species group. The regression variables are given in Table 5. Note that regression lines are not provided for the group designated as oysters and open symbols filled with an X are outliers that were not included in the regression analysis (see text for details).

cumulation rates, being low for fish, high for algae, and intermediate for arthropods (Fig. 5A; Table 6). The analysis of the arthropod data was done excluding the single elevated value of Brown [127], where tissue concentrations were 175-fold higher than any of the other arthropod values (Fig. 5A, marked open square). As with Cu, the data available for mollusks showed different accumulation patterns, and therefore this group was separated. A relatively high accumulation group, from the study by Schulz-Baldes [128] with *Mytilus edulis* (Fig. 5C, filled squares), was characterized by a relatively low rate of accumulation, with a slope of 0.47 ± 0.07, $n = 3$ (Fig. 5C, filled squares and dashed line). Another mussel study, by Kraak et al. [129], measured Pb accumulation in *Dreissena polymorpha* (Fig. 5C, open squares) and yielded an exposure-to-body concentration relationship with a slope of 0.92 ± 0.09 (significant, $n = 5$). The average of the two mussel studies is presented in Table 6.

When all the data were pooled, the overall body concentration-to-exposure relationship from all data produced a slope of 1.0 (Table 6). While this suggests that each unit increase in exposure was matched by an equal increase in concentration, this was clearly an artifact of pooling the data. An examination of data on a species and individual study basis reveals that there is some degree of control over accumulation (Table 6, overall concentration by species). The disparity between results of the regression analysis for the overall data set and that of the species groups would appear to be due to the range of body concentrations that occur over the exposure range. When all of the data were pooled together, the subtleties of the actual exposure to accumulation relationships are not illustrated.

The BCF versus exposure values showed a significant and inverse relationship for all species groups (Fig. 5B and D and Table 6), with algae and fish exhibiting the lowest and highest BCF rates of change with exposure, respectively. For subgroupings within the mollusk data set (as above), the individual studies with *M. edulis* [128] (Fig. 5D, filled squares) and *D. polymorpha* [129] (Fig. 5D, open squares) produced BCF versus exposure slopes of -0.52 ($n = 3$) and -0.08 ($n = 5$), respectively, and the average of these two is presented in Table 6. As with the body-concentration data, the overall pooling of all of the Pb BCF data did not provide an accurate reflection of the data (Table 6).

No studies were identified in the scientific literature demonstrating that Pb tissue concentrations can be actively regulated by aquatic biota. However, Pb will bind to metallothionein and also probably has a higher affinity for other metabolic ligands, as it is often associated with deposited inorganic granules with high concentrations of calcium [47]. Hopkin and Nott [130] demonstrated that the shore crab (*Carcinus maenas*) detoxifies lead in calciferous granules in the midgut gland. The detoxification and storage of Pb in shellfish has been suggested for the zebra mussel *Dreissena polymorpha* [129,131], the blue mussel *Mytilus edulis* [132,133], the Eastern oyster *Crassostrea virginica* [89,134,135], and the softshell clam *Mya arenaria* [134]. Ideally, a bioaccumulation measure linked to the potential impact of Pb should be able to distinguish between accumulated Pb that is detoxified and stored and that which is available to cause toxic impacts. Therefore, Pb bioaccumulation is characterized by the storage of detoxified forms, an inverse relationship between BCF and exposure concentrations, and considerable variability associated with the mean BCF values.

According to reviews by Eisler [136] and Suedel et al. [108], there is no evidence that lead biomagnifies in higher trophic levels of either freshwater or marine food webs. As reviewed by Demayo et al. [137], dietary lead may be virtually unavailable to fish such as rainbow trout. This is supported by lab and field studies [138,139] that show decreasing Pb concentrations with increasing trophic level. While dietary Pb may be unavailable to some species, it must be recognized that, for others, dietary Pb can be taken up; however, the very low efficiency of uptake [138] ensures that it does not biomagnify.

The data for Ni were somewhat limited compared with those for Zn, Cd, Cu, and Pb. Nonetheless, there were sufficient data to calculate a mean BCF, which was similar to Cu and Cd but exceptionally variable, with a CV of 521% (Table 1). The exceptional variation for the Ni BCF was associated with the study of Wilson [140], using the bivalve *Cerastoderme edule*, where BCF values were as high as 59,600 (Fig. 6D, see marked open squares). The removal of these three exceptional BCF values resulted in a 10-fold decrease in the mean BCF value and in a SD that was approximately the same as the mean, to yield a CV of 86%. When the exposure concentrations were limited to the range 5 to 50 μg/L, the mean BCF value was further reduced by 33% (Table 1).

Nickel accumulation and BCF

The Ni accumulation data are shown in Figures 6A and C. Although the data are somewhat limited, there is an overall trend of increased body concentrations as exposure concentrations increased. Both overall and within each of the indi-

Table 5. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne Cu exposure concentration to Cu content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Cu ($\log_{10}:\log_{10}$ basis). Data are grouped by species as shown in Figure 4, where the associated best fit lines are shown. Overall relationships for slope and intercept are given as either the mean of species groups or the linear regression when all data were pooled. The number of observations is shown for each relationship, and * indicates that the slope or intercept are significantly different ($p < 0.05$) from zero as determined by the regression analysis

		Regression variables					
Variable	Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	*n*
BCF/BAF versus exposure							
	Algae[a]	−0.92*	0.24	0.93*	0.35	0.44	21
	Annelids[b]	−0.51	0.11	2.17	0.26	0.86	11
	Arthropods	−0.41*	0.12	2.46*	0.21	0.55	12
	Mollusks[a]	−0.30	0.21	2.19*	0.41	0.07	30
	Salmonids	−0.58*	0.08	1.30*	0.18	0.72	25
By species	Other fish	−0.56	0.38	0.97	0.87	0.12	17
	Species mean[c]	−0.55	0.09	1.67	0.38		6
Overall	All data[a]	−0.30*	0.07	2.10*	0.15	0.13	121
Content versus exposure							
	Algae[a]	0.08	0.24	0.93*	0.35	0.01	21
	Annelids[b]	0.49	0.11	2.17	0.26	0.85	11
	Arthropods	0.59*	0.12	2.46*	0.21	0.71	12
	Mollusks[a]	0.70*	21	2.19*	0.41	0.29	30
	Salmonids	0.42*	0.08	1.30*	0.18	0.56	25
By species	Other fish	0.44	0.38	0.97	0.87	0.08	17
	Species mean[c]	0.45	0.09	1.67	0.38		6
Overall	All data[a]	0.70*	0.07	2.10*	0.15	0.45	124

[a] Outlier data points were not included in the regression analysis; see Figure 4 and text.
[b] Mean of two studies used; see text and Figure 4 for details.
[c] Statistical significance of the mean of species was not assessed.

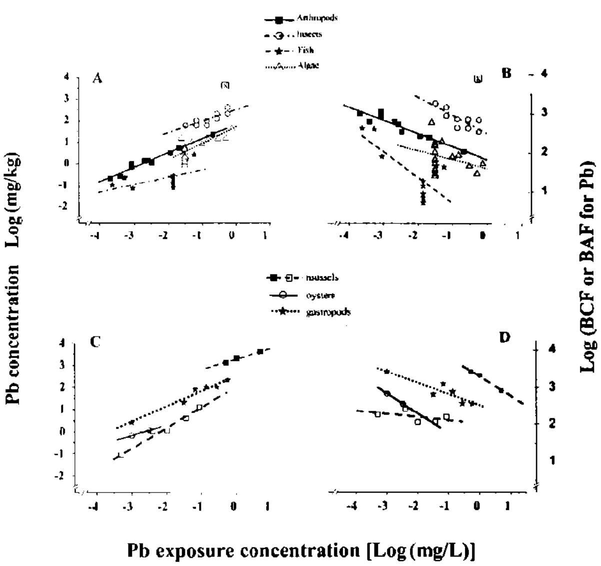

Fig. 5. Effect of chronic Pb exposure on Pb content in aquatic biota (**A**, **C**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Pb (**B**, **D**). Data are on a log-log basis and the best fit line from the linear regression analysis is shown for each species group. The regression variables are given in Table 6. Note that, due to distinct differences in tissue concentrations, data for the mussel species group was separated into two groups, and these are shown in **C** and **D** as open and filled squares (see text for details).

vidual species groups, there was a significant slope associated with the accumulation versus exposure relationship (Table 7). However, as with the other metals, these accumulation slopes were less than unity and therefore BCF was inversely correlated with exposure. The negative relationship between Ni BCF and Ni exposure concentration was significant in all cases tested (Table 7). The data illustrate that, although Ni bioaccumulates, the resulting BCF values are inversely correlated with exposure and therefore BCF cannot be considered as an inherent property of Ni, and this undermines it use in hazard identification.

As a nutritionally essential element, the fact that the bioaccumulation of Ni occurs is unequivocal. No studies were identified that illustrated active regulation of Ni tissue concentrations in aquatic biota, although Ni has not been studied to the same extent as some of the other essential metals. An improved understanding of the mechanisms and physiology of Ni bioaccumulation and relationships to chronic impact are clearly required.

There is no evidence that nickel biomagnifies in aquatic food webs [108]. Watras et al. [141] studied nickel accumulation in *Daphnia magna* fed nickel-enriched algae and demonstrated that nickel is not transferred significantly between trophic levels. In a field study reported by Mathis and Cummings [142], nickel concentrations were also found to decrease with increasing trophic level in a food web characterized by clams, oligochaetes, omnivorous fish, and carnivorous fish, again demonstrating that food chain transfer of nickel is minimal.

Silver accumulation and BCF

Data on Ag BCFs were relatively limited; however, as with the other metals, the BCF values were highly variable, with a

Table 6. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne Pb exposure concentration to Pb content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Pb ($\log_{10} : \log_{10}$ basis). Data are grouped by species as shown in Figure 5, where the associated best fit lines are shown. Overall relationships for slope and intercept are given as either the mean of species groups or the linear regression when all data were pooled. The number of observations is shown for each relationship, and * indicates that the slope or intercept are significantly different ($p < 0.05$) from zero as determined by the regression analysis

		Regression variables					
Variable	Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	*n*
BCF/BAF versus exposure							
By species	Algae	−0.23	0.18	1.60*	0.24	0.09	18
	Insects	−0.47*	0.11	2.50*	0.11	0.69	10
	Arthropods[a]	−0.34*	0.04	1.83*	0.11	0.88	10
	Gastropods	−0.30*	0.07	2.51*	0.11	0.81	6
	Mussels[bc]	−0.30	0.08	2.65	0.11	0.55	8
	Fish	−0.65*	0.19	0.07	0.44	0.56	11
Overall	Species mean[b]	−0.38	0.06	1.86	0.40		6
	All data	0.01	0.09	2.33*	0.17	0.0001	66
Content versus exposure							
By species	Algae	0.77*	0.18	1.60*	0.24	0.53	18
	Insects	0.53*	0.11	2.50*	0.11	0.74	10
	Arthropods[a]	0.66*	0.04	1.83*	0.11	0.96	10
	Gastropods	0.70*	0.07	2.51*	0.11	0.92	6
	Mussels[bc]	0.70	0.08	2.65	0.11	0.98	8
	Fish	0.35	0.19	0.07	0.44	0.26	11
Overall	Species mean[b]	0.62	0.06	1.86	0.04		6
	All data	1.01*	0.09	2.33*	0.17	0.66	66

[a] Outlier data point of Brown [127] was not included in the regression analysis; see Figure 5 and text.
[b] Statistical significance of the mean of species was not assessed.
[c] Values for mollusks represent an average of individual species and studies; see Figure 5 and text.

CV of 190% (Table 1). Reducing the Ag exposure range to 0.4 to 5 μg/L resulted in only a 16% decrease in the mean BCF, although the variation was reduced considerably to a CV of 43%. Data on bioaccumulation clearly show that Ag tissue and body concentrations rise with increasing exposure concentration. However, body concentration does not increase in equal proportion to exposure concentration and therefore an inverse relationship between exposure and BCF occurs (Table 8 and Fig. 7).

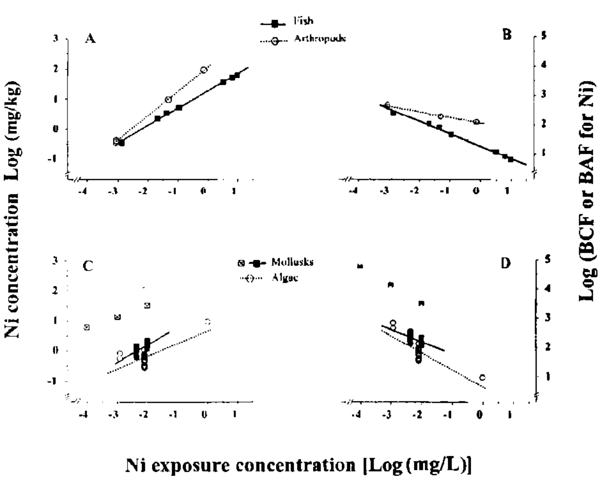

Fig. 6. Effect of chronic Ni exposure on Ni content in aquatic biota (**A**, **C**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Ni (**B**, **D**). Data are on a log-log basis and the best fit line from the linear regression analysis is shown for each species group. The regression variables are given in Table 7. Note that, within the mollusk species group, there were outlier data points that were excluded from the regression analysis, and these are shown as open squares filled with an X in **C** and **D** (see text for details).

No studies were identified in the scientific literature demonstrating that Ag tissue concentrations can be actively regulated by aquatic biota. Studies such as those of Bryan [143] suggest that Ag is not actively regulated but rather stored. This premise is supported by studies with rainbow trout and European eel, which illustrate the time course of tissue-specific internal Ag accumulation [144,145]. However, the recent study by N. Bury (Kings College London, UK, personal communication) suggests that Ag-specific transporters may exist in the gill of rainbow trout and opens the possibility of some degree of control over uptake and accumulation.

Mercury accumulation and BCF

The mean BCFs for methylmercury and inorganic Hg (Table 1) were greater than those for other elements assessed but were also highly variable (CVs of 276 and 204% respectively). When all the BCF data were used to calculate these means, the bioaccumulative nature of methylmercury was apparent and its mean BCF was considerably higher (Table 1). Limiting the data to the range of 0.1 to 1 μg/L resulted in no substantive change in mean and CV for methylmercury and a large, nearly threefold, increase in mean BCF for inorganic Hg (CV of 109%). The dramatic increase in mean BCF inorganic Hg was associated with limiting the data to the lower 25% of the exposure range. In other words, 75% of the exposures for inorganic Hg were at concentrations above 1 μg/L.

The bioaccumulation data for Hg show that, in general,

Table 7. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne Ni exposure concentration to Ni content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Ni ($\log_{10}$: $\log_{10}$ basis). Data are grouped by species as shown in Figure 6, where the associated best fit lines are shown. Overall relationships for slope and intercept are given as either the mean of species groups or the linear regression when all data were pooled. The number of observations is shown for each relationship, and * indicates that the slope or intercept are significantly different ($p < 0.05$) from zero as determined by the regression analysis

	Regression variables						
Variable	Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	n
BCF/BAF versus exposure							
By species	Algae	−0.58*	0.11	0.65*	0.23	0.66	17
	Arthropods	−0.19*	0.02	2.05*	0.03	0.98	4
	Mollusks[a]	−0.42*	0.14	1.35*	0.31	0.32	20
	Fish	−0.42*	0.02	1.26*	0.02	1.00	7
Overall	Species mean[b]	−0.40	0.08	1.33 ± 0.15			4
	All data	−0.53*	0.07	1.11*	0.16	0.53	51
Content versus exposure							
By species	Algae	0.42*	0.11	0.65*	0.23	0.50	17
	Arthropods	0.81*	0.02	2.05*	0.03	1.00	4
	Mollusks[a]	0.58*	0.14	1.35*	0.31	0.49	20
	Fish	0.58*	0.02	1.26*	0.02	1.00	7
Overall	Species mean[b]	0.60	0.08	1.33 ± 0.15			4
	All data	0.47*	0.07	1.11*	0.16	0.48	51

[a] Outlier data points from Wilson [140] were not included in the analysis; see Figure 6 and text.
[b] Statistical significance of the mean of species was not assessed.

tissue concentrations of Hg increased with increased exposure, although the trends were not always clear (Table 9 and Fig. 8, C, E, and G). For inorganic Hg exposures, the cyprinid species showed a significant positive relationship between exposure and concentration (Fig. 8E, open squares and solid line, and Table 9). Although not tested due to the paucity of data, salmonids would appear to have a similar relationship [146] between whole-body concentrations and inorganic Hg exposure (Fig. 8E, open circles). In contrast, mollusks showed a significant reduction in tissue concentration as inorganic Hg exposure increased (Fig. 8C, open circles and solid line, and Table 9). Bioaccumulation data for methylmercury were also equivocal, showing a significant and positive relationship between exposure and accumulation for some fish species groups but not for other species groups (Fig. 8A, C, E, and G, filled symbols). There was a relative lack of data on Hg exposures in invertebrates and therefore the insect, annelid, and arthropod groups were pooled for regression analysis. The relationship between BCF and exposure concentration was generally negative, although there was considerable variability in some species groups; a few others, such as cyprinids exposed to inorganic Hg and centrarchids exposed to methylmercury, did not have an inverse relationship (Table 9, Fig. 8B, D, F, H).

As with the other metals, water chemistry influences Hg bioavailability, but additionally, accumulation is strongly affected by methylation/demethylation reactions, which are microbially mediated [147–149]. It is generally agreed that methylmercury is the most bioaccumulative form of Hg and it is known to biomagnify in aquatic food webs [150–155], and this was seen in the mean BCFs when all the data were used. Overall, the high BCF values are a function of high assimilation efficiency, particularly of the neutral and lipid-soluble methylmercury, and the fact that, for fish at least, the eliminated very slowly relative to uptake [156].

Given the neutral and lipophilic nature as well as the biomagnification potential of methylmercury, our hypothesis was that Hg bioaccumulation would be consistent with the theoretical BCF model (i.e., relatively constant over the exposure range, as HCB was). While this occurred for a few species groups, there was considerable variability and also an unexpected negative relationship between BCF and exposure for a number of groups. The data available are not extensive, but it

Table 8. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne Ag exposure concentration to Ag content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Ag ($\log_{10}$: $\log_{10}$ basis). Data are grouped to show the overall relationship when all data are pooled together as shown in Figure 7

	Regression variables						
Variable	Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	n
BCF/BAF versus exposure							
Overall	All data	−0.54	0.07	1.22	0.23	0.64	23
Content versus exposure							
Overall	All data	0.46	0.07	1.22	0.23	0.72	23

Table 9. Regression coefficients (slope and intercept given with standard error of means [SEM]) for the linear relationship of waterborne Hg exposure, either as methylmercury (CH_3-Hg) or inorganic Hg salt, to the Hg content in aquatic biota as well as bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Hg ($\log_{10}:\log_{10}$ basis). Data are grouped by species as shown in Figure 8, where the associated best fit lines are shown. Overall relationships for slope and intercept are given as either the mean of species groups or the linear regression when all data were pooled. The number of observations is shown for each relationship, and * indicates that the slope or intercept are significantly different ($p < 0.05$) from zero as determined by the regression analysis

Variable		Regression variables						
		Species group	Slope	SEM	Intercept	SEM	Coefficient of determination	*n*
BCF/BAF versus exposure								
By species	Hg salt	Insects, annelids, and arthropods	−0.39	0.42	2.04	0.42	0.09	11
	Hg salt	Mollusks	−1.45*	0.11	−0.32	0.20	0.37	30
	Hg salt	Cyprinids	−0.20	0.14	2.83*	0.43	0.71	15
	CH_3-Hg	Salmonids	−0.84*	0.26	1.02	0.79	0.46	14
	CH_3-Hg	Centrarchids	0.07	0.30	3.23*	0.95	0.01	7
	CH_3-Hg	Other fish	−0.38	0.25	1.93*	0.71	0.10	22
Overall	Hg salt	All data	−1.00*	0.12	0.43	0.24	0.61	60
	CH_3-Hg	All data	−0.17	0.11	2.83*	0.35	0.05	49
Content versus exposure								
By species	Hg salt	Insects, annelids, and arthropods	−0.61	0.42	2.04	0.42	0.19	11
	Hg salt	Mollusks	−0.45*	0.11	0.32	0.20	0.37	30
	Hg salt	Cyprinids	0.80*	0.14	2.83*	0.43	0.71	15
	CH_3-Hg	Salmonids	0.16	0.26	1.02	0.79	0.03	14
	CH_3-Hg	Centrarchids	1.07*	0.30	3.23*	0.95	0.72	7
	CH_3-Hg	Other fish	0.62*	0.25	1.93*	0.71	0.24	22
Overall	Hg salt	All data	−0.002	0.11	0.43	0.24	0.0000	60
	CH_3-Hg	All data	0.83*	0.11	2.83*	0.35	0.53	49

would appear that the BCF model may not fully capture the complexities of Hg uptake and accumulation in some species. Clearly, further investigation would be beneficial in this regard, and discriminating among field and laboratory exposures as well as accounting for the influence of water chemistry are examples of avenues to pursue. Additionally, a better understanding of the relative exposure to methylmercury and inorganic Hg forms during chronic exposures to either methylmercury or inorganic Hg would be useful. It is likely that, whether the exposure regime involves dosing with methylmercury or with an inorganic salt of Hg, there will be at least some exposure to both methylated and inorganic forms of Hg.

Accumulation factors for Zn, Cd, Cu, and Pb

The concept of the ACF variable was to provide a ratio of accumulation that was similar to BCF but that accounted for only the increased accumulation that arises from an increase in exposure concentration (see *Methods*). By removing the preexisting concentrations, which (presumably) cause no adverse effect, from the calculation, the focus is on accumulation that results from elevated metal exposure. Sufficient data were available for ACF calculations for Zn, Cu, Cd, and Pb, with only a few data points available for Ni. Among Zn, Cu, Cd, and Pb, the mean ACF values were lower than BCF values by a factor in the range 1.7 to 21.5 defined by Pb and Zn, respectively. The difference between BCF and ACF values was most dramatic for Zn, for which the mean ACF value was 90% lower (Table 1). In the cases of Zn and Cd, the mean ACF values were severely skewed by extremely high single ACF values, and removal of these single values dramatically reduced both the mean and its associated variability (Table 1). The variability of the mean ACF values was in general a bit lower compared with the mean BCF values but was nonetheless elevated, with CVs ranging from 123 to 175%.

The differences between mean ACF and BCF values provide some insight into the bioaccumulation of naturally oc-

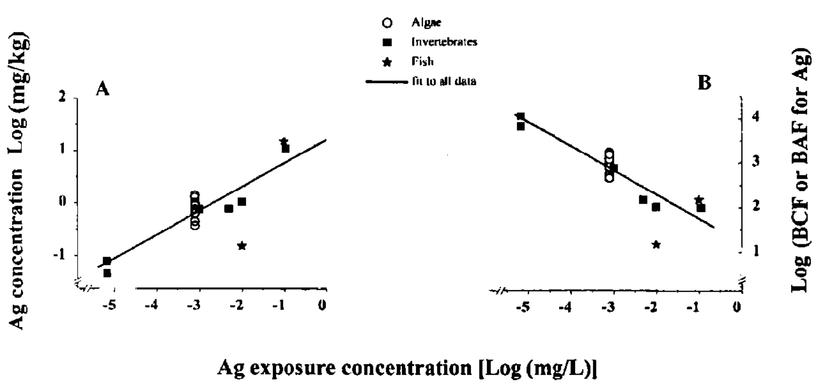

Fig. 7. Effect of chronic Ag exposure on Ag content in aquatic biota (**A**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Ag (**B**). Data are on a log-log basis and the best fit line from the linear regression analysis is shown for all species grouped together. The regression variables are shown in Table 8.

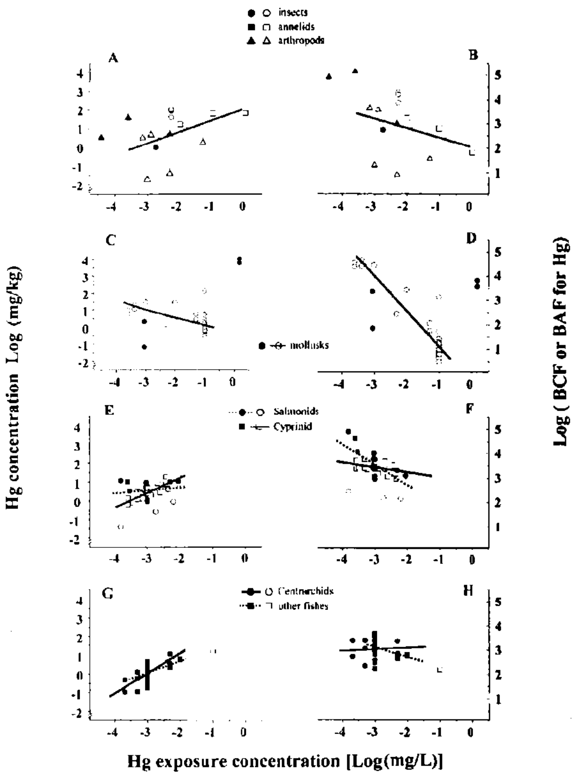

Fig. 8. Effect of chronic Hg exposure on Hg content in aquatic biota (**A**, **C**, **E**, **G**) and associated bioconcentration factor and bioaccumulation factor (BCF/BAF) values for Hg (**B**, **D**, **F**, **H**). Data are on a log-log basis and, for each species group, filled symbols represent exposures where methylmercury was administered, while open symbols represent those for an inorganic Hg salt such as the chloride or nitrate. The best fit line from the linear regression analysis is shown for species groups with seven or more data points expect for insects, arthropods, and annelids, where data for inorganic exposure (open symbols in **A** and **B**) were pooled for analysis. The regression variables are shown in Table 9.

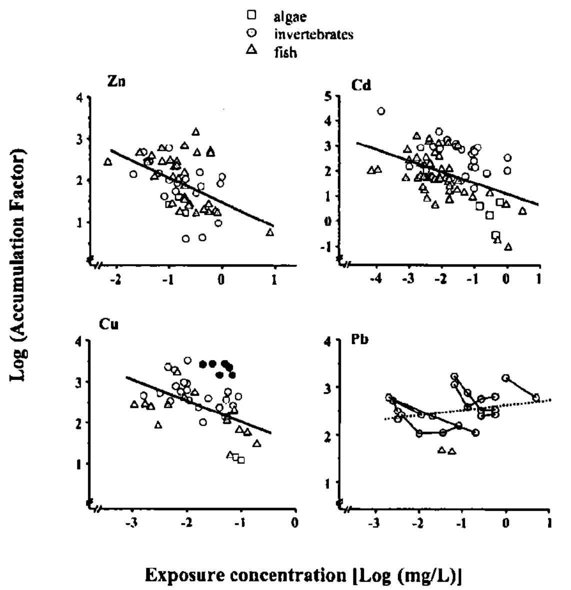

Fig. 9. Accumulation factor (ACF) as a function of aquatic exposure concentration for Zn (top left panel), Cd (top right panel), Cu (bottom left panel), and Pb (bottom right panel) for algae (squares), invertebrates (circles), and fish (triangles). The ACF values were calculated as the ratio of concentration to exposure after removing preexisting background (see text for details). The best fit lines derived from linear regression analysis with all data pooled are shown as solid lines for Zn, Cd, and Cu and a dotted line for Pb. Note that, in the case of Cu, data from one study were omitted from the analysis, and this has been indicated by filled symbols. For Pb, solid lines connecting points show data from exposure series within individual studies.

curring substances. Both ACFs and BCFs are measures of accumulation, but ACF values are limited to the additional whole-body concentration of metal that results from an additional exposure to that metal. The BCF values not only include the incremental amounts but also include all accumulations, including those that result from normal exposure concentrations. An example is Zn, with a mean ACF value that is a mere 9.6% of the mean BCF value (Table 1). This 90% reduction illustrates not only the nutritional accumulation of Zn for essential physiological functions but also the ability of animals to regulate Zn concentrations when faced with elevated exposure levels. The difference between AFC and BCF values is not only a feature of essential minerals, as mean ACF values for Cd and Pb were 81 and 41% less than mean BCF values (Table 1). Therefore, even for nonessential elements, the preexisting low-level exposure concentrations prior to experimental exposures, which are assumed to result in no toxic effects, play a significant role in BCF values. However, the ACF approach could have a significant impact on hazard classification when one considers the threshold values range from 500 to 5,000, and therefore the use of ACFs may preclude classification of some metals under some hazard classification schemes.

The ACF data were also evaluated to determine if there were relationships to exposure concentrations. With all the data pooled by metal, there was a significant and negative relationship between ACF values for Zn, Cd, and Cu and exposure concentration (Fig. 9). The log-log linear regressions of ACF to exposure concentration (Fig. 9) slope for Zn was -0.58 ± 0.14 ($n = 58$, $r^2 = 0.23$, $p < 0.05$), for Cd was -0.46 ± 0.10 ($n = 88$, $r^2 = 0.18$, $p < 0.05$), and for Cu was -0.51 ± 0.13 ($n = 40$, $r^2 = 0.30$, $p < 0.05$). Note that, for Cu, the mollusk data of McLusky and Phillips [119] were omitted from the analysis, as previously discussed. As revealed by the dotted line in the Pb panel of Figure 9, only the ACF values for Pb showed a nonsignificant regression slope when all the data were pooled. However, when trends within studies as per the solid lines in the Pb panel are examined, it is clear that there was a negative correlation between exposure and ACF within each of the individual studies. Therefore, with respect to the ACF values for Zn, Cd, Cu, and Pb, the ACF values are dependent on exposure concentration. As previously discussed, this negative relationship results from an ability to acclimate to elevated exposures and thereby control metal accumulation. In addition to active regulation, the negative correlation is also a function of uptake being a rate-limited process.

CONCLUSIONS

The accumulation of Zn, Cd, Cu, Pb, Ni, and Ag in aquatic biota were, in general, remarkably consistent, particularly for Zn, where total body/tissue concentration varied little over a wide range of exposure concentrations, exposure conditions, and species. However, mean BCF values for the six metals were characterized by high variability, and there was an inverse relationship between BCF and exposure concentration. Therefore, using the weight of evidence available, it is virtually impossible to derive a meaningful BCF value that one could say is representative of the BCF for each of the metals. Even when BCFs are limited to the exposure range where chronic toxicity might be expected (based on water-quality guidelines), it is not possible to derive a precise and accurate BCF value. In addition, the inverse correlation between BCF and exposure for these metals produces the possibility of inadequate and faulty predictions for hazard. For example, hazard identification based on BCFs indicates that hazard is reduced as concentration increases, a conclusion that is inconsistent with the toxicological literature. Because the hazard identification of chemical substances is intended to be based on their intrinsic properties, which by definition are independent of exposure, the variability in the values of BCF versus exposure concentration for metals should preclude the use of BCFs for hazard identification of inorganic metal substances.

Clearly, bioaccumulation is a characteristic of the metals examined, but the BCF parameter does not characterize this bioaccumulation nor is it related to the potential for toxic impacts. This conclusion has a theoretical, chemical, physiological, and pragmatic basis. The BCF model was designed, developed, and adapted to describe neutral and lipid-soluble organic substances of anthropogenic origin, and its application to metals for the purposes of hazard identification is not supported by the scientific data.

This is not to say that bioaccumulation of metals is unimportant. Understanding and predicting bioaccumulation of metals is one of the key requirements in understanding their fate and toxicity in aquatic environments and for environmental protection measures. However, the BCF criterion does not reflect the current understanding of metal bioaccumulation and cannot predict it. Bioaccumulation of metals follows a different paradigm relative to neutral organics. For example, metal uptake occurs via specific mechanisms that can often be modified as a result of exposure. Additionally, low-level accumulation at background concentrations is a natural phenomenon, detoxification and elimination of accumulated metals is part of acclimation, and toxicity (acute) is predominantly associated only with charged cations. The ACF values, while offering the potential to deal with at least one of the shortcomings of the BCF model (bioaccumulation at low exposure levels), are insufficient as a replacement for BCF. Moreover, due to the storage of metals in granules and as metallothioneins, metal bioaccumulation is not necessarily indicative of secondary poisoning or chronic effects.

Recommendations for alternative approaches

Accumulation models specific to metals have been published for Cu, Cd, Zn, Cr, and Ni [86,157–159], but they have not been adapted for use in the context of hazard identification. Other metal-specific bioaccumulation models such as the biotic ligand model [10–12] or the free-ion activity model [54] might be developed to elaborate a criterion that could be used as the basis for hazard identification. However, currently these models only predict acute toxicity. The origin of bioaccumulation as a criterion in hazard identification for organic substances was based, along with persistence, on their link to potential chronic impacts (toxicity and biomagnification). Linking bioaccumulation to chronic impacts is exceptionally difficult, in part because chronic indicators and effects are not as clearly delineated as they are for acute toxicity. It is important that bioaccumulation not be an independent end point in and of itself. Instead, directed and validated links between a bioaccumulation criterion and chronic impacts in the environment are needed.

Mechanistically based chronic toxicity and bioavailability models for metals are currently under development and may provide a validated bioaccumulation criterion for use in hazard identification. The focus of these developing models is primarily chronic toxicity predictions for the purpose of improved water and effluents quality criteria and guidelines. This interdisciplinary research applies aquatic geochemistry, physiology, and toxicology to link waterborne and dietary exposure, bioaccumulation, and adverse effects. It therefore seems possible that the results may provide a scientifically validated bioaccumulation criterion for aquatic hazard identification and thereby fill the regulatory gap that exists due to the lack of validity of the BCF model as applied to metals.

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Laura Hunter

From: Ed Kimura [emkimr@cts.com]
Sent: Friday, June 20, 2003 11:20 AM
To: Laura Hunter; elainecarlin@att.net; Denise Klimas
Subject: Related Navy Guidance

FYI-

I came across this Navy guidance while searching for fines normalization. The fines normalization is in the appendix:
http://web.ead.anl.gov/ecorisk/related/documents/Appendix_B_-_Geochemical_Analysis_Overview.pdf

So it is no coincidence that the Board Staff put the normalization of metals in the 9 June letter .

I have not read the guidance document except for the appendix B

Ed

Navy Guidance for Conducting Ecological Risk Assessments

Related Navy Guidance

Guidance for Sediment Evaluation

An update to the Implementation Guide for Assessing and Managing Contaminated Sediment at Navy Facilities has been made. A revisions page has been added to the updated document to notify the reader of changes that have been made in the document since the previous version.

- Sediment Guide *(2276 KB)*
  - Appendix A - Rapid Screening Methods *(95 KB)*
  - Appendix B - Geochemical Analysis Overview *(66 KB)*
  - Appendix C - Hypothetical ERA *(109 KB)*
  - Appendix D - Planning Matrix Table *(101 KB)*
  - Appendix E - North Island RI *(18565 KB)*

- Watershed Contaminant Source Document (WCSD) Fact Sheet *(3100 KB)*

Guidance for Environmental Background Analysis

- Volume I: Soils *(5928 KB)*
- Volume II: Sediment *(5049 KB)*

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Quantico Case Studies Available

An updated sediment guide document is available

Guidance for Environmental Background Analysis Volume II: Sediment

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Laura Hunter

From: Denise Klimas [Denise.Klimas@noaa.gov]
Sent: Friday, June 20, 2003 2:37 PM
To: Ed Kimura
Cc: Laura Hunter; elainecarlin@att.net
Subject: Re: Related Navy Guidance

Ed,
I know about this guidance but have not had the chance to look at it carefully. I am not sure that info. in this doc. entered into the RB decsion to normalize to fines (at least they didn't cite it). But from what you say, it may provide the RB with some further precedence for the normalization.

Unfortunately, you all were not privy to some of the discussions and rationales that the RB used in their decision making, but on May 15, the staff sent the trustees a working draft with some rationale for normalizing to fines. However, what they presented was info on where all types of normalizing has been used, and cited EPA , the State of FL, and NOAA Status and Trends. These cited studies did not necessarily use fines to normalize. For example, FL normalizes to Aluminum. They also cited that SCCWRP "in particular, believes it is appropriate to normalize", even tho SCWWRP normalized to iron. Pete Peuron did some graphing of the data both normalized to fines and without normalizing to fines and liked what he saw even tho some of the correlations were .3 and .4 (for Hg and Cd). Since Pete now is their in-house statistician, I think that is why they chose to normalize to fines.

We (me, Don, Scott, and Mike) had a conf call with the RB and told them that they needed a better justification as to why normalization to FINES is appropriate for these data and this intended use. Just because other studies have normalized is not a justification. In addition, related to the use of the 95% UPL, we also requested that they provide the original regression line that they calculated, along with p values and r-squared. In the working draft doc., they only showed us the 95%UPL they calculated from the regression, juxtiposed with the 95%UPL calculated by Bay, et al. for each contaminant. Everytime, the line calculated by the RB with the 95%UPL on the regression line identified more of the site locations as contaminated. However, we were interested in seeing the fit of the line the RB used to calcualte the 95% UPL.

We have not rec'd either requested information, so we have not written them a letter stating whether we think the idea is good or not. I assume that we will see that additional information in their expanded justification later on. I think that I am going to wait to see what the SY come up with and then comment on the approach the RB has taken. I still have to speak with Scott and Mike to see if they agree to wait and see how the SYs use the reference pool. I will let you know what we are doing.

What did you think of the Navy guidance?
d
(916) 255-6686

Ed Kimura wrote:

> FYI- I came across this Navy guidance while searching for fines normalization. The fines normalization is in the appendix:http://web.ead.anl.gov/ecorisk/related/documents/Appendix_B_-

Table 4.3-5

ACCEPTABLE LAND USE AND MINIMUM BUILDING SOUND LEVEL REQUIREMENTS

Facility	Outdoor Noise Environment (Ldn in dBA)				
	85-89	80-84	75-79	70-74	65-69
Family Housing	No	No	No	NLR30(4)	NLR25(4)
Bachelor Housing	No	No	NLR35(4)	NLR30(4)	NLR25(4)
Transient Lodging, Hotel, Motel, etc.	No	No	NLR35(4)	NLR35(4)	NLR25(4)
Classrooms, Libraries, Churches	No	No	No	NLR30	NLR25
Offices & Administration Buildings - Military	NLR40	NLR35	NLR30	NLR25	Yes
Offices - Business & Professional	No	No	NLR35	NLR25	Yes
Hospitals, Medical Facilities, Nursing Homes (24-hour Occupancy)	No	No	No	NLR30	NLR25
Dental Clinic, Medical Dispensaries	No	No	NLR30	NLR25	Yes
Outdoor Music Shells	No	No	No	No	No
Commercial & Retail Stores, Exchanges, Movie Theaters, Restaurants & Cafeterias, Banks, Credit Unions, EM/Officer Clubs	No	No	NLR30	NLR25	Yes
Flight Line Operations, Maintenance & Training	NLR35(5)	NLR30(5)	Yes	Yes	Yes
Industrial, Manufacturing & Laboratories	No	NLR35(5)	NLR30(5)	NLR25(5)	Yes
Outdoor Sports Arenas, Outdoor Spectator Sports	No	No	No	Yes(1)	Yes(1)
Playgrounds, Active Sport Recreational Areas	No	No	No	Yes	Yes
Neighborhood Parks	No	No	No	Yes	Yes
Gymnasiums, Indoor Pools	No	NLR30	NLR25	Yes	Yes
Outdoor - Frequent Speech Communication	No(2,3)	No(2,3)	No(2)	No(2)	No(2)
Outdoor - Infrequent Speech Communication	No(2,3)	No(2,3)	Yes	Yes	Yes
Livestock Farming, Animal Breeding	No	No	No	Yes	Yes
Agricultural (except Livestock)	Yes(3)	Yes(3)	Yes	Yes	Yes

_Geochemical_Analysis_Overview.pdfSo it is no coincidence that the Board Staff put the normalization of metals in the 9 June letter .I have not read the guidance document except for the appendix BEd

Navy Guidance for Conducting Ecological Risk Assessments

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Related Navy Guidance

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4.3.5 Noise

4.3.5.1 Criteria for Significance Determination

Military Regulations

The DoD has established acceptable land use and minimum building sound level requirements for various land uses. These criteria are outlined in the NAVFAC P-970 document, Planning in the Noise Environment (DoD 1978), and are presented in Table 4.3-2. In the table, the outdoor noise environment is considered in five noise "zones" of five decibels each. For each zone, acceptability is noted by one of the following four entries: 1) yes; 2) noise level reduction (NLR); 3) no; or 4) one of the above with additional stipulations described in the footnote.

Where "yes" is indicated, no special noise control restrictions are necessary and normal construction appropriate to the activity may be used. For many land uses, higher levels of exterior noise exposure are acceptable provided there is a proper degree of interior noise attenuation. Such tradeoffs are possible for land uses where indoor activities predominate. When such tradeoffs are appropriate, the amount of noise insulation required is enumerated in the table in units of NLR. NLR is measured in dBA and is the difference between the noise measured outside the building and the noise measured inside the building. If land use compatibility is contingent upon meeting the NLR requirements, then a site specific interior acoustical analysis must be performed to ensure that the proposed building design will provide the required level of noise reduction. A "no" indication means that the noise environment is not suitable for the designated activity or facility, even if special building noise insulation is provided. The table footnotes indicate exceptions where special conditions apply.

Civil Regulations

The City of Coronado, through the Noise Element of its General Plan has established sound levels that are compatible with various land uses. Sound levels up to 65 CNEL are normally acceptable for single-family residences, townhouses and apartments.

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4.3.4.6.1 Construction-related Impacts

Mitigation measures are required for NOx emissions for 1996 construction because they exceed the significance criteria of 50 tons per year of emissions. One of the largest contributors of NOx emissions is the dredging operation. Dredging equipment will be required to undergo New Source Review, and under the SDAPCD Rules and Regulations, must demonstrate that dredging operations will not cause or contribute to an air quality violation. Dredging equipment may also be subject to offset requirements. Therefore, construction-related NOx emissions will be mitigated through equipment permitting and possibly through offsetting emissions of NOx.

4.3.4.6.2 Operational-related Impacts

Stationary Sources Equipment

No mitigation measures are required beyond those included as part of the SDAPCD permitting process.

Radiological Air Emissions

No mitigation is required since no significant impacts have been identified.

Vessel Emissions

No mitigation is required since no significant impacts have been identified.

Vehicular Emissions

No mitigation is required since no significant impacts have been identified.

NATIONAL STEEL AND SHIPBUILDING COMPANY
A GENERAL DYNAMICS COMPANY

LANE L. McVEY
VICE PRESIDENT & GENERAL COUNSEL

2003 JUN 25 A 8: 14

SAN DIEGO REGIONAL
WATER QUALITY
CONTROL BOARD

June 24, 2003

David Barker, P.E.
Supervising Water Resource Control Engineer
California Regional Water Quality Control Board
San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Re: Reference Pool for NASSCO and Southwest Marine Sediment Investigation

Dear Mr. Barker:

This letter is submitted on behalf of National Steel and Shipbuilding Company ("NASSCO") and Southwest Marine, Inc. ("Southwest Marine") in response to your letter of June 9, 2003, in which you provided the Regional Board's "final decision" on a reference pool to "be used to determine statistically significant differences between site sediment conditions (at NASSCO, Southwest Marine, mouth of Chollas Creek, and the 7th Street Channel) and reference sediment quality conditions." For the reasons set forth below and in the attached letters from Exponent, Inc., NASSCO and Southwest Marine believe that the staff's decision is in error and conflicts with both established regulatory practices for contaminated sediment cleanups and applicable state law and guidance.

At its heart, the assessment and remediation of contaminated sediments at the shipyard sites is an administrative regulatory proceeding. As such, the Regional Board's decisions and actions must be in accordance with applicable law and supported by substantial evidence. Regional Board decisions that are arbitrary or capricious and that fail to articulate the reasons and bases for Regional Board action will not withstand State Water Resources Control Board ("State Board") or judicial review. The shipyards have invested substantial time and money to ensure that the shipyard sediment proceeding is conducted in a scientifically and legally appropriate fashion. Unfortunately, the staff's reference pool decision falls far short of satisfying either the science or the law.

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A. The Legal Basis for Establishing "Background" Does Not Support the Reference Pool Selected by the Regional Board

At the outset, it should be noted that NASSCO and Southwest Marine have been working cooperatively with the Regional Board staff in conducting exhaustive scientific analyses in accordance with the "Guidelines for Assessment and Remediation of Contaminated Sediments in San Diego Bay at NASSCO and Southwest Marine," dated June 1, 2001 ("Guidelines"). To date, the shipyards have spent more than $3,000,000 in direct costs on the project, to say nothing of the substantial time incurred by shipyard personnel. The Guidelines state that the Regional Board is acting pursuant to State Board Resolution 92-49, which establishes policies and procedures for investigations and cleanups or abatements conducted under section 13304 of the Water Code. The shipyards previously raised their objections to, and concerns regarding the applicability and use of, Resolution 92-49 in conducting a sediment cleanup. We will not repeat those objections and concerns in this letter. However, even assuming the applicability of 92-49, we believe the staff's actions in establishing the reference pool are in conflict with that directive and with cleanups conducted in California and other locales.

Resolution 92-49 defines "background" as "water quality that existed before the discharge." Significantly, the State Board did not define background as "pristine conditions" or "conditions that would exist absent any anthropogenic influences." Rather, the definition seeks to determine site conditions that would exist *but for* the discharge from the facility.

The definition of background in Resolution 92-49 is consistent with guidance documents and regulations promulgated by other environmental agencies, which routinely describe background as conditions existing at a site that are not influenced by site activities (i.e., conditions that would exist but for the discharge from the facility). See, e.g., Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites, EPA 540/S-96/500, at 3 (defining "background" as "the concentration of inorganics found in ... sediments surrounding a waste site, but which are not influenced by site activities or releases," including "both the naturally occurring and local/regional anthropogenic contributions"); Selecting and Using Reference Information in Superfund Ecological Risk Assessments, EPA/540/F-94/050, September 1994 ("A general guideline is to select reference locations that reflect the overall environmental conditions that can reasonably be expected in the site area given current uses other than those associated with the contamination under investigation."); 43 CFR § 11.72(b)(1) (Dept. of Interior NRDA Regulations) ("Baseline data should reflect conditions that would be expected at the assessment area had the discharge of oil or release of hazardous substances not occurred, taking into account both natural processes and those that are the result of human activities."); Risk Assessment Guidance for

Superfund, EPA 540-1-89-002, §§ 4.5, 6.5; Guidance for Characterizing Background Chemicals in Soils at Superfund Sites, EPA 540-R-01-003, § 1.5 (June 2001).

Therefore, for purposes of defining background (and determining statistically significant deviations from background conditions), reference stations should "have the same physical, chemical, geological, and biological characteristics as the site being investigated, but have not been affected by activities at the site."[1] Reference stations "need not be pristine."[2] Indeed, the Regional Board recognized this definition in establishing the parameters for the study at the shipyards in the first instance. See Guidelines for Assessment and Remediation of Contaminated Sediments in San Diego Bay at NASSCO and Southwest Marine Shipyards, San Diego Regional Water Quality Control Board, June 1, 2001 ("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 non-toxic) and excluding sources of pollutants associated with shipbuilding and repair activities.").

The reference pool selected by the Regional Board fails to meet the standard required by Resolution 92-49 (and other state and federal regulations and guidance documents). The shipyards' consultant, Exponent, has concluded that the selected reference stations are not similar to the conditions that would exist at the site but for the shipyard activities. See Letter from D. Nielsen to M. Chee and S. Halvax, dated June 23, 2003, at 2 (attached as Exhibit "A").

The reference stations chosen by the Regional Board appear to be erroneously based on the lowest chemical concentrations and lowest toxicity among stations anywhere in San Diego Bay, rather than being based on conditions that would exist at the site but for the discharge from shipyard activities. Many of the reference stations are far from shore, and are therefore not affected by near-shore anthropogenic and natural influences. In many instances, the reference sites do not have similar chemical, biological, or geological conditions as the shipyards would have, absent the impact of shipyard activities. Id.

Exponent concludes that:

> Appropriate site-specific reference stations for the shipyard study should be located in the nearshore environment, in the same mid-Bay region as the shipyards, and in locations not directly influenced by the shipyards. The set of stations

---

1 Guidance for Characterizing Background Chemicals in Soils at Superfund Sites, EPA 540-R-01-003, § 1.5 (June 2001).

2 Ecological Risk Assessment Guidance for Superfund, Interim Final, EPA, June 5, 1997.

> that Board staff have designated excludes stations meeting these criteria, and includes instead stations that are in distant parts of the Bay and not in the nearshore environment. The stations in the reference pool identified in David Barker's letter therefore do not represent conditions that would be present at the shipyard locations but for the influence of the shipyards themselves.

Id. Therefore, comparison of shipyard conditions to the proposed reference stations cannot be used as a basis for decisions regarding remediation at the shipyards, because such reference stations are inconsistent with the legal requirements for defining "background" conditions.

B. The Reference Pool Appears to Be Arbitrarily Selected

The Regional Board's letter of June 9, 2003, identifying the "final" reference stations does not include any explanation of the bases for selecting the sites. The Regional Board (i) excluded recent data collected in the site specific shipyard study, (ii) replaced some of it with data collected from the same reference station years earlier in the Bight '98 study, (iii) supplemented the reference stations with sites not representative of shipyard conditions, and (iv) made inconsistent decisions concerning specific reference stations or types of data collected. Therefore, the resultant reference pool appears to be arbitrarily selected.

In the letter attached as Exhibit "A," Exponent provides numerous examples of arbitrary decisions made by the Regional Board in selecting the reference stations:

> [S]hipyard station 2231 has been completely excluded, possibly because of the altered benthic community at that station, despite the fact that the alteration was due to an invasive species and not to chemical toxicity. In contrast, David Barker's letter indicates that all data except benthic macroinvertebrate data can be used from shipyard station 2243, despite the fact that benthic community metrics for station 2243 indicate that it is one of the best of the five reference stations sampled. ...
>
> As a second example, Board staff have retained shipyard stations 2433 and 2441, which are arguably unsuitable as site-specific reference stations because of their location in a distant part of the Bay and because they have benthic

> communities that are apparently influenced by continental shelf species. ...
>
> As a third example, Board staff have included Bight '98 stations 2241, 2256, and 2257, but have excluded Bight '98 station 2258, despite the fact that all of these stations are in proximity to one another. If stations 2241, 2256, and 2257 represent an area that is characteristic of reference conditions, then station 2258 should also be representative of reference conditions. This situation indicates that Board staff selected reference stations based on judgments about the acceptability of individual data points, rather than by selecting stations based on established standards (i.e., location and influence of sources). Selection of specific individual data points rather than data representative of reference areas within the bay biases the results toward the cleanest conditions, rather than establishing appropriate site-specific reference conditions.
>
> As a fourth example, Board staff have excluded all of the 2002 data collected by the shipyards (at the Board staff's direction) at candidate reference stations that were previously sampled by the Bight '98 study.

The examples highlighted by Exponent demonstrate that the Regional Board has taken inconsistent and sometimes contradictory approaches in establishing the reference pool. In light of the Regional Board's failure to set forth the bases for its decisions (and show the relationship between the selected reference stations and the standards applicable to defining reference stations generally), the reference pool selection is not supported by substantial evidence and is arbitrarily defined.

C. <u>Selection of Reference Stations by the Regional Board Is Also Scientifically Flawed</u>

As discussed more fully in the attached letter from Exponent, the reference stations selected by the Regional Board to comprise the reference pool are not supported by substantial scientific evidence, and are therefore not defensible.

In its letter, Exponent explains that the data from the Bight '98 study did not include many of the same test methods or parameters as the site-specific shipyard study. Chemical detection limits in the shipyard study are better than the Bight study, and not all chemicals measured during the shipyard investigation were measured during the Bight study. Further, only one type of toxicity test was conducted during the Bight study; three types were conducted in the shipyard study. Exponent concludes that, because of the differences in field and laboratory methods employed in the Bight '98 study and the shipyard study, the designated reference pool "will result in inconsistent and inaccurate comparisons with shipyard data."

Data from the Bight '98 study is also significantly older than the data recently obtained in the site-specific study conducted by the shipyards. Not only is the data less representative of conditions that currently exist, but temporal variability (e.g., in benthic communities) suggests that any decisions based the Bight '98 data are not supportable from a technical perspective.

Further, as discussed above, many of the reference stations added by the Regional Board do not adequately represent background conditions at the shipyard, because they are further from shore, do not exhibit similar physical properties or toxicity, are affected by continental shelf species, etc.

The Regional Board's conclusions are also suspect because the underlying scientific rationale for selecting the reference sites is flawed. The reference pool is apparently based on two theories not subjected to the scrutiny of peer review in the scientific community -- the southern California bay Benthic Response Index ("BRI")[3] and the "distance-from shore" approach. The Regional Board emphasized the BRI in selecting reference stations. The BRI has not been published or scrutinized in recognized scientific journals, and its potential error rate is unknown. The "distance-from-shore" rationale was also used to identify a list of 22 candidate reference stations from the Bight '98 study, selected in January 2003 (of which 17 stations are currently included in the reference pool). Like the BRI, this approach has not been fully vetted in the scientific community.

In admitting evidence of scientific methods in California, the evidence generally must demonstrate that the technique has been tested, the technique has been subject to peer review, the potential rate of error is known, and there is a degree of acceptance in the relevant scientific community. See, e.g., People v. Kelly, 17 Cal. 3d 24 (1976); People v. Leahy, 8 Cal. 4th 587 (1994). As shown above, the distance-from-shore approach and the BRI likely do not meet this standard.

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3 Exponent submitted an extensive technical memorandum on June 4, 2003, describing the various deficiencies in the BRI approach. Exponent concludes that: "Given the uncertainties inherent in the BRI approach and its arbitrary and unvalidated classification of response levels, it should not be used to assess the benthic communities at the shipyard sites or reference stations." See Technical Memorandum 6 at 22 (June 2003).

Hence, the reference stations are not scientifically defensible, and any decision made by the Regional Board based on those reference stations would not be supported by the weight of the evidence.

D. The Regional Board's Selection of Reference Stations Fails to Adequately Weigh Data from the Site Specific Study and Would Result in a Significant Waste of Resources Already Expended to Meet Regional Board Requirements

The addition of 17 reference stations from the Bight '98 study effectively results in heavily weighting (by an order of magnitude) the older data gathered in the generic study, and placing little weight on the recent, more complete site-specific study. The result of the Regional Board's action is to make the site-specific reference data statistically insignificant in the final analysis of background conditions.

It is arbitrary and capricious for the Regional Board to (i) exclude recent, site-specific reference data collected by the shipyards in compliance with Regional Board directives; (ii) replace more than half of the recent data with older data collected in a generic study; and then (iii) supplement the data with an overwhelming number of selected reference sites from the older, generic study such that the new, site-specific reference data is effectively completely diluted. Exponent concludes that, as a result of the reference pool being heavily weighted with Bight '98 data (which has significant differences in test methods, etc.), "comparison of a predominantly Bight '98 reference pool to the shipyard stations is likely to result in the identification of differences that are solely the result of variation in methods, rather than of effects of the shipyards themselves." Exhibit "A" at 4.

E. The Regional Board's Approach Is Also Procedurally Flawed

Not only would any conclusion based on this reference pool be arbitrary and capricious (because it is not supported by substantial scientific evidence), but the result would also be unreasonable and patently unjust in light of the procedure employed by the Regional Board in finalizing the reference pool.

For more than two years, the Regional Board has repeatedly changed the parameters of the investigation (in identifying and then changing various reference sites, "background" concentrations, and "ambient" conditions), in its meandering pursuit of reference conditions. The series of decisions and changes follows no discernable path in terms of policy or methods for determining background or reference conditions. See Exhibit "B" (letter from D. Nielsen to L. McVey, dated June 13, 2003 (summarizing the history of Regional Board actions on this issue)). Despite the lack of consistency in the Regional Board's approach, the shipyards have repeatedly cooperated with the Regional

Board and complied with its shifting demands. Several of these changes are briefly highlighted below.

The scope and concept of the reference locations have varied significantly from the plan developed by the Regional Board at the outset of the study in 2001. In the Guidelines established by the Regional Board on June 1, 2001, background chemical concentrations were described, based on a weighted average of 13 years of data from NPDES station REF-03, which is close to station 2440 of the Bight '98 study.

On June 13, 2001, twelve candidate reference stations were identified for the shipyard investigation through selective screening by SCCWRP of the Bight '98 stations, with respect to physical, chemical, and toxicological characteristics. Five of the stations were recommended by SCCWRP. The shipyards initiated an investigation of the five sites, as required by the Regional Board.

Nine months later (March 2002), the Regional Board issued a letter to the shipyards reporting their evaluation of NPDES stations REF-01, REF-02 and REF-03, including a statistical comparison to NSS-STD-01. The evaluation identified REF-03 as most similar to the shipyards.

The March 2002 Regional Board letter also identified a subset of 12 candidate reference stations from the Bight '98 study, using SCCWRP criteria, and directed that data from those stations be used instead of data from station REF-03 to define background conditions. Notably, the 12 sites do not match the 12 sites identified a year earlier by SCCWRP. No explanation was provided for the inconsistency.

On July 29, 2002, Regional Board staff requested that NASSCO and Southwest Marine sample the 12 newly-identified reference stations for the full suite of Phase 1 analytes. NASSCO and Southwest Marine again complied with the Regional Board's changing demands concerning reference conditions.

Then in January 2003, SCCWRP identified 22 Bight '98 stations as representative of bay-wide ambient conditions, using a "distance-from-shore" approach.[4] This served to introduce, more than 18 months after the Regional Board staff had established the Guidelines for conducting the sediment investigation, an entirely new

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4 Significantly, the SCCWRP did not state that the 22 sites were representative of conditions that would exist at the shipyard but for the impacts of shipyard operations.

concept – bay-wide ambient conditions – that, as evidenced by its very name, had nothing to do with the site-specific conditions at the shipyard.[5]

Finally, on June 9, 2003, Regional Board staff identified 17 of the 22 stations to be included in the final reference pool, again without any explanation of the basis for the decision. These stations appear to be a subset of the 22 Bight '98 stations identified using the "distance-from-shore" approach for determining "bay-wide ambient conditions." Although Bight '98 data from these stations is to be included in the reference pool, data from the more recent study (required by the Regional Board) from the same locations is not included.

The history of the Regional Board's actions demonstrates either an inconsistent, ever-changing, and arbitrary approach to the establishment of background conditions, or an intentional effort to continually change the scope of the investigation for some yet-to-be disclosed reason. In either case, the staff's position is arbitrary, unreasonable, and not supportable.

Moreover, the staff's current approach unreasonably eliminates a large amount of data from the research conducted by the shipyards. The Regional Board required the shipyards to conduct certain studies, costing more than $3,000,000, and then disregarded substantial portions of the reference station analyses. In the most recent letter, the Regional Board defined the reference pool as comprising only 10 percent from the site-specific reference stations, and 90 percent from the Bight '98 study (data that was available at the time the Regional Board ordered the shipyards to undertake the site-specific study, and available at the time the five initial reference stations were selected based on the Bight '98 sites!). Even more alarming is the fact that the shipyards' experts inform us that the heavily weighted reference stations from the Bight study are not even appropriate from a technical standpoint.

F. The Regional Board Must Address These Issues to Legitimize Any Decisions Based on the Reference Pool Data

Having the determination of reference stations be a moving target has rendered much of the detailed investigative work either unnecessary or of little to no value. If the Regional Board spent its own money in doing so, that would be one thing. But it is very different to require the shipyards to spend their money doing the study (and

5 Throughout this process, the Regional Board has often confused or conflated the concepts of "background," "ambient conditions," and "reference sites." In a letter to Regional Board staff, dated February 2, 2002, Exponent requested that the Regional Board clarify the relationship of these terms, and the process for determining site-specific cleanup levels. The Regional Board has not responded to that letter.

indeed, to also reimburse the Regional Board for overseeing their efforts as staff vacillated on the issue of reference stations), when a selection of these reference stations at the outset obviously would have facilitated refining the entire investigative program in a way that would ensure the usability of all of the data. It is arbitrary and capricious for the agency staff to be moving the target around as the shipyards conducted the investigation required by the Regional Board.

The final determination concerning reference stations should be intended to ensure maximum use and comparability of the compiled data. Under the Regional Board's current approach, the utility of the information gathered in the studies has been potentially greatly restricted, both to the shipyards in supporting a reasoned approach to remediation and to the Regional Board in making a factually informed supportable decision.

For the reasons stated above, any decision by the Regional Board based on the flawed reference pool would not be supported by the evidence, and would amount to arbitrary and capricious agency action.

We look forward to resolving this issue with Regional Board staff as soon as possible. We remain committed to working with the Regional Board staff in arriving at a scientifically and legally defensible decision.

Very truly yours,

Lane L. McVey
Vice President & General Counsel

Enclosures

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June 23, 2003

Mike Chee
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Shaun Halvax
Southwest Marine
Foot of Sampson Street
San Diego, CA 92113

Subject: Reference Stations for NASSCO and Southwest Marine Detailed Sediment Investigations
Project Nos. 8601718.002 and 8601731.002

Dear Mike and Shaun:

Exponent has reviewed David Barker's letter of June 9, 2003, containing the Regional Board's latest position regarding reference stations in San Diego Bay. There are several aspects of this position to which we have some technical objection. Mr. Barker's letter is lacking any citation or description of a regulatory foundation for reference areas; any discussion or acknowledgement of a distinction between background and reference conditions; and any description of the technical analyses and decision-making criteria that were employed. As a consequence, the position taken by the Regional Board is technically unsupported and appears to be arbitrary. Thus, any cleanup decisions resulting from the use of this approach would be vulnerable because of the apparent lack of a sound scientific or regulatory basis.

The remainder of this letter describes some of the problems with the Regional Board's selection of a reference pool. There are additional issues and problems that are not listed here, but that will need to be resolved if analyses are actually to be carried out using this inappropriate set of reference stations.

1. The designated pool of reference stations characterizes Bay-wide ambient conditions, focusing on the least contaminated areas, rather than representing shipyard-specific reference stations.

Extensive regulatory guidelines and precedent have established that the appropriate basis for assessing the effects due to a particular site are site-specific reference stations, not necessarily stations that represent the optimal environmental conditions in the region. Although a set of stations representing the cleanest ambient conditions may be suitable for determining the overall level of impairment at a site, such a set is not appropriate for identifying the contribution of a specific activity or party at a specific location. The approach that Regional Board staff have taken, of examining data from throughout San Diego Bay and identifying stations with the lowest overall levels of sediment chemistry and toxicity, results in a set of stations that characterizes clean ambient conditions, and not site-specific reference stations. The Board staff's direction to use the same set of stations for both the shipyard study and the Seventh Street Channel study is an indication that site-specific issues have not been considered. Appropriate site-specific reference stations for the shipyard study should be located in the nearshore environment, in the same mid-Bay region as the shipyards, and in locations not directly influenced by the shipyards. The set of stations that Board staff have designated excludes stations meeting these criteria, and includes instead stations that are in distant parts of the Bay and not in the nearshore environment. The stations in the reference pool identified in David Barker's letter therefore do not represent conditions that would be present at the shipyard locations but for the influence of the shipyards themselves. Therefore, comparison of shipyard conditions to these stations cannot be used as a scientifically defensible basis for decisions regarding the shipyards' responsibility for cleanup. Although Regional Board staff have a legitimate interest in defining clean ambient conditions for San Diego Bay, and also in determining whether site-specific reference stations fall within the range of clean ambient conditions, the use of clean ambient conditions should not be substituted for the appropriate use of site-specific reference stations.

2. There is no technical or regulatory justification for selection or omission of stations contained in the reference pool.

David Barker's letter does not include even a partial explanation of the overall decision-making process that was followed, much less the rationale for each of the many individual decisions that must have been made. The resultant reference pool therefore appears to be arbitrarily selected. Although we are aware of some of the analyses that have been conducted using San Diego Bay data, and have even contributed to some of these, David Barker's letter does not indicate which analyses were relied on, which analyses were discounted, and why. Were we to present the Regional Board staff with a list of the reference stations that we intend to use, without any supporting technical analysis, they would surely recognize that the selections were not adequately justified. The need for adequate technical justification is not waived just because the regulatory agency rather than the regulated party is making decisions about reference stations.

There are several specific decisions that Regional Board staff have made that particularly deserve an explanation. For example, shipyard station 2231 has been completely excluded, possibly because of the altered benthic community at that station, despite the fact that the alteration was due to an invasive species and not to chemical toxicity. In contrast, David Barker's letter indicates that all data except benthic macroinvertebrate data can be used from shipyard station 2243, despite the fact that benthic community metrics for station 2243 indicate that it is one of the best of the five reference stations sampled. The inconsistent treatment of benthic data, and of stations as a whole, indicates that the decision-making process was arbitrary.

As a second example, Board staff have retained shipyard stations 2433 and 2441, which are arguably unsuitable as site-specific reference stations because of their location in a distant part of the Bay and because they have benthic communities that are apparently influenced by continental shelf species. Retention of these stations indicates that established regulatory standards for the definition of reference stations for cleanup studies were ignored.

As a third example, Board staff have included Bight '98 stations 2241, 2256, and 2257, but have excluded Bight '98 station 2258, despite the fact that all of these stations are in proximity to one another. If stations 2241, 2256, and 2257 represent an area that is characteristic of reference conditions, then station 2258 should also be representative of reference conditions. This situation indicates that Board staff selected reference stations based on judgments about the acceptability of individual data points, rather than by selecting stations based on established standards (i.e., location and influence of sources). Selection of specific individual data points rather than data representative of reference areas within the bay biases the results toward the cleanest conditions, rather than establishing appropriate site-specific reference conditions.

As a fourth example, Board staff have excluded all of the 2002 data collected by the shipyards (at the Board staff's direction) at candidate reference stations that were previously sampled by the Bight '98 study. This is another indication of inconsistent treatment of locations and data sets.

Although these four examples are illustrative of the more obviously questionable decisions in David Barker's letter, adequate justification should be provided for every decision that was made regarding the Board staff's latest choice of reference stations.

3. The predominance of Bight '98 stations in the designated reference pool will result in inconsistent and inaccurate comparisons with shipyard data.

The set of reference stations that Regional Board staff have selected is dominated by stations from the Bight '98 study, for which field and laboratory methods are not necessarily consistent with those used in the shipyard study. Examples of these differences include:

- Chemical detection limits achieved during the shipyard investigation are substantially better (lower) than those in the Bight '98 data set.
- Not all chemicals measured during the shipyard investigation were measured during Bight '98 (e.g., butyltins, polychlorinated terphenyls), leading to inconsistent levels of power for statistical comparisons.
- Only one of the three types of toxicity tests conducted during the shipyard investigation was also conducted during Bight '98 (amphipod survival), and the existence of outliers in the Bight '98 amphipod survival data set indicates that there are systematic differences in the method or its performance.
- Because of the temporal variability of benthic macroinvertebrate communities, it is not appropriate to use reference data that were collected as part of a different investigation conducted 3 years prior to the shipyard study. The existence of such temporal variability is illustrated by the major changes in the benthic community that have occurred at station 2231, and possibly others. In addition, some systematic differences in benthic macroinvertebrate taxonomy apparently exist between the two data sets.

As a consequence of these (and possibly other) differences, comparison of a predominantly Bight '98 reference pool to the shipyard stations is likely to result in the identification of differences that are solely the result of variation in methods, rather than of effects of the shipyards themselves.

The purpose of sampling reference stations with every individual site investigation is the collection of comparable site and reference data, using identical field and laboratory methods. This includes pairing site and reference stations in toxicity test batches, an assurance of consistency that is impossible to achieve when reference data are mixed across investigations. If use of consistent methods for site and reference stations was not important, then the U.S. Environmental Protection Agency and other regulatory agencies (including the California Water Resources Control Board) would not require that reference stations be sampled as part of every site-specific investigation. Analyses using reference data from different investigations with different methods or data quality standards will lead to increased uncertainty about the results of comparisons to site data. The result of increasing uncertainty is greater difficulty in decision-making, which regulatory agencies typically compensate for by making more conservative—and therefore contentious—decisions.

Summary

Regional Board staff have repeatedly provided the shipyards with varying, inconsistent, and unexplained directions regarding background or reference area data to be used to evaluate shipyard conditions. In the June 2001 investigation guidelines, a set of point concentrations for individual chemicals was proposed as representing background conditions, and the shipyards were also directed to sample five stations to use as reference conditions for this study. Although these two (actual or potential) sets of values might have been intended to represent ambient background and site-specific reference conditions, respectively, Regional Board staff never made it clear whether they intended this, or some other, relationship to hold between these values. On March 6, 2002, John Robertus sent a letter to the shipyards specifying different background chemical concentrations to replace those in the June 2001 guidance. Once again, there was no explanation of how the Regional Board staff viewed the relationship between these numbers and the data from the reference stations that they had directed the shipyards to sample. Regional Board staff subsequently directed the shipyards to sample an additional 12 reference stations in San Diego Bay that were originally sampled during the Bight '98 study. This set of stations differed from the set of 10 candidate Bight '98 reference stations identified by SCCWRP, although Regional Board staff apparently based their selection on SCCWRP's analysis. No explanation for that difference has ever been provided. Now the Board staff have presented another set of specifications for reference stations, again without adequate explanation, and again without making clear their understanding of the relationship between background and site-specific reference conditions.

The Regional Board staff's continual pursuit of a "better" set of background or reference stations has taken place without any clear statement on their part of regulatory goals or policies regarding adherence to regulatory standards. Without a clear statement of goals, policies, or standards, it is perhaps not surprising that the process has involved repeated revisions and delays. However, the latest set of recommended reference stations does not solve these problems. Because the recommendations are not clearly founded on established regulatory standards, and are not justified with reference to appropriate technical analyses and decision-making criteria, there can be no assurance that they will not be replaced soon by yet another set of specifications intended to characterize either background or reference conditions.

Given the flaws in the Regional Board staff's latest recommendations for a reference pool, use of this pool as site-specific reference stations for the shipyard investigation is technically unsupportable. Sound science dictates that site-specific reference stations should be established *a priori* based on specific criteria, the most important of which is the similarity of physical, biological, and water quality conditions to the test site, except for the effects of any chemicals released at the site. Appropriate decisions regarding the shipyards' responsibility for cleanup cannot be made using an inappropriate set of reference stations.

Sincerely,

Dreas Nielsen
Project Manager

Ex

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June 13, 2003

Lane McVey, Esq.
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Harbor Drive and 28th Street
San Diego, CA 92186

Subject: History of Background and Reference Specifications for the Shipyard Study
Project No. 8601718.002

Dear Lane:

In response to your request, this letter provides a brief history of the various specifications of background or reference conditions that have been provided for the current shipyard study.

Several different sets of concentrations, or sets of stations to be used to establish concentrations, have been presented by Regional Board staff (or the Southern California Coastal Water Research Project [SCCWRP] staff on their behalf). These concentrations, or stations, have been variously described as representative of "background," "reference," or "ambient background." The series of changes follow no clear trend in terms of policy or methods for defining background or reference conditions. Following is the set of background or reference condition specifications provided by (or for) Regional Board staff:

1. Background chemical concentrations in the Regional Board's June 1, 2001, guidelines for the sediment investigation

2. Reference stations specified for the sediment investigation

3. Background chemical concentrations, and Bight '98 stations, specified in John Robertus' March 6, 2002, letter

4. Bight '98 stations identified as "ambient background" stations by the distance-from-shore analysis conducted by Steve Bay

5. Stations listed in the June 9, 2003, reference pool specifications.

Each of these is described in the following sections. All of the Bight '98 stations referenced are shown in Figure 1 and listed in Table 1 (attached).

Background Chemical Concentrations per June 1, 2001, Guidance

These background chemical concentrations were based on data from NPDES station REF-03, which is located at the Broadway Pier, at or close to the location of Bight '98 station 2440 (which is one of the shipyard reference stations). There is no indication in the guidance document regarding how the cited concentrations were derived, but this process was subsequently described in John Robertus' letter (Robertus 2002, pers. comm.) as a weighted average of 13 years of monitoring data, with greater weight being given to more recent data. Because the concentrations are averages, approximately half of the data at the reference station would exceed these values. Consequently, these concentrations have little value for differentiating site stations from reference conditions.

Reference Stations Specified for the Sediment Investigation

The five reference stations for the shipyard investigation were selected through a process of screening Bight '98 stations with respect to physical, chemical, and toxicological characteristics. The screening process was conducted by Steve Bay of SCCWRP. The set of five selected reference stations was conveyed to Exponent by e-mail (Bay 2001a, pers. comm.), with an accompanying document that described the selection process (Bay 2001b). Overall, 12 Bight '98 stations passed the screening, of which five were recommended for use in the shipyard and Chollas/Paleta investigations. Of the five that were recommended in the document (Bay 2001b), the transmittal e-mail (Bay 2001a, pers. comm.) specified that one station was to be dropped (2238) and a different station substituted (2231). Both the total pool of 12 stations (from Bay 2001b) and the selected five stations (from Bay 2001a, pers. comm.) are listed in Table 1.

Steve Bay has subsequently described the screening process as having produced a set of 10, rather than 12, recommended stations (Bay 2002). In meetings and other conversations, he has indicated that the difference was due to the omission of two stations that are located in marinas.

Background Chemical Concentrations Specified in John Robertus' March 6, 2002, Letter

This letter and its attachment describe the process used to evaluate the NPDES stations REF-01, REF-02, and REF-03 relative to the NASSCO and SWM leaseholds. This evaluation consisted of statistical comparisons to stations NSS-STD-01 and SWM-STD-01, which "are assumed to be mostly affected by watershed runoff and have minimal influence by shipyard discharges." The result of this evaluation was the identification of station REF-03 as most similar to the shipyards. Concentrations from station REF-03 formed the basis for the background values in the June 1, 2001, guidance document (RWQCB 2001). The description of this screening process indicates that Regional Board staff at this time intended to identify background stations that were similar to shipyard stations in all respects except for the influence of shipyard activities. This clear statement of intent is notable for its absence from other specifications of background or reference conditions.

The letter also summarizes the process used to screen Bight '98 stations, as previously described by Steve Bay (2001b). There is no apparent difference in the process described, but the set of 12 stations that are identified as making up the candidate reference pool (shown in Table 1) are not the same as the 12 originally identified by Steve Bay. Specifically, four of the stations listed in the attachment to John Robertus' letter are not included in Steve Bay's list. No explanation for the difference was included in John Robertus' letter or attachment.

Finally, the attachment to the letter presents a rationale for substituting data from Bight '98 for data from NPDES station REF-03, and presents a set of chemical concentrations that are specified to be representative of background conditions. These chemical concentrations are the upper 95 percent confidence limit on the mean concentration. Because they are confidence limits on the mean, the most appropriate basis for comparing site data to these values is to use the mean site concentration for each chemical. Thus, these concentrations have little value for identifying important spatial differences within the shipyard sites.

By e-mail to Mike Chee and Shaun Halvax on July 29, 2002, Tom Alo asked the shipyards to also sample all of the 12 Bight '98 stations listed in the attachment to John Robertus' March 6, 2002, letter. The stated purpose of this sampling was to define background concentrations for butyltins, polychlorinated terphenyls, and petroleum hydrocarbons. Tom Alo requested that the samples from these stations also be analyzed for the full suite of Phase 1 analytes. These samples were collected, and analyses conducted, during Phase 2.

Stations Identified by the Distance-from-shore Approach

In support of the continuing re-evaluation of background conditions by Regional Board staff, Steve Bay and Jeff Brown of SCCWRP evaluated the Bight '98 data using decreases in concentration with distance from shore as a means to identify "baywide ambient" concentrations (Bay and Brown 2003). This technique depends on a consistent decline in concentration with distance from shore, which occurs for many chemicals. The distance at which concentration ceases to decline is taken to represent ambient background. This distance was found to be approximately 290 m for all chemicals evaluated. The upper 95 percent confidence limit on the mean was calculated for all data from stations at a greater distance. All stations with concentrations below the upper 95 percent confidence limit are regarded as representative of ambient background conditions. Concentrations of metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) were evaluated in this way. The result was the identification of 22 Bight '98 stations in San Diego Bay as representative of baywide ambient conditions. These stations are listed in Table 1.

Stations Listed in the June 9, 2003, Reference Pool Specifications

David Barker's June 9, 2003, letter lists 17 Bight '98 stations that are to be included in the reference pool. This list of stations is a subset of the 22 stations identified by the distance-from-shore approach, but no explanation is provided for why some stations are omitted, or for why these 17 "ambient background" stations are considered appropriate for site-specific reference stations. Also, although all Bight '98 data from these stations are to be included in the reference pool, not all data from the 2001 shipyard and Navy investigations, though collected at the same stations, are to be included in the reference pool.

If you have any questions or would like to discuss any of these issues further, please give me a call at (425) 643-9803.

Sincerely,

Dreas Nielsen
Project Manager

cc: Mike Chee, NASSCO

Attachments

References

Barker, D. 2003. Personal communication (letter to M. Chee, NASSCO; S. Halvax, Southwest Marine; B. Chadwick, U.S. Navy; and S. Bay, SCCWRP, dated June 9, 2003, regarding the Regional Board final position on a reference pool for the NASSCO, Southwest Marine, mouth of Chollas Creek, and 7th Street Channel sediment investigations). California Regional Water Quality Control Board, San Diego Region, San Diego, CA.

Bay, S. 2001a. Personal communication (e-mail to D. Nielsen, Exponent, Bellevue, WA, dated June 13, 2001, regarding San Diego reference sites). Southern California Coastal Water Research Project.

Bay, S. 2001b. Summary of reference site selection for San Diego Bay sediment quality studies. June 13, 2001. Southern California Coastal Water Research Project. 8 pp.

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Bay, S., and J. Brown. 2003. Distance-from-shore approach to identify Bight '98 reference sites in San Diego Bay. January 8, 2003 Southern California Coastal Water Research Project.

Robertus, J. 2002. Personal communication (letter to M. Chee, NASSCO, and S. Halvax, Southwest Marine, dated March 8, 2002, regarding background water quality conditions for NASSCO and Southwest Marine Shipyards as determined by reference station REF-03 and Bight '98 reference sites). California Regional Water Quality Control Board, Region 9, San Diego, CA.

RWQCB. 2001. Guidelines for assessment and remediation of contaminated sediments in San Diego Bay at NASSCO and Southwest Marine Shipyards. June 1, 2001. San Diego Regional Water Quality Control Board.

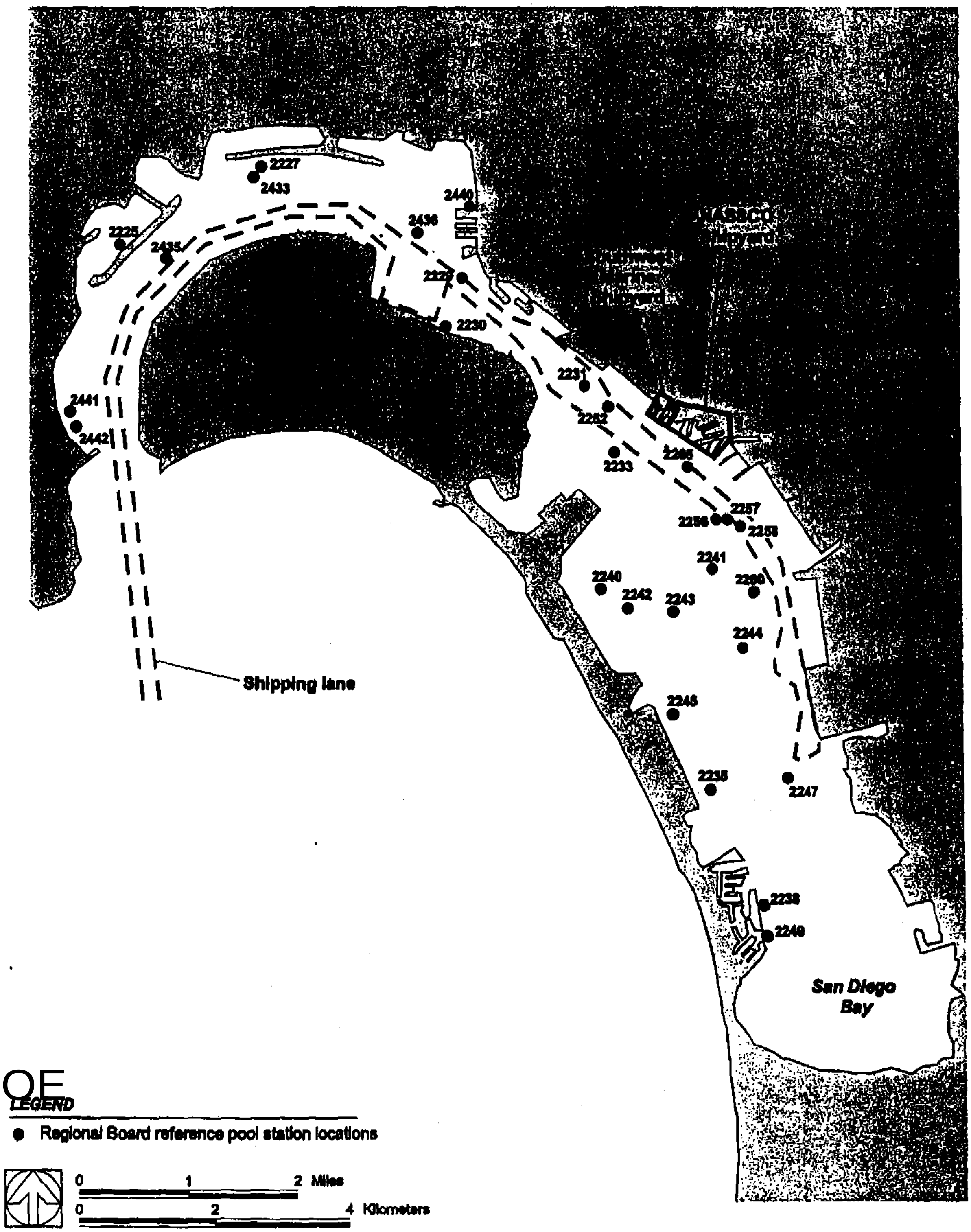

Figure 1. Bight '98 stations used for background or reference conditions

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Table 1. Summary of Bight '98 stations used for background or reference specifications

Station	Passed Initial Screening (Bay 2001b)	Specified for Shipyard Study (Bay 2001a, pers. comm.)	Used to Calculate Second Set of Background Values (Robertus 2002, pers. comm.)[a]	Identified by Distance-from-shore Approach (Bay and Brown 2003)	Listed in Revised Reference Specifications (Barker 2003)
2225	X				
2227	X				
2229	X		X		
2230			X		
2231	X	X	X	X	X
2233				X	X
2235				X	
2238	X			X	X
2240	X		X	X	X
2241			X	X	X
2242				X	X
2243	X	X	X	X	X
2244			X	X	X
2245				X	
2247				X	X
2249				X	
2252				X	X
2256				X	X
2257				X	X
2258				X	
2260				X	
2265			X	X	X
2433	X	X	X	X	X
2435	X		X	X	X
2436				X	X
2440	X	X	X	X	X
2441	X	X	X		
2442	X				

[a] This set of stations was also sampled during Phase 2, at the request of Tom Alo.

Laura Hunter

From: Ed Kimura [emkimr@cts.com]
Sent: Friday, June 20, 2003 11:10 AM
To: Laura Hunter; elainecarlin@att.net; Denise Klimas
Subject: Related Navy Guidance For Sediment Evaluation

FYI

I found this today while searching for fines normalization. It is in the appendix: http://web.ead.anl.gov/ecorisk/related/documents/Appendix_B_-_Geochemical_Analysis_Overview.pdf

I have'nt gone through the major document

Navy Guidance for Conducting Ecological Risk Assessments

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Navy Policy
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Site Closeout Process
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An updated sediment guide document is available

Guidance for Environmental Background Analysis Volume II: Sediment

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Related Navy Guidance

Guidance for Sediment Evaluation

An update to the Implementation Guide for Assessing and Managing Contaminated Sediment at Navy Facilities has been made. A revisions page has been added to the updated document to notify the reader of changes that have been made in the document since the previous version.

- Sediment Guide *(2276 KB)*
  - Appendix A - Rapid Screening Methods *(95 KB)*
  - Appendix B - Geochemical Analysis Overview *(66 KB)*
  - Appendix C - Hypothetical ERA *(109 KB)*
  - Appendix D - Planning Matrix Table *(101 KB)*
  - Appendix E - North Island RI *(18565 KB)*

Watershed Contaminant Source Document (WCSD) Fact Sheet *(3100 KB)*

Guidance for Environmental Background Analysis

- Volume I: Soils *(5928 KB)*
- Volume II: Sediment *(5049 KB)*

Last Modified: 06/12/2003

Navy Human Health
Risk Assessment
Web Site

Navy Risk
Communication Web
Site

Laura Hunter

From: elainecarlin@att.net
Sent: Wednesday, August 06, 2003 10:22 AM
To: Alan Monji
Cc: Laura Hunter; emkimura@earthlink.net; peurp@rb9.swrcb.ca.gov

Alan - As I mentioned I am on a fast track to prepare comments on your final reference pool. Given Tom's absense this week, could you or Pete get the OK and then Ed can take a look at the analyses when he meets with Pete. Thanks, E.

Hi Tom:

Here is the request we discussed yesterday - we would very much benefit from seeing the results that you have already run on the 28 station pool, that allow one to get a feel for the chemical concentration levels that result from running the statistics you have prescribed. This would include if possible the amphipod survival rate and benthic measures that result from running the statistics.

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The requested information is necessary for the public and other stakeholders - who do not have expertise in the statistical methods and normalization techniques - to assess and provide feedback on your determination of a final reference pool.

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Many thanks,

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> > >

> > > http://www.msnbc.com/news/948189.asp?0dm=C21DN
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Laura Hunter

From: Denise Klimas [Denise.Klimas@noaa.gov]
Sent: Thursday, May 22, 2003 4:52 PM
To: Laura Hunter; Elaine Carlin
Subject: regarding my BIG PROBLEM email

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EHC 000219

Laura Hunter

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Sent: Thursday, May 22, 2003 1:15 PM
To: Elaine Carlin; Laura Hunter
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I am so furious that I can hardly see straight!!!!! See email that I just sent to Tom!
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Date: Thu, 22 May 2003 13:07:56 -0700
From: Denise Klimas <denise.klimas@noaa.gov>
To: Tom Alo <alot@rb9.swrcb.ca.gov>
CC: Craig Carlisle <craigc@rb9.swrcb.ca.gov>,David Barker <barkd@rb9.swrcb.ca.gov>,Alan Monji <Monja@rb9.swrcb.ca.gov>,pete peuron <Peurp@rb9.swrcb.ca.gov>,Donald Macdonald <Donald.Macdonald@noaa.gov>,scott sobiech <scott_sobiech@fws.gov>,Michael Martin <Mmartin@OSPR.DFG.CA.GOV>

Tom,
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From: Denise Klimas [Denise.Klimas@noaa.gov]
Sent: Tuesday, April 29, 2003 5:33 PM
To: Elaine Carlin; Laura Hunter
Subject: [Fwd: initial cmts on RWQCB Ref. approach]

This is sent to you FYI and to PLEASE keep CONFIDENTIAL. I'll let you know what kind of response I get from these guys. Just FYI, Jay Field has asked one of the statisticians that works with NOAA all the time for some advice on this project, so we'll see what she says. More later and Thanks.
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CC: David Barker <barkd@rb9.swrcb.ca.gov>,Craig Carlisle <craigc@rb9.swrcb.ca.gov>,Alan Monji <Monja@rb9.swrcb.ca.gov>,pete peuron <Peurp@rb9.swrcb.ca.gov>,Brennan Ott <otbre@rb9.swrcb.ca.gov>,scott sobiech <scott_sobiech@fws.gov>,Michael Martin <Mmartin@OSPR.DFG.CA.GOV>,Donald Macdonald <Donald.Macdonald@noaa.gov>,Jay Field <Jay.Field@noaa.gov>,Charles Cheng <chenc@rb9.swrcb.ca.gov>

April 29, 2003

Mr. Tom Alo,
San Diego RWQCB
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

Tom,
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unexplained statistics on some tables, and most tables do not have units labeled. In addition, this document does not include positions put forward by the trustees and the San Diego Bay Council, so as such, it should not be titled a "consensus" document.

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afforded to the responsible parties. We hope to have a discussion with you on the value of this approach when applied in the absence of other invested parties.

Tom, please let me know as soon as you can if you will be able to get us answers to the questions that we have posed. Thanks, and we look forward to continuing to work with you and the rest of the Board on this important project.

Denise

Denise M. Klimas
NOAA Coastal Resources Coordinator

Laura Hunter

From: Denise Klimas [Denise.Klimas@noaa.gov]
Sent: Wednesday, March 26, 2003 5:35 PM
To: Tom Alo
Cc: Donald Macdonald; scott sobiech; Michael Martin; Laura Hunter; Elaine Carlin; David Barker
Subject: Results of steps 1-4?

Hi Tom,
I was just reviewing some notes from our meeting in January and saw that there were several action items that are outstanding from the meeting.

One in particular involved work that was to be done by SCCWRP, Exponent, and the Navy. They agreed to 1) evaluate the original 10 stations for normality; 2) calculate an upper (lower) one-tail 95% PI that is not adjusted for multiple comparisons; and 3) do a comparison of each 2001 sampling station for chemistry, toxicity, and benthos using the one-tailed PI calculated in step 2.

My notes say that these steps would be done and the results will be shared with the rest of the group that attended the meeting.

Other action items include 1) determining whether the BPTCP data could be used for the PI analysis for contams not present in both the Bight '98 and Phase II Shipyard data, and 2) Steve Bay getting access to the data from the Bight '98 Benthic Response Index that is specific for San Diego Bay.

Could you let me know the status of these action items, and where the RB is going from here. We haven't talked about the reference site issue in a long time....

Thanks Tom, and I look forward to hearing from you.
denise

EHC 000224

Laura Hunter

From: Elaine Carlin [elainecarlin@worldnet.att.net]

Sent: Friday, August 01, 2003 7:20 AM

To: alot@rb9.swrcb.ca.gov

Cc: monja@rb9.swrcb.ca.gov; peurp@swrcb.ca.gov; carlc@swrcb.ca.gov; emkimr@cts.com; Laura Hunter

Subject: Request to review regression lines...

Hi Tom:

Here is the request we discussed yesterday – we would very much benefit from seeing the results that you have already run on the 28 station pool, that allow one to get a feel for the chemical concentration levels that result from running the statistics you have prescribed. This would include if possible the amphipod survival rate and benthic measures that result from running the statistics.

If you do decide to run the statistics on the final pool, this of course would be the most helpful.

The requested information is necessary for the public and other stakeholders – who do not have expertise in the statistical methods and normalization techniques - to assess and provide feedback on your determination of a final reference pool.

I will review the EPA documents you described relating to selection of reference sites – could you please send the citations for these?

I look forward to continuing the meeting we began yesterday – and given the draft nature of your analyses – would be happy to come in and review with you these analyses, if this works better for you.

Many thanks,

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Sent: Wednesday, August 06, 2003 10:22 AM
To: Alan Monji
Cc: Laura Hunter; emkimura@earthlink.net; peurp@rb9.swrcb.ca.gov

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San Diego, CA 92123-4340

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Laura Hunter

From: Elaine Carlin [elainecarlin@worldnet.att.net]

Sent: Friday, August 01, 2003 7:20 AM

To: alot@rb9.swrcb.ca.gov

Cc: monja@rb9.swrcb.ca.gov; peurp@swrcb.ca.gov; carlc@swrcb.ca.gov; emkimr@cts.com; Laura Hunter

Subject: Request to review regression lines...

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From: elainecarlin@att.net
Sent: Wednesday, August 06, 2003 10:22 AM
To: Alan Monji
Cc: Laura Hunter; emkimura@earthlink.net; peurp@rb9.swrcb.ca.gov

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Laura Hunter

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To: Laura Hunter; Elaine Carlin
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To: Elaine Carlin; Laura Hunter
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April 29, 2003

Mr. Tom Alo,
San Diego RWQCB
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

Tom,
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Denise

Denise M. Klimas
NOAA Coastal Resources Coordinator

From: Denise Klimas [Denise.Klimas@noaa.gov]
Sent: Wednesday, March 26, 2003 5:35 PM
To: Tom Alo
Cc: Donald Macdonald; scott sobiech; Michael Martin; Laura Hunter; Elaine Carlin; David Barker
Subject: Results of steps 1-4?

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Hi Tom,
I was just reviewing some notes from our meeting in January and saw that there were several action items that are outstanding from the meeting.

One in particular involved work that was to be done by SCCWRP, Exponent, and the Navy. They agreed to 1) evaluate the original 10 stations for normality; 2) calculate an upper (lower) one-tail 95% PI that is not adjusted for multiple comparisons; and 3) do a comparison of each 2001 sampling station for chemistry, toxicity, and benthos using the one-tailed PI calculated in step 2.

My notes say that these steps would be done and the results will be shared with the rest of the group that attended the meeting.

Other action items include 1) determining whether the BPTCP data could be used for the PI analysis for contams not present in both the Bight '98 and Phase II Shipyard data, and 2) Steve Bay getting access to the data from the Bight '98 Benthic Response Index that is specific for San Diego Bay.

Could you let me know the status of these action items, and where the RB is going from here. We haven't talked about the reference site issue in a long time....

Thanks Tom, and I look forward to hearing from you.
denise

Laura Hunter

From: Elaine Carlin [elainecarlin@worldnet.att.net]

Sent: Friday, August 01, 2003 7:20 AM

To: alot@rb9.swrcb.ca.gov

Cc: monja@rb9.swrcb.ca.gov; peurp@swrcb.ca.gov; carlc@swrcb.ca.gov; emkimr@cts.com; Laura Hunter

Subject: Request to review regression lines...

Hi Tom:

Here is the request we discussed yesterday – we would very much benefit from seeing the results that you have already run on the 28 station pool, that allow one to get a feel for the chemical concentration levels that result from running the statistics you have prescribed. This would include if possible the amphipod survival rate and benthic measures that result from running the statistics.

If you do decide to run the statistics on the final pool, this of course would be the most helpful.

The requested information is necessary for the public and other stakeholders – who do not have expertise in the statistical methods and normalization techniques - to assess and provide feedback on your determination of a final reference pool.

I will review the EPA documents you described relating to selection of reference sites – could you please send the citations for these?

I look forward to continuing the meeting we began yesterday – and given the draft nature of your analyses – would be happy to come in and review with you these analyses, if this works better for you.

Many thanks,

Elaine

9174 Sky Park Court, Suite 100
San Diego, California 92123-4340
Phone: (858) 467-2952
Fax: (858) 571-6972

California Regional Water Quality Control Board, San Diego Region

Fax

To: LAURA HUNTER		From: TOM ALO	
Fax: (619) 232-3670		Date: 9/9/03	
Phone:		Pages: 4	
Re:			

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Winston H. Hickox
Secretary for Environmental Protection

Gray Davis
Governor

September 5, 2003

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Sincerely,

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JOHN H. ROBERTUS
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Executive Officer

STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

AGENDA

NO QUORUM

Kelly
Minan
Anderson
Butcher-

Wednesday, September 10, 2003
9:00 a.m.

Water Quality Control Board
Regional Board Meeting Room
9174 Sky Park Court
San Diego, California

The Regional Board requests that all lengthy comments be submitted in writing in advance of the meeting date. To ensure that the Regional Board has the opportunity to fully study and consider written material, comments should be received in the Regional Board's office no later than 5:00 P.M. on Wednesday, August 27, 2003, and should indicate the agenda item to which it is applicable. If the submitted written material is more than 5 pages or contains foldouts, color graphics, maps, etc., 20 copies must be submitted for distribution to the Regional Board members and staff. Written material submitted after 5:00 P.M. on Wednesday, September 3, 2003 will not be provided to the Regional Board members and will not be considered by the Regional Board. *PLEASE NOTE THAT SOME ITEMS ON THE AGENDA MAY HAVE BEEN PREVIOUSLY NOTICED WITH EARLIER DEADLINES FOR SUBMITTING WRITTEN COMMENTS. IN THOSE CASES THE EARLIER DEADLINES APPLY.*

Comments on agenda items will be accepted by E-mail subject to the same conditions set forth for other written submissions as long as the total submittal (including attachments) does not exceed five printed pages in length. E-mail should be submitted to: rbagenda@rb9.swrcb.ca.gov. Write the word "Agenda" in the subject line.

Pursuant to Title 23, California Code of Regulations, Section 648.2, the Regional Board may refuse to admit written testimony into evidence if it is not submitted to the Regional Board in a timely manner, unless the proponent can demonstrate why he or she was unable to submit the material on time or that compliance with the deadline would create an unreasonable hardship.

NOTE C, attached to this Notice, contains a description of the hearing procedures that will be followed by the Regional Board. Hearings before the Regional Board are normally conducted using procedures that do not include cross-examination. Parties requesting use of more formal procedures must do so in accord with the directions in NOTE C. Any such request, together with supporting material, must be received in the Regional Board's office no later than 5:00 P.M. on Wednesday, August 27, 2003.

Except for items designated as time certain, there are no set times for agenda items. Items may be taken out of order at the discretion of the Chairman.

1. Roll Call and Introductions

2. PUBLIC FORUM: Any person may address the Regional Board at this time regarding any matter within the jurisdiction of the Board which is not on the agenda. Submission of information in writing is encouraged. **Presentations will be limited to three minutes.**

3. Minutes of Board Meeting of August 13, 2003.

4. Chairman's, Board Members', State Board liaison's and Executive Officer's Reports: These items are for Board discussion only. No public testimony will be allowed, and the Board will take no formal action.

Consent Calendar: Items 5 through 9 are considered non-controversial issues. (NOTE: If there is public interest, concern or discussion regarding any consent calendar item or a request for a public hearing, then the item(s) will be removed from the consent calendar and considered after all other agenda items have been completed)

5. A Resolution requesting two hundred sixty thousand dollars from the State Water Resources Control Board's Cleanup and Abatement Account fund to assess atmospheric deposition, measure flow, and collect water quality data, perform modeling, and develop cleanup levels for the mouth of Chollas Creek in San Diego Bay. (Tentative Resolution No. R9-2003-0312) *(Brennan Ott)*

6. A Resolution requesting fifty four thousand dollars from the State Water Resources Control Board's Cleanup and Abatement Account fund to study marine sediment cleanup levels in San Diego Bay. (Tentative Resolution No. R9-2003-0315) *(Brennan Ott)*

7. Modification to Cease and Desist Order: California Department of Transportation, San Joaquin Hills Transportation Corridor (SR-73), Orange County, (revision to monitoring requirements) (Tentative Addendum No. 1 to Cease and Desist Order No. 2001-198) *(Christopher Means)*

8. Settlement of liability against Ryland Homes of California, Inc. for violation of Water Code sections 13376, 13267, and 13383 and SWRCB Order No. 99-08-DWQ, Waste Discharge Requirements for discharges of storm water runoff associated with construction activity, Serenada Development, Murrieta, Riverside County. The Regional Board will consider accepting a proposed settlement for the liability. If the Regional Board decides to reject the settlement, the matter will be rescheduled to a future public hearing at which time the Regional Board will consider assessment of civil liability. (Tentative Resolution No. R9-2003-0291) *(Frank Melbourn)*

9. Settlement of liability against Ashby Homes for violation of SWRCB Order No. 99-08-DWQ, Waste Discharge Requirements for discharges of storm water runoff associated with construction activity, Roripaugh Ranch construction site, Temecula, Riverside County. The Regional Board will consider accepting a proposed settlement for the liability. If the Regional Board decides to reject the settlement, the matter will be rescheduled to a future public hearing at which time the Regional Board will consider assessment of civil liability. (Tentative Resolution No. R9-2003-0302) *(Rebecca Stewart)*

Remainder of the Agenda (Non-Consent Items):

10. Administrative Assessment of Civil Liability against Pioneer Builders for violations of the State Board's General Construction Storm Water Permit Order No. 99-08-DWQ, San Diego Region Basin Plan, and Cleanup and Abatement Order No. R9-2003-158 at the Castillo del Mar subdivision in Dana Point, California. If agreement on settlement of this matter is not reached prior to the meeting date the Regional Board may deliberate and decide on assessment of civil liability based on testimony from the August 13, 2003 hearing. *The Public Comment period is closed on this item.* (Tentative Order No. R9-2003-0301) *(Rebecca Stewart)*

11. Status Report: San Diego River Watershed *(Michael Porter)*

12. NPDES Permit Reissuance: Padre Dam Municipal Water District, Padre Dam Water Recycling Facility, Discharge to Sycamore Creek and the San Diego River, San Diego County (tentative Order No. R9-2003-0179, NPDES No. CA0107492) *(David Hanson)*

13. Status Report: Duke Energy South Bay LLC, a report on the studies being conducted to assess the impact of the intake structures and thermal discharge of the South Bay Power Plant on the biological resources and beneficial uses of south San Diego Bay. *(Hashim Navrozali)*

14. Status Report: The National Steel and Shipbuilding Company (NASSCO) and Southwest Marine, Inc. (Southwest Marine) contaminated sediment investigation in San Diego Bay. Note: *This is a status report. The Regional Board will not be making any decisions regarding this item. (Tom Alo)*

15. *Executive Session* - Discussion of Ongoing Litigation
The Regional Board may meet in closed session to discuss ongoing litigation for the following cases:

    People of the State of California Ex Rel. the Regional Water Quality Control Board, San Diego Region v. Robert Ortega, an individual in his capacity as Acting Commissioner of the International Boundary and Water Commission, United States Section, et al.. United States District Court, Southern District of California, Case No. 01-CV-027BTM(JFS); violation of effluent limits in waste discharge requirements for the International Wastewater Treatment Plant contained in Order No. 96-50 (NPDES No. CA0108928) and of Cease and Desist Order No. 96-52; Referral Order No. 99-61; and the related "Surfrider" case:

    Surfrider Foundation, San Diego Chapter v. Robert Ortega, et al., Case No. 99-CV-2441-BTM(JFS)

    Rakhra Groups, Inc., v. San Diego Regional Water Quality Control Board Superior Court of California, San Diego County; Case No. GIC 776251 and Case No. GIC 786516

    San Diego BayKeeper and Surfrider Foundation, San Diego Chapter v. City of San Diego; U.S. District Court, Southern District of California; Case No. 01-CV-0550-B (POR)

16. *Executive Session* - Consideration of Initiation of Litigation
The Regional Board may meet in closed session to consider initiating criminal prosecution against persons who are alleged to have violated the Porter-Cologne Water Quality Control or the federal Clean Water Act.

17. *Executive Session* - Discussion of Pending Litigation
The Regional Board may meet in closed session to discuss pending litigation.

18. *Executive Session* - Personnel
The Regional Board may meet in closed session to consider personnel matters involving exempt employees [Authorized under Government Code Section 11126(a)]

19. Arrangements for Next Meeting and Adjournment
Wednesday, November 12, 2003 - 9:00 a.m.
Water Quality Control Board
Regional Board Meeting Room
9174 Sky Park Court
San Diego, California

Notifications

A. On November 12, 2003, the Regional Board is scheduled to consider tentative Addendum No. 4 to Order No. 97-11: "General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Hazardous and Nonhazardous Waste Landfills". The tentative addendum will: a.) add the San Pasqual Burn Ash site to the General Order, and b) transfer responsibility for compliance with the Order to new dischargers identified for the Rainbow Canyon Landfill and the Naval Training Center Landfill (aka NTC/MCRD Landfill). *(Brian McDaniel)*

B. On July 23, 2003, the Executive Officer issued Addendum No. 4 to Cleanup and Abatement Order (CAO) No. 91-45. This addendum was issued to the Redevelopment Agency of San Diego, G.T.F. Properties and Shell Oil Company, Golden West Hotel and the Unocal Corporation, and Greyhound Lines, Incorporated and Transportation Leasing Company-Greyhound Maintenance Center (the dischargers named in the CAO for the downtown San Diego commingled plume). Addendum No. 4 rescinds the ground-water monitoring directives (directives 1, 4, and 7 of CAO No. 91-45, directives 2, 3, 4, and 5 of Addendum No. 1, directives 2(a) and (b) of Addendum No. 2, and directives 8(a) through (c), 9, and 10 of Addendum No. 3) and removes the dischargers who have completed all phases of corrective action from the order (Redevelopment Agency of San Diego, G.T.F. Properties and Shell Oil, Greyhound Lines and Transportation Leasing). *(Sue Pease)*

DIRECTIONS TO REGIONAL BOARD MEETING

Regional Water Quality Control Board
9174 Sky Park Court, Suite 100, San Diego

From Downtown: I-15 north - take the Aero Drive exit - turn left (west). Proceed to the 3rd stoplight, which is Ruffin Road – turn right. Turn left on Sky Park Court (stoplight). Our building is located at the end of the court – veer to the right into the parking lot.

From the North: I-15 south - take the Balboa Ave. exit - turn right (west). Proceed to the 2nd stoplight, which is Ruffin Road – turn left. Turn right on Sky Park Court (stoplight). Our building is located at the end of the court - veer to the right into the parking lot.

Agenda Notice for September 10, 2003

NOTES:

A. GENERAL STATEMENT

The primary duty of the Regional Board is to protect the quality of the waters within the region for all beneficial uses. This duty is implemented by formulation and adopting water quality plans for specific ground or surface water basins and by prescribing and enforcing requirements on all domestic and industrial waste discharges. Responsibilities and procedures of the Regional Water Quality Control Board come from the State's Porter-Cologne Water Quality Act and the Nation's Clean Water Act.

The purpose of the meeting is for the Board to obtain testimony and information from concerned and affected parties and make decisions after considering the recommendations made by the Executive Officer.

B. CONSENT CALENDAR

All the items appearing under the heading "Consent Calendar" will be acted upon by the Board by one motion without discussion, provided that any Board member or other person may request that any item be considered separately and it will then be taken up at a time as determined by the Chairman.

Any person may request a hearing on an item on the Consent Calendar. If a hearing is requested, the item will be withdrawn and the hearing will be held at the end of the regular agenda.

C. HEARING PROCEDURES

Hearings before the San Diego Regional Board are not conducted pursuant to Chapter 5 of the California Administrative Procedure Act, commencing with Section 11500 of the Government Code. Regulations governing the procedures of the regional boards are codified in Chapter 1.5, commencing with Section 647, of the State Water Resources Control Board regulations in Division 3 of Title 23 of the California Code of Regulations.

Testimony and comments presented at hearings need not conform to the technical rules of evidence provided that the testimony and comments are reasonably relevant to the issues before the Board. Testimony or comments that are not reasonably relevant, or that are repetitious, will be excluded. Cross-examination may be allowed by the Chairman as necessary for the Board to evaluate the credibility of factual evidence or the opinions of experts. Video taped testimony by witnesses who are not present at the hearing will not be accepted unless such testimony was subject to cross-examination by all designated parties[1].

Pursuant to Government Code § 11445.20, the Board will use an informal hearing procedure, which does not include the right of cross-examination. Failure to make a timely objection to the use of an informal procedure, in accord with the directions below, will constitute consent to the informal hearing (See Title 23, California Code of Regulations, Section 648.7). Even with a timely objection, an informal procedure may be used under the circumstances identified in Government Code § 11445.20 (a) (b) or (d).

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[1] This does not preclude the use of videotape to present graphic images, provided that the person who took the videotape is available for questioning; this is intended to apply to spoken testimony of witnesses who are not available for cross-examination at the hearing.

For formal hearings, designated parties must submit witness testimony prior to the hearing date. During the formal hearing, witnesses will be allowed a limited time to orally summarize the pertinent points of their testimony. Designated parties requesting a formal hearing must submit 20 copies of the following information to the Regional Board. This information must be received in the Regional Board's Office by the date indicated on the first page of this Agenda Notice for the submission of a request for formal hearing:

- Witness testimony;
- The name of each proposed witness and the order in which witnesses will be called;
- A description/summary of what each witness' testimony is intended to prove; and,
- Identification of material factual issues in the dispute.

When a hearing is conducted using formal procedures, participants will be determined to be either "designated parties" or other "interested persons". Only designated parties will have the right to cross-examine witnesses. Interested persons do not have a right to cross-examination, but may ask the Regional Board to clarify testimony.

Designated parties automatically include the Regional Board and any person to whom an order is addressed (i.e., the Discharger(s)). All other persons wishing to testify or provide comments at a formal hearing are interested persons. An interested person may request status as a designated party for purposes of the formal hearing. A request must be received in the Regional Board's Office by the date indicated on the first page of this Agenda Notice for the submission of a request for formal hearing. The request must explain the basis for status as a designated party and, in particular, how the person is directly affected by the possible actions of the Regional Board.

For any hearing (formal or informal) the Chair will allocate time for each party to present testimony and comments and to question other parties if appropriate. Interested parties will generally be given 3 minutes for their comments. Where speakers can be grouped by affiliation or interest, such groups will be asked to select a spokesperson. The Chair may allocate additional time for rebuttal or for a closing statement. Time may be limited due to the number of persons wishing to speak on an item, or the number of items on the Board's agenda, or for other reasons.

All persons testifying must state their name, address, affiliation, and whether they have taken the oath before testifying. The order of testimony for hearings generally will be as follows, unless modified by the Regional Board Chair:

- Testimony* of Regional Board staff
- Testimony* of discharger
- Testimony* of other designated parties
- Testimony* of interested persons
- Closing statement by designated parties other than discharger
- Closing statement by discharger
- Closing statement by staff
- Recommendation by Executive Officer (as appropriate)
- Close public hearing
- Deliberation and voting by Regional Board

*includes cross examination if formal hearing

Closing statements shall be for the purpose of summarization and rebuttal, and are not to be used to introduce new evidence or testimony, or to restate direct testimony. After considering evidence, testimony, and comments, the Regional Board may choose to adopt an order regarding a proposed agenda item. All Regional Board files, exhibits, and agenda material pertaining to items on the agenda are made a part of the record. Persons wishing to introduce item exhibits (i.e., maps, charts, photographs) must leave them with the Regional Board's Executive Assistant and must provide sufficient copies for distribution to the Regional Board, designated parties, and interested persons. Photographs or slides of large exhibits are acceptable.

D. CONTRIBUTIONS TO REGIONAL BOARD MEMBERS

Persons applying for or actively supporting or opposing waste discharge requirements or other Regional Board orders must comply with legal requirements if they or their agents have contributed or proposed to contribute $250 or more to the campaign of a Regional Board member for elected office. Contact the Regional Board for details if you fall into this category.

E. PROCEDURAL INFORMATION

The Regional Board may meet in closed session to deliberate on a decision to be reached based upon evidence introduced in an adjudicatory hearing [Authority: Government Code 11126(d)]; or to consider the appointment, employment or dismissal of a public employee to hear complaints or charges brought against a public employee [Authority: Government Code Section 11126(a)].

The Regional Board may break for lunch at approximately noon at the discretion of the Chairman. During the lunch break Regional Board members may have lunch together. Regional Board business will not be discussed.

Agenda items are subject to postponement. A listing of postponed items will be posted in the meeting room. You may contact the designated staff contact person in advance of the meeting day for information on the status of any agenda item.

Speaker Cards. All persons desiring to address the Regional Board are required to fill out a speaker card. Cards are normally provided near the entrance to the meeting room. Regional Board staff can assist you in locating the cards.

Please fill out a separate card for each item you plan to speak on. All relevant sections, including the oath, must be completed. Please use the appropriate color card, as indicated below:

- Blue: Public Comments (for items requiring no Regional Board action - Public Forum, status reports, etc.).
- Green: Public Testimony, in support of the tentative action.
- Pink: Public Testimony, opposed to the tentative action.

F. AVAILABILITY OF EXECUTIVE OFFICER'S REPORT AND AGENDA MATERIAL

Visit our website at www.swrcb.ca.gov/rwqcb9 to view the Executive Officer's Report over the internet two days prior to the Regional Board meeting. A copy can also be obtained by contacting the staff office. A limited number of copies are available at the meeting.

Details concerning other agenda items are available for public reference during normal working hours at the Regional Board's office. The appropriate staff contact person, indicated with the specific agenda item, can answer questions and provide additional information. For additional information about the Board, please see the attached sheet.

G. PETITION OF REGIONAL BOARD ACTION

Any person affected adversely by a decision of the California Regional Water Quality Control Board, San Diego Region (Regional Board) may petition the State Water Resources Control Board (State Board) to review the decision. The petition must be received by the State Board within 30 days of the Regional Board's meeting at which the adverse action was taken. Copies of the law and regulations applicable to filing petitions will be provided upon request.

NOTE: If the State Board accepts a petition for review, the Regional Board will be required to file the record in the matter with the State Board. The costs of preparing and filing the record are the responsibility of the person(s) submitting the petition. The Regional Board will contact the person(s) submitting a petition and inform them of the payment process and any amounts due.

H. HEARING RECORD

Material presented to the Board as part of testimony (e.g. photographs, slides, charts, diagrams etc.) that is to be made part of the record must be left with the Board. Photographs or slides of large exhibits are acceptable.

All Board files, exhibits, and agenda material pertaining to items on this agenda are hereby made a part of the record.

I. ACCESSIBILITY

The facility is accessible to people with disabilities. Individuals who have special accommodation or language needs, please contact Ms. Lori Costa at (858) 467-2357 or costl@rb9.swrcb.ca.gov at least 5 working days prior to the meeting. TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.

J. PRESENTATION EQUIPMENT

Providing and operating projectors and other presentation aids are the responsibilities of the speakers. Some equipment may be available at the Board Meeting; however, the type of equipment available will vary dependent on the meeting location. Because of compatibility issues, provision and operation of laptop computers and projectors for Power Point presentations will generally be the responsibility of the individual speakers. To ascertain the availability of presentation equipment please contact Ms. Lori Costa at (858) 467-2357 or costl@rb9.swrcb.ca.gov at least 5 working days prior to the meeting.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
Summary of Board Actions and Proceedings
at the August 13, 2003 Board Meeting

MINUTES	REGIONAL BOARD ACTIONS
Minutes of Board Meeting of June 11, 2003.	Approved minutes.
CONSENT ITEMS	
Modification to Waste Discharge Requirements: Frank and Janice Mendenhall, Lake Henshaw Resort, Inc., San Diego County (change in owner) (tentative Addendum No. 3 to Order No. 94-03) *(Christopher Means)*	Approved Addendum No. 3 to Order No. 94-03.
Modification to Waste Discharge Requirements: Mr. Charles J. Williams, Champagne Lakes RV Resort, San Diego County (change in owner) (tentative Addendum No. 1 to Order No. 94-21) *(Christopher Means)*	Approved Addendum No. 1 to Order No. 94-21.
Modification to Waste Discharge Requirements: Northrop Grumman Space Technology and Mission Systems Corporation, Capistrano Test Site, Orange County (change in owner) (tentative Addendum No. 1 to Order No. 94-78) *(Jeremy Haas)*	Approved Addendum No. 1 to Order No. 94-78.
Modification to Waste Discharge Requirements: Vail Lake Village & Resort LLC; Mr. Bill Johnson, Vail Lake Village & Resort, Riverside County (change in owner and facility name) (tentative Addendum No. 3 to Order No. 88-44) *(Eric Becker)*	Approved Addendum No. 3 to Order No. 88-44.
Waste Discharge Requirements Update: Production and Purveyance of Recycled Water, City of San Clemente Water Reclamation Plant, Orange County (tentative Order No. R9-2003-0123) *(Bryan Ott)*	Approved Order No. R9-2003-0123.
NPDES Permit Revision: Adding the San Diego County Regional Airport Authority as a Copermittee to the San Diego County MS4 Storm Water Permit (Tentative Addendum No. 1 to Order No. 2001-01) *(Phil Hammer)*	Approved Addendum No. 1 to Order No. 2001-01.

CONSENT ITEMS (Con't.)	REGIONAL BOARD ACTIONS
Administrative Assessment of Civil Liability with Mandatory Minimum Penalties against the City of San Diego for violation of effluent limits established by Order Nos. 95-25 and 2000-90, for a permanent groundwater discharge to San Diego Bay from the San Diego Convention Center. (Tentative Order No. R9-2003-0286) *(Rebecca Stewart)*	Affirmed Order No. R9-2003-0286.
Administrative Assessment of Civil Liability with Mandatory Minimum Penalty against the South Orange County Wastewater Authority for violation of effluent limitations established by Order No. R9-2000-0013 (NPDES No. CA0107417), for the discharge of treated wastewater to the Pacific Ocean through the San Juan Creek Ocean Outfall. (Tentative Order No. R9-2003-0304) *(David Hanson)*	Affirmed Order No. R9-2003-0304.
NON-CONSENT ITEMS	
NPDES Permit: U.S. Marine Corps Base Camp Pendleton, Wastewater Treatment Plant Nos. 1, 2, 3 & 13, Discharge to the Pacific Ocean via the Oceanside Ocean Outfall, San Diego County (tentative Order No. R9-2003-0155, NPDES Permit No. CA0109347) *(Chiara Clemente)*	Approved Order No. R9-2003-0155.
NPDES Permit: Waste Discharge Requirements for IDEC Pharmaceuticals Corporation New IDEC Manufacturing Operations (NIMO), Oceanside, San Diego County (tentative Order No. R9-2003-0140, NPDES Permit No. CA0109193) *(Hashim Navrozali)*	Approved Order No. R9-2003-0140 with errata.
NPDES Permit Renewal: Waste Discharge Requirements for U.S. Navy Graving Dock Located at Naval Station San Diego, San Diego Bay, San Diego County (tentative Order No. R9-2003-0265, NPDES Permit No. CA0107867) *(Paul Richter)*	Approved Order No. R9-2003-0265.

NON-CONSENT ITEMS (Con't.)	REGIONAL BOARD ACTIONS
Settlement of Potential liability against Shea Homes for violation of SWRCB Order No. 99-08-DWQ, Waste Discharge Requirements for discharges of storm water runoff associated with the Kelly Core construction site located at Cannon Road and Faraday Avenue, Carlsbad in San Diego County. (Tentative Resolution No. R9-2003-0253) *(Vicente Rodriguez)*	Adopted Resolution No. R9-2003-0253 with errata.
PUBLIC HEARING: Administrative Assessment of Civil Liability against Pioneer Builders for violations of the State Board's General Construction Storm Water Permit Order No. 99-08-DWQ, San Diego Region Basin Plan, and Cleanup and Abatement Order No. R9-2003-158 at the Castillo del Mar subdivision in Dana Point, California. (Tentative Order No. R9-2003-0301) *(Rebecca Stewart)*	The Hearing was closed. The Board recommended exploring settlement opportunities with the discharger.
POSTPONED ITEMS	
PUBLIC HEARING: Administrative Assessment of Civil Liability against Ashby USA for violations of the State Board's General Construction Storm Water Permit Order No. 99-08-DWQ at its Roripaugh Ranch construction site in Temecula, California. (Tentative Order No. R9-2003-0302) *(Rebecca Stewart)*	This item was postponed.
PUBLIC HEARING: Administrative Assessment for Civil Liability against Richmond American Homes for failure to pay annual fees for enrollment in the State Board's General Construction Storm Water Permit No. 99-08-DWQ in violation of California Water Code section 13260 for the sites listed below. If the discharger elects to waive their right to a hearing, the matter will be rescheduled to allow for a 30-day public review period at which time the Regional Board will consider assessment of civil liability. *(Vicente Rodriguez)*	This item was postponed.

POSTPONED ITEMS (Con't.)	REGIONAL BOARD ACTIONS
a. Sunbow Phase 2A/B in Temecula (tentative Order No. R9-2003-0287) b. Barcelona Classics in Wildomar (tentative Order No. R9-2003-0288) c. San Marcos site (tentative Order No. R9-2003-0289) d. Tract No. 28753 Rancho Bella Vista in Temecula (tentative Order No. R9-2003-0290) e, Portion of Murietta Hotsprings in Temecula (tentative Order No. R9-2003-0292) f. Richmond American in Rancho Bernardo (tentative Order No. R9-2003-0293)	
Waste Discharge Requirements: California Dept. of Parks and Recreation, Crystal Cove State Park, El Morro Trailer Park, Orange County (tentative Order No. R9-2003-0228) *(Victor Vasquez)*	This item was postponed.
PUBLIC HEARING: Cease and Desist Order, California Dept. of Parks and Recreation, Crystal Cove State Park, El Morro Trailer Park, Orange County (tentative Order No. R9-2003-0285) *(Victor Vasquez)*	This item was postponed.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

9174 Sky Park Court, Suite 100
San Diego, California 92123

Information: (858) 467-2952
CALNET: (8) 734-2952

BOARD MEMBERS	CITY OF RESIDENCE	APPOINTMENT CATEGORY
John Minan - Chair	San Diego	Water Quality
Gary Stephany - Vice Chair	San Diego	Undesignated (Public)
Janet Keller	Laguna Beach	Recreation/Wildlife
Terese Ghio	Poway	Industrial Water Use
Richard Wright	Jamul	County Government
Vickie Butcher	El Cajon	Water Supply
Eric Anderson	Escondido	Irrigated Agriculture
Vacant		Water Quality
Vacant		Municipal Government

Executive Staff
John H. Robertus, *Executive Officer*
Arthur L. Coe, *Assistant Executive Officer*
Lori Costa, *Executive Assistant*

State Board Staff Counsel
John Richards

State Board Member Liaison
Peter Silva

WATERSHED BRANCH
Michael McCann, *Supervising Engineer*

Watershed Protection Northern Region
Robert Morris, *Sr. Water Resource Control Engineer*
Megan Quigley, *Environmental Scientist-C*
Jeremy Haas, *Environmental Scientist-C*
Christopher Means, *Environmental Scientist-B*
Eric Becker, *Water Resource Control Engineer-C*

Watershed Protection Southern Region
Stacey Baczkowski, *Senior Environmental Scientist*
Kristin Schwall, *Water Resource Control Engr-D*
Dat Quach, *Water Resource Control Engr-D*
Phil Hammer, *Environmental Scientist-C*
Michael Porter, *Environmental Scientist-C*
Benjamin Tobler, *Water Resource Control Engr-C*
Ben Neill, *Water Resource Control Engineer-A*

Compliance Assurance
Mark Alpert, *Senior Engineering Geologist*
Frank Melbourn, *Water Resource Control Engr-D*
Vicente Rodriguez, *Water Resource Control Engr-C*
Rebecca Stewart, *Sanitary Engineering Associate*

Grants & Projects Assistance Unit
David Gibson, *Senior Environmental Scientist* (Acting)
Deborah Woodward, *Environmental Scientist-C*

Publicly Owned Treatment Works Compliance
Brian Kelley, *Senior WRC Engineer*
Chiara Clemente, *Environmental Scientist-C*
Victor Vasquez, *Water Resource Control Engr-C*
David Hanson, *Water Resource Control Engr-D*
Bryan Ott, *Water Resource Control Engineer-B*

Industrial Compliance
John Phillips, *Senior WRC Engineer*
Paul Richter, *Water Resource Control Engr-D*
Hashim Navrozali, *Water Resource Control Engr-C*
Chehreh Komeylyan, *Water Resource Control Engr-C*
Sabine Knedlik, *Water Resource Control Engr-A*
Anthony Felix, *Water Resource Control Engr-A*
Whitney Ghoram, *Sanitary Engineering Associate*
Gloria Fulton, *Sanitary Engineering Associate*

Marine Waters
Peter Michael, *Staff Environmental Scientist*

Watershed Management Coordinator
Bruce Posthumus, *Senior WRC Engineer*

WATER RESOURCE PROTECTION BRANCH
David Barker, *Supervising Engineer*

Land Discharge Unit
John Odermatt, *Senior Engineering Geologist*
Carol Tamaki, *Water Resource Control Engr-D*
Brian McDaniel, *Engineering Geologist-D*
Amy Grove, *Engineering Geologist-C*

Site Mitigation & Cleanup Unit
John Anderson, *Senior Engineering Geologist*
Charles Cheng, *Engineering Geologist-D*
Beatrice Griffey, *Engineering Geologist-D*
Peter Peuron, *Environmental Scientist-C*
Laurie Walsh, *Water Resource Control Engr-C*

<u>Tank Site Mitigation & Cleanup Unit</u>
Julie Chan, *Senior Engineering Geologist*
Sue Pease, *Environmental Scientist-C*
Barry Pulver, *Engineering Geologist-D*
Jody Ebsen, *Engineering Geologist-B*
Kelly Dorsey, *Engineering Geologist-C*

<u>Water Quality Standards Unit</u>
Deborah Jayne, *Senior Environmental Scientist*
Linda Pardy, *Environmental Scientist-C*
Lesley Dobalian, *Environmental Scientist-B*
James Smith, *Environmental Scientist-B*
Christina Arias, *Water Resource Control Engr-B*

<u>Pollutant Load Reduction Program</u>
Craig Carlisle, *Senior Engineering Geologist*
Alan Monji, *Environmental Scientist-C*
Lisa Brown, *Environmental Scientist-C*
Tom Alo, *Water Resource Control Engr-C*
Brennan Ott, *Water Resource Control Engr-B*

<u>Information Systems Management</u>
Bob Rossi, *Staff Information Systems Analyst*

<u>Business Support Services Unit</u>
DiAnne Broussard, *Regional Administrative Officer II*

Information Management
Rina Dalyot, *Information Systems Technician*
Denise Rhaney, *Information Systems Technician*
Michael Gallina, *Office Assistant*

Administrative Support Services
Equilla Harris, *Staff Services Analyst*
Denise Smith, *Office Technician*
Sylvia Wellnitz, *Office Technician*
Shane Landry, *Office Assistant*

Revised 7/03

STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

NO QUORUM

AGENDA

Keller
Minan
Anderson
Butcher-

Wednesday, September 10, 2003
9:00 a.m.

Water Quality Control Board
Regional Board Meeting Room
9174 Sky Park Court
San Diego, California

The Regional Board requests that all lengthy comments be submitted in writing in advance of the meeting date. To ensure that the Regional Board has the opportunity to fully study and consider written material, comments should be received in the Regional Board's office no later than 5:00 P.M. on Wednesday, August 27, 2003, and should indicate the agenda item to which it is applicable. If the submitted written material is more than 5 pages or contains foldouts, color graphics, maps, etc., 20 copies must be submitted for distribution to the Regional Board members and staff. Written material submitted after 5:00 P.M. on Wednesday, September 3, 2003 will not be provided to the Regional Board members and will not be considered by the Regional Board. *PLEASE NOTE THAT SOME ITEMS ON THE AGENDA MAY HAVE BEEN PREVIOUSLY NOTICED WITH EARLIER DEADLINES FOR SUBMITTING WRITTEN COMMENTS. IN THOSE CASES THE EARLIER DEADLINES APPLY.*

Comments on agenda items will be accepted by E-mail subject to the same conditions set forth for other written submissions as long as the total submittal (including attachments) does not exceed five printed pages in length. E-mail should be submitted to: rbagenda@rb9.swrcb.ca.gov. Write the word "Agenda" in the subject line.

Pursuant to Title 23, California Code of Regulations, Section 648.2, the Regional Board may refuse to admit written testimony into evidence if it is not submitted to the Regional Board in a timely manner, unless the proponent can demonstrate why he or she was unable to submit the material on time or that compliance with the deadline would create an unreasonable hardship.

NOTE C, attached to this Notice, contains a description of the hearing procedures that will be followed by the Regional Board. Hearings before the Regional Board are normally conducted using procedures that do not include cross-examination. Parties requesting use of more formal procedures must do so in accord with the directions in NOTE C. Any such request, together with supporting material, must be received in the Regional Board's office no later than 5:00 P.M. on Wednesday, August 27, 2003.

Except for items designated as time certain, there are no set times for agenda items. Items may be taken out of order at the discretion of the Chairman.

1. Roll Call and Introductions

2. PUBLIC FORUM: Any person may address the Regional Board at this time regarding any matter within the jurisdiction of the Board which is not on the agenda. Submission of information in writing is encouraged. **Presentations will be limited to three minutes.**

3. Minutes of Board Meeting of August 13, 2003.

4. Chairman's, Board Members', State Board liaison's and Executive Officer's Reports: These items are for Board discussion only. No public testimony will be allowed, and the Board will take no formal action.

Consent Calendar: Items 5 through 9 are considered non-controversial issues. (NOTE: If there is public interest, concern or discussion regarding any consent calendar item or a request for a public hearing, then the item(s) will be removed from the consent calendar and considered after all other agenda items have been completed)

5. A Resolution requesting two hundred sixty thousand dollars from the State Water Resources Control Board's Cleanup and Abatement Account fund to assess atmospheric deposition, measure flow, and collect water quality data, perform modeling, and develop cleanup levels for the mouth of Chollas Creek in San Diego Bay. (Tentative Resolution No. R9-2003-0312) *(Brennan Ott)*

6. A Resolution requesting fifty four thousand dollars from the State Water Resources Control Board's Cleanup and Abatement Account fund to study marine sediment cleanup levels in San Diego Bay. (Tentative Resolution No. R9-2003-0315) *(Brennan Ott)*

7. Modification to Cease and Desist Order: California Department of Transportation, San Joaquin Hills Transportation Corridor (SR-73), Orange County, (revision to monitoring requirements) (Tentative Addendum No. 1 to Cease and Desist Order No. 2001-198) *(Christopher Means)*

8. Settlement of liability against Ryland Homes of California, Inc. for violation of Water Code sections 13376, 13267, and 13383 and SWRCB Order No. 99-08-DWQ, Waste Discharge Requirements for discharges of storm water runoff associated with construction activity, Serenada Development, Murrieta, Riverside County. The Regional Board will consider accepting a proposed settlement for the liability. If the Regional Board decides to reject the settlement, the matter will be rescheduled to a future public hearing at which time the Regional Board will consider assessment of civil liability. (Tentative Resolution No. R9-2003-0291) *(Frank Melbourn)*

9. Settlement of liability against Ashby Homes for violation of SWRCB Order No. 99-08-DWQ, Waste Discharge Requirements for discharges of storm water runoff associated with construction activity, Roripaugh Ranch construction site, Temecula, Riverside County. The Regional Board will consider accepting a proposed settlement for the liability. If the Regional Board decides to reject the settlement, the matter will be rescheduled to a future public hearing at which time the Regional Board will consider assessment of civil liability. (Tentative Resolution No. R9-2003-0302) *(Rebecca Stewart)*

Remainder of the Agenda (Non-Consent Items):

10. Administrative Assessment of Civil Liability against Pioneer Builders for violations of the State Board's General Construction Storm Water Permit Order No. 99-08-DWQ, San Diego Region Basin Plan, and Cleanup and Abatement Order No. R9-2003-158 at the Castillo del Mar subdivision in Dana Point, California. If agreement on settlement of this matter is not reached prior to the meeting date the Regional Board may deliberate and decide on assessment of civil liability based on testimony from the August 13, 2003 hearing. *The Public Comment period is closed on this item.* (Tentative Order No. R9-2003-0301) *(Rebecca Stewart)*

11. Status Report: San Diego River Watershed *(Michael Porter)*

12. NPDES Permit Reissuance: Padre Dam Municipal Water District, Padre Dam Water Recycling Facility, Discharge to Sycamore Creek and the San Diego River, San Diego County (tentative Order No. R9-2003-0179, NPDES No. CA0107492) *(David Hanson)*

13. Status Report: Duke Energy South Bay LLC, a report on the studies being conducted to assess the impact of the intake structures and thermal discharge of the South Bay Power Plant on the biological resources and beneficial uses of south San Diego Bay. *(Hashim Navrozali)*

14. Status Report: The National Steel and Shipbuilding Company (NASSCO) and Southwest Marine, Inc. (Southwest Marine) contaminated sediment investigation in San Diego Bay. Note: *This is a status report. The Regional Board will not be making any decisions regarding this item. (Tom Alo)*

15. *Executive Session* - Discussion of Ongoing Litigation
The Regional Board may meet in closed session to discuss ongoing litigation for the following cases:

People of the State of California Ex Rel. the Regional Water Quality Control Board, San Diego Region v. Robert Ortega, an individual in his capacity as Acting Commissioner of the International Boundary and Water Commission, United States Section, et al.. United States District Court, Southern District of California, Case No. 01-CV-027BTM(JFS); violation of effluent limits in waste discharge requirements for the International Wastewater Treatment Plant contained in Order No. 96-50 (NPDES No. CA0108928) and of Cease and Desist Order No. 96-52; Referral Order No. 99-61; and the related "Surfrider" case:

Surfrider Foundation, San Diego Chapter v. Robert Ortega, et al., Case No. 99-CV-2441-BTM(JFS)

Rakhra Groups, Inc., v. San Diego Regional Water Quality Control Board Superior Court of California, San Diego County; Case No. GIC 776251 and Case No. GIC 786516

San Diego BayKeeper and Surfrider Foundation, San Diego Chapter v. City of San Diego; U.S. District Court, Southern District of California; Case No. 01-CV-0550-B (POR)

16. *Executive Session* - Consideration of Initiation of Litigation
The Regional Board may meet in closed session to consider initiating criminal prosecution against persons who are alleged to have violated the Porter-Cologne Water Quality Control or the federal Clean Water Act.

17. *Executive Session* - Discussion of Pending Litigation
The Regional Board may meet in closed session to discuss pending litigation.

18. *Executive Session* - Personnel
The Regional Board may meet in closed session to consider personnel matters involving exempt employees [Authorized under Government Code Section 11126(a)]

19. Arrangements for Next Meeting and Adjournment
Wednesday, November 12, 2003 - 9:00 a.m.
Water Quality Control Board
Regional Board Meeting Room
9174 Sky Park Court
San Diego, California

Notifications

A. On November 12, 2003, the Regional Board is scheduled to consider tentative Addendum No. 4 to Order No. 97-11: "General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Hazardous and Nonhazardous Waste Landfills". The tentative addendum will: a.) add the San Pasqual Burn Ash site to the General Order, and b) transfer responsibility for compliance with the Order to new dischargers identified for the Rainbow Canyon Landfill and the Naval Training Center Landfill (aka NTC/MCRD Landfill). *(Brian McDaniel)*

B. On July 23, 2003, the Executive Officer issued Addendum No. 4 to Cleanup and Abatement Order (CAO) No. 91-45. This addendum was issued to the Redevelopment Agency of San Diego, G.T.F. Properties and Shell Oil Company, Golden West Hotel and the Unocal Corporation, and Greyhound Lines, Incorporated and Transportation Leasing Company-Greyhound Maintenance Center (the dischargers named in the CAO for the downtown San Diego commingled plume). Addendum No. 4 rescinds the ground-water monitoring directives (directives 1, 4, and 7 of CAO No. 91-45, directives 2, 3, 4, and 5 of Addendum No. 1, directives 2(a) and (b) of Addendum No. 2, and directives 8(a) through (c), 9, and 10 of Addendum No. 3) and removes the dischargers who have completed all phases of corrective action from the order (Redevelopment Agency of San Diego, G.T.F. Properties and Shell Oil, Greyhound Lines and Transportation Leasing). *(Sue Pease)*

DIRECTIONS TO REGIONAL BOARD MEETING

Regional Water Quality Control Board
9174 Sky Park Court, Suite 100, San Diego

From Downtown:	I-15 north - take the Aero Drive exit - turn left (west). Proceed to the 3rd stoplight, which is Ruffin Road – turn right. Turn left on Sky Park Court (stoplight). Our building is located at the end of the court – veer to the right into the parking lot.
From the North:	I-15 south - take the Balboa Ave. exit - turn right (west). Proceed to the 2nd stoplight, which is Ruffin Road – turn left. Turn right on Sky Park Court (stoplight). Our building is located at the end of the court – veer to the right into the parking lot.

Agenda Notice for September 10, 2003

NOTES:

A. GENERAL STATEMENT

The primary duty of the Regional Board is to protect the quality of the waters within the region for all beneficial uses. This duty is implemented by formulation and adopting water quality plans for specific ground or surface water basins and by prescribing and enforcing requirements on all domestic and industrial waste discharges. Responsibilities and procedures of the Regional Water Quality Control Board come from the State's Porter-Cologne Water Quality Act and the Nation's Clean Water Act.

The purpose of the meeting is for the Board to obtain testimony and information from concerned and affected parties and make decisions after considering the recommendations made by the Executive Officer.

B. CONSENT CALENDAR

All the items appearing under the heading "Consent Calendar" will be acted upon by the Board by one motion without discussion, provided that any Board member or other person may request that any item be considered separately and it will then be taken up at a time as determined by the Chairman.

Any person may request a hearing on an item on the Consent Calendar. If a hearing is requested, the item will be withdrawn and the hearing will be held at the end of the regular agenda.

C. HEARING PROCEDURES

Hearings before the San Diego Regional Board are not conducted pursuant to Chapter 5 of the California Administrative Procedure Act, commencing with Section 11500 of the Government Code. Regulations governing the procedures of the regional boards are codified in Chapter 1.5, commencing with Section 647, of the State Water Resources Control Board regulations in Division 3 of Title 23 of the California Code of Regulations.

Testimony and comments presented at hearings need not conform to the technical rules of evidence provided that the testimony and comments are reasonably relevant to the issues before the Board. Testimony or comments that are not reasonably relevant, or that are repetitious, will be excluded. Cross-examination may be allowed by the Chairman as necessary for the Board to evaluate the credibility of factual evidence or the opinions of experts. Video taped testimony by witnesses who are not present at the hearing will not be accepted unless such testimony was subject to cross-examination by all designated parties[1].

Pursuant to Government Code § 11445.20, the Board will use an informal hearing procedure, which does not include the right of cross-examination. Failure to make a timely objection to the use of an informal procedure, in accord with the directions below, will constitute consent to the informal hearing (See Title 23, California Code of Regulations, Section 648.7). Even with a timely objection, an informal procedure may be used under the circumstances identified in Government Code § 11445.20 (a) (b) or (d).

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[1] This does not preclude the use of videotape to present graphic images, provided that the person who took the videotape is available for questioning; this is intended to apply to spoken testimony of witnesses who are not available for cross-examination at the hearing.

For formal hearings, designated parties must submit witness testimony prior to the hearing date. During the formal hearing, witnesses will be allowed a limited time to orally summarize the pertinent points of their testimony. Designated parties requesting a formal hearing must submit 20 copies of the following information to the Regional Board. This information must be received in the Regional Board's Office by the date indicated on the first page of this Agenda Notice for the submission of a request for formal hearing:

- Witness testimony;
- The name of each proposed witness and the order in which witnesses will be called;
- A description/summary of what each witness' testimony is intended to prove; and,
- Identification of material factual issues in the dispute.

When a hearing is conducted using formal procedures, participants will be determined to be either "designated parties" or other "interested persons". Only designated parties will have the right to cross-examine witnesses. Interested persons do not have a right to cross-examination, but may ask the Regional Board to clarify testimony.

Designated parties automatically include the Regional Board and any person to whom an order is addressed (i.e., the Discharger(s)). All other persons wishing to testify or provide comments at a formal hearing are interested persons. An interested person may request status as a designated party for purposes of the formal hearing. A request must be received in the Regional Board's Office by the date indicated on the first page of this Agenda Notice for the submission of a request for formal hearing. The request must explain the basis for status as a designated party and, in particular, how the person is directly affected by the possible actions of the Regional Board.

For any hearing (formal or informal) the Chair will allocate time for each party to present testimony and comments and to question other parties if appropriate. Interested parties will generally be given 3 minutes for their comments. Where speakers can be grouped by affiliation or interest, such groups will be asked to select a spokesperson. The Chair may allocate additional time for rebuttal or for a closing statement. Time may be limited due to the number of persons wishing to speak on an item, or the number of items on the Board's agenda, or for other reasons.

All persons testifying must state their name, address, affiliation, and whether they have taken the oath before testifying. The order of testimony for hearings generally will be as follows, unless modified by the Regional Board Chair:

- Testimony* of Regional Board staff
- Testimony* of discharger
- Testimony* of other designated parties
- Testimony* of interested persons
- Closing statement by designated parties other than discharger
- Closing statement by discharger
- Closing statement by staff
- Recommendation by Executive Officer (as appropriate)
- Close public hearing
- Deliberation and voting by Regional Board

  *includes cross examination if formal hearing

Closing statements shall be for the purpose of summarization and rebuttal, and are not to be used to introduce new evidence or testimony, or to restate direct testimony. After considering evidence, testimony, and comments, the Regional Board may choose to adopt an order regarding a proposed agenda item. All Regional Board files, exhibits, and agenda material pertaining to items on the agenda are made a part of the record. Persons wishing to introduce item exhibits (i.e., maps, charts, photographs) must leave them with the Regional Board's Executive Assistant and must provide sufficient copies for distribution to the Regional Board, designated parties, and interested persons. Photographs or slides of large exhibits are acceptable.

D. CONTRIBUTIONS TO REGIONAL BOARD MEMBERS

Persons applying for or actively supporting or opposing waste discharge requirements or other Regional Board orders must comply with legal requirements if they or their agents have contributed or proposed to contribute $250 or more to the campaign of a Regional Board member for elected office. Contact the Regional Board for details if you fall into this category.

E. PROCEDURAL INFORMATION

The Regional Board may meet in closed session to deliberate on a decision to be reached based upon evidence introduced in an adjudicatory hearing [Authority: Government Code 11126(d)]; or to consider the appointment, employment or dismissal of a public employee to hear complaints or charges brought against a public employee [Authority: Government Code Section 11126(a)].

The Regional Board may break for lunch at approximately noon at the discretion of the Chairman. During the lunch break Regional Board members may have lunch together. Regional Board business will not be discussed.

Agenda items are subject to postponement. A listing of postponed items will be posted in the meeting room. You may contact the designated staff contact person in advance of the meeting day for information on the status of any agenda item.

Speaker Cards. All persons desiring to address the Regional Board are required to fill out a speaker card. Cards are normally provided near the entrance to the meeting room. Regional Board staff can assist you in locating the cards.

Please fill out a separate card for each item you plan to speak on. All relevant sections, including the oath, must be completed. Please use the appropriate color card, as indicated below:

Blue: Public Comments (for items requiring no Regional Board action - Public Forum, status reports, etc.).
Green: Public Testimony, in support of the tentative action.
Pink: Public Testimony, opposed to the tentative action.

F. AVAILABILITY OF EXECUTIVE OFFICER'S REPORT AND AGENDA MATERIAL

Visit our website at www.swrcb.ca.gov/rwqcb9 to view the Executive Officer's Report over the internet two days prior to the Regional Board meeting. A copy can also be obtained by contacting the staff office. A limited number of copies are available at the meeting.

Details concerning other agenda items are available for public reference during normal working hours at the Regional Board's office. The appropriate staff contact person, indicated with the specific agenda item, can answer questions and provide additional information. For additional information about the Board, please see the attached sheet.

G. PETITION OF REGIONAL BOARD ACTION

Any person affected adversely by a decision of the California Regional Water Quality Control Board, San Diego Region (Regional Board) may petition the State Water Resources Control Board (State Board) to review the decision. The petition must be received by the State Board within 30 days of the Regional Board's meeting at which the adverse action was taken. Copies of the law and regulations applicable to filing petitions will be provided upon request.

NOTE: If the State Board accepts a petition for review, the Regional Board will be required to file the record in the matter with the State Board. The costs of preparing and filing the record are the responsibility of the person(s) submitting the petition. The Regional Board will contact the person(s) submitting a petition and inform them of the payment process and any amounts due.

H. HEARING RECORD

Material presented to the Board as part of testimony (e.g. photographs, slides, charts, diagrams etc.) that is to be made part of the record must be left with the Board. Photographs or slides of large exhibits are acceptable.

All Board files, exhibits, and agenda material pertaining to items on this agenda are hereby made a part of the record.

I. ACCESSIBILITY

The facility is accessible to people with disabilities. Individuals who have special accommodation or language needs, please contact Ms. Lori Costa at (858) 467-2357 or costl@rb9.swrcb.ca.gov at least 5 working days prior to the meeting. TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.

J. PRESENTATION EQUIPMENT

Providing and operating projectors and other presentation aids are the responsibilities of the speakers. Some equipment may be available at the Board Meeting; however, the type of equipment available will vary dependent on the meeting location. Because of compatibility issues, provision and operation of laptop computers and projectors for Power Point presentations will generally be the responsibility of the individual speakers. To ascertain the availability of presentation equipment please contact Ms. Lori Costa at (858) 467-2357 or costl@rb9.swrcb.ca.gov at least 5 working days prior to the meeting.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
Summary of Board Actions and Proceedings
at the August 13, 2003 Board Meeting

MINUTES	REGIONAL BOARD ACTIONS
Minutes of Board Meeting of June 11, 2003.	Approved minutes.
CONSENT ITEMS	
Modification to Waste Discharge Requirements: Frank and Janice Mendenhall, Lake Henshaw Resort, Inc., San Diego County (change in owner) (tentative Addendum No. 3 to Order No. 94-03) *(Christopher Means)*	Approved Addendum No. 3 to Order No. 94-03.
Modification to Waste Discharge Requirements: Mr. Charles J. Williams, Champagne Lakes RV Resort, San Diego County (change in owner) (tentative Addendum No. 1 to Order No. 94-21) *(Christopher Means)*	Approved Addendum No. 1 to Order No. 94-21.
Modification to Waste Discharge Requirements: Northrop Grumman Space Technology and Mission Systems Corporation, Capistrano Test Site, Orange County (change in owner) (tentative Addendum No. 1 to Order No. 94-78) *(Jeremy Haas)*	Approved Addendum No. 1 to Order No. 94-78.
Modification to Waste Discharge Requirements: Vail Lake Village & Resort LLC; Mr. Bill Johnson, Vail Lake Village & Resort, Riverside County (change in owner and facility name) (tentative Addendum No. 3 to Order No. 88-44) *(Eric Becker)*	Approved Addendum No. 3 to Order No. 88-44.
Waste Discharge Requirements Update: Production and Purveyance of Recycled Water, City of San Clemente Water Reclamation Plant, Orange County (tentative Order No. R9-2003-0123) *(Bryan Ott)*	Approved Order No. R9-2003-0123.
NPDES Permit Revision: Adding the San Diego County Regional Airport Authority as a Copermittee to the San Diego County MS4 Storm Water Permit (Tentative Addendum No. 1 to Order No. 2001-01) *(Phil Hammer)*	Approved Addendum No. 1 to Order No. 2001-01.

CONSENT ITEMS (Con't.)	REGIONAL BOARD ACTIONS
Administrative Assessment of Civil Liability with Mandatory Minimum Penalties against the City of San Diego for violation of effluent limits established by Order Nos. 95-25 and 2000-90, for a permanent groundwater discharge to San Diego Bay from the San Diego Convention Center. (Tentative Order No. R9-2003-0286) *(Rebecca Stewart)*	Affirmed Order No. R9-2003-0286.
Administrative Assessment of Civil Liability with Mandatory Minimum Penalty against the South Orange County Wastewater Authority for violation of effluent limitations established by Order No. R9-2000-0013 (NPDES No. CA0107417), for the discharge of treated wastewater to the Pacific Ocean through the San Juan Creek Ocean Outfall. (Tentative Order No. R9-2003-0304) *(David Hanson)*	Affirmed Order No. R9-2003-0304.
NON-CONSENT ITEMS	
NPDES Permit: U.S. Marine Corps Base Camp Pendleton, Wastewater Treatment Plant Nos. 1, 2, 3 & 13, Discharge to the Pacific Ocean via the Oceanside Ocean Outfall, San Diego County (tentative Order No. R9-2003-0155, NPDES Permit No. CA0109347) *(Chiara Clemente)*	Approved Order No. R9-2003-0155.
NPDES Permit: Waste Discharge Requirements for IDEC Pharmaceuticals Corporation New IDEC Manufacturing Operations (NIMO), Oceanside, San Diego County (tentative Order No. R9-2003-0140, NPDES Permit No. CA0109193) *(Hashim Navrozali)*	Approved Order No. R9-2003-0140 with errata.
NPDES Permit Renewal: Waste Discharge Requirements for U.S. Navy Graving Dock Located at Naval Station San Diego, San Diego Bay, San Diego County (tentative Order No. R9-2003-0265, NPDES Permit No. CA0107867) *(Paul Richter)*	Approved Order No. R9-2003-0265.

NON-CONSENT ITEMS (Con't.)	REGIONAL BOARD ACTIONS
Settlement of Potential liability against Shea Homes for violation of SWRCB Order No. 99-08-DWQ, Waste Discharge Requirements for discharges of storm water runoff associated with the Kelly Core construction site located at Cannon Road and Faraday Avenue, Carlsbad in San Diego County. (Tentative Resolution No. R9-2003-0253) *(Vicente Rodriguez)*	Adopted Resolution No. R9-2003-0253 with errata.
PUBLIC HEARING: Administrative Assessment of Civil Liability against Pioneer Builders for violations of the State Board's General Construction Storm Water Permit Order No. 99-08-DWQ, San Diego Region Basin Plan, and Cleanup and Abatement Order No. R9-2003-158 at the Castillo del Mar subdivision in Dana Point, California. (Tentative Order No. R9-2003-0301) *(Rebecca Stewart)*	The Hearing was closed. The Board recommended exploring settlement opportunities with the discharger.
POSTPONED ITEMS	
PUBLIC HEARING: Administrative Assessment of Civil Liability against Ashby USA for violations of the State Board's General Construction Storm Water Permit Order No. 99-08-DWQ at its Roripaugh Ranch construction site in Temecula, California. (Tentative Order No. R9-2003-0302) *(Rebecca Stewart)*	This item was postponed.
PUBLIC HEARING: Administrative Assessment for Civil Liability against Richmond American Homes for failure to pay annual fees for enrollment in the State Board's General Construction Storm Water Permit No. 99-08-DWQ in violation of California Water Code section 13260 for the sites listed below. If the discharger elects to waive their right to a hearing, the matter will be rescheduled to allow for a 30-day public review period at which time the Regional Board will consider assessment of civil liability. *(Vicente Rodriguez)*	This item was postponed.

POSTPONED ITEMS (Con't.)	REGIONAL BOARD ACTIONS
a. Sunbow Phase 2A/B in Temecula (tentative Order No. R9-2003-0287) b. Barcelona Classics in Wildomar (tentative Order No. R9-2003-0288) c. San Marcos site (tentative Order No. R9-2003-0289) d. Tract No. 28753 Rancho Bella Vista in Temecula (tentative Order No. R9-2003-0290) e, Portion of Murietta Hotsprings in Temecula (tentative Order No. R9-2003-0292) f. Richmond American in Rancho Bernardo (tentative Order No. R9-2003-0293)	
Waste Discharge Requirements: California Dept. of Parks and Recreation, Crystal Cove State Park, El Morro Trailer Park, Orange County (tentative Order No. R9-2003-0228) *(Victor Vasquez)*	This item was postponed.
PUBLIC HEARING: Cease and Desist Order, California Dept. of Parks and Recreation, Crystal Cove State Park, El Morro Trailer Park, Orange County (tentative Order No. R9-2003-0285) *(Victor Vasquez)*	This item was postponed.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

9174 Sky Park Court, Suite 100
San Diego, California 92123

Information: (858) 467-2952
CALNET: (8) 734-2952

Tank Site Mitigation & Cleanup Unit
Julie Chan, *Senior Engineering Geologist*
Sue Pease, *Environmental Scientist-C*
Barry Pulver, *Engineering Geologist-D*
Jody Ebsen, *Engineering Geologist-B*
Kelly Dorsey, *Engineering Geologist-C*

Water Quality Standards Unit
Deborah Jayne, *Senior Environmental Scientist*
Linda Pardy, *Environmental Scientist-C*
Lesley Dobalian, *Environmental Scientist-B*
James Smith, *Environmental Scientist-B*
Christina Arias, *Water Resource Control Engr-B*

Pollutant Load Reduction Program
Craig Carlisle, *Senior Engineering Geologist*
Alan Monji, *Environmental Scientist-C*
Lisa Brown, *Environmental Scientist-C*
Tom Alo, *Water Resource Control Engr-C*
Brennan Ott, *Water Resource Control Engr-B*

Information Systems Management
Bob Rossi, *Staff Information Systems Analyst*

Business Support Services Unit
DiAnne Broussard, *Regional Administrative Officer II*

Information Management
Rina Dalyot, *Information Systems Technician*
Denise Rhaney, *Information Systems Technician*
Michael Gallina, *Office Assistant*

Administrative Support Services
Equilla Harris, *Staff Services Analyst*
Denise Smith, *Office Technician*
Sylvia Wellnitz, *Office Technician*
Shane Landry, *Office Assistant*

Revised 7/03

Internet Address: http://www.swrcb.ca.gov/rwqcb9
9174 Sky Park Court, Suite 100, San Diego, California 92123
Phone (858) 467-2952 • FAX (858) 571-6972

REC'D OCT 09 2003

October 7, 2003

Ms. Laura Hunter
Environmental Health Coalition
1717 Kettner Boulevard, #100
San Diego, CA 92101

Mr. Bruce Reznik
San Diego Baykeeper
2924 Emerson Street, Suite 220
San Diego, CA 92106

Mr. Ed Kimura
Sierra Club
3820 Ray Street
San Diego, CA 92104

Mr. Jim Peugh
San Diego Audubon Society
2776 Nipoma Street
San Diego, CA 92106

Mr. Marco Gonzalez
Surfrider Foundation - San Diego Chapter
P.O. Box 1511
Solana Beach, CA 92075

Dear Ms. Hunter and Messrs. Reznik, Kimura, Peugh, and Gonzalez:

REGIONAL BOARD DETAILED RESPONSES TO SAN DIEGO BAY COUNCIL'S MAY 5, 2003 AND AUGUST 12, 2003 LETTERS COMMENTING ON THE SELECTION OF REFERENCE STATIONS FOR THE NASSCO, SOUTHWEST MARINE, MOUTH OF CHOLLAS CREEK, AND 7TH STREET CHANNEL SEDIMENT INVESTIGATIONS

The Regional Board received your written comments dated May 5, 2003 and August 12, 2003 regarding the Regional Board's selection of reference stations for the National Steel and Shipbuilding Company (NASSCO), Southwest Marine, Inc. (Southwest Marine), Mouth of Chollas Creek, and 7th Street Channel sediment investigations. We appreciate the time and effort San Diego Bay Council has taken to provide us with views on the reference station issue.

We provided an initial response in a letter dated September 5, 2003 (Attachment A). My staff has spent a considerable amount of time reviewing your comments in detail. Prior to finalizing the reference pool we carefully considered your input, including that provided in your letter dated May 5, 2003. The Regional Board's decision on a final reference pool is provided in Attachment B as emailed to you on June 9, 2003. Staff's detailed written responses to your May 5 and August 12 letters are provided in Attachment C.

Should you have any questions, or require additional information, please contact either Mr. Tom Alo of my staff at (858) 636-3154 or Mr. Craig Carlisle of my staff at (858) 637-7119.

Sincerely,

JOHN H. ROBERTUS
Executive Officer

JHR:dtb:clc:tca

Attachments: A. Regional Board Response to Comment Letters from San Diego Bay Council Regarding the Selection of Reference Stations for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel Sediment Investigations (September 5, 2003)

B. Regional Board Decision on Final Reference Pool

C. Regional Board Detailed Responses to San Diego Bay Council's May 5, 2003 and August 12, 2003 Letters

cc: Elaine Carlin, Representative for San Diego Bay Council
Mike Chee, NASSCO
Shaun Halvax, Southwest Marine
Dreas Nielsen, Exponent
Michael Martin, CA Department of Fish and Game
Scott Sobiech, U.S. Fish and Wildlife
Denise Klimas, National Oceanic and Atmospheric Administration
Donald MacDonald, National Oceanic and Atmospheric Administration
Steve Bay, Southern California Coastal Water Research Project
Bart Chadwick, SPAWAR Systems Center San Diego
Chuck Katz, SPAWAR Systems Center San Diego
Brian Anderson, UC Davis – Marine Pollution Studies Laboratory
John Hunt, UC Davis – Marine Pollution Studies Laboratory
Russell Fairey, San Jose State University – Moss Landing Marine Laboratories

ATTACHMENT A

Regional Board Response to Comment Letters from San Diego Bay Council Regarding the Selection of Reference Stations for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel Sediment Investigations (September 5, 2003)

September 5, 2003

Ms. Laura Hunter
Environmental Health Coalition
1717 Kettner Boulevard, #100
San Diego, CA 92101

Mr. Bruce Reznik
San Diego Baykeeper
2924 Emerson Street, Suite 220
San Diego, CA 92106

Mr. Ed Kimura
Sierra Club
3820 Ray Street
San Diego, CA 92104

Mr. Jim Peugh
San Diego Audubon Society
2776 Nipoma Street
San Diego, CA 92106

Mr. Marco Gonzalez
Surfrider Foundation - San Diego Chapter
P.O. Box 1511
Solana Beach, CA 92075

Dear Ms. Hunter and Messrs. Reznik, Kimura, Peugh, and Gonzalez:

REGIONAL BOARD RESPONSE TO COMMENT LETTERS FROM SAN DIEGO BAY COUNCIL REGARDING THE SELECTION OF REFERENCE STATIONS FOR THE NASSCO, SOUTHWEST MARINE, MOUTH OF CHOLLAS CREEK, AND 7TH STREET CHANNEL SEDIMENT INVESTIGATIONS

This is in response to the San Diego Bay Council's letters of May 5, 2003 and August 12, 2003 regarding the Regional Board's final selection of reference stations for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel sediment investigations. We were in the process of finalizing our response to your May 5, 2003 letters when we received your August 12 letter. I elected to delay our original response to your May 5 letter in order to address all of your concerns with the reference stations from both of your letters. We are now drafting detailed written response to both your May 5, 2003 and August 12, 2003 letters, and will issue those responses under separate cover in the near future.

As you know the Regional Board has been considering for some time how to deal with the reference pool issue. I appreciate the time and effort the San Diego Bay Council has taken to provide the Regional Board with comments and perspective on selecting appropriate reference stations for inclusion in the reference pool. I do not agree with your characterization of the Regional Board's selected reference pool, your critique of the decision making process, your

recommendation that the Board use the reference pool favored by San Diego Bay Council, and in particular your comments that my staff excluded you from critical deliberations on the reference pool.

In our deliberations on this issue we have considered a significant amount of information and comment from all stakeholders, including San Diego Bay Council, regarding the NASSCO, Southwest Marine, Chollas Creek and Seventh Street Channel contaminated marine sediment investigations. We have also consulted with a number of recognized technical experts in the sediment quality assessment field. At the conclusion of a final extensive two day January 22-23, 2003 technical meeting on the reference pool issue (attended by technical experts, the Natural Resource Trustee Agencies, NASSCO, Southwest Marine, the Navy, and the Bay Council) David Barker of my staff announced that it was the Regional Board's intent to consider all of the information and perspectives presented by the stakeholders and make a decision on the reference pool.

The staff spent a considerable amount of time following the January meetings, pouring over the data and evaluating various reference pool options favored by different stakeholders, including San Diego Bay Council, from a number of different perspectives. We think we arrived at a decision on a suitable reference pool that will provide a sound scientific basis for developing protective cleanup levels. On June 9, 2003 we informed you of our decision on the reference station pool and our intent to direct NASSCO and Southwest Marineto move forward with finalizing the technical report using that reference station pool.

In June 2003 my staff instructed NASSCO and Southwest Marine to proceed with completing their technical report on the sediment quality investigation using the reference pool selected by my staff. NASSCO and Southwest Marine are well into preparing the report and it is due to be submitted in approximately two weeks on September 30, 2003. I cannot support delaying the submission of this report and further delaying a Regional Board decision on cleanup in order to continue the debate on the relative technical merits of alternative reference station pool approaches.

I think we are at the point where it would be useful to apply the Regional Board's reference pool and appropriate statistical procedures to the NASSCO and Southwest Marine sediment site data and see what the various cleanup scenarios are. There is lot of good solid information that has been collected on multiple lines of evidence on this project. Therefore I am anticipating that there will be sufficient information in the technical report to ensure that the Regional Board will be able to evaluate options and make a cleanup decision that is protective of beneficial uses. Staff resource considerations and competing work on other priority projects are also pressing issues for us.

At this juncture I believe that the efficacious course for the Regional Board to conclude the investigation and determine cleanup levels is to obtain the technical report from NASSCO and Southwest Marine on September 30, 2003. The technical report will be available for public review upon our receipt of the document. My staff will review the report to determine its adequacy to develop appropriate cleanup levels and has tentatively scheduled the Regional Board's consideration of cleanup and abatement orders for NASSCO and Southwest Marine at the February 2004 Regional Board meeting. The Regional Board will provide ample opportunity for public comment on the cleanup and abatement orders, including the recommended cleanup levels as well as the reference station pool used in deriving the cleanup levels, during the public review process for the cleanup and abatement orders.

Should you have any questions, or require additional information, please contact either Mr. Tom Alo of my staff at (858) 636-3154 or Mr. Craig Carlisle of my staff at (858) 637-7119.

Sincerely,

John H. Robertus

JOHN H. ROBERTUS
Executive Officer

ATTACHMENT B

Regional Board Decision on Final Reference Pool

Winston H. Hickox
Secretary for Environmental Protection

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Gray Davis
Governor

REGIONAL BOARD DECISION ON FINAL REFERENCE POOL

The goal of the sediment quality assessment at National Steel and Shipbuilding Company (NASSCO), Southwest Marine, Inc. (Southwest Marine), Mouth of Chollas Creek, and 7th Street Channel is to identify polluted marine sediment areas that may require cleanup in order to protect or restore beneficial uses. In accordance with State Water Resources Control Board – Resolution No. 92-49 (SWRCB, 1996), the Regional Board reference pool was selected to represent the pre-discharge condition at these sites (i.e., the current sediment quality condition absent these sites) and protection of aquatic life beneficial uses. The purpose of the reference pool is to determine if there are statistically significant differences between site sediment quality conditions (NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel) and reference sediment quality conditions with respect to sediment chemistry, toxicity, and benthic community structure. The results of the statistical comparisons will be used in a weight-of-evidence approach to determine whether site stations exhibit impacts to aquatic-life beneficial uses.

The Regional Board's decision on a reference pool for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel sediment investigations was provided to all stakeholders on June 9, 2003 (RWQCB, 2003a). The final reference pool, as shown below, is based on a modified version of Reference Pool #2b as proposed by SCCWRP, the Navy, and Exponent (Bay et. al., 2003). Reference Pool #2b was primarily developed based on the comments and decisions made by the stakeholders present at the January 22-23 technical meeting held at the Regional Board (details provided in Attachment C - Regional Board response to Comment #3 - Status of Tasks (May 5, 2003 Letter)). These comments and decisions were documented and subsequently used to guide SCCWRP, the Navy, and Exponent in developing Reference Pool #2b (RWQCB, 2003b).

Table 1. Regional Board Final Reference Pool.

2001 Chollas/Paleta (CP) Reference Station Data	2001 Shipyard (SY) Reference Station Data	1998 Bight'98 Station Data
2433	2441	2231
2238*	2433	2233
	2243*	2238
		2240
		2241
		2242
		2243
		2244
		2247
		2252
		2256
		2257
		2265
		2433
		2435
		2436
		2440

* The benthic community data including the Benthic Response Index (BRI) scores for CP Station 2238 and SY Station 2243 should not be used in this final reference pool.

The Regional Board's modifications to Reference Pool #2b and rationale for selecting stations in the final reference pool are provided in Appendix 5 of Attachment C. In summary, the approach we used to modify Reference Pool #2b was based on weight of evidence using the triad approach and best professional judgement. The triad of data (sediment chemistry, amphipod toxicity, and benthic community) analyzed at each of the proposed reference stations included in Reference Pool #2b were evaluated and a decision was made whether to accept or reject the proposed station. The results of the final screening evaluation are provided in Appendix 6 of Attachment C.

REFERENCES

Bay, S., B. Chadwick, and D. Neilsen. 2003. Consensus Evaluation of Candidate Reference Sites for Use in Evaluating Data from the NASSCO/SWM Shipyard and Chollas/Paleta Creek THS Areas. Southern California Coastal Water Research Project, Westminster, CA, SPAWAR System Center, U.S. Navy, San Diego, CA, and Exponent, Bellevue, WA.

RWQCB. 2003a. Regional Board Final Position on a Reference Pool for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel Sediment Investigations. California Regional Water Quality Control Board, San Diego Region.

RWQCB. 2003b. Personal Communication (Email to S. Bay (SCCWRP), B. Chadwick (Navy) and D. Neilsen (Exponent)] regarding instructions to evaluate 4 candidate reference pools). California Regional Water Quality Control Board, San Diego Region.

SWRCB. 1996. Resolution 92-49: Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304. State Water Resources Control Board, Sacramento, CA.

ATTACHMENT C

Regional Board Detailed Responses to San Diego Bay Council's May 5, 2003 and August 12, 2003 Letters

California Regional Water Quality Control Board

San Diego Region

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Winston H. Hickox
Secretary for Environmental Protection

Gray Davis
Governor

REGIONAL BOARD RESPONSES TO SAN DIEGO BAY COUNCIL'S MAY 5, 2003 AND AUGUST 12, 2003 LETTERS

REGIONAL BOARD RESPONSES TO MAY 5, 2003 LETTER

1. EPA Definition of Reference Conditions and Reference Sites

Comment from San Diego Bay Council:
One of the most critical steps – and the step that has held up progress toward cleanup of San Diego Bay – is the *selection of reference sites* for the Bay that will establish background levels, and thus, determine how clean San Diego Bay will ever get. There are EPA guidelines for this process that are readily achievable in San Diego Bay. We wish to re-emphasize that these are widely accepted practices; the selection of reference sites is a relatively simple, straightforward exercise when executed properly. The real basis is simply common sense. Reference stations are those that represent relatively undisturbed conditions within the Bay or within a study area.

Regional Board Response:
The Regional Board recognizes that there are various documents (from EPA and the Department of Interior (DOI)) that provide definitions on reference conditions. The definitions provided in these documents have some similarities and some differences. In making our reference pool decision for the National Steel and Shipbuilding Company (NASSCO), Southwest Marine, Inc. (Southwest Marine), Mouth of Chollas Creek, and 7th Street Channel sediment investigations, the Regional Board managed to balance these differences by selecting reference stations based on the following key criteria:

- Located within San Diego Bay away from known point sources;
- Physical characteristics similar to study sites (sediment grain size, total organic carbon, and water depth);
- Level of sensitivity that separates the effects on organisms due to natural non-pollutant factors (e.g., grain size, unionized ammonia, and sulfides) from the effects due to pollutants.
- Protective of aquatic life beneficial uses (i.e., relatively low sediment chemistry, lack of acute toxicity, and relatively healthy benthic community); and
- Representative of the pre-discharge conditions at these sites.

In addition to the EPA document cited by Bay Council (U.S. EPA, 2000) there are several other EPA and DOI documents that provide definitions on reference conditions. Reference definitions from these other documents are provided below:

"The degree of sediment contamination in a particular area is often evaluated by comparing the structure of benthic communities, levels of pollutants, or bioassay test results in sediments collected from the area being investigated with those in the surrounding area. The terms used to describe the different sediments in the comparisons are test sediments, control sediments, and reference sediments. As used in sediment assays and assessments, a test sediment is sampled from the area whose quality is being assessed. A control sediment is a pristine (or nearly so) sediment, free from localized anthropogenic inputs of pollutants with contamination present only because of inputs from the global spread of pollutants. A reference sediment, on the other hand, is collected from a location that may contain low to moderate levels of pollutants resulting from both the global inputs and some localized anthropogenic sources, representing the background levels of pollutants in an area. The reference sediment is to be as similar as possible to the test sediments in grain size, total organic carbon (TOC), and other physical characteristics." (U.S. EPA, 1992)

"A general guideline is to select reference locations that reflect the overall environmental conditions that can reasonably be expected in the site area given current uses other than those associated with the contamination under investigation." (U.S. EPA, 1994)

"Baseline data should reflect conditions that would be expected at the assessment area had the discharge of oil or release of hazardous substances not occurred, taking into account both natural processes and those that are the result of human activities." (U.S. DOI, 1996)

"A relatively uncontaminated site used for comparison to contaminated sites in environmental monitoring studies ... Reference biological samples may be taken from a reference area outside the influence of the site ... The reference area should be close to the site. It should have habitats, size, and terrain similar to the site under investigation ... The reference site need not be pristine." (U.S. EPA, 1997)

"The reference area should have the same physical, chemical, geological, and biological characteristics as the site being investigated, but has not been affected by activities on the site." (U.S. EPA, 2002)

2. Bay Council Participation in Regional Board Workshops

Comment from San Diego Bay Council:
There have been at least two lengthy workshops held by staff to discuss the selection of reference sites, however, we have only been included in the second of these.

Regional Board Response:
The Regional Board has received and considered numerous comments from Bay Council regarding the suitability of the 5 reference stations originally selected for the shipyard sediment investigations. Consequently, the Regional Board decided to hold a meeting on December 12, 2002 to solicit the assistance of various technical experts to address and respond to Bay Council's concerns with the reference stations. The technical experts included representatives from the Department of Fish and Game (DFG), U.S. Fish and Wildlife (USFW), National Oceanic and Atmospheric Administration (NOAA), Southern California Coastal Water Research Project (SCCWRP), San Jose State University - Moss Landing Marine Laboratories (San Jose State), UC Davis - Marine Pollution Studies Laboratory (UC Davis), SPAWAR Systems Center – Marine Environmental Quality Branch (SPAWAR), and Exponent. Representatives from NASSCO and Southwest Marine shipyards were also present at the meeting to listen to the concerns raised on the 5 reference stations selected for their sediment investigations.

Bay Council was not included in this meeting because it was a "technical" meeting and not a "public" meeting. The purpose of the technical meeting was to allow Regional Board staff to consult with other technical experts regarding the selection of a suitable reference pool and the reference station concerns raised by Bay Council. It was always our intention to present the Regional Board's response to comments on the reference stations to Bay Council and others following the December 12 meeting. We were informed of Bay Council's desire to provide additional input to us on the reference stations rather than wait on our response to comments. As such, we invited Bay Council to attend the technical meeting on January 22-23, 2003.

3. Status of Tasks

Comment from San Diego Bay Council:
Our expectation was that these tasks would be carried out in a transparent manner with all participants informed, provided with the necessary data, and provided the opportunity to offer input. We are very unclear as to the status of these overarching tasks and are concerned that decisions are being made with discharger input but not with the other interests represented.

Regional Board Response:
The Regional Board disagrees with Bay Council that decisions are being made without input from other interested stakeholders. The Regional Board has followed a lengthy and open process in considering the views of all stakeholders on the reference station issue. We have included all key stakeholders in the reference pool decision process as evidenced by participation in the technical meetings we held on December 12, 2002 and January 22-23, 2003. We received a significant amount of input at these technical meetings from NASSCO and Southwest Marine as well as groups representing:

- the interests of the public (San Diego Bay Council);
- the protection and conservation of State and Federal natural resources (DFG, USFW, and NOAA); and
- the scientific community (SCCWRP, San Jose State, UC Davis, and SPAWAR).

We have also considered all additional stakeholder input provided via written comments and conference calls subsequent to the technical meetings.

Following these meetings, it remained for the Regional Board to decide on how to proceed forward in selecting the reference pool for the NASSCO, Southwest Marine, Chollas Creek and 7th Street Channel sediment investigations . We announced our intent to do that at the conclusion of the January 2003 meetings and took on that task using the weight-of-evidence tables (sediment chemistry and toxicity only) and criteria developed by all stakeholders present during the January meetings. Accordingly, the Regional Board decided to narrow the reference pool options to the four alternatives listed below. It should be noted that Reference Pools #1a and #1b are based on the weight-of-evidence tables and Reference Pools #2a and #2b are based on the criteria developed by the group to evaluate the suitability of the 2001 Shipyard (and Chollas/Paleta) reference stations.

(1) Reference Pool #1a - 6 Reference Stations from 2001 data

(2) Reference Pool #1b - Reference Pool #1a + 22 Bight'98 stations selected from the Distance-From-Shore approach (Appendix 3 of Attachment C)

(3) Reference Pool #2a - Reference Stations selected from the criteria established at the January 23 meeting

(4) Reference Pool #2b - Reference Pool #2a + 22 Bight'98 stations selected from the Distance-From-Shore approach

On February 3 we requested that SCCWRP, Navy, and Exponent calculate the descriptive statistics for each of these four candidate reference pools (Appendix 1 of Attachment C). We would like to clarify that the April 10, 2003 document produced by SCCWRP, Navy, and Exponent was developed in accordance with the instructions prepared by the Regional Board (Appendix 4 of Attachment C). Furthermore, the Regional Board instructions were prepared based on the comments received from the entire stakeholder group present at the January 22-23 meeting.

The Regional Board has gone to great lengths to afford an opportunity for all stakeholders to participate in the shipyard investigation decision making process. We have held numerous meetings and teleconferences with Bay Council, the Natural Resource Trustee Agencies, NASSCO, Southwest Marine, and other stakeholders to discuss concerns and technical issues associated with the investigation. At times we have had daylong meetings with Bay Council and others to ensure that all issues and input have been considered and discussed. The Regional Board has also provided detailed written responses to comments received from stakeholders such as the Bay Council regarding the shipyard investigation and has held several workshops to update the public including the Regional Board members on current sediment investigation and cleanup projects in San Diego Bay. A list of the key technical meetings, Regional Board written responses, and public workshops involving Bay Council is provided in Table 1 below.

Table 1. Regional Board's Commitment to Involve Bay Council in the Shipyard Sediment Investigation Process.

Type	Date	Purpose	Participants
Public Workshop	Aug 3, 2001	Public workshop held by the Regional Board to receive public comment on current sediment investigation and cleanup projects in San Diego Bay.	Public (including representatives from the **Bay Council**).
Meeting	Aug 14, 2001	Meeting with **Bay Council** to discuss technical issues identified by Bay Council on the Shipyard workplan.	Regional Board and **Bay Council**.
Meeting	Oct 12, 2001	Joint meeting to provide a forum for discussion and resolution of the technical issues raised by **Bay Council** on the Shipyard workplan.	Regional Board, **Bay Council**, NASSCO, Southwest Marine, Exponent, SCCWRP, and SPAWAR Systems Center – Marine Environmental Quality Branch (Navy).
Letter	Jan 15, 2002	Regional Board response to comments on 8/21/01 letter and 10/10/01 list of questions from **Bay Council** regarding the Shipyard sediment investigation workplan.	Not applicable.

Meeting	Jan 30, 2002	Formal presentation on the Phase 1 sampling results and receive comments.	Regional Board, **Bay Council**, Natural Resource Trustee Agencies, Exponent, NASSCO, Southwest Marine, SCCWRP, and Navy.
Meeting	Mar 29, 2002	Discuss issues raised in **Bay Council's** March 6, 2002 letter regarding the Shipyard sediment investigation.	Regional Board, **Bay Council**, Natural Resource Trustee Agencies, and SCCWRP.
Public Workshop	Jun 18, 2002	Update the Board Members and the public on current sediment investigation and cleanup projects in San Diego Bay. As part of the workshop agenda, **Bay Council** presented their opinions on the Shipyard investigation.	Regional Board members and the Public (including **Bay Council**.
Meeting	Aug 22, 2002	Formal presentation on the Shipyard draft Phase 2 workplan and receive comments.	Regional Board, **Bay Council**, Natural Resource Trustee Agencies, Exponent, NASSCO, and Southwest Marine.
Letter	Nov 14, 2002	Regional Board response to comments on 8/28/02 letter from **Bay Council** regarding the Shipyard draft Phase 2 field sampling plan.	Not applicable.
Meeting	Dec 12, 2002	Technical meeting to solicit the assistance of various technical experts to address and respond to **Bay Council's** reference station comments.	Regional Board, Natural Resource Trustee Agencies, SCCWRP, Moss Landing Marine Laboratories, UC Davis - Marine Pollution Studies Laboratory, SPAWAR Systems Center – Marine Environmental Quality Branch, Exponent, NASSCO, and Southwest Marine.

Meeting	Jan 22-23, 2003	Technical meeting to solicit the assistance of various technical experts to address and respond to **Bay Council's** reference station comments.	Regional Board, **Bay Council**, Natural Resource Trustee Agencies, SCCWRP, UC Davis - Marine Pollution Studies Laboratory, SPAWAR Systems Center – Marine Environmental Quality Branch, Exponent, NASSCO, and Southwest Marine.
Meeting	Jul 31, 2003	Meeting to discuss **Bay Council's** concerns on the Regional Board's final reference pool.	Regional Board and **Bay Council**.
Meeting	Aug 8, 2003	Meeting to discuss **Bay Council's** concerns on the statistical procedures.	Regional Board and **Bay Council**.

In addition to the above list of meetings, letters, and workshops, the Regional Board has communicated extensively with Bay Council and other stakeholders via telephone conversations, conference calls, and email.

4. Access to Data

Comment from San Diego Bay Council:
Access to the data sets being used is critical for our meaningful participation. As you know, despite repeated requests for data – data that staff, the industry, and Navy have been using for quite some time – we were only provided access after the second meeting, in January of 2003. This has put us at a considerable disadvantage. We are concerned that it was indicated that the input we provided before we had access to the data, is what you are considering the full extent of our input. It is not.

Regional Board Response:
The Regional Board provided all available data requested by your scientific consultant, Ms. Elaine Carlin, prior to the January 2003 technical meetings. The only requested data that we could not provide was SCCWRP's complete Bight'98 data set. At that time the Regional Board did not have all of the sediment quality data electronically (incomplete sediment chemistry data set and no benthic community data) and suggested that Ms. Carlin contact SCCWRP directly for

the complete Bight'98 data set. We understand that SCCWRP provided you with the data needed to complete your analysis following the January 2003 meetings.

We carefully reviewed and considered the full extent of your input in making our final reference pool decision. For example, as you pointed out in your approach, the benthic community data is considered an important criterion that should be used to select reference stations. The Regional Board, as a final screen of the reference stations in Reference Pool #2b, used the Benthic Response Index for Embayments (BRI-E) developed by SCCWRP to evaluate the benthic community (Ranasinghe et. al., 2003). By incorporating the BRI-E we removed stations with disturbed benthic communities from the reference pool. Additionally, the Regional Board has essentially used the same weight of evidence approach used by Bay Council to select stations in the final reference pool. Details are provided in Regional Board response to Comment #6 – Identification of a Set of Relatively Clean Sites (May 5, 2003 Letter).

5. Request for Working Group Meeting

Comment from San Diego Bay Council:
To expedite action we request that the staff hold a full working group meeting to address the various proposals and the action items identified at the last work group meeting. We request that the Regional Board solicit and distribute written comments on the pool of reference stations we have proposed here as well as other proposals such as NOAA's 14 and the Regional Board's set of 12 stations used to set background levels in March 2002 from the various entities and individuals participating in this process prior to the working group meeting.

Regional Board Response:
The Regional Board disagrees that written comments be solicited on various reference pool proposals including the Regional Board's March 6, 2002 letter establishing background conditions for NASSCO and Southwest Marine, and that another technical workgroup meeting be held to discuss these proposals. The Regional Board has thoroughly reviewed and considered all proposals, including comments received on these proposals, in the selection process of the final reference stations. The proposals received to date include those from NOAA (MacDonald and Klimas, 2003) and the Bay Council (Carlin, 2003). In addition, the background sediment concentrations defined in the Regional Board's March 6 letter is being replaced with the background sediment concentrations established by the final reference pool (n = 22) selected by the Regional Board. The Regional Board has already instructed NASSCO and Southwest Marine to use the final reference pool in determining areas exceeding background conditions within and adjacent to their respective leaseholds. We have requested that these areas be depicted in maps provided in the comprehensive technical report. The comprehensive technical report will be submitted to the Regional Board in mid October 2003 and will be available for public review and comment.

The NOAA reference pool approach was distributed to the technical workgroup for review and was formerly presented by NOAA at the January 22-23 meeting. The approach was discussed extensively at the meeting and comments were provided by the workgroup. We would like to clarify that the NOAA approach does not specifically recommend using just the 14 Bight'98 stations as you stated in your letter. Rather, NOAA suggested the possible use of 6 reference stations sampled in the 2001 sediment investigations (NASSCO, Southwest Marine, Chollas Creek, and 7th Street Channel) plus the 14 Bight'98 stations; for a total of 20 recommended stations.

Even though Bay Council submitted their proposed reference pool approach after the January 22-23 technical meeting, the Regional Board spent a significant amount of time reviewing their approach prior to issuing our decision on a final reference pool. In fact, both the Regional Board and Bay Council used the same weight-of-evidence approach to select reference stations by considering the triad of data (sediment chemistry, amphipod toxicity, and benthic community structure). The screening criteria differed as shown in Appendix 5 of Attachment C.

The Regional Board's reference station pool includes reference stations recommended in the NOAA and Bay Council approaches. The reference pool includes 13 of 20 NOAA reference stations and 3 of 7 Bay Council reference stations. These stations are shown in Tables 2 and 3 below.

Table 2. 13 of 20 NOAA Reference Stations Included in Regional Board Final Pool (bold and shaded).

2001 Chollas/Paleta Reference Stations	2001 Shipyard Reference Stations	Bight'98 Reference Stations
2433	**2243**	2224
2238	**2433**	2239
2243	**2441**	**2436**
		2231
		2434
		2228
		2243
		2229
		2433
		2227
		2242
		2440
		2233
		2435

Table 3. 3 of 7 Bay Council Reference Stations Included in Regional Board Final Pool (bold and shaded).

2001 Chollas/Paleta Reference Stations	2001 Shipyard Reference Stations	Bight'98 Reference Stations
Not Applicable	Not Applicable	**2252**
		2435
		2229
		2433
		2227
		2434
		2441

The Regional Board also compared the mean values between the Regional Board reference pool and the reference pools proposed by NOAA and Bay Council to determine the similarities and differences. The mean values were used because it allows for a simple, baseline comparison between all of the various pools. The Regional Board recognizes that there are a variety of statistical methods to compare the various reference pools and that the mean is not the statistics used to compare reference to site stations.

As shown in Table 4 below, the reference pools are generally not significantly different from one another with respect to sediment chemistry (except for total priority pollutant PAHs [PP-PAHs]) and amphipod toxicity. The Regional Board's pool for total PP-PAHs is significantly lower (i.e., more protective) than both Bay Council's pool and NOAA's pool. The Bay Council's pool and NOAA's pool are approximately 50% and 30% higher, respectively, in PP-PAH concentrations.

Another significant difference is the mean Benthic Response Index Embayment (BRI-E) scores for the reference pools. Bay Council's pool for the BRI-E score is significantly lower, as expected, because the Regional Board's pool included stations within the BRI-E Response Level 1 threshold (details provided in Appendix 5 of Attachment C). Bay Council's pool only included stations within the BRI-E Reference Level threshold. Also worth noting is that the mean BRI-E scores for the Regional Board's pool and NOAA's pool are similar.

Table 4. Comparison of Mean Values Between the Regional Board, Bay Council, and NOAA Reference Pools.

		Mean Values(1)		
		Regional Board Pool	**Bay Council Pool**	**NOAA Pool**
		n = 22	n = 7	n = 20
Sediment Chemistry(2)	**Units**			
Arsenic	mg/kg	5.45	6.76	5.45
Cadmium	mg/kg	0.14	0.16	0.15
Chromium	mg/kg	30.8	31.8	32.3
Copper	mg/kg	56.7	54.9	54.9
Lead	mg/kg	23.5	19.7	23.1
Mercury	mg/kg	0.26	0.18	0.28
Nickel	mg/kg	9.37	11.1	9.87
Silver	mg/kg	0.52	0.56	0.50
Zinc	mg/kg	112	103	109
Total PP-PAHs(3)	**ug/kg**	**346**	**803**	**513**
Total PCBs	ug/kg	43.3	51.3	42.0
Toxicity				
Amphipod Survival (control-adjusted)	%	95	98	95
Benthic Community				
BRI-E(4)	**unitless**	**27.6**	**15.1**	**26.0**

Notes: (1) Sediment quality data taken from April 10, 2003 document produced by SCCWRP, Navy, and Exponent (Bay et. al., 2003).

(2) One-half of the method detection limit was substituted for nondetect values, except for the Shipyard data, where one-half of the reporting was used (Bay et. al., 2003).

(3) Total PP-PAHs = Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz[a]anthracene, Chrysene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, Dibenz[a,h]anthracene, and Benzo[ghi]perylene.

(4) BRI-E = Benthic Response Index - Embayments

6. Identification of a Set of Relatively Clean Sites

Comment from San Diego Bay Council:
To move the process forward, and because of profound concerns about how this selection process appears to be unfolding, (and now that we have the necessary data), we have identified a set of relatively clean sites, with relatively healthy benthic communities, to be used as a reference pool for the Bay (enclosed). We had the following in mind as we proceeded:

- *Select a Pool of Reference Stations that will define background (ambient) conditions in San Diego Bay.*
- *This pool can be used for general assessments of whether areas of the Bay are degraded.*
- *This pool, or a subset of this Pool, can be used as reference for site-specific cleanups, including clean-up of the NASSCO and Southwest Marine Shipyards sites.*
- *Recommend that the stations that make up this pool be protected from degradation.*

Regional Board Response:
The criteria the Regional Board had in mind when selecting the reference pool is provided in our response to Comment #1 – EPA Definition on Reference Conditions and Reference Sites (May 5, 2003 letter). The Regional Board believes that the best way to move the project forward is to apply the Regional Board's reference pool and appropriate statistical procedures to the NASSCO and Southwest Marine sediment site data and evaluate the resultant cleanup scenarios. A lot of good solid information that has been collected on multiple lines of evidence on this project. Therefore we are anticipating that there will be sufficient information in the technical report to ensure that the Regional Board will be able to evaluate options and make a cleanup decision that is protective of beneficial uses.

The Regional Board has considered all stakeholder input, including the Bay Council's proposed reference pool, and believes we have arrived at a decision on a suitable reference pool that will provide a sound scientific basis for identifying site stations exceeding reference conditions. All of the stations in the Regional Board's final reference pool meet the screening criteria used to evaluate sediment chemistry, amphipod toxicity, and benthic community structure. The weight-of-evidence, therefore, concludes that each station included in the Regional Board's final reference pool is not impacted by sediment contamination (relatively low sediment chemistry, lack of acute toxicity, and a healthy benthic community) and is supportive of aquatic life beneficial uses. Consequently, we are confident that the Regional Board's reference pool is suitable for the NASSCO, Southwest Marine, Chollas Creek, and 7th Street Channel sediment investigations.

The screening criteria used by the Regional Board to select stations in the final reference pool and the results are provided in Appendices 5 and 6 of Attachment C, respectively.

REGIONAL BOARD RESPONSES TO AUGUST 12, 2003 LETTER

1. Precedent for Cleanup in San Diego Bay and California

Comment from San Diego Bay Council:
We have invested very significant time and resources in this, and we believe that the outcome of the Regional Board process, and your ultimate decision will provide a very significant precedent for clean up, not only of San Diego Bay, but for sediments in the rest of the State.

Regional Board Response:
We appreciate the time and resources the Bay Council has spent on this project and we have fully considered all of your input. The Regional Board process on the NASSCO and Southwest Marine projects do not set a binding precedent for current and future sediment investigations in San Diego Bay and throughout the State of California.

We have stated repeatedly in our technical meetings and workshops, the framework we developed to assess the contaminated sediments at NASSCO and Southwest Marine Chollas Creek and Seventh Street Channel is an evolving process. The Regional Board will continue to consult with stakeholders representing the interests of the public, the protection of State and Federal natural resources, and the scientific community to improve the decision-making process for other current and future sediment projects in San Diego Bay.

The Regional Board will not be setting a precedent for the entire state of California. The State Water Resources Control Board (SWRCB) is conducting an independent effort to establish sediment quality objectives (SQOs) and an implementation policy for California's enclosed bays and estuaries. The SWRCB has already initiated the process. A workplan was adopted by the SWRCB at its May 21, 2003 Board meeting which describes the approach and key tasks that will be implemented to develop SQOs for California (SWRCB, 2003). It is anticipated that the process through adoption of the SQOs will take approximately four years to complete (Year 2007). Also worth noting is that the SQOs will only provide protection to aquatic life (i.e., benthic community). A framework for the calculation of sediment objectives based on fish bioaccumulation and consumption by humans or wildlife will be developed and illustrated through its application in a case study. This framework and case study will serve to illustrate the methods and data needed to develop bioaccumulation-based sediment objectives by regulatory agencies.

2. Problems Identified by the Natural Resource Trustee Agencies

Comment from San Diego Bay Council:
We would like to take this opportunity to update you regarding serious concerns we have about how the cleanup effort is proceeding, particularly as it relates to the pool of reference stations

selected and recently released by your staff. These problems with the selection and approach used have also been identified by the natural resource trustee agencies, including the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service, and California Fish and Game.

Regional Board Response:
The Resource Agencies recently submitted comments on September 12, 2003 regarding the Regional Board's reference pool (Appendix 2 of Attachment C). Prior to issuing our final reference pool decision we consulted with the Resource Agencies extensively and took significant steps to address the Resource Agencies' concerns. While we recognize that there are a few issues that still need to be resolved with the Resource Agencies, we do not agree with Bay Council that the Resource Agencies have identified the same set of problems as the Bay Council with the reference pool selection.

3. NOAA and Bay Council Proposed Reference Pools

Comment from San Diego Bay Council:
Previously NOAA and the San Diego Bay Council each submitted for consideration proposed pools of reference stations representing *the least impaired, or "cleanest" sites in San Diego Bay.* These approaches are based on widely accepted scientific practices used throughout the nation and supported by EPA Guidance (See for example, U.S. Environmental Protection Agency, Office of Water. December 2000. *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance.* EPA-822-B-00-024).

Regional Board Response:
See Regional Board responses to Comment #1 – EPA Definition of Reference Conditions and Reference Sites (May 5, 2003 Letter) and Comment #5 – Request for Working Group Meeting (May 5, 2003 Letter).

4. Pristine Levels not required for Cleanup

Comment from San Diego Bay Council:
Using reference sites within San Diego Bay takes into account that while the Shipyards must cleanup contamination they contributed to the Bay, cleanup cannot be required to pristine levels.

Regional Board Response:
Water Code Section 13304 provides 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 … may be required to clean up the discharge and abate the effects thereof." This section authorizes the Regional

Board 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).

5. Solicit Comments on Bay Council and NOAA Proposals

Comment from San Diego Bay Council:
The Bay Council requested that the staff solicit comment on our proposal from members of the working group. We have also inquired about the status of NOAA's proposal, a proposal we could support, and requested a meeting at which both of these proposals along with others could be fully considered. These requests were denied, and we have received no response to our proposal, or to request that comment be solicited from members of the working group.

Regional Board Response:
See Regional Board responses to Comment #3 – Status of Tasks (May 5, 2003 Letter) and Comment #5 – Request for Working Group Meeting (May 5, 2003 Letter).

6. Bay Council Proposal used by the Navy and Regional Board Staff

Comment from San Diego Bay Council:
In the meantime, our proposal has received very favorable review from several individuals and agency representatives both prominent in the field and familiar with San Diego Bay. Our proposal has been used in the selection of reference stations by the Navy and by other members of your staff for TMDL and other cleanup projects in the Bay.

Regional Board Response:
The Regional Board is not aware of any sediment investigation projects in San Diego Bay that has used the Bay Council's approach in selecting reference stations. In fact, we are puzzled with your comment that Staff has used the Bay Council approach for TMDL sediment investigations. The Regional Board has not used the Bay Council approach in determining a reference pool for any of the TMDL sites in San Diego Bay. We recognize that we are using three of the same Bight'98 stations (2435, 2441, and 2229) identified in the Bay Council approach in the Switzer Creek, Downtown Anchorage, and B Street/Broadway Piers TMDLs. However, Bay Council's approach was not used to select these three stations. These three stations were selected based on the results of previous studies (Bight'98, BPTCP, Shipyard Investigation) and specific criteria:

- Location (i.e., not located in a marina);
- Low sediment chemistry;
- Lack of acute toxicity;
- Healthy benthic community;
- Similar physical characteristics to study sites (total organic carbon and sediment grain size); and

- Level of sensitivity that separates the effects on organisms due to natural non-pollutant factors (e.g., grain size, unionized ammonia, and sulfides) from the effects due to pollutants.

The Regional Board requests that the Bay Council provide us a list of sediment projects in San Diego Bay that have used the Bay Council approach in selecting reference stations, including detailed information on how the approach was applied. In addition, the Regional Board requests that the Bay Council provide us a separate list of the agencies and sediment experts that have reviewed the Bay Council reference pool approach. Please include their name, title, organization, and phone number when providing us this list. We would like to contact them to receive additional input on the Bay Council approach for potential application to future sediment investigations in San Diego Bay.

7. Excluded from First Key Meeting

Comment from San Diego Bay Council:
Despite our deep involvement and commitment to this process from the beginning, and our provision of valuable scientific input, we were excluded from the first key meeting of the reference pool working group.

Regional Board Response:
See Regional Board response to Comment #2 – Bay Council Participation in Regional Board Workshops (May 5, 2003 Letter).

8. Lack of Balanced Input

Comment from San Diego Bay Council:
We, along with other parties involved in the process, are fundamentally concerned about the lack of balanced input and heavy access and influence afforded by the dischargers – staff has worked very closely with the Navy and shipyards and their consultants in selecting an approach, selecting the pool of stations, and the statistical approach. We have been excluded from these critical deliberations.

Regional Board Response:
The Regional Board is disappointed in Bay Council's assertions that we have not provided equal attention to all stakeholders interested in the reference pool selection process and that we have excluded Bay Council from "critical deliberations" we have had with the Shipyards and the Navy. The Regional Board has maintained an open process to ensure that we have considered the views of all key stakeholders on the reference station issue. We have held three day-long technical meetings to discuss the approach and selection of reference stations and have also considered all additional stakeholder input provided to us before and after these technical

meetings. The Regional Board had several discussions separately with the Shipyards and the Navy following the technical meetings to provide further clarification on the instructions we provided to them and because they had questions regarding the candidate reference pools identified in the instructions. As a reminder, the Regional Board instructions including the candidate reference pools were prepared based on the input received from the entire stakeholder group present at the January 22-23 technical meeting (RWQCB, 2003a). There were no "critical deliberations" following the technical meetings that warranted the inclusion of the entire stakeholder group. The purpose of the limited discussions between the Regional Board and the Shipyards/Navy were to keep the reference pool analysis proceeding forward.

9. Process Deserves Full Stakeholder Participation

Comment from San Diego Bay Council:
As a result, the staff's proposed reference pool and approach were determined without full stakeholder participation and despite the fact that stakeholders were providing high caliber scientific input. Management of the San Diego Bay contaminated sediment clean up process deserves transparency and full participation of the stakeholders including the public.

Regional Board Response:
See Regional Board responses to Comment #3 – Status of Tasks (May 5, 2003 letter) and Comment #8 – Lack of Balanced Input (August 12, 2003 letter).

10. Regional Board Reference Pool not Protective of Beneficial Uses

Comment from San Diego Bay Council:
The approach and reference pool decided upon your staff does not appear to be scientifically defensible, and no evidence has been presented that beneficial uses will be protected.

Regional Board Response:
The Regional Board disagrees with Bay Council that the approach used to select the reference pool is scientifically indefensible and that the final pool does not protect beneficial uses. As we stated in Regional Response to Comment #6 – Identification of a Set of Relatively Clean Sites (May 5, 2003 letter), the final reference pool is based on a final screening evaluation using the triad approach and best professional judgement. The triad approach is a widely-accepted approach that is used throughout the United States to evaluate sediment quality. In fact, Bay Council in selecting a proposed reference pool also used the triad approach. Based on the final screening evaluation, the reference stations in the Regional Board's final pool are not impacted by sediment contamination and are supportive of aquatic life beneficial uses (relatively low sediment chemistry, lack of acute toxicity, and a healthy benthic community). The evaluation results are provided in Appendix 6 of Attachment C.

11. Distance-From-Shore Approach

Comment from San Diego Bay Council:
The approach is based on the concept that the contamination levels decrease with the distance from shore – despite the fact that some of the cleanest sites are relatively close to shore. The Trustee Agencies and sediment experts experienced in the Bay rejected this method when it was first proposed last January. It has not been peer-reviewed, and to our knowledge has never been used before.

Regional Board Response:
The Regional Board recognizes that the Bay Council does not agree with the approach used to identify additional reference stations for the NASSCO, Southwest Marine, Chollas Creek, and 7th Street Channel sediment investigations (distance-from-shore approach). We also recognize that the Resource Agencies are not in full agreement with the use of the distance-from-shore approach and need further clarification on its development and application (Appendix 2 of Attachment C).

The Regional Board disagrees with Bay Council that the distance-from-shore approach is an inappropriate approach because it does not consider "clean" stations close to shore. In order to clear up confusion on the approach provided below is a brief summary of the distance-from-shore approach. Also discussed are why it was developed, how it accounts for near-shore (and far from shore) Bight'98 stations, and how the remaining distance-from-shore stations are protective of beneficial uses.

Distance-From-Shore Approach (Appendix 3 of Attachment C):

One of the concerns raised by some of the participants in the technical workgroup was the number of reference stations (*n*) used to calculate the parametric statistics for sediment chemistry, toxicity, and benthic community structure. The Regional Board, among others, decided that it was important to increase *n* to improve the power of the statistical procedures for the NASSCO, Southwest Marine, Chollas Creek, and 7th Street Channel sediment investigations. As a first step, the reference stations from these investigations were combined to increase *n* to 11 (five from NASSCO and Southwest Marine, and six from Chollas Creek and 7th Street Channel). It was appropriate to combine these reference stations because they: (1) are the same stations with respect to location (with the exception of one station), (2) were sampled within the same time frame (July and August 2001), (3) were sampled for the same sediment quality data, and (4) followed the Bight'98 sampling and analysis protocols. Because the chemical and biological results from some of these reference stations were considered to be unsuitable for representing reference conditions; thus decreasing *n*, the Regional Board and others decided that it was necessary to supplement the combined reference stations. Consequently, SCCWRP identified additional reference stations in San Diego Bay from the Bight'98 data set. The approach used by SCCWRP is based on the premise that contaminant concentrations in sediments decrease away from shore (i.e., away from point and non-point sources). SCCWRP determined that concentrations of copper, chromium, mercury, lead, zinc, total PAHs, and total PCBs (common chemicals of concern) appeared to level off at approximately 290 meters from shore. Threshold chemical concentrations for each of these constituents were then calculated using only stations greater than or equal to 290 meters from shore. All 46 Bight'98 stations in San Diego Bay were compared to these threshold values (regardless of distance from shore) and stations below these threshold values were identified as suitable reference stations. Twenty-two stations from the Bight'98 data set were below the threshold values ranging from 10 to 1,080 meters from shore. These stations were, therefore, considered as candidate supplemental reference stations.

The Regional Board, as a final screen of these additional 22 stations, evaluated the triad of data (sediment chemistry, amphipod toxicity, and benthic community structure) using the criteria specified in Appendix 5 of Attachment C. Based on the results of the Regional Board's screening evaluation (Appendix 6 of Attachment C), 5 of 22 stations were removed based on their respective BRI scores. The remaining 17 stations were retained in the final reference pool because they met all screening criteria. The weight-of-evidence, therefore, concludes that the 17 stations are not impacted by sediment contamination (based on weight-of-evidence: relatively low sediment chemistry, lack of acute toxicity, and a healthy benthic community) and are therefore supportive of aquatic life beneficial uses.

12. Number of Reference Stations in Final Pool

Comment from San Diego Bay Council:
The pool is exceptionally large, and as a result contains stations that are too contaminated or impaired to be used to establish the bar to which cleanup will be required – the pool has over 20 stations, where other reference pools for San Diego Bay have 5 or 6 stations. It has been demonstrated that much smaller pools – if selected properly – provide the necessary range of physical characteristics and statistical power, and importantly, allow for a cleaner reference condition.

Regional Board Response:
From a statistical standpoint, a large pool is typically preferable to a small pool, yet the comment suggests otherwise. The Bay Council's standard being used to justify a "smaller pool" is that it allows for a "cleaner reference condition". The goal in choosing reference sites is not to choose the cleanest reference condition. It is to choose reference conditions that represent the pre-discharge conditions at the site.

The Regional Board disagrees with Bay Council that the reference stations in the final pool are "too contaminated or impaired." Each reference station in the final pool has relatively low sediment chemistry, lack of acute toxicity, and a healthy benthic community. See response to Comment #6 – Identification of a Set of Relatively Clean Sites (May 5, 2003 letter). Furthermore, the reference stations included in the final pool provide the necessary range of physical characteristics at NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel: Fines content (13% - 77%), Total Organic Carbon (0.30% - 1.63%), and Depth (3 – 12 meters).

The Regional Board is familiar with only one site in San Diego Bay that has used 5 reference stations: Site 12 - Boat Channel at the Former Naval Training Center (Bechtel, 1999). The Regional Board requests that Bay Council provide a list of San Diego Bay sites that have used 5 or 6 reference stations and include a detailed rationale with supporting documentation on how these sites demonstrate that "much smaller pools – if selected properly – provide the necessary range of physical characteristics and statistical power, and importantly, allow for a cleaner reference condition."

Finally, Bay Council's above comment recommending the use of "much smaller pools" is not consistent with the Bay Council's endorsement of the NOAA reference pool, which recommends a total of 20 reference stations (2 reference stations less than the Regional Board's final pool). We request that Bay Council clarify their position on the number of stations in the large NOAA pool.

13. Choice of Statistical Techniques

Comment from San Diego Bay Council:
The second major set of problems involves the choice of statistical techniques which apparently will result in a less protective level of cleanup. Commonly used, simpler, and much more transparent statistics are the appropriate tools to use and would be expected to result in significantly more protection for the Bay. These simpler techniques are entirely consistent with the triad approach to selecting reference sites.

Regional Board Response:
The Regional Board is unclear as to which statistics Bay Council is referring to that is "commonly used, simpler, and much more transparent ... and would be expected to result in significantly more protection for the Bay". Therefore, we cannot respond specifically to your suggestion.

The Regional Board is aware that the Bay Council used the 95% upper confidence limit (UCL) on the mean as the statistic for evaluating their proposed reference pool. We disagree with Bay Council in using UCL's when comparing a reference pool to individual site stations because it is technically incorrect. The Regional Board recommends using the 95% upper predictive limit

(UPL) as specified in our June 9, 2003 letter to the Shipyards (RWQCB, 2003). A detailed discussion on the UCL and UPL is provided below.

A confidence limit on the mean is an estimate of the value for which there is a specific chance that the true mean of a population is less than this value (e.g. 95%). The 95% UCL is a population statistic because it describes a characteristic of the entire population. For example, one could use the UCL to represent a reference condition to evaluate dissolved phase concentrations in a pond. Since it is the pond as a whole that one is concerned with and the mean concentration of a chemical represents this pond, the 95% UCL may be used to estimate if the pond concentrations exceed reference.

A predictive limit (e.g. the 95% UPL) is an estimate of the value for which there is a 95% chance that a future selected sample will not exceed this value if it is actually a member of the population (or site) being studied. The 95% UPL is a statistic that applies to individual samples. When we evaluate exceedences of sediment quality, we look at individual sediment samples. We are interested in knowing whether or not there is impairment in the immediate vicinity of the sample. Therefore, we want to know if the individual sample is a member of the reference sampling population and the UPL is the appropriate statistic to use.

Confidence limits and predictive limits are generically referred to as interval estimates. According to Dennis Helsel and Robert Hirsch (authors of "Statistical Methods in Water Resources") (Helsel and Hirsh, 2002) there are two types of interval estimates:

> "Interval estimates can provide two pieces of information which point estimates cannot:
>
> 1. A statement of the probability or likelihood that the interval contains the true population value (its reliability).
> 2. A statement that the likelihood that a single data point with specified magnitude comes from the population under study.
>
> Interval estimates for the first purpose are called confidence intervals; intervals for the second purpose are called prediction intervals. Though related, the two types of interval estimates are not identical and cannot be interchanged."

The authors further describe how prediction intervals are appropriate for evaluating individual data points and confidence intervals are not:

> "Prediction intervals are computed for a different purpose than confidence intervals – they deal with individual data values as opposed to a summary statistic such as the mean. A prediction interval is wider than the corresponding confidence interval, because an individual observation is more variable than is a summary statistic computed from several observations.

Unlike a confidence interval, a prediction interval takes into account the variability of single data points around the median or mean, in addition to the error in estimating the center of the distribution. When the mean +/- 2 standard deviations are mistakenly used to estimate the width of a prediction interval, new data are asserted as being from a different population more frequently than should."

Some notable investigations in which the UPL was used to differentiate contaminated sediments from reference station conditions include:

- Southern California Bight 1998 Regional Monitoring Program (Noblet et. al., 2003)
- Natural Trace Metals Concentrations in Estuarine and Coastal Marine Sediments of the Southeastern United States (Windom et al., 1989)
- Statistical Approach for Discrimination of Background and Impacted Areas for Midnite Mine RI/FS (URS Greiner, 2001)
- Remedial Investigation, Naval Air Station, North Island, San Diego, California (SPAWAR, 1999)
- Sediment Quality in Puget Sound (Long et. al., 2000)

It should be noted that the above are the only investigations identified by the Regional Board, thus far, that have used the UPL. There may be more investigations.

14. Calculations on the Regional Board Reference Pool

Comment from San Diego Bay Council:
Staff has indicated that we should wait until the shipyards make these calculations or run them ourselves, and that even the staff has not run these calculations on the pool they selected. This is confusing – how has staff evaluated its final pool and approach as to whether it is protective of beneficial uses, and how will staff evaluate the shipyard's work?

Regional Board Response:
The Regional Board met with Ms. Elaine Carlin (Bay Council's scientific consultant) and Mr. Ed Kimura of Sierra Club on July 31, 2003 to discuss Bay Council's comments on the final reference pool. At that meeting, we indicated that we did not need to perform the statistical calculations on the final pool because: (1) we directed the Shipyards to conduct the calculations (RWQCB, 2003b), (2) the calculations would be available in the Shipyard's comprehensive report due in mid October 2003, and (3) the Regional Board had limited time and resources. The Regional Board, however, has evaluated the final pool by using the triad approach to screen and select the final reference stations (for details see Regional Board response to Comment #6 – Identification of a Set of Relatively Clean Sites). We evaluated the sediment chemistry, amphipod toxicity, and benthic community structure data in each of the reference stations included in Reference Pool #2b (Bay et. al., 2003) and removed stations that did not meet our

criteria. The final remaining stations are stations that are not impacted by sediment contamination (based on weight-of-evidence: relatively low sediment chemistry, lack of acute toxicity, and a healthy benthic community) and are therefore supportive of aquatic life beneficial uses.

Finally, the Regional Board has the necessary resources to review the Shipyard's comprehensive sediment investigation report, which includes the statistical calculations. We will also seek assistance, as necessary, from the Natural Resource Trustee Agencies and others that have the technical expertise on issues such as risks to human health and wildlife. Furthermore, we will consider all input received from interested stakeholders on the comprehensive technical report.

15. Site-Specific Approach to Select Reference Stations

Comment from San Diego Bay Council:
Each of these problems has also been identified by the Trustee agencies, and you should know that the Trustees and the San Diego Bay Council have gone to extraordinary lengths to identify, communicate, and provide assistance with these problems as we have become aware of them. In response to these efforts, staff has indicated that the approach they are using will only be used for the commercial shipyard cleanup, a response that belies the precedent-setting nature of the staff's decision, and the fact that the approach is already being cited by other dischargers in their work on other cleanup sites in the Bay.

Regional Board Response:
See Regional Board response on Comment #1 - Precedent for Cleanup in San Diego Bay and California (August 12, 2003 Letter).

16. Request for Hearing on Reference Pool Issue

Comment from San Diego Bay Council:
By this letter we are appealing to you to schedule this issue for a hearing so that the Board can provide direction on selection of the pool of reference stations and so that all information and scientifically credible proposals – including those by NOAA and by the Bay Council – can be brought before the decision-makers.

Regional Board Response:
The Regional Board disagrees with Bay Council that a hearing be held specifically to discuss the reference station issues. As we pointed out in our above responses we have already gone through extensive discussions with all key stakeholders on the process to select a reference pool for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel sediment investigations. The Regional Board has held three day-long technical meetings with groups representing:

- the interests of the public (Bay Council),
- the protection and conservation of State and Federal natural resources (DFG, USFW, and NOAA),
- the scientific community (SCCWRP, San Jose State, UC Davis, and SPAWAR), and
- the potential responsible parties (NASSCO, Southwest Marine, and Navy).

In addition, we have held numerous meetings and teleconferences separately with most of the groups mentioned above. The Regional Board has considered all stakeholder input not only from these technical workgroup meetings and teleconferences, but also from input provided via written comments (e.g., proposed approaches and comments received on these approaches).

In June 2003 Regional Board staff instructed NASSCO and Southwest Marine to proceed with completing their technical report on the sediment quality investigation using the reference pool selected by staff. NASSCO and Southwest Marine's consultant is already well into preparing the technical report and it is due to be submitted in mid October 2003. It should be noted that the Regional Board will be scheduling a day-long workshop in November 2003 to: (1) present an overview of the technical report, (2) provide an opportunity for the public to provide comments on the technical report, and (3) solicit input on the development of the Cleanup and Abatement Orders (CAOs) for NASSCO and Southwest Marine.

The purpose of the technical report is to present the data and findings of the comprehensive sediment investigation conducted within and adjacent to the NASSCO and Southwest Marine leaseholds. The technical report will, at a minimum, include the following:

- Sediment quality data collected at each shipyard. The data consists of bulk sediment and pore water chemistry, sediment and pore water toxicity, benthic community structure, and bioaccumulation.
- Nature and areal extent of sediment contamination resulting from current and historical waste discharges from the shipyards.
- Biological effects and risks to San Diego Bay beneficial uses (aquatic life, aquatic-dependent wildlife, and human health) associated with sediment contamination at the shipyards.
- Determination and evaluation of cleanup levels protective of beneficial uses, including cleanup levels representing background conditions in San Diego Bay.
- Analysis of sediment remedial alternatives.

Staff does not support delaying the submission of this report and further delaying a Regional Board decision on cleanup in order to continue the debate on the relative technical merits of alternative reference station approaches. At this juncture the efficacious course for the Regional Board to conclude the investigation and determine cleanup levels is to obtain the technical report from the shipyards in mid October 2003. Staff will review the report to determine appropriate cleanup levels and has tentatively scheduled the Regional Board's consideration of CAOs for NASSCO and Southwest Marine at the February 2004 Regional Board meeting. The CAOs will include directives to cleanup and abate the effects of the discharges in accordance with the final cleanup levels and include a time schedule for compliance with the directives. The Regional Board will provide ample opportunity for public comment on the CAOs, including the recommended cleanup levels as well as the reference station pool used in deriving the cleanup during the public review process for the CAOs.

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APPENDIX 1
OF ATTACHMENT C

Regional Board Instructions to Evaluate 4 Candidate Reference Pools

I. CANDIDATE REFERENCE POOLS #1A & #1B

The tables provided below indicate which stations should be included in candidate reference pools #1a and #1b.

Reference Pool #1a – 6 Reference Stations from 2001 Data

2001 Chollas/Paleta Reference Station Data	2001 Shipyard Reference Station Data	1998 Bight'98 Station Data
2433	2231	None
2238	2243	
	2433	
	2441	

Reference pool #1a is a modified version of the pool that was developed during the January 23 meeting using a weight-of-evidence approach (plus and minus table for chemistry and toxicity). Regional Board staff modified the agreed pool by removing Chollas/Paleta Station 2243 because of the 55% amphipod survival rate. We will, however, consider retaining Chollas/Paleta Station 2243 if information is presented to establish a much h` gher survival rate.

Reference Pool #1b – Reference Pool #1a + 18 Bight'98 Stations

2001 Chollas/Paleta Reference Station Data	2001 Shipyard Reference Station Data	1998 Bight'98 Station Data
2433	2231	2238
2238	2243	2440
	2433	2433
	2441	2231
		2252
		2265
		2435
		2258
		2257
		2240
		2436
		2256
		2247
		2242
		2233
		2244
		2243
		2241

Reference pool #1b is a combination of the stations in Reference pool #1a and 18 of 22 Bight'98 stations selected in the distance-from-shore approach developed by SCCWRP. Regional Board staff removed four Bight'98 stations due to the low amphipod survival rates. Stations 2249, 2245, 2235, and 2260 had survival rates of 75%, 66%, 71%, and 73%, respectively.

Descriptive Statistics for Reference Pools #1a and #1b

Descriptive statistics should be performed on the following parameters: sediment chemistry, amphipod toxicity, benthic community, and physical characteristics (% fines, % TOC). The sediment quality data and statistical results should be summarized in a table similar to the table provided in the NOAA document titled "An Approach for Selecting a San Diego Bay Reference Envelope to Evaluate Site-Specific Reference Stations" (January 16, 2003).

- **Sediment Chemistry**

Statistics
- Mean
- Standard Deviation
- Upper one-tail 95% prediction interval (not adjusted)
- Upper one-tail 95% prediction interval (adjusted)

Details
- Provide statistical results for all contaminants of concern identified for Chollas/Paleta and NASSCO/SWM. A list of the combined COCs is provided in Attachment #5.
- Provide statistical results for ERMq. The ERMq should be calculated based on the same contaminant suite used in the November 8, 2002 document titled "Evaluation of Reference Station Data Obtained During the Shipyard or Chollas/Paleta Spatial Survey" prepared by Steve Bay et. al.
- For non-detects use ½ the detection limit reported by the analytical laboratory. USEPA 2002 guidance should be followed for summing ½ detection limit values (EPA 540-R-01-003, Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA sites, September 2002). Do you want to cite the EPA document discussed at the meeting as a possible reference?
- Total PCBs should be calculated using the 18 specific congeners recommended by NOAA (Attachment #2).
- Total PAHs should be calculated using the 23 specific PAHs used by NOAA in the document titled "An Approach for Selecting a San Diego Bay Reference Envelope to Evaluate Site-Specific Reference Stations" (January 16, 2003).
- Total DDTs should be calculated using …
- Total chlordanes should be calculated using …
- Include the ERM and ERL for each COC in the table.

- **Toxicity**

Statistics
- Mean
- Standard Deviation
- Lower one-tail 95% prediction interval (not adjusted)
- Lower one-tail 95% prediction interval (adjusted)

Details
- Provide statistical results for % amphipod survival.

- **Benthic Community**

Statistics
- Mean
- Standard Deviation
- ?Lower/upper? one tail 95% prediction interval (not adjusted)
- ?Lower/upper? one tail 95% prediction interval (adjusted)

Details
- Provide statistical results for number of taxa, abundance, and Shannon-Wiener diversity.
- Provide an interpretation of the statistical results using best professional judgement.

- **Physical Characteristics**

Statistics
- Provide % fines and % TOC ranges.

Details
- Provide statistical results for % fines and % TOC.

II. CANDIDATE REFERENCE POOLS #2A & #2B

Reference pools #2a and #2b will be based on the criteria established at the January 23 meeting. Please use these criteria to establish candidate reference pools #2a and #2b. The criteria, as typed by Steve Bay at the meeting, are provided in Attachment #5. Please note that in the attachment we included some instruction/direction on a few criteria (red text and underlined).

Reference Pool #2a – Reference Stations selected from 2001 Data

The following two tables should be developed prior to identifying potential suitable stations for reference pool #2a:

- Table A – Identify Outliers

  The purpose of this table is to identify outliers in the 2001 reference station data from the NASSCO/Southwest Marine and Chollas/Paleta investigations. Table 1 should be formatted similar to the table provided in the November 8, 2002 document titled ""Evaluation of Reference Station Data Obtained During the Shipyard or Chollas/Paleta Spatial Survey" prepared by Steve Bay et. al.

- Table B – Weight-of-Evidence

  The purpose of this table is to identify potential suitable reference stations from the Table A results using best professional judgement (i.e., weight-of-evidence approach). Table B should be formatted similar to the table with the pluses and minuses developed at the January 23 meeting (See Attachment #5). Additionally, Table B should include a column that provides a brief rationale for accepting or rejecting the station.

The selected stations from Table B should be placed in the following table:

2001 Chollas/Paleta Reference Station Data	2001 Shipyard Reference Station Data	1998 Bight'98 Station Data
Table B Results	Table B Results	None

Reference Pool #2b – Reference Pool #2a + 18 Bight'98 Stations

The selected stations from Table B should be placed in the following table:

2001 Chollas/Paleta Reference Station Data	2001 Shipyard Reference Station Data	1998 Bight'98 Station Data
Table B Results	Table B Results	2238
		2440
		2433
		2231
		2252
		2265
		2435
		2258
		2257
		2240
		2436
		2256
		2247
		2242
		2233
		2244
		2243
		2241

Descriptive Statistics for Reference Pools #2a and #2b

Descriptive statistics should be performed on the following parameters: sediment chemistry, amphipod toxicity, benthic community, and physical characteristics (% fines and % TOC). Please follow the instructions provided above in the descriptive statistics for reference pools #1a and #1b (if applicable).

Issues and Decisions

What process should be used to evaluate suitability of 2001 reference station data?

1. Bight'98 comparison data set to use: 10 stations identified in 2001 Chollas/Paleta SAP (may use phase II data also).
2. Confirm normal distribution or do appropriate transformation
3. Calculate upper (lower) one tail 95% prediction interval, nonadjusted for multiple comparisons (or nonparametric substitute).
4. Compare to each 2001 station for chemistry, toxicity (% amphipod survival), and benthos (abundance, number of taxa, Shannon-wiener diversity) data using PI approach. Use chemistry contaminants of concern list.

	Shipyard	Chollas/Paleta		
As	X	X		
Cd	X	X		
Cu	X	X		
Cr	X	X		
Pb	X	X		
Hg	X	X		
Ag	X	X		
Ni	X	X		
Zn,	X	X		
(Butylytin)	X			
PCB/(PCT)	X	X		
PAH	X	X		
DDT		X		
Chlordane		X		
(Tot petrol)	X			

( ) not in Bight'98 dataset

Nondetects: use ½ detection limit reported by the analytical lab. Follow USEPA guidance (2002) guidance for summing ½ detection limit values and determining use of data.

-Consider Use Phase II Shipyard data for TBT, PCB and PAH comparisons.

- **The Bight'98 study had either detection limit issues or had a majority of non-detects for total PCBs and total PAHs. Do not use the Bight'98 data for these contaminants. Use the PCB and PAH data from the 12 Bight'98 stations resampled by the Shipyards in 2001 (` ttachment #3).**
- **The Bight'98 study did not analyze for TBT and TPH. Use the TBT and TPH data from the 12 Bight'98 stations resampled by the Shipyards in 2001 (Attachment #3).**

Do a separate statistical comparison using the 12 phase II stations.

- **Perform comparison to 10 Bight'98 Stations using upper one tail 95% prediction interval, nonadjusted to determine if sediment chemistry data is suitable for use in the reference pool. For contaminants not anaylyzed in Bight'98 (include PCBs too because of the detection limit issues in Bight'98) use the 7 BPTCP reference sites located in SD Bay.)**

Obtain BPTCP data for 7 established SD Bay reference sites and use for prediction interval analyses for contaminants of concern not represented in Bight'98 dataset (10 stations) and shipyard Phase II dataset.

- **The Bight'98 study had either detection limit issues or had a majority of non-detects for total DDT and total chlordane. Do not use the Bight'98 data for these contaminants. Use the DDT and chlordane data from the 7 BPTCP reference stations located in San Diego Bay (Attachment #4).**

5. Do a best professional judgment evaluation of chemistry, benthos and toxicity data.
6. Use results of 4 & 5 to decide on suitability of each station's data.

Conditional exclusion, based on the type of outlier?

Action items:
a. Mike M. will provide EPA guidance document on nondetect chemistry data treatment. Jan 31.
b. Circulate Phase II shipyard data for potential use in steps 1-6 analyses and make a decision regarding its use and specific stations to include (e.g, 2441). ~~Get data by Jan 31, agencies provide comments to Regional Board by Feb. 5 COB.~~
c. Do steps 1-4 and circulate results (SCCWRP, NAVY, exponent). ~~2 weeks after decision on inclusion of shipyard Phase II data.~~
d. Complete steps 1-6 and provide recommendations to Regional Board. ~~Submit within 4 weeks of decision on item c.~~

e. Draft final decision regarding inclusion/acceptability of 2001 data will be made by Regional Board. Decision will be circulated to interested parties for comment by email.

What data sets should be included in the analysis data pool? To be used in evaluating the study site stations for differences relative to the pool.

Step 7. Skip steps 1-6 and use best professional judgment

			C/P								
	c-n/ noaa	c- fws	c-	t-n/ noaa	t-fws	c-n/ noaa	c- fws	c-	t-n/ noaa	t- fws	
2231	+	-		-	-	+	+		+	+	
2243	+	+		-(+)	+	+	+		+	+	
2433	+	+		+	+	+	+		+	+	
2440	-	-		+	-	-	-		+	-	
2441	(+)	-		+	-	+	+		+	+	
2238	+	+		+	+						

~~Acceptable 2001 data~~
~~Bight'98 subset~~
~~Shipyard Phase II data (acceptable data, judged using a similar process to that applied to the 2001 data)~~

~~How to select the additional Bight'98 data for inclusion?~~
~~— Include the 10 identified previously?~~
~~— Include the 14 identified by NOAA?~~
~~— Include the 22 identified with the distance approach?~~
~~— Use a combination of PCA and distance from shore?~~
~~— Use a combination of NOAA and distance approaches?~~

~~Outliers in Chollas/Paleta toxicity data?~~

~~What statistics/technique will be used to make comparisons between the reference data pool and the study site station?~~

~~1. Treat each sample as an independent replicate for statistical purposes (n=7 or 8).~~

~~2. Follow steps 1-6 previously identified for the evaluation of the 2001 reference site data.~~

~~3. Adjustment for multiple comparisons: to be determined later.~~

~~4. Use a limited list of constituents for the statistical comparisons in order to minimize the need to adjust for multiple corrections.~~

APPENDIX 2
OF ATTACHMENT C

Comment Letter from Natural Resource Trustee Agencies
(September 12, 2003)

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF RESPONSE & RESTORATION
COASTAL PROTECTION & RESTORATION DIVISION
c/o California Department of Toxic Substance Control,
Human and Ecological Risk Division
8800 Cal Center Drive
Sacramento, CA 95826

September 12, 2003

Mr. John Robertus
California Regional Water Quality Control Board
San Diego Region
9174 Sky Park Court, Suite 100
San Diego, California 92123

Dear Mr. Robertus,

As you are aware, representatives from affected Federal and State natural resource trustees have been working with the Board staff as part of a multi-stakeholder work group to develop a process to evaluate sediment contamination at the National Steel and Shipbuilding Company (NASSCO), the South West Marine Shipyard, and the Chollas and Paleta Creek TMDL. On behalf of the natural resource trustee representatives, the National Oceanic and Atmospheric Administration (NOAA), would like to address the role of the natural resources trustees related to the cleanup of contaminated sites, and also present the trustees comments on the selected reference pool approach and it's implementation.

The Natural Resource Trustees derive their authority from the Clean Water Act (CWA) §311, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the CERCLA enabling regulations in the National Contingency Plan (NCP) §300.600. In the event of a release of a hazardous substance into the environment, the natural resource trustees act on behalf of the public to protect natural resources that may be impacted by the hazardous substance releases, and the trustees ensure that the impacted resource, and the human and ecological services that the resource provides, are appropriately restored. The trustees carry out their designated responsibilities for protection and restoration by first working cooperatively within the cleanup process with the regulatory agencies and the parties responsible for the release. This cooperation, which includes technical support to the regulatory agencies, is specifically intended to lead to establishing cleanup numbers that will eliminate or limit future harm to trust resources and will allow for the restoration of the impacted habitat.

The trustees also have an expressed interest in negotiating with the responsible party in order to grant them a release from future natural resource liability under the authorized Federal acts. This release from future liability can only occur if the trustees determine that the cleanup protects trust resources, and that restoration of the resource is achieved. Working in close partnership with the regulatory agencies is the most direct and productive avenue by which the trustees can fulfill their obligation to the public under the designated statutes and regulations. The trustees do have the option of working independently with the responsible party to achieve both a protective cleanup and restoration for the site, but it is clearly more timely, and in the best interest of the resources for all parties to work in a cooperative manner.

Each trustee agency named in the NCP has designated natural resources that they are tasked with protecting. Many times these natural resources co-exist, are contiguous, and/or have concurrent jurisdictions. In these cases, the trustees work together as co-trustees to carry out their designated responsibilities. For the investigation and remediation of the Shipyards, the Federal trustees with jurisdiction are NOAA, and the Department of the Interior, represented by the United States Fish and Wildlife Service (USFWS). The State of California is also a co-trustee for this site. As stated in the NCP, the Governor of the state has the authority to appoint the trustee(s). The designated natural resource trustees for the State of California are the Department of Fish and Game, trustee for all state fish and wildlife resources; the Regional Water Quality Control Board for surface water, groundwater and sediment; and the Department of Toxics Substances Control for soils.

The trustees have been involved in the ecological risk assessment process for the Shipyards since 2001 and have worked closely with the Board staff on development of several work plans associated with the risk assessment. The trustees participated in technical workshops in December 2002, and January 2003 to determine a reference pool to help evaluate site-related contaminants. During the January 2003 meeting, NOAA, along with the Navy, the Southern California Coastal Water Research Program (SCCWRP), and the Shipyards, submitted different approaches for establishing a reference pool and determining the appropriate statistics to use in analysis of the data. The San Diego Bay Council also submitted an approach after the January meeting. In the months since the January meeting, the trustees have provided significant, additional technical information to the Board staff regarding methodologies for selecting and statistically evaluating a reference pool. Given that the trustees and the Board have complementary authorities for protecting the public resources, the trustees believe that there should be more conferring with, and reliance on the technical guidance and expertise of the trustees.

The trustees recognize that this has been a difficult process and, given any complex problem, there are multiple approaches for addressing the issues. The trustees had the opportunity to attend a meeting on September 3rd where the Board staff explained the process they used to select the final reference pool, and describe the statistical approach that was selected to evaluate the pool. Based on those discussions, and the trustee's current understanding of the approach, the trustees would like to provide you with the following comments.

"Distance from Shore" Approach

The trustees have previously expressed concern to the Board staff regarding the selection of the "Distance from Shore" approach to establish the reference pool. Little scientific justification has been provided for the initial screening process used to establish the pivotal threshold chemical concentrations. These threshold chemical concentrations were used to determine the initial reference pool, and there is some question as to whether all qualifying stations were included in the pool. In light of the precedent setting nature of this exercise, it is essential to ensure that the process is scientifically sound. Until the various questions surrounding this approach can be answered and validated, the trustees recommend that the Board staff not adopt the "Distance from Shore" approach for establishing a reference pool for any future site investigations in San Diego Bay.

Statistical Approach

Despite the fact that there are several uncertainties associated with the initial "Distance from Shore" approach, the Board staff utilized additional selection criteria, and selected a reference pool for the shipyards that appears to be reasonable. The <u>average</u> concentration of contaminants in sediment are close to NOAA's conservative screening values (Effects Range-Low), the <u>average</u> survival of organisms exposed to the reference pool sediments is 95%, and the <u>average</u> benthic community index for the reference pool stations is within the acceptable impact category. However, these averaged, apparently protective numbers are not the criteria that will be used to determine whether a location at the shipyard will be remediated.

An additional statistical approach will be applied to the reference pool to evaluate the differences between contaminant levels in shipyard samples and those in the reference pool. The trustees have had discussions with the Board staff with regard to choosing the appropriate statistic to apply to this data set, particularly when taking into consideration the inherent non-random and non-normal distribution of the selected reference pool. The trustees welcome the opportunity to assist the Board staff in their further determination of the appropriate statistical method for evaluating whether <u>individual</u> sites (i.e., samples) are considered different from the reference pool. We also anticipate working closely with the Board staff to: 1) assess the risk the impacted sites may pose to the trust resources that utilize the area; and 2) determine if the designated beneficial uses are being impacted by releases from the site.

Use of the Reference Pool

It is the understanding of the trustees that the Board staff is proposing to use the reference pool in the risk assessment for the shipyards. It is important to separate the risk assessment process from the risk management process (selecting the appropriate cleanup level). The risk the shipyards pose to exposed ecological receptors must be evaluated first. Once this risk is assessed, site specific data (shipyard samples) should be compared with the reference pool to determine if those risks are site-related and warrant further consideration.

Although there are still several questions and levels of uncertainty around the selection of the reference pool, and the statistics that will be applied to the pool, the trustees believe that these issues can be resolved to arrive at cleanup levels that will reduce risk and lead to restoration. The trustees also believe that the public interest can best be served and protected by having an open and deliberative process involving the input of all stakeholders. The Board staff has invested considerable effort and capital into putting forward this approach for determining a reference pool, and they are to be recognized for embracing a difficult and complex task.

In recognition of the shared vision, that in the future, San Diego Bay will meet all designated beneficial uses established under the Porter-Cologne Act, the trustees would like to have the Board ensure that a close partnership, which is reliant and built upon all the appropriate, invested authorities, is established between the trustees and the San Diego Regional Water Quality Control Board staff. The trustees look forward to enhanced coordination with the Board and Board staff in working toward our mutual goal of protecting and restoring San Diego Bay. The trustees also appreciate your time and effort in responding to our aforementioned concerns. If you have any questions regarding these comments and concerns, please feel free to contact me at (916) 255-6686.

Thank you for your consideration.

Sincerely,

Denise M. Klimas

Denise M. Klimas
NOAA Coastal Resource Coordinator
Office of Response and Restoration
Coastal Protection and Restoration Division

Attachment included

Reviewed by:

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Cc: Mr. John Minan and Regional Board Members
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APPENDIX 3
OF ATTACHMENT C

Distance-From-Shore Approach

Distance-from-shore approach to identify Bight'98 reference sites in San Diego Bay

Steve Bay and Jeff Brown, SCCWRP
January 8, 2003

Introduction

An approach to identify potential reference stations in San Diego Bay was created with the assumption that most contaminants in the bay's sediments originate from land-based discharges. Following this assumption, contaminant concentrations in sediments should diminish with distance from land, and eventually reach levels consistent with bay-wide ambient levels. By identifying background levels of contaminants, stations with contamination below the concentration threshold (regardless of distance from shore) can be used as appropriate reference sites. This summary describes the distance-from-shore approach that was used with Bight'98 data to identify reference sites in San Diego Bay.

Methods

The relationship between contaminant concentration and distance from shore was examined for 38 non-marina stations in San Diego Bay sampled during Bight'98. Seven contaminants were examined, including five metals (Cu, Cr, Hg, Pb, Zn) and two organics (total PAHs, total PCBs). Metal concentrations were iron-normalized and plotted versus distance from shore. Iron normalization was used in order to minimize the bias of selecting only stations with larger grain sizes, since concentrations of metals tend to increase naturally in finer grain sediments. Iron has been shown to be a conservative tracer that can help differentiate natural from anthropogenic concentrations of metals in the Southern California Bight. Iron normalization consists of dividing the concentration of a given metal (mg/kg) by the concentration of iron present (mg/kg). The organics data were not normalized. Non-detect values were substituted with the method detection limit.

Results

Each of the seven constituents tended to have diminished concentrations with distance from shore (Figures 1-7). For metals, concentrations appeared to level off at around 240 m for Cu, 160 m for Cr, and 150 m for Hg, Pb and Zn. For the organics, concentrations leveled off at around 290 m and 170 m for PAHs and PCBs, respectively.

Based on the plots, stations that are 290 m or greater from shore were determined to represent ambient conditions. An upper threshold concentration was developed for Cu, Cr, Hg, Pb, Zn, and PAHs by using the mean concentration + 1.64 standard deviations for stations that are $\geq$290 m from shore (equivalent to the one-tailed upper 95% confidence limit). The threshold for PCBs was derived from the maximum value for stations $\geq$290 m because PCB values were below the detection limit at a majority of sites, and the upper 95% confidence limit could not be calculated. The following upper threshold values were obtained: PAHs = 1040 ng/g, PCBs = 101.6 ng/g, Fe normalized Cr = 0.0022, Fe normalized Cu = 0.0044, Fe normalized Hg = 2.3×10^{-5}, Fe normalized Pb = 0.0020, Fe normalized Zn = 0.0073. All stations below the threshold levels for any of the seven indicator contaminants were then identified, regardless of distance from shore (Table 1). Those stations with constituents below the threshold concentrations for all of the indicators (Cr, Cu, Hg, Pb, Zn, PAHs, and PCBs) were considered to be representative of bay-wide ambient conditions. Twenty two stations were identified as revised reference sites, ranging from 10-1080 m from shore (Table 1). The location of these sites in San Diego Bay is shown in Figure 8.

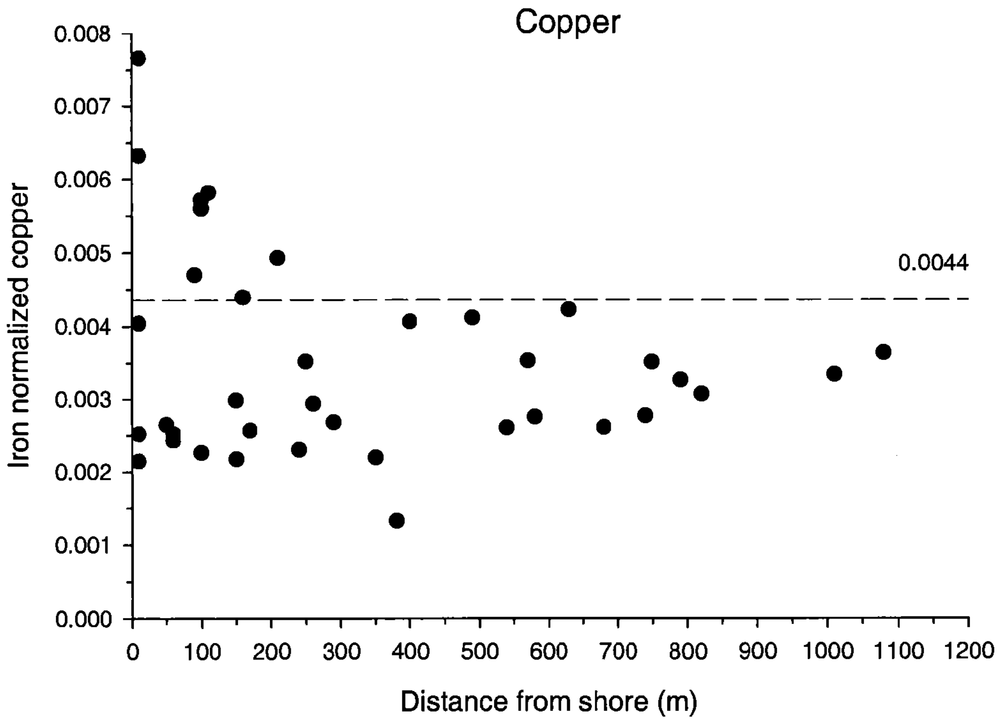

Figure 1. Relationship between the concentration of iron normalized copper and distance from shore. The dashed line indicates the upper threshold concentration.

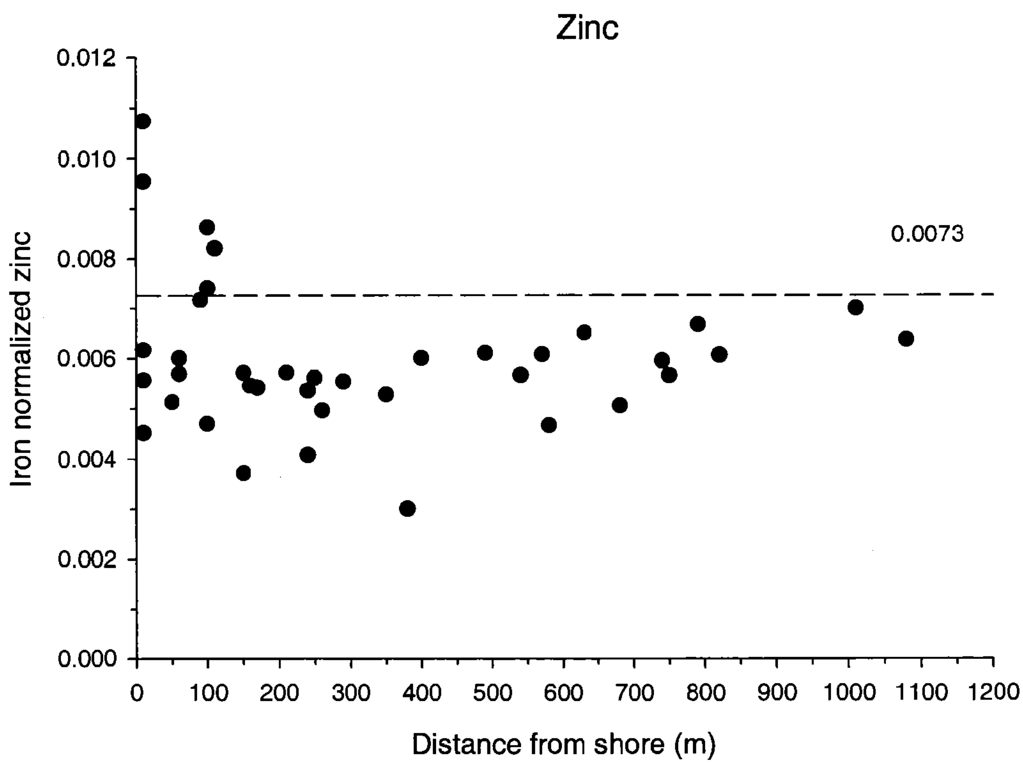

Figure 2. Relationship between the concentration of iron normalized zinc and distance from shore. The dashed line indicates the upper threshold concentration.

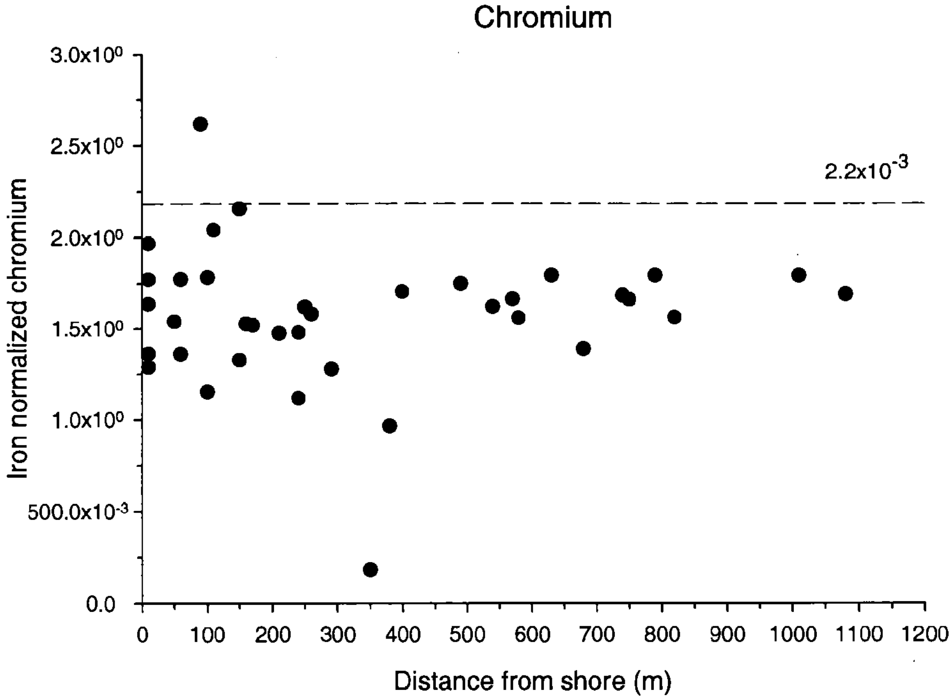

Figure 3. Relationship between the concentration of iron normalized chromium and distance from shore. The dashed line indicates the upper threshold concentration.

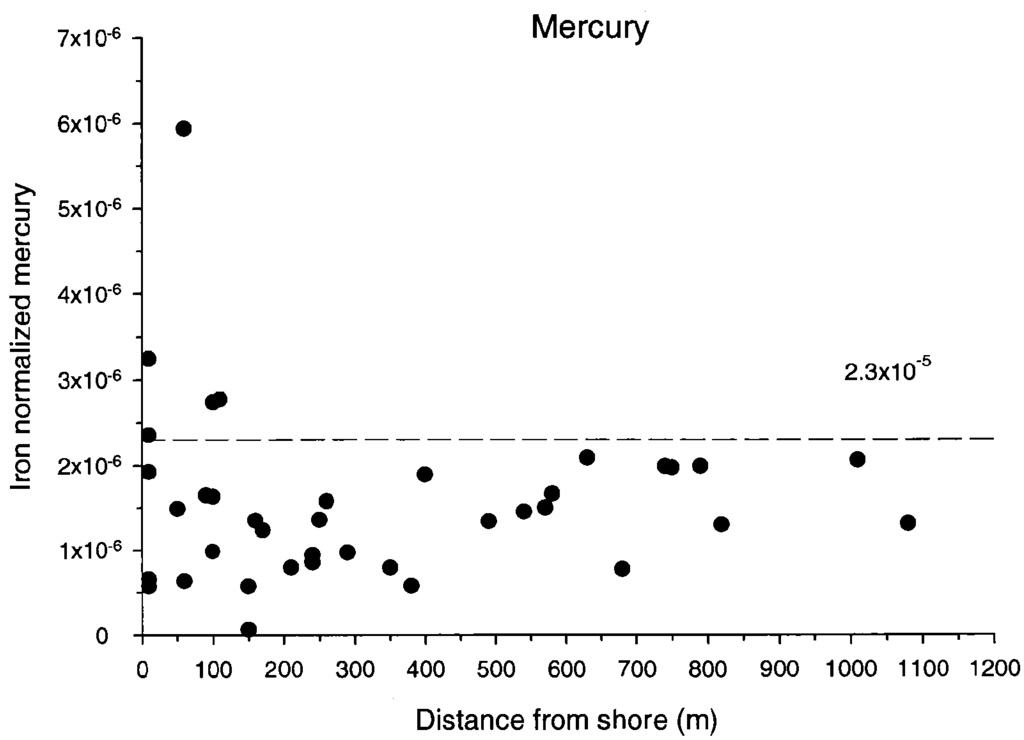

Figure 4. Relationship between the concentration of iron normalized mercury and distance from shore. The dashed line indicates the upper threshold concentration.

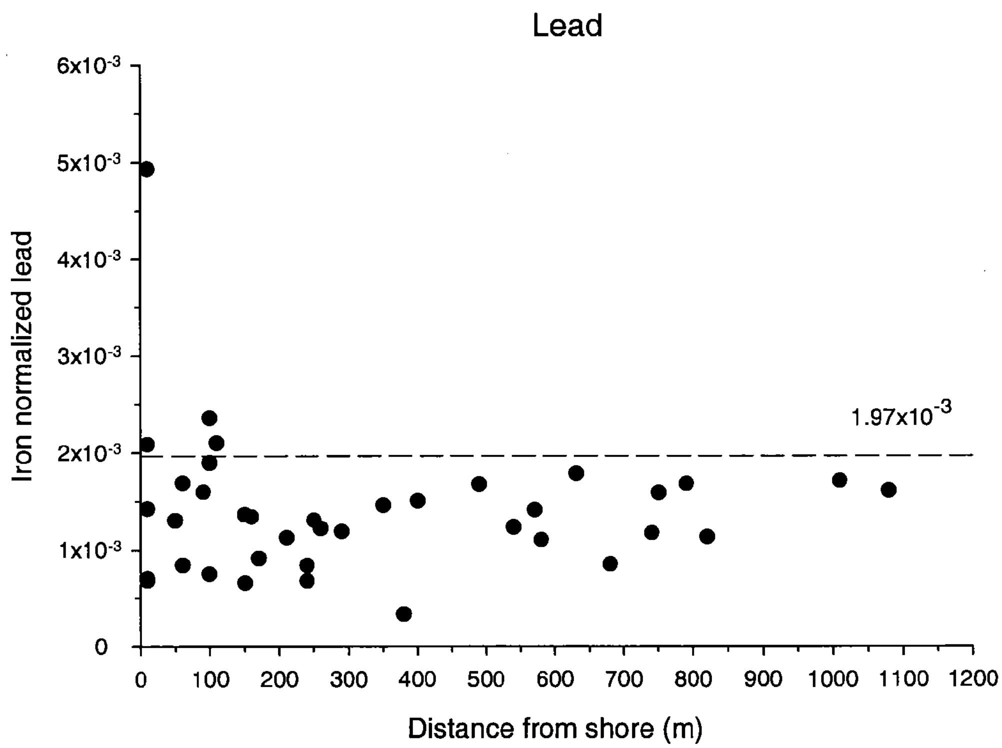

Figure 5. Relationship between the concentration of iron normalized lead and distance from shore. The dashed line indicates the upper threshold concentration.

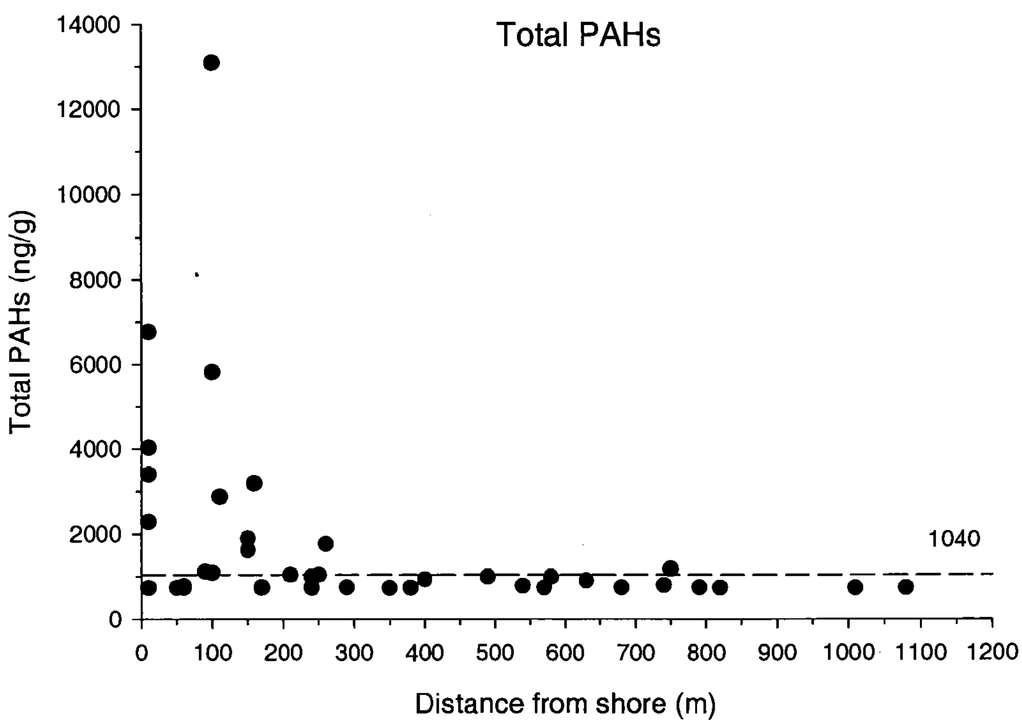

Figure 6. Relationship between the concentration of total PAHs and distance from shore. The dashed line indicates the upper threshold concentration. Non-detects were treated as equal to the method detection limit.

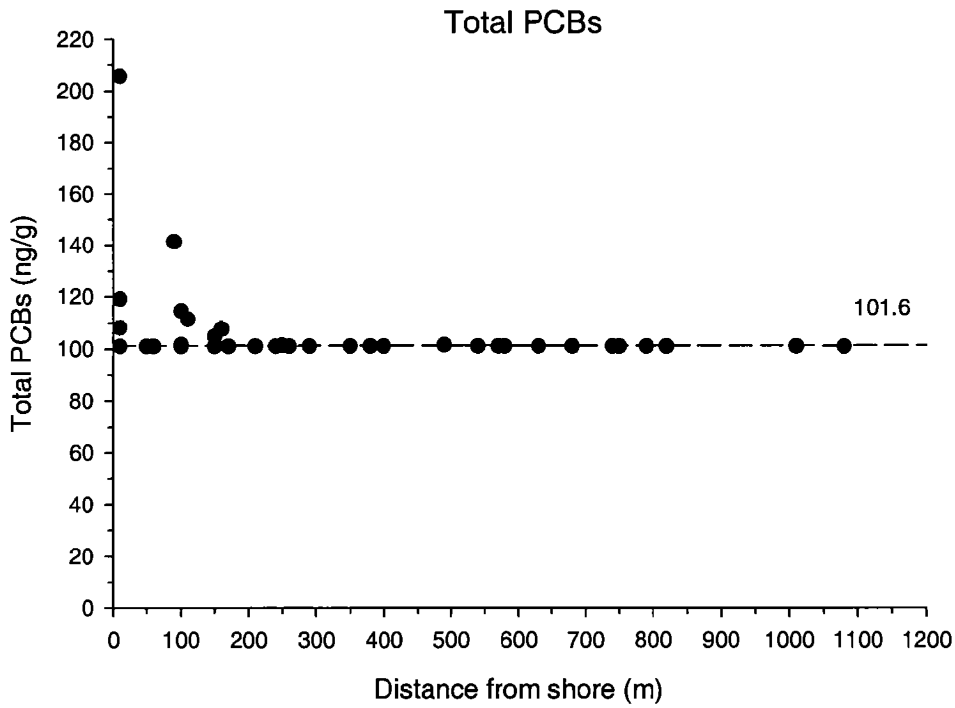

Figure 7. Relationship between the concentration of total PCBs and distance from shore. The dashed line indicates the threshold concentration. Non-detects were treated as equal to the method detection limit.

Table 1. Data used for selection of reference stations from the Bight'98 survey. Concentrations of Cu, Cr, Hg, Pb, Zn, PAHs or PCBs below the upper thresholds are indicated in grey. Stations where the concentrations are below the threshold for each of these constituents are considered to represent bay-wide ambient conditions; these stations are indicated with a Y in the Revised Reference site column. Iron normalized data have been multiplied by 1000 for convenience. The method detection limit was substituted for non-detect values.

Station	Distance from nearest shore (m)	Sampling Plan Reference site	Revised Reference site	Cu/Fe $x10^3$	Cr/Fe $x10^3$	Hg/Fe $x10^3$	Pb/Fe $x10^3$	Zn/Fe $x10^3$	Total PAHs ng/g	Total PCBs ng/g	Fe mg/kg	% Fines	% TOC
2238	10	Y	Y	2.1	1.29	0.007	0.70	5.6	735	101.1	25700	57	0.96
2253	10			7.7	1.64	0.032	2.09	9.5	2279	205.7	32900	66	1.57
2263	10			4.0	1.97	0.024	1.42	6.2	3389	108.1	29200	73	1.25
2264	10			6.3	1.77	0.019	4.94	10.7	4020	119.1	39100	73	2.01
2442	10			2.5	1.36	0.006	0.69	4.5	6771	101.1	30800	79	1.99
2440	50	Y	Y	2.6	1.54	0.015	1.30	5.1	735	101.1	15800	38	0.50
2230	60			2.5	1.77	0.059	1.69	6.0	735	101.1	6380	10	0.20
2249	60		Y	2.4	1.36	0.006	0.84	5.7	778	101.1	34600	72	1.35
2439	90			4.7	2.62	0.017	1.60	7.2	1119	141.3	28300	53	1.03
2227	100	Y		2.3	1.15	0.010	0.75	4.7	1088	101.1	23800	50	0.93
2251	100			5.6	1.78	0.016	2.36	7.4	5825	114.5	35000	72	1.99
2254	100			5.7	1.78	0.027	1.90	8.6	13087	101.7	13100	35	0.66
2255	110			5.8	2.04	0.028	2.10	8.2	2871	111.4	25100	59	1.18
2434	150			3.0	2.16	0.001	1.37	5.7	1614	104.8	23100	45	0.71
2441	150	Y		2.2	1.33	0.006	0.66	3.7	1890	101.1	33100	79	1.97
2259	160			4.4	1.53	0.013	1.35	5.5	3182	107.7	33000	68	1.24
2245	170		Y	2.6	1.52	0.012	0.92	5.4	745	101.1	26850	60	0.78
2262	210			4.9	1.47	0.008	1.12	5.7	1036	101.1	40600	74	1.64
2235	240		Y	2.3	1.48	0.009	0.84	5.4	735	101.1	25400	45	0.64
2433	240	Y	Y	2.3	1.12	0.009	0.68	4.1	994	101.1	30900	71	1.17
2231	250	Y	Y	3.5	1.62	0.014	1.31	5.6	1037	101.4	16500	31	0.64

Table 1 continued.

Station	Distance from nearest shore (m)	Sampling Plan Reference site	Revised Reference site	Cu/Fe $x10^3$	Cr/Fe $x10^3$	Hg/Fe $x10^3$	Pb/Fe $x10^3$	Zn/Fe $x10^3$	Total PAHs ng/g	Total PCBs ng/g	Fe mg/kg	% Fines	% TOC
2229	260	Y		2.9	1.58	0.016	1.23	5.0	1753	101.1	20000	43	0.92
2252	290		Y	2.7	1.28	0.010	1.19	5.5	737	101.1	11600	16	0.59
2265	350		Y	2.2	0.18	0.008	1.47	5.3	735	101.1	8190	13	0.35
2435	380	Y	Y	1.3	0.96	0.006	0.33	3.0	735	101.1	21400	49	0.55
2258	400		Y	4.1	1.70	0.019	1.51	6.0	925	101.1	35200	71	1.44
2257	490		Y	4.1	1.75	0.013	1.68	6.1	987	101.6	38200	77	1.63
2240	540	Y	Y	2.6	1.62	0.014	1.24	5.7	777	101.1	18200	44	0.55
2260	570		Y	3.5	1.66	0.015	1.42	6.1	735	101.1	14400	27	0.51
2436	580		Y	2.8	1.56	0.017	1.10	4.7	977	101.1	31133	55	1.36
2256	630		Y	4.2	1.79	0.021	1.79	6.5	895	101.1	30300	67	1.26
2247	680		Y	2.6	1.39	0.008	0.85	5.0	738	101.1	20400	44	0.58
2242	740		Y	2.8	1.68	0.020	1.18	5.9	791	101.1	15100	31	0.74
2239	750			3.5	1.66	0.020	1.59	5.7	1178	101.1	21400	34	0.72
2233	790		Y	3.3	1.79	0.020	1.69	6.7	738	101.1	15900	36	0.45
2244	820		Y	3.1	1.56	0.013	1.13	6.1	735	101.1	13600	20	0.30
2243	1010	Y	Y	3.3	1.79	0.021	1.72	7.0	735	101.1	11600	35	0.49
2241	1080		Y	3.6	1.69	0.013	1.62	6.4	735	101.1	16290	18	0.52

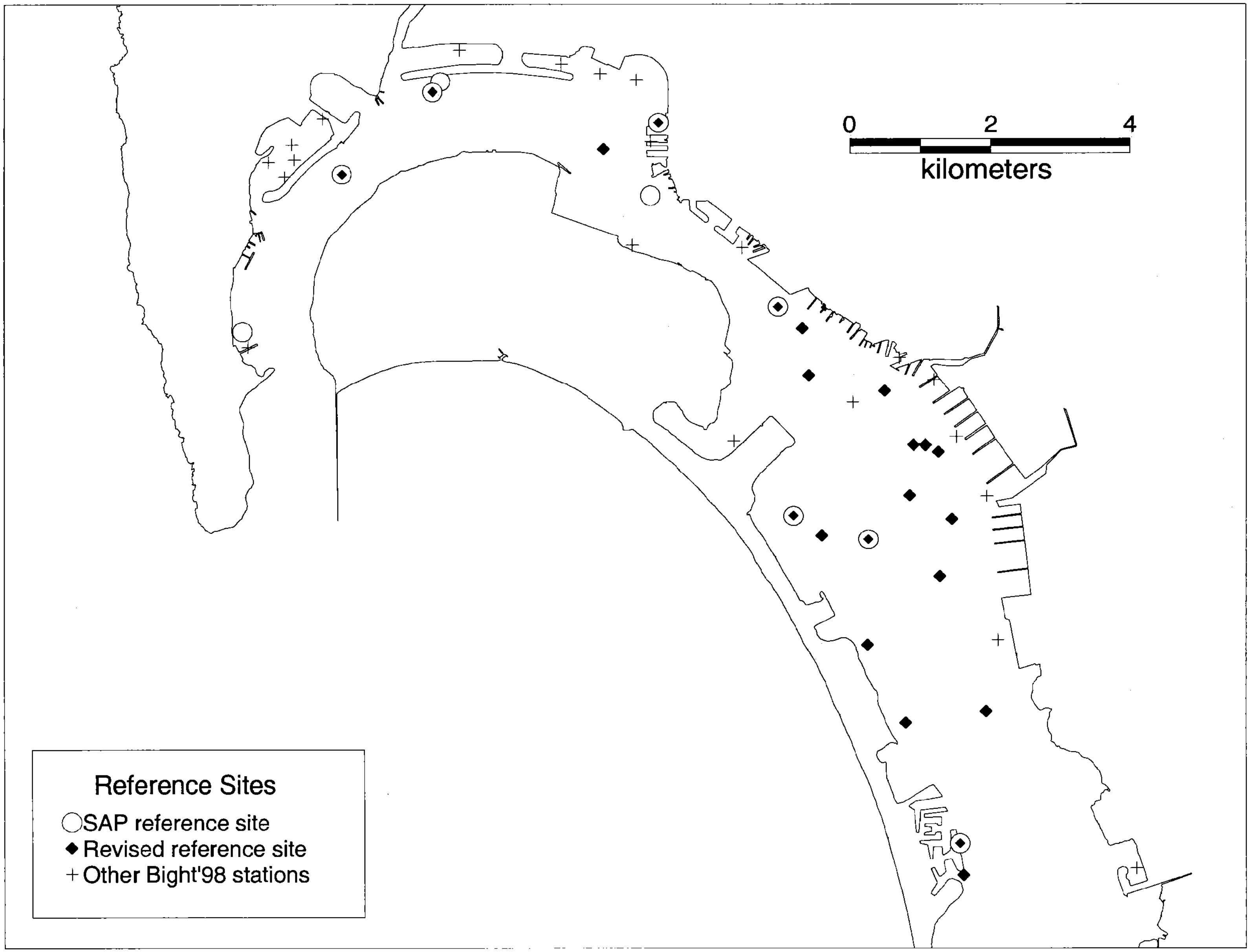

Figure 8. Bight'98 stations in San Diego Bay. Stations that represent bay-wide ambient conditions, based on the distance-from-shore approach, are indicated by diamonds. The ten reference sites identified in the Chollas/Paleta Sampling and Analysis Plan (SAP) are indicated by open circles. The remaining Bight'98 stations in San Diego Bay are indicated by crosses.

APPENDIX 4
OF ATTACHMENT C

Consensus Evaluation of Candidate Reference Sites for Use in Evaluating Data from the NASSCO/SWM Shipyard and Chollas/Paleta Creek THS Areas

[Data Not Provided in Appendix]

Consensus Evaluation of Candidate Reference Sites for Use in Evaluating Data from the NASSCO/SWM Shipyard and Chollas/Paleta Creek THS Areas

Steve Bay, SCCWRP
April 10, 2003

Background

This document summarizes the analyses conducted by SCCWRP, SSC, and Exponent in response to the 2/3/03 request by the San Diego Regional Water Quality Control Board to evaluate various reference data pools. These analyses had two objectives: to provide recommendations regarding the inclusion of candidate reference stations sampled in 2001 into an analysis pool (2A) and to summarize the characteristics of several combinations of reference stations using various measures of variability and prediction.

The information presented here represents the combined recommendations of SCCWRP, SSC, and Exponent specifically with regard to the evaluation of data from the NASSCO/SWM Shipyard and Chollas/Paleta Toxic Hot Spot (THS) assessment studies. While these recommendations may be applicable to the establishment of a regional reference data pool for other areas of San Diego Bay, decisions regarding the establishment of a regional reference data pool should include consideration of additional data and factors that have not been included here.

Candidate Reference Pool 2A

Methods

Statistical analyses were conducted in order to describe the similarity of chemical, biological, and toxicological characteristics of the 2001 reference sites to expectations based on prior data. These analyses followed steps 1-6 of the process developed during the January 22-23 2003 meeting on reference sites, as modified on February 7. These steps were:

<u>Step 1. Compile data from the relevant studies</u>. Data for the contaminants of concern (specified in the 2/3/03 instructions from the Regional Board), benthos (abundance, number of taxa, and diversity), and toxicity (amphipod survival) were compiled for the six 2001 Chollas/Paleta reference sites, five 2001 (phase I) and 12 2002 (phase II) Shipyard reference sites, selected Bight'98 candidate reference sites, and seven BPTCP reference sites. One-half of the method detection limit was substituted for nondetect values, except for the shipyard data, where one-half of the reporting limit was used. Sums of some organic contaminant groups were calculated as follows: total PCB = sum of measured congeners, total DDT or Chlordane = sum of measured isomers/metabolites, total PPAH = sum of priority pollutant PAHs. The individual constituents comprising each of these sums and the raw data are shown in the enclosed workbook (ReferenceEnvelope_Sc_Nv_Ex.xls). Amphipod survival data are expressed as a percentage of the control sample to facilitate comparisons among datasets. In addition, the survival data for the CP stations has been modified by the removal of outlier replicates as endorsed by the Regional Board.

Step 2. Confirm normal distribution of the chemistry data. The Bight'98 chemistry data for non-marina stations within San Diego Bay were analyzed using the Kolmogorov-Smirnov (K-S) test for normality. Separate tests were conducted for untransformed and natural log transformed data.

Step 3. Calculate one-tailed 95% prediction intervals for the Bight98, phase II, or BPTCP data. Three types of prediction intervals were calculated. The 95% one-tailed prediction interval was calculated without adjustment for multiple comparisons. A multiple comparison prediction interval was also calculated by adjusting the alpha level of the test for the number of expected comparisons to the 2001 reference sites. In most cases, this adjustment was accomplished by using an alpha of 0.004 (0.05/11) for the prediction interval calculation.

Finally, the tolerance limit was calculated for each parameter in order to resolve uncertainty regarding the appropriate adjustment of the prediction interval for multiple comparisons. Whereas the prediction interval gives us a concentration that the next sample (or next n samples) will not exceed (with a given level of confidence), the tolerance limit gives us a concentration that a specified fraction of the population will not exceed (with a given level of confidence). Because the number of candidate reference stations that may ultimately be compared to the screening level is indefinite, the tolerance limit is most appropriate to characterize the expected results of an indefinite number of future comparisons to the reference area population. Use of tolerance limits to screen data requires an explicit recognition that there is a specific expected error rate, which is analogous to the type I and II errors associated with other statistical tests. The parameters used here represent 95% coverage of reference area conditions (i.e. an alpha of 0.05), with 99% confidence. These parameters produce tolerance limits that are, in most cases, comparable to the multiple-comparison-corrected upper prediction limit. Calculations of the tolerance interval are based on: Natrella, M.G. 1963. Experimental Statistics. National Bureau of Standards Handbook 91. National Bureau of Standards., U.S. Department of Commerce, Washington, D.C.

All metals data were normalized to the percent fines before statistical analysis.

Step 4. Compare the prediction/tolerance intervals to the 2001 data. The number of exceedences for each of the identified parameters was tabulated for each station using each of the three types of intervals. Comparisons involving the shipyard phase II data set excluded station 2440 since this station has been identified in previous discussions as probably not representative of ambient reference conditions in San Diego Bay.

Steps 5 & 6. Use best professional judgment to evaluate the statistical comparison results and decide on the suitability of each 2001 reference site. Factors considered in the evaluation included: the number and type of intervals exceeded (e.g. unadjusted/adjusted prediction interval and tolerance interval) and the magnitude of the deviation in relation to ER-M/ER-L sediment guidelines or to the mean of the data. Separate evaluations were conducted for the chemistry, benthos, and toxicity data.

Results

Step 1. The compiled data is shown in the sheet named "total .5mdl" of the "ReferenceEnvelope.." workbook. Additional sheets showing each individual data sheet are also included.

Step 2. The results of the K-S normality test of the Bight'98 data are shown in Table 1. Analyses are shown only for metal constituents of concern. Analyses could not be conducted for PAHs, DDTs, Chlordane, or PCBs due to the presence of multiple nondetect values in the dataset. Nonnormality was indicated for arsenic and mercury. A retest of natural log transformed data resulted in a better fit to a normal distribution for As and Hg ($p>0.05$). Consequently all subsequent analyses were conducted with transformed data for these two metals. Data for tributyltin was also natural log transformed, based on prior studies by Exponent indicating that this constituent usually had a log normal distribution in environmental samples. No transformation was applied to any of the other chemical constituents because there was no conclusive indication from the Bight98 San Diego Bay dataset indicating nonnormality.

Table 1. Results of K-S normality test on Bight'98 data (marina stations excluded). Boxed cells indicate parameters where nonnormality is indicated in nontransformed data. Normality of organics data could not be evaluated due to the relatively high number of nondetect values.

	Non-transformed	Natural log transformed
Ag	>0.15	<0.0100
As	**0.0259**	**>0.15**
Cd	0.0811	<0.0100
Cr	>0.15	0.0373
Cu	>0.15	>0.15
Hg	**<0.0100**	**0.072**
Ni	>0.15	0.1045
Pb	>0.15	>0.15
Zn	0.0983	>0.15

Step 3. The data and resulting prediction interval calculations are shown (magenta highlight) in the sheet named "calcs as per 23 jan meeting" of the "ReferenceEnvelope…" workbook. The tolerance interval calculations are shown (yellow highlight) in the "data for calcs" sheet. A summary of the prediction/tolerance intervals and a tabulation of the number of exceedences for each station is shown in the sheet named "site comparisons". The total number of interval exceedences is summarized in Table 2.

Each of the stations, except for CP 2238, had at least one exceedence of the nonadjusted prediction interval. The number of exceedences declined for the adjusted PI and tolerance interval, indicating that some of these exceedences may be due to random variability in the data. Station 2440 for both the CP and SY datasets demonstrated the highest number of exceedences for each type of interval. Almost all of the interval exceedences were due to elevated chemistry. Benthic parameter intervals were only exceeded for reduced diversity at station 2231, which has been identified previously as having an atypical fauna dominated by a crustacean species. Several stations exceeded the unadjusted PI for reduced amphipod survival (2231, CP 2433, and CP 2441), but no exceedences for toxicity using the adjusted PI or tolerance interval were present.

Table 2. Results of prediction and tolerance limit comparison for each 2001 reference site.

Study	Station	# over Unadjusted PI	# over Adjusted PI	# over Tolerance interval	# total possible
CP	2231	8	3	2	17
CP	2243	8	3	1	17
CP	2433	5	1	1	17
CP	2440	10	9	8	17
CP	2441	3	1	1	17
CP	2238	0	0	0	17
SY I	2231	7	1	1	16
SY I	2243	2	0	0	16
SY I	2433	1	1	1	16
SY I	2440	6	5	4	16
SY I	2441	1	1	1	16

Steps 4 & 5. The consensus results of the evaluation of the data regarding inclusion of the reference sites in pool 2A are summarized in Table 3. The pool 2A recommendations agree with the pool 1A recommendations for 8 of 11 stations and no additional discussion of these stations is therefore needed. Discussion of the three stations showing different recommendations is provided below.

CP 2231: The pool 2A recommendation is to include this station in the dataset. The benthos community at this station is atypical of other reference areas and those data should be excluded from a general reference data pool. However, the chemistry and toxicity data are consistent with other reference areas and these data should be retained because this station has high temporal and method comparability with the CP study sites. Examination of the number of unadjusted and adjusted PI exceedences shows that the concentrations of Cd, Cr, Ni, and DDT are relatively small; equal to or less than the adjusted PI. Thus, these exceedences are likely due to low variability in the data and the application of multiple statistical comparisons, not the presence of site-specific contamination. Similarly, the reduced amphipod survival reported for this station (76% of control) is a marginal decrease that is within the test-to-test variability observed in other studies. The concentration of PPAH at CP 2231 is substantially elevated relative to the comparison dataset. However, the PPAH concentration is well below the ERL, indicating a low potential for toxicity, and within a factor of 2 of the concentration reported for SY 2231. It is concluded that the CP 2231 PPAH is a marginal exceedence that may be due to analytical lab variability and not of sufficient biological significance to outweigh the benefits of including the data.

CP 2441: The pool 2A recommendation is to include this station in the dataset. This station shows exceedences of the unadjusted PI for Cd, PPAH, and toxicity. The Cd and toxicity deviations are small and likely due to statistical artifacts (low data variability and multiple comparisons) since they do not exceed the adjusted PI. The PPAH concentration of 2143 ug/kg is above the tolerance interval and is considered a substantial elevation relative to the dataset. However, this station contains a relatively high TOC content that is likely to account for the elevated concentration. Figure 1 shows the relationship of PPAH concentration to TOC. A general direct relationship is evident and station CP 2441 lies close to the apparent regression line, while the points for the clearly contaminated stations CP 2440 and SY 2440 lie much further from the regression line. This plot shows that variation in TOC is a likely contributing factor to the PPAH data variation. A similar trend is also present for grain size, as shown in the plot in the enclosed workbook named "RefPAHAnalysis.xls". Normalization of the data to TOC (Figure 2) or percent fines shows that the PPAH concentration is similar to that of other stations with acceptable nonnormalized PPAH concentrations (e.g., 2433). An analysis of the pattern (i.e., fingerprint) of PAH compounds also indicates that CP 2441 is similar to other acceptable reference sites. The relative (%) concentration of each parent PAH to the total PPAH is shown in Figure 3. Station CP 2441 has a relative PAH concentration that is similar to the values for the three stations with the lowest total PPAH concentrations (2243, 2433, 2238) for 16 of 20 analytes, whereas CP 2440 is similar for only 9 analytes. This figure demonstrates that the source of PAH at CP 2441 is similar to that of other less contaminated stations, indicating that this station reflects ambient PAH exposure, not a site-specific source.

SY 2231: This station shows an atypical benthos community and those specific data should not be included in a general reference pool. Exceedences of the unadjusted PI were also present for As, Pb, PPAH, PCB, toxicity, and TBT, but these parameters did not exceed the adjusted PI, which indicates that statistical artifacts were likely responsible. The chemistry and toxicity data for this station should be included in the general data pool because the benefit of including data with high comparability to the CP and SY studies is greater than the negative impact of including a site with marginal elevated contaminants. This station also includes a relatively high TOC and fines content, which makes it valuable for data interpretation.

Table 3. Station inclusion recommendations for reference pool 2A based on Table 2 results and best professional judgment. Pool 1A inclusion based on results of Jan 23rd meeting as modified by the Regional Board. Areas of difference between pool 1A and 2A designations are highlighted within boxes.

Study	StationID	%FINES	%TOC	Chemistry	Toxicity	Benthos	Overall	Pool 1A Inclusion
CP	2231	41.24	1	yes	yes	N/A	*yes	no
CP	2243	30.25	0.56	yes	yes	yes	yes	yes
CP	2433	38.44	0.53	yes	yes	yes	yes	yes
CP	2440	26.4	1.04	no	yes	yes	no	no
CP	2441	82.83	1.82	yes	yes	yes	yes	no
CP	2238	69	1.01	yes	yes	yes	yes	yes
SY I	2231	45	1.3	yes	yes	N/A	*yes	no
SY I	2243	28	0.51	yes	yes	yes	yes	yes
SY I	2433	41	0.67	yes	yes	yes	yes	yes
SY I	2440	32	1.62	no	yes	yes	no	no
SY I	2441	41	1.1	yes	yes	yes	yes	yes

* Not suitable for overall benthos evaluation in this study.

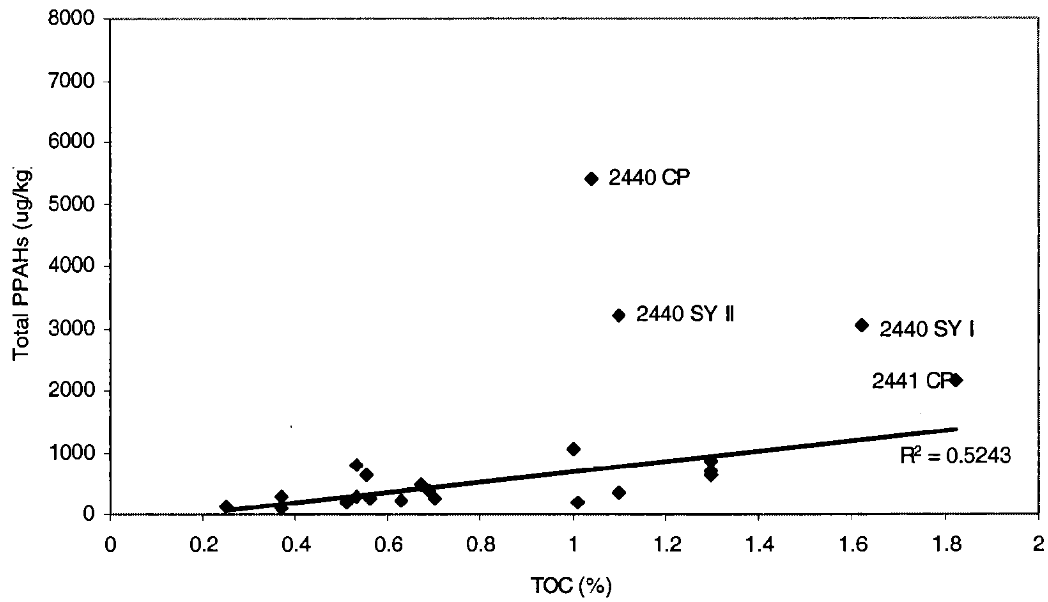

Figure 1. Relationship of total PPAHs to TOC for 2001/2002 reference sites.

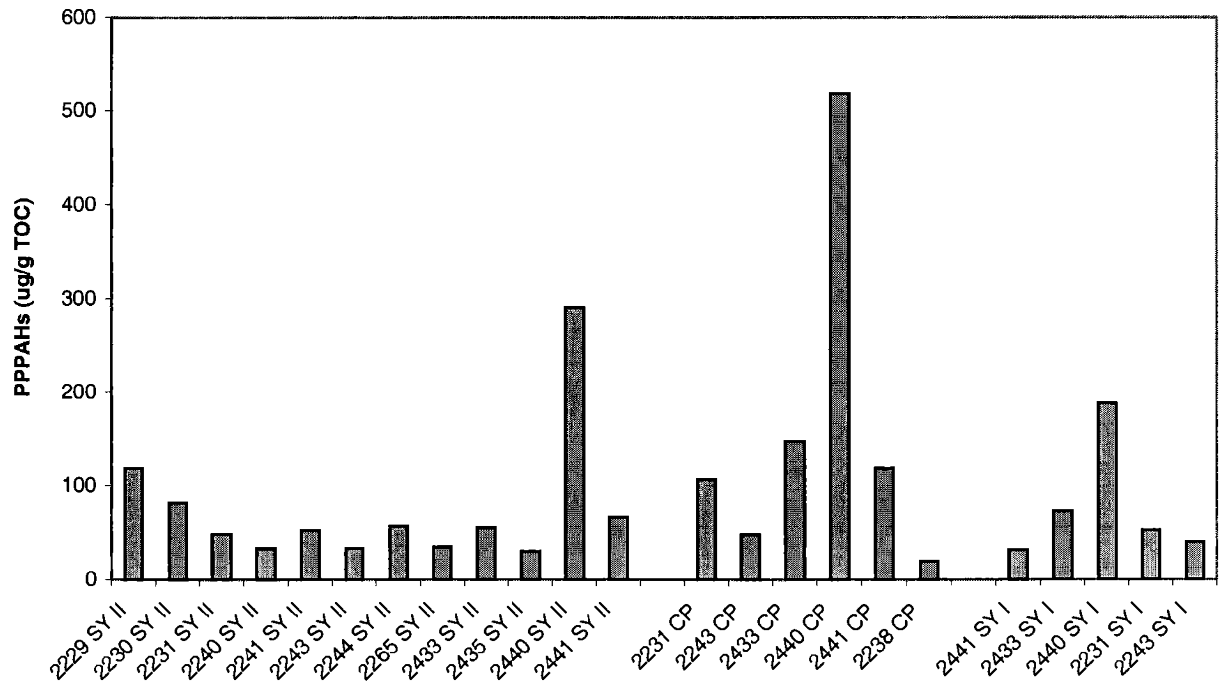

Figure 2. TOC-normalized total PPAHs for the 2001/2002 reference sites.

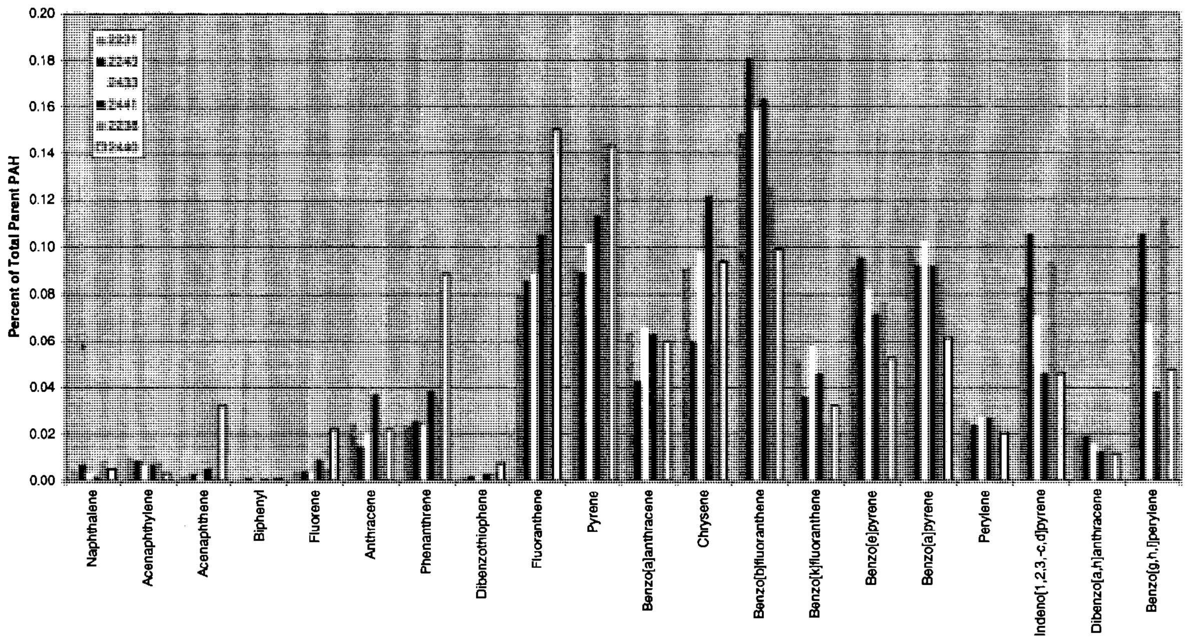

Figure 3. Relative composition of parent PAH compounds at the Chollas/Paleta reference sites.

Summary of Reference Data Pools

Methods

Calculations of the unadjusted/adjusted 95% PI and tolerance intervals were conducted using the same methods as for the evaluation of reference pool 2A (described previously). The adjusted PI calculations assumed that 31 station comparisons would be carried out, which is equivalent to the maximum number of stations at either the shipyard or Chollas/Paleta study sites. All calculations for As, Hg, and TBT were conducted using ln transformed data, but the results have been converted to the untransformed state for presentation in the tables. The calculations for pools 2A and 2B incorporate the recommendations for station inclusion described above. The workbook named "ReferenceEnvelope..." shows contains the calculations for all of the statistics.

Results

The descriptive statistics and prediction/tolerance intervals for each of the 4 reference pools is summarized in Table 4. Bar plots of the intervals for most of the parameters are contained in the sheet named "envelope summary" in the workbook "ReferenceEnvelope...".

Table 4. Descriptive statistics for the various reference data pools. Tolerance values could not be determined for some parameters in pools 1A or 2A due to a sample size less than 4.

Envelope		Ag norm	*As norm	Cd norm	Cr norm	Cu norm	*Hg norm	Ni norm	Pb norm	Zn norm	*TBT
1A	N	6	6	6	6	6	6	6	6	6	3
1B	N	28	28	28	28	28	28	28	28	28	3
2A	N	9	9	9	9	9	9	9	9	9	4
2B	N	31	31	31	31	31	31	31	31	31	4
1A	Mean	1.2	13.9	0.5	87.1	126.3	0.6	24.8	59.5	295.6	3.2
1B	Mean	1.4	13.8	0.3	78.6	147.8	0.6	23.4	62.8	293.5	3.2
2A	Mean	1.0	14.4	0.4	87.0	134.1	0.6	24.4	64.4	280.6	4.7
2B	Mean	1.3	14.0	0.3	79.4	148.0	0.6	23.4	63.9	289.4	4.7
1A	SD	0.7	1.2	0.2	30.2	40.5	1.5	5.8	25.6	78.2	1.2
1B	SD	0.9	1.3	0.2	27.4	55.1	1.5	5.7	27.0	86.1	1.2
2A	SD	0.6	1.3	0.2	26.8	41.7	1.6	4.9	28.3	74.8	2.2
2B	SD	0.8	1.3	0.2	26.9	53.8	1.6	5.5	27.5	84.7	2.2
1A	95% PI Uncorr.	2.7	22.0	1.0	152.9	214.4	1.6	37.4	115.1	465.7	5.8
1B	95% PI Uncorr.	2.8	22.1	0.7	126.2	243.4	1.3	33.3	109.6	442.7	5.8
2A	95% PI Uncorr.	2.2	23.0	0.9	139.5	215.8	1.6	34.1	119.9	427.3	37.5
2B	95% PI Uncorr.	2.7	22.3	0.6	125.7	240.7	1.3	32.9	111.4	435.4	37.5
1A	95% PI Corr.	5.1	46.4	1.8	259.7	357.6	7.3	57.8	205.4	742.1	121.9
1B	95% PI Corr.	4.2	33.5	0.9	168.8	329.2	2.6	42.2	151.6	576.7	121.9
2A	95% PI Corr.	3.7	40.9	1.5	204.1	316.4	5.0	46.1	188.0	607.6	10054.7
2B	95% PI Corr.	4.0	33.8	0.9	166.8	322.9	2.6	41.3	153.5	564.9	10054.7
1A	Tolerance limit	5.6	55.6	2.0	285.7	392.5	10.6	62.8	227.4	809.4	
1B	Tolerance limit	3.6	27.6	0.8	149.1	289.5	1.9	38.0	132.2	514.7	
2A	Tolerance limit	3.7	39.4	1.5	200.0	310.0	4.6	45.3	183.7	596.2	1.2E12
2B	Tolerance limit	3.4	27.6	0.8	146.7	282.7	1.9	37.2	132.9	501.6	1.2E12

Table 4. Continued.

Envelope		PPPAHs	PCBs	Chlordane	DDT	Abundance	# Taxa	S-W Diversity	Survival
1A	N	6	6	3	3	6	6	6	6
1B	N	6	6	3	3	28	28	28	28
2A	N	9	9	5	5	9	9	9	9
2B	N	9	9	5	5	31	31	31	31
1A	Mean	379.7	18.8	0.3	1.6	577.8	65.5	2.6	90.2
1B	Mean	379.7	18.8	0.3	1.6	820.4	47.7	2.5	91.5
2A	Mean		29.6	0.5	3.9	563.3	65.6	2.6	87.1
2B	Mean	685.7	29.6	0.5	3.9	808.5	48.3	2.5	90.4
1A	SD	223.0	6.5	0.2	0.4	226.1	27.9	0.2	5.1
1B	SD	223.0	6.5	0.2	0.4	473.8	18.5	0.4	8.7
2A	SD	620.3	20.5	0.3	4.0	209.9	25.5	0.2	6.6
2B	SD	620.3	20.5	0.3	4.0	469.6	18.5	0.4	9.0
1A	95% PI Uncorr.	865.1	33.0	1.1	3.0	85.7	4.8	2.2	79.2
1B	95% PI Uncorr.	865.1	33.0	1.1	3.0	-0.8	15.6	1.9	76.3
2A	95% PI Uncorr.	1901.5	69.7	1.3	13.2	151.7	15.7	2.2	74.2
2B	95% PI Uncorr.	1901.5	69.7	1.3	13.2	-1.3	16.5	1.9	75.0
1A	95% PI Corr.	1653.3	56.0	4.7	10.0	-713.4	-93.8	1.5	61.2
1B	95% PI Corr.	1653.3	56.0	4.7	10.0	-738.2	-13.1	1.2	62.7
2A	95% PI Corr.	3396.5	119.0	2.9	31.5	-354.3	-45.7	1.7	58.3
2B	95% PI Corr.	3396.5	119.0	2.9	31.5	-719.0	-11.8	1.3	61.3
1A	Tolerance limit	1845.3	61.6			-908.0	-117.8	1.4	56.8
1B	Tolerance limit	1845.3	61.6			-397.0	0.2	1.5	69.0
2A	Tolerance limit	3301.4	115.9	3.8	42.4	-322.1	-41.8	1.8	59.3
2B	Tolerance limit	3301.4	115.9	3.8	42.4	-368.1	2.0	1.6	68.0

APPENDIX 5
OF ATTACHMENT C

Regional Board Screening Criteria Used to Evaluate Reference Pool #2b

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FINAL SCREENING CRITERIA USED TO EVALUATE REFERENCE POOL #2b

The Regional Board's decision on a reference pool for the NASSCO, Southwest Marine, Mouth of Chollas Creek, and 7th Street Channel sediment investigations was provided to all stakeholders on June 9, 2003 (RWQCB, 2003a). The final reference pool, as shown below, is based on a modified version of Reference Pool #2b as proposed by SCCWRP, the Navy, and Exponent (Bay et. al., 2003). In other words, the Regional Board used Reference Pool #2b as a baseline pool and evaluated the stations in Reference Pool #2b to determine the final pool.

Table 1. Station Comparison Between Pool #2b and Regional Board Final Reference Pool.

Reference Pool #2b		Regional Board Final Reference Pool (modified Reference Pool #2b)	
CP	2231	CP	~~2231~~
	2243		~~2243~~
	2433		2433
	2441		~~2441~~
	2238		2238*
SY	2231	SY	~~2231~~
	2243		2243*
	2433		2433
	2441		2441
Bight'98	2231	Bight'98	2231
	2233		2233
	2235		~~2235~~
	2238		2238
	2240		2240
	2241		2241
	2242		2242
	2243		2243
	2244		2244
	2245		~~2245~~
	2247		2247
	2249		~~2249~~
	2252		2252

	2256		2256
	2257		2257
	2258		~~2258~~
	2260		~~2260~~
	2265		2265
	2433		2433
	2435		2435
	2436		2436
	2440		2440

* The benthic community data including the BRI scores for CP Station 2238 and SY Station 2243 will not be used in the final reference pool.

Reference Pool #2b was primarily developed based on the comments and decisions made by the stakeholders present at the January 22-23 technical meeting held at the Regional Board (details provided in Attachment C - Regional Board response to Comment #3 - Status of Tasks (May 5, 2003 Letter)). These comments and decisions were documented and subsequently used to guide SCCWRP, the Navy, and Exponent in developing Reference Pool #2b (RWQCB, 2003b).

The Regional Board's modifications to Reference Pool #2b and rationale for selecting stations in the final reference pool was based on weight of evidence using the triad approach and best professional judgement. The triad of data (sediment chemistry, amphipod toxicity, and benthic community) analyzed at each of the proposed reference stations included in Reference Pool #2b were evaluated and a decision was made whether to accept or reject the proposed station. The screening criteria used by the Regional Board is provided below.

Sediment Chemistry

- ***Effects Range Median (ERM).*** The ERM is the median of the total number of data points identified with adverse biological effects as developed from a national database compiled by NOAA. These data points are associated with chemical data and are ordered via increasing concentrations. The database contains matched sediment chemistry and biological effects information generated from a variety of sediment quality approaches. According to NOAA, ERM values are considered better indicators of concentrations associated with biological effects than the Effects Range Low (ERL) (NOAA, 1999). However, there is no assurance that sediments in which ERM values are exceeded will be toxic.

- ***Sediment Quality Guideline Quotient (SQGQ1).*** Mean SQGQs were developed by Russell Fairey et. al. (2001) to represent the presence of chemical mixtures in sediment. The SQGQs are calculated by normalizing a specific group of chemicals to their respective numerical sediment quality guidelines. The mean SQGQ that was most predictive of acute toxicity to amphipods was the SQGQ1 combination consisting of the following chemical mixtures: cadmium, copper, lead, silver, zinc, total chlordane, dieldrin, total PCBs, and total PAHs. It should be noted that the SQGQ1 is a updated version of the mean ERM-quotient (ERMQ) used in the Bay Protection and Toxic Cleanup Programs (BPTCP). An SQGQ1 threshold value of 0.50 was selected so that its corresponding amphipod survival rate (76%) would match up with the amphipod survival rate (75% for *Eohaustorius estuarius*) determined by the 90th Percentile Minimum Significant Difference (MSD) approach (discussed below).

- ***Consensus Sediment Quality Guidelines for PAHs.*** The consensus guidelines for PAHs were developed by Richard Swartz of USEPA (1999). These guidelines provide an integration of existing PAH SQGs, reflect casual rather than correlative effects, account for chemical mixtures, and predict sediment toxicity and benthic community effects at sites with PAH contamination. Consensus guidelines for PAHs consist of the Threshold Effects Concentrations (TEC), Median Effects Concentrations (MEC), and Extreme effects concentrations (EEC):

  - TEC = 290 milligrams per kilogram Organic Carbon normalized (mg/kg OC). PAH mixtures below the TEC indicate adverse effects on benthic communities are unlikely.
  - MEC = 1,800 mg/kg OC. The greatest uncertainty is between the TEC and the EEC. As such, it is recommended that the MEC should not be used to distinguish acceptable from unacceptable conditions.
  - EEC = 10,000 mg/kg OC. PAH mixtures above the EEC indicate adverse effects on benthic communities are likely.

- ***Consensus-Based Sediment Effect Concentrations (SECs) for PCBs.*** The consensus-based SECs were developed by Donald MacDonald et. al. (2000) to provide an integration and reconciliation of existing PCB SQGs. The SECs have been demonstrated to accurately predict both the presence and absence of toxicity in field-collected sediments. Consensus-based SECs for PCBs consist of the Threshold Effect Concentration (TEC), Midrange Effect Concentration (MEC), and the Extreme Effect Concentration (EEC):

  - TEC = 0.04 mg/kg. The TEC is used to identify sediments that are unlikely to adversely affect sediment-dwelling organisms due to PCBs; below which adverse effects are unlikely to occur.
  - MEC = 0.40 mg/kg. The MEC is used to identify sediments that are likely to adversely affect sediment-dwelling organisms due to PCBs; above which adverse effects frequently occur.
  - EEC = The EEC is used to identify sediments that are highly likely to adversely affect sediment-dwelling organisms due to PCBs; above which adverse effects usually or always occur.