Report

DREDGE MATERIAL EVALUATION
DANA POINT HARBOR MAINTENANCE DREDGING

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EXECUTIVE SUMMARY

The County of Orange proposes to carry out maintenance dredging to remove shoaled areas throughout Dana Point Harbor (Figure 1). In addition, the County wishes to remove fine-grained material from the inter-tidal shore face at Baby Beach located within the Harbor, which may be conducive to fecal indicator bacteria (FIB) growth, and replace it with coarse-grained material. All together there are nine units (Figure 2) requiring dredging. One of these dredge units is in front of a major storm drain entering the East Basin. A tenth unit, the East Anchorage, was dropped from the testing program. Design depths (before overdepth) vary between -6 and -15 feet mean lower low water (MLLW) with the exception of Baby Beach. Surface material will also be removed from Baby Beach.

Sediments in the West Anchorage and West Main Channel contain predominantly coarse grain material. Total combined volume of theses dredge units is 57,900 cubic yards (cy) with a two foot overdredge and a 10% contingency for ongoing sedimentation and localized variation in bathymetry. The remaining dredge units contain predominantly fine grain sediments and encompass a combined total of 59,900 cy with a two foot overdredge and a 10% contingency.

It is preferred to beneficially reuse the 57,900 cy of coarse material for beach nourishment. Between 5,700 and 9,500 cy of this material are proposed to replace the material removed from Baby Beach. The remaining quantity of sand is proposed to be placed directly on Capistrano Beach County Park or just offshore of the Beach (Figure 4). Preferred disposal of fine grain material is at the LA-3 offshore disposal site.

This environmental characterization study was conducted in conformity with a Sampling and Analysis Plan (SAP) approved by the regulatory agencies (Kinnetic Laboratories, 2006). Dana Point Harbor was divided up into three testing Areas. Six cores were collected in Area A representing material for beach replenishment, eight cores were collected in Area B representing ocean disposal material in the western half of Dana Point Harbor, and six cores were collected from Area C representing ocean disposal material in the eastern half of Dana Point Harbor. Using an electric vibracore, samples were collected to three feet below design depths in Area A and four feet below design depths in Areas B and C. All cores in Area B were combined into a single composite sample and all cores in Area C were combined into a single composite sample since the stratigraphy of each of these areas recognized no significant layering of sediment type or visual contamination. No compositing was conducted in Area A. Instead, the entire length of each core down to the sample depths was analyzed individually. Individual cores samples from Areas B and C were also analyzed for bulk chemistry and grain size, in addition to the composite samples. Reference samples were also collected at LA-3, Capistrano Beach and Baby Beach.

Bulk sediment chemical and physical testing was performed on all individual core samples. Prior to sediment compositing, a review of the results from the individual core analyses was conducted to determine if any dredge units should be treated separately or eliminated from an ocean disposal composite. In collaboration with the USEPA and USACE, it was determined to proceed with the compositing and testing as outlined in the SAP. For the Area B and C composite samples formed, testing consisted of additional physical and chemical analyses of the bulk sediments, toxicity and bioaccumulation assessments of the sediments, and toxicity and chemical testing of sediment elutriates. As specified in the Ocean Disposal Manual (USEPA/USACE, 1991) and Inland Testing Manual (USEPA/USACE 1998), toxicity and bioaccumulation results were statistically evaluated against the LA-3 reference site.

Coarse grain sediments from Area A do not appear to have excess amounts of fine grain material and total organic carbon that would preclude the sediments for beach replenishment. In addition, contaminant concentrations in Area A sediments are similar to or only slightly elevated above contaminant concentrations in the Capistrano and Baby Beach reference samples.

The results of the Areas B and C study were used to evaluate the potential suitability for disposal at the LA-3 ocean disposal site. Contaminants were not found in the Area B (western) composite sample in excess of Effects Range Low (ERL) screening values, while several contaminants (copper, total chlordane compounds, acenaphthene, benzo(a)pyrene, benzo(a)anthracene, total high molecular weight PAHs and total PAHs) were found in the Area C composite sample in excess of lower effects based screening values.

Calculated Effects Range Median (ERM) quotients for both Area B and Area C composite samples indicate that overall contamination is unlikely to cause toxicity to benthic organisms. This was verified by the lack of significant toxicity to amphipods and polychaete worms exposed to the test sediments compared to amphipods and worms exposed to the LA-3 reference sediments. By inference, the limiting permissible concentration (LPC) of contaminants would not be exceeded at the LA-3 disposal site.

Bioaccumulation testing was carried out for both Area B and Area C composite samples using both clams and worms.

Test results with the clam tissues showed that for Area B, statistically significant bioaccumulation of cadmium was evident in the tissues of clams exposed to the Dana Point Harbor test sediments in comparison to the tissues of clams exposed to LA-3 reference sediments. For Area C, lead, zinc and several PAH compounds were statistically elevated in the clam test tissues.

Test results with worm tissues showed statistically significant bioaccumulation of chromium, mercury and nickel in Area B tissues. For Area C worm tissues, chromium, mercury, nickel, 2,6-dimethylnaphthalene and acenaphthylene were statistically elevated in comparison to the tissues of worms exposed to LA-3 reference sediments.

Although statistically significant, metal bioaccumulation appears to be minor in the clams. For all three metals significantly elevated above the LA-3 reference tissues (cadmium, lead and zinc), mean bioaccumulation in the clam test samples was less than two times higher than in the reference sample. Zinc is the only metal listed in the USACE/USEPA Environmental Residue-Effects On-line Database (ERED, http://el.erdc.usace.army.mil/ered/), and the zinc concentrations measured in the Dana Point clam tissues was below the lowest observable effects levels.

In worm tissues, metal bioaccumulation appears to also be minor for mercury and lead but more pronounced for chromium and nickel. Mercury bioaccumulation in the worm test samples was less than two times higher than in the reference sample, and lead bioaccumulation in worm tissues was slightly more than two times higher than the reference sample. Chromium and nickel bioaccumulation in worm tissues was more substantial and variable, especially for Area B. No U.S. Food and Drug Administration (FDA) action levels (USFDA, 2000) for seafood or ERED database effects levels for polychaetes exist for these metals to assist in interpretation.

The magnitude of PAH bioaccumulation in the Area C clam tissues appears to be minor. Of the six PAH compounds in Area C clam tissues that were significantly elevated above LA-3 reference clam tissues, one compound was detected below the reporting limit, two compounds were detected slightly above the reporting limit, two compounds were about twice as high as the reporting limit, and two compounds were detected about three times higher than the reporting. These same compounds in the LA-3 reference clam tissues were either not detected or they were detected below the reporting limit.

PAH bioaccumulation in worms was more difficult to interpret because of high variability and extreme values associated with some Area C and LA-3 tissue samples. After a thorough review of the data it was concluded that four samples among all of the replicate tissue samples exhibited evidence of PAH contamination and should not be considered as valid. This conclusion was validated by the fact that Theoretical Bioaccumulation Potentials (TBPs) calculated for these samples were one to two orders of magnitude lower than indicated by the tissue data of these four samples showing that these replicates exceed realistic bioaccumulation levels. Statistical analysis after elimination of the suspect replicates revealed 14 of the individual PAH compounds, as well as total PAHs, in worm tissue from Area C were found to occur in statistically higher concentrations than those measured in worms exposed to both Home and LA-3 sediment. The limited information on the effects of bioaccumulation of PAHs on *Nephtys* or other marine polychaete worms suggested that concentrations of at least two of the PAH compounds, fluoranthene and phenanthrene, were well below concentrations known to have measurable biological effects (e.g. growth, reproduction, behavior, and physiology).

Final dredging and disposal decisions can only be made by the regulating agencies. However, after review of all data, Area A sediments should be acceptable for reuse on Baby and Capistrano Beaches and Area B sediments should be acceptable for placement at LA-3. Despite contaminant issues associated with Area C sediments, all or some of the Area C sediments may also be suitable for placement at LA-3. As defined by the individual core analyses, the bulk of the observed contamination in Area C can be attributed to the shoaled area in front of the 60-inch storm water outfall entering the East Basin.

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1.0 INTRODUCTION AND PURPOSE

Operators of Dana Point Harbor (Figure 1) and the Dana Point Harbor Patrol Office have reported navigational hazard conditions due to shoaling that has occurred in the vicinity of storm drain outfalls and along the West and East Breakwaters. The County of Orange proposes to carry out maintenance dredging to remove these shoaled areas and other areas that have experienced siltation. In addition, the County wishes to remove fine-grained material, which may be conducive to fecal indicator bacteria (FIB) growth in coarse-grained material, from the inter-tidal shore face at Baby Beach located within the Harbor. All together there are ten units identified in Figure 2 requiring dredging. These units are identified as follows:

- West Anchorage adjacent to the West Breakwater and Ocean Institute Docks.
- East Anchorage (not sampled)
- Main Channel West
- West Basin Channel
- Inter-tidal shore face at Baby Beach
- West Turning Basin between the Pier and Youth and Group Docks
- Pilgrim Moorage
- Boat Launch Ramp Basin
- East Basin adjacent to a 60-inch storm drain outfall
- East Basin Channel

Sediments in the West Anchorage and Main Channel West contain predominantly coarse grain material. The East Anchorage was originally identified to be dredged and material was to be used for beach replenishment. However, fine-grain material was encountered during sampling, existing depths were acceptable, and it was thus decided to remove this area from current evaluation. Total volume of the combined dredge units with coarse material is 57,900 cubic yards (cy). This volume includes one foot paid overdepth and an allowance for ongoing sedimentation and localized variations in bathymetry (up to a maximum of one additional foot throughout the dredge footprint). The remaining dredge units containing predominantly fine grained sediments encompass a combined total of 59,900 cy also accounting for one foot of paid overdepth and an allowance for ongoing sedimentation/localized variations in dredge depths. The proposed depths (before overdepth) of these units vary between -6 and -15 feet from mean lower low water (MLLW) with the exception of Baby Beach. Surface material will be removed from Baby Beach. Latest bathymetry is illustrated in Figure 3. Table 1 identifies the individual dredge units, dredge depths, and estimated quantities of dredge material.

The preferred project intent is to beneficially reuse the 57,900 cy of coarse grain material for beach nourishment. Between 5,700 and 9,500 cy of this material are proposed to replace the material removed from Baby Beach. The remaining quantity of coarse material is proposed to be placed directly on Capistrano Beach County Park or just offshore of the Beach (Figure 4). The other units contain much finer grain material and preferred disposal of this material is at the LA-3 offshore disposal site.

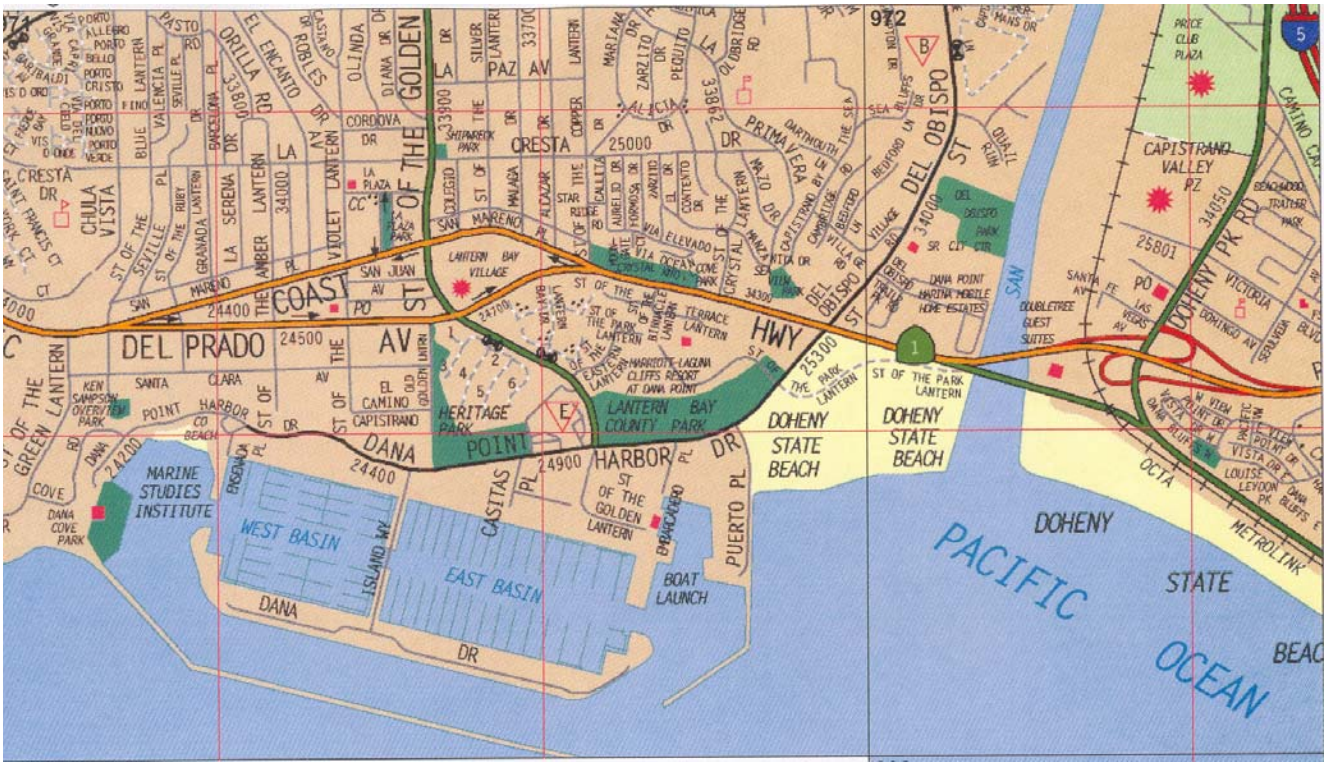

Figure 1. Location of Dana Point Harbor

The purpose of this report is to provide sediment quality data that summarizes the sediments within the proposed dredge area for evaluation of dredging and disposal options. An environmental sampling and analysis plan (Kinnetic Laboratories, 2006) was prepared prior to sampling to detail sampling methods, analytical and biological testing procedures, and reporting procedures to be employed. This report summarizes the physical, chemical and biological data necessary to support dredging and disposal and provides a discussion of the results in terms of available guidelines. The intent of this report is to provide the regulators with enough data to make decisions on dredging and disposal suitability.

1.1 Site Description

The construction of Dana Point Harbor began in the late 1960's and the Harbor was officially dedicated on July 31st, 1971. The Harbor is located in Capistrano Bay on the southern Orange County coastline, approximately half way between Los Angeles and San Diego (Figure 1). Dana Point Harbor is a County Park located within the City of Dana Point, and serves recreational boaters and County residents alike with numerous recreational and leisure activities. It is a vital commercial and community center.

Facilities within the harbor immediately adjacent to the water include the East and West Marinas containing approximately 2,500 slips, a fuel dock, bait barge, boat launch ramps, commercial fishing docks, a boatyard, guest docks, boat rental docks, yacht clubs, the youth and group facility, an interior swim beach (Baby Beach), a fishing pier, and the Ocean Institute docks for tall ships and research vessels.

The intertidal beach at Capistrano Beach County Park is composed of a mixture of sand and cobble. The shallow subtidal area (out to approximately -12 feet MLLW) is low relief rock with isolated rocks up to 2 meters in height (Chambers, 2006). The beach abuts Doheny State Beach on the west, which extends 1.2 miles up coast of the Harbor. Doheny State Beach overlaps with Doheny Beach Marine Sanctuary, which extends 600 feet offshore.

Figure 2. Dana Point Harbor Limits of Dredging and Final Sampling Locations

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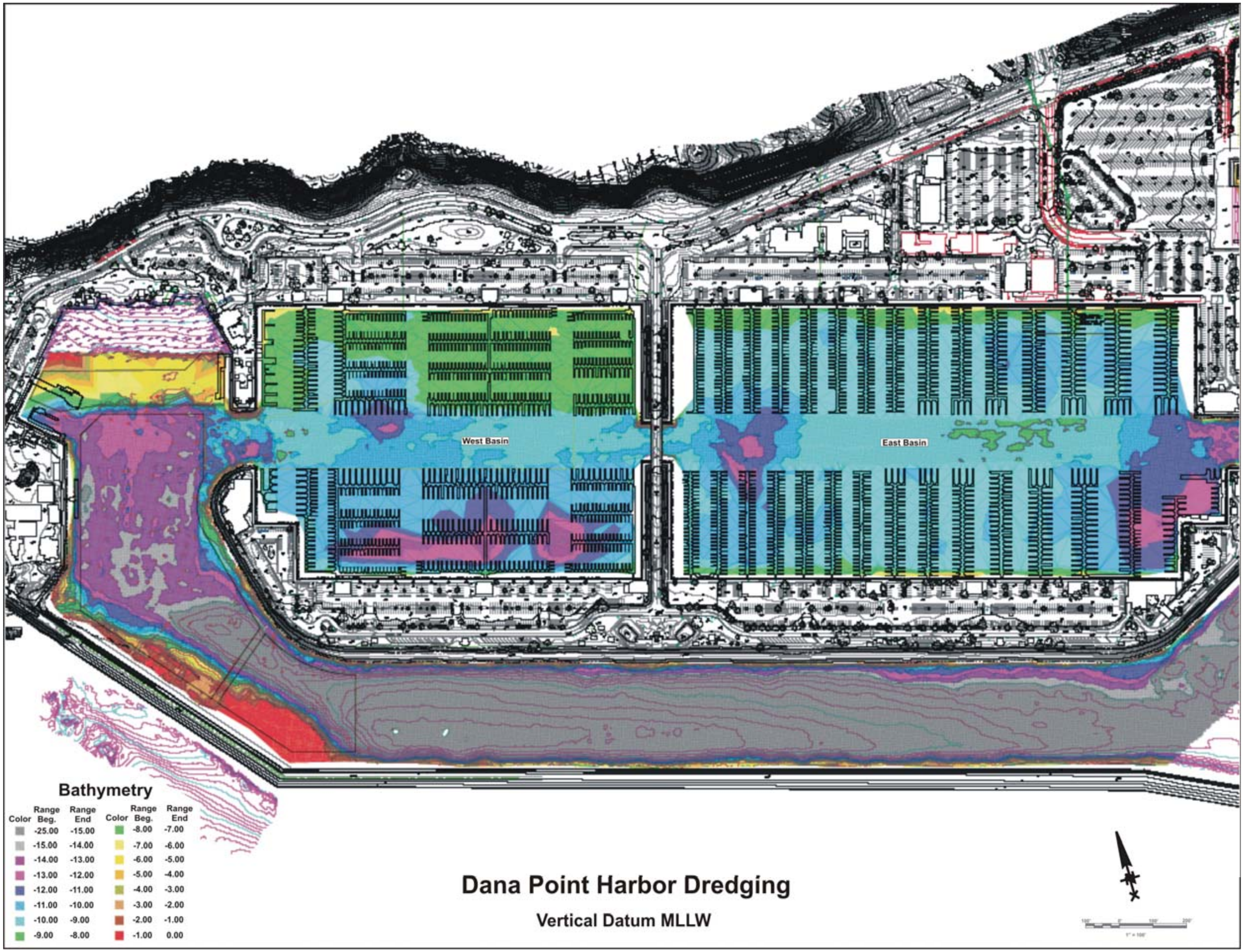

Figure 3. Most Recent Bathymetry of Dana Point Harbor (County of Orange and USACE June 2006 Survey).

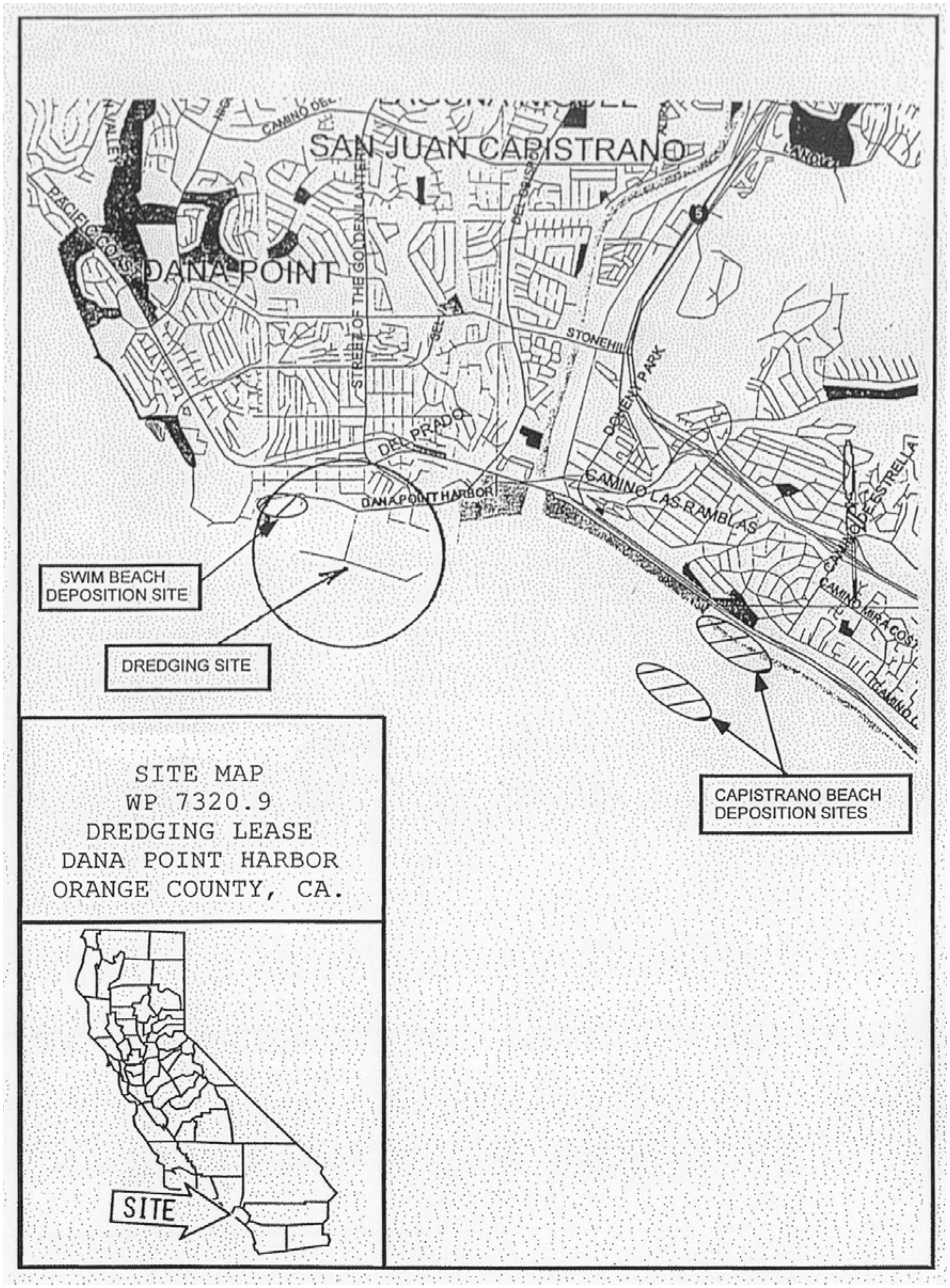

Figure 4. Capistrano Beach County Park Deposition Sites

Table 1. Dredge Depths and Estimated Dredge Quantities of Shoaled Areas within Dana Point Harbor

Composite Areas and Dredge Units	Number of Cores Collected	Dredge Depth (ft, MLLW)	Estimated Dredge Quantities (cy)		
			Without Overdredge	With 2 ft Overdredge	With 2 ft Overdredge and 10% Contingency
Area A					
West Anchorage and Turning Basin	2	-10	12,700	16,700	18,400
Main Channel (West)	4	-15	32,900	35,900	39,500
Total Area A Volumes			45,600	52,600	57,900
Area B					
West Basin Channel	2	-10	1,100	8,100	9,000
Pilgrim Moorage	1	-14	500	1,100	1,300
West Turning Basin (Youth Docks)	3	-6	8,000	12,000	13,200
Offshore Baby Beach	2	--	2,850	8,550	9,500
Total Area B Volumes			12,450	29,750	33,000
Area C					
East Basin (60" Outfall)	2	-10	1,700	3,500	3,900
East Basin Channel	2	-10	3,900	12,900	14,200
Boat Launch Ramp Basin	2	-8	4,800	8,000	8,800
Total Area C Volumes			10,400	24,400	26,900
Total Project Volumes			68,450	106,750	117,800

1.2 Previous Dredge Studies

Historically, the County of Orange has carried out maintenance dredging in navigation channels, anchorages, and areas under docks within Dana Point Harbor that have become shoaled due to sediment build up. The previous dredging cycle occurred in 1999/2000 when approximately 50,500 cubic yards of sediment were dredged in accordance with General Waste Discharge Requirements Order No. 96-32 (SDRWQCB, 1996). Of this volume, it is estimated that 32,500 cubic yards of clean sand was placed on or near shore to Capistrano Beach, 3,000 cubic yards of clean sand were placed on the interior swim beach (Baby Beach), and the remaining 15,000 cubic yards of fine silty and clayey material were deposited at the EPA-approved LA-3 offshore disposal site.

Advance Biological Testing, Inc. (1997) performed chemical and bioassay testing on three composite samples and bioaccumulation testing on two composite samples prior to dredging. Test sediments contained between 47% and 97% sand and the concentration of contaminants were similar or less than concentrations found in the LA-3 reference site sediments. Suspended phase bioassays produced 50% Lethal Concentrations (LC_{50}s) that were greater than 100% in all samples and the Limiting Permissible Concentration (LPC) was not exceeded. *Ampelisca* and *Nephtys* benthic bioassays revealed no significant toxicity over the reference site. However, the *Mysidopsis* benthic bioassay revealed significant toxicity over the LA-3 reference sediment in one of the three composite samples (80% survival), thus the LPC was exceeded. Tissues obtained from test sediment bioaccumulation exposures of both test species contained levels of Cr, Cd, Pb and Zn that were slightly elevated over tissues obtained from the LA-3 reference sediment exposures. There was no significant bioaccumulation of organic compounds. It was determined that the two composite areas tested for ocean disposal were suitable for disposal at LA-3. The third composite area tested for beach replenishment only was suitable for reuse at Capistrano County Beach.

2.0 SCOPE OF STUDY

2.1 Approach

This study was designed to characterize the relatively small amounts of total sediment to be dredged that is distributed within Dana Point Harbor by an efficient and cost effective plan suitable for a routine small harbor maintenance project. Classification of sediments according to grain size and previous data has been used to define test units and to optimize compositing to reduce costs.

The Harbor was divided up into three testing areas based on sediment grain size characteristics and geographic location. Area A, consisting of the West Anchorage and Main Channel West, contains predominantly coarse grain material. Area A was tested in accordance to the Inland Testing manual (ITM) (USEPA/USACE, 1998) for beach replenishment use. Only Tier II (chemical) testing was conducted on the sediments from Area A, and compositing was <u>not</u> used to reduce the number of samples. Areas B and C consisted of the remaining seven dredge units with predominantly fine-grained sediments. Area B consists of the Baby Beach, West Turning Basin, West Basin Channel, and Pilgrim Moorage; and Area C consisted of the Boat Launch Ramp Basin, East Basin Channel, and East Basin Outfall. All sediment collected within each of these two areas was combined into a composite sample and tested for ocean disposal at LA-3 in accordance with the ITM (USEPA/USACE, 1998) and the Ocean Disposal Testing Manual (USEPA/USACE, 1991). Thus, two composite samples were formed for ocean disposal testing. Figure 2 defines the limits of dredging for all areas, with the exception that the East Anchorage area that has been removed from the dredging program.

According to the ITM, each geographically separated dredge area should be treated as separate dredge units or project segments. However, it would be economically infeasible to do so when the preferred disposal option is at an open water environment requiring full biological testing. Because of the relatively small amount of dredge material within areas considered for open water disposal, only two composite samples for Tier III testing were formed. Tier II testing (bulk chemistry and grain size analyses) was done for each individual core for all areas and on the composite samples for ocean disposal testing.

A total of twenty-three cores were sampled within the Dana Point Harbor. Table 2 lists the dredge elevations, core lengths obtained and final sample coordinates. Core locations are also depicted in Figure 2. It was necessary to collect two or three cores from each of the Area B and C locations in order to obtain enough material for all Tier II and III analyses.

The study design was based upon sediment sampling for environmental and geotechnical testing and utilized a vibracore sampler working off Kinnetic Laboratories' survey barge. The vibracore obtained 4-inch diameter continuous cores to dredge depth plus the defined overdredge depth. Geotechnical logging was also conducted by Laguna Geosciences, Inc to identify any distinct layers within these cores.

The basic approach for each core collected was to form single vertical composite samples from the mudline to project depth plus two feet for overdredge. The basic overdredge sampling and testing approach is consistent with the US Army Corps of Engineers' draft guidance document on "overdepth" allowance (USACE, 2005) and with a memorandum from the Director of Civil Works for the USACE to USACE Commanders of Major Subordinate Commands on assuring the adequacy of environmental documentation for the maintenance dredging of federal navigation projects (USACE, 2006). As justified in the Sampling and Analysis Plan (Kinnetic Laboratories, 2006), an additional one-foot of overdepth sampling was added to the basic approach for Area A cores and two feet of overdepth sampling was added to the Composite Areas B and C cores to accommodate inaccuracies in the dredging process. This brings the total sampling and characterization depth to three feet below design depths and two feet below paid overdredge allowance for Area A and four feet below design depths and three feet below paid overdredge allowance for Areas B and C.

Table 2. Sampling Specifics for Cores Collected from Dana Point Harbor August 2006.

Sample ID	Date Sampled	Mudline Elevation (MLLW)	Core Length Obtained (feet)	Elevation Obtained (MLLW)	Interval Sampled (Feet BGS*)	Latitude (NAD 1983)	Longitude (NAD 1983)
A1	25/08/2006	-8.3	1.4	-9.7	0-1.4	33° 27' 38.8"	117° 42' 22.9"
A2	22/08/2006	-6.5	6.8	-10.0	0-6.8	33° 27' 36.1"	117° 42' 22.8"
A3	22/08/2006	-5.6	9.3	-14.9	0-8.4	33° 27' 34.8"	117° 42' 20.8"
A4	24/08/2006	-8.2	3.0	-11.2	0-3.0	33° 27' 38.3"	117° 42' 17.1"
A5	22/08/2006	-8.0	10.7	-18.7	0-10.7	33° 27' 32.7"	117° 42' 18.2"
A6	22/08/2006	-8.1	10.1	-18.1	0-10.1	33° 27' 31.1"	117° 42' 15.6"
B1	23/08/2006	1.5	4.9	-3.4	0-4.9	33° 27' 45.6"	117° 42' 20.0"
B2	23/08/2006	1.2	6.0	-4.8	0-5.0	33° 27' 45.2"	117° 42' 18.0"
B3	23/08/2006	-7.0	0.7	-7.7	0-0.7	33° 27' 44.1"	117° 42' 21.1"
B4	23/08/2006	-6.4	1.2	-7.6	0-1.2	33° 27' 43.0"	117° 42' 18.4"
B5	27/08/2006	-7.2	1.6	-8.8	0-1.6	33° 27' 43.2"	117° 42' 15.5"
B6	24/08/2006	-13.7	2.3	-16.0	0-2.3	33° 27' 42.9"	117° 42' 21.9"
B7	24/08/2006	-9.6	6.0	-15.6	0-3.4	33° 27' 40.8"	117° 42' 12.9"
B8	24/08/2006	-9.5	3.5	-13.0	0-3.5	33° 27' 40.2"	117° 42' 12.3"
C1	24/08/2006	-9.0	4.2	-13.2	0-4.0	33° 27' 37.4"	117° 41' 39.8"
C2	24/08/2006	-8.6	4.4	-13.0	0-4.4	33° 27' 37.1"	117° 41' 38.2"
C3	24/08/2006	-9.3	3.3	-12.6	0-3.3	33° 27' 33.7"	117° 41' 43.9"
C4	24/08/2006	-9.6	2.3	-11.9	0-2.3	33° 27' 33.0"	117° 41' 41.8"
C5	21/08/2006	-7.8	4.0	-11.8	0-3.2	33° 27' 40.0"	117° 41' 29.7"
C6	21/08/2006	-7.1	4.5	-11.6	0-3.9	33° 27' 39.6"	117° 41' 27.1"

To assist in the evaluation of the Dana Point Harbor sediments, reference sediment was collected from the LA-3 reference site. Sediment was collected with a towed 15 gallon, fiberglass bucket dredge. Two deployments of the dredge were necessary to collect enough material to conduct all Tier II and III analyses.

For Areas B and C, no vertical strata in the cores were greater than two feet. Therefore, the entire vertical segment from each Areas B and C core was homogenized. One liter of each homogenous vertical composite was sent to the analytical laboratory and analyzed for bulk sediment chemistry and grain size distribution on a quick turn around basis. The remainder of each vertical composite was archived for future compositing. The results of the individual cores were compared to sediment quality guidelines to determine if the sediments from the individual dredge units will have a reasonable chance of qualifying for ocean disposal. Since unreasonable contamination was not evident for any core (based on empirically derived toxicity effects levels and consultation with EPA Region 9 and the Los Angeles District USACE), no cores or dredge units were excluded from biological (Tier III) testing. Subsequently, archived vertical composites from the B and C composite areas were proportionally combined into two horizontal composite samples. These composite samples were also analyzed for bulk sediment chemistry. In addition, a standard elutriate was prepared from each (Areas B and C) composite sediment sample. Standard elutriates and site water used to prepare the elutriates were analyzed for much of the same list of constituents performed on the bulk sediments.

Biological testing was also conducted on the Dana Point Areas B and C sediment samples, including both benthic and water column bioassays and bioaccumulation exposures. Suspended particulate-phase (water column) bioassays were conducted using mysids, larval fish and the larvae of mussels. Standard elutriates were prepared with water collected from the Main Channel, and dilution water was clean open-coast seawater from ToxScan's laboratory at Santa Cruz. Concurrent bioassays were performed on elutriates and laboratory control water. Results of elutriate bioassays were statistically compared with control water bioassays. Those elutriates which produced significantly greater toxicity than control water were identified; and if mortality and/or development effects were sufficiently high to produce LC_{50} and/or EC_{50} values, initial mixing calculations were performed to specify LPCs. Sediments that would not exceed their LPCs meet criteria for open-water disposal site. Worms and amphipods were used for the solid phase (benthic) tests. Test sediments underwent bioassay testing concurrently with LA-3 reference sediments and control sediments collected from the organisms' home environment. Results of the benthic bioassays were statistically compared with reference sediment bioassay results. Those test sediments that produce statistically greater mortality than reference sediments and in which test mortality exceeded reference mortality by greater than an allowable percentage, would be considered to exceed the LPC for disposal. The 28-day bioaccumulation exposures were performed using worms and clams. Test sediments were exposed concurrently with reference and control sediments, and tissues were analyzed for a suite of constituents of concern. Concentrations of metal and organic contaminants in tissues of organisms exposed to LA-3 reference sediments were compared with concentrations in organisms exposed to test sediments. Constituents that showed statistically significantly elevated concentration in test tissues were considered to be potentially bioaccumulative and were then evaluated to determine if those levels were biologically important.

Coarse grain material (e.g. Area A) is less likely to be a carrier of contamination. Per ITM guidance, dredged materials proposed for beach nourishment often can be excluded from chemical or biological testing and instead focus on determining physical compatibility with the disposal area as measured by grain size and total organic carbon (TOC). However, since the harbor is not isolated from sources of pollution, both grain size and bulk sediment chemistry testing was conducted. Therefore, for Area A, the basic approach was to collect six cores to project depth plus four feet for overdredge, as explained earlier. In several locations in Area A, the depth of sediment over rock wasn't deep enough to allow for the adjusted coring depth.

There were also no vertical strata in the Area A cores greater than two feet. Therefore an entire vertical composite sample of each Area A core was analyzed for bulk sediment chemistry and grain size to determine suitability for beach replenishment. Laguna Geosciences analyzed additional grain size samples from discrete layers within each core (Appendix A).

To determine if the Area A sediments are compatible with Capistrano Beach County Park sand, surface samples were collected from the exposed and subtidal portions of the beach disposal area. Two perpendicular transects to the beach face were formed and sampled from elevations of +12 feet MLLW to –30 feet MLLW. An attempt was made to space sampling locations every six feet in elevation along these transects. Specifically, an attempt was made to collect samples at +12, +6, 0, -6, -12, -18, -24, and –30 feet MLLW along each transect. This proved to be difficult because the beach slope was irregular, especially offshore. There were also pockets of hard or compacted bottom offshore, especially near the surf zone. Sampling crews stayed with the original sampling plan as best as they could, but transects did not follow straight lines as depicted on Figure 4 and certain elevations were adjusted slightly. Clean stainless-steel utensils were used to sample exposed portions and surf zone of the beach and a grab sampler was used to sample subtidal portions of Capistrano Beach. Grain size and TOC were determined from each sample collected. In addition, a portion of each sample collected at and above 0.0 feet MLLW was composited into a single sample for bulk sediment chemistry in order to assess baseline concentrations of contaminants.

To assess ambient conditions in the upper tidal area of Baby Beach proposed to receive coarse grain material from shoaled locations in Area A, samples for grain size and bulk sediment chemistry were also collected using clean stainless steel utensils. Samples were collected at three locations along a shorelineperpendicular transect in the center of the beach. The three sample locations were at the waterline, middle and top of the beach. Grain size was measured from each location, and material from each location was combined into a single sample for chemical analysis.

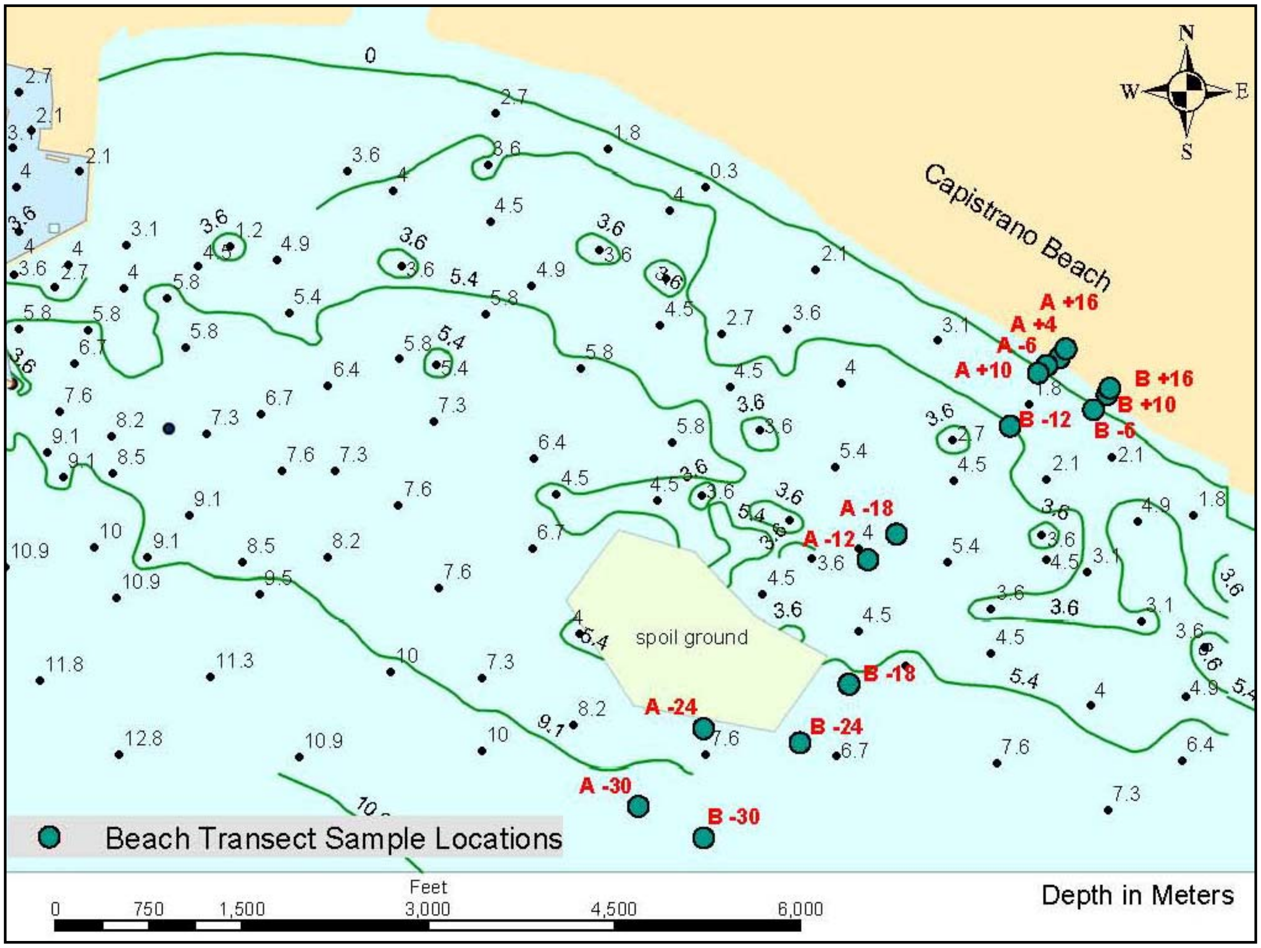

Figure 4. Capistrano Beach Sampling Locations

2.2 Evaluation Criteria

The determination of whether the sediments are hazardous waste can be made by comparison of chemical analysis results with State of California Code of Regulations Title 22 Total Threshold Limiting Concentrations (TTLC limits), supplemented if necessary by a State of California Waste Extraction Test (WET) for any analytes that exceed ten times Soluble Threshold Limiting Concentrations (STLC limits).

Contaminants found within the sediments were compared to NOAA sediment quality guidelines (Long et. al., 1995). These guidelines (Table 3) 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:

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

Table 3. NOAA Sediment Screening Values for Selected Analytes.

Analyte	Units	ER-L[1]	ER-M[1]
Silver (Ag)	mg/kg	1.0	3.7
Arsenic (As)	mg/kg	8.2	70
Cadmium (Cd)	mg/kg	1.2	9.6
Chromium (Cr)	mg/kg	81	370
Copper (Cu)	mg/kg	34	270
Mercury (Hg)	mg/kg	0.15	0.71
Nickel (Ni)	mg/kg	20.9	51.6
Lead (Pb)	mg/kg	46.7	218
Zinc (Zn)	mg/kg	150	410
DDT Total	µg/kg	1.58	46.1
DDE	µg/kg	2.2	27
Dieldrin	µg/kg	0.02	8.0
Chlordane	µg/kg	0.5	6.0
PCBs Total	µg/kg	22.7	180
PAHs Total[2]	µg/kg	4022	44,792
LMW PAHs	µg/kg	552	3160
HMW PAHs	µg/kg	1700	9600
Phenanthrene	µg/kg	240	1500
Pyrene	µg/kg	665	2600
Benzo(a)anthracene	µg/kg	261	1600
Chrysene	µg/kg	384	2800
Benzo(a)pyrene	µg/kg	430	1600
Dibenzo(a,h)anthracene	µg/kg	63.4	260
Fluoranthene	µg/kg	660	5100
Anthracene	µg/kg	85.3	1100
Acenaphthene	µg/kg	16	500
Acenaphthylene	µg/kg	44	640
Naphthalene	µg/kg	160	2100
Fluorene	µg/kg	19	540
Methylnaphthalene, 2-	µg/kg	70	670

1. Concentration below ERL values, biological effects are rarely observed. Concentrations above ERL values and below ERM values occasionally exhibited biological effects. Concentrations above ERM values most often exhibit biological effects. ERL and ERM values are from Long, et. al. (1995).
2. The definition of total PAHs in the scientific literature is highly variable, so comparing different studies can be misleading. Previous studies most often included the sum of 13 to 18 individual compounds.

3.0 METHODS

3.1 Sampling Methods

3.1.1 Sediment Sampling

Vibracore sampling at Dana Point Harbor was carried out from a Kinnetic Laboratories portable barge. This 14-foot X 10-foot vessel is equipped with a quadrapod frame and winch suitable for handling coring equipment. A 17-foot Boston Whaler was used to position the barge and transport sediment core samples to processing areas on shore.

A Kinnetic Laboratories vibracore was used to collect sediment core samples for the underwater portion of the survey. This system consists of a 4-inch diameter aluminum coring tube lined with clean food-grade 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 casing. A three-phase, 240V generator powers the motors electrically. The Vibracore head and tube were lowered overboard from the on-board quadrapod with a winch. Under the weight of the vibra-head, the core tube was allowed to penetrate the surficial materials below the mud line to as great a depth as possible without vibrating. The sample tube was then vibrated down to project depth plus three or four feet for overdredge allowance. To accurately calculate penetration depth, the depth of water was measured with a lead line just prior to each coring operation.

Sample coordinates, water depths, and mudline elevations corrected to MLLW were recorded at each sampling location. Navigation and final positioning were conducted using a Garmin 215D series differential GPS navigation system, operating in differential mode. Water depths were measured with a graduated lead line. Tidal stage was determined using *Tide Tool 2.1a* software checked against a local tide gauge. Table 2 shows the core locations sampled, the core lengths obtained, mudline elevations and sample recovery elevations.

After successfully penetrating to the desired depth, power was shut off to the vibracore head, and the vibracore was brought aboard the vessel. A check valve located on 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 core tube was then detached from the vibra-head and the core cutter and catcher were removed. The core liners were then sealed and the core tubes were capped and transported to the shore-based processing facility. Two sites, B3 and B4, had shallow sediments and therefore a Ponar Grab was used to collect the sediment for analysis.

Except for the fiberglass bucket dredge used for reference sediment collection, 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 site-water rinse, a Micro-90® soap wash, 2 molar Nitric Acid rinse, and then finished with deionized water rinses.

3.1.2 Water Sampling

Water was collected in the channel and near the bridge between the East and West Basins. A peristaltic pump with Teflon® tubing was used to collect water from a depth of 1 foot below the water surface. Chemistry elutriate prep water was pumped into borosilicate 20 liter glass bottles and bioassay water was pumped into polyethylene 2.5 and 5.0 gallon cubitainers. Laboratory supplied bottles were dipped below the surface for background water collection. All water samples were immediately preserved with ice and kept on ice for transport to the laboratories.

3.1.3 Core Processing

Following retrieval, all cores were transported to a shore-based processing area and processed immediately. Core liners and sediment were placed on cleaned PVC core racks. The liners were then cut open using a clean stainless steel blade. Once exposed, sediment that came in contact with the core liner was removed with a pre-cleaned stainless steel spoon.

Before sub-sampling, each core was photographed, measured, and lithologically logged according to the United Soil Classification System (USCS). Additional sediment characteristics including likely sediment origin and other observations were also recorded. Logged physical characteristics for each core can be found in the geotechnical report prepared by Laguna Geosciences, Inc. and attached as Appendix A.

Following logging, a vertical composite was taken from each core by a vertical scrape protocol that resulted in equal sub-sampling along the entire length of the core. Each vertical composite was manually homogenized in a pre-cleaned stainless steel tray and then combined into composite samples according to the composite area. Once each composite area was manually homogenized, a portion of each composite sample was then transferred to certified pre-cleaned sample container consisting of an 8 oz glass jar with a Teflon®-lined lid for most chemical analyses, and an 8 oz high density polyethylene (HDPE) jar for dissolved sulfides analysis. In addition, each core had a second vertical scrape that was homogenized and placed into additional 8 oz jars for discrete chemical analysis. Remaining sediment from each core, to be used for bioaccumulation and bioassay assessments, was placed in pre-cleaned 3.5 gallon buckets with food grade HDPE liners. Bioassay and bioaccumulation sediments were later homogenized and composited at the laboratory. Except for dissolved sulfides, all sediment samples were placed into a refrigerated truck where they were maintained at 2-4º C until delivery to the laboratory. Dissolved sulfides were frozen with dry ice and kept frozen until analyzed by the laboratory.

3.1.4 Reference and Control Sediments

A sediment sample was collected for biological and chemical testing from the designated reference site (Figure 5) in the vicinity of the LA-3 open water disposal site. The target coordinates used for the reference site are 33˚ 31’ 42” N; 117˚ 51’ 18” W. In addition, reference samples were collected from the beaches proposed to receive coarse grain materials, as described previously in Section 2.1.

Several methods were used to obtain reference samples. LA-3 reference samples were obtained using a protocol cleaned, chain-rigged, fiberglass and stainless steel bucket dredge deployed from the Kinnetic Laboratories’ research vessel *D.W. HOOD*. The bucket dredge was lowered to the bottom and then towed for several minutes around the target sampling coordinates before retrieval. Beach reference samples were collected with stainless steel utensils for exposed portions of the beach and a petite Ponar grab for subtidal portions. Subtidal samples were collected from a 17 ft Boston Whaler with a 70hp outboard engine. All retrieved reference samples were immediately placed into appropriate containers and iced. In addition, sample splits of the beach reference samples were submitted for physical testing.

Samples of control sediment were collected for biological testing. Control sediment for amphipod bioassays were the “home sediment” from the area where amphipods were collected. Control sediment for *Nephtys* bioassays were “home sediment” from the area where polychaetes were collected (Tomales Bay). Tomales Bay sediment also served as the control sediment for bioaccumulation exposures.

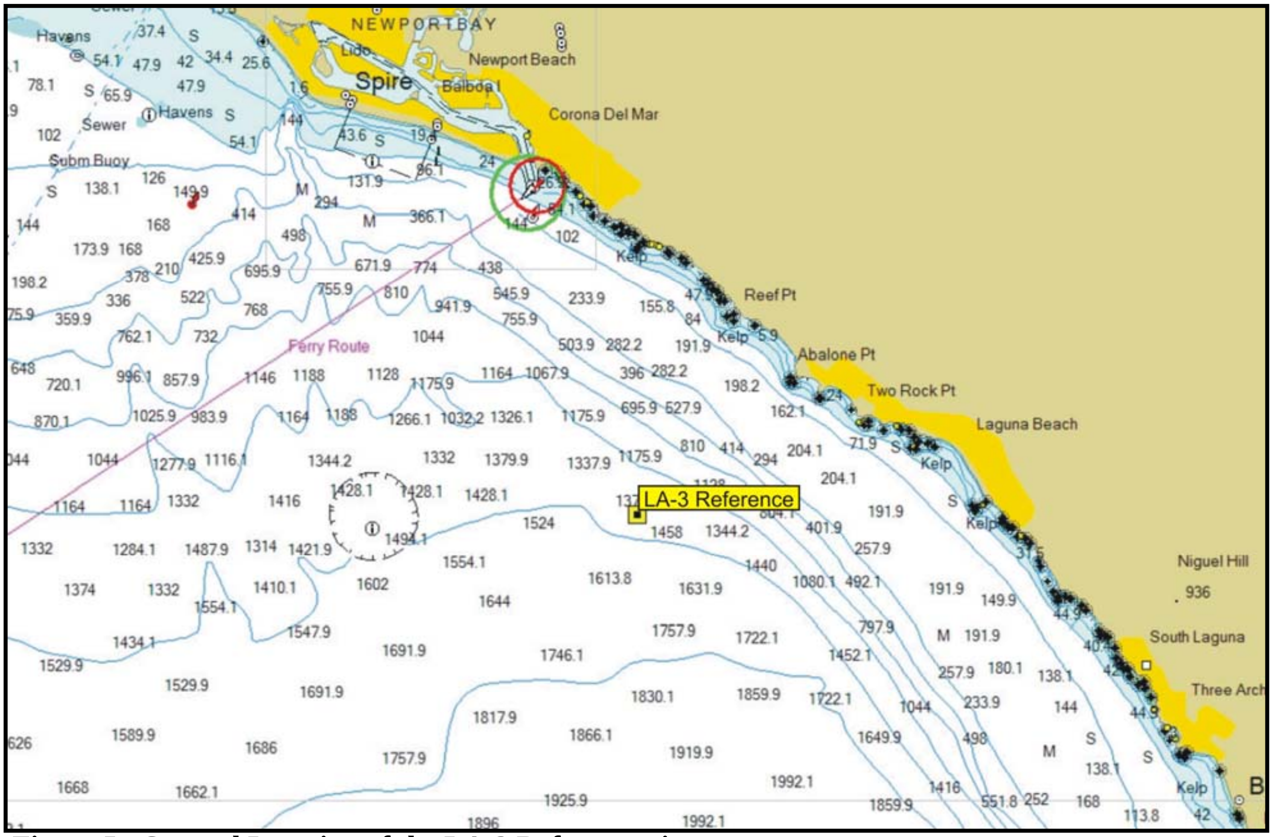

Figure 5. General Location of the LA-3 Reference site.

3.1.5 Documentation

All samples were handled under Chain of Custody protocols beginning at the time of collection. Sampling data was also recorded on field log sheets. Samples were marked with pre-printed, waterproof labels listing unique alphanumeric identifications. Duplicate information was recorded on Chain of Custody forms, which also includes sampling information such as matrix, analysis, methods and detection limits. Completed Chain of Custody forms accompany the Laboratory Reports on CD-ROM in Appendix D.

The following information was recorded on unique field logs for each boring: station identification, date and time, climatic and rainfall data, sea state observations, total coring time, boring coordinates, core number, depth of penetration, core length recovery, core length requirement, sample type and interval, tidal stage and water depth. Copies of the completed field logs are provided in Appendix B.

3.2 Laboratory Testing Methods

Laboratory analyses were carried out by CRG Marine Laboratories (CRG) (Cal-ELAP No. 2261) for most chemical analyses, Applied Marine Sciences (E87596) for total organic carbon, and ToxScan (Cal-ELAP No. 1515) for toxicity testing. All laboratories used are State certified testing laboratories 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).

3.2.1 Bulk Sediment Analysis

Bulk sediment analytical parameters, methods, and target reporting limits are presented in Table 4. Sediment samples were analyzed in a manner consistent with guidelines for dredge material testing methods in the USEPA/USACE (1998) Inland Testing manual. Samples were extracted and analyzed for the most part within established holding times, and all analyses were accomplished with appropriate quality control measures.

3.2.2 Elutriate Preparation Methods

Standard elutriates were prepared according to ITM methods. Sediments from Areas B and C were mixed with dredge site water in a 4:1 volumetric ratio. Vigorous mixing proceeded for 30 minutes, and the mixture was allowed to settle undisturbed. The clear supernatant was carefully collected and used as the test media for chemical and bioassay analyses.

3.2.3 Water and Elutriate Analysis

Analytes, test methods, and reporting limits for elutriate and background water analyses are presented in Table 5. Metal analyses were performed on unfiltered samples in addition to filtered samples (0.45µ). This allows comparison to either Ocean Plan or CTR criteria. Organic analyses utilized unfiltered elutriate to determine total concentrations.

3.2.4 Bioassay Analyses

The composite sediments along with reference-area and control sediments were tested for toxicity following the ITM (USEPA/USACE, 1998) for both Suspended Particulate (elutriate) Phase and Solid Phase bioassays. Tier III testing for CDF disposal requires only a single Suspended Particulate-Phase bioassay.

All species used in this testing program comply with ITM recommendations and guidelines for bioassay and bioaccumulation tests.

The following organisms were used for the Suspended Particulate-Phase bioassays (open water):

Mysidopsis bahia (mysid)
Menidia beryllina (fish)
larvae of *Mytilus galloprovincialis* (mussel)

For Solid Phase Bioassays the following organisms were used:

Nephtys caecoides (worm)
Ampelisca abdita (amphipod)

The methods and endpoints used for the bioassays are listed in Table 6.

Table 4. Analytical Methods and Reporting Limits for Bulk Sediment and Tissue Samples.

Analysis	Analytical Method	Reporting Limits		Units
		Sediments	Tissues	
PHYSICAL CONVENTIONALS				
Grain Size Distribution	Plumb (1981)	na	--	
Percent Solids	EPA 160.3	0.1	0.1	% -wet
Total Volatile Solids	EPA 160.4	0.2	--	% -wet
Ammonia-N	SM 4500-NH3-F	0.05	--	mg/kg - dry
Total Organic Carbon	EPA 9060A	0.03	--	% dry
Total Sulfides	Plumb (1981)/EPA 9030	0.1	--	mg/kg - dry
Water Soluble Sulfides	Plumb (1981)/EPA 9030	0.1		mg/kg - dry
Percent lipids	Gravimetric	--	0.05	%-wet
METALS				
Antimony (Sb)	EPA 6020M	0.05	0.05	mg/kg - dry
Arsenic (As)	EPA 6020M	0.05	0.05	mg/kg - dry
Cadmium (Cd)	EPA 6020M	0.05	0.05	mg/kg - dry
Chromium (Cr)	EPA 6020M	0.05	0.05	mg/kg - dry
Copper (Cu)	EPA 6020M	0.05	0.05	mg/kg - dry
Lead (Pb)	EPA 6020M	0.05	0.05	mg/kg - dry
Mercury (Hg)	EPA 245.7M	0.02	0.02	mg/kg - dry
Nickel (Ni)	EPA 6020M	0.05	0.05	mg/kg - dry
Selenium (Se)	EPA 6020M	0.05	0.05	mg/kg - dry
Silver (Ag)	EPA 6020M	0.05	0.05	mg/kg - dry
Zinc (Zn)	EPA 6020M	0.05	0.05	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	5	µg/kg - dry
2,4'-DDE	EPA 8270Cm	5	5	µg/kg - dry
2,4'-DDT	EPA 8270Cm	5	5	µg/kg - dry
4,4'-DDD	EPA 8270Cm	5	5	µg/kg - dry
4,4'-DDE	EPA 8270Cm	5	5	µg/kg - dry
4,4'-DDT	EPA 8270Cm	5	5	µg/kg - dry
Aldrin	EPA 8270Cm	5	5	µg/kg - dry
BHC-alpha	EPA 8270Cm	5	5	µg/kg - dry
BHC-beta	EPA 8270Cm	5	5	µg/kg - dry
BHC-delta	EPA 8270Cm	5	5	µg/kg - dry
BHC-gamma	EPA 8270Cm	5	5	µg/kg - dry
Chlordane-alpha	EPA 8270Cm	5	5	µg/kg - dry
Chlordane-gamma	EPA 8270Cm	5	5	µg/kg - dry
cis-Nonachlor	EPA 8270Cm	5	5	µg/kg - dry
Dieldrin	EPA 8270Cm	5	5	µg/kg - dry
Endosulfan Sulfate	EPA 8270Cm	5	5	µg/kg - dry
Endosulfan-I	EPA 8270Cm	5	5	µg/kg - dry
Endosulfan-II	EPA 8270Cm	5	5	µg/kg - dry
Endrin	EPA 8270Cm	5	5	µg/kg - dry
Endrin Ketone	EPA 8270Cm	5	5	µg/kg - dry
Heptachlor	EPA 8270Cm	5	5	µg/kg - dry
Heptachlor Epoxide	EPA 8270Cm	5	5	µg/kg - dry
Methoxychlor	EPA 8270Cm	5	5	µg/kg - dry

Table 4. Analytical Methods and Reporting Limits for Bulk Sediment and Tissue Samples.

Analysis	Analytical Method	Reporting Limits		Units
		Sediments	Tissues	
Mirex	EPA 8270Cm	5	5	µg/kg - dry
Oxychlordane	EPA 8270Cm	5	5	µg/kg - dry
Perthane	EPA 8270Cm	10	10	µg/kg - dry
Toxaphene	EPA 8270Cm	50	50	µg/kg - dry
trans-Nonachlor	EPA 8270Cm	5	5	µg/kg - dry
ORGANICS – GENERAL HYDROCARBONS				
Oil and Grease	EPA 1664HEM	0.02	--	% - dry
TRPH	EPA 1664HEM/SGT	0.02	--	% - dry
ORGANICS -BUTYLTINS				
(Tripentyltin)				% 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 - PHTHALATES				
bis(2-Ethylhexyl) Phthalate	EPA 8270Cm	10	--	µg/kg - dry
Butylbenzyl Phthalate	EPA 8270Cm	10	--	µg/kg - dry
Diethyl Phthalate	EPA 8270Cm	10	--	µg/kg - dry
Dimethyl Phthalate	EPA 8270Cm	10	--	µg/kg - dry
Di-n-butyl Phthalate	EPA 8270Cm	10	--	µg/kg - dry
Di-n-octyl Phthalate	EPA 8270Cm	10	--	µg/kg - dry
ORGANICS - PHENOLS				
(2,4,6-Tribromophenol)	EPA 8270Cm			% rec
(d5-Phenol)	EPA 8270Cm			% rec
2,4,6-Trichlorophenol	EPA 8270Cm	100	--	µg/kg - dry
2,4-Dichlorophenol	EPA 8270Cm	100	--	µg/kg - dry
2,4-Dimethyphenol	EPA 8270Cm	200	--	µg/kg - dry
2,4-Dinitrophenol	EPA 8270Cm	200	--	µg/kg - dry
2-Methylphenol	EPA 8270Cm	100	--	µg/kg - dry
4-Methylphenol	EPA 8270Cm	100	--	µg/kg - dry
2-Methyl-4,6-dinitrophenol	EPA 8270Cm	100	--	µg/kg - dry
2-Chlorophenol	EPA 8270Cm	100	--	µg/kg - dry
4-Chloro-3-methylphenol	EPA 8270Cm	200	--	µg/kg - dry
2-Nitrophenol	EPA 8270Cm	200	--	µg/kg - dry
4-Nitrophenol	EPA 8270Cm	200	--	µg/kg - dry
Pentachlorophenol	EPA 8270Cm	100	--	µg/kg - dry
Phenol	EPA 8270Cm	200	--	µg/kg - dry
ORGANICS – PCB AROCLORS				
Aroclor 1016	EPA 8270Cm	20	20	µg/kg - dry
Aroclor 1221	EPA 8270Cm	20	20	µg/kg - dry
Aroclor 1232	EPA 8270Cm	20	20	µg/kg - dry
Aroclor 1242	EPA 8270Cm	20	20	µg/kg - dry
Aroclor 1248	EPA 8270Cm	20	20	µg/kg - dry
Aroclor 1254	EPA 8270Cm	20	20	µg/kg - dry
Aroclor 1260	EPA 8270Cm	20	20	µg/kg - dry

Table 4. Analytical Methods and Reporting Limits for Bulk Sediment and Tissue Samples.

Analysis	Analytical Method	Reporting Limits		Units
		Sediments	Tissues	
ORGANICS – PCB CONGENERS				
PCB008	EPA 8270Cm	5	5	µg/kg - dry
PCB018	EPA 8270Cm	5	5	µg/kg - dry
PCB028	EPA 8270Cm	5	5	µg/kg - dry
PCB031	EPA 8270Cm	5	5	µg/kg - dry
PCB033	EPA 8270Cm	5	5	µg/kg - dry
PCB037	EPA 8270Cm	5	5	µg/kg - dry
PCB044	EPA 8270Cm	5	5	µg/kg - dry
PCB049	EPA 8270Cm	5	5	µg/kg - dry
PCB052	EPA 8270Cm	5	5	µg/kg - dry
PCB066	EPA 8270Cm	5	5	µg/kg - dry
PCB070	EPA 8270Cm	5	5	µg/kg - dry
PCB074	EPA 8270Cm	5	5	µg/kg - dry
PCB077	EPA 8270Cm	5	5	µg/kg - dry
PCB081	EPA 8270Cm	5	5	µg/kg - dry
PCB087	EPA 8270Cm	5	5	µg/kg - dry
PCB095	EPA 8270Cm	5	5	µg/kg - dry
PCB097	EPA 8270Cm	5	5	µg/kg - dry
PCB099	EPA 8270Cm	5	5	µg/kg - dry
PCB101	EPA 8270Cm	5	5	µg/kg - dry
PCB105	EPA 8270Cm	5	5	µg/kg - dry
PCB110	EPA 8270Cm	5	5	µg/kg - dry
PCB114	EPA 8270Cm	5	5	µg/kg - dry
PCB118	EPA 8270Cm	5	5	µg/kg - dry
PCB119	EPA 8270Cm	5	5	µg/kg - dry
PCB123	EPA 8270Cm	5	5	µg/kg - dry
PCB126	EPA 8270Cm	5	5	µg/kg - dry
PCB128+167	EPA 8270Cm	5	5	µg/kg - dry
PCB138	EPA 8270Cm	5	5	µg/kg - dry
PCB141	EPA 8270Cm	5	5	µg/kg - dry
PCB149	EPA 8270Cm	5	5	µg/kg - dry
PCB151	EPA 8270Cm	5	5	µg/kg - dry
PCB153	EPA 8270Cm	5	5	µg/kg - dry
PCB156	EPA 8270Cm	5	5	µg/kg - dry
PCB157	EPA 8270Cm	5	5	µg/kg - dry
PCB158	EPA 8270Cm	5	5	µg/kg - dry
PCB168+132	EPA 8270Cm	5	5	µg/kg - dry
PCB169	EPA 8270Cm	5	5	µg/kg - dry
PCB170	EPA 8270Cm	5	5	µg/kg - dry
PCB177	EPA 8270Cm	5	5	µg/kg - dry
PCB180	EPA 8270Cm	5	5	µg/kg - dry
PCB183	EPA 8270Cm	5	5	µg/kg - dry
PCB187	EPA 8270Cm	5	5	µg/kg - dry
PCB189	EPA 8270Cm	5	5	µg/kg - dry
PCB194	EPA 8270Cm	5	5	µg/kg - dry
PCB195	EPA 8270Cm	5	5	µg/kg - dry
PCB200	EPA 8270Cm	5	5	µg/kg - dry
PCB201	EPA 8270Cm	5	5	µg/kg - dry
PCB206	EPA 8270Cm	5	5	µg/kg - dry
PCB209	EPA 8270Cm	5	5	µg/kg - dry

Table 4. Analytical Methods and Reporting Limits for Bulk Sediment and Tissue Samples.

Analysis	Analytical Method	Reporting Limits		Units
		Sediments	Tissues	
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	5	µg/kg
1-Methylphenanthrene	EPA 8270Cm	5	5	µg/kg
2,3,5-Trimethylnaphthalene	EPA 8270Cm	5	5	µg/kg
2,6-Dimethylnaphthalene	EPA 8270Cm	5	5	µg/kg
2-Methylnaphthalene	EPA 8270Cm	5	5	µg/kg
Acenaphthene	EPA 8270Cm	5	5	µg/kg
Acenaphthylene	EPA 8270Cm	5	5	µg/kg
Anthracene	EPA 8270Cm	5	5	µg/kg
Benz[a]anthracene	EPA 8270Cm	5	5	µg/kg
Benzo[a]pyrene	EPA 8270Cm	5	5	µg/kg
Benzo[b]fluoranthene	EPA 8270Cm	5	5	µg/kg
Benzo[e]pyrene	EPA 8270Cm	5	5	µg/kg
Benzo[g,h,i]perylene	EPA 8270Cm	5	5	µg/kg
Benzo[k]fluoranthene	EPA 8270Cm	5	5	µg/kg
Biphenyl	EPA 8270Cm	5	5	µg/kg
Chrysene	EPA 8270Cm	5	5	µg/kg
Dibenz[a,h]anthracene	EPA 8270Cm	5	5	µg/kg
Dibenzothiophene	EPA 8270Cm	5	5	µg/kg
Fluoranthene	EPA 8270Cm	5	5	µg/kg
Fluorene	EPA 8270Cm	5	5	µg/kg
Indeno[1,2,3-c,d]pyrene	EPA 8270Cm	5	5	µg/kg
Naphthalene	EPA 8270Cm	5	5	µg/kg
Perylene	EPA 8270Cm	5	5	µg/kg
Phenanthrene	EPA 8270Cm	5	5	µg/kg
Pyrene	EPA 8270Cm	5	5	µg/kg
Total Detectable PAHs	EPA 8270Cm	5	5	µg/kg

Table 5. Analytical Methods and Reporting Limits for Water and Elutriate Samples.

Analysis	Analytical Method	Reporting Limits	Units
CONVENTIONALS			
Ammonia	SM 4500-NH3 F	50	µg/L
Total Suspended Solids	SM 2540 D	5	mg/L
Total Sulfides	SM 4500-S2 D	50	µg/L
TOTAL AND DISSOLVED METALS			
Arsenic (As)	EPA 1640M	0.015	µg/L
Cadmium (Cd)	EPA 1640M	0.01	µg/L
Chromium (Cr)	EPA 1640M	0.05	µg/L
Copper (Cu)	EPA 1640M	0.02	µg/L
Lead (Pb)	EPA 1640M	0.01	µg/L
Mercury (Hg)	EPA 245.7M	0.02	µg/L
Nickel (Ni)	EPA 1640M	0.01	µg/L
Selenium (Se)	EPA 1640M	0.015	µg/L
Silver (Ag)	EPA 1640M	0.04	µg/L
Zinc (Zn)	EPA 1640M	0.01	µg/L
ORGANICS – CHLORINATED PESTICIDES			
(PCB030)	EPA 625M		% rec
(PCB112)	EPA 625M		% rec
(PCB198)	EPA 625M		% rec
(TCMX)	EPA 625M		% rec
2,4'-DDD	EPA 625M	5	ng/L
2,4'-DDE	EPA 625M	5	ng/L
2,4'-DDT	EPA 625M	5	ng/L
4,4'-DDD	EPA 625M	5	ng/L
4,4'-DDE	EPA 625M	5	ng/L
4,4'-DDT	EPA 625M	5	ng/L
Aldrin	EPA 625M	5	ng/L
BHC-alpha	EPA 625M	5	ng/L
BHC-beta	EPA 625M	5	ng/L
BHC-delta	EPA 625M	5	ng/L
BHC-gamma	EPA 625M	5	ng/L
Chlordane-alpha	EPA 625M	5	ng/L
Chlordane-gamma	EPA 625M	5	ng/L
cis-Nonachlor	EPA 625M	5	ng/L
DCPA (Dacthal)	EPA 625M	10	ng/L
Dicofol	EPA 625M	100	ng/L
Dieldrin	EPA 625M	5	ng/L
Endosulfan Sulfate	EPA 625M	5	ng/L
Endosulfan-I	EPA 625M	5	ng/L
Endosulfan-II	EPA 625M	5	ng/L
Endrin	EPA 625M	5	ng/L
Endrin Ketone	EPA 625M	5	ng/L
Heptachlor	EPA 625M	5	ng/L
Heptachlor Epoxide	EPA 625M	5	ng/L
Methoxychlor	EPA 625M	5	ng/L
Mirex	EPA 625M	5	ng/L
Oxychlordane	EPA 625M	5	ng/L
Perthane	EPA 625M	10	ng/L
Toxaphene	EPA 625M	50	ng/L
trans-Nonachlor	EPA 625M	5	ng/L

Table 5. Analytical Methods and Reporting Limits for Water and Elutriate Samples.

Analysis	Analytical Method	Reporting Limits	Units
ORGANICS – GENERAL HYDROCARBONS			
Oil and Grease	EPA 1664HEM	0.05	mg/L
TRPH	EPA 1664HEM/SGT	0.01	mg/L
ORGANICS -BUTYLTINS			
(Tripentyltin)			% rec
Dibutyltin	Krone, 1989	3	ng/L
Monobutyltin	Krone, 1989	3	ng/L
Tetrabutyltin	Krone, 1989	3	ng/L
Tributyltin	Krone, 1989	3	ng/L
ORGANICS – PCB AROCLORS			
Aroclor 1016	EPA 625M	20	ng/L
Aroclor 1221	EPA 625M	20	ng/L
Aroclor 1232	EPA 625M	20	ng/L
Aroclor 1242	EPA 625M	20	ng/L
Aroclor 1248	EPA 625M	20	ng/L
Aroclor 1254	EPA 625M	20	ng/L
Aroclor 1260	EPA 625M	20	ng/L
ORGANICS – PCB CONGENERS			
PCB008	EPA 625M	5	ng/L
PCB018	EPA 625M	5	ng/L
PCB028	EPA 625M	5	ng/L
PCB031	EPA 625M	5	ng/L
PCB033	EPA 625M	5	ng/L
PCB037	EPA 625M	5	ng/L
PCB044	EPA 625M	5	ng/L
PCB049	EPA 625M	5	ng/L
PCB052	EPA 625M	5	ng/L
PCB066	EPA 625M	5	ng/L
PCB070	EPA 625M	5	ng/L
PCB074	EPA 625M	5	ng/L
PCB077	EPA 625M	5	ng/L
PCB081	EPA 625M	5	ng/L
PCB087	EPA 625M	5	ng/L
PCB095	EPA 625M	5	ng/L
PCB097	EPA 625M	5	ng/L
PCB099	EPA 625M	5	ng/L
PCB101	EPA 625M	5	ng/L
PCB105	EPA 625M	5	ng/L
PCB110	EPA 625M	5	ng/L
PCB114	EPA 625M	5	ng/L
PCB118	EPA 625M	5	ng/L
PCB119	EPA 625M	5	ng/L
PCB123	EPA 625M	5	ng/L
PCB126	EPA 625M	5	ng/L
PCB128+167	EPA 625M	5	ng/L
PCB138	EPA 625M	5	ng/L
PCB141	EPA 625M	5	ng/L
PCB149	EPA 625M	5	ng/L
PCB151	EPA 625M	5	ng/L

Table 5. Analytical Methods and Reporting Limits for Water and Elutriate Samples.

Analysis	Analytical Method	Reporting Limits	Units
PCB153	EPA 625M	5	ng/L
PCB156	EPA 625M	5	ng/L
PCB157	EPA 625M	5	ng/L
PCB158	EPA 625M	5	ng/L
PCB168+132	EPA 625M	5	ng/L
PCB169	EPA 625M	5	ng/L
PCB170	EPA 625M	5	ng/L
PCB177	EPA 625M	5	ng/L
PCB180	EPA 625M	5	ng/L
PCB183	EPA 625M	5	ng/L
PCB187	EPA 625M	5	ng/L
PCB189	EPA 625M	5	ng/L
PCB194	EPA 625M	5	ng/L
PCB195	EPA 625M	5	ng/L
PCB200	EPA 625M	5	ng/L
PCB201	EPA 625M	5	ng/L
PCB206	EPA 625M	5	ng/L
PCB209	EPA 625M	5	ng/L
ORGANICS – PAHs			
(d10-Acenaphthene)	EPA 625M		% Rec
(d10-Phenanthrene)	EPA 625M		% Rec
(d12-Chrysene)	EPA 625M		% Rec
(d12-Perylene)	EPA 625M		% Rec
(d8-Naphthalene)	EPA 625M		% Rec
1-Methylnaphthalene	EPA 625M	5	ng/L
1-Methylphenanthrene	EPA 625M	5	ng/L
2,3,5-Trimethylnaphthalene	EPA 625M	5	ng/L
2,6-Dimethylnaphthalene	EPA 625M	5	ng/L
2-Methylnaphthalene	EPA 625M	5	ng/L
Acenaphthene	EPA 625M	5	ng/L
Acenaphthylene	EPA 625M	5	ng/L
Anthracene	EPA 625M	5	ng/L
Benz[a]anthracene	EPA 625M	5	ng/L
Benzo[a]pyrene	EPA 625M	5	ng/L
Benzo[b]fluoranthene	EPA 625M	5	ng/L
Benzo[e]pyrene	EPA 625M	5	ng/L
Benzo[g,h,i]perylene	EPA 625M	5	ng/L
Benzo[k]fluoranthene	EPA 625M	5	ng/L
Biphenyl	EPA 625M	5	ng/L
Chrysene	EPA 625M	5	ng/L
Dibenz[a,h]anthracene	EPA 625M	5	ng/L
Dibenzothiophene	EPA 625M	5	ng/L
Fluoranthene	EPA 625M	5	ng/L
Fluorene	EPA 625M	5	ng/L
Indeno[1,2,3-c,d]pyrene	EPA 625M	5	ng/L
Naphthalene	EPA 625M	5	ng/L
Perylene	EPA 625M	5	ng/L
Phenanthrene	EPA 625M	5	ng/L
Pyrene	EPA 625M	5	ng/L
Total Detectable PAHs	EPA 625M	5	ng/L

Table 6. Species, Methods, and End-Points for Biological Testing

Test Type	Species	Method	End Points
BIOASSAYS:			
Suspended Particulate Phase:			
Bivalve Larvae	*Mytilus galloprovincialis*	ASTM, 1998 E 724 98	48 hr. survival and normal development
Fish Larvae	*Menidia beryllina*	USACE/USEPA 1998	4 day survival
Mysid Shrimp	*Mysidopsis bahia*	USACE/USEPA 1998	4 day survival
Solid Phase:			
Amphipod	*Ampelisca abdita*	ASTM, 1999a E 1367 92; USEPA 1994	10 day survival
Polychaete worm	*Nephtys caecoides*	ASTM, 1999b E 1611 94	10 day survival
BIOACCUMULATION EXPOSURES:			
Clam	*Macoma nasuta*	USACE/USEPA 1998	28 day benthic exposure
Worm	*Nephtys caecoides*	USACE/USEPA 1998	28 day benthic exposure

3.2.5 Bioaccumulation Assessment

The ITM requires a 28-day exposure period of two benthic species to test, reference, and control sediments prior to tissue analysis (Table 6). The species used for this program, which conform to ITM recommendations, are as follows:

Nephtys caecoides (worm)
Macoma nasuta (clam)

Following exposure of the organisms to the test sediments, they were placed in a clean, non-stressful environment to purge their systems of test sediment. The purge time was long enough to purge sediment, but not long enough to allow them to depurate accumulated toxicants. Generally, 24 hours was sufficient, but a few organisms were sacrificed to ensure completion of the purge.

Tissue samples were thoroughly homogenized with a stainless steel Tekmar Tissuemizer. The entire blade and barrel assembly was pre-cleaned with hot DI water and Micro 90® detergent and then rinsed thoroughly with DI water. The blade was rinsed again with DI water just prior to use. The Tissuemizer was triple rinsed between samples to minimize sample cross contamination. Samples were triple-wrapped and frozen when not in use. All tissue handling and processing was conducted at a laminar flow bench in a trace-metal clean laboratory.

A more complete description of the methods employed for the bioaccumulation exposures can be found in Appendix E.

Bioaccumulation tissue samples were analyzed according to the list of constituents in Table 4. Methods and proposed analytical detection limits for the analysis of these tissues are also listed in Table 4.

3.2.6 Statistical Evaluations

Statistical analysis of experimental data was performed for each of the bioassay and bioaccumulation assessments. Tests of fundamental assumptions (e.g., variance homogeneity) were followed by the appropriate parametric or non-parametric analyses.

In cases where a contaminant was detected in tissues of organisms exposed to test sediment but was not detected (ND) in reference tissues, a value was assigned to the ND sample which equaled 50% of the analytical detection limit (DL) for that contaminant. This is consistent with interim recommendations published in the ITM (USEPA/USACE, 1998).

Variance homogeneity is one of the underlying assumptions of most parametric statistics. Bartlett's or Cochran's test was therefore applied to the data from the bioassays and the tissue chemistry of the bioaccumulation assessments. Significant results for this and all subsequent parametric tests were determined by the critical value (alpha = 0.05) of the appropriate distributions.

Once homogeneity has been established, the ANOVA and Dunnett's test were employed to analyze differences between treatment responses (e.g., test sediment tanks). Survival responses in the control tanks serve primarily for procedural quality assurance.

When sample variances did not exhibit homogeneity, as determined by Cochran's test, the Testing Manual recommends a data transformation. Arcsine Check was applied to proportional data of bioassays and log(x + 1) was applied to bioaccumulation data which are not homogenous. When the data transformation was unable to compensate the deviation, non-parametric tests were employed.

Non-parametric procedures use ranked values for calculating test statistics and the corresponding hypotheses use rank sums for comparison. Kruskal-Wallace and Wilcoxson-Wilcox tests were used to identify differences between treatment responses.

ITM guidelines for interpretation of suspended particulate-phase bioassays require that initial mixing calculations be performed to determine the concentration of suspended particulate material remaining at the disposal site within four hours after dumping (Csp) for any sample producing toxicity sufficient to generate an LC_{50}. If the Csp does not exceed 1% of the LC_{50}, the sediment was judged to comply with water column toxicity criteria.

Guidelines for interpretation of benthic bioassay results are published in the ITM. If survival responses in test sediment were statistically significantly lower than those in reference sediment *and* if the difference in mean survival between groups was greater than 10% (20% for amphipods), then the test sediment was considered to have the potential to significantly degrade the marine environment.

Guidelines for evaluation of bioaccumulation are described in the ITM and the District Engineer and the Regional Administrator make final interpretation. Therefore, statistical testing of bioaccumulation test phase results was complete when appropriate comparison (Dunnett's or Wilcoxson-Wilcox) described significant or non-significant tissue burden from exposure to dredged material.

3.3 Geotechnical Testing

Laguna Geosciences, Inc. performed the geotechnical portion of this study. A complete report prepared by Laguna Geosciences, which includes the procedures used to determine grain size distribution, has been attached as Appendix A.

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) 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. Appendix C describes QA/QC procedures employed in this program as well as a summary of laboratory QA/QC results.

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, duplicates, surrogates and calibration standards.

QA/QC findings presented are based on the validation of the data according to the quality assurance objectives detailed in the Sampling and Analysis Plan (Kinnetic Laboratories, 2006) and using guidance from EPA National Functional Guidelines for inorganic and organic data review (USEPA, 1999 and 2002).

The results were carefully reviewed to check that the laboratories met project detection limits and that chemical analyses were completed within holding times. Due to the delay from analyzing individual cores and making decisions to proceed with ocean disposal testing, several organic compound analyses were initiated outside holding times as noted in Appendix C. Sediment samples were frozen after they were received by the laboratory and kept frozen until analyzed. There is no EPA guidance on whether it is acceptable or not to extend the holding time of organic constituents by freezing although it is widely practiced by many laboratories. Due to the fact that all individual core sediments were maintained at <4°C prior to compositing and then frozen after compositing, none of the data were qualified.

QA/QC records for the sediment chemical analyses included method blanks, laboratory duplicates, certified reference material samples and their duplicates, and matrix spikes and spike duplicates. Data were shown to be both accurate and precise and free of contamination, with the exception of matrix interference and contamination issues for the phthalates and PAH compounds, which are discussed further below.

A summary of findings based upon the validation of the data generated by this project is as follows:

- Except for phthalate compounds, method blanks for all analyses indicated no contamination associated with the analytical procedures. Significant exceptions were blanks for bis(2-ethylhexyl)phthalate and butylbenzyl phthalate associated with sediment analyses. Phthalates provide for a special case because of ubiquitous nature of these contaminants. Those samples whose values were less than 10 times the blank concentrations but greater than the reporting limit were qualified with a "U" to indicate undetected at the sample value. Water and elutriate analyses had no method blank issues.

- Based upon laboratory duplicate analyses, acceptable precision was achieved for all analyses with the exception of cadmium and selenium in sediment and five PAH constituents in *Macoma* tissues. Since these constituents showed good precision and accuracy in all other QC results and the sample concentrations were low, "J" qualifiers were not applied to the sample values.

- Recovery and variability between matrix spikes and matrix spike duplicates was within acceptable limits except for monobutyltin in site water, total sulfides in sediment and water, zinc in the reference sediment, bis(2-ethylhexyl) phthalate and di-n-butyl phthalate in sediments, endrin aldehyde in tissues, and methoxychlor and perylene in control ("Home") tissue. Of these, only monobutyltin required qualification because of either low spike concentrations relative to the sample concentrations or all other QC data met objectives (Appendix C).

- Good recovery of analytes in standard and certified reference materials showed a high degree of accuracy for metals and conventional analyses.

- Target reporting limits were met for most analytes. Exceptions were aroclors and chlorinated pesticides in sediments and tissues, acid extractable compounds, total volatile solids, oil and grease and total recoverable hydrocarbons in sediment, and butyltins in water. Aroclor PCBs were reported with a reporting limit of 0.02 mg/Kg but the SAP specified a reporting limit of 0.01 mg/Kg in sediments and tissues. Chlorinated pesticides were reported with a reporting limit of 0.005 mg/Kg but were requested with a reporting limit of 0.002 mg/Kg in sediments and tissues. Butyltins were reported with a reporting limit of 0.003 ug/L but were requested with a reporting limit 0.002 ug/L in the standard elutriate test and site water. Total volatile solids were reported with a reporting limit of 0.2% dry weight but were requested with a reporting limit of 0.1% dry weight. TRPH and oil & grease were reported with a reporting limit of 0.01 % dry weight but were requested with a reporting limit of 0.02 % dry weight in sediments. Elevated reporting limits supplied by the laboratory were the lowest limits that could be achieved by the laboratory using the methods specified. These shortfalls in reporting limits are mitigated by estimating chemical concentrations down to the method detection limits. These few minor differences between requested project reporting limits and actual reporting limits achieved by the laboratory were not considered to have any deleterious impact on the final data set.

Summary bioassay and bioaccumulation testing and quality assurance information is provided in the bioassay report (Appendix E). This appendix includes documentation of: 1) test animal collection, shipping and holding/acclimation, 2) water quality parameters monitored during the test, and 3) the positive (reference toxicant) control. Negative control performance is included in the bioassay report. After an initial rerun of the *M. beryllina* and *M. bahia* water column bioassays, all controls met performance criteria. Control survival was below acceptable limits on the initial run of these bioassays. By the time additional water was collected and elutriates prepared, the second run of tests was initiated about three weeks after sediment holding time. All reference toxicant results met laboratory control chart limits, and environmental test conditions remained within limits called for by the methods except for a couple minor and short-term temperature excursions.

5.0 RESULTS AND DISCUSSION

The results of this study are presented in a series of summary tables. These tables include the bulk sediment chemistry results, standard and effluent elutriate results, bioassay results for both benthic phase and suspended phase, and bioaccumulation results. Complete analytical laboratory reports are included in Appendix D and a report on the bioassay results is included in Appendix E.

Testing results for sediment proposed for beach replenishment and ocean disposal are discussed separately below.

5.1 Beach Replenishment Sediments (Area A)

Six core samples were collected for evaluation of beach replenishment purposes (Area A). For samples A1 through A4, the target sampling depth was -14 feet MLLW and actual sample recovery depths ranged from -9.7 feet to -14 feet MLLW. Cores A5 and A6 had a target sampling depth of -19 feet MLLW and actual recoveries were -18.7 and -18.1 feet MLLW, respectively. The lack of core recovery was attributed to encountering riprap or bedrock. Core refusal should not matter in these cases since it is unlikely that the dredge will penetrate into the hard substrate, and except for Core A1, sampling depths were all greater than design depths.

Bulk sediment chemistry and physical testing were performed on each of the individual core samples. Bulk sediment chemistry results for the beach replenishment source and reference areas are presented in Table 7. Title 22 criteria, ERL and ERM effects levels, and reference sediment results are included with the bulk sediment table to assist in evaluation.

Area A sediments consist primarily of coarse grain material. The core with the lowest percentage of sand or gravel is Core A4 (67% sand, 28% silt, 6% clay), and the core with the highest percentage of sand or gravel is Core A3 (98% sand, 2% silt, 0% clay). For beach replenishment comparison, Baby Beach and Capistrano Beach were both classified as sand or sand and gravel above 0.0 ft MLLW. The Capistrano Beach composite sample analyzed for chemistry consisted of 100% sand and gravel for both beaches, while the quantity of fine-grained material from discrete locations above 0.0 ft MLLW ranged from 0% to 3% (Appendix A). The quantity of fine-grained material measured at discrete locations on Baby beach was generally around 1%. The sand content below 0.0 ft MLLW at Capistrano Beach averages 89% with the highest percentage of fine grain material (44-45%) out at -30 ft MLLW (Appendix A).

Discrete areas from Capistrano Beach and Baby Beach were analyzed for TOC to determine compatibility with Area A sediment for beach replenishment (Table 8). TOC at Capistrano Beach ranges from 0.01% to 0.13% dry weight with a mean of 0.06% dry weight, while TOC in Area A cores ranges from 0.09% to 0.21% dry weight with a mean of 0.13% dry weight. Composite samples from Capistrano Beach and Baby Beach, obtained above 0.0 ft MLLW, both have TOC values of 0.04% dry weight.

As far as other conventional constituents, ammonia, sulfides and total volatile solids are higher in Area A samples compared to beach reference samples (Table 7). Ammonia concentrations range from 0.07 to 16.8 mg/kg in Area A samples compared to 0.09 mg/kg and 0.14 mg/kg in Capistrano Beach and Baby Beach samples above 0.0 ft MLLW, respectively. Total sulfide range from 0.75 to 4.6 mg/kg in Area A samples and were not detected in the beach samples above 0.0 ft MLLW. Likewise, water-soluble sulfides range from 0.13 to 0.35 mg/kg in Area A samples and are not present in the beach samples above reporting limits. Total volatile solids range from 0.77% to 1.64% dry weight in the Area A samples compared to 0.47% and 0.56% dry weight in Capistrano Beach and Baby Beach samples above 0.0 ft MLLW, respectively.

Table 7. Bulk Sediment Chemistry Summary for Dredge Unit A and Reference Sites, Dana Point Harbor Reference Sites

Analytical Parameter	Reference Sites[3]		Core/Sample Identification						Screening Values		
	Capistrano Beach	Baby Beach	A1	A2	A3	A4	A5	A6	Salt ERL[1]	Salt ERM[1]	TTLC[2]
GRAIN SIZE (% dry)											
Sand and Gravel (>0.063 mm)	100	100	75.0	96.4	97.9	66.7	95.1	92.0			
Silt (0.004 mm - 0.063 mm)	0	0	20.9	3.6	2.1	27.6	4.7	7.5			
Clay (<0.004 mm)	0	0	3.5	0	0	5.8	0.17	0.45			
SEDIMENT CONVENTIONALS											
Percent Solids (% by wt., wet)	92.4	87.5	75.8	78.2	76.2	76.7	77.7	78.3			
Total Volatile Solids (% by wt., dry)	0.47	0.56	1.19	1.64	0.86	1.13	0.79	0.77			
Total Ammonia (as N) (mg/kg, dry)	0.09	0.14	4.79	7.44	16.8	0.71	8.16	3.81			
Oil and Grease (mg/kg, dry)	0.02U	0.02U	0.02U	0.01J	0.02U	0.02U	0.02U	0.02U			
TRPH (mg/kg, dry)	0.01J	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U			
Total Sulfides (mg/kg, dry)	0.1U	0.1U	1.41	1.55	1.44	0.75	4.60	2.00			
Water Soluble Sulfides (mg/kg, dry)	0.09J	0.04J	0.35	0.16	0.13	0.31	0.16	0.15			
Total Organic Carbon (% by wt., dry)	0.04	0.04	0.15	0.12	0.09	0.21	0.11	0.12			
METALS (mg/kg, dry wt)											
Arsenic	1.4	0.9	2.4	0.9	0.9	1.6	1.1	0.8	8.2	70	500
Cadmium	0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	1.2	9.6	100
Chromium	2.5	8.4	6.2	9.2	11.6	11.9	11.8	10.1	81	370	2500
Copper	2.7	2.7	8.9	3.2	3.4	5.4	3.5	2.2	34	270	2500
Lead	1.67	1.77	2.07	1.45	3.42	1.95	1.45	2.41	46.7	218	1000
Mercury	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U	0.15	0.71	20
Nickel	2	4.4	4	5.5	6.4	6.1	6.5	5.8	20.9	51.6	2000
Selenium	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.1			100
Silver	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	1	3.7	500
Zinc	8.9	10.5	18.3	9.2	9	16.1	9.3	7.2	150	410	5000
ORGANOTINS (ug/kg, dry wt)											
Dibutyltin	3U	3U	3U	3U	3U	3U	3U	3U			
Tributyltin	3U	3U	6	3U	3U	2.3J	3U	3U			
Tetrabutyltin	3U	3U	3U	3U	3U	3U	3U	3U			
CHLORINATED PESTICIDES (ug/kg, dry wt)											
2,4'-DDT	5U	5U	5U	5U	5U	5U	5U	5U			1400
2,4'-DDE	5U	5U	5U	5U	5U	5U	5U	5U			
2,4'-DDD	5U	5U	5U	5U	5U	5U	5U	5U			
4,4'-DDT	5U	5U	5U	5U	5U	5U	5U	5U	1	7	1000
4,4'-DDE	5U	5U	5U	**2.9J**	5U	**2.7J**	5U	5U	2.2	27	1000

Table 7. Bulk Sediment Chemistry Summary for Dredge Unit A and Reference Sites, Dana Point Harbor Reference Sites

Analytical Parameter	Reference Sites[3]		Core/Sample Identification						Screening Values		
	Capistrano Beach	Baby Beach	A1	A2	A3	A4	A5	A6	Salt ERL[1]	Salt ERM[1]	TTLC[2]
4,4'-DDD	5U	5U	5U	5U	5U	5U	5U	5U	2	20	1000
Total DDT	0	0	0	**2.9J**	0	**2.7J**	0	0	1.58	46.1	1000
Aldrin	5U	5U	5U	5U	5U	5U	5U	5U			1400
Dieldrin	5U	5U	5U	5U	5U	5U	5U	5U	0.02	8	8000
Endrin	5U	5U	5U	5U	5U	5U	5U	5U			200
Endrin ketone	5U	5U	5U	5U	5U	5U	5U	5U			
Endrin aldehyde	5U	5U	5U	5U	5U	5U	5U	5U			
Endosulfan II	5U	5U	5U	5U	5U	5U	5U	5U			
Endosulfan I	5U	5U	5U	5U	5U	5U	5U	5U			
Endosulfan sulfate	5U	5U	5U	5U	5U	5U	5U	5U			
alpha-BHC	5U	5U	5U	5U	5U	5U	5U	5U			200
beta-BHC	5U	5U	5U	5U	5U	5U	5U	5U			
delta-BHC	5U	5U	5U	5U	5U	5U	5U	5U			
gamma-BHC (Lindane)	5U	5U	5U	5U	5U	5U	5U	5U			4000
Methoxychlor	5U	5U	5U	5U	5U	5U	5U	5U			100000
Mirex	5U	5U	5U	5U	5U	5U	5U	5U			21000
Toxaphene	50U	50U	50U	50U	50U	50U	50U	50U			5000
Heptachlor epoxide	5U	5U	5U	5U	5U	5U	5U	5U			
Heptachlor	5U	5U	5U	5U	5U	5U	5U	5U			4700
alpha-Chlordane	5U	5U	5U	5U	5U	5U	5U	5U			
gamma-Chlordane	5U	5U	5U	5U	5U	5U	5U	5U			
Oxychlordane	5U	5U	5U	5U	5U	5U	5U	5U			
cis-Nonachlor	5U	5U	5U	5U	5U	5U	5U	5U			
trans-Nonachlor	5U	5U	5U	5U	5U	5U	5U	5U			
Total Chlordane	0	0	0	0	0	0	0	0	0.5	6	
PCBs (ug/kg, dry weight)											
Aroclor 1016	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1221	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1232	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1242	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1248	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1254	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1260	20U	20U	20U	20U	20U	20U	20U	20U			
Total Aroclor PCB	0	0	0	0	0	0	0	0	22.7	180	
PCB008	NR	NR	NR	NR	NR	NR	NR	NR			
PCB018	5U	5U	5U	5U	5U	5U	5U	5U			

Table 7. Bulk Sediment Chemistry Summary for Dredge Unit A and Reference Sites, Dana Point Harbor Reference Sites

Analytical Parameter	Reference Sites[3]		Core/Sample Identification						Screening Values		
	Capistrano Beach	Baby Beach	A1	A2	A3	A4	A5	A6	Salt ERL[1]	Salt ERM[1]	TTLC[2]
PCB028	5U	5U	5U	5U	5U	5U	5U	5U			
PCB031	5U	5U	5U	5U	5U	5U	5U	5U			
PCB033	5U	5U	5U	5U	5U	5U	5U	5U			
PCB037	5U	5U	5U	5U	5U	5U	5U	5U			
PCB044	5U	5U	5U	5U	5U	5U	5U	5U			
PCB049	5U	5U	5U	5U	5U	5U	5U	5U			
PCB052	5U	5U	5U	5U	5U	5U	5U	5U			
PCB066	5U	5U	5U	5U	5U	5U	5U	5U			
PCB070	5U	5U	5U	5U	5U	5U	5U	5U			
PCB074	5U	5U	5U	5U	5U	5U	5U	5U			
PCB077	5U	5U	5U	5U	5U	5U	5U	5U			
PCB081	5U	5U	5U	5U	5U	5U	5U	5U			
PCB087	5U	5U	5U	5U	5U	5U	5U	5U			
PCB095	5U	5U	5U	5U	5U	5U	5U	5U			
PCB097	5U	5U	5U	5U	5U	5U	5U	5U			
PCB099	5U	5U	5U	5U	5U	5U	5U	5U			
PCB101	5U	5U	5U	5U	5U	5U	5U	5U			
PCB105	5U	5U	5U	5U	5U	5U	5U	5U			
PCB110	5U	5U	5U	5U	5U	5U	5U	5U			
PCB114	5U	5U	5U	5U	5U	5U	5U	5U			
PCB118	5U	5U	5U	5U	5U	5U	5U	5U			
PCB119	5U	5U	5U	5U	5U	5U	5U	5U			
PCB123	5U	5U	5U	5U	5U	5U	5U	5U			
PCB126	5U	5U	5U	5U	5U	5U	5U	5U			
PCB128+167	5U	5U	5U	5U	5U	5U	5U	5U			
PCB138	5U	5U	5U	5U	5U	5U	5U	5U			
PCB141	5U	5U	5U	5U	5U	5U	5U	5U			
PCB149	5U	5U	5U	5U	5U	5U	5U	5U			
PCB151	5U	5U	5U	5U	5U	5U	5U	5U			
PCB153	5U	5U	5U	5U	5U	5U	5U	5U			
PCB156	5U	5U	5U	5U	5U	5U	5U	5U			
PCB157	5U	5U	5U	5U	5U	5U	5U	5U			
PCB158	5U	5U	5U	5U	5U	5U	5U	5U			
PCB168+132	5U	5U	5U	5U	5U	5U	5U	5U			
PCB169	5U	5U	5U	5U	5U	5U	5U	5U			
PCB170	5U	5U	5U	5U	5U	5U	5U	5U			

Table 7. Bulk Sediment Chemistry Summary for Dredge Unit A and Reference Sites, Dana Point Harbor Reference Sites

Analytical Parameter	Reference Sites[3]		Core/Sample Identification						Screening Values		
	Capistrano Beach	Baby Beach	A1	A2	A3	A4	A5	A6	Salt ERL[1]	Salt ERM[1]	TTLC[2]
PCB177	5U	5U	5U	5U	5U	5U	5U	5U			
PCB180	5U	5U	5U	5U	5U	5U	5U	5U			
PCB183	5U	5U	5U	5U	5U	5U	5U	5U			
PCB187	5U	5U	5U	5U	5U	5U	5U	5U			
PCB189	5U	5U	5U	5U	5U	5U	5U	5U			
PCB194	5U	5U	5U	5U	5U	5U	5U	5U			
PCB195	NR	NR	NR	NR	NR	NR	NR	NR			
PCB200	5U	5U	5U	5U	5U	5U	5U	5U			
PCB201	5U	5U	5U	5U	5U	5U	5U	5U			
PCB206	5U	5U	5U	5U	5U	5U	5U	5U			
PCB209	NR	NR	NR	NR	NR	NR	NR	NR			
Total PCB Congeners	0	0	0	0	0	0	0	0			
SEMIVOLATILE COMPOUNDS (ug/kg, dry wt)											
2,4,6-Trichlorophenol	100U	100U	100U	100U	100U	100U	100U	100U			
2,4-Dichlorophenol	100U	100U	100U	100U	100U	100U	100U	100U			
2,4-Dimethylphenol	200U	200U	200U	200U	200U	200U	200U	200U			
2,4-Dinitrophenol	200U	200U	200U	200U	200U	200U	200U	200U			
2-Chlorophenol	100U	100U	100U	100U	100U	100U	100U	100U			
2-Methyl-4,6-dinitrophenol	200U	200U	200U	200U	200U	200U	200U	200U			
2-Nitrophenol	200U	200U	200U	200U	200U	200U	200U	200U			
4-Chloro-3-methylphenol	200U	200U	200U	200U	200U	200U	200U	200U			
4-Nitrophenol	200U	200U	200U	200U	200U	200U	200U	200U			
Pentachlorophenol	100U	100U	100U	100U	100U	100U	100U	100U			50000
Phenol	200U	200U	200U	200U	200U	200U	200U	200U			
Total Phenolic Compounds	0	0	0	0	0	0	0	0			
bis-(2-Ethylhexyl)phthalate	57.9U	40.6U	12.2U	122U	93.9U	57.3U	54.6U	61.9U			
Di-n-octyl phthalate	10U	10U	10U	10U	107	10U	10U	10U			
Diethyl phthalate	26.3U	14.6U	18.3U	11.4U	9.4J	21.9U	29.3U	33.2U			
Di-n-butyl phthalate	1100U	225U	851	233	467	872	639	812			
Benzyl butyl phthalate	10U	10U	7.4J	10U	143	10U	5.3J	10U			
Dimethyl phthalate	10U	10U	10U	10U	10U	10U	10U	10U			
Phenanthrene	5U	5U	5U	8.5	5U	5U	5U	5U	240	1500	
Naphthalene	5U	5U	5U	5U	5U	5U	5U	5U	160	2100	
Fluorene	5U	5U	5U	5U	5U	5U	5U	5U	19	540	
Dibenzothiophene	5U	5U	5U	5U	5U	5U	5U	5U			

Table 7. Bulk Sediment Chemistry Summary for Dredge Unit A and Reference Sites, Dana Point Harbor Reference Sites

Analytical Parameter	Reference Sites[3]		Core/Sample Identification						Screening Values		
	Capistrano Beach	Baby Beach	A1	A2	A3	A4	A5	A6	Salt ERL[1]	Salt ERM[1]	TTLC[2]
Biphenyl	5U	5U	5U	5U	5U	5U	5U	5U			
Anthracene	5U	5U	5U	2.7J	5U	5U	5U	5U	85.3	1100	
Acenaphthylene	5U	5U	5U	5U	5U	5U	5U	5U	44	640	
Acenaphthene	5U	5U	5U	5U	5U	5U	5U	5U	16	500	
2-Methylnaphthalene	5U	5U	5U	5U	5U	5U	5U	5U	70	670	
2,6-Dimethylnaphthalene	5U	5U	5U	5U	5U	5U	5U	5U			
2,3,5-Trimethylnaphthalene	5U	5U	5U	5U	5U	5U	5U	5U			
1-Methylphenanthrene	5U	5U	5U	3.12J	7.17	5U	5U	5U			
1-Methylnaphthalene	5U	5U	5U	5U	5U	5U	5U	5U			
Pyrene	1.4J	5U	5.55	30.4	20.6	2.82J	2.72J	1.71J	665	2600	
Perylene	5U	5U	37.2	50.1	21.9	16.6	15.2	8.76			
Indeno(1,2,3-cd)pyrene	5U	5U	5U	20.1	5U	5U	5U	5U			
Fluoranthene	1.5J	5U	4.73J	26.2	4.26J	1.95J	2.49J	2.08J	600	5100	
Dibenzo(a,h)anthracene	5U	5U	5U	4.6J	5U	5U	5U	5U	63.4	260	
Chrysene	5U	5U	1.51J	21.6	5U	5U	5U	5U	384	2800	
Benzo(k)fluoranthene	5U	5U	5U	26.2	5U	5U	5U	5U			
Benzo(g,h,i)perylene	5U	5U	5U	18.6	5U	5U	5U	5U			
Benzo(e)pyrene	5U	5U	5U	15.9	5U	5U	5U	5U			
Benzo(b)fluoranthene	5U	5U	5U	16.3	5U	5U	5U	5U			
Benzo(a)pyrene	5U	5U	5U	27.4	5U	5U	5U	5U	430	1600	
Benzo(a)anthracene	5U	5U	2.01J	16.5	5U	5U	5U	5U	261	1600	
Total Low Weight PAHs	0	0	0	14.3	7.17	0	0	0	552	3160	
Total High Weight PAHs	2.9	0	51	274	46.8	21.4	20.4	12.6	1700	9600	
Total PAHs	2.9	0	51	288	54	21.4	20.4	12.6	4022	44792	
ERM Quotient	0.003	0.003	0.006	0.016	0.005	0.012	0.004	0.004			

1. Effects Range Low (ERL) and Effect Range Median (ERM) sediment quality objectives from Long *et al.* (1995).
2. California Code of Regulations Title 22 Total Threshold Limit Concentrations.
3. Reference site samples were composites of samples collected from several elevations above 0.0 ft MLLW.

U= Not measured above reported sample reporting limit.
J= The result is an estimated quantity.
J+= The result is an estimated quantity but result may be biased high.
NR= No value reported by analytical laboratory.
Bolded values exceed ERL values
Bolded and underlined values exceed ERM values

Table 8. Comparison of Total Organic Carbon in Dana Point Harbor with Capistrano Beach and Baby Beach Reference Samples.

Sample ID	% TOC	Mean
Capistrano Beach Composite	0.04	0.04
Capistrano T1-A (+16 MLLW)	0.03	0.06
Capistrano T1-B (+10 MLLW)	0.01	
Capistrano T1-C (+4 MLLW)	0.02	
Capistrano T1-D (-6 MLLW)	0.03	
Capistrano T1-E (-12 MLLW)	0.05	
Capistrano T1-F (-18 MLLW)	0.04	
Capistrano T1-G (-24 MLLW)	0.08	
Capistrano T1-H (-30 MLLW)	0.13	
Capistrano T2-A (+16 MLLW)	0.08	
Capistrano T2-B (+10MLLW)	0.12	
Capistrano T2-C (+4 MLLW)	0.02	
Capistrano T2-D (-6 MLLW)	0.03	
Capistrano T2-E (-12 MLLW)	0.06	
Capistrano T2-F (-18MLLW)	0.10	
Capistrano T2-G (-24MLLW)	0.08	
Capistrano T2-H (-30 MLLW)	0.10	
Baby Beach Composite	0.04	0.04
Dana A1	0.15	0.13
Dana A2	0.12	
Dana A3	0.09	
Dana A4	0.21	
Dana A5	0.11	
Dana A6	0.12	

Sediments from Area A contain relatively low values of contaminants (Table 7). There were no TTLC or ERM exceedances. 4,4'-DDE and total DDT (as 4,4'-DDE) in Cores A2 and A4 was the only contaminant to exceed ERL values. 4,4'-DDE and total DDT (as 4,4'-DDE) concentrations in these samples are only slightly above the ERL value and were estimated between the reporting limit and method detection limit.

Besides PAHs and the isolated DDT values noted above, contaminant concentrations in Area A are fairly similar to contaminant concentrations in the beach reference samples, which were collected above 0.0 ft MLLW. PAH concentrations of the Area A samples range from 4 to 100 times higher than the reference samples, but are still considered to be relatively low.

5.2 Ocean Disposal Sediments (Areas B and C)

For ocean disposal testing, eight cores were collected in Area B and combined into a single composite sample and six cores were collected in Area C and combined into a single composite sample. All target sampling depths were met except for four cores which had early rejections due to what was perceived as bedrock or riprap. In addition to bulk sediment and elutriate analyses, bioassay and bioaccumulation exposures were performed on the composite samples. Chemical and physical testing was also performed on each of the individual core samples.

5.2.1 Bulk Sediment Chemistry

The bulk sediment chemistry results for Areas B and C are presented in Table 9. Title 22 criteria, ERL and ERM effects levels, and LA-3 reference sediment results are included with the bulk sediment table to assist in evaluation.

Sediment from the finer grain size areas of Dana Point Harbor considered for ocean disposal is a mixture of sand and silt. The sand and silt content for the Area B composite is 51.7% and 39.8%, respectively. The sand and silt content for the Area C composite is 37.6% and 50.9%, respectively. LA-3 reference sediments consist of even finer grain sediments with 64.3% silt, 23.2% clay and 12.5% sand.

The Dana Point Harbor composite samples contain low levels of total organic carbon (TOC) and total volatile solids (TVS). TOC is 0.5% dry weight in the Area B composite and 0.7% dry weight in the Area C composite, while TVS is 0.8% dry weight in the Area B composite and 1.0 % dry weight in the Area C composite. The LA-3 reference site has higher levels of both TOC (2.2%) and TVS (6.7%).

Low levels of petroleum hydrocarbons are present in the Dana Point Harbor composite samples. Oil and grease was not detected above the reporting limit in the Area B composite and is 0.05% dry weight in the Area C composite. Total recoverable petroleum hydrocarbons (TRPH) were also not detected above the reporting limit in the Area B composite and are 0.03% dry weight in the Area C composite. On an individual core basis, oil and grease and TRPH levels range from below the reporting limit to 0.07% dry weight in Area C. Oil and Grease and TRPH levels were not detected above the reporting limit in the LA-3 reference sediments.

Ammonia as nitrogen levels in ocean disposal composite samples from Dana Point Harbor are similar to ammonia levels in the LA-3 reference sediment, and sulfide levels appear to be elevated in the Dana Point Harbor ocean disposal sediments, especially in comparison to LA-3 levels. Ammonia as nitrogen is 3.4 mg/kg in the Area B composite and 5.6 mg/kg in the Area C composite, while LA-3 reference sediment has a concentration of 6.7 mg/kg. Total sulfide levels are 15.6 mg/kg in the Area B composite and 78.2 mg/kg in the Area C composite, while LA-3 reference sediment has a concentration of 10 mg/kg. Total sulfides were extremely variable in the individual core analyses and do not support the findings in the composite analyses. Therefore, these data should be used with caution. Dissolved sulfide concentrations are 0.36 mg/kg in the Area B composite and 0.37 mg/kg in the Area C composite. Dissolved sulfides were not detected in the LA-3 reference sediment.

All contaminants were well below Title 22 hazardous waste levels. Furthermore, there were no contaminants that exceeded ten times Title 22 STLC levels. Therefore, leachate analysis using the State of California Waste Extraction Test was not necessary.

Metal concentrations are relatively low in the Dana Point Harbor composite samples and are very similar to LA-3 metals concentrations. The only ERL exceedance is for copper in the Area C composite sample. Occasional ERL exceedances were also noted for copper in the individual core analyses.

Most organic contaminants are not present at detectable levels in the Dana Point Harbor sediment composites, especially for the Area B composite. There are no ERL or ERM exceedances in the Area B composite for organic compounds. Except for 4,4'-DDE and total DDT, there are no ERL exceedances in the LA-3 reference sediment. In the Area C composite sample, ERL values are exceeded for total chlordane compounds, acenaphthene, benzo(a)pyrene, benzo(a)anthracene, total high molecular weight PAHs and total PAHs. Several individual cores in both Area B and C also contain 4,4'-DDE and/or total DDT in excess of ERL values. Except for total chlordane in one core sample, there are no ERM exceedances in the composite or individual core samples. Although no effects based guidelines exist for

Table 9. Bulk Sediment Chemistry for Dana Point Harbor Areas B & C Composites and Individual Cores.

Analytical Parameter	LA-3	Composites		Individual Cores														Screening Values		
		B	C	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4	C5	C6	Salt ERL	Salt ERM	TTLC
GRAIN SIZE (% dry)																				
Sand and Gravel	12.5	51.7	37.6	50.0	45.1	54.0	57.8	57.5	29.0	66.0	45.3	25.9	27.1	68.5	32.6	43.6	28.4			
Silt	64.3	39.8	50.9	42.5	48.2	39.9	35.4	37.4	62.9	31.4	44.7	63.7	59.9	28.1	57.7	48.5	60.4			
Clay	23.2	8.5	11.7	7.5	6.7	6.2	6.8	5.1	8.0	3.6	9.9	10.3	12.9	3.4	9.6	7.8	11.1			
SEDIMENT CONVENTIONALS																				
Percent Solids (% wet)	47.3	82.3	74.3	83.1	80	68.4	78.3	77.6	53.8	80.2	78.8	68.2	72	76.3	72.1	71.5	56.1			
Total Volatile Solids (% dry)	6.7	0.8	1.0	0.79	1.11	2.96	2.54	1.38	4.07	1.81	1.88	2.97	2.34	0.86	2.07	1.89	4.39			
Total Ammonia (as N) (mg/kg, dry)	6.7	3.4	5.58	0.43	0.93	4.14	1.51	0.23	5.98	0.17	0.51	2.04	1.46	0.11	0.27	0.61	2.65			
Oil and Grease (% dry)	0.02U	0.02U	0.05	0.02U	0.02U	0.02U	0.02U	0.02U	0.01J	0.02U	0.01J	0.07	0.05	0.02U	0.01J	0.01J	0.02			
TRPH (% dry)	0.02U	0.02U	0.03	0.02U	0.02U	0.01J	0.02U	0.02U	0.02	0.01J	0.02U	0.07	0.05	0.02U	0.01J	0.01J	0.02			
Total Sulfides (mg/kg, dry)	10	15.6	78.2	1	58	160	3	3	349	0.39	0.19	1.32	58.4	0.42	5	2	236			
Soluble Sulfides (mg/kg, dry)	0.2U	0.36	0.37	0.23	0.37	0.7	0.5	0.25	0.88	0.07J	0.1	0.25	0.26	0.11	0.22	0.17	0.15			
TOC (% by wt., dry)	2.2	0.47	0.65	0.12	0.17	0.77	0.7	0.19	1.51	0.28	0.46	1.36	1.09	0.39	0.71	0.55	2.44			
METALS (mg/kg, dry wt)																				
Arsenic	5.3	2.59	2.85	1.3	1.9	4.4	3.3	1.9	6.2	1.3	2.2	3.7	2.7	1.2	2.5	2.4	5.3	8.2	70	500
Cadmium	0.6	0.287	0.523	0.1	0.1	0.3	0.4	0.1	0.5	0.4	0.6	1	0.7	0.3	0.5	0.3	0.5	1.2	9.6	100
Chromium	34.4	19.1	16.8	5.8	7.7	23.6	19	18.4	32.8	10.8	12	15.6	13.4	6.7	11.7	13.1	24.6	81	370	2500
Copper	19.7	14.9	**42.1**	4.2	6	**46.4**	16	15.3	**59.3**	7.7	9.6	**74.8**	**40.8**	13.6	**35.1**	29.1	**71.3**	34	270	2500
Lead	10.3	3.14	10.5	5.15	3.47	8.72	2.49	2.93	12.7	1.3	1.52	17	16.4	1.67	6.93	12.4	21.8	46.7	218	1000
Mercury	0.0516	0.015J	0.02U	0.02U	0.02U	0.022	0.012J	0.02U	0.029	0.02U	0.02U	0.097	0.054	0.02U	0.038	0.018J	0.053	0.15	0.71	20
Nickel	16.7	10.9	9.15	4	4.4	12.1	12.9	11.2	18	8.9	13.1	8.5	8.2	5.9	7.7	8.8	12.9	20.9	51.6	2000
Selenium	1	0.668	0.534	0.2	0.2	0.6	1	0.4	0.9	1.1	1	0.4	0.4	0.6	0.5	0.6	0.9			100
Silver	0.1	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.1	0.05U	0.05U	0.1	0.05U	0.05U	0.05U	0.05U	0.1	1	3.7	500
Zinc	64.8	37.2	69.8	18	21.5	72.9	32.1	41.7	101	28.8	31.6	107	85.7	30	47.2	48.9	101	150	410	5000
ORGANOTINS (ug/kg, dry wt)																				
Dibutyltin	3U	3U	16.9	3U	3U	2.5J	2J	3U	13.2	3U	3U	5	8.3	3U	6	5	33.1			
Tributyltin	3U	3U	78.6	3U	9.7	30	13.4	25.4	28.1	8.4	3	92.9	416	12.7	35.8	27.3	115			
Tetrabutyltin	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U	3U			
CHLORINATED PESTICIDES (ug/kg, dry wt)																				
2,4'-DDT	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			1400
2,4'-DDE	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
2,4'-DDD	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
4,4'-DDT	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	1	7	1000
4,4'-DDE	**4.9J**	5U	5U	5U	5U	4.7J	2.6J	3.3J	**5.6**	5U	3.7J	**6.4**	4.6J	1.8J	3.6J	**7.6**	4.8J	2.2	27	1000
4,4'-DDD	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	2	20	1000
Total DDT	**4.9J**	0	0	0	0	**4.7J**	**2.6J**	**3.3J**	**5.6**	0	**3.7J**	**6.4**	**4.6J**	**1.8J**	**3.6J**	**7.6**	**4.8J**	1.58	46.1	1000
Aldrin	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			1400
Dieldrin	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	0.02	8	8000
Endrin	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			200
Endrin ketone	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
Endrin aldehyde	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
Endosulfan II	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
Endosulfan I	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
Endosulfan sulfate	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
alpha-BHC	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			200
beta-BHC	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			

Table 9. Bulk Sediment Chemistry for Dana Point Harbor Areas B & C Composites and Individual Cores.

Analytical Parameter	LA-3	Composites		Individual Cores														Screening Values		
		B	C	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4	C5	C6	Salt ERL	Salt ERM	TTLC
delta-BHC	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
gamma-BHC (Lindane)	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			4000
Methoxychlor	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			100000
Mirex	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			21000
Toxaphene	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U			5000
Heptachlor epoxide	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
Heptachlor	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			4700
alpha-Chlordane	5U	5U	1.54J	5U	5U	5U	5U	5U	5U	5U	5U	1.1J	1.4J	5U	5U	5U	5U			
gamma-Chlordane	5U	5U	2J	5U	5U	5U	5U	5U	5U	5U	5U	2.2J	3.1J	5U	5U	5U	5U			
Oxychlordane	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
cis-Nonachlor	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
trans-Nonachlor	5U	5U	1.05J	5U	5U	5U	5U	5U	5U	5U	5U	2J	1.9J	5U	5U	5U	5U			
Total Chlordane	0	0	**5.13J**	0	0	0	0	0	0	0	0	**5.3J**	**6.4J**	0	0	0	0	0.5	6	
PCBs (ug/kg, dry weight)																				
Aroclor 1016	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1221	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1232	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1242	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1248	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1254	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U			
Aroclor 1260	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U			
Total Aroclor PCBs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22.7	180	
PCB008	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR			
PCB018	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB028	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB031	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB033	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB037	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB044	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB049	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB052	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB066	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB070	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB074	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB077	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB081	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB087	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB095	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB097	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB099	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB101	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB105	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB110	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB114	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB118	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB119	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB123	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB126	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			

Table 9. Bulk Sediment Chemistry for Dana Point Harbor Areas B & C Composites and Individual Cores.

Analytical Parameter	LA-3	Composites		Individual Cores														Screening Values		
		B	C	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4	C5	C6	Salt ERL	Salt ERM	TTLC
PCB128+167	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB138	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB141	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB149	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB151	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB153	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB156	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB157	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB158	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB168+132	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB169	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB170	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB177	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB180	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB183	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB187	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB189	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB194	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB195	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR			
PCB200	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB201	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB206	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U			
PCB209	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR				
Total PCB Congeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
SEMIVOLATILE COMPOUNDS (ug/kg, dry wt)																				
2,4,6-Trichlorophenol	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U			
2,4-Dichlorophenol	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U			
2,4-Dimethylphenol	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U			
2,4-Dinitrophenol	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U			
2-Chlorophenol	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U			
2-Methyl-4,6-dinitrophenol	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U			
2-Nitrophenol	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U			
4-Chloro-3-methylphenol	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U			
4-Nitrophenol	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U			
Pentachlorophenol	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U	100U			50000
Phenol	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U	200U			
Total Phenolic Compounds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
bis-(2-Ethylhexyl)phthalate	68.1U	93.6U	2860	57.4U	104U	246U	94.4U	147U	295U	76.6U	80.6U	8870	5300	186U	334U	1580	3310			
Di-n-octyl phthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U			
Diethyl phthalate	12.1U	13.5U	14.8U	11.8U	16.7U	16.4U	34.9U	27U	36.8U	39.1U	33.9U	40.4U	31.3U	16.8U	35.6U	130U	47.7U			
Di-n-butyl phthalate	854U	703U	798U	238U	536U	275U	946U	529U	952U	859U	629U	654U	818U	757U	1280U	2950	1790U			
Benzyl butyl phthalate	14.5	10U	49	10U	8.8J	22.2	10.2	9.8J	34.1	71.3	12.1	2200	40.2	6.2J	15.9	4150	41.9			
Dimethyl phthalate	10U	10U	18.6	10U	10U	27.1	10U	10U	10U	10U	10U	9.3J	9.7J	10U	10.9	40	52.5			
Phenanthrene	2.21J	2.1J	79.1	5U	5U	173	5U	5U	5.01	5U	5U	50.2	170	5U	2.17J	18.7	15.2	240	1500	
Naphthalene	5U	5U	3.5J	5U	5U	1.51J	5U	5U	5U	5U	5U	3.03J	5.25	5U	5U	2.75J	2.46J	160	2100	
Fluorene	5U	5U	5.4	5U	5U	5.99	5U	5U	5U	5U	5U	3.27J	13.7	5U	5U	5U	1.99J	19	540	
Dibenzothiophene	5U	5U	3.8J	5U	5U	6.99	5U	5U	5U	5U	5U	3.53J	8.53	5U	5U	5U	2.08J			
Biphenyl	5U	5U	5U	5U	5U	1.43J	5U	5U	1.11J	5U	1.38J	1.44J	2.3J	5U	1.3J	4.76J	1.55J			

Table 9. Bulk Sediment Chemistry for Dana Point Harbor Areas B & C Composites and Individual Cores.

Analytical Parameter	LA-3	Composites		Individual Cores														Screening Values		
		B	C	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4	C5	C6	Salt ERL	Salt ERM	TTLC
Anthracene	5U	1.8J	36.6	5U	5U	30.1	5U	5U	4.85J	5U	5U	13.3	67.5	5U	5U	5U	3.99J	85.3	1100	
Acenaphthylene	5U	1.5J	5U	5U	5U	15.6	5U	5U	2.69J	5U	5U	1.3J	5U	5U	5U	5U	1.18J	44	640	
Acenaphthene	5U	5U	**18.7**	5U	5U	4.43J	5U	5U	5U	5U	5U	1.79J	**37.3**	5U	5U	5U	1.35J	16	500	
2-Methylnaphthalene	5U	5U	2.1J	5U	5U	1.89J	5U	5U	5U	5U	5U	3.76J	3.82J	5U	5U	7.16	2.24J	70	670	
2,6-Dimethylnaphthalene	5U	5U	1.2J	5U	5U	2.51J	5U	5U	2.39J	5U	3.67J	5U	2.74J	5U	1.72J	6.59	5U			
2,3,5-Trimethylnaphthalene	5U	5U	5U	5U	5U	3.2J	5U	5U	5U	5U	2.72J	1.24J	1.71J	5U	5U	5U	5U			
1-Methylphenanthrene	5U	1J	12.4	5U	5U	20.2	5U	5U	5U	4.61J	5U	6.6	22.9	5U	5U	5U	5U			
1-Methylnaphthalene	5U	5U	1.2J	5U	5U	1.54J	5U	5U	5U	5U	5U	1.35J	1.9J	5U	5U	2.94J	5U			
Pyrene	4.69J	8.6	494	2.31J	6.13	266	6.42	7.8	37.8	12.8	4.33J	172	**880**	5.95	23.1	91	79.1	665	2600	
Perylene	4.52J	107	292	20.2	17.9	57.1	318	31.2	68.3	249	1300	74.9	269	40.7	122	196	289			
Indeno(1,2,3-cd)pyrene	2.57J	8.4	453	5U	3.04J	77.4	5U	3.51J	27.5	5U	5U	135	552	9.8	21.2	148	121			
Fluoranthene	4.17J	8.1	444	2.25J	3.1J	340	6.79	5.39	32.5	3.44J	3.51J	142	**799**	4.78J	16.1	71.4	54.6	600	5100	
Dibenzo(a,h)anthracene	5U	5U	67	5U	5U	15.6	5U	5U	5U	5U	5U	36.3	133	5U	6.29	34.8	26.8	63.4	260	
Chrysene	3.06J	5.7	340	1.14J	2.93J	116	3.67J	4.35J	33.3	2.71J	5U	83.1	**616**	5.08	15.2	69	44.6	384	2800	
Benzo(k)fluoranthene	2.8J	11.5	403	5U	3.5J	151	3.25J	5.31	32	2.13J	5U	135	549	6.55	25.7	124	93.3			
Benzo(g,h,i)perylene	2.38J	6.4	330	5U	3.15J	56.2	5U	5.89	30.6	5U	5U	144	385	7.49	19.7	157	123			
Benzo(e)pyrene	3.44J	8.3	306	5U	3.68J	78.8	5U	5.6	21.7	5U	5U	95.2	400	6.4	15.6	89.8	76.6			
Benzo(b)fluoranthene	2.88J	9.3	429	5U	3.29J	127	2.69J	6.35	28.6	2.64J	5U	125	691	6.41	16.2	102	102			
Benzo(a)pyrene	3.89J	11.7	**600**	5U	4.21J	163	5U	6.8	26.4	5U	5U	155	**1070**	12.3	24.6	115	82.3	430	1600	
Benzo(a)anthracene	5U	4.4J	**394**	1.79J	3.08J	68.8	3.57J	4.26J	21.8	2.51J	5U	91.7	**746**	4.89J	13	56	36.8	261	1600	
Total Low Weight PAHs	2.2	6.4	160	0	0	261	0	0	16.1	4.61	7.77	87.3	329	0	5.19	42.9	30	552	3160	
Total High Weight PAHs	34.4	189	**4552**	27.7	54	1517	344	86.5	361	275	1308	1389	**7090**	110	319	1254	1129	1700	9600	
Total PAHs	36.6	196	**4712**	27.7	54	1778	344	86.5	377	280	1316	1476	**7419**	110	324	1297	1159	4022	44792	
ERM Quotient	0.038	0.013	0.08	0.005	0.007	0.061	0.019	0.019	0.051	0.008	0.019	0.077	0.149	0.013	0.03	0.05	0.06			

1. Effects Range Low (ERL) and Effect Range Median (ERM) sediment quality objectives from Long *et al.* (1995).
2. California Code of Regulations Title 22 Total Threshold Limit Concentrations.

U = Not measured above reported sample reporting limit.
J = The result is an estimated quantity.
J+ = The result is an estimated quantity but result may be biased high.
NR = No value reported by analytical laboratory.
Bolded values exceed ERL values
<u>Bolded and underlined</u> values exceed ERM values

organotins, dibutyltin and tributyltin are present in the Area C composite sample and not present in the LA-3 reference sediment. Dibutyltin is within the range reported by the California State Water Resources Control Board (1988) for sediment in California coastal and delta waters, while tributyltin is more than twice as high as the upper end of this range.

Based on individual core analyses, most of the organic contamination in the Area C composite sample appears to come from the sediments in front of the 60-inch storm water outfall within the East Basin (Cores C1 and C2). The only cores with detectable chlordane were C1 and C2. Total chlordane is above the ERM value in Core C2 and between ERL and ERM values in Core C1. Most of the PAH contamination noted in the Area C composite comes from Core C2 with six individual PAH compounds exceeding ERL values along with total high molecular weight PAHs and total PAHs. There are no PAH ERL exceedances in any other Area C core.

Overall contamination is put into a better context by calculating mean ERM quotients. For the Dana Point Harbor ocean disposal sediments, the mean ERM quotient is 0.013 for the Area B composite and 0.08 for the Area C composite. At these levels, a low potential for toxicity can be expected. Sediments with ERM quotients below 0.1 are unlikely to cause a toxic response (Long *et al.*, 1998). Sediments with values greater than 1.5 are considered likely to cause toxicity.

5.2.2 Elutriate Chemistry

Results of the chemical analysis of the standard elutriates are shown in Table 10. California Toxics Rule, Ocean Plan and Title 22 STLC criteria are included with the elutriate results to assist in evaluation. Results of the background water used to prepare the elutriate are also included in the table with the elutriate results.

For both composites, only inorganic contaminants and few PAH compounds were detected in the standard elutriate samples. To determine if metal concentrations in the elutriate samples will not adversely impact the water column, standard elutriate results are compared to Ocean Plan objectives. All metal concentrations are below Ocean Plan objectives indicating that the sediments from Newport Dunes will not adversely impact water quality during disposal through the water column.

5.2.3 Toxicity Testing

Survival data for the solid phase bioassays are presented in Table 11 along with statistical comparisons with the LA-3 reference site solid phase bioassay results. Survival, LC_{50} and EC_{50} data for the bivalve larvae suspended particulate-phase bioassays are presented in Table 12. Survival and LC_{50} data for the mysid shrimp and teleost fish suspended particulate-phase bioassays are presented in Table 13.

Solid Phase Bioassays

For amphipods, sediment from Areas B and C composites produced 83% and 77% survival, respectively, compared to 87% survival in the reference site exposures. Lower survival in the composite sediments was not statistically significantly lower than reference sediment survival ($p<0.05$). The amphipod bioassays met test acceptability criteria of 90% survival in the control ("Home") sediments. Sediment LPCs were not exceeded by these results (Table 11).

For polychaete worms, the two Dana Point Harbor sediment composites produced 90% survival for Area B and 98% survival for Area C compared to 98% survival in the Home and LA-3 reference site exposures. Statistical analysis revealed that the 90% survival in Area B was significantly decreased compared to the reference site sediment (Dunnett's test, $p<0.05$). The bioassays met the test acceptability criteria of 90% survival in the control sediments. Although there was significantly decreased survival in Area B sediments, the sediment LPC was not exceeded since the difference in survival between Area B and LA-3 was less than 10%.

Table 10. Standard Elutriate Chemistry Summary, Dana Point Harbor Maintenance Dredging

Analytical Parameter	Standard Elutriate		Background Water	CA Toxics Rule			CA Ocean Plan	
	Area B	Area C		Salt CMC[1]	Salt CCC[2]	Title 22 STLC	Daily Max[3]	Instant. Max[4]
CONVENTIONALS								
Total Ammonia (as N)	0.43	0.49	0.05U				2400	6000
Oil and Grease (mg/L)	5U	2.2J	1J					
TRPH (mg/L)	0.5	0.2	1.3					
Total Sulfides (mg/L)	0.011J	0.012J	0.05UJ					
TSS (mg/L)	7.3	9	5.3					
DISSOLVED METALS (ug/L)								
Arsenic	0.64	1.3	1.28	69	36	5000		
Cadmium	0.02	0.025	0.058	42	9.3	1000		
Chromium	0.54	0.72	0.64	10300		560000		
Copper	0.28	0.9	2.92	4.8	3.1	25000		
Lead	0.005J	0.021	0.009J	210	8.1	5000		
Nickel	1.15	1.55	0.419	74	8.2	20000		
Selenium	0.15	0.13	0.03	290	71	1000		
Silver	0.04U	0.04U	0.04U	0.95		5000		
Zinc	2.26	2	10.9	90	81	250000		
TOTAL RECOVERABLE METALS (ug/L)								
Arsenic	0.015U	0.015U	0.015U				32	80
Cadmium	0.02	0.03	0.06				4	10
Chromium	0.05	0.05U	0.05U				8	20
Copper	0.63	1.93	4.75				12	30
Lead	0.16	0.54	0.16				8	20
Mercury	0.02U	0.02U	0.02U				0.16	0.4
Nickel	1.26	1.58	0.40				20	50
Selenium	0.12	0.12	0.015U				60	150
Silver	0.04U	0.04U	0.04U				2.8	7
Zinc	0.01U	0.01U	0.01U				80	200
ORGANOTINS (ug/L)								
Dibutyltin	0.003U	0.003U	0.003U					
Tributyltin	0.003U	0.003U	0.003U	0.374	0.014			
Tetrabutyltin	0.003U	0.003U	0.003U					
CHLORINATED PESTICIDES (ug/L)								
2,4'-DDT	0.005U	0.005U	0.005U					
2,4'-DDE	0.005U	0.005U	0.005U					
2,4'-DDD	0.005U	0.005U	0.005U					
4,4'-DDT	0.005U	0.005U	0.005U	0.13	0.001			
4,4'-DDE	0.005U	0.005U	0.005U					
4,4'-DDD	0.005U	0.005U	0.005U					
Total DDT	0	0	0			100		
Aldrin	0.005U	0.005U	0.005U	1.3		140		
Dieldrin	0.005U	0.005U	0.005U	0.71	0.0019			
Endrin	0.005U	0.005U	0.005U	0.037	0.0023	20	0.004	0.006
Endrin ketone	0.005U	0.005U	0.005U			20	0.004	0.006
Endrin aldehyde	0.005U	0.005U	0.005U			20	0.004	0.006
Endosulfan II	0.005U	0.005U	0.005U	0.034	0.0087		0.018	0.027
Endosulfan I	0.005U	0.005U	0.005U	0.034	0.0087		0.018	0.027
Endosulfan sulfate	0.005U	0.005U	0.005U				0.018	0.027
alpha-BHC	0.005U	0.005U	0.005U				0.008	0.012
beta-BHC	0.005U	0.005U	0.005U				0.008	0.012
delta-BHC	0.005U	0.005U	0.005U				0.008	0.012
gamma-BHC (Lindane)	0.005U	0.005U	0.005U	0.16			0.008	0.012
Methoxychlor	0.005U	0.005U	0.005U			10000		

Table 10. Standard Elutriate Chemistry Summary, Dana Point Harbor Maintenance Dredging

Analytical Parameter	Standard Elutriate		Background Water	CA Toxics Rule			CA Ocean Plan	
	Area B	Area C		Salt CMC[1]	Salt CCC[2]	Title 22 STLC	Daily Max[3]	Instant. Max[4]
Mirex	0.005U	0.005U	0.005U					
Toxaphene	0.05U	0.05U	0.05U	0.21	0.0002	500		
Heptachlor epoxide	0.005U	0.005U	0.005U	0.053	0.0036	470		
Heptachlor	0.005U	0.005U	0.005U	0.053	0.0036	470		
alpha-Chlordane	0.005U	0.005U	0.005U	0.09	0.004			
gamma-Chlordane	0.005U	0.005U	0.005U	0.09	0.004			
Oxychlordane	0.005U	0.005U	0.005U					
cis-Nonachlor	0.005U	0.005U	0.005U					
trans-Nonachlor	0.005U	0.005U	0.005U					
Total Chlordane	0	0	0					
PAHs (ug/L, dry wt.)								
Phenanthrene	0.005U	0.005U	0.005U					
Naphthalene	0.005U	0.005U	0.0039J					
Fluorene	0.005U	0.005U	0.005U					
Dibenzothiophene	0.005U	0.005U	0.005U					
Biphenyl	0.005U	0.005U	0.005U					
Anthracene	0.005U	0.005U	0.005U					
Acenaphthylene	0.005U	0.005U	0.005U					
Acenaphthene	0.005U	0.005U	0.005U					
2-Methylnaphthalene	0.005U	0.0015J	0.0012J					
2,6-Dimethylnaphthalene	0.005U	0.005U	0.005U					
2,3,5-Trimethylnaphthalene	0.005U	0.005U	0.005U					
1-Methylphenanthrene	0.005U	0.005U	0.005U					
1-Methylnaphthalene	0.005U	0.0011J	0.005U					
Pyrene	0.005U	0.0193	0.0051					
Perylene	0.005U	0.005U	0.005U					
Indeno(1,2,3-cd)pyrene	0.005U	0.0028J	0.005U					
Fluoranthene	0.005U	0.0086	0.0036J					
Dibenzo(a,h)anthracene	0.005U	0.005U	0.005U					
Chrysene	0.005U	0.012	0.005U					
Benzo(k)fluoranthene	0.005U	0.005U	0.005U					
Benzo(g,h,i)perylene	0.005U	0.0051	0.005U					
Benzo(e)pyrene	0.005U	0.005U	0.005U					
Benzo(b)fluoranthene	0.005U	0.005U	0.005U					
Benzo(a)pyrene	0.005U	0.005U	0.005U					
Benzo(a)anthracene	0.005U	0.0073	0.005U					
Total LMWPAHs	0	0.0026	0.0051					
Total HMWPAHs	0	0.0551J	0.0087J					
Total PAHs	0	0.0577J	0.0138J					
PCBs (ug/L)								
Aroclor 1016	0.02U	0.02U	0.02U					
Aroclor 1221	0.02U	0.02U	0.02U					
Aroclor 1232	0.02U	0.02U	0.02U					
Aroclor 1242	0.02U	0.02U	0.02U					
Aroclor 1248	0.02U	0.02U	0.02U					
Aroclor 1254	0.02U	0.02U	0.02U					
Aroclor 1260	0.02U	0.02U	0.02U					
Total Aroclors	0	0	0	10	0.03	5000		
PCB018	0.005U	0.005U	0.005U					
PCB028	0.005U	0.005U	0.005U					
PCB031	0.005U	0.005U	0.005U					
PCB033	0.005U	0.005U	0.005U					

Table 10. Standard Elutriate Chemistry Summary, Dana Point Harbor Maintenance Dredging

Analytical Parameter	Standard Elutriate		Background Water	CA Toxics Rule			CA Ocean Plan	
	Area B	Area C		Salt CMC[1]	Salt CCC[2]	Title 22 STLC	Daily Max[3]	Instant. Max[4]
PCB037	0.005U	0.005U	0.005U					
PCB044	0.005U	0.005U	0.005U					
PCB049	0.005U	0.005U	0.005U					
PCB052	0.005U	0.005U	0.005U					
PCB066	0.005U	0.005U	0.005U					
PCB070	0.005U	0.005U	0.005U					
PCB074	0.005U	0.005U	0.005U					
PCB077	0.005U	0.005U	0.005U					
PCB081	0.005U	0.005U	0.005U					
PCB087	0.005U	0.005U	0.005U					
PCB095	0.005U	0.005U	0.005U					
PCB097	0.005U	0.005U	0.005U					
PCB099	0.005U	0.005U	0.005U					
PCB101	0.005U	0.005U	0.005U					
PCB105	0.005U	0.005U	0.005U					
PCB110	0.005U	0.005U	0.005U					
PCB114	0.005U	0.005U	0.005U					
PCB118	0.005U	0.005U	0.005U					
PCB119	0.005U	0.005U	0.005U					
PCB123	0.005U	0.005U	0.005U					
PCB126	0.005U	0.005U	0.005U					
PCB128+167	0.005U	0.005U	0.005U					
PCB138	0.005U	0.005U	0.005U					
PCB141	0.005U	0.005U	0.005U					
PCB149	0.005U	0.005U	0.005U					
PCB151	0.005U	0.005U	0.005U					
PCB153	0.005U	0.005U	0.005U					
PCB156	0.005U	0.005U	0.005U					
PCB157	0.005U	0.005U	0.005U					
PCB158	0.005U	0.005U	0.005U					
PCB168+132	0.005U	0.005U	0.005U					
PCB169	0.005U	0.005U	0.005U					
PCB170	0.005U	0.005U	0.005U					
PCB177	0.005U	0.005U	0.005U					
PCB180	0.005U	0.005U	0.005U					
PCB183	0.005U	0.005U	0.005U					
PCB187	0.005U	0.005U	0.005U					
PCB189	0.005U	0.005U	0.005U					
PCB194	0.005U	0.005U	0.005U					
PCB200	0.005U	0.005U	0.005U					
PCB201	0.005U	0.005U	0.005U					
PCB206	0.005U	0.005U	0.005U					
Total PCB Congeners	0	0	0					

Bold indicates a sample value exceeding the CCC.
<u>Underline</u> 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 four 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) Daily Maximum - Criteria Maximum Concentration is the highest level for a 24-hour average exposure and is synonymous with "chronic." California Ocean Plan (2005).
4) Instantaneous Maximum - Criteria Maximum Concentration is the highest level for a 1-hour average exposure and is synonymous with "accute" California Ocean Plan (2005).

Table 11. Solid Phase Bioassay Results, Dana Point Harbor Maintenance Dredging.

Sample	*A. abdita* Survival			*N. caecoides* Survival		
	Mean	Sig?[1]	Exceeds LPC?[2]	Mean	Sig?[1]	Exceeds LPC?[2]
Home	91	--	--	98	--	--
LA-3 Ref	87	--	--	98	--	--
Area B	83	NO	NO	90	YES	NO
Area C	77	NO	NO	98	NO	NO

[1] Significantly reduced ($p<0.05$) from Reference?
[2] Significantly reduced from Ref by >20% (amphipod) or >10% (polychaete).

Table 12. Water Column (SPP) Bioassays Results for *M. galloprovincialis* (Bivalve Lavae), Dana Point Harbor Maintenance Dredging.

Sample	*M. galloprovincialis* Percent Survival				*M. galloprovincialis* Percent Normal Development			
	Mean[1]	NOEC	LC_{50}	Exceeds LPC?	Mean	NOEC	EC_{50}	Exceeds LPC?
Lab Control	87.9	--	--	--	94.5	--	--	--
Site Control	86.4	--	--	--	92.3	--	--	--
Area B	86.7	100	>100	NO	93.7	100	>100	NO
Area C	80.7	100	>100	NO	95.3	100	>100	NO

Mean response is for 100% elutriates
[1] Pooled (n=5) for *M. galloprovincialis*

Table 13. Water Column (SPP) Bioassays Results for *A. bahia* (Mysid) and *M beryllina* (Fish), Dana Point Harbor Maintenance Dredging.

Sample	*A. bahia* Survival				*M. beryllina* Survival			
	Mean	NOEC	LC_{50}	Exceeds LPC?	Mean	NOEC	LC_{50}	Exceeds LPC?
Lab Control	96	--	--	--	100	--	--	--
Site Control	96	--	--	--	94	--	--	--
Area B	92	100	>100	NO	100	100	>100	NO
Area C	80*	<10	>100	NO	88	10	>100	NO

* Interrupted dose response

Suspended Particulate Phase Bioassays

For the bivalve larvae bioassays, there was no significantly decreased mean survival and normal development compared with dilution water controls in any of the elutriate concentrations (Table 12). No observable effects concentrations (NOECs) for survival and normal development were 100% elutriate for the Area B and C composites and LC_{50} values for both composites were >100%. Therefore, water column LPCs were not exceeded by these results.

The undiluted Dana Point Harbor elutriates produced means of 92% and 80% mysid survival in the Area B and Area C exposures, respectively (Table 13). The laboratory and site water controls each produced 96% survival. The Area B elutriate did not produce significantly decreased survival compared with either control (NOEC = 100%, LC_{50} >100%). The Area C elutriate showed an interrupted dose-response, with significantly decreased survival in the 10% and 100% concentrations but no decreased survival at the 50% concentration. The NOEC for Area C was therefore <10% elutriate, while the LC_{50} was >100%. The minor toxicity observed with *A. bahia* was not sufficient to exceed the water column LPC after initial dilution.

The undiluted Dana Point Harbor elutriates produced 100% and 88% *M. beryllina* mean survival in Areas B and C, respectively. Survival in the laboratory control was 100% and survival in the site water control was 94%. Compared with the lab water controls, simple inspections showed no significantly decreased survival in any of the Area B elutriate concentrations (NOEC = 100%, LC_{50} >100%). The Area C elutriates showed significantly decreased survival in the 50% and 100% elutriate concentrations. Therefore, the NOEC for Area C was 10% elutriate, whereas the LC_{50} was >100%. Despite the observed toxicity in Composite Area C, the water column LPC for *M. beryllina* was not exceeded after initial dilution calculations.

5.2.4 Bioaccumulation Assessment

Summaries of mean tissue concentrations after 30-day exposures of *Macoma nasuta* and *Nephtys caecoides* to test sediments are presented respectively in Tables 14 and 15 along with a statistical comparison with mean tissue concentrations derived from test organisms exposed to the LA-3 reference sediment. Table 17 summarizes the results of statistical comparisons of PAH concentrations in tissues of *Nephtys caecoides* after removal of data determined to exhibit external contamination. Raw data for individual replicates are summarized in Appendix F (Tables F1 through F4). For statistical evaluations, analytes undetected in the tissues were equivalent to 50% of the reporting limit.

Macoma nasuta

Analysis of clam (*Macoma*) tissues after exposure to the Dana Point Harbor sediment composites revealed the mean concentration of cadmium was statistically significantly higher in Area B tissues compared to LA-3 reference tissues and the mean concentrations of lead and zinc are statistically significantly higher in Area C tissues compared to LA-3 reference tissues (Table 14). Although significant, the mean concentration of cadmium at 0.499 mg/kg in Area B tissues appears similar to the mean concentration of cadmium at 0.412 mg/kg in the LA-3 reference tissues. For Area C clam tissues, the mean concentration of lead is only 1.7 times higher than the mean concentration in LA-3 reference tissues and the mean concentration of zinc is only 1.1 times higher than the mean concentration in LA-3 reference tissues. No U.S. Food and Drug Administration (FDA) action levels for seafood exist for these metals, and the only metal listed for whole body bivalves in the U.S. Army Corps of Engineers/U.S. Environmental Protection Agency Environmental Residue-Effects On-line Database (ERED, http://el.erdc.usace.army.mil/ered/) is zinc. The ERED database is a compilation of data, taken from the literature, where biological effects (e.g., reduced survival, growth, etc.) and tissue contaminant concentrations were simultaneously measured in the same organism. These data were last updated in October 2006. All effects data are presented in terms of wet weight concentrations. The lowest effects level for zinc listed in the database is 18.0 mg/kg wet. The mean wet weight tissue concentration of zinc in the Area C clam tissues was 12.6 mg/kg.

For organic analyses, there are only a few PAH compounds in clam tissues exposed to the Area C sediment composite that are statistically significantly elevated over reference tissue levels (Table 14). Chlorinated pesticides and PCBs were not detected in any sample. Only total PAHs in the Area B tissues are significantly elevated over LA-3 reference tissues. PAH compounds that are significantly elevated in Area C tissues are acenaphthene, benz[a]anthracene, chrysene, fluoranthene, phenanthrene and pyrene along with total PAHs. Of these, only phenanthrene and total PAHs are actually detected in one or more of the reference tissue replicates limiting the power of the statistical analyses for the remaining compounds (USACE, 1998). Overall, the mean concentration of total PAHs is about 2.5 times higher in Area B tissues and about 13 times higher in the Area C tissues compared to LA-3 reference tissues. Note that the baseline mean total PAH tissue concentration is higher than the LA-3 mean total PAH tissue concentration, indicating possible PAH tissue depuration.

Nephtys caecoides

Analysis of worm (*Nephtys caecoides*) tissues after exposure to the Dana Point Harbor sediment composites revealed, for both areas, mean concentrations of three metals (chromium, mercury and nickel) are statistically significantly higher than in LA-3 reference tissues (Table 15). In addition, the mean concentration of lead is statistically significantly higher in Area C worm tissues by a factor of 2.2 times. Mean chromium tissue concentrations for Areas B and C are significantly elevated over the LA-3 mean tissue concentrations by a factor of 15.4 times and 7.4 times, respectively. In both cases, there is high variability among tissue replicates. Mean mercury tissue concentrations for Areas B and C are significantly elevated over the LA-3 mean tissue concentrations by a factor of 2.3 times and 1.9 times, respectively, with low variability among replicates. Mean nickel tissue concentrations for Areas B and C are significantly elevated over the LA-3 mean tissue concentrations by a factor of 14.1 times and 7.0 times, respectively, with high variability among replicates. No FDA action levels for seafood and no effects levels from the ERED database exist for these metals to help in the interpretation of the observed bioaccumulation.

For all organic contaminants, only PAH compounds bioaccumulated in the Area B and C worm tissues (Table 15). Mean PAH values were considerably less in Area B worm tissues compared to LA-3 reference worm tissues. For both LA-3 reference tissues and Area C tissues, there was extreme variability in PAHs among replicates with very high mean concentrations for a majority of the PAH compounds. Although there are very high mean PAH concentrations in the Area C worm tissues, these values, except for 2,6-dimethylnaphthalene and acenaphthylene, are not significantly elevated over mean LA-3 tissue concentrations because of the strong variability. This extreme variability among replicates and particularly high PAH concentrations in two of the worm tissue replicates from LA-3 and two of the worm tissue replicates from Area C cannot be explained since the total PAH concentration in sediment from LA-3 is 185 times less than the mean total PAH concentration in LA-3 worm tissues and the total PAH concentration in the composite sediment from Area C is 35 times less than the mean total PAH concentration in Area C worm tissues.

The very large mean PAH concentrations in worm tissues mentioned above were obviously of concern and required verification. For LA-3, total PAHs were particularly high in Replicates 1 and 4. LA-3, Replicate 1 had a total PAH concentration of 1,599 µg/kg dry, and LA-3, Replicate 4 had a total PAH concentration of 32,322 µg/kg dry (Appendix F, Table F4). For Area C, total PAHs were particularly high in Replicates 2 and 5. Area C, Replicate 2 had a total PAH concentration of 629,365 µg/kg dry, and

Area C, Replicate 5 had a total PAH concentration of 203,976 µg/kg dry. For comparison, the total PAH concentrations in the remaining three replicates from LA-3 ranged from 2.7 to 12.5 µg/kg dry, and the total PAH concentrations in the remaining three replicates from Area C ranged from 689 to 1,286 µg/kg dry. A request was made to the analytical laboratory to confirm these numbers, which they did. Therefore, a second request was made to the laboratory to reanalyze the remaining tissue for PAH compounds from the replicates in question. Results from the re-extraction and re-analysis of the replicates in question were not drastically different from the original results. The LA-3, Replicate 1 total PAH confirmation value is 348 µg/kg dry, and the LA-3, Replicate 4 total PAH confirmation value is 38,921 µg/kg dry. The Area C, Replicate 5 total PAH confirmation value is 175,810 µg/kg dry, while the Area C, Replicate 2 total PAH confirmation value was off scale and not enough tissue remained to quantify through dilution. Since the re-extraction and re-analysis results were still elevated at the same magnitude, the original results were kept for statistical evaluation.

Theoretical bioaccumulation potentials (TBP) were then examined to assist in evaluating whether the samples with extremely high PAH concentrations were within the range that could reasonably be expected to occur. TBP is an estimation of the magnitude at which nonpolar organic compounds may bioaccumulate in the tissues of a particular organism based on contaminant levels in the sediment. According to the ITM (USEPA/.USACE, 1998), TBP is calculated relative to Biota Sediment Accumulation Factors (BSAFs) for whole-bodied organisms. BSAF is a comparison of the relative concentration of a substance in the tissues of an organism compared with the same substance in the sediment. Since non-polar organic compounds affiliate with organic molecules in the sediment, the PAH sediment concentrations are normalized to the total organic carbon content of the sediment. Since the sediment contaminant concentration is directly proportional to an organism's lipid content, the BSAF value is multiplied by the lipid content of the organism in question. The equation to calculate TBP is as follows:

$$\text{TBP} = \text{BSAF}\ (C_s\ /\ \%\text{TOC})\ \%\text{L}.$$

An ultraconservative BSAF value of 4.0, noted in the ITM, was used in calculating worst-case TBP values. In fact, this conservative BSAF is not truly applicable to PAHs since they are not known to be highly bioaccumulative. BSAF values listed in the USACE BSAF database (http://el.erdc.usace.army.mil/bsaf/BSAF.html) for individual PAH compounds available for *Nephtys* spp. vary from as little as 0.001 to 0.093. The BSAF for total PAHs in this database is 0.124. TBPs calculated using both the ITM default BSAF value and those from the USACE BSAF database for PAH compounds detected in the Area C sediments are summarized in Table 16 along with sediment concentrations and mean worm tissue concentrations.

The magnitude of PAH bioaccumulation in the Area C and LA-3 worm tissues is greater than predicted by theoretical bioaccumulation potential (TBP) values. These data show that TBP values calculated with USACE BSAF values are nearly two orders of magnitudes less than Dana Area C *Nephtys* tissue concentrations and more than two orders of magnitudes less than the LA-3 *Nephtys* tissue concentrations. Observed *Nephtys* tissue concentrations in Area C are predicted much closer with a BSAF value of 4, while TBP values for LA-3 are still a magnitude less than actual *Nephtys* tissue concentrations with a BSAF value of 4. If one applies these calculations to four individual replicates identified with extraordinarily high concentrations of PAHs, it is clear that the reported levels at in these replicates exceed realistic bioaccumulation levels.

Previous bioaccumulation data from LA-3 also do not support the elevated PAH values observed in the worm tissues from LA-3. In September 2006, sediment was collected from LA-3 for a recent Port of Los Angeles study (Kinnetic Laboratories, 2007 draft) concurrently with the LA-3 sediment collected for Dana Point Harbor. Entirely different batches of *Nephtys* were used for each study but were exposed to the same LA-3 sediments. The mean total PAH concentration in LA-3 worm tissues for the Port of Los

Angeles study was 26.2 µg/kg dry compared to 6,790 µg/kg dry for this study. The mean total PAH concentration in worm tissue exposed to LA-3 reference sediments for the Port of Los Angeles study is also consistent with TBP calculations summarized in Table 16 (25.1 µg/kg dry).

Based upon this analysis, the two LA-3 and two Area C replicates with exceedingly high levels of PAHs can only be attributed to contamination during the handling process at either the bioassay or chemistry laboratories. PAH bioaccumulation data in worm tissues were therefore reanalyzed with these replicates removed (Table 17). As a result of elimination of these apparently contaminated samples from the analysis results, 13 of the individual PAH compounds in worm tissue from Area C were found to occur in statistically higher concentrations than those measured in worms exposed to both Home and LA-3 sediment. By removing the contaminated sediments from the comparison, the resulting mean tissue concentrations were consistent with the magnitude of bioaccumulation predicted using the USACE BSAF database (Table 16). Average concentrations of individual PAH compounds in the worm tissues exposed to Area C sediments ranged from below detection limits to 122 µg/kg dry. Only two PAH compounds, benzo(a)pyrene and benzo(k)fluoranthene, were present at concentrations above 100 µg/kg dry. The mean concentration of total PAHs in worm tissues exposed to Area C sediments was 927 µg/kg dry. Based upon an average percent solids concentration of 19.8%, this would correspond to 184 µg/kg wet.

Information on the effects of the bioaccumulation of PAHs on *Nephtys* or other marine polychaete worms is limited. The ERED database provides some limited information. PAH data for polychaetes are limited to two studies that looked at the effects of fluoranthene on the spionid polychaete, *Streblospio benedicti*, and one study that examined the effects on phenanthrene on *Nereis arenaceodentata*. Fluoranthene was found to have the strongest impact on growth of *Streblospio* with a reported lowest observed effective dose (LOED) of 220 µg/kg wet. The LOED for combined effects of phenanthrene on *Nereis* was reported to be 780 µg/kg wet. Wet weight equivalents for fluoranthene in tissue of *Nephthys* exposed to Area C sediment would have been 15.8 µg/kg wet. This is an order of magnitude below the lowest measured effect of fluoranthene. Similarly, the weight equivalents for phenanthrene in tissue of *Nephthys* exposed to Area C sediment would have been 4.3 µg/kg wet which is approximately 0.5 % of the LOED for phenanthrene in tissues of *Nereis*. Based upon this information one would not expect to see biological impacts at the concentrations that these two PAHs were measured in *Nephtys* exposed to Area C sediment.

Table 14. Summary of Bioaccumulation Results for *Macoma nasuta* exposed to Dana Point Harbor Sediments.

Analyte (dry wt)	Mean Tissue Concentration (Standard Error)				
	Baseline	Reference		Area	
		Home	LA-3	B	C
Metals (mg/kg)					
Arsenic	19.38 (1.14)	26.64 (1.63)	29.33 (0.75)	24.97 (0.95)	23.78 (0.74)
Cadmium	0.492 (0.023)	0.411 (0.016)	0.412 (0.008)	**0.499 (0.048)**	0.484 (0.023)
Chromium	3.68 (0.34)	4.54 (0.50)	5.92 (0.24)	4.30 (0.48)	4.49 (0.33)
Copper	9.75 (0.39)	8.07 (0.22)	9.27 (0.34)	10.61 (0.95	12.54 (0.75)
Lead	1.38 (0.02)	1.18 (0.07)	1.46 (0.07)	1.68 (0.03)	**2.51 (0.16)**
Mercury	0.057 (0.004)	0.065 (0.003)	0.036 (0.002)	0.047 0.003)	0.042 (0.010)
Nickel	2.51 (0.18)	3.08 (0.28)	3.58 (0.09)	3.35 (0.13)	3.20 (0.17)
Selenium	1.98 (0.02)	1.96 (0.07)	3.70 (0.09)	1.94 (0.07)	2.05 (0.05)
Silver	2.25 (0.20)	1.73 (0.24)	3.33 (0.21)	1.98 (0.21)	2.23 (0.20)
Zinc	84.56 (4.48)	78.62 (2.43)	85.56 (2.66)	84.21 (3.70)	**97.17 (1.42)**
Chlorinated Pesticides (µg/kg) All below the detection limit					
Aroclors (µg/kg) All below the detection limit					
PCB congeners (µg/kg) All below the detection limit					
PAH Compounds (µg/kg)					
1-Methylnaphthalene	2.5 (0.4)	<2.5	2.1 (0.3)	1.5 (0.2)	2.2 (0.2)
1-Methylphenanthrene	2.0 (0.5)	3.5 (0.6)	<2.5	<2.5	2.0 (0.3)
2-Methylnaphthalene	3.0 (0.3)	<2.5	3.3 (0.5)	2.5 (0.1)	3.2 (0.2)
2,6-Dimethylnaphthalene	<2.5	<2.5	<2.5	<2.5	1.1 (0.6)
Acenaphthene	<2.5	<2.5	<2.5	<2.5	**3.3 (0.3)**
Anthracene	<2.5	<2.5	<2.5	2.0 (0.3)	3.2 (0.6)
Benz[a]anthracene	<2.5	2.74 (0.2)	<2.5	2.3 (0.8)	**5.9 (1.2)**
Benzo[a]pyrene]	<2.5	<2.5	<2.5	<2.5	12.6 (9.0)
Benzo[b]fluoranthene	<2.5	<2.5	<2.5	<2.5	7.1 (3.6)
Benzo[e]pyrene	<2.5	<2.5	<2.5	<2.5	8.9 (5.3)
Benzo[g,h,i]perylene	<2.5	<2.5	<2.5	<2.5	9.3 (6.8)
Benzo[k]fluoranthene	<2.5	<2.5	<2.5	<2.5	11.1 (6.2)
Biphenyl	3.2 (0.2)	3.7 (1.8)	2.9 (0.3)	2.0 (0.2)	2.4 (0.2)
Chrysene	3.7 (0.5)	<2.5	<2.5	3.1 (0.3)	**10.7 (2.0)**
Dibenz[a,h]anthracene	<2.5	<2.5	<2.5	<2.5	4.9 (2.4)
Fluoranthene	23.4 (1.9)	3.3 (0.9)	<2.5	3.3 (0.3)	**18.0 (3.3)**
Fluorene	<2.5	<2.5	<2.5	2.3 (0.2)	1.9 (0.2)
Indeno[1,2,3-c,d]pyrene	<2.5	<2.5	<2.5	<2.5	9.6 (7.1)
Naphthalene	7.3 (0.4)	5.0 (1.6)	4.9 (0.6)	4.5 (0.3)	5.7 (0.4)
Perylene	<2.5	<2.5	<2.5	8.0 (3.0)	7.5 (2.4)
Phenanthrene	6.9 (0.5)	3.5 (0.4)	2.3 (0.2)	2.6 (0.3)	**6.6 (0.7)**
Pyrene	11.0 (1.2)	3.0 (0.5)	<2.5	2.1 (0.4)	**17.8 (3.7)**
Total Detectable PAHs	42.5 (10.6)	17.3 (3.0)	11.0 (1.7)	**27.6 (5.1)**	**145.4 (37.4)**

BOLD indicates result is significantly higher than LA-3 reference.
Underline indicates result is significantly higher than Home sediment.

Table 15. Summary of Bioaccumulation Results for *Nephtys caecoides* exposed to Dana Point Harbor Sediments.

Analyte (dry wt)	Mean Tissue Concentration (standard error)									
	Baseline		Reference				Area			
			Home		LA-3		B		C	
Metals (mg/kg)										
Arsenic	13.38	(0.25)	14.01	(0.45)	16.62	(2.42)	15.48	(0.64)	15.99	(1.30)
Cadmium	1.80	(0.04)	1.33	(0.10)	1.02	(0.16)	1.46	(0.13)	1.29	(0.06)
Chromium	1.56	(0.11)	4.52	(0.95)	3.99	(1.19)	**61.44**	**(33.74)**	**29.69**	**(13.65)**
Copper	7.71	(0.31)	7.80	(0.36)	8.07	(1.19)	20.65	(9.14)	17.25	(1.61)
Lead	0.49	(0.01)	0.61	(0.03)	0.80	(0.13)	2.09	(1.11)	**1.75**	**(0.28)**
Mercury	0.033	(0.001)	0.048	(0.003)	0.024	(0.004)	**0.055**	**(0.009)**	**0.045**	**(0.004)**
Nickel	1.61	(0.07)	3.11	(0.74)	3.24	(0.83)	**45.78**	**(23.99)**	**22.83**	**(9.38)**
Selenium	3.12	(0.05)	3.23	(0.14)	4.17	(0.65)	3.58	(0.16)	3.24	(0.18)
Silver	0.87	(0.05)	1.58	(0.19)	1.21	(0.22)	1.24	(0.07)	1.02	(0.07)
Zinc	117	(2)	142	(4)	132	(19)	144	(6)	137	(11)
Chlorinated Pesticides (µg/kg) All below the detection limit										
Aroclors (µg/kg) All below the detection limit										
PCB congeners (µg/kg) All below the detection limit										
PAH Compounds (µg/kg)										
1-Methylnaphthalene	2.4	(0.1)	<2.5		5.4	(3.4)	1.5	(0.4)	28.9	(24.7)
1-Methylphenanthrene	4.3	(2.2)	3.1	(0.9)	33.9	(29.6)	<2.5		657.8	(498.7)
2,3,5-Trimethylnaphthalene	<2.5		<2.5		2.9	(0.4)	<2.5		13.8	(8.6)
2,6-Dimethylnaphthalene	<2.5		<2.5		5.0	(2.5)	2.3	(0.4)	**37.3**	**(29.4)**
2-Methylnaphthalene	2.5	(0.1)	<2.5		5.5	(3.1)	3.2	(0.4)	9.4	(5.3)
Acenaphthene	<2.5		<2.5		160.2	(153.4)	<2.5		2130	(1635)
Acenaphthylene	<2.5		<2.5		2.7	(0.2)	<2.5		**7.4**	**(3.9)**
Anthracene	2.4	(0.1)	<2.5		148.1	(138.7)	<2.5		2550	(2075)
Benzo[a]anthracene	3.4	(0.9)	2.6	(0.1)	679.8	(637.1)	<2.5		17888	(12880)
Benzo[a]pyrene	<2.5		<2.5		596.0	(565.6)	<2.5		17631	(12656)
Benzo[b]fluoranthene	<2.5		<2.5		393.8	(372.3)	<2.5		13549	(9952)
Benzo[e]pyrene	<2.5		<2.5		343.0	(319.6)	<2.5		9088	(6491)
Benzo[g,h,i]perylene	<2.5		<2.5		264.2	(246.2)	<2.5		7353	(5264)
Benzo[k]fluoranthene	<2.5		<2.5		507.8	(469.9)	<2.5		14691	(10919)
Biphenyl	2.4	(0.1)	2.7	(0.2)	5.7	(3.0)	2.5	(0.5)	36.1	(23.1)
Chrysene	<2.5		<2.5		648.3	(605.0)	2.3	(0.3)	16374	(11749)
Dibenz[a,h]anthracene	<2.5		<2.5		55.5	(50.3)	<2.5		2518	(1805)
Dibenzothiophene	<2.5		<2.5		19.0	(15.5)	<2.5		216.7	(188.5)
Fluoranthene	3.9	(1.5)	2.9	(0.4)	1104	(1035)	2.2	(0.3)	23370	(16828)
Fluorene	<2.5		<2.5		41.2	(38.4)	<2.5		502.0	(444.9)
Indeno[1,2,3-c,d]pyrene	<2.5		<2.5		326.2	(305.7)	<2.5		9606	(6889)
Naphthalene	3.2	(0.4)	3.6	(0.7)	16.0	(12.5)	5.3	(0.5)	13.0	(5.3)
Perylene	<2.5		<2.5		139.8	127.5	14.3	(11.8)	4558	(3240)
Phenanthrene	4.2	(0.6)	2.6	(0.1)	439.0	(421.3)	2.5	(0.2)	5977	(5453)
Pyrene	3.4	(0.9)	2.5	(0.1)	880.8	(825.9)	1.9	(0.3)	18425	(13227)
Total Detectable PAHs	19	(7)	9	(6)	6790	(6391)	31	(12)	167224	(122043)

BOLD indicates result is significantly higher than LA-3 reference.
Underline indicates result is significantly higher than Home sediment.

Table 16. A Comparison of Dana Point Harbor Area C and LA-3 Reference Mean *Nephtys caecoides* Tissue Concentrations with Area C and LA-3 Sediment Concentrations and Calculated Theoretical Bioaccumulation Potential (TBP) Values.

PAH Compound	LA-3 Reference				Dana Point Area C			
	Mean Tissue Concentration (µg/kg, Dry)	Sediment Concentration (µg/kg, Dry)	TBP Value (µg/kg, Dry)		Mean Tissue Concentration (µg/kg, Dry)	Sediment Concentration (µg/kg, Dry)	TBP Value (µg/kg, Dry)	
			Using BSAF Values from USACE Database[1]	Using BSAF of 4.0[2]			Using BSAF Values from USACE Database[1]	Using BSAF of 4.0[2]
1-Methylnaphthalene	5.4	<5	--	NA	28.9	1.2	--	1846
1-Methylphenanthrene	33.9	<5	--	NA	658	12.4	--	367
2,3,5-Trimethylnaphthalene	2.9	<5	--	NA	13.8	<5	--	NA
2,6-Dimethylnaphthalene	5.0	<5	--	NA	37.3	1.2	--	35.4
2-Methylnaphthalene	5.5	<5	--	NA	9.4	2.1	--	62.0
Acenaphthene	160	<5	--	NA	2130	8.7	--	257
Acenaphthylene	2.7	<5	--	NA	7.4	<5	--	NA
Anthracene	148	<5	--	NA	2550	36.6	--	1081
Benzo[a]anthracene	680	<5	--	NA	17888	394	--	11638
Benzo[a]pyrene	596	2.9	0.02	63.8	17631	600	4.4	17723
Benzo[b]fluoranthene	394	3.4	0.06	76.2	13549	429	9.5	12672
Benzo[e]pyrene	343	2.4	--	52.7	9088	306	--	9039
Benzo[g,h,i]perylene	264	2.8	0.004	62.0	7353	330	0.51	9748
Benzo[k]fluoranthene	508	3.1	0.02	67.8	14691	403	3.0	11904
Biphenyl	5.7	<5	--	NA	36.1	<5.0	--	NA
Chrysene	648	3.1	0.12	67.8	16374	340	17.6	10043
Dibenzo[a,h]anthracene	55.5	<5	--	NA	2518	67	--	1979
Dibenzothiophene	19.0	<5	--	NA	217	3.8	--	112
Fluoranthene	1104	4.2	0.10	92.4	23370	444	3.1	13115
Fluorene	41.2	<5	--	NA	502	5.4	--	159
Indeno[1,2,3-c,d]pyrene	326	2.6	0.01	56.9	9606	453	3.3	13381
Naphthalene	16.0	<5	NA	NA	13.0	3.5	0.26	103
Perylene	140	4.5	--	100	4558	292	--	8625
Phenanthrene	439	2.2	1.14	49.0	5977	79.1	54.3	2337
Pyrene	881	4.7	0.23	30.7	18425	494	109	14592
Total Detectable PAHs	6790	36.6	25.1	811	167224	4712	4314	139185

For Area C, a TOC value of 0.65% dry and mean lipid value of 4.8% dry were used.
For LA-3 Reference, a TOC value of 2.2% dry and a mean lipid values of 3.6% dry were used.
1. USACE Biota Sediment Accumulation Factors Database (http://el.erdc.usace.army.mil/bsaf/BSAF.html)
2. Derived from Section 10.2 of the ITM (USACE, 1998)
NA = Not applicable when not detected in the sediment.

Table 17. PAH Bioaccumulation Results and Statistical Comparisons for *Nephtys caecoides* Exposed to Dana Point Harbor Sediments with Outliers from LA-3 and Area C Removed.

	Mean Tissue Concentration (standard error)				
		Reference		Area	
Analyte (dry wt)	**Baseline**	**Home**	**LA-3**	**B**	**C**
PAH Compounds (µg/kg)					
1-Methylnaphthalene	2.4 (0.1)	<2.5	2.1 (0.3)	1.5 (0.4)	2.2 (0.5)
1-Methylphenanthrene	4.3 (2.2)	3.1 (0.9)	<2.5	<2.5	4.0 (0.8)
2,3,5-Trimethylnaphthalene	<2.5	<2.5	<2.5	<2.5	<2.5
2,6-Dimethylnaphthalene	<2.5	<2.5	<2.5	2.3 (0.4)	2.4 (0.1)
2-Methylnaphthalene	2.5 (0.1)	<2.5	2.7 (0.1)	3.2 (0.4)	3.4 (1.2)
Acenaphthene	<2.5	<2.5	<2.5	<2.5	**8.3 (2.7)**
Acenaphthylene	<2.5	<2.5	<2.5	<2.5	2.0 (0.5)
Anthracene	2.4 (0.1)	<2.5	<2.5	<2.5	**13.4 (2.7)**
Benz[a]anthracene	3.4 (0.9)	2.6 (0.1)	<2.5	<2.5	**70.9 (26.8)**
Benzo[a]pyrene	<2.5	<2.5	<2.5	<2.5	**122.0 (34.4)**
Benzo[b]fluoranthene	<2.5	<2.5	<2.5	<2.5	**74.0 (20.0)**
Benzo[e]pyrene	<2.5	<2.5	<2.5	<2.5	**72.0 (18.7)**
Benzo[g,h,i]perylene	<2.5	<2.5	<2.5	<2.5	**52.9 (10.3)**
Benzo[k]fluoranthene	<2.5	<2.5	<2.5	<2.5	**101.8 (43.7)**
Biphenyl	2.4 (0.1)	2.7 (0.2)	2.8 (0.6)	2.5 (0.5)	3.0 (0.8)
Chrysene	<2.5	<2.5	2.1 (0.4)	2.3 (0.3)	**76.0 (27.2)**
Dibenz[a,h]anthracene	<2.5	<2.5	<2.5	<2.5	**18.0 (5.4)**
Dibenzothiophene	<2.5	<2.5	3.5 (1.0)	<2.5	1.8 (0.4)
Fluoranthene	3.9 (1.5)	2.9 (0.4)	<2.5	2.2 (0.3)	**80.0 (36.7)**
Fluorene	<2.5	<2.5	<2.5	<2.5	2.9 (0.8)
Indeno[1,2,3-c,d]pyrene	<2.5	<2.5	<2.5	<2.5	**66.0 (15.8)**
Naphthalene	3.2 (0.4)	3.6 (0.7)	3.1 (0.3)	5.3 (0.5)	6.1 (1.4)
Perylene	<2.5	<2.5	<2.5	14.3 (12)	**55.5 (4.5)**
Phenanthrene	4.2 (0.6)	2.6 (0.1)	2.1 (0.2)	2.5 (0.2)	**21.9 (6.1)**
Pyrene	3.4 (0.9)	2.5 (0.1)	<2.5	1.9 (0.3)	**71.7 (28.9)**
Total Detectable PAHs	19 (7)	9 (6)	9.1 (2.8)	31 (12)	**927.0 (183)**

BOLD indicates result is significantly higher than LA-3 reference.
Underline indicates result is significantly higher than Home sediment.

6.0 SUMMARY AND CONCLUSIONS

The results of this study will be used to evaluate the potential suitability for disposal of coarse grain Dana Point Harbor maintenance dredge sediments at nearby Capistrano Beach and Baby Beach and fine grain dredge sediments at the LA-3 ocean disposal site.

Coarse grain sediments defined as Area A sediments do not appear to have excess amounts of fine grain material and total organic carbon that would preclude the sediments for beach replenishment at Capistrano Beach and Baby Beach. In addition, contaminant concentrations in Area A sediments are similar to or only slightly elevated above contaminant concentrations found in the beach reference samples.

The seven individual dredge units containing fine grain material were combined into eastern and western composite samples, defined as Areas B and C composites. Contaminants were not found in the Area B (western) composite sample in excess of lower effects based screening values, while several contaminants (copper, total chlordane compounds, acenaphthene, benzo(a)pyrene, benzo(a)anthracene, total high molecular weight PAHs and total PAHs) were found in the Area C composite sample in excess of lower effects based screening values. As defined by the individual core analyses, the bulk of this contamination can be attributed to the shoaled area in front of the 60-inch storm water outfall entering the East Basin.

Calculated ERM quotients indicate that overall contamination will most likely not cause toxicity to benthic organisms. This was verified by the lack of significant toxicity to amphipods and polychaete worms exposed to the test sediments compared to amphipods and worms exposed to the LA-3 reference sediments. By inference, the limiting permissible concentration (LPC) of contaminants would not be exceeded at the LA-3 disposal site.

Bioaccumulation testing was carried out for both Area B and Area C composite samples using both clams and worms. Test results with the clam tissues showed that for Area B, statistically significant bioaccumulation of cadmium was evident in the tissues of clams exposed to the Dana Point Harbor test sediments in comparison to the tissues of clams exposed to LA-3 reference sediments. For Area C, lead, zinc and several PAH compounds were statistically elevated in the clam tissues. Test results with worm tissues showed statistically significant bioaccumulation of chromium, mercury and nickel in Area B tissues. For Area C worm tissues, chromium, mercury, nickel, 2,6-dimethylnaphthalene and acenaphthylene were statistically elevated in comparison to the tissues of worms exposed to LA-3 reference sediments.

Although statistically significant, metal bioaccumulation appears to be minor in the clams. For all three metals significantly elevated above the LA-3 reference tissues (cadmium, lead and zinc), mean bioaccumulation in the clam test samples was less than two times higher than in the reference sample. Zinc is the only metal listed in the USACE/USEPA Environmental Residue-Effects On-line Database (ERED, http://el.erdc.usace.army.mil/ered/), and the zinc concentrations measured in the Dana Point clam tissues was below the lowest observable effects levels.

In worm tissues, metal bioaccumulation appears to also be minor for mercury and lead but more pronounced for chromium and nickel. Mercury bioaccumulation in the worm test samples was less than two times higher than in the reference sample, and lead bioaccumulation in worm tissues was slightly more than two times higher than the reference sample. Chromium and nickel bioaccumulation in worm tissues was more substantial and variable, especially for Area B. No U.S. Food and Drug Administration (FDA) action levels (USFDA, 2000) for seafood or ERED database effects levels for polychaetes exist for these metals to assist in interpretation.

The magnitude of PAH bioaccumulation in the Area C clam tissues appears to be minor. Of the six PAH compounds in Area C clam tissues that were significantly elevated above LA-3 reference clam tissues, one compound was detected below the reporting limit, two compounds were detected slightly above the reporting limit, two compounds were about twice as high as the reporting limit, and two compounds were detected about three times higher than the reporting. These same compounds in the LA-3 reference clam tissues were either not detected or they were detected below the reporting limit.

PAH bioaccumulation in worms was more difficult to interpret because of high variability and extreme values associated with some Area C and LA-3 tissue samples. After a thorough review of the data it was concluded that four samples among all of the replicate tissue samples exhibited evidence of PAH contamination and should not be considered as valid. This conclusion was validated by the fact that Theoretical Bioaccumulation Potentials (TBPs) calculated for these samples were one to two orders of magnitude lower than indicated by the tissue data of these four samples showing that these replicates exceed realistic bioaccumulation levels. Statistical analysis after elimination of the suspect replicates revealed 14 of the individual PAH compounds, as well as total PAHs, in worm tissue from Area C were found to occur in statistically higher concentrations than those measured in worms exposed to both Home and LA-3 sediment. The limited information on the effects of bioaccumulation of PAHs on *Nephtys* or other marine polychaete worms suggested that concentrations of at least two of the PAH compounds, fluoranthene and phenanthrene, were well below concentrations known to have measurable biological effects (e.g. growth, reproduction, behavior, and physiology).

Final dredging and disposal decisions can only be made by the regulating agencies. However, after review of all data, Area A sediments should be acceptable for reuse on Baby and Capistrano Beaches and Area B sediments should be acceptable for placement at LA-3. Despite contaminant issues associated with Area C sediments, all or some of the Area C sediments may also be suitable for placement at LA-3. As defined by the individual core analyses, the bulk of the observed contamination in Area C can be attributed to the shoaled area in front of the 60-inch storm water outfall entering the East Basin.

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