MONTROSE SETTLEMENTS RESTORATION PROGRAM: FISH SAMPLING PLAN

FINAL

22 OCTOBER 2002

Prepared for:

NOAA Damage Assessment Center and the Montrose Settlements Restoration Program

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1 INTRODUCTION

1.1 Background

From the late 1940s to the early 1970s, millions of pounds of DDTs and PCBs were discharged from industrial sources through a sewer outfall into the ocean near Los Angeles. Throughout the 1970s and 1980s, researchers identified fish in the Palos Verdes vicinity that were highly contaminated with PCBs and DDTs. In particular, the Southern California Coastal Water Research Project (SCCWRP) identified multiple areas during their studies of the Southern California Bight. In 1987, the California Office of Environmental Health Hazard Assessment (OEHHA), with a mandate from the State of California, undertook a comprehensive study of fish contamination between Point Dume and Dana Point (Pollock *et al.* 1991). This project examined 16 species at 24 locations frequented by boat-based and shore-based anglers. The results of this study led to the issuance by OEHHA of fishing advisories at 11 sites, which recommended either reducing or avoiding consumption of eight different species or species groups at various locations from Malibu to Newport Beach. Surveys by the United States Geological Survey (USGS) found more than 100 metric tons of DDTs and 10 metric tons of PCBs remaining in the ocean bottom sediments of the Palos Verdes Shelf in 1992-1993. In the Southern California Bight Pilot Project (Allen *et al.* 1998, Schiff and Gossett 1998) contaminated sediments were found from the Palos Verdes Shelf well into the Santa Monica Bay.

Under the federal Superfund Law (the Comprehensive Environmental Response, Compensation and Liability Act, or CERCLA) the United States Government and the State of California filed a lawsuit, alleging that a number of defendants were responsible for releasing DDTs and PCBs and other hazardous substances into the environment. The lawsuit charged that the DDTs and PCBs injured natural resources, including fish and wildlife that live in and around coastal waters in Southern California. The court granted that the white croaker bag limits and fish consumption advisories were *per se* injuries under the law.

Final settlements were reached in 2000. The settlement monies go to the U.S. EPA and the California Department of Toxic Substances Control to minimize exposures to DDTs and PCBs, and to the Natural Resource Trustees to restore resources injured by DDTs and PCBs. The Trustees comprise the following federal and State resource agencies: NOAA; the U.S. Fish and Wildlife Service; the National Park Service; the California Department of Fish and Game; the California State Lands Commission, and the California Department of Parks and Recreation. As required by Superfund law, the Natural Resource Trustees must use the settlement monies to restore natural resources that were harmed by chemicals at issue in this case. The highest priority will go to projects that most directly and effectively restore the natural resources harmed by the DDTs and PCBs. Thus, the Trustees will focus restoration efforts on the birds and fishing resources affected by these contaminants.

1.2 Subsistence and Sport Fishing Injuries (boat- and shore-based)

For the present project, the injuries of interest are the subsistence and sport fishing injuries, identified as the 10-fish bag limit for white croaker and the fish consumption advisories

in place between Newport and Malibu. The Trustees are in the process of determining the most cost-effective projects to address the injuries and provide anglers with less contaminated ("cleaner") fish in the area of injury. One avenue under consideration is to change the underwater habitat around piers and other easily accessible fishing locations to both displace highly contaminated fish species and increase the availability of cleaner fish species. The method under consideration is the introduction of artificial reefs into soft-bottom fishing areas. Studies have indicated that the most highly contaminated fish (in particular, white croaker) are those which feed on organisms in contaminated bottom sediments. Fish in nearby locations with different feeding patterns have much lower levels of contamination. Therefore, the introduction of rocky habitats to contaminated soft-bottom areas can reduce the contaminant load of the fish present in that area.

Additionally, public information will help to minimize the on-going fishing injuries. Effective public education, which will inform anglers of the species and fishing locations with low levels of contamination, will be an immediate action to both reduce the public's exposure to DDTs and PCBs and increase their opportunities for safe fishing, both from shore and from boats.

1.3 Information Required for Addressing Injuries

1.3.1 Purposes of Information

The Trustees are undertaking a sampling program to evaluate two specific potential methods for addressing fishing injuries:

(a) To identify locations where soft-bottom fish are too contaminated for consumption, but the reef-type fish are clean enough to construct fishing reefs; and

(b) To have trustworthy information about contaminant levels in fish caught for subsistence and recreational purposes that the Trustees can pass on to the public.

Due to the involvement of the U.S. EPA in the minimization of public exposure to DDTs and PCBs through fish consumption, the U.S. EPA is also involved in this analysis of contaminant levels in sports fish. Throughout the plan, areas which are described as for public information purposes will be jointly supported by the U.S. EPA and the Trustees.

1.3.2 Importance of Accurate Data

Since both major restoration projects and wide-scale public health efforts are dependent on these data, every effort will be made to ensure the collection of accurate data that provide a suitable confidence level for decision-making. Past studies in the area have been questioned for inaccurate chemical analyses and insufficient determination of individual variability in fish (SMBRP, 2000). Therefore, extensive quality assurance and quality control (QA/QC) mechanisms have been built into this sampling plan. Individual fish analysis has also been built into the plan in order to develop a high confidence level in the measured average and extreme contaminant concentrations in fish.

1.4 Sampling Plan Design

1.4.1 Goals for Design

The primary goal of the sampling plan is to provide scientifically defensible measures of the current geographic extent and severity of DDT and PCB contamination in local sports and subsistence fish. This requires a logical selection of sampling locations and sampling species, as well as a thorough QA/QC plan. The rationale for each decision is discussed throughout the plan.

This plan will be used to aid in the selection of contractors for the fish collection and chemical analysis efforts. The requirements for the collectors and laboratories are described in detail in this plan in order to allow them to make informed bids on these portions of the project.

1.4.2 Plan Development Process

The plan was developed with the assistance of a scientific review board, who provided key information and guidance throughout the entire process. The review board consists of a wide selection of public- and private-sector individuals with expertise specific to the Southern California coastal areas and experience in key technical areas necessary to the development of the plan. A full list of the scientific review board is provided as { REF _Ref9684978 \h * MERGEFORMAT }. In particular, many of these individuals represent the organizations that have been conducting sampling in Southern California over the past twenty-five years, and they bring an in-depth knowledge of the problems and complications faced during sampling over that time.

1.4.3 Format of the Sampling Plan

The body of the sampling plan is divided into three sections. The first outlines the species and site locations to be sampled and analyzed, the second discusses the sampling procedures, and the third outlines the analytical procedures. The second and third sections in particular discuss the QA/QC requirements for this sampling effort.

1.4.3.1 Sampling Design (Section 2)

This section specifies target species, sampling locations, timing of sampling, the types and numbers of target species for collection, chemicals of potential concern, and the chemical analysis plan. The project consists of a single round of fish collection, followed by an initial analysis round and further rounds of adaptive analysis based on initial results. While it is possible that additional rounds of fish collection may be undertaken by the Trustees, such efforts are outside the scope of this plan.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 } Members of the Scientific Review Board for the Montrose Settlements Fish Sampling Program	
Name	**Organization**
M. James Allen	Southern California Coastal Water Research Program (SCCWRP)
Richard Ambrose	UCLA Department of Environmental Health Sciences
Ralph Appy	Port of Los Angeles
Ann Bailey	EcoChem
Dennis Bedford	California Dept. of Fish and Game (DFG)
Robert Brodberg	California Office of Environmental Health Hazard Assessment (OEHHA)
Pam Castens	Montrose Settlements Restoration Program
John Cubit	NOAA Damage Assessment and Restoration Program
Mark Gold	Heal the Bay
Rich Gossett	CRG Laboratories
Michelle Horeczko	Pacific States Marine Fisheries Commission
Joe Meistrell	Los Angeles County Sanitation District (LACSD)
Dave Montagne	LACSD
Harvey Motulsky	GraphPad
Ken Nielsen	SeaVentures
Fred Schauffler	U.S. EPA
Steve Schroeter	UCSB Marine Science Institute
Jan Stull	LACSD (retired)
Alyce Ujihara	California Dept. of Health Services (DHS)
Patty Velez	California DFG
Guang-Yu Wang	Santa Monica Bay Restoration Project

1.4.3.2 Field Operations (Section 3)

The field operations section describes the required field sampling methods and procedures for handling, preserving, and transporting fish samples collected in the field, as well as related QA/QC procedures. Detailed standard operation procedures (SOPs) will be developed with input from the contractor(s) selected to perform the fish collection work. These SOPs will conform with all requirements described in this sampling plan. This approach will enhance sampling efficiency and effectiveness by avoiding arbitrary changes to collectors' normal procedures in circumstances where more than one procedure can meet Trustee requirements. The sampling procedures outlined within the section were developed based on Trustee field experience and input from fish collectors, laboratory personnel, and scientists experienced with the Southern California Bight. The procedures include the precautions to be taken to ensure

accuracy in species location and identification, the minimization of cross-contamination, and proper record keeping.

1.4.3.3 Chemical Analysis (Section 4)

This section outlines the guidelines for the laboratory procedures to be followed for preparation and contaminant analysis of the collected fish. Considerations for laboratory selection, sample preparation (dissection and homogenization), sample handling, analytical methods, and data validation are included. Detailed laboratory SOPs will be developed with input from the laboratory(ies) selected to perform the analysis work. A detailed Quality Assurance Project Plan (QAPP) will be developed at the same time, consistent with the requirements outlined in this plan and finalized laboratory SOPs.

2 SAMPLING DESIGN

The following sub-sections identify and describe species selection, sampling location selection, timing of sampling, the types and numbers of target species for collection, chemicals of potential concern, and the contaminant analysis plan.

2.1 Identification of Target Fish Species

The selection methodology for target fish species is specified in the following section. Overall, 22 species and 3 species groups will be targeted for collection (7 soft-bottom, 7 hard-bottom, 6 hard/soft-bottom, 5 pelagic). The rationale for their inclusion in the target list is described in the following sections. The Trustees note that, consistent with the adaptive analysis approach utilized in this study (see Section { REF _Ref9307284 \r \h * MERGEFORMAT }), only a subset of collected fish will be analyzed for contaminants. Collection of fish samples from a broad set of species will, however, provide important analytical flexibility.

2.1.1 Species Selection Process

The following factors were considered as part of the fish species selection process:

(a) *Shore-based and boat-based biomass of each species caught by recreational and subsistence anglers* – Target species should include those frequently caught by anglers;

(b) *Biomass of each species caught per angler trip* – Consideration should be given to species that may rank low in total biomass caught, but represent a high proportion of the catch for sub-populations of anglers targeting these species;

(c) *Fishing advisories* – Collection of species included in DDT- and/or PCB- based consumption advisories will allow for current assessment of contaminant levels in these fish and evaluation of spatial gradients in contamination;

(d) *Historical fish contamination data* – Historical data from the study area may identify additional species (other than those included in fishing advisories) likely to have elevated levels of DDTs and PCBs (and species for which data are lacking); and

(e) *Likelihood that the species would be attracted to artificial reefs* – For this study, it is important to determine contamination levels in the types of species that would inhabit artificial reefs.

Sources of information on fishing and contamination were analyzed as part of the evaluation of these factors. Data compiled from the Pacific States Marine Fisheries Commission's Recreational Fishing Information Network (RecFIN) were used to estimate the angler trips and biomass of various species caught from shore and by boat (within three miles of

shore) by anglers at each RecFIN sampling site within the study area.[1] Angler intercept studies and population-level fishing estimates were analyzed over the 1996-2000 period. All numbers used are an estimate for the five-year plan. RecFIN data utilized in this analysis are included in Appendix A. In this plan, RecFIN-based estimates are reported to the nearest kilogram or trip.

Fish advisories established by the state of California (see Appendix B), along with historical fish contamination data sets in the study area (*e.g.*, CFCP 2001, LACSD 2000, QEA 2000, TSMP 1995, Allen and Cross 1994, SCCWRP *et al.* 1992, and Pollock 1991) provide information considered in the species selection process. Input from experienced fishermen and biologists familiar with the study area was utilized to help address limitations associated with available data.

2.1.2 Target Fish Species - Reef Purposes

Exhibit { REF _Ref9392188 \r \h * MERGEFORMAT } identifies target species and summarizes information used in the selection process. Species identified in { REF _Ref2570140 \h * MERGEFORMAT } with an "R" in the "Primary Study Objective" column are important to catch for potential reef siting purposes. To meet this objective, the Trustees must identify locations with high DDT and/or PCB levels in soft-bottom fish that could be "replaced" by less contaminated hard-bottom or hard/soft-bottom fish that would inhabit an artificial reef. As indicated in { REF _Ref2570140 \h * MERGEFORMAT }, all seven target soft-bottom species have shore-based Los Angeles County catches of more than 5,000 kilograms between 1996 and 2000. This level of catch is sufficient to provide several thousand meals of fish to anglers and their families per year. Several of these target soft-bottom species are nocturnal feeders, and so biomass catch data may be undercounted by RecFIN.[2] Non-commercial boat-based catch (0 to 3 miles offshore) also was considered to ensure inclusion of species frequently caught by boat-based anglers.

Data addressing species-specific biomass caught per angler trip were evaluated, but did not indicate enough variation to merit changes to the target list. For Los Angeles County, RecFIN data indicate that anglers collected an average of approximately 0.35 kg of fish per species they successfully caught, per trip. Catch per angler trip was higher than this average for some species, but was less than 0.8 kg for all but two species (striped mullet and zebra perch). However, these two species were very infrequently found during RecFIN angler surveys (only 13 and 9 anglers, respectively, during five years of surveys in all of Los Angeles County). In addition, catch per angler trip calculations are difficult to interpret, as they do not account for the possibility that reported catch may be consumed by multiple people.

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[1] Because these estimates are extrapolations based on sampling data, there is uncertainty associated with them; available information from RecFIN is not sufficient to quantify this uncertainty.

[2] For safety reasons, RecFIN intercept surveys are not conducted after dark. As a result, RecFIN may understate species catch totals for those species caught at night. However, experienced fishermen and biologists note that nocturnal feeding fish may still take bait presented to them during the day; thus, the magnitude of potential understatement is uncertain.

From a contamination standpoint, historical data indicate that soft-bottom-feeding fish generally have the highest levels of DDTs and PCBs in the study area. { REF _Ref9251752 \h * MERGEFORMAT } and Exhibit 2-3 plot DDT levels in fish fillets from LACSD (fifteen years) and Pollock (1991) according to sampling location. Three of the target soft-bottom species (white croaker, California corbina and queenfish) are the subject of state consumption advisories established for specific sites within the study area. Other target soft-bottom species (jacksmelt, yellowfin croaker and shovelnose guitarfish) were not tested as part of the study on which consumption advisories are based, but utilize feeding modes similar to those used by fish known to be highly contaminated. To address this data gap, these species are included in the target list. Finally, based on RecFIN data, jacksmelt and California halibut are caught in relatively large numbers by anglers in the study area (particularly boat-based anglers for halibut); for that reason it is important to obtain current information about contaminant levels in those species.

For reef purposes, it also is necessary to collect and analyze fish that are likely to inhabit artificial reefs. All of the hard-bottom and hard/soft-bottom species identified in { REF _Ref2570140 \h * MERGEFORMAT } meet this criterion, based on Allen, 2001. The particular species most likely to inhabit a reef will vary with reef location, type of reef and other factors; by targeting a relatively broad number of reef species for collection, the Trustees will maximize flexibility during the chemical analysis phase of this program.

As indicated in { REF _Ref2570140 \h * MERGEFORMAT }, the Trustees group the large number of surfperch species into two complexes, based on similar feeding modes (and therefore likely similar contaminant profiles). Collection requirements described later in this plan can be met by catching any combination of surfperch species included in the specified complex. The "BF" (benthic feeding) surfperch complex includes white seaperch, barred surfperch, calico surfperch, pile perch, black perch, rainbow seaperch, dwarf perch, striped seaperch and rubberlip seaperch. The "WCF" (water column feeding) surfperch complex includes walleye surfperch, silver surfperch, spotfin surfperch, shiner perch and kelp perch. The choice of species to include in each complex is based on species-specific foraging mode information provided in Allen, 2002.

Finally, the Trustees group all rockfish into a single complex, except for California scorpionfish (which has its own category) and blue rockfish (which will not be analyzed as part of this sampling plan). California scorpionfish are kept separate because they typically forage in soft-bottom habitats more frequently than other species of rockfish (and so may be more contaminated). Blue rockfish are diurnal, tend to forage on nekton (e.g., fish, zooplankton, and squid), and so are likely to be lower in contamination than other rockfish species (which feed more frequently on benthos). As a result, blue rockfish are not included in the rockfish complex defined for this study. Rockfish species-specific foraging mode information was obtained from Allen, 2002.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

Summary of Target Species, Catch in Los Angeles County 1996-2000 and Selection Considerations

Species	Considerations for inclusion[1]						
	Shore Biomass (kg)	Boat Biomass (kg)	Total Biomass (kg)	Likely attracted to reefs	Nocturnal feeders[5]	Fishing Advisory	Primary Study Objective[6]
HARD-BOTTOM SPECIES							
Opaleye	36,656	26,312	62,968	✓			R
Sargo	8,515	6,391	14,906	✓	✓		R
Kelp Bass	7,275	373,561	380,836	✓		✓	B
Surfperches- BF[2]	29,277	214,187	243,464	✓		✓	B
Surfperches - WCF[3]	3,825	314	4,139	✓		✓	B
Rockfishes[4]	720	113,340	114,060	✓		✓	B
California Sheephead	2,337	117,649	119,986	✓			R
HARD/SOFT-BOTTOM SPECIES							
Topsmelt	8,844	40	8,884	✓			R
Barred Sandbass	5,830	464,870	470,700	✓			R
Halfmoon	2,807	67,808	70,615	✓			R
California Scorpionfish	1,231	161,697	162,928	✓	✓	✓	B
White Seabass	3,179	187,506	190,685	✓	✓		R
Black Croaker	1,095	609	1,704	✓	✓	✓	B
PELAGIC SPECIES							
Chub Mackerel	210,425	282,497	492,922				P
Pacific Sardine	11,709	253	11,962				P
Pacific Bonito	7,651	78,441	86,092				P
Pacific Barracuda	1,709	1,102,716	1,104,425				P
Yellowtail	0	644,250	644,250				P
SOFT-BOTTOM SPECIES							
White Croaker	50,187	68,081	118,268		✓	✓	B
Jacksmelt	27,735	4,334	32,069				R
Yellowfin Croaker	21,442	4,482	25,924		✓		R
California Corbina	15,133	578	15,711		✓	✓	B
California Halibut	15,009	435,749	450,758				R
Shovelnose Guitarfish	13,458	19,813	33,271		✓		R
Queenfish	6,928	2,607	9,535		✓	✓	B

[1] Biomass estimates are developed from RecFIN data and Fishing Advisories are as reported by OEHHA. Shore is all fishing from shore-based modes (beach/bank/pier) and Boat is boat-based modes 0-3 miles from shore. Species are grouped according to their habitats (based on information presented in Allen, 2001).

[2] The "Surfperches - BF" complex includes the following benthic feeding species of surfperch: white seaperch, barred surfperch, calico surfperch, pile perch, black perch, rainbow seaperch, dwarf perch, striped seaperch and rubberlip seaperch.

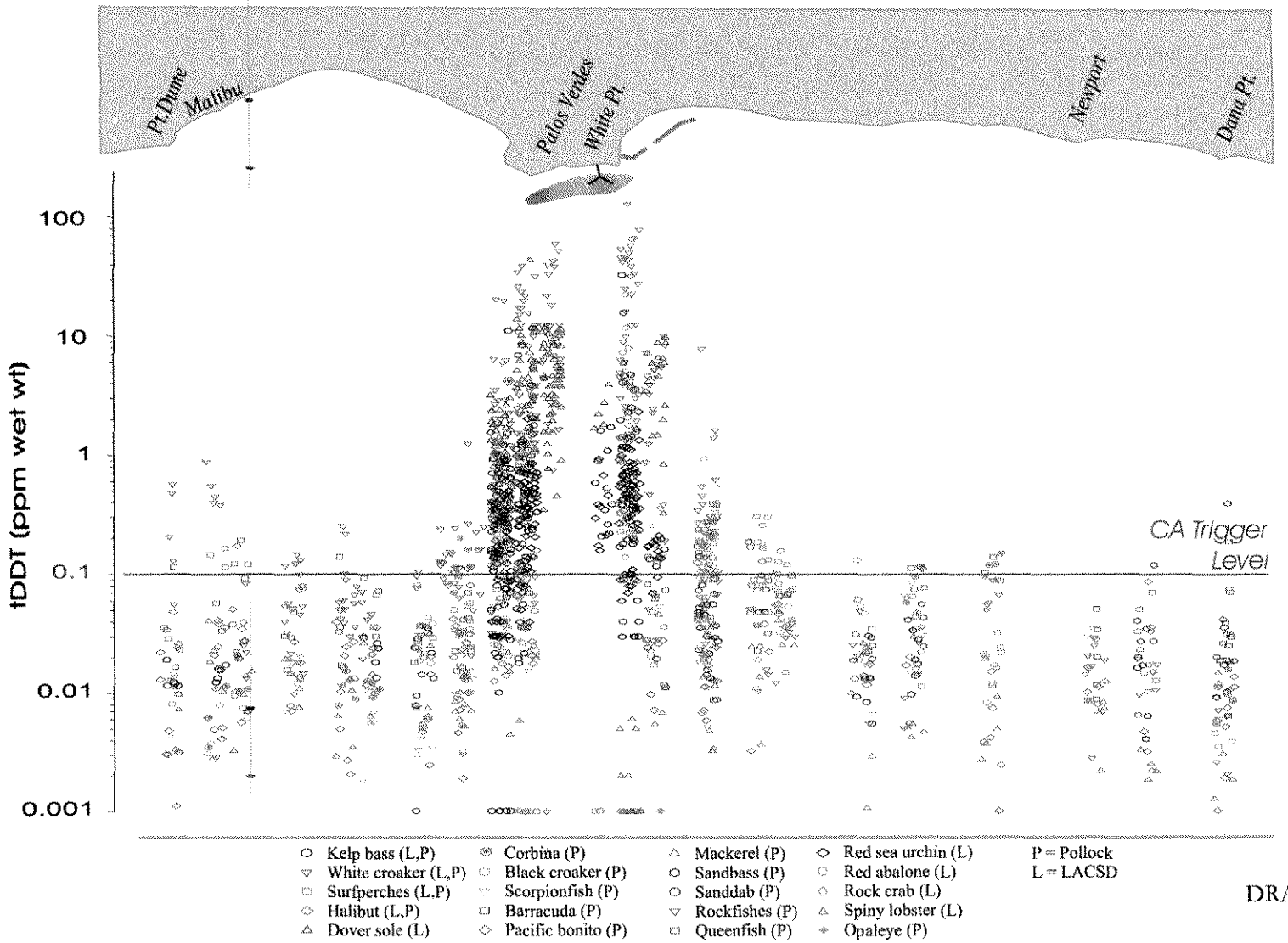
[3] The "Surfperches - WCF" complex includes the following water column feeding species of surfperch: walleye surfperch, silver surfperch, spotfin surfperch, shiner perch and kelp perch.

[4] The "Rockfishes" complex includes the entire *Sebastes* genus EXCEPT California Scorpionfish (which has its own category) and blue rockfish (which will not be analyzed as part of this sampling plan).

[5] As described in the text, this category is included because RecFIN data do not include night catch. As a result, RecFIN data may undercount total catch for nocturnal feeders commonly caught in the evening.

[6] As described in the text, an "R" in this column indicates that the species is an important indicator species for potential reef siting purposes. A "P" in this column indicates that the species is particularly important for public information purposes. A "B" indicates that the species is important for both purposes.

Geographical Patterns of tDDT in Fish Fillet and Shellfish 1980-1995 *(Log Scale of tDDT)*



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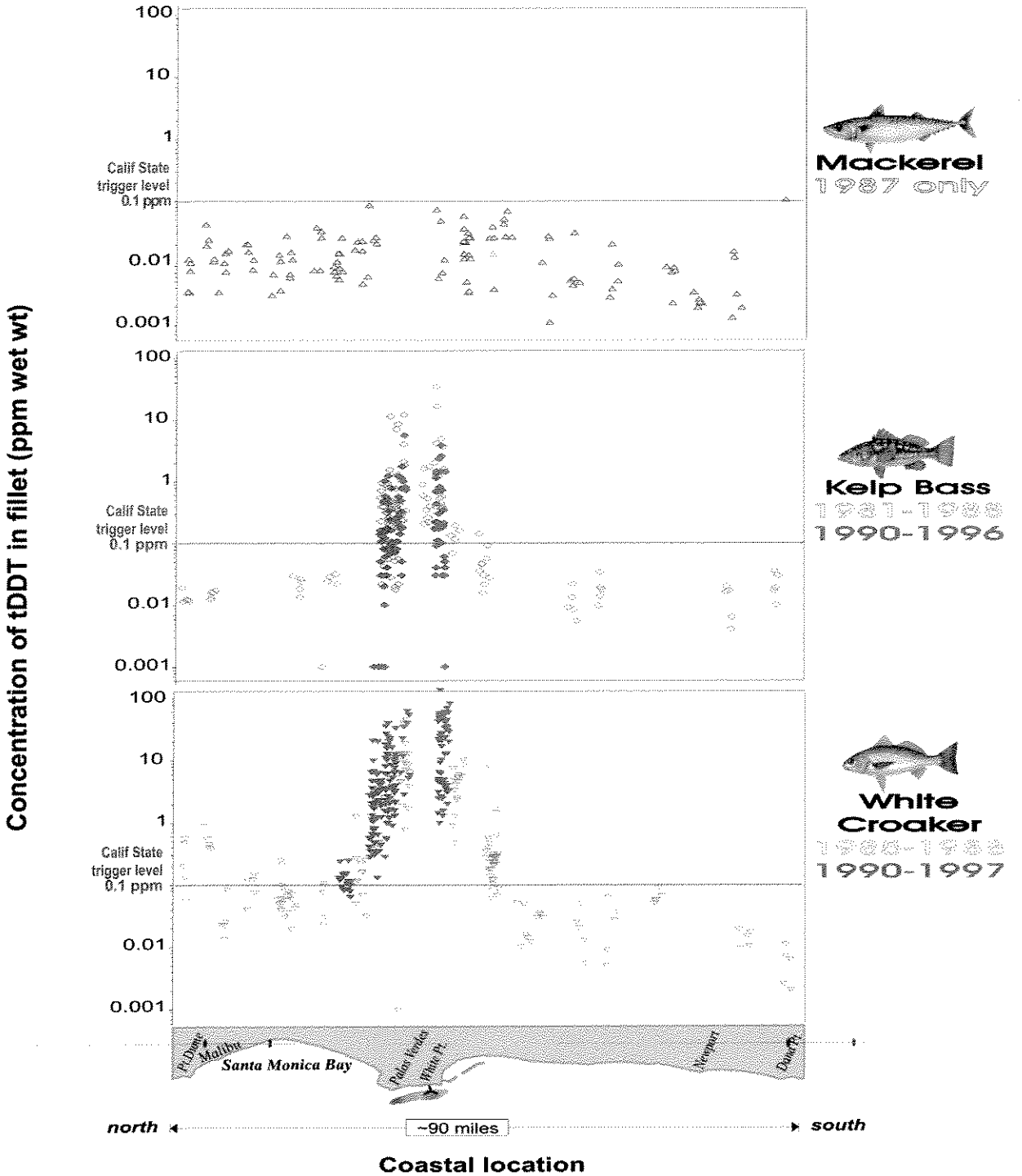
DDT in Fish Fillet between Malibu and Dana Point



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2.1.3 Target Fish Species – Public Information Purposes

Species identified in { REF _Ref2570140 \h * MERGEFORMAT } with a "P" in the "Primary Study Objective" column are important to catch for public information purposes. While all data collected for this project will have public information value, certain species are particularly important for this purpose. For example, all species that are the subject of DDT- and/or PCB-based fishing advisories established by the state of California in the study area are included in the target list. Species that are highly caught from shore in particular segments (defined as greater than 10% of the total county catch of that species) are included. Also, for locations commonly used by boat-based anglers, we include species in the top 10% of Los Angeles County offshore (0-3 mile) catch. Current information on contaminant levels in these fish can help anglers make informed decisions about where to fish, what to catch, and contaminant exposure associated with fish consumption.

The pelagic species on the target list are included because they are caught in relatively large amounts by recreational and subsistence anglers, and there is limited recent information available characterizing DDT and PCB levels in these fish. Since many pelagic species forage over broad areas, the Trustees expect that contaminant levels will be relatively low and exhibit limited variability within the study area. Available historical data support this assumption (see Exhibits 2-2 and 2-3). As a result, the Trustees expect to limit chemical analysis of pelagic fish in the initial rounds of the adaptive analysis program (see Section { REF _Ref9307284 \r \h * MERGEFORMAT }). To the extent initial contaminant test results confirm Trustee expectations, further testing will not be required. Alternatively, additional samples can be analyzed if contaminant levels are found to exceed relevant thresholds.

For public information purposes, it is important to ensure that other species commonly caught by anglers are collected by the Trustees. Overall, the target species/species groups identified in { REF _Ref2570140 \h * MERGEFORMAT } include the ten species of fish most frequently caught (on a biomass basis) from Los Angeles County shore-based locations between 1996 and 2000, and 19 of the top 20 (based on RecFIN data). The target list also includes the five species most frequently caught by Los Angeles County boat-based anglers within three miles of shore between 1996 and 2000, and nine of the top ten (also based on RecFIN data).

2.1.4 Target Fish Species – Both Purposes

Species that meet both public information and reef selection criteria are indicated with a "B" in { REF _Ref2570140 \h * MERGEFORMAT }.

2.2 Identification of Sampling Locations for Collection of Fish

{ REF _Ref9251828 \h * MERGEFORMAT } provides overview maps of sampling segments. The first map in the exhibit shows the entire study area, with areas marked as described within this section. This map does not identify individual sampling segments, but shows the northern and southern boundaries of sampling and general areas particularly important for reef purposes (labeled with an "R") and for public information purposes (labeled with a "Ck"). Three submaps (A, B and C, included as part of { REF _Ref9251828 \h *

MERGEFORMAT }) specify the approximate boundaries of sampling segments from which fish will be collected. Latitude and longitude coordinates, compass headings, visual reference points and similar data will be provided to fish collectors to more precisely define segment boundaries for their needs. Descriptions of each segment and factors considered in segment selection are provided in the following sections of this document.

As indicated in { REF _Ref9251828 \h * MERGEFORMAT }, fish collectors will be required to catch target fish from specified sampling segments, rather than specific sites (*i.e.*, individual piers and jetties). While consumption advisories established by OEHHA (Pollock *et al.* 1991) target particular species at very specific locations, this site-based approach makes it difficult for anglers who fish at multiple sites to evaluate health risk implications of changes in their fishing patterns. For the purposes of this sampling plan, the Trustees define sampling segments that encompass multiple individual sites, and so will provide information applicable to various sites within a segment. The data used to identify sampling segments and define segment boundaries are described below. { REF _Ref9251872 \h * MERGEFORMAT } summarizes key information for each segment.

2.2.1 Geographic Extent of Sampling Area

Sampling locations were considered within an area bounded by Ventura to the north and Dana Point to the south. Scientific studies, including those conducted as part of the Montrose litigation (*e.g.*, QEA 2000), determined that fish (and other biota) within this area are exposed to DDT and PCB contamination released by Montrose and other defendants bound by the litigation and resulting settlement. While elevated levels of DDTs and PCBs may exist in other regions, sampling of those areas is outside the scope of this effort.

2.2.2 Segment Selection Process

Several factors were considered as part of the segment identification and selection process:

(a) *Fishing pressure at shore-based fishing locations* – Among other considerations, it is important to define and include segments that capture locations frequently used by recreational and subsistence anglers.

(b) *Biomass of target species caught at shore-based fishing locations* – RecFIN data indicate substantial differences between sites in the types and amounts of fish caught by shore-based anglers. Selected sites include those with historically large catches of targeted species.

(c) *Site-specific fishing advisories* – The state of California has established several site specific fishing advisories in the study area based on DDT and PCB contamination levels in fish. Sites specified in these advisories (along with neighboring sites) will be included to provide updated data on fish contaminant levels in these areas.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

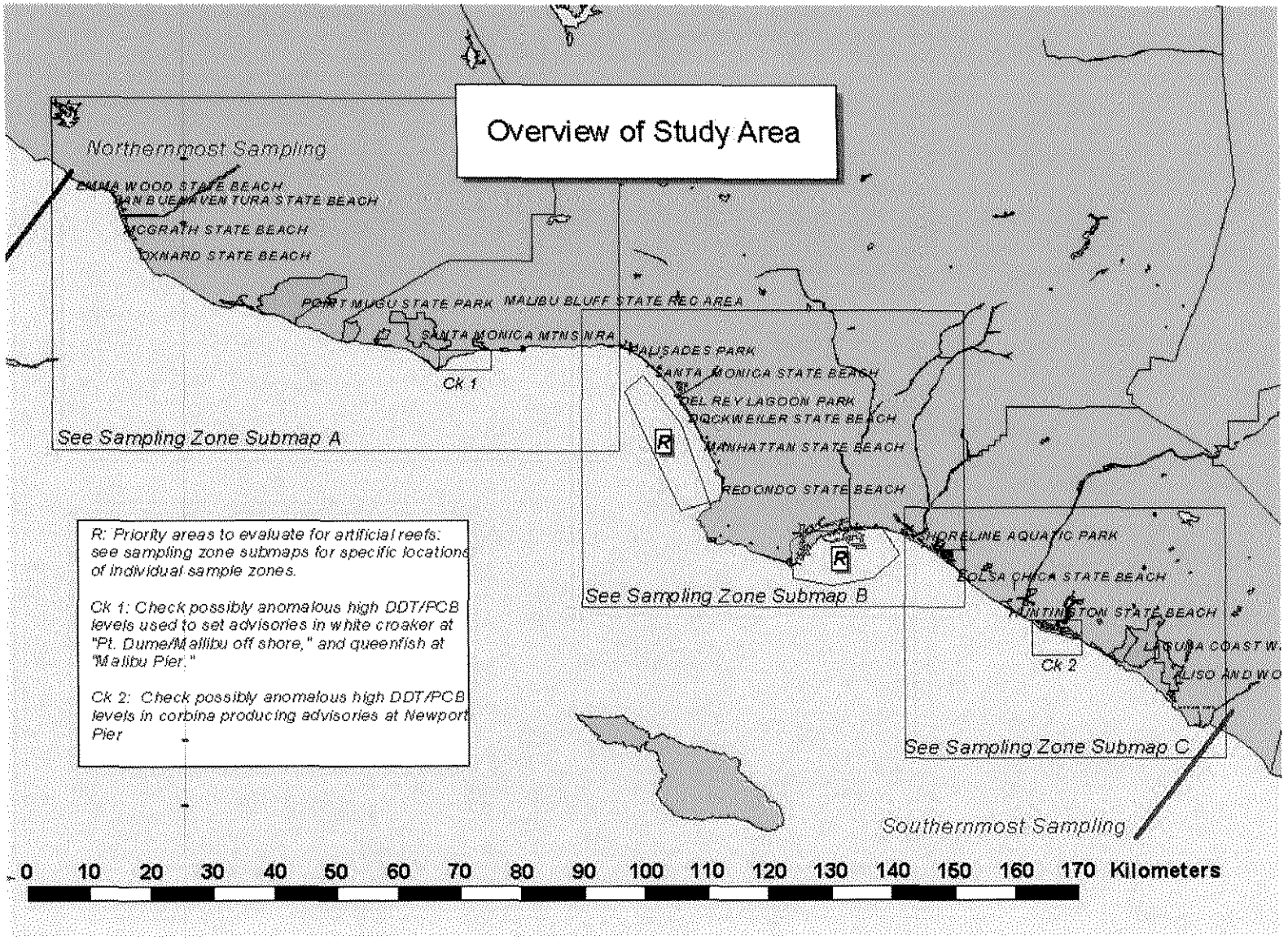
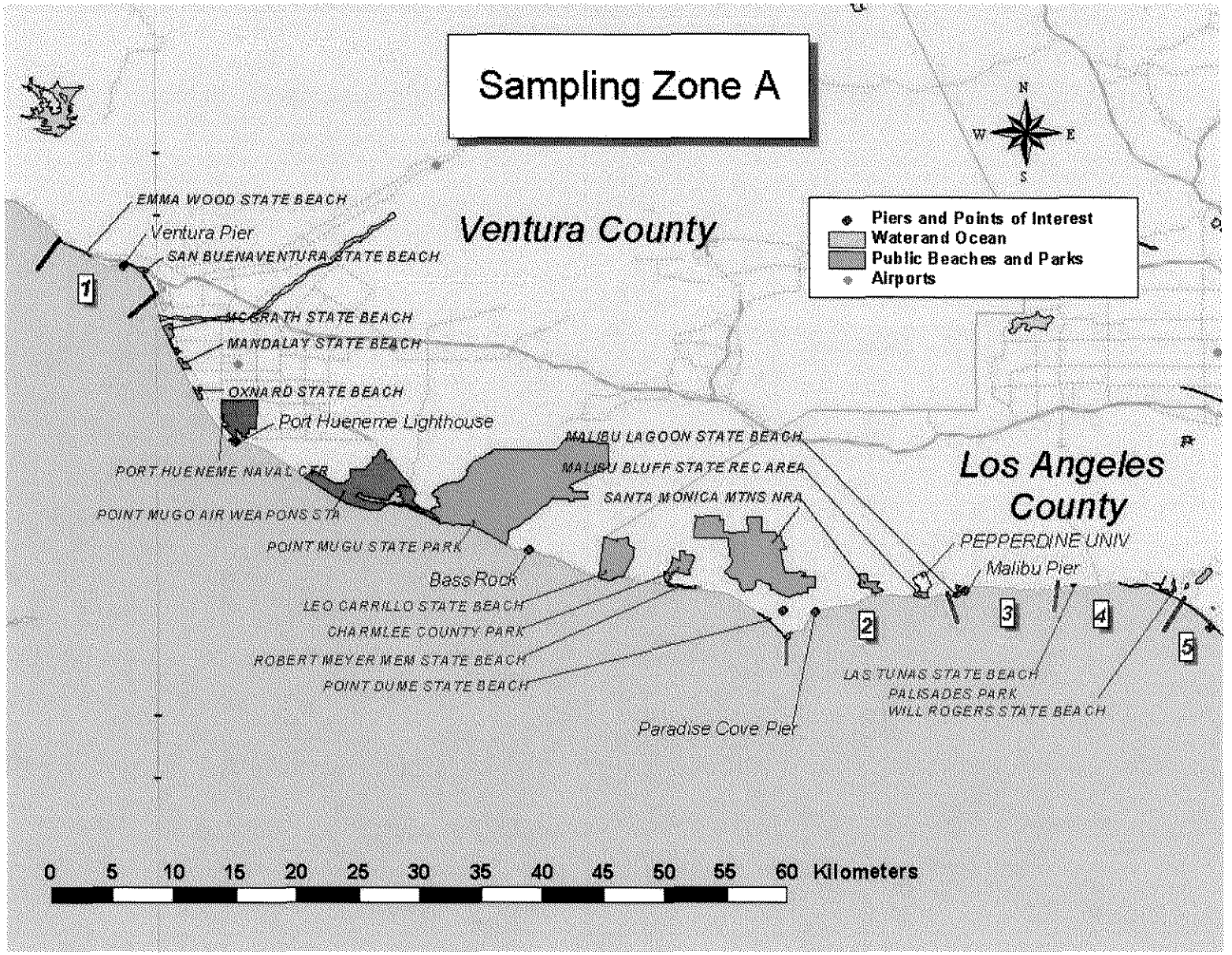


Exhibit 2-4 (continued)



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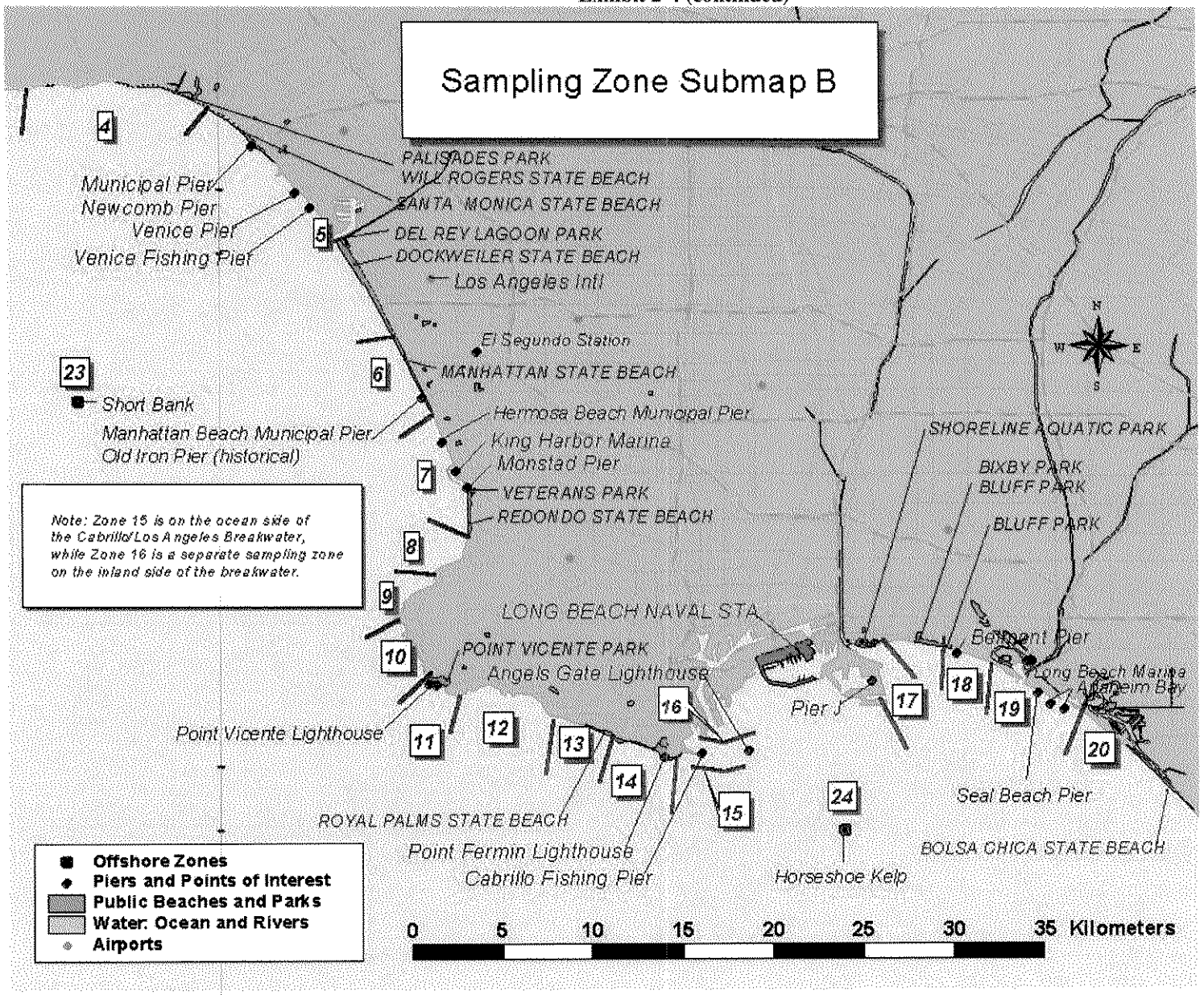

Exhibit 2-4 (continued)

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(d) *Fishing pressures and catch rates at offshore locations:* Data on fishing pressures and catch rates from CPFVs (commercial passenger fishing vessels) from RecFIN and the California DFG was used to identify locations commonly fished by boat-based anglers.

(e) *Historical DDT and PCB contamination data* – Historical gradients in DDT and PCB contamination within the study area were considered to help determine the sampling density needed for shoreline fishing locations. Areas characterized by relatively constant or slight changes in contamination levels require a lower sampling density than areas characterized by variable or rapid monotonic changes in levels. Evaluation of historical information also helps identify spatial gaps in fish contamination data and additional areas with elevated DDT and PCB levels.

(f) *Commercial Catch Ban* – The U.S. EPA currently maintains a commercial catch ban for white croaker in parts of the Palos Verdes Shelf and adjacent areas. The edges of this ban, both nearshore and offshore, will be tested to determine whether the ban should be expanded or contracted.

Several sources of information were analyzed as part of the evaluation of these factors. RecFIN data were used to estimate site-specific fishing pressure, species and biomass catch from shore-based locations (piers/man-made structures, beaches, and banks) in the study area (see Appendix A for the RecFIN data used in the site selection process). Information on catch and fishing location from commercial passenger fishing vessels obtained from the California DFG was used to identify off-shore fishing locations. Contaminant studies performed in previous years (*e.g.*, CFCP 2001, LACSD 2000, QEA 2000, TSMP 1995, Allen and Cross 1994, SCCWRP *et al.* 1992, Pollock *et al.* 1991) provide information about historical spatial gradients of DDT and PCB contamination in fish (and other media). As described above, information from state of California fishing advisories in the study area was included in the site selection process.

2.2.3 Selected Sampling Segments - Reef Purposes

As indicated in { REF _Ref9251828 \h * MERGEFORMAT }, for potential reef siting purposes fish will be collected from multiple sampling segments within two general areas. The first area includes the nearshore waters (less than 30m depth) between Flat Rock Point (northwestern Palos Verdes) and Santa Monica beach. The second area includes the nearshore waters between the ocean side of the Cabrillo/LA breakwater and Alamitos Bay. These areas were selected for reasons described below. A summary of the segments is presented in Exhibit 2-5.

Historical data identify relatively steep declines in soft-bottom and reef fish DDT and PCB levels in these areas (see { REF _Ref9251752 \h * MERGEFORMAT } and Exhibit 2-3). The Trustees expect that collection and chemical analysis of fish from sampling segments within these areas will identify locations where contaminant levels in reef fish are sufficiently low and contaminant levels in soft-bottom feeding sufficiently high to merit further evaluation of this potential restoration approach.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }
Summary of Nearshore Segments for Fish Sampling and Selection Considerations

Segment	Segment Boundaries[1]	RecFIN Sites Included in Segment[2]	5 Year Angler Trip Estimate[3]	5 Year Target Species Catch[3] (kg)	Fishing Advisory[4]	Primary Study Objective[5]
1	Ventura: Emma Wood Beach to San Buenaventura Beach	103, 213, 219, 302, 305	375,236	75,070		P
2	Pt. Dume to West End of Malibu Lagoon Beach	314[6]	4,984	1,073		P
3	West End of Malibu Lagoon Beach to Las Flores	None[6,7]	N/A	N/A	✓	P
4	Las Flores to West End of Santa Monica Beach	None[6]	N/A	N/A		P
5	Santa Monica Beach to El Segundo	10, 12, 35, 305, 315[8]	286,571	52,208		R
6	El Segundo to the South End of Manhattan Beach	316[8]	18,274	13,723		R
7	King Harbor Area: South End of Manhattan Beach to Redondo Beach	303, 306, 308[8]	295,431	105,619	✓	R
8	Redondo Beach to Flat Rock Pt.	None[8]	N/A	N/A		R
9	Flat Rock Pt. to Palos Verdes Pt.	None	N/A	N/A		P
10	Palos Verdes Pt. to Pt. Vicente	None	N/A	N/A	✓	P
11	Pt. Vicente to Long Pt.	27	5,538	0	✓	P
12	Long Pt. to Bunker Pt.	205	4,984	1,930	✓	P
13/ 14	Bunker Pt. to Pt. Fermin, including White Point	206	34,056	15,022	✓	P
15	Cabrillo/LA Breakwater: Ocean Side	None	N/A	N/A	✓	R
16	Cabrillo/LA Breakwater: Inland Side	110, 309	254,176	97,567	✓	R
17	Pier J to Finger Piers/Shoreline Park	201, 202	293,493	63,029	✓	R
18	Belmont Pier/ Seaport Village	204, 402	346,100	94,043	✓	R
19	Seal Beach: Alamitos Bay Jetties to Anaheim Bay	105, 214, 311, 301, 306, 307	214,210	31,223		R
20	West End of Sunset Beach to Huntington Beach (Hwy. 39)	201, 302[9]	86,607	23,862		P
21	Huntington Beach (Hwy. 39) to Pelican Pt.	106, 111, 203, 211, 303, 304, 309[9]	344,213	120,259	✓	P
22	Dana Pt.: East End of Mussel Cove to East End of Doheny Beach	313[10]	3,597	877		P

[1] Segment names are intended to provide the reader with approximate indications of segment boundaries. Fish collectors will be provided with precise segment boundaries based on latitude and longitude coordinates, fixed physical reference points, depths and similar data.

[2] RecFIN sites included wholly within a segment are identified below. Note that RecFIN site numbers are county-based; in some cases, the same site number is used in different counties (and refers to different sites). See Appendix A for more information about RecFIN data.

[3] Angler trip estimates and species catch estimates are from the RecFIN database for 1996-2000. "N/A" indicates that RecFIN does not collect data from any sites within that particular segment.

[4] Fishing advisories are as reported by OEHHA: a ✓ indicates a segment with a site-specific advisory within its boundary.

[5] An "R" in this column indicates that the species is particularly important for potential reef siting purposes. A "P" in this column indicates that the species is particularly important for public information purposes.

[6] RecFIN site 209 extends across Segments 2, 3 and 4. RecFIN data indicate that 50,115 angler trips were taken and 12,435 kg of target fish caught at this site between 1996 and 2000.

[7] RecFIN began collecting data at Malibu Pier in 2000, but these data are not yet available.

[8] RecFIN site 210 extends across Segments 4, 5, 6, 7 and 8. RecFIN data indicate that 30,457 angler trips were taken and 12,474 kg of target fish caught at this site between 1996 and 2000.

[9] RecFIN site 202 extends across Segments 20 and 21. RecFIN data indicate that 41,228 angler trips were taken 3,256 kg of target fish caught at this site between 1996 and 2000.

[10] RecFIN sites 206 and 207 are partly included in Segment 22. RecFIN data indicate that 83,010 angler trips were taken and 10,018 kg of target fish caught at these sites between 1996 and 2000.

The Trustees considered other sampling areas for reef placement purposes, but expect them to be substantially less suitable. At the "central" portion of the Palos Verdes shelf (approximately from Pt. Fermin to Palos Verdes Point), for example, historical data indicate that DDT and PCB levels in reef fish generally are above state of California trigger levels (see Exhibits 2-2 and 2-3). In addition, EPA sediment capping activities conducted on the Palos Verdes shelf as part of Superfund remediation activities may result in disturbances that reduce the viability of reef placement in this area. Finally, there already are substantial areas of rocky habitat on the Palos Verdes shelf. The Trustees expect the incremental benefit associated with expanding reef habitat in this area to be low.

The Trustees also considered areas northwest of Santa Monica and southeast of Anaheim Bay for reef placement purposes. However, historical data suggest that areas closer in to the Palos Verdes Shelf will have contaminant levels in reef fish below the State of California trigger levels, making the sites further from the damaged areas unlikely reef candidates (see Exhibits 2-2 and 2-3). In addition, fishing pressure is generally lower in areas outside the reef sampling segments designated in this plan. While the Trustees are not ruling out consideration of potential reef sites outside the reef sampling segments identified in { REF _Ref9251828 \h * MERGEFORMAT }, the Trustees will focus this sampling effort on areas close to Palos Verdes.

Finally, while reef placement may be considered in areas further offshore, such locations are lower priority because they would be less accessible to shore-based anglers, particularly those who lack the income needed to maintain regular access to boats and/or are otherwise unable to regularly participate in boat-based fishing trips. In addition, boat-based anglers have more flexibility in selecting fishing locations than shore-based anglers, given access limitations from shore. By providing boat-based anglers with updated contamination data for fish caught at various off-shore fishing locations, these anglers can make better decisions about where they choose to fish.

Nine sampling segments have been identified for reef placement purposes. Several of these are relatively short in length (a few kilometers long); all are less than ten kilometers long. In general, these segments are smaller than those defined for public information purposes (described in Section { REF _Ref9247004 \r \h * MERGEFORMAT }). This is because DDT and PCB levels in soft-bottom feeding fish and reef fish decline rapidly to the north and south of Palos Verdes (see Exhibits 2-2 and 2-3). In areas of rapidly changing contaminant levels, dense sampling (*i.e.*, smaller segments) is required to identify areas suitable for reef placement with sufficient precision.

In addition, particularly within LA Harbor, fishing pressure is substantial at several discrete locations within several kilometers of each other (*e.g.*, Pier J, Belmont Pier, Alamitos Bay/jetties and Seal Beach Pier). Narrowly defined sampling segments will provide the Trustees with the flexibility to evaluate differences in fish contamination levels (if any) between these areas. The adaptive analysis program (see Section { REF _Ref9307284 \r \h * MERGEFORMAT }) will allow the Trustees to perform such evaluations in a step-wise, cost-effective manner.

Although generally contiguous, there are some gaps between reef sampling segments identified in LA Harbor. These "gaps" correspond to certain shoreline areas (*e.g.*, the U.S. Naval Reservation) that are not accessible to anglers and/or otherwise clearly not suitable for reef placement. Brief descriptions of the nine reef sampling segments in the study area are provided below. As described in Section { REF _Ref9307284 \r \h * MERGEFORMAT }, selected fish from five of these segments (segments 7, 15, 16, 17 and 18) will be analyzed for contaminants in the initial round of the adaptive analysis program. These five segments are in areas heavily fished by recreational and subsistence anglers and close to Palos Verdes. To the extent reef fish in these segments are too highly contaminated, fish collected from the remaining reef segments (5, 6, 8 and 19) will be analyzed in subsequent rounds of chemical testing.

(a) *Santa Monica Beach to El Segundo (Segment 5)* – This segment includes Santa Monica Pier and Marina del Rey and is the northernmost area for reef evaluation. Samples of reef fish are expected to be collected from the rocky habitat around Marina del Rey. Recreational and subsistence fishing activity at sites within this segment totaled 286,571 angler trips between 1996 and 2000 (based on RecFIN data).[3]

(b) *El Segundo to the South End of Manhattan Beach (Segment 6)* – This segment includes Manhattan Beach Pier. Because of its relatively northern location and low fishing pressure (18,274 angler trips between 1996 and 2000), reef fish collected from this segment also will not be tested in the initial round of chemical analysis.

(c) *King Harbor Area: South End of Manhattan Beach to Redondo Beach (Segment 7)* – This segment includes Hermosa Beach Pier, King Harbor Pier/Jetties and Redondo Beach Pier. Samples of reef fish are expected to be collected from the rocky habitat near the King Harbor breakwater. Recreational and subsistence fishing activity at sites within this segment totaled 295,431 angler trips between 1996 and 2000 (based on RecFIN data).

(d) *Redondo Beach to Flat Rock Point (Segment 8)* – Although this segment is low in fishing pressure (there are no RecFIN data within this segment), its location near Palos Verdes will provide important information about spatial contamination gradients in soft-bottom feeding fish and reef fish. Fish collected from this segment will not be tested in the initial phase of the adaptive analysis program.

(e) *Cabrillo/Los Angeles Breakwater: Ocean Side (Segment 15)* – This segment includes the nearshore waters on the ocean side of the breakwater. A separate segment has been established for the inland side of the breakwater (see segment described below). Habitat conditions, fish species and foraging patterns are expected to differ between these two areas.

(f) *Cabrillo/Los Angeles Breakwater: Inland Side (Segment 16)* - Target fish for this segment will be collected from the inland side of the breakwater. Recreational and

[3] In addition, RecFIN data indicate that 50,115 angler trips took place at various unspecified locations between Pt. Dume and Santa Monica Pier (Sampling Segments 2, 3 and 4).

subsistence fishing activity at Cabrillo Beach and the fishing pier totaled 254,176 angler trips between 1996 and 2000 (based on RecFIN data).

(g) *Pier J to Finger Piers at Shoreline Park (Segment 17)* - This sampling segment is in the nearshore waters off Long Beach, on the eastern side of Pier J. Recreational and subsistence fishing activity at sites within this segment totaled 293,493 angler trips between 1996 and 2000 (based on RecFIN data).

(h) *Belmont Pier/ Seaport Village (Segment 18)* - This sampling segment is approximately three to four kilometers southeast of Pier J, and is the southernmost segment that will be tested for reef purposes during the initial round of the adaptive analysis program. Recreational and subsistence fishing activity at sites within this segment totaled 346,100 angler trips between 1996 and 2000 (based on RecFIN data).

(i) *Seal Beach: Alamitos Bay Jetties to Anaheim Bay (Segment 19)* - This sampling segment is approximately one kilometer south of the Belmont Pier segment. Recreational and subsistence fishing activity at sites within this segment totaled 214,210 angler trips between 1996 and 2000 (based on RecFIN data).

2.2.4 Selected Nearshore Sampling Segments - Public Information Purposes

Fish will be collected from additional sampling segments in the study area for public information purposes. Additional nearshore segments (less than 30 meters depth) are identified and described below. Segments located to the north of Santa Monica and to the south of LA Harbor generally are broader than those defined for reef purposes, reflecting the Trustee expectation (based on historical data) that DDT and PCB levels exhibit limited variability in these areas (see Exhibits 2-2 and 2-3). Exceptions to this general approach include Malibu and Newport, where relatively narrow sampling segments have been established to evaluate indications of elevated contaminant levels in fish at these locations that contributed to the issuance of fish consumption advisories.

In the Palos Verdes area, sampling segments also are narrowly defined, for two reasons. First, dense sampling is required to measure rapid changes in contamination levels that occur in this area. Second, sampling segment boundaries match those used by LACSD, which will enhance comparability with their fish collection and chemical analysis efforts.

White croaker will be collected from all of the segments identified below to evaluate spatial contaminant gradients in that species. Other species collection requirements for each sampling segment are described in Section { REF _Ref9307373 \r \h * MERGEFORMAT }.

(a) *Ventura: Emma Wood Beach to San Buenaventura Beach (Segment 1)* – This sampling segment includes Ventura Pier and Marina and is the northernmost of all sampling areas in this study, approximately 50 kilometers northwest of the next closest segment (Pt. Dume to Coral Beach). Recreational and subsistence fishing activity in the Ventura segment totaled 375,236 angler trips between 1996 and 2000 (based on RecFIN data).

(b) *Pt. Dume to West End of Malibu Lagoon Beach (Segment 2)* - This sampling segment is immediately west of the Malibu segment. Although angler activity in the Pt. Dume segment is low (4,984 trips at Paradise Cove Pier between 1996 and 2000 based on RecFIN[4]), historical data indicate relatively high DDT concentrations in white croaker caught in the Malibu area (see Exhibits 2-2 and 2-3). To allow for evaluation of contamination gradients in this region, Malibu and adjacent areas have been divided into distinct sampling segments.

(c) *West End of Malibu Lagoon Beach to Las Flores (Segment 3)* - This sampling segment includes the Malibu region. No RecFIN data are available for this segment, although RecFIN began collecting data from Malibu Pier in 2000 (but no data have been released to date).

(d) *Las Flores to West End of Santa Monica Beach (Segment 4)* - This sampling segment is immediately east of the Malibu segment. Although low in angler activity (RecFIN data do not identify specific sites within this segment), fish collected from this segment will provide important comparative information with those collected from Malibu.

(e) *Flat Rock Point to Palos Verdes Point (Segment 9)* - This sampling segment has the same boundaries as LACSD Sample Zone 3 (although LACSD sampling takes place in deeper waters: 60 meters and 100 meters).

(f) *Palos Verdes Point to Point Vicente (Segment 10)* - This sampling segment is between LACSD Sample Zones 2 and 3.

(g) *Point Vicente to Long Point (Segment 11)* - This sampling segment has the same boundaries as LACSD Sample Zone 2.

(h) *Long Point to Bunker Point (Segment 12)* - This sampling segment is between LACSD Sample Zones 1 and 2.

(i) *Bunker Point to Point Fermin (Segment 13/14)* - This sampling segment encompasses LACSD Sample Zone 1 and the area immediately to the east of it, including White Point.

(j) *West End of Sunset Beach to Huntington Beach (Hwy. 39) (Segment 20)* - This sampling segment includes Huntington Beach Pier. It extends approximately one kilometer to the east of the Pier, where Hwy. 39 intersects the Pacific Coast Highway. Recreational and subsistence fishing activity at sites within this segment totaled approximately 86,607 angler trips between 1996 and 2000 (based on RecFIN data).[5]

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[4] In addition, RecFIN data indicate that 30,457 angler trips took place at various unspecified locations between Santa Monica Pier and Malaga Cove (Sampling Segments 5, 6, 7 and 8).

[5] In addition, RecFIN data indicate that 41,228 angler trips took place at the "Huntington Beach" RecFIN site, which extends from Huntington Beach Pier to the Santa Ana River, and so is partly in Sampling Segment 20 and partly in Sampling Segment 21.

(k) *Huntington Beach (Hwy. 39) to Pelican Point (Segment 21)* - This sampling segment includes Newport. The state has established a fish consumption advisory for corbina caught at Newport Pier. Fish collected from the Newport segment will be compared to those collected in the Huntington Beach and Dana Point segments to assess contamination gradients in this region. Recreational and subsistence fishing activity at sites within the Newport segment totaled approximately 364,826 angler trips between 1996 and 2000 (based on RecFIN data).

(l) *Dana Point: East End of Mussel Cove to East End of Doheny Beach (Segment 22)* - This sampling segment includes Dana Point, and is the southernmost of all sampling areas in this study. Recreational and subsistence fishing activity at sites within this segment totaled approximately 3,597 angler trips between 1996 and 2000 (based on RecFIN data).[6]

2.2.5 Selected Offshore Sampling Segments – Public Information Purposes

Boat-based fishing within three miles of shore is commonly practiced by local anglers. California DFG data on CPFVs and information from local fishermen regarding private boating locations indicate that many boat-based fishing locations overlap with the near-shore sampling segments defined in Section { REF _Ref9246992 \r \h * MERGEFORMAT } and { REF _Ref9247004 \r \h * MERGEFORMAT }. Specifically, segments 2, 5, 9, 10, 12, 14, 15, 16, 19, and 20 above are important for boat-based anglers, based on these data.

In addition to the segments identified above, the offshore sampling segments identified below will be sampled as part of this study. These additional segments farther offshore are selected due to their high fishing rate and past indication of contamination (Pollock *et al.* 1991 and DFG data). Offshore fishing segments included in the segments above (in sections { REF _Ref9246992 \r \h * MERGEFORMAT } and { REF _Ref9247004 \r \h * MERGEFORMAT }) were selected based on CPFV data from RecFIN and the California DFG, as well as information on private boaters from the California DHS and local fishermen. The areas necessary to determine appropriate boundaries for the white croaker commercial catch ban are also included below.

(a) *Short Bank (Segment 23)* - This sampling segment has boundaries similar to Segment 5, but is further offshore. A fish consumption advisory exists for white croaker caught within this area. While Short Bank is a large deepwater area, the sampling will be centered near the location from the Pollock *et al.* 1991 study.

(b) *Horseshoe Kelp (Segment 24)* - This sampling segment is on the ocean side of the Cabrillo/Los Angeles Breakwater, several miles east of Segment 15. A fish consumption advisory exists for white croaker and California scorpionfish caught within this area.

[6] In addition, portions of RecFIN sites 206 and 207 extend into Segment 22. RecFIN data indicate that 83,010 angler trips were taken at these sites between 1996 and 2000.

(c) *Middle Breakwater (Segment A)* – This segment approximates location 17 from the Pollock *et al.* 1991 study. The segment covers the ocean side of the middle breakwater between Los Angeles and Long Beach. Current consumption advisories exist in this location for surfperches, black croaker, white croaker, and queenfish.

(d) *Approximately 2 miles offshore of Segment 15 (Segment B)* – As specified, for evaluation of the white croaker commercial catch ban.

(e) *Approximately 5 miles southeast of Pt. Fermin (Segment C)* – As specified, for evaluation of the white croaker commercial catch ban.

(f) *Approximately 7 miles south-southeast of Station A (Segment D)* – As specified, for evaluation of the white croaker commercial catch ban.

(g) *West of Palos Verdes Point before Redondo Canyon (Segment E)* – As specified, for evaluation of the white croaker commercial catch ban.

(h) *West of Station E on the north side of Redondo Canyon (Segment F)* – As specified, for evaluation of the white croaker commercial catch ban.

2.3 Timing/Frequency of Sampling

A one-time sampling effort will take place in August-November 2002. White croaker spawn in the fall, and lipid levels and DDT levels are generally highest prior to spawning (SCCWRP 1986). Not all target species have the same spawning schedule; however, late summer/early fall also coincides with high fishing pressures (based on RecFIN fishing pressures data). Preliminary discussions with experienced, local fish collectors indicate that it should be possible to collect most if not all of the target species at that time. If key target species are not found in sufficient numbers and locations during the August/September 2002 sampling, an additional phase of fish collection may be considered at that time.

2.4 Fish Collection: Minimum Sampling Segment/Species Requirements

Fish collectors will endeavor to collect samples of all listed species at each site; however, the Trustees recognize that some species may not be available at certain sites. Furthermore, certain species are higher priority at particular sites, given the presence of fishing advisories, information needs for reef placement evaluation and similar project considerations. Minimum species requirements at each sampling segment have been determined and are summarized in { REF _Ref9252064 \h * MERGEFORMAT }. Species-Sampling segment combinations indicated with an "R" were selected primarily for reef placement purposes. Species-Sampling segment combinations indicated with a "P" were selected primarily for public information purposes. Where public information and reef purposes overlap, species/segment combinations are marked with a "B." Areas being monitored in order to assess the commercial catch ban are marked with a "C." The supporting rationale for these selections is described in the following sections of the plan.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

Exhibit has been modified from previous version to reflect the EPA commercial catch ban requirements, joined segments, and other location decisions from the Trustees.

Summary of Minimum Species/Sampling Segment Collection Requirements

Segment	Segment Name	Hard-Bottom Species							Hard/Soft-Bottom Species						Pelagic Species					Soft-Bottom Species						
		Opaleye	Sargo	Kelp Bass	Surfperches - BF	Surfperches-WCF	Rockfishes	California Sheephead	Barred Sandbass	Topsmelt	Halfmoon	California Scorpionfish	White Seabass	Black Croaker	Chub Mackerel	Pacific Sardine	Pacific Bonito	Pacific Barracuda	Yellowtail	White Croaker	Jacksmelt	Yellowfin Croaker	California Corbina	California Halibut	Shovelnose Guitarfish	Queenfish
1	Ventura																			P						
2	Pt. Dume to West End of Malibu Lagoon Beach								P											P						P
3	West End of Malibu Lagoon Beach to Las Flores														P	P		P	P	P						P
4	Las Flores to West End of Santa Monica Beach																			P						P
5	Santa Monica Beach to El Segundo	B	B	B	R				B	B	B			B						B	R	B	B	B	R	B
6	El Segundo to the South End of Manhattan Beach	R		R	R				R	R - 2 of 5 species					P	P		P	P	B	R	R	B	R	R	R
7	King Harbor Area	R	B	R	R				B		B			B						B	B	R	B	B	R	R
8	Redondo Beach to Flat Rock Pt.	R		R	R				R	R - 2 of 5 species										B	R	R	B	R	R	R
9	Flat Rock Pt. to Palos Verdes Pt.								P											CR						
10	Palos Verdes Pt. to Pt. Vicente								P											B						
11	Pt. Vicente to Long Pt.																			CR						
12	Long Pt. to Bunker Pt.			P			P		P			P			P	P		P	P	B						
13/ 14	Bunker Pt. to Pt. Fermin, including White Point	P		P	P	P	P	P	P		P	P		P						B						
15	Cabrillo/LA Breakwater: Ocean Side	R		B	B	B	B		B	B - 1 of 4 species				B						CR	R	R	R	R	R	R
16	Cabrillo/LA Breakwater: Inland Side	B		B	B	B			B	B	B	B	B	B						CR	B	R	R	B	B	B
17	Pier J to Finger Piers at Shoreline Park	R		R	B	B			R	B		B	B	B	P	P		P	P	CR	B	R	R	B	R	B
18	Belmont Pier /Seaport Village	R		R	B	B			B	B			B	B						CR	B	B	B	R	B	B
19	Seal Beach	R		B	B	B			B	B - 2 of 5 species										B	R	R	R	B	R	R
20	West End of Sunset Beach to Huntington Beach (Hwy. 39)								P						P	P		P	P	C			P			
21	Huntington Beach (Hwy. 39) to Pelican Pt.																			C			P			
22	Dana Pt.								P											C			P			
23	Short Bank			P				P	P			P	P							P						

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

Exhibit has been modified from previous version to reflect the EPA commercial catch ban requirements, joined segments, and other location decisions from the Trustees.

Summary of Minimum Species/Sampling Segment Collection Requirements

Segment	Segment Name	Hard-Bottom Species							Hard/Soft-Bottom Species						Pelagic Species					Soft-Bottom Species						
		Opaleye	Sargo	Kelp Bass	Surfperches - BF	Surfperches-WCF	Rockfishes	California Sheephead	Barred Sandbass	Topsmelt	Halfmoon	California Scorpionfish	White Seabass	Black Croaker	Chub Mackerel	Pacific Sardine	Pacific Bonito	Pacific Barracuda	Yellowtail	White Croaker	Jacksmelt	Yellowfin Croaker	California Corbina	California Halibut	Shovelnose Guitarfish	Queenfish
24	Horseshoe Kelp			P				P	P			P	P							C						
A	Middle Breakwater (1991 OEHHA #17)				P	P								P						C						P
B	Approx. 2 miles offshore of Segment 15																			C						
C	Approx. 5 miles SE of Pt. Fermin																			C						
D	Approx. 7 miles S/SE of station A																			C						
E	West of Palos Verdes Pt. before Redondo Canyon																			C						
F	West of Station E on north side of Redondo Canyon																			C						

Collection key: P: for Public Information Purposes; R: for Reef purposes; C: for Commercial Catch Ban purposes; B: for both Public Information and Reef purposes; CR: for both Commercial Catch Ban and Reef purposes. Highlighted squares indicate State of California fish consumption advisories.

It is important to note that chemical analysis will only be undertaken on a subset of collected fish. As described in the adaptive chemical analysis program (see Section { REF _Ref9307284 \r \h * MERGEFORMAT }), analysis results from limited, initial rounds of contaminant testing will be used to carefully define the species and sampling segment locations of fish needed in later rounds of analysis.

2.4.1 Minimum Collection Requirements for Reef Purposes

White croaker will be collected in all sampling segments, including those important for reef purposes (*i.e.*, segments 5-8 and 15-19). As indicated in Exhibits 2-2 and 2-3, historical data indicate that white croaker is the fish species with the highest levels of DDTs and PCBs in the study area. Collecting this species in every segment will allow for precise determination of contamination gradients and locations where contaminant concentrations are at or above levels of concern.

All of the other target soft-bottom feeding species also must be collected in each of the segments important for reef purposes (segments 5-8 and 15-19). As described previously (see { REF _Ref9251872 \h * MERGEFORMAT }), historical data suggest that these segments are the most likely locations for a potential reef placement project. To determine in which of these locations, if any, reef restoration merits further evaluation, it is important to collect these soft-bottom species. Based on the RecFIN data and input from locally experienced marine biologists and fish collectors, the Trustees expect that all of these fish can be caught in the specified segments. In other sampling segments, these soft-bottom feeding target fish will be kept if caught, but special effort will not be undertaken to collect them.

Species attracted to reefs also must be caught in the segments specified in the preceding paragraph. As indicated in Exhibit 2-6, three specific hard-bottom target species/species groups (Surfperches-BF, kelp bass and opaleye) must be collected in each of the nine "reef" segments. These species were selected in part because of their expected availability. RecFIN data indicate that these species are among the most commonly caught reef species from shore-based fishing locations. In addition, these three species can be found in different types of reef habitat. Allen[7] indicates that black perch (included in the Surfperches-BF complex) is the most common species found on rocky reefs at depths less than 30m, and is found on high and low-relief reefs. Black perch will be the primary indicator of the benthic-feeding surfperches group, and will be the preferred species within the group. Black perch will be identified separately from the other benthic-feeding surfperches. Kelp bass is also common but prefers high-relief reefs or those with kelp. Opaleye are found on reefs with good algal coverage, and in kelp beds (most commonly inshore of the main bed). RecFIN data indicate that these species are among the most commonly caught reef species from shore-based fishing locations.

Target hard/soft-bottom species also are likely to inhabit artificial reefs. As indicated in { REF _Ref9252064 \h * MERGEFORMAT }, one species from this category, barred sandbass, must be caught by collectors at each of the reef sampling segments identified above. This species is relatively common, and is found over low-relief reefs and sand bottoms, and also near high-

[7] Personal communication with M.J. Allen *via* electronic mail, April 9, 2002.

relief reefs (Allen, 2002). This species is commonly caught both from shore-based fishing modes and boat-based modes. Because of concerns about potential spatial variability in the frequency of hard/soft-bottom species, the Trustees require that specific species be caught at segments where they have high catch rates (greater than 10% of the Los Angeles County catch); at segments where none of the remaining hard/soft-bottom fish meet these requirements, a minimum of two of the target species (topsmelt, halfmoon, California scorpionfish, white seabass and black croaker) will be caught at each of the reef sampling segments. The particular two species caught can vary between segments, as indicated in { REF _Ref9252064 \h * MERGEFORMAT }.[8]

2.4.2 Minimum Collection Requirements for Public Information Purposes

Minimum species-sampling locations collection requirements for public information purposes are based on the following criteria:

(a) *Fishing Advisories* – Species must be collected in sampling segments containing sites where consumption advisories have been established for them. These species-segment combinations are shaded in { REF _Ref9252064 \h * MERGEFORMAT }. These same species also must be collected in adjacent sampling segments, to provide comparative information. Several species-location combinations that meet this criterion already are included in minimum collection requirements for reef purposes;

(b) *Pelagic Species* - Pelagic species will be collected in fewer segments, given the limited variability in contamination levels found in past studies (see Exhibits 2-2 and 2-3). In addition, bonito will be kept if caught but is not a "required" species, given its declining availability in the study area in recent years. As indicated in { REF _Ref9252064 \h * MERGEFORMAT }, four pelagic species (chub mackerel, Pacific sardine, Pacific barracuda, and yellowtail) must be caught somewhere within in each of five "combined" collection areas. Specifically, for pelagic fish sampling purposes, we have combined segments 2-4; segments 5-8; segments 9-14; segments 15-19; and segments 20-21.

(c) *Species-specific Biomass Catch* – Segment/species combinations are included in minimum collection requirements if sites within a particular segment are responsible for 10 percent or more of the 1996 to 2000 Los Angeles County catch of that species (based on RecFIN shore catch data).

(d) *Target species for boat-based anglers* – In segments commonly used by boat-based anglers (segments 2, 5, 9, 10, 12, 14, 15, 16, 19, and 20), barred sandbass must be caught. RecFIN data and information from locally experienced fishermen indicate that this species is frequently caught by boat-based anglers 0-3 miles from shore.

[8] For some segments, target species also must be caught for public information purposes (generally because there is a consumption advisory for that species at a location within the segment or the fish is commonly caught by anglers in that segment). Such species/segment combinations are specified in Exhibit 2-6.

All target species (see { REF _Ref2570140 \h * MERGEFORMAT } for a complete list) caught by fish collectors should be kept, consistent with the number and size requirements specified in the following section of this plan.

2.4.3 Minimum Collection Requirements for Both Purposes

Minimum species-sampling segment combinations needed for both reef and public information purposes are indicated with a "B" in { REF _Ref9252064 \h * MERGEFORMAT }. Species-sampling segment combinations for both reef and commercial catch ban evaluation purposes are indicated as "C/R."

2.5 Fish Collection: Number/Size Requirements

At least 15 fish must be collected in a segment for each of the species specified in { REF _Ref9252064 \h * MERGEFORMAT } to meet minimum collection requirements. These fish must be within the size range normally caught by anglers, as specified in { REF _Ref9844616 \h * MERGEFORMAT }. These ranges are determined from the catch examined by survey personnel in RecFIN angler intercept studies. Minimum and maximum lengths are based on the middle 80% of observed catch from these studies. Modifications may be made as the collection effort progresses, particularly if substantial numbers of fish close in size to the specified range are caught, with insufficient numbers caught within the size range. Such changes, if any, will be documented in the field collection report.

All fish caught that are on the target species list and within the size range should be kept, up to a maximum of 30 fish per species, per site. Extra fish will be used to repeat chemistry analysis as needed, to replace samples that are damaged or lost, to increase sample size if it is later determined that additional precision is necessary, and for other QA/QC considerations. Live fish not on the target list should be returned to the water. Dead fish in excess of the 30 fish maximum or not on the target list should be disposed of in accordance with the field sampling procedures described in Section { REF _Ref10001283 \r \h * MERGEFORMAT }. For benthic-feeding surfperches, a minimum of 15 black perch must be caught, but additional benthic-feeding surfperches of other species will be kept as well.

All fish that are kept will be within the legal size limits, as specified in the California Ocean Fishing Regulations. Applicable limits are as follows:

(a) Barred sandbass, California sheephead, kelp bass: greater than 305 mm;

(b) California halibut: greater than 560 mm;

(c) California scorpionfish: greater than 255 mm;

(d) Pacific barracuda: greater than 710 mm;

(e) Pacific bonito: less than 610 mm.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

Acceptable Size Ranges for Collected Fish

Species	Minimum Total Length (mm)	Maximum Total Length (mm)
HARD-BOTTOM SPECIES		
Opaleye	165	330
Sargo	170	350
Kelp bass	305[3]	420
Surfperches – BF	150	360
Surfperches – WCF[1]	100	200
Rockfishes (*Sebastes*)	200	310
California sheephead[2]	305[3]	540
HARD/SOFT-BOTTOM SPECIES		
Topsmelt	130	240
Barred sandbass	305[3]	400
Halfmoon	210	330
California scorpionfish	255[3]	350
White seabass	200	500
Black croaker	180	360
PELAGIC SPECIES		
Chub mackerel	130	460
Pacific sardine	150	220
Pacific bonito	290	510
Pacific barracuda[2]	720	900
Yellowtail[2]	550	940
SOFT-BOTTOM SPECIES		
White croaker	160	300
Jacksmelt	220	390
Yellowfin croaker	200	380
California corbina	280	520
California halibut	560[1]	820
Shovelnose guitarfish	500	1100
Queenfish	120	260

Based on 1996-2000 RecFIN observed catch in Los Angeles, Ventura, and Orange Counties at shore-based sites. Minimum and maximum lengths are based on the middle 80% of observed catch from angler intercept surveys. RecFIN lengths are reported based on fork length, but RecFIN provides conversion factors for many species. Where not available, total length conversion factors were estimated from species with similar fin structures.

[1]Values are based on available data, which is only for walleye and shiner perch. Other water-column feeding surfperch can be outside this range.

[2]Reported lengths are for catch 0-3 miles off shore, due to insufficient shore-based catch.

[3]Minimum lengths are truncated at the State of California legal size limits, as specified in Section 2.5.

Barred sandbass minimum was changed to reflect the State of California legal size limits. Other highlighted maximum and minimum lengths have been modified based on the on-going collection.

2.6 Identification of Chemicals of Potential Concern

Chemicals of potential concern (COPCs) for this project include DDTs, PCBs, chlordane, mercury, inorganic arsenic, dieldrin, and dioxins. The rationale underlying selection of these COPCs is provided below.

2.6.1 Chemicals of Potential Concern Selection Process

Several factors were considered as part of the COPC selection process:

(a) *DDTs and PCBs* – These contaminants were the basis for the injuries to fishing resources identified in the Montrose litigation and resulting settlement and are also the basis for fishing advisories in the study area (see Appendix B). For these reasons, DDTs and PCBs are a central focus of this project.

(b) *Bioaccumulation potential in fish* – Contaminants that bioaccumulate through the foodweb result in a greater risk to subsistence and sport fishers due to higher contaminant exposure.

(c) *Persistence in the environment* – Contaminants that are persistent within the environment (*e.g.*, organochlorines and inorganics) have a greater potential of impact on subsistence and sport fishers over time.

(d) *Detection history of other contaminants in the study area* – Other chemicals (*e.g.*, mercury, chlordane) have been detected in fish (and other biota and media) in the study area and may accumulate to levels of concern to subsistence and recreational anglers. Analysis for such contaminants will provide important, current information to the public about contaminant levels. An additional, related concern is that anglers not be directed to fish (at existing sites or sites that may be augmented with artificial reefs) with low levels of DDTs and PCBs but high levels of other contaminants.

(e) *Contaminant thresholds for human health effects from consumption pathways* – To assist in the evaluation of whether other contaminants are likely to be present at levels of concern, contaminant levels in fish from historical studies were compared to various human-health based effects thresholds.

Several sources of information were analyzed as part of the evaluation of these factors. The Coastal Fish Contamination Program (CFCP 2001) tested fish collected in 1999 and 2000 in some portions of the study area for a variety of contaminants (see Appendix C for the CFCP data). Other sources for area-specific contaminant data in fish tissue include LACSD 2000, Pollock *et al.* 1991, Allen and Cross 1994, TSMP 1995, and Allen *et al.* 1998. Information about human health effects thresholds was obtained from EPA's IRIS database.[9] Estimated fish consumption rates (*i.e.*, grams of fish consumed per unit of time) for study area anglers was

[9] Available electronically from the U.S. EPA at http://www.epa.gov/iris/

obtained from several sources, including U.S. EPA 2000, OEHHA 2001, Allen *et al.* 1996, and Puffer 1982.

2.6.2 Analysis of Historical Contaminant Data

In addition to DDTs and PCBs, selected fish samples will be tested for chlordane, mercury, inorganic arsenic, dieldrin, and/or dioxins. Available information, described in more detail below, suggests a reasonable likelihood that these contaminants may be found in study area fish at levels above screening level thresholds for human health effects. At this point in time, it is difficult to assess likely spatial variability in levels of these contaminants throughout the study area. This issue is important because if levels are relatively constant, analysis may not be necessary at all sample sites. To address this issue, the Trustees will make use of an "adaptive" sampling approach that will test for contaminants at a few representative sites before making decisions about additional analysis needs. This adaptive analysis approach is described in more detail in Section { REF _Ref9307284 \r \h * MERGEFORMAT }, and, for each of these chemicals, takes into account both the varying costs and the information provided by testing for that chemical.

The CFCP data provide recent chemical analysis results for a few dozen contaminants in several different species of fish at locations within the study area (see Appendix C). The CFCP analysis data are for 86 composite samples (between 2 and 15 fish per composite) of fish fillet (muscle) tissue. Some composites include the skin; others are for skin-off fillets. The fish were collected in 1999 and 2000.

As an initial step in the chemical selection process, the CFCP data were compared to various screening values determined for human health effects (see { REF _Ref9252171 \h * MERGEFORMAT }). These screening values were determined at different consumption rates, given toxicity data. Toxicity information for cancer and non-cancer effects (*i.e.*, cancer slope factors for carcinogenic effects and reference doses for non-carcinogenic effects) was obtained from EPA's IRIS database.

EPA produces two sets of standard screening values for fish advisories: one for recreational fishers and one for subsistence fishers (U.S. EPA 2000). The differences are based on assumed consumption rate, the varying factor in individual risk. Recreational fisher consumption rates are 17.5 g/day and subsistence fisher consumption rates are 142.4 g/day. These numbers are derived from the 1994-1996 USDA Continuing Survey of Food Intake by Individuals, and are 90th and 99th percentile values, respectively, for daily fish consumption for the participants in the 3-day interview/diary study. Over 20,000 individuals participated in the study, selected in multistage, stratified-cluster area probability samples, from all states except Alaska and Hawaii. Participants in this study are drawn from the general population (*i.e.*, the study includes people who do not fish).

Comparison of Coastal Fish Contamination Program (CFCP) Data to Potential "Screening Values"

Contaminant[1]	CFCP Min (ppb)	CFCP Max (ppb)	% samples > ND	SV (ppb, based on 17.5 g/day fish consumption)	% Samples Exceeding Screeing Value	SV (ppb, based on 142.4 g/day fish consumption)	% Samples Exceeding Screeing Value	SV (ppb, based on 225 g/day fish consumption)	% Samples Exceeding Screeing Value	SV (ppb, based on 339 g/day fish consumption)	% Samples Exceeding Screeing Value
Aldrin	ND	ND	0%	--	--	--	--	--	--	--	--
Arsenic[2]	202.00	7943.30	100%	27.0	?	3.0	?	2.1	?	1.4	?
Cadmium	ND	63.00	33%	4000	0%	492	0%	311	0%	206	0%
Chlordane[3]	ND	26.23		114	0%	14	5%	9	8%	6	15%
Chlorpyrifos	ND	ND	0%	--	--	--	--	--	--	--	--
Dacthal	ND	4.32	1%	40000	0%	4916	0%	3111	0%	2065	0%
Diazinon	ND	ND	0%	--	--	--	--	--	--	--	--
Dieldrin	ND	2.85	5%	2.5	2%	0.3	5%	0.2	5%	0.1	5%
Endosulfan	ND	ND	0%	--	--	--	--	--	--	--	--
Endrin	ND	ND	0%	--	--	--	--	--	--	--	--
Ethion	ND	ND	0%	--	--	--	--	--	--	--	--
HCH isomers	ND	ND	0%	--	--	--	--	--	--	--	--
Heptachlor	ND	ND	0%	--	--	--	--	--	--	--	--
Heptachlor Epoxide	ND	ND	0%	--	--	--	--	--	--	--	--
Hexachlorobenzene	ND	4.18	14%	25.0	0%	3.0	2%	1.9	2%	1.3	2%
Methoxychlor	ND	11.90	2%	20000	0%	2458	0%	1556	0%	1032	0%
Mercury[4]	ND	673.00	79%	400	2%	49	38%	31	65%	21	79%
Mirex	ND	ND	0%	--	--	--	--	--	--	--	--
Oxadiazon	ND	1.56	1%	20000	0%	2458	0%	1556	0%	1032	0%
Ethyl Parathion	ND	14.60	1%	NA		NA		NA		NA	
Methyl Parathion	ND	11.00	2%	NA		NA		NA		NA	
Selenium	106.00	931.00	100%	20000	0%	2458	0%	1556	0%	1032	0%
2,3,4,6-Tetrachlorophenol	ND	2.50	1%	120000	0%	14747	0%	9333	0%	6195	0%
Toxaphene	ND	24.70	1%	36.0	0%	4.0	1%	3.0	1%	1.9	1%

Cells are shaded if the screening value is exceeded in the data set.

1 - DDTs and PCBs will be analyzed as part of this project for reasons already described; as a result; DDT and PCB data are not included in this exhibit.

2 - CFCP measurements are total arsenic, while screening values are for inorganic arsenic.

3 - The "Chlordane" row represents the sum of CFCP measurements for the same chlordane congeners used in the screening value, which is for technical chlordane (and includes alpha/gamma chlordane, oxychlordane, cis/trans nonachlor, heptachlor, and heptachlor epoxide).

4 - CFCP measurements are for total mercury, while the screening values are for methylmercury. Methylmercury is typically 95% of total mercury in fish.

Due to the limits of these consumption data, EPA recommends use of local information to estimate area-specific fish consumption rates among particular populations. Based on a literature survey by OEHHA (2001), as well as past studies specific to the area (Allen *et al.* 1996, Puffer *et al.* 1982) the Trustees also considered higher consumption rates than those used by EPA, in order to consider potential local consumption rates of subsistence anglers. An overview is presented in { REF _Ref9252197 \h * MERGEFORMAT }. Upper estimates for fisher populations are the basis for subsistence fisher estimates. Puffer *et al.* (1982) found the 90th percentile for Los Angeles metropolitan area fishers to be 225 g/day and the 95th percentile to be 339 g/day. OEHHA analysis of consumption data from Santa Monica Bay fishers (Allen *et al.* 1996) found 90th and 95th percentile values of 107 g/day and 161 g/day, respectively, from the general fishing population. From Allen *et al.* (1996), Asian fishers are identified as having the highest consumption rate, with an upper decile of 137 g/day. For this initial evaluation, screening levels were calculated for four consumption rates (17.5, 142.4, 225.0 and 339.0 grams per day), which both bracketed all the reported values and used the EPA values for ready cross-comparison with published screening values.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }
Overview of Consumption Rate Studies

Reference	Observed Population	Criteria	Consumption Rate (g/day)
U.S. EPA (2000)	National	90th percentile	17.5
		99th percentile	142.4
Puffer *et al.* (1982)	Los Angeles Harbor anglers	90th percentile	225
		99th percentile	339
Allen *et al.* (1996)	Santa Monica Bay anglers	90th percentile	107
		90th percentile, Asian anglers	137
OEHHA (2001) from Allen *et al.* (1996)	Santa Monica Bay anglers	95th percentile	161

Based on comparison of CFCP data and screening values, several contaminants (mercury, arsenic, chlordane, hexachlorobenzene, toxaphene and dieldrin) show at least one exceedence.[10] However, exceedences were rare for toxaphene and hexachlorobenzene. Only one percent of CFCP samples showed an exceedence for toxaphene (this exceedence occurred for consumption rates at or above 142.4 g/day). Two percent of hexachlorobenzene samples exceeded screening values (also based on at least 142.4 g/day consumption). Approximately five percent of samples exceeded dieldrin screening values, with half of those exceeding at the lowest consumption rate. This is complicated by the MDL for dieldrin in the CFCP study of 2 ppb, which is higher than the screening value for all but the lowest consumption rate. Dieldrin analysis will require a more sensitive detection method (*i.e.,* one with an MDL near 0.1 ppb) due to its toxicity.

[10] If screening values exist for both cancer and non-cancer effects, the lower (*i.e.* more protective) screening value was used.

CFCP exceedences for mercury and chlordane were more common.[11] Mercury exceeded screening thresholds in 38 percent of samples (based on 142.4 grams per day of fish consumption). Mercury levels showed some spatial variation: approximately 20 percent of samples were non-detect. Chlordane levels exceeded thresholds in five percent of samples (based on 142.4 grams per day of fish consumption) and eight percent of samples based on the 225 gram per day assumption. Arsenic exceedences are difficult to determine, because screening thresholds are based on inorganic arsenic while CFCP measurements are based on total arsenic. The relative proportion of inorganic and organic arsenic is not known; review of tissue sampling in the Handbook of Chemical Risk Assessment (Eisler, 2000) suggests that between 1 and 10% of total arsenic can be inorganic arsenic (the rest is composed of organic complexes of arsenic, primarily arseno-sugars, and of negligible health concern). Screening thresholds will be exceeded in several samples if inorganic arsenic levels are even a few percent of total arsenic. Total arsenic concentrations found in the CFCP data appear to be species-dependent to some degree; croakers are at the low end and turbots are particularly high.

Dioxins also are chemicals of potential concern. Studies in the San Francisco Bay indicated dioxin levels of concern (SFEI 1999). However, due to the great expense of dioxin analysis, only a minimal number of samples were tested. Additional data on dioxins in southern California fish are forthcoming from the CFCP and 1998 SCCWRP research in the Bight (SCCWRP 1998); decisions on dioxin analysis will consider these data as they become available.

Literature reviews provide support for the selection of chlordane, mercury and arsenic. Chlordane has been detected in various other studies in the southern California area. Pollock *et al.* (1991) found levels in white croaker up to 30 ppb (at Malibu), in queenfish up to 23 ppb (at Malibu) and in surfperches up to 9 ppb (at Newport). These are averages for five-fish composites. Over all species, five sites had levels above the 14.2 ppb screening value for 142.4 g/day consumption rate (Point Dume, Malibu, Malibu Pier, White Point, Pier J). Allen and Cross (1994) found chlordane levels in white croaker muscle tissue up to 19.3 ppb. Three Palos Verdes shelf locations were highest, above the 14.2 ppb screening value, and five additional sites (Hyperion, Marina del Rey, El Segundo, Malibu, and Hermosa Beach) had mean concentrations above the 6 ppb screening value. The California Toxic Substances Monitoring Program (TSMP 1995) found elevated levels of chlordane (30.7 ppb total chlordane) in sargo muscle fillets at Marina del Rey Basin D, but not in round stingray or yellowfin croaker fillets at that location.

Mercury levels in Pollock *et al.* (1991) showed minimal differences between species (possibly due to similar trophic levels, according to the study) and found levels between <50 and 724 ppb. They found these to be consistent with values of <100 ppb to 600 ppb throughout southern California reported in prior studies. Mercury also was detected at similar levels in the TSMP. As part of the adaptive sampling program, initial analytical results at a few sites will be used to determine if variation in mercury levels at different areas is sufficient to merit testing at more sites.

[11] CFCP measurements are for total mercury, while the screening values are for methylmercury. Typically, methylmercury is approximately 95% of total mercury in fish tissue samples (Bloom 1992). For chlordane, we compare the sum of CFCP measurements for the same chlordane congeners used in the screening value, which is for technical chlordane (and includes alpha/gamma chlordane, oxychlordane, cis/trans nonachlor, heptachlor, and heptachlor epoxide).

Arsenic was measured as total arsenic in historic studies. Because of uncertainty about levels of inorganic arsenic present in fish tissue, we propose testing for inorganic arsenic (and total arsenic) in a limited set of samples as part of the adaptive analysis program. The need for additional sampling will be determined based on these initial results.

2.7 Analysis Plan

The following subsections describe the analysis plan for this effort. A key underlying principle of the analysis plan is that it is "adaptive." Although all fish will be collected at one time, they will be analyzed in phases. The approach for the initial phase of analysis is described in the following sections of this plan. Subsequent decisions about species, locations, contaminants and tissues to be tested for later analysis phases will be made in light of results obtained from the first phase. As described below in more detail, this type of approach will substantially improve the cost-effectiveness of chemical analyses by limiting additional analyses to those samples and contaminants most needed to address project goals.

2.7.1 Initial Analysis Phase: Contaminants

During the initial analysis phase, DDTs and PCBs will be the only contaminants tested. As described in Section { REF _Ref9850808 \r \h * MERGEFORMAT }, these are the primary contaminants of concern for this project. Other contaminants will be measured in later rounds, based on initial analysis results. For example, in areas found to be highly contaminated on the basis of concentrations of DDTs and PCBs, it may not be necessary to verify levels of other contaminants.

2.7.2 Initial Analysis Phase: Individual vs. Composite Samples

Unless otherwise specified, individual samples (rather than composites) will be analyzed in the initial phase. This approach is necessary for both reef and public information purposes for at least two reasons:

(a) To provide statistical information needed to quantify uncertainty in contaminant mean estimates and allow for quantitative comparisons of means among different species/segment combinations and comparisons of means with various contaminant levels of concern;

(b) To provide "process" information that may be important for reef and/or publication information purposes and may affect decisions about later rounds of analysis in the adaptive program. For example, a set of ten individual samples for a particular species/segment comprised of a few very high concentrations and several very low concentrations may be indicative of different foraging patterns, rates of contaminant accumulation over time, or other factors within a species at a particular location that may be important to understand.

2.7.3 Initial Analysis Phase: Number of Samples

Ten samples from selected species/segment combinations (identified below) will be tested for DDTs and PCBs. If fewer than 10 samples are caught of a particular target species, all available samples will be tested. Each sample will be analyzed individually (*i.e.*, not in composite form), except for pelagic species expected to have uniform, low contaminant levels throughout the study area (see Exhibits 2-2 and 2-3), which will initially be tested as 10-fish composites.

The choice of ten samples per species per location for analysis reflects a balance between analytical costs and the need for sufficient samples to provide a reasonable level of confidence in the decisions and recommendations made from the data. Through the use of statistical power analyses and similar calculations, it is possible to estimate the level of confidence that reported means and distributions of contamination derived from the sampling program accurately reflect the populations of fish from which they were taken. However, prior to sampling, such calculations must be made from historical data, which are limited or not available for many target species, and in other cases may not reflect current contamination levels and distributions. After the initial round of analysis, choices concerning the number of fish samples to analyze in later phases of testing will take into account data from the first phase.

2.7.4 Initial Analysis Phase: Tissues for Analysis

A skin-off fillet (muscle tissue) preparation will be analyzed from every sample in the initial analysis phase. This preparation is used by the state of California to determine fishing advisories, is a preparation method commonly used by anglers and is relatively simple to prepare, and so less likely than other preparations (*e.g.*, whole body) to generate analytical results that vary due to sample homogenization or similar preparation issues.

In later rounds of the analysis, a comparison of fillet versus whole-body contaminant concentrations will be made in selected species at varying contaminant levels. This comparison of skin-off fillets with whole, gutted fish will be undertaken for a few reasons. First, fish are eaten both ways by recreational and subsistence anglers. For example, Allen *et al.* (1996) indicate that a large percentage (68%) of the population consuming white croaker eat whole, gutted fish. Anglers also eat skin-off fillets, and California fishing advisories are based on this preparation method. Second, these two preparations may provide reasonable bounds on potential contaminant exposures to anglers. For example, results from a 1996 Heal the Bay study (Gold *et al.* 1997) generally indicate a trend of higher DDT levels in whole, gutted fish compared to fillets or muscle tissue. Skin-off fillets are likely to have less fat and other tissues that can preferentially store organochlorine contaminants, while whole, gutted fish typically will include more of these tissues and contaminants (although whole, gutted fish also will contain some material, such as bones, that is likely to store few contaminants). Finally, this approach will allow for evaluation of relationships between whole, gutted fish and skin-off fillets, and may provide conversion factors that can be used to estimate one from the other. Development of such factors could reduce the need for testing both preparations (skin-off fillet and whole, gutted fish) in later analysis phases, and may improve the ability of the Trustees (and others) to compare results with other studies that test one but not both preparations.

2.7.5 Initial Analysis Phase: Species/Segment Combinations to be Analyzed

The first round of analysis will provide information on levels of DDTs and PCBs in selected species and segments. All white croakers will be sampled, as well as other species at locations of interest due to prior fishing advisories, and in species likely to be applicable to reef purposes, as well as pelagic species. Not all species/segment combinations specified in Exhibit 2-10 are required to be collected in { REF _Ref9252064 \h * MERGEFORMAT }; however, any specified combinations from Exhibit 2-10 that are collected will be analyzed.

2.7.5.1 Summary of Rationale and Guide to Exhibit 2-10

DDTs and PCBs will be tested in all initially selected fish because they are the primary contaminants of concern. Selected species/segment combination can have three designations:

(a) "R": Sample/segment combinations essential for evaluating potential reef sites are marked with an "R" in Exhibit 2-10.

(b) "P": Sample/segment combinations essential for public information are marked with a "P." (Public information needs include species/locations with fishing advisories and species that are frequently caught from shore or from boats.)

(c) "B": Sample/segment combinations fulfilling both (a) and (b) are marked with a "B."

(d) "C": Sample/segment combinations for evaluating the commercial catch ban on white croaker.

For pelagic species, 10-sample composites will be analyzed in the initial round, reflecting historical information that DDT and PCB levels in these species are low and exhibit limited variability. These composites are indicated by a superscript "^{C}." For reference, shaded areas in Exhibit 2-10 indicate segment/species combinations that are the subject of consumption advisories based on Pollock *et al.* (1991).

2.7.5.2 Initial Analysis Phase: White Croaker

White croaker from every segment will be analyzed. This species generally has the highest levels of DDTs and PCBs in the study area and is the subject of numerous site-specific consumption advisories. The following points provide a segment-by-segment description from north to south of additional, specific reasons for white croaker analysis.

(a) Segment 1: End point comparison region. (P)

(b) Segments 2-4: Evaluation of the historical contaminant advisories around Malibu with determination of any potential gradient. (P)

(c) Segments 5-8: Both potential reef placement segments and areas of historical steep decline in contaminant levels. (B)

(d) Segments 9-14: Areas along the Palos Verdes peninsula at highest risk of elevated DDT and PCB levels. (P)

(e) Segments 15-19: Both potential reef placement segments and areas of historical steep decline in contaminant levels. (B)

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

Exhibit has been modified from previous version to reflect the EPA commercial catch ban requirements, joined segments, and other location decisions from the Trustees.

Initial Analysis Phase: Segment/Species Combinations to be tested for DDTs and PCBs

		Hard-Bottom Species							Hard/Soft-Bottom Species						Pelagic Species					Soft-Bottom Species						
Segment	Segment Name	Opaleye	Sargo	Kelp Bass	Surfperches - BF	Surfperches-WCF	Rockfishes	California Sheephead	Barred Sandbass	Topsmelt	Halfmoon	California Scorpionfish	White Seabass	Black Croaker	Chub Mackerel	Pacific Sardine	Pacific Barracuda	Yellowtail	Pacific Bonito	White Croaker	Jacksmelt	Yellowfin Croaker	California Corbina	California Halibut	Shovelnose Guitarfish	Queenfish
1	Ventura: Emma Wood Beach to San Buenaventura Beach																			C						
2	Pt. Dume to Malibu Bluff	P		P	P				P											P						P
3	Malibu Bluff to Las Flores																			P						P
4	Las Flores to W. End of Santa Monica Beach														P[C]	P[C]	P[C]	P[C]	P[C]	P						P
5	Santa Monica Beach to El Segundo																			B						
6	El Segundo to S. End of Manhattan Beach																			B			B			
7	King Harbor Area: S. End of Manhattan Beach to Redondo Beach	R		R	R				B											B	B	R	B	B	R	R
8	Redondo Beach to Flat Rock Pt.																			B			B			
9	Flat Rock Pt. to Palos Verdes Pt.																			C						
10	Palos Verdes Pt. to Pt. Vicente																			P						
11	Pt. Vicente to Long Pt.														P[C]	P[C]	P[C]	P[C]	P[C]	C						
12	Long Pt. to Bunker Pt.			P			P		P			P								P						
13/14	Bunker Pt. to Pt. Fermin (White Point)			P	P	P	P					P		P						P						
15	Cabrillo/LA Breakwater: Ocean Side	R		B	R	R	B		R			P		R						CR	R	R	R	R	R	R
16	Cabrillo/LA Breakwater: Inland Side	B		B	B	B			B					B						CR	B	R	R	B	B	B
17	Pier J to Finger Piers at Shoreline Park	R		R	B	B			R					B						CR	B	R	R	B	R	B
18	Belmont Pier/Seaport Village	R		R	B	B			B											CR	B	B	B	R	B	B
19	Seal Beach: Alamitos Bay jetties to Anaheim Bay				B	B														B						
20	W. End of Sunset Beach to Huntington Beach (Hwy. 39)								P											C			P			
21	Huntington Beach (Hwy. 39) to Pelican Pt.														P[C]	P[C]	P[C]	P[C]	P[C]	P			P			
22	Dana Pt.: East End of Mussel Cove to East End of Doheny Beach	P		P	P				P											P			P			
23	Short Bank								P											P						
24	Horseshoe Kelp								P			P								C						

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

Exhibit has been modified from previous version to reflect the EPA commercial catch ban requirements, joined segments, and other location decisions from the Trustees.

Initial Analysis Phase: Segment/Species Combinations to be tested for DDTs and PCBs

		Hard-Bottom Species							Hard/Soft-Bottom Species						Pelagic Species					Soft-Bottom Species						
Segment	Segment Name	Opaleye	Sargo	Kelp Bass	Surfperches - BF	Surfperches-WCF	Rockfishes	California Sheephead	Barred Sandbass	Topsmelt	Halfmoon	California Scorpionfish	White Seabass	Black Croaker	Chub Mackerel	Pacific Sardine	Pacific Barracuda	Yellowtail	Pacific Bonito	White Croaker	Jacksmelt	Yellowfin Croaker	California Corbina	California Halibut	Shovelnose Guitarfish	Queenfish
A	Middle Breakwater (1991 OEHHA #17)				P	P								P						C						P
B	Approx. 2 miles offshore of Segment 15																			C						
C	Approx. 5 miles SE of Pt. Fermin																									
D	Approx. 7 miles S/SE of station A																									
E	West of Palos Verdes Pt. before Redondo Canyon																			C						
F	West of Station E on north side of Redondo Canyon																									

Collection key: P: for Public Information Purposes; R: for Reef purposes; C: for Commercial Catch Ban purposes; B: for both Public Information and Reef purposes; CR: for both Commercial Catch Ban and Reef purposes.

A superscript "C" indicates that a composite sample will be analyzed.

Highlighted squares indicate State of California fish consumption advisories.

(f) Segments 20-21: Large segments to continue the determination of the gradient. (P)

(g) Segment 22: End point comparison region. (P)

(h) Segments A, B, E: Commercial catch ban evaluation (C)

2.7.5.3 Initial Analysis Phase: Soft-bottom Feeding Species

Species predominantly found in soft-bottom locations will be analyzed both in likely reef segments and in segments where they have had a fishing advisory.

(a) Individual samples (10 each) of soft-bottomed species will be analyzed in the five segments that are most likely candidates for reef placement (segments 7, 15, 16, 17, 18). These sites are marked with an "R."

(b) For public information purposes, segment/species combinations that are the subject of consumption advisories, as well as adjacent segments, will be tested. Individual analyses (as opposed to composite) are required to allow for statistical comparison of species means with trigger levels. These sites are marked with a "P."

(c) Segment/species combinations meeting the above two criteria are marked with a "B."

2.7.5.4 Initial Analysis Phase: Pelagic Species

Sampling segments have been combined for collection of pelagic species, reflecting historical information that DDT and PCB levels in these species are low and exhibit limited variability. A composite sample of 10 individuals will be tested for each targeted pelagic species in each of three broad areas (northern Santa Monica Bay, Palos Verdes, and Newport).

2.7.5.5 Initial Analysis Phase: Hard- and Hard/Soft-Bottom Species

(a) In the five segments that are most likely candidates for reef placement (segments 7,15, 16, 17, and 18) initial analysis will be done on the four potential reef species that are most likely to be attracted to reefs in the area (opaleye, kelp bass, benthic-feeding surfperches [black perch], and barred sandbass), based on information from local fish biology experts and recreational fishing data. Individual analyses will be performed in order to provide sufficient information on variability for comparison of contaminant levels to the appropriate trigger levels and to the mean contaminant values of soft-bottom feeding species.

(b) For public information purposes, segment/species combinations that are the subject of consumption advisories also will be tested, as well as adjacent segments. Individual analyses are required to provide sufficient information for statistical comparison of species means with trigger levels.

2.7.6 Subsequent Rounds of Adaptive Analysis

Following the initial round of analysis described above, additional rounds of adaptive analysis will be carried out. While the details of these follow-up rounds will need to reflect initial results, key issues for Round 2 are included below:

(a) *Analysis of Whole Body Versus Fillet* – The Round 1 analyses will be done on skin-off fillets. However, once the Round 1 analytical results are available, three segments representative of high, medium, and low DDT and PCB levels in white croaker (and potentially other species) will be selected for whole-body analysis. The samples for whole-body analysis will be the remainders of fillet samples used in the above fillet analyses. (All fish remainders will be kept throughout the program to enable either the whole body to fillet analysis or the use of the second fillet on a fish in the event of destruction or contamination of the sample fillet.) Viscera will also be kept from white croaker and kelp bass at locations likely to be representative of high, medium, and low DDT and PCB levels. The corresponding viscera for the samples selected above will also be analyzed in order to allow for the determination of contaminant levels in whole fish. Together, this will allow a comparison of same-fish contaminant levels in skin-off fillet, whole gutted fish, and whole fish preparations.

(b) *Additional Analyses Required for Reef Purposes* – One possible outcome of Round 1 is that a specific segment or segments are identified that are good candidates for reef placement (*i.e.*, soft-bottom feeding fish are above the trigger levels and potential reef fish are both below the trigger levels and substantially below the soft-bottom feeding fish contaminant levels.) Two types of additional analysis may take place in these segments: (1) analysis of additional reef species for DDTs and PCBs and (2) analysis for levels of other contaminants of concern (see section 2.6) in the reef fish from these segments.

(c) *Additional Analyses Required for Reef Purposes* – Another possible outcome of Round 1 is that none of the initial reef segments analyzed are suitable. In that case, the Trustees will consider testing fish in the remaining segments identified as potential reef locations, using a parallel approach to that used in Round 1.

(d) *Additional Analyses for Public Information Purposes* – The Round 2 approach to public information will depend on Round 1 results. For example, additional samples may be tested for (1) species/segment combinations that appear to have anomalously high or low contaminant levels relative to nearby segments, or (2) species not tested in Round 1 that utilize feeding modes similar to species found to be highly contaminated.

(e) *Additional Analyses for One or Both Purposes* – Other analysis approaches also may be considered in later rounds. For example, the Trustees may choose to test composites to improve accuracy of estimates of mean DDT or PCB levels for certain species/segment combinations. They may also do further testing of individual samples for statistical purposes and/or to gain additional "process" information. Specified species/segment combinations may be tested for other COPCs to determine

if the presence of other contaminants precludes the use of a segment for reef purposes or affects the content of messages to be conveyed to the public.

3 FIELD OPERATIONS

The following subsections outline the required aspects of field sampling methods and procedures for handling, preserving, and transporting fish samples collected in the field, as well as related quality assurance/quality control (QA/QC) procedures. Detailed SOPs will be developed with input from the contractor(s) selected to perform the fish collection work. These SOPs will conform with all requirements described in this sampling plan. This approach will enhance sampling efficiency and effectiveness by avoiding arbitrary changes to collectors' procedures in circumstances where more than one procedure can meet Trustee requirements.

The sampling procedures outlined below were developed based on Trustee field experience and input from fish collectors, laboratory personnel, and scientists experienced with the Southern California Bight. The procedures include the precautions to be taken to ensure accuracy in location species and identification, the minimization of cross-contamination, and proper record keeping.

3.1 Sampling Methods

This plan does not specify which fish collection methods must be used by fish collectors. Collection methods used will depend on the judgment of the collection contractor(s) and site-specific considerations. All methods used will conform with federal, state and local regulatory requirements and must not damage the physical integrity of the fish (*i.e.,* no puncture or gouging of skin of fish). Overall, the Trustees expect fish collectors to use efficient, cost-effective methods to catch the required types and numbers of fish and minimize the catch of non-target species. The collection method for each fish sample will be clearly noted in the field logbook. Sampling locations will be specified as areas by latitude and longitude or by appropriate permanent markers, and depths may be specified as well.

3.2 Sample Collection and Handling

Overall, sample collection at each sampling location will be conducted to meet the following requirements:

(a) Designated target fish species will be collected at the specified sampling locations (see Section { REF _Ref9307373 \r \h * MERGEFORMAT } of this plan for minimum collection requirements, and Section { REF _Ref9394656 \r \h * MERGEFORMAT } for detailed specification of sampling segments) in specified numbers and sizes (see Section { REF _Ref9850833 \r \h * MERGEFORMAT } of this plan).

(b) Fish collectors will use GPS to verify they are within location boundaries (and record the location in a sampling log), will follow the SOPs for each collection method, and will follow field QA/QC measures outlined in Section { REF _Ref2135700 \r \h * MERGEFORMAT } and relevant SOPs.

3.2.1 Species Identification

Fish will be identified by species as soon as they are collected and non-target species will be returned to the water (or disposed of as specified in the detailed SOPs). Standard fish identification guides for Southern California will be used. In the field logbook, the data sheets, and on the sample identification cards, fish will be identified by a unique common name that is referenced to the scientific name in the identification guides.

3.2.2 Sample Processing

Samples will be prepared using the following general procedures. As noted above, detailed SOPs reflecting the requirements described below will be developed with input from selected fish collector(s).

(a) Each fish of a target species, identified by its common name as described in { REF _Ref2681801 \r \h * MERGEFORMAT }, will be assigned a unique identification code. This code will be an alpha-numeric formula containing the species (2 letters) and the sequential number (3 digits). For example, WC-001 would be used to designate the first white croaker (*Genyonemus lineatus*) sample collected. A mock-up of the format is included as Appendix E. On the data sheet, samplers will record the identification code, the specific sampling location (in GPS coordinates), the sampling method, and the standard and total lengths of each fish, in mm. Numbers repeated in multiple rows can be indicated with a continuing line.

(b) Sampling methods used each day at a given location will be recorded in the field book.

(c) Individual fish will be rinsed in ambient water to remove debris from the external surface. If larger fish must be stunned, this will be done with a sharp blow to the base of the skull, with a wooden club or metal rod, kept reasonably clean with seawater between fish.

(d) The standard and total lengths of each fish will be recorded on the data sheet. Only fish within the acceptable length range (specified in Section 2.5) will be kept.

(e) Fish will be gilled and gutted (head stays on) by the fishing crew. They will be gutted on a hard plastic surface, which will be scrubbed and washed between fish. The implements used for gutting will be cleaned between fish.

(f) For specified locations and species, the viscera will be retained and stored in borosilicate jars and frozen.

(g) Each fish will be tagged with the appropriate sequential pre-printed tag. The tag will be attached to the tail with a stainless-steel staple.

(h) Each individual fish will be wrapped in heavy duty aluminum foil, with spines sheared to minimize punctures. The second portion of the tag will be included with the wrapped fish in a waterproof plastic bag so the information on the tag is visible through the bag. The fish will then be frozen onboard the sampling vessel.

(i) Fish will be accompanied by a chain of custody and transferred to the freezer facility for storage, upon removal from the ship. Scaling, weighing, and dissection of selected fish will be performed in the analytical laboratory (see Section 4.1).

3.3 Sample Preservation

As described above, individual fish will be frozen aboard ship and transferred to a freezer location upon reaching shore. The long-term storage location will be used to store the samples until they are ready for shipment to the laboratory. The shipment method to the laboratory will be specified in the field SOPs, dependent on location and preferences of the selected laboratory.

3.4 Field QA/QC Methods

3.4.1 Sample Collection

The QA/QC procedures specified in the following sections must be followed by fish collectors and incorporated into the detailed field SOPs.

3.4.1.1 Observers

An independent Observer (see { REF _Ref7322822 \r \h * MERGEFORMAT }) selected by the Trustees will accompany fish collector(s) on their initial sampling trip to ensure that all sampling methods, sample preparation and handling, and preservation procedures are understood and followed. The Trustees reserve the right to have observers accompany fish collector(s) on additional sampling trips, at the sole discretion of the Trustees.

3.4.1.2 Sample Identification and Cataloging

Each fish will be identified by a knowledgeable person on the staff of the ship. On the initial sampling run, as described above, an independent Observer will be present to confirm understanding of specified procedures. This person will also be knowledgeable in the identification of the desired fish, and will confirm the species of each fish caught to provide verification of the species identifications made by the fish collectors. If there are any problems with the fish collectors' identifications, further training will be undertaken. All fish kept will be cataloged as described in Section { REF _Ref2138871 \r \h * MERGEFORMAT }. Since many of the species being collected have similar appearances, collectors should note on the data sheet if they are unsure of a sample's species identification. The identity will then be verified later on shore.

A digital voucher collection will be assembled. This will include a photograph of each target species with an appropriate identification. The Observer will evaluate this collection to ensure its accuracy.

3.4.1.3 Prevention of Cross-Contamination

(a) Cross-contamination from one fish to another should not be significant while the fish are intact (*e.g.*, while hauling in nets or during a holding period prior to sorting), but care will be taken to clean equipment between fish while gutting. The gutting will take place on a plastic board that is cleaned between fish. The board will be scrubbed and rinsed with seawater and Alconox between fish. Fish handlers' gloves should also be thoroughly rinsed between fish.

(c) Fish that have been visibly damaged in the collection process will be discarded.

(d) Following gutting, the fish should be rinsed in seawater. Any organ punctures during the gutting process should be noted on the datasheet.

(e) Field personnel should also be able to recognize and avoid potential sources of sample contamination (*e.g.*, engine exhaust, winch wires, deck surfaces and ice used for cooling).

(f) Field blanks to analyze for potential cross-contamination will be collected as wipe tests of gutting utensils and the gutting surface at the beginning and end of each collection day. Equipment will be wiped with chemically clean filter paper following decontamination. These will be wrapped in foil, stored in plastic bags, labeled with location and date, and frozen using the same procedures as fish samples. If field cross-contamination is suspected during laboratory analysis of fish, then the wipe tests from that location will be analyzed. A filter paper blank will also be kept from each batch of paper.

3.4.1.4 Sampling Equipment Material

(a) The fish will be gutted with stainless steel equipment, which is then soaked in a bucket of sea water and Alconox, brushed to remove any debris, and rinsed with clean (sea) water. When utensils are stored between sampling runs, they will be wrapped in aluminum foil.

(b) Collection implements and utensils that come in contact with fish should be made of non-contaminating material (*e.g.*, nylon, glass, or high-quality stainless steel).

(c) Gutting utensils will be thoroughly cleaned with Alconox and sea water after sharpening.

3.4.2 Record Keeping and Field Documentation

3.4.2.1 Control of Field Documentation

Field documentation will be maintained in the following types of documents: field logbooks, sample labels, chain of custody (COC) forms, and field data sheets for recording sampling activities. Samples of a label and a data sheet are shown in Appendix E. The Trustees will provide the fish collector with the appropriate materials for documenting the collection effort. The following general guidelines will be used for maintaining field documentation:

(a) Documentation will be completed in permanent dark ink.

(b) All entries will be legible.

(c) Errors will be corrected by crossing out with a single line, dating, and initialing.

(d) Each page will be signed and dated at bottom.

3.4.2.2 Field Log Book

A field log book will be kept detailing the location, time, and method of each collection, and the fish on the selection list kept from that site. After data entry on each collected fish, the data sheets will be stored in the field log book in a secure location until they can be duplicated. If non-continuous sample numbering occurs, a notation will be made on the unused identification codes in the log book, indicating the reason for not using them. The Chief Field Scientist (see Section { REF _Ref7322822 \r \h * MERGEFORMAT }) or a designated on-board crew member will review and sign each page of the field log book daily. The information will be transferred to an electronic spreadsheet each collection day.

Field data sheets will be used to track collection of samples, and will include the following information for each fish:

(a) Sampling location

(b) Sampling date and time

(c) Sampling methods used at that location

(d) Sampling depth

(e) Habitat sampled

(f) Species name, identification code, and total length

3.4.2.3 Sample Labels

As described in Section { REF _Ref2138871 \r \h * MERGEFORMAT }, each individual fish will be uniquely labeled with an identification code. The label will consist of an alpha-numeric code to represent the species (2 letters) and sample number (3 digits). The number will be specified in multiple locations on the card. If any identification labels in the

middle of a sequence are unused, the reason for discarding them will be designated in the log book.

3.4.2.4 Chain of Custody Documentation

A chain of custody (COC) will be initiated by samplers and will accompany samples to storage. The COC will list all identification codes included in the group (*e.g.*, WC-001 to WC-025, meaning the 25 white croaker specimens at segment 1). A new COC will be created for each subset of samples when they are sent to the analytical laboratory.

3.5 Required Permits and Paperwork

A scientific collection permit from the California Department of Fish and Game will be required. The cost is $45 for a two-year permit. Passenger insurance will be required to allow for Trustee-determined observers on board the vessel. Additional liability insurance will also be required.

3.6 Health and Safety

A Health and Safety Plan specific to this assignment will be developed by the contractor(s) in conjunction with the SRB and Trustees. This will include considerations for the training requirements (*e.g.*, Coast Guard) of the boat crew and species-specific warnings on likely fish hazards.

3.7 Personnel

The Trustees will appoint several personnel to oversee the collection phase of the Plan. The primary positions are described below. Additional personnel will be retained as necessary.

(a) *Chief Field Scientist* - The Chief Field Scientist will confer regularly with the sampling crew and provide ongoing evaluation of the collection process. This person will make decisions regarding variances in collection areas or species requirements and extensions of sampling at a particular site.

(b) *On-Shore Coordinator* - The On-Shore Coordinator will arrange for the storage and transport of fish, check in records as they are received from the sampler, and transmit information to the Chief Field Scientist as necessary. This person will be responsible for the day-to-day, on-shore work during the sampling phase.

(c) *Observer* - An independent Observer, separate from the firm hired to complete the sampling, will evaluate the sampling crew on its initial run to ensure understanding of and compliance with the Sampling Plan. This person will be thoroughly familiar with the details and requirements of the Sampling Plan, and will be knowledgeable in the species identification of fish in order to provide confirmations.

4 CHEMICAL ANALYSIS

This section outlines the guidelines for the laboratory procedures to be followed for preparation and contaminant analysis of the collected fish. Considerations for laboratory selection, sample preparation (dissection and homogenization), sample handling, analytical methods, and data validation are included. Detailed laboratory SOPs will be developed with input from the laboratory(ies) selected to perform the analysis work. These SOPs will conform with all requirements described in this sampling plan. This approach will enhance analytical efficiency and effectiveness by avoiding arbitrary changes in the procedures used by a laboratory in circumstances where more than one procedure can meet Trustee requirements. A detailed Quality Assurance Project Plan (QAPP) will be developed at the same time, consistent with the requirements outlined in this plan and finalized laboratory SOPs.

4.1 Laboratory Selection

A request for proposals (RFP) will be sent to a list of laboratories (Appendix D) that have recently provided strong technical proposals for another project that involves Total PCB/PCB congener work in biota or that have been recommended by SRB members from past experience. Candidate laboratories will not be limited to California, but sample delivery logistics will be a consideration in the selection process. Likewise, state certification in California is not a requirement for this work, but may be a secondary consideration in the proposal evaluation process. The following criteria describe the requirements for potential laboratories, and will be evaluated by the Trustees as part of the selection process:

(a) Fish dissection and tissue preparation experience and capabilities;

(b) Past laboratory experience with organochlorine analyses of fish tissue;

(c) Laboratory analysis of the standard reference material (SRM);

(d) Review of the laboratory's proposed analytical methods for lipids, DDTs, PCBs, chlordanes, dieldrin, dioxins, total mercury, and inorganic and total arsenic in fish tissue as well as review of laboratory facilities and equipment;

(e) Laboratory staff experience and experience of proposed laboratory project manager;

(f) Adequacy of laboratory capacity;

(g) Laboratory information management system and electronic reporting experience;

(h) Laboratory quality assurance plan;

(i) Location and sample delivery logistics; and

(j) Cost Proposal

Each laboratory will provide the Trustees with a description of their proposed technical approach (*e.g.*, equipment, project manager, and relationship with consultants and Trustees) and cost information (*e.g.*, a per-sample price quote for each chemical analysis). The Trustees will then evaluate the proposals based on technical qualifications and price to make a final selection. The laboratory selection process will proceed through the following steps:

1. A request for qualifications and proposed methodology is sent to the list of laboratories in Appendix D.

2. As part of their submission, each laboratory will provide information to enable the performance of a Laboratory Cost Evaluation on the following issues:

   (a) Charge per sample given the estimated minimum number of samples, and for additional larger ranges.

   (b) Methods for meeting QC requirements.

   (c) Sample reanalysis and MDL requirements.

3. After Trustee evaluation of submittals, laboratories that are judged most qualified will be asked to submit a Laboratory Performance Evaluation which will include the following information:

   (a) Analysis of white croaker tissue prepared by NIST (and analyzed by NIST for DDTs and PCBs).

   (b) Analysis of CARP-2 (National Research Council of Canada [NRC] reference material) ('low level' DDTs and PCBs, *trans*-nonachlor, γ-chlordane, and dieldrin).

   (c) Full electronic and written deliverables from the CARP-2/Croaker RM analysis. The full data package and electronic deliverables will be required for reporting the results of the Laboratory Performance Evaluation. Each laboratory will perform, and provide as part of the package, a detection limit study for the specific matrix being used.

4.2 Sample Preparation

For the initial phase of analysis, individual fish (except for pelagic species) will be analyzed separately (*i.e.*, not combined into composite samples). Therefore, each fish will be catalogued and processed separately in the field (see Section { REF _Ref2138871 \r \h * MERGEFORMAT }). Fish will be gutted and held frozen (-20°C) in the field prior to shipment to the laboratory. Scaling and resection of the fillet material will be performed in a laboratory environment to ensure consistency and minimize potential sample contamination during sample preparation.

It is important to recognize that tissue contaminant concentrations from collected fish likely will span a wide range of levels (*i.e.*, multiple orders of magnitude). Samples will be grouped based on historical contaminant levels into low and high groups, but this will not be any assurance of a particular contaminant range. For all laboratory activities, the following precautions must be taken to protect against cross-contamination and contamination of laboratory surfaces:

(a) Laboratory personnel should use nitrile gloves when handling fish and change gloves between fish.

(b) All surfaces in contact with the fish during handling, weighing, and resection must be cleaned thoroughly (laboratory-grade soap and distilled-deionized water) between

fish, or surfaces that are in contact with the fish must be covered with aluminum foil that is replaced after each fish.

(c) Methods and frequency for collection of rinsate blanks and wipe tests will be specified in an SOP prior to commencing the fish preparation.

4.2.1 Fish Measurements

Each fish will have been measured on the boat to allow selection of certain size classes for analysis. In the laboratory, each fish selected for resection and analysis will be measured again and weighed. Total length (to 1 mm) and weight (to 0.1 gram for small fish and 1 gram for fish greater than 100 grams) of each fish will be measured and recorded, along with the identification code. If there is a significant discrepancy in the total length (greater than 10 % and greater than one centimeter) the sample will be flagged and only used for analysis if there are fewer than ten adequate samples for that species, due to the indication of a potentially mis-recorded fish.

4.2.2 Fish Dissection

As described in Section { REF _Ref9401146 \r \h * MERGEFORMAT }, a fillet sample will be analyzed from each fish. The identification code will be verified and the tag will remain with the fish (the remainder of which will be refrozen after the fillet is removed). Fish will be scaled and filleted in the laboratory following methods described by U.S. EPA (2000) and by LACSD. A fillet will be taken from the whole of one side of the partially frozen fish, beginning directly behind the pectoral fin. The laboratory will be provided with a videotape or other demonstration of the filleting technique. When thawing fish, the laboratory should take care to ensure that any resulting liquid is not contaminated and, if necessary, is added back to the whole body homogenate. The fillet will be carefully cleaned to remove skin and fatty tissue. Any trimmings will be retained with the remainder of the fish. In a second round of analysis, the remainders of fish from three sites will be analyzed as a whole-body gutted preparation, including skin and bones. These samples will be retagged during analysis to indicate that they are a whole-body preparation. The corresponding frozen viscera (shipped separately in jars) will also be analyzed.

If homogenization is not completed at the same time, the fillet sample will be placed on a tared sheet of aluminum foil and weighed. It is expected that a minimum weight of 50 grams, and preferably at least 100 grams, will be required to run all analyses (based on information from U.S. EPA [2000] and laboratory personnel). The fillet will then be rewrapped and stored in a plastic bag. The sample will be labeled with identification code and an identifier (*e.g.*, adding F to the identification code) to indicate that it is the fillet portion. The remainder of the body will be kept in the original packaging until homogenization. A label specifying the portion (*e.g.*, W for whole body) and the identification code will be added to the bag.

4.2.3 Homogenization of Whole-Body and Fillet Samples

The fillet, the gutted whole body, and the viscera samples should each be homogenized thoroughly by the laboratory using the same decontamination precautions as when performing the dissections. Laboratories will provide specifications for their methods of homogenizing whole fish; the detailed laboratory SOPs will then specify exact procedures for homogenizing fillets, whole fish, and viscera. Multiple fractions of homogenate for each sample will be kept, stored frozen in tared, certified clean glass jars with a PTFE lid. (PTFE [polytetrafluoroethylene] will be required due to its inertness, in order to prevent contamination of the sample from materials in the lid.) At least four analysis fractions will be kept; at a minimum, these will be 25 grams for organic analyses, 10 grams for metals, and 15 grams for any repeat or additional analyses. Any remaining material will also be preserved as a fourth fraction. The sample number will be amended to indicate the fraction number (*e.g.*, WC-003-F-1 and WC-003-F-2, for two fractions of a fillet from white croaker number 3). Viscera will be analyzed primarily for organic contaminants, and so a smaller volume is acceptable.

Sample duplicates will be run once with each batch, to ensure adequate homogenization. If the laboratory duplicate results do not meet the specified data qualify objective, the batch will be re-homogenized and re-sampled. Rinsate blanks will be collected at a minimum of once per day or every 20 samples, whichever is more frequent. Initial rinsate samples will be analyzed to determine if decontamination between samples is adequate. If potentially significant contamination is noted in the rinsates, then decontamination procedures will be re-evaluated. If rinsates indicate no cross contamination, then future rinsates will be archived but not analyzed (unless there are questionable data).

4.3 Chemical Analyses

4.3.1 Chemicals to be Measured

COPCs for the study area are described in Section { REF _Ref9850808 \r \h * MERGEFORMAT }. DDTs (*p,p'*-DDT, *o,p'*-DDT, *p,p'*-DDE, *o,p'*-DDE, *p,p'*-DDD, *o,p'*-DDD) and PCBs will be measured for all samples included in the initial analysis phase. Mercury (total), chlordane (the sum of *cis/trans* chlordane, oxychlordane, and *cis/trans* nonachlor) and arsenic (inorganic and total) will be spot-checked as described in Section { REF _Ref9401272 \r \h * MERGEFORMAT }. Dieldrin and dioxins may also be examined at certain sites in certain species, dependent on forthcoming results from the CFCP and Bight '98 analyses.

4.3.2 Analytical Methods

Prior to beginning the sample analyses, the laboratory will be required to provide the Standard Operating Procedures for each analytical method to be performed. All results will be reported on a wet-weight basis, but lipid and moisture content of each sample also will be reported to facilitate interpretation of results and conversion of results to lipid- or dry-weight bases. The general methodology expected to be used for each chemical and the target detection limits are outlined in { REF _Ref2402310 \h * MERGEFORMAT }. Target detection limits

have been determined from other recent sampling programs and from EPA recommended values (SCCWRP [1998], CFCP [2001], U.S. EPA [2000])

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 }

Specifications for Likely Analytical Methods

Method	Parameter	Analyte	Target Detection Limit (ng/g wet weight)
GC/MS-SIM (Gas Chromatography/ Mass Spectrometry with Single Ion Monitoring)	Organochlorine pesticides and PCBs	P, p' and o,p' isomers DDT, DDE and DDD isomers	1.0
		PCB Congeners	0.1
		Each chlordane component	1.0
		Dieldrin	0.1
High Resolution Mass Spectrometry	Dioxins	Dioxin congeners	0.001
Cold Vapor Atomic Absorption Spectroscopy	Mercury	Total mercury	15
Hydride Generation Atomic Absorption Spectroscopy	Arsenic	Total inorganic arsenic	30

4.3.2.1 DDTs and PCBs

The analysis of the fish tissue will be by gas chromatography with low resolution mass spectrometry detection in selected ion monitoring mode (GC/MS-SIM). PCBs are to be identified and measured as individual congeners as well as a total for each homologue group (*i.e.*, by level of chlorination). [12] Total PCBs are to be determined by summing the homologue groups. DDT isomers are to be identified and measured individually.

[12] The method for identification and quantitation of PCB homologues and congeners by GC/MS-SIM will be detailed in the laboratory SOP. The general methodology is as follows: For each homologue group, a primary ion (such as 324 for the pentachlorobiphenyls) and a secondary ion (such as 326) will be selected The identity of a compound will be based on the ratio of the primary and secondary ions, the relative retention times of the primary and secondary ions, the absolute retention times of the ions (as compared to the labeled standards and the retention times in the calibrations), and the relative intensities of the ions as compared to the background noise. To quantitate, first, the concentrations of all target compounds that meet the identification acceptance criteria will be calculated, and reported individually on the sample result summary form. Next, each remaining peak will be evaluated to determine if it meets the identification acceptance criteria for a PCB congener. If the criteria are met, these peaks will be included as the other non-target congeners within the appropriate homologue group. (The ICAL will contain at least one peak in each homologue group, and the concentrations of the non-target congeners will be determined using a representative response factor from the ICAL.) If a peak does not meet the identification criteria, the peak is not included in the summation. The total for each homologue group will be obtained by summing all target and non-target congener concentrations within each homologue group. If a congener is reported as non-detected, then zero will be used in the summation. Total PCBs will be calculated by summing the

The following list of PCB congeners will be tested for: 18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, 206. This list of congeners was assembled for the Bight '98 survey based on results of past work in the Southern California Bight (SCCWRP 1998). The laboratory will specify the primary and secondary ions that they intend to use for each homologue group.

4.3.2.2 Other Organochlorines

Concentrations of chlordane components (*i.e.*, *cis*- and *trans*-chlordane, *cis*- and *trans*-nonachlor, and oxychlordane) and dieldrin will be determined in selected samples, also by GC/MS-SIM or another method demonstrated to have similar accuracy. It is our understanding that laboratories may be able to make these measurements as part of their determination of DDT and PCB levels. The specific approach to be used to measure chlordane or dieldrin levels will be specified by participating laboratories, incorporated into their SOPs and subject to all QA/QC requirements.

4.3.2.3 Dioxins

If it is determined that dioxins will be measured in samples, a suitable performance-based method will be used. Decisions on congeners to measure will be based on other samples analyzed in southern California.

4.3.2.4 Mercury

Selected samples will be analyzed for total mercury by cold vapor atomic absorption spectroscopy or another proposed method that meets required standards. Inorganic and methyl mercury will not be measured separately because it has been shown that greater than 95 percent of mercury in fish samples is methylmercury (Bloom, 1992).

4.3.2.5 Arsenic

Selected samples will be analyzed for total and inorganic arsenic. Samples for inorganic arsenic will be measured as the sum of arsenate and arsenite ions, as is done in the EPA standard method 1632 (Revised) for determination of inorganic arsenic (which specifies use of hydride generation atomic absorption spectroscopy) or by another method proven to have similar accuracy.

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concentrations of PCB homologues. If a homologue group is reported as non-detected, then zero will be used in the summation.

4.3.2.6 Other Variables

The following additional variables will be measured:

(a) *Percent lipid* – Determination will be made using a gravimetric method on an aliquot of the extract used for organochlorine analysis. Weight will be determined using a balance of appropriate sensitivity (to be specified in the SOPs) until constant weight is obtained.

(b) *Moisture content* – An aliquot of each sample, taken from the organic analyses fraction, will be dried at 105 °C until constant weight is obtained using a balance of appropriate sensitivity (to be specified in the SOPs).

4.4 Data Reporting

Data will be reported by the analytical laboratory in an electronic database format as well as in hard copy format. The analytical laboratory will be required to provide "full data packages" (Contract Laboratory Program-equivalent package plus raw data) with the data report, including all backup information from the time of sample receipt to the final printout from the analytical instrument. { REF _Ref2488284 \h * MERGEFORMAT } indicates the necessary information in the package. This documentation allows independent (*i.e.,* outside of the laboratory) validation of the results and allows for permanent and readily accessible documentation of the analytical results.

Exhibit { STYLEREF 1 \s }-{ SEQ Exhibit * ARABIC \s 1 } Data Package Deliverables
Case Narrative
Cross reference of Field Sample No., Laboratory Sample No., and Analytical Batch
Chain-of-Custody Form (including Sample Receipt Checklist)
Sample Calculation
Results Summary for Each Sample and Blank
Blank Spike Results
Surrogates Recovery
Matrix Spike Results and Recoveries
Sample Duplicate Results and RPD Values
Reference Material Results and Performance Criteria Assessment
Internal Standard Recoveries (Format at Laboratory Discretion)
Instrument Tune
Initial Calibration for Single Component Analytes, Retention Time Windows
Initial Calibration for Single Component Analytes, Response Factors.
Calibration Verification Including End-of-Run Verification.
Gel Permeation Chromatography Check (if GPC performed)
Chromatograms and Instrument Printouts for Each Sample, Blank, and Standard
Quantitation Report
Copies of Sample Preparation Work Sheets
Copies of Run Logs

4.5 Analytical QA/QC

The analytical QA/QC procedures presented in the following sections will provide the basic guidance for laboratory protocols to ensure the quality of the data. As indicated above, the laboratory will provide a QA Plan as part of the selection criteria, and will also provide specific QA/QC procedures for each analytical method used. These QA/QC considerations will be incorporated in the final SOPs and QAPP for the study. General QA/QC components that must be included/addressed as part of this project are identified below:

(a) Initial Documentation of Detection Limits

(b) Initial Calibration of Equipment

(c) On-going Detection Limits

(d) Calibration Verification

(e) Certified Reference Materials

(f) Method Blanks

(g) Matrix Spikes

Remote User

Job 18348
03/25/05 08:05 AM

ERROR: unmatchedmark
OFFENDING COMMAND:]
STACK: 6 , 78 , 44 , 28 , 33 , 28 , 51 , 66 , 39 , 50 , 28 , 50 , 44 , 39 , 25 , 66 , 39 , 50 , 28 , 50 , 44 , 51 , 66
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45 , 44 , 28 , 44 , 39 , 25 , 66 , 28 , 50 , 29 , 44 , 33 , 50 , 44 , 28 , 66 , 39 , 28 , 44 , 50 , 51
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