

Report
**INITIAL DREDGE MATERIAL EVALUATION FOR
THE CONSTRUCTION OF A NEW BOAT BASIN IN
PILLAR POINT HARBOR**



Prepared for:

**SAN MATEO HARBOR DISTRICT
400 OYSTER POINT BLVD., SUITE 300
SOUTH SAN FRANCISCO, CA 94080**

**WINZLER & KELLY CONSULTING ENGINEERS
417 MONTGOMERY STREET, SUITE 600
SAN FRANCISCO, CA 94104**

Prepared by:



**307 WASHINGTON STREET
SANTA CRUZ, CA 95060**

June 2007

Report

**INITIAL DREDGE MATERIAL EVALUATION FOR
THE CONSTRUCTION OF A NEW BOAT BASIN IN
PILLAR POINT HARBOR**

June 2007

TABLE OF CONTENTS

	<u>Page No</u>
1.0 INTRODUCTION.....	1
2.0 STUDY DESIGN.....	1
3.0 METHODS.....	4
3.1 Sediment Sampling.....	4
3.2 Core Processing.....	4
3.3 Laboratory Analyses.....	5
3.3.1 Bulk Sediment Analysis.....	6
3.3.2 DI-WET Analyses.....	6
4.0 RESULTS AND DISCUSSION.....	10
4.1 Sediment Physical Properties.....	10
4.2 Sediment Chemistry.....	10
4.3 Leaching Characteristics.....	13
5.0 QUALITY ASSURANCE/QUALITY CONTROL SUMMARY.....	14
5.1 Holding Times.....	14
5.2 Blanks.....	14
5.3 Laboratory Replicates.....	14
5.4 Laboratory Control Samples.....	15
5.5 Matrix Spikes/Matrix Spike Duplicates.....	15
5.6 Standard Reference Material.....	15
5.7 QA/QC Conclusions.....	15
6.0 SUMMARY AND CONCLUSIONS.....	15
7.0 REFERENCES.....	16
Appendix A. Field Logs	
Appendix B. Analytical Reports	
Appendix C. Core Photographs	

LIST OF FIGURES

	<u>Page No</u>
Figure 1. Preliminary Design for New Boat Basin at Pillar Point Harbor.....	2
Figure 2. Core Locations, Limits of Dredging, Proposed Fill Area and Current Bathymetry Within the Pillar Point Harbor Project Area.....	3

LIST OF TABLES

Table 1. Core Positions, Lengths, and Sampled Intervals.....	5
Table 2. DI-WET Chemistry Analytes, Analytical Methods and Reporting Limits.....	6
Table 3. Analytical Methods and Reporting Limits for Sediment Samples.....	7
Table 4. Sediment Chemistry Summary Results for Pillar Point Harbor.....	11
Table 5. DI-WET Results for Pillar Point Harbor.....	13

Report

**INITIAL DREDGE MATERIAL EVALUATION FOR
THE CONSTRUCTION OF A NEW BOAT BASIN IN
PILLAR POINT HARBOR**

June 2007

1.0 INTRODUCTION

Part of the new development plan for the Pillar Point Harbor calls for dredging up to 56,200 cy of material to form a new 71 berth boat basin (Figure 1). This volume estimate is based on a one-foot overdredge allowance. Characterization was performed to a two-foot overdepth. With a two-foot overdepth, the project depth is -10 ft Mean Lower Low Water (MLLW).

Currently, only 27,300 cy of material has been identified for reuse. This material will be deposited at an adjacent Perched Beach. Disposal and reuse options for the remaining material include beach replenishment, open water disposal at SF-DODS and disposal at some yet identified upland site.

Insufficient data exists on the physical and chemical characteristics of the sediment to make final disposal decisions. Therefore sampling and testing is being conducted in two phases. The first phase focuses on gathering sufficient physical and chemical data of the dredge material to narrow down disposal options, particularly to determine if enough clean, coarse grain material exists for beach replenishment. Chemical results of the first phase are presented in this report. Once disposal options have been firmed up, the second phase of sampling and testing will be conducted to satisfy any Tier III requirements. A formal Sampling and Analysis plan will be submitted to the San Francisco District of the US Army Corps of Engineers, EPA Region IX, Monterey Bay National Marine Sanctuary, and the Regional Water Quality Control Board, San Francisco Bay Region for approval prior to implementation of Phase II.

2.0 STUDY DESIGN

For Phase I testing, the new boat basin was divided up into two composite areas where sediments were collected at five locations within each composite area (Figure 2) using an electric vibrocore. Each core collected consisted of the sediments from the mudline/water interface to project depth plus two feet for overdredge allowance (-10 ft MLLW), unless refusal was encountered.

The five cores in each composite area were combined into top and bottom composite samples for chemical analysis. Each top composite sample extended from the mudline down to a significant sediment horizon. Therefore, the division point between the top and bottom samples was based on the physical properties of the sediment determined by an onsite geotechnical engineer from ENGEIO, Inc. The bottom composite samples extended to -10 ft MLLW or refusal.

To determine contaminant concentrations, all dredge material composite samples were subjected to bulk sediment chemical analyses. Included with the analyses were grain size distribution, total solids, total organic carbon, trace elements (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Zn), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), speciated butyltins and organochlorine pesticides. In addition, the leaching characteristics of soluble contaminants were determined for the top samples. Prior to sampling, it was assumed that the top sediments are more likely to be disposed on the Perched Beach. A modified waste extraction test, using DI water as the extractant (DI-WET), was used to assess leaching characteristics.

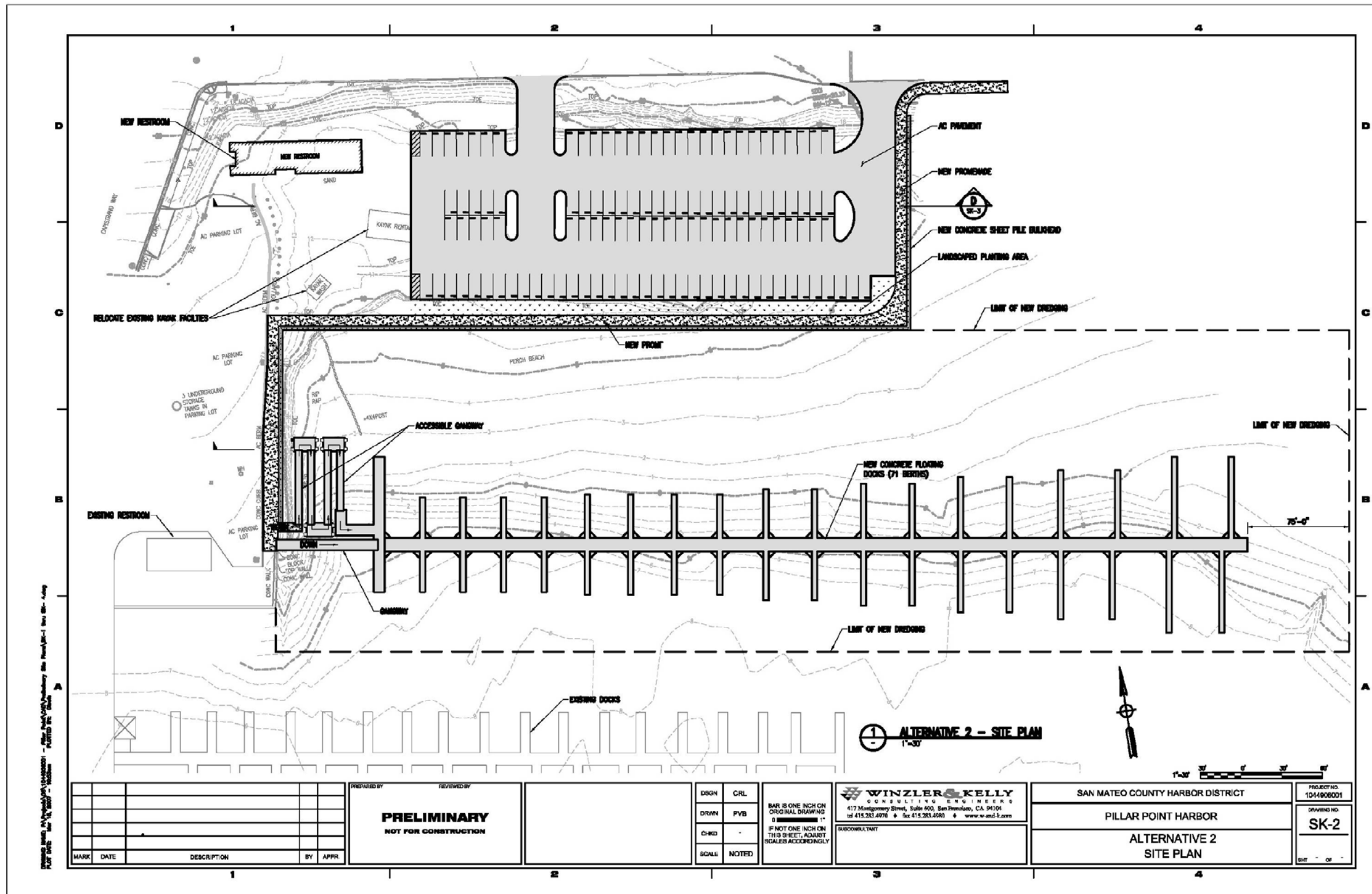
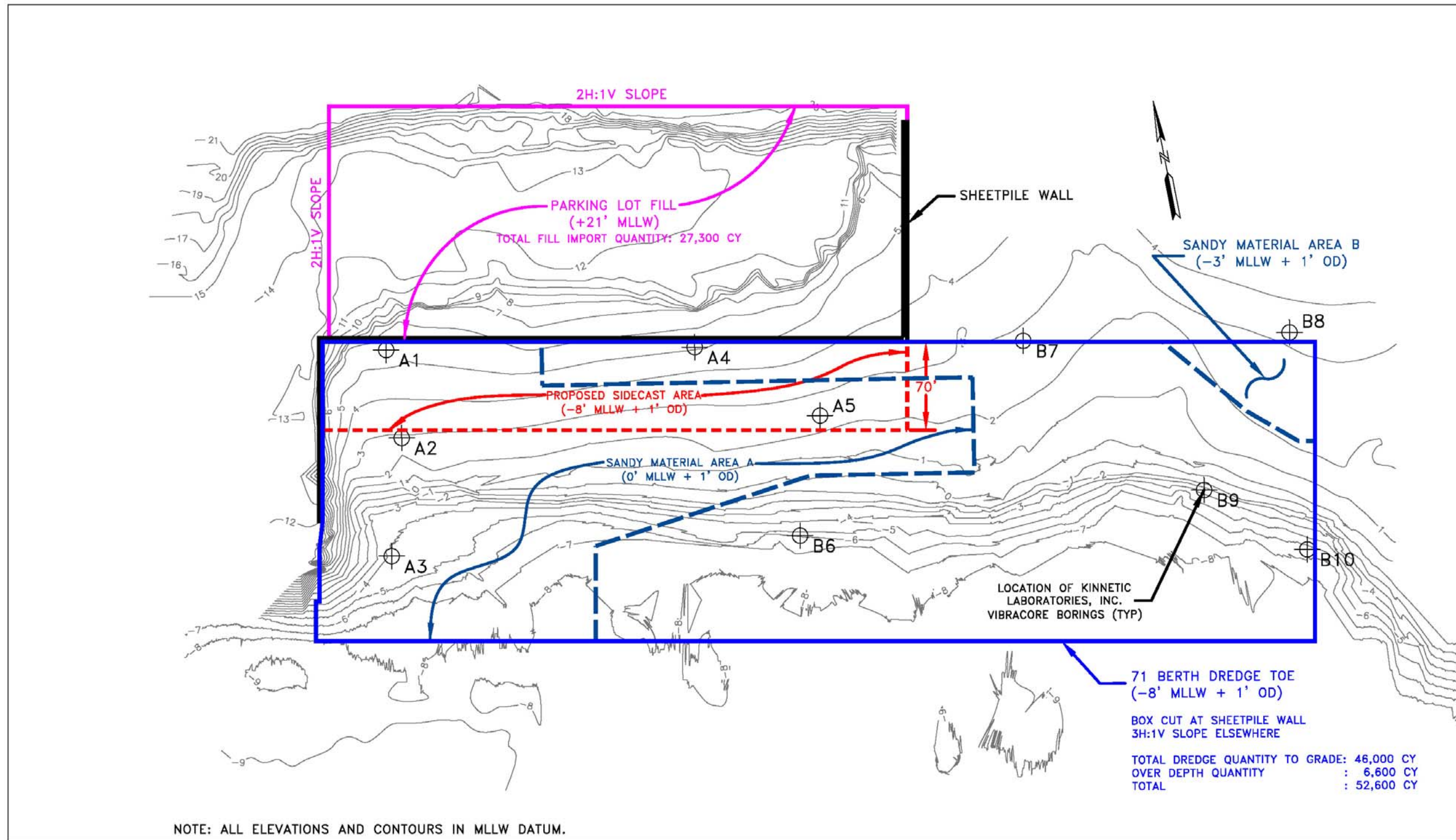


Figure 1. Preliminary Design for New Boat Basin at Pillar Point Harbor



<p>33 Commercial Blvd. Suite A Novato, CA 94949-6113 Phone (415) 883-7883</p>	SAN MATEO COUNTY HARBOR DISTRICT PILLAR POINT HARBOR DREDGING COST ESTIMATE STUDY	SCALE: 1"=70' DATE: 06/18/07
	71 BERTH DREDGING PROJECT – SCHEMATIC CUT/FILL LOCATIONS	
	FIGURE 1	

Figure 2. Core Locations, Limits of Dredging, Proposed Fill Area and Current Bathymetry Within the Pillar Point Harbor Project Area.

3.0 METHODS

3.1 Sediment Sampling

Vibracore deployment was conducted from an offshore vessel and a modified track mounted truck. For subtidal regions of the dredge area, vibracore sampling was conducted from Kinnetic Laboratories' research vessel *R.V. Prophecy*. This vessel is equipped with an A-frame and winch suitable for handling the coring equipment. Vibracore samples located within the intertidal zone were obtained at low tide from the tracked truck, which was also equipped with an A-Frame and winch. Coordinates for each sampling location are provided in Table 1.

Kinnetic Laboratories built the vibracore equipment used for this program. This vibracore consists of a 4-inch diameter aluminum coring tube lined with clean polyethylene tubing, a stainless steel cutting tip, and a stainless-steel core catcher. The vibrating unit has two counter-rotating motors encased in a waterproof aluminum housing. A three-phase, 240-volt generator powers the motors. The vibracore head and tube were lowered overboard with a hydraulic A-frame and winch. The core tube was allowed to penetrate the surficial materials below the mudline as far as possible under the static weight of the vibracore unit. The unit was then vibrated until it reached project depth plus two feet for overdredge or refusal.

After penetrating to the desired depth, or after reaching rejection, the power was shut off to the vibracore head. A check valve located at the top of the core tube reduces or prevents sediment loss during pullout. The length of sediment recovered was noted by measuring down the interior of the core tube to the top of the sediment. The check valve and core cutter and catcher were removed to allow removal of the core liners and sediment. The core liners were then sealed on both ends to preserve the samples. All sample contact surfaces were either stainless steel, polyethylene, Halar[®], or Teflon coated. Compositing tools were stainless steel or Halar[®]-coated stainless steel. All contact surfaces of the sampling devices were cleaned for each sampling area. The cleaning protocol consisted of a Micro-90[®] soap wash, de-ionized water rinse, 2N nitric acid rinse, and finished with a de-ionized water triple rinse.

The desired sampling depth for Phase I was -10 MLLW. However, this could not be obtained at four sites in the Area A composite group and two sites in the Area B composite group. Sediments at these depths were highly consolidated to the point the vibracore could no longer penetrate. These compacted materials were considered to be native material which are less likely to contain contaminants. Core lengths and elevations obtained for each location and sample interval are provided in Table 1.

3.2 Core Processing

After placement in a clean PVC core rack, the core liners were split lengthwise to expose the recovered sediment. Once exposed, sediment that came in contact with the core liner was removed by scraping with a pre-cleaned stainless steel spoon. Each core was photographed, measured, and lithologically logged by the geotechnical technician in accordance with the Unified Soil Classification System (USCS) as outlined in ASTM Standards D-2487 and D-2488 (Visual-Manual Procedure). Geotechnical core logs are provided in a separate report prepared by ENGEO, Inc. Photographs of the cores are presented in Appendix C.

Following logging, a vertical representation of each individual core interval was formed by combining and homogenizing a representative portion of each core interval in a pre-cleaned stainless steel or Halar[®]-coated tray. A one-liter portion of each vertical representation was placed in a pre-cleaned and certified glass jar with a Teflon[®]-lined lid for archived material.

Table 1. Core Positions, Lengths, and Sampled Intervals.

Core ID	Date	Time	Latitude	Longitude	Mudline Depth (ft MLLW)	Target Sampling Depth (ft)	Core Length (ft)	Core Interval Sampled (ft MLLW)
Area A								
A-1-Top	4/4/07	1020	37° 30' 11.9"	122° 28' 52.5"	+5.5	-10.0	10.4	+5.5 to -2.1
A-1-Bot								-2.1 to -4.9
A-2-Top	4/4/07	0840	37° 30' 11.2"	122° 28' 52.5"	+2.9	-10.0	8.9	+2.9 to -0.9
A-2-Bot								-0.9 to -6.0
A-3-Top	4/3/07	1607	37° 30' 10.2"	122° 28' 52.8"	-3.8	-10.0	3.2	-3.8 to -4.8
A-3-Bot								-4.8 to -7.0
A-4-Top	4/4/07	1100	37° 30' 11.5"	122° 28' 49.5"	+5.1	-10.0	7.8	+5.1 to -1.4
A-4-Bot								-1.4 to -2.7
A-5-Top	4/4/07	0750	37° 30' 10.8"	122° 28' 48.4"	+2.5	-10.0	9.1	+2.5 to -2.7
A-5-Bot								-2.7 to -6.6
Area B								
B-6-Top	4/3/07	1510	37° 30' 09.9"	122° 28' 48.8"	-6.7	-10.0	5.0	-6.7 to -9.6
B-6-Bot								-9.6 to -10.0
B-7-Top	4/3/07	1820	37° 30' 11.1"	122° 28' 46.3"	+2.8	-10.0	6.8	2.8 to 0.3
B-7-Bot								0.3 to -4.0
B-8-Top	4/3/07	0945	37° 30' 10.8"	122° 28' 43.7"	+2.8	-10.0	10.8	2.8 to -0.6
B-8-Bot								-0.6 to -8.0
B-9-Top	4/3/07	1400	37° 30' 09.7"	122° 28' 44.8"	-5.3	-10.0	5.2	-5.3 to -8.0
B-9-Bot								-8.0 to -10.0
B-10-Top	4/3/07	1430	37° 30' 09.1"	122° 28' 43.9"	-6.8	-10.0	5.0	-6.8 to -8.7
B-10-Bot								-8.7 to -10.0

The representative material from each of the five cores in each composite area was combined into top and bottom composite samples. Each top composite sample consisted of the sediment from the mudline down to a significant sediment horizon, and each bottom composite sample consisted of the sediment from the horizon down to -10 ft MLLW or refusal.

All sediment samples were placed on ice immediately following sampling and maintained at 2 to 4°C until delivery to the laboratory. All samples were handled under Chain of Custody protocols beginning at the time of collection. Redundant sampling data was also recorded on field log sheets, which are provided in Appendix A.

3.3 Laboratory Analyses

Laboratory analyses were carried out by CRG Marine Laboratories (CRG) (Cal-ELAP No. 2261) for most chemical analyses and Soil Control, Inc., (Cal-ELAP No. 1494) for metals, TOC, grain size and DI-WET chemistry. Both laboratories used are State certified and use USEPA and USACE approved methodologies. CRG specializes in the marine chemistry and the required detection limits necessary for this dredge material and water quality characterization. Chemical constituents analyzed include those required by the USEPA/USACE Inland Testing Manual (USEPA/USACE, 1998) according to guidance provided by Public Notice 01-01 (USACE, 2001) for San Francisco Bay.

3.3.1 Bulk Sediment Analysis

Chemical testing of the bulk sediment was carried out for the dredge material parameters and protocols defined in Table 3. These parameters include grain size, percent solids, total organic carbon, heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Zn), speciated butyltins, chlorinated pesticides, PCBs (arochlors and individual congeners) and polynuclear aromatic hydrocarbons (PAHs). For the most part, samples were extracted and analyzed within established holding times, and all analyses were accomplished with appropriate quality control measures.

3.3.2 DI-WET Analyses

Leaching characteristics for metals in the Pillar Point Harbor upper sediments were evaluated with a modification of the State of California, Title 22 Waste Extraction Test (WET) known as DI-WET. This modified WET uses deionized water as an extractant rather than a pH 5 citrate buffer as used in the standard WET. The results are used address possible impacts on surface water or groundwater. The DI-WET test involves extracting 50 grams of sediment for 24 hours at a ratio of one part sediment to ten parts deionized water (10 parts pH 5 citrate buffer for the WET). After extraction, the solution is filtered through a 0.45-micron filter prior to analysis. Analytical results are reported as micrograms of each constituent per liter of extractant. Test methods and reporting limits for DI-WET analyses are shown in Table 2.

Table 2. DI-WET Chemistry Analytes, Analytical Methods and Reporting Limits

Required Analysis	Methods	Reporting Limits
Arsenic	EPA 200.8	0.5 ug/L
Cadmium	EPA 200.8	0.2 ug/L
Chromium	EPA 200.8	0.5 ug/L
Copper	EPA 200.8	0.5 ug/L
Lead	EPA 200.8	0.2 ug/L
Mercury	EPA 245.7	0.2 ug/L
Nickel	EPA 200.8	0.5 ug/L
Selenium	EPA 200.8	0.1 ug/L
Silver	EPA 200.8	0.2 ug/L
Zinc	EPA 200.8	1.0 ug/L

Table 3. Analytical Methods and Reporting Limits for Sediment Samples.

Analysis	Analytical Method	Reporting Limit	Units
PHYSICAL CONVENTIONALS			
Percent Solids	EPA 160.3	0.1	% -wet
Grain Size Distribution	Plumb (1981)	na	--
Total Organic Carbon	EPA 9060A	0.03	% dry
METALS			
Arsenic (As)	EPA 6020M	0.058-0.075	mg/kg - dry
Cadmium (Cd)	EPA 6020M	0.058-0.075	mg/kg - dry
Chromium (Cr)	EPA 6020M	0.058-0.075	mg/kg - dry
Copper (Cu)	EPA 6020M	0.058-0.075	mg/kg - dry
Lead (Pb)	EPA 6020M	0.058-0.075	mg/kg - dry
Mercury (Hg)	EPA 245.5	0.0072-0.0094	mg/kg - dry
Nickel (Ni)	EPA 6020M	0.058-0.075	mg/kg - dry
Selenium (Se)	EPA 6020M	0.14-0.19	mg/kg - dry
Silver (Ag)	EPA 6020M	0.058-0.075	mg/kg - dry
Zinc (Zn)	EPA 6020M	0.29-0.38	mg/kg - dry
ORGANICS – CHLORINATED PESTICIDES			
(PCB030)	EPA 8270Cm	--	% rec
(PCB112)	EPA 8270Cm	--	% rec
(PCB198)	EPA 8270Cm	--	% rec
(TCMX)	EPA 8270Cm	--	% rec
2,4'-DDD	EPA 8270Cm	5	µg/kg - dry
2,4'-DDE	EPA 8270Cm	5	µg/kg - dry
2,4'-DDT	EPA 8270Cm	5	µg/kg - dry
4,4'-DDD	EPA 8270Cm	5	µg/kg - dry
4,4'-DDE	EPA 8270Cm	5	µg/kg - dry
4,4'-DDT	EPA 8270Cm	5	µg/kg - dry
Aldrin	EPA 8270Cm	5	µg/kg - dry
BHC-alpha	EPA 8270Cm	5	µg/kg - dry
BHC-beta	EPA 8270Cm	5	µg/kg - dry
BHC-delta	EPA 8270Cm	5	µg/kg - dry
BHC-gamma	EPA 8270Cm	5	µg/kg - dry
Chlordane-alpha	EPA 8270Cm	5	µg/kg - dry
Chlordane-gamma	EPA 8270Cm	5	µg/kg - dry
cis-Nonachlor	EPA 8270Cm	5	µg/kg - dry
Dieldrin	EPA 8270Cm	5	µg/kg - dry
Endosulfan Sulfate	EPA 8270Cm	5	µg/kg - dry
Endosulfan-I	EPA 8270Cm	5	µg/kg - dry
Endosulfan-II	EPA 8270Cm	5	µg/kg - dry
Endrin	EPA 8270Cm	5	µg/kg - dry
Endrin Ketone	EPA 8270Cm	5	µg/kg - dry
Heptachlor	EPA 8270Cm	5	µg/kg - dry
Heptachlor Epoxide	EPA 8270Cm	5	µg/kg - dry
Methoxychlor	EPA 8270Cm	5	µg/kg - dry
Mirex	EPA 8270Cm	5	µg/kg - dry
Oxychlordane	EPA 8270Cm	5	µg/kg - dry
Perthane	EPA 8270Cm	10	µg/kg - dry
Toxaphene	EPA 8270Cm	50	µg/kg - dry
trans-Nonachlor	EPA 8270Cm	5	µg/kg - dry

Table 3. Analytical Methods and Reporting Limits for Sediment Samples.

Analysis	Analytical Method	Reporting Limit	Units
ORGANICS -BUTYLTINS			
(Triphenyltin)	--	--	% rec
Dibutyltin	Krone, 1989	3	µg/kg - dry
Monobutyltin	Krone, 1989	3	µg/kg - dry
Tetrabutyltin	Krone, 1989	3	µg/kg - dry
Tributyltin	Krone, 1989	3	µg/kg - dry
ORGANICS – PCB AROCLORS			
Aroclor 1016	EPA 8270Cm	20	µg/kg - dry
Aroclor 1221	EPA 8270Cm	20	µg/kg - dry
Aroclor 1232	EPA 8270Cm	20	µg/kg - dry
Aroclor 1242	EPA 8270Cm	20	µg/kg - dry
Aroclor 1248	EPA 8270Cm	20	µg/kg - dry
Aroclor 1254	EPA 8270Cm	20	µg/kg - dry
Aroclor 1260	EPA 8270Cm	20	µg/kg - dry
ORGANICS – PCB CONGENERS			
PCB008	EPA 8270Cm	5	µg/kg - dry
PCB018	EPA 8270Cm	5	µg/kg - dry
PCB028	EPA 8270Cm	5	µg/kg - dry
PCB031	EPA 8270Cm	5	µg/kg - dry
PCB033	EPA 8270Cm	5	µg/kg - dry
PCB037	EPA 8270Cm	5	µg/kg - dry
PCB044	EPA 8270Cm	5	µg/kg - dry
PCB049	EPA 8270Cm	5	µg/kg - dry
PCB052	EPA 8270Cm	5	µg/kg - dry
PCB066	EPA 8270Cm	5	µg/kg - dry
PCB070	EPA 8270Cm	5	µg/kg - dry
PCB074	EPA 8270Cm	5	µg/kg - dry
PCB077	EPA 8270Cm	5	µg/kg - dry
PCB081	EPA 8270Cm	5	µg/kg - dry
PCB087	EPA 8270Cm	5	µg/kg - dry
PCB095	EPA 8270Cm	5	µg/kg - dry
PCB097	EPA 8270Cm	5	µg/kg - dry
PCB099	EPA 8270Cm	5	µg/kg - dry
PCB101	EPA 8270Cm	5	µg/kg - dry
PCB105	EPA 8270Cm	5	µg/kg - dry
PCB110	EPA 8270Cm	5	µg/kg - dry
PCB114	EPA 8270Cm	5	µg/kg - dry
PCB118	EPA 8270Cm	5	µg/kg - dry
PCB119	EPA 8270Cm	5	µg/kg - dry
PCB123	EPA 8270Cm	5	µg/kg - dry
PCB126	EPA 8270Cm	5	µg/kg - dry
PCB128+167	EPA 8270Cm	5	µg/kg - dry
PCB138	EPA 8270Cm	5	µg/kg - dry
PCB141	EPA 8270Cm	5	µg/kg - dry
PCB149	EPA 8270Cm	5	µg/kg - dry
PCB151	EPA 8270Cm	5	µg/kg - dry
PCB153	EPA 8270Cm	5	µg/kg - dry
PCB156	EPA 8270Cm	5	µg/kg - dry
PCB157	EPA 8270Cm	5	µg/kg - dry

Table 3. Analytical Methods and Reporting Limits for Sediment Samples.

Analysis	Analytical Method	Reporting Limit	Units
PCB158	EPA 8270Cm	5	µg/kg - dry
PCB168+132	EPA 8270Cm	5	µg/kg - dry
PCB169	EPA 8270Cm	5	µg/kg - dry
PCB170	EPA 8270Cm	5	µg/kg - dry
PCB177	EPA 8270Cm	5	µg/kg - dry
PCB180	EPA 8270Cm	5	µg/kg - dry
PCB183	EPA 8270Cm	5	µg/kg - dry
PCB187	EPA 8270Cm	5	µg/kg - dry
PCB189	EPA 8270Cm	5	µg/kg - dry
PCB194	EPA 8270Cm	5	µg/kg - dry
PCB195	EPA 8270Cm	5	µg/kg - dry
PCB200	EPA 8270Cm	5	µg/kg - dry
PCB201	EPA 8270Cm	5	µg/kg - dry
PCB206	EPA 8270Cm	5	µg/kg - dry
PCB209	EPA 8270Cm	5	µg/kg - dry
ORGANICS – PAHs			
(d10-Acenaphthene)	EPA 8270Cm	--	% Rec
(d10-Phenanthrene)	EPA 8270Cm	--	% Rec
(d12-Chrysene)	EPA 8270Cm	--	% Rec
(d12-Perylene)	EPA 8270Cm	--	% Rec
(d8-Naphthalene)	EPA 8270Cm	--	% Rec
1-Methylnaphthalene	EPA 8270Cm	5	µg/kg
1-Methylphenanthrene	EPA 8270Cm	5	µg/kg
2,3,5-Trimethylnaphthalene	EPA 8270Cm	5	µg/kg
2,6-Dimethylnaphthalene	EPA 8270Cm	5	µg/kg
2-Methylnaphthalene	EPA 8270Cm	5	µg/kg
Acenaphthene	EPA 8270Cm	5	µg/kg
Acenaphthylene	EPA 8270Cm	5	µg/kg
Anthracene	EPA 8270Cm	5	µg/kg
Benz[a]anthracene	EPA 8270Cm	5	µg/kg
Benzo[a]pyrene	EPA 8270Cm	5	µg/kg
Benzo[b]fluoranthene	EPA 8270Cm	5	µg/kg
Benzo[e]pyrene	EPA 8270Cm	5	µg/kg
Benzo[g,h,i]perylene	EPA 8270Cm	5	µg/kg
Benzo[k]fluoranthene	EPA 8270Cm	5	µg/kg
Biphenyl	EPA 8270Cm	5	µg/kg
Chrysene	EPA 8270Cm	5	µg/kg
Dibenz[a,h]anthracene	EPA 8270Cm	5	µg/kg
Dibenzothiophene	EPA 8270Cm	5	µg/kg
Fluoranthene	EPA 8270Cm	5	µg/kg
Fluorene	EPA 8270Cm	5	µg/kg
Indeno[1,2,3-c,d]pyrene	EPA 8270Cm	5	µg/kg
Naphthalene	EPA 8270Cm	5	µg/kg
Perylene	EPA 8270Cm	5	µg/kg
Phenanthrene	EPA 8270Cm	5	µg/kg
Pyrene	EPA 8270Cm	5	µg/kg
Total Detectable PAHs	EPA 8270Cm	5	µg/kg

4.0 RESULTS AND DISCUSSION

Bulk sediment chemical results from the Phase I testing are summarized in Table 4 and DI-WET results are presented in Table 5. A complete set of laboratory analytical reports are included in Appendix B.

Numeric sediment guidelines are included in the sediment results table. Sediment concentrations were first compared with California Code of Regulations Title 22 Total Threshold Limit Concentration (TTLC) hazardous waste criteria. Contaminants found within the sediments were also compared to NOAA sediment quality guidelines (Long et. al., 1995). These guidelines can be used to screen sediments for contaminant concentrations that might cause biological effects and to identify sediments for further toxicity testing. For any given contaminant, the Effects Range Low (ERL) guideline represents the 10th percentile concentration value in the NOAA database that might be expected to cause adverse biological effects and the Effects Range Median (ERM) reflects the 50th percentile value in the database. Note that ERLs and ERMs are not available for all contaminants. Those available were only used as a screening tool. They were not and should not be used as criteria in determining suitability for ocean disposal.

As an additional measure of potential toxicity, the mean ERM quotient was calculated according to Long et al. (1998) and Hyland et al. (1999) for each composite sample. Using a subset of 24 of the larger ERM analyte list, the sample concentrations were divided by their respective ERM levels and averaged as shown in the following equation:

$$ERMQuotient = \frac{1}{24} \sum \frac{SampleConcentration}{ERM}$$

DI-WET chemistry results were compared to saltwater quality criteria for enclosed bays and estuaries for priority toxic pollutants in the State of California (California Toxics Rule), (USEPA, 2000). Freshwater quality objectives were not evaluated because of the proximity of the proposed disposal site to marine waters.

4.1 Sediment Physical Properties

Pillar Point Harbor sediment composites were predominantly sand and did not differ substantially between top and bottom sediments. The two top composite samples consisted of 83.9% and 64.7% sand, and the two bottom composite samples consisted of 62.2% and 68.5% sand. The remaining percentage of each composite sample contained an average of 19.3 % silt and 10.9 % clay.

Due to the high proportion of sandy sediment, the Pillar Point composite samples retained very little water. Moisture content was an average of 17.5% among the four sediment samples.

Both sediment samples taken from composite Area A had values below the reporting limit for total organic carbon. Area B sediments contained only slightly higher values at 0.51% and 0.21%, respectively for the top and bottom samples.

4.2 Sediment Chemistry

Overall contaminant levels in the Pillar Point Harbor sediments are relatively low. In fact, for organic compounds, only low levels of tributyltin and a few PAH compounds were detected in the sediments. For the few PAH compounds present, concentrations are far below ERL values. Metal concentrations are also below ERL values and are somewhat consistent among the four composite samples. Based on the low levels of contaminants present in the sediments, toxic effects to benthic invertebrates is not anticipated. This is supported by the fact that all mean ERM quotients were below 0.1 (0.01 to 0.02), which at these levels, a toxic response to marine organisms is unlikely (Long et al., 1998).

Table 4. Sediment Chemistry Summary Results for Pillar Point Harbor.

Analyte	Units	Area A		Area B		NOAA Screening		Title 22 TTLC
		Top	Bottom	Top	Bottom	ERL	ERM	
Grain Size								
Sand	%	83.9	62.2	64.7	68.5			
Silt	%	10.6	23.7	22.1	20.7			
Clay	%	5.4	14.0	13.3	10.7			
Conventionals								
Percent Solids	%	84	90	72	84			
Total Organic Carbon	% dry	0.09J	0.065J	0.56J	0.21J			
Total Metals								
Arsenic	mg/kg dry	1.9	0.85	2.6	1.2	8.2	70	500
Cadmium	mg/kg dry	0.062J	0.038J	0.12	0.056J	1.2	9.6	100
Chromium	mg/kg dry	13	26	23	22	81	370	2500
Copper	mg/kg dry	9.9	7.0	17	6.8	34	270	2500
Lead	mg/kg dry	5.2	3.3	6.3	3.8	46.7	218	1000
Mercury	mg/kg dry	0.023	0.022	0.033	0.021	0.15	0.71	20
Nickel	mg/kg dry	7.8	12	12	9.8	20.9	51.6	2000
Selenium	mg/kg dry	0.46	0.64	0.71	0.54			100
Silver	mg/kg dry	0.035J	0.029J	0.040J	0.031J	1	3.7	500
Zinc	mg/kg dry	35	39	59	41	150	410	5000
Speciated Butyltins								
Monobutyltin	ug/kg dry	3U	3U	3U	3U			
Dibutyltin	ug/kg dry	3U	3U	3U	3U			
Tributyltin	ug/kg dry	3.3	3U	2.6J	3U			
Tetrabutyltin	ug/kg dry	3U	3U	3U	3U			
Chlorinated Pesticides								
2,4'-DDT	ug/kg dry	5U	5U	5U	5U			
2,4'-DDE	ug/kg dry	5U	5U	5U	5U			
2,4'-DDD	ug/kg dry	5U	5U	5U	5U			
4,4'-DDT	ug/kg dry	5U	5U	5U	5U	1	7	1000
4,4'-DDE	ug/kg dry	5U	5U	5U	5U	2.2	27	1000
4,4'-DDD	ug/kg dry	5U	5U	5U	5U	2	20	1000
Total DDT	ug/kg dry	0	0	0	0	1.58	46.1	1000
Aldrin	ug/kg dry	5U	5U	5U	5U			1400
DCPA (Dacthal)	ug/kg dry	10U	10U	10U	10U			
Dieldrin	ug/kg dry	5U	5U	5U	5U	0.02	8	8000
Dicofol	ug/kg dry	5U	5U	5U	5U			
Endrin	ug/kg dry	5U	5U	5U	5U			200
Endrin ketone	ug/kg dry	5U	5U	5U	5U			
Endrin aldehyde	ug/kg dry	5UJ	5UJ	5UJ	5UJ			
Endosulfan II	ug/kg dry	5U	5U	5U	5U			
Endosulfan I	ug/kg dry	5U	5U	5U	5U			
Endosulfan sulfate	ug/kg dry	5U	5U	5U	5U			
alpha-BHC	ug/kg dry	5U	5U	5U	5U			
beta-BHC	ug/kg dry	5U	5U	5U	5U			
delta-BHC	ug/kg dry	5U	5U	5U	5U			
gamma-BHC (Lindane)	ug/kg dry	5U	5U	5U	5U			
Methoxychlor	ug/kg dry	5U	5U	5U	5U			
Mirex	ug/kg dry	5U	5U	5U	5U			
Perthane	ug/kg dry	10U	10U	10U	10U			
Toxaphene	ug/kg dry	5U	5U	5U	5U			
Heptachlor epoxide	ug/kg dry	5U	5U	5U	5U			
Heptachlor	ug/kg dry	5U	5U	5U	5U			
alpha-Chlordane	ug/kg dry	5U	5U	5U	5U			
gamma-Chlordane	ug/kg dry	5U	5U	5U	5U			
Oxychlordane	ug/kg dry	5U	5U	5U	5U			
cis-Nonachlor	ug/kg dry	5U	5U	5U	5U			
trans-Nonachlor	ug/kg dry	5U	5U	5U	5U			
Total Chlordane	ug/kg dry	0	0	0	0	0.5	6	

Table 4 Continued.

Analyte	Units	Area A		Area B		NOAA Screening ¹		Title 22 TTLc
		Top	Bottom	Top	Bottom	ERL	ERM	
PCBs								
Aroclor 1016	ug/kg dry	20U	20U	20U	20U			500000
Aroclor 1221	ug/kg dry	20U	20U	20U	20U			500000
Aroclor 1232	ug/kg dry	20U	20U	20U	20U			500000
Aroclor 1242	ug/kg dry	20U	20U	20U	20U			500000
Aroclor 1248	ug/kg dry	20U	20U	20U	20U			500000
Aroclor 1254	ug/kg dry	20U	20U	20U	20U			500000
Aroclor 1260	ug/kg dry	20U	20U	20U	20U			500000
Total Aroclors PCBs	ug/kg dry	0	0	0	0			500000
PAHs								
Phenanthrene	ug/kg dry	2.3J	5U	3J	5U	240	1500	
Naphthalene	ug/kg dry	1.5J	5U	1J	5U	160	2100	
Fluorene	ug/kg dry	5U	5U	1.2J	5U	19	540	
Dibenzothiophene	ug/kg dry	5U	5U	5U	5U			
Biphenyl	ug/kg dry	5U	5U	5U	5U			
Anthracene	ug/kg dry	1.2J	5U	1.4J	5U	85.3	1100	
Acenaphthylene	ug/kg dry	5U	5U	5U	5U	44	640	
Acenaphthene	ug/kg dry	2.8J	5U	5U	5U	16	500	
2-Methylnaphthalene	ug/kg dry	2J	1.1J	1J	1.1J	70	670	
2,6-Dimethylnaphthalene	ug/kg dry	5U	5U	1.1J	5U			
2,3,5-Trimethylnaphthalene	ug/kg dry	5U	5U	5U	5U			
1-Methylphenanthrene	ug/kg dry	5U	5U	5U	5U			
1-Methylnaphthalene	ug/kg dry	1J	5U	1J	5U			
Pyrene	ug/kg dry	10	5U	14.9	2.1J	665	2600	
Perylene	ug/kg dry	6.9	61	15.6	33.4			
Indeno(1,2,3-cd)pyrene	ug/kg dry	3.3J	5U	4.3J	5U			
Fluoranthene	ug/kg dry	13.5	5U	7.8	1.7J	600	5100	
Dibenz(a,h)anthracene	ug/kg dry	2.3J	5U	5U	5U	63.4	260	
Chrysene	ug/kg dry	7.1	5U	4J	2.7J	384	2800	
Benzo(k)fluoranthene	ug/kg dry	1.8J	5U	4.2J	5U			
Benzo(g,h,i)perylene	ug/kg dry	2.8J	5U	3.1J	2.2J			
Benzo(e)pyrene	ug/kg dry	4.5J	5U	3.4J	4J			
Benzo(b)fluoranthene	ug/kg dry	3.6J	5U	4J	5U			
Benzo(a)pyrene	ug/kg dry	4.5J	5U	2.4J	5U	430	1600	
Benzo(a)anthracene	ug/kg dry	5.3	5U	3.3J	1.3J	261	1600	
Total Low Weight PAHs	ug/kg dry	9.8J	1.1J	9.7J	1.1J			
Total High Weight PAHs	ug/kg dry	65.6	61	67	47.4			
Total PAHs	ug/kg dry	75.4	62.1	76.7	48.5	4022	44792	
ERM Quotient		0.01	0.01	0.02	0.01			

Bolded values exceed ERL guidelines.

Bold and underlined values exceed ERM guidelines

U qualifier indicates analyte was not found at or above the associated reporting limit.

UJ qualifier indicates that the analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

J qualifier indicates that the result is an estimated quantity. Most J qualifiers are for detections below reporting limits.

J- qualifier indicates that the result is an estimated quantity but result may be biased low.

R qualifier indicates that the data are unusable (the analyte may or may not be present).

Table 5. DI-WET Results for Pillar Point Harbor.

	DI-WET RESULTS		CTR Criteria	
	A Top	B Top	CMC Salt ²	CCC Salt ¹
METALS, FILTERED (ug/L)				
Arsenic	10	9.6	69	36
Cadmium	0.25	0.38	40	8.8
Chromium	1.7	3.3	1100	50
Copper	49	64	4.8	3.1
Lead	30	30	210	8.1
Mercury	0.13J	0.15J	0.4 ³	0.16 ³
Nickel	5.2	5.9	74	8.2
Selenium	1.8	2.4	290	71
Silver	0.20U	0.064J	1.9	
Zinc	100	120	90	81

Bold indicates a sample value exceeding the CCC.

Bold and Underline indicates a sample value exceeding the CMC.

- 1) CMC – Criteria Maximum Concentration is the highest level for a 1-hour average exposure not to be exceeded more than once every three years, and is synonymous with “acute”. 40 CFR Part 131 (EPA, 2000)
- 2) CCC – Criteria Continuous Concentration is the highest level for a 4-day average exposure not to be exceeded more than once every three years, and is synonymous with “chronic”. 40 CFR Part 131 (EPA, 2000).
- 3) California Ocean Plan acute and chronic objectives for total mercury (California State Water Resources Control Board , 2005).

U qualifier indicates analyte was not found at or above the associated reporting limit.

UJ qualifier indicates that the analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

J qualifier indicates that the result is an estimated quantity. All J qualifiers are for detections below reporting limits.

J- qualifier indicates that the result is an estimated quantity but result may be biased low.

R qualifier indicates that the data are unusable (the analyte may or may not be present).

4.3 Leaching Characteristics

Leaching characteristics of sediments are important when making upland disposal decisions. To assess leaching characteristics, a DI-WET extract was analyzed from each of the top sediment composites for soluble metals that might leach from the sediments into groundwater and receiving waters. In both top samples, the saltwater chronic criterion (CCC) was exceeded for lead, and copper and zinc exceeded acute criteria (CMC). Without taking natural attenuation and dilution into account, results indicate that copper, lead and zinc could be mobile and thus impact receiving waters. However, attenuation and initial dilution should mitigate these impacts.

5.0 QUALITY ASSURANCE/QUALITY CONTROL SUMMARY

Kinnetic Laboratories conducts its activities in accordance with formal QA/QC procedures. The objectives of the QA/QC Program are to fully document the field and laboratory data collected, to maintain data integrity from the time of field collection to storage at the end of the project, and to produce the highest quality data possible. The program is designed to allow the data to be assessed by the following parameters: Precision, Accuracy, Comparability, Representativeness, and Completeness. These parameters are controlled by adhering to documented methods and procedures (SOPs), and by the analysis of quality control (QC) samples on a routine basis.

Field Quality Control includes adherence to SOPs and formal sample documentation and tracking. Analytical chemistry Quality Control is formalized by EPA and State Certification agencies, and involves internal quality control checks such as method blanks, matrix spike/spike duplicates (MS/MSDs), blank spike/blank spike duplicates, laboratory replicates and calibration standards. Standard Reference Materials (SRMs) are also run along with calibration standards for each batch of samples.

All analytical data collected for this sediment-testing program underwent QA/QC evaluation according to EPA National Functional Guidelines for inorganic and organic data review (USEPA, 2001; 2002).

5.1 Holding Times

In the case of sediments, appropriate holding times are still the subject of debate. Kinnetic Laboratories has adopted a conservative approach and requests 14 days to sample preparation for organic analyses in sediment and 28 days for total organic carbon. Metals have a 6-month holding time. A careful review of the results confirmed that the laboratories completed most analyses within holding times. The one exception was total organic carbon, which was run 14 days out of holding time. Since total organic carbon did exceed holding times, the results had to be qualified as an estimate (“J”).

5.2 Blanks

Method and filter blanks were run on carbon free water to assess contamination introduced in the laboratory. In all cases, procedural blanks for sediment and water did not contain any quantifiable concentrations indicating the methods and equipment used were free of or did not introduce contamination. Several metals were detected below the reporting limit, but since these values are considered estimates, no qualifications were necessary.

5.3 Laboratory Replicates

The control limit established for laboratory replicate relative percent differences (RPDs) for all chemical constituents is 30 percent. Sediment RPDs met QA/QC objectives with the following exceptions:

- Laboratory replicates for copper in sediment had an elevated RPD of 39.3%. Both values, the original and the duplicate, were greater than five times the reporting limit. Since all other quality control objectives were met, including the MS/MSD RPD, and the RPD for copper was only slightly above the control limit of 30%, the copper data was not qualified.
- Silver had a laboratory replicate RPD above the acceptable QC limit of 30%. Since both the original sample and the duplicate were less than the reporting limit, no qualifications were necessary.
- The RPDs for chrysene and fluoranthene laboratory replicates were also above the acceptable QC limit of 30%. Since both the original sample and the duplicate were less than the reporting limit, no qualifications were necessary.

5.4 Laboratory Control Samples

All Laboratory control samples associated with this project were well within QC limits indicating proper analytical performance in the absence of matrix effects.

5.5 Matrix Spikes/Matrix Spike Duplicates

Matrix Spike and Matrix Spike Duplicates (MS/MSD) percent recoveries were evaluated to determine acceptable accuracy based on method-specific percent recoveries. Additional precision was evaluated by calculating the RPD of the MS/MSD recovery results.

The general rule is that when spikes are reported below the accepted range they indicate a low bias to the results and when reported above the accepted range they indicate a high bias. However, if the spike concentration was low in comparison with the sample concentration, a poor recovery is not in itself indicative of a QC problem. Data that did not meet established QC objects are as follows:

- The MSD for endrin aldehyde in sediment had low percent recoveries (13% and 15%), which was below the acceptable QC range of 60-120%. Endrin aldehyde was not detected in any sample. Therefore, these results were qualified as not detected but possibly present (UJ).

5.6 Standard Reference Material

All reference materials percent recoveries for this project were well within QC limits indicating proper analytical performance in the absence of matrix effects.

5.7 QA/QC Conclusions

A careful review of the results confirmed that the laboratories met most QA/QC requirements. Holding time violations for total organic carbon caused all values to be qualified (J) indicating that they are estimates. With this exception, overall evaluation of the QA/QC data indicates that the chemical data for the most part are within established performance criteria and can be used for general characterization of sediments in the proposed project area.

6.0 SUMMARY AND CONCLUSIONS

Contaminant concentrations are at low levels and fairly evenly distributed throughout the footprint of the Pillar Point project area. The relative risk of causing toxic effects to marine benthic organisms is minor as predicted by the use of ERM quotients. Metals in the sediment to be dredged are fairly soluble and could migrate through the ground or from runoff to receiving waters. However, natural attenuation and initial dilution should mitigate any potential impacts. Paving over the Perched Beach fill area would also minimize the chances of metals becoming mobile.

Although complete testing for all potential disposal options was not conducted, chemical results that were gathered indicate that the Pillar Point sediments should be suitable for a variety of disposal/reuse options including use as fill on the Perched Beach or for beach replenishment. Although, grain size characteristics and other physical properties of the sediments may be undesirable for beach replenishment. This report should be able to be used to obtain a partial or total Tier I exemption once the dredge material permitting process is initiated. If open water disposal options are being considered, than additional Tier III testing would be required.

75.0 REFERENCES

- American Society for Testing and Materials, 2004a, ASTM D 2487-00, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System): ASTM Annual Book of Standards, Volume 04.08 on Soil and Rock, Section 4 – Construction, West Conshohocken, PA.
- American Society for Testing and Materials, 2004b, ASTM D 2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure): ASTM Annual Book of Standards, Volume 04.08 on Soil and Rock, Section 4 – Construction, West Conshohocken, PA.
- California State Water Resources Control Board. 2005. Water Quality Control Plan Ocean Waters of California. California Ocean Plan. Approved by the U.S. Environmental Protection Agency on February 14, 2006.
- Hyland, J.L., R.F. Van Dolah, and T.R. Snoots, 1999. Predicting Stress in Benthic Communities of Southeastern U.S. Estuaries in Relation to Chemical Contamination of Sediments. *Environ Tox. Chem.* Vol. 18: 2557-2564.
- Krone CA, Brown, DW, Burrows, DG, Chan, S-L, Varanasi, U (1989). Butyltins in Sediment from Marinas and Waterways in Puget Sound, Washington State, U.S.A. *Mar Poll Bull* 20:528-31.
- Long, E.R., D.D. MacDonald, S.I. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects Within the ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environmental Management*, Vol. 19:81-97.
- Long, E.R., L.J. Field, and D.D. MacDonald. 1998. Predicting Toxicity in Marine Sediments With Numerical Sediment Quality Guidelines. *Environ. Tox. Chem.* Vol. 17:714-727.
- Plumb, R.H., Jr., 1981. Procedures for Handling and Chemical Analysis of Sediment and Water Samples. Environmental Laboratory. Technical Report. EPA/CE-81-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- U.S. Army Corps of Engineers (USACE). 2001. Guidelines for Implementing the Inland Testing Manual within the San Francisco Bay Region. Public Notice 01-01.
- United States Environmental Protection Agency (USEPA), 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. Federal Register, 40 CFR Part 131.
- United States Environmental Protection Agency (USEPA), 2001. USEPA Contract Laboratory Program, National Functional Guidelines for Low Concentration Organic Data Review. EPA540-R-00-006.
- United States Environmental Protection Agency (USEPA), 2002. USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review. EPA 540-R-01-008.
- U.S. Environmental Protection Agency/U.S. Army Corps of Engineers. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the United States – Inland Testing Manual. EPA-823-B-98.