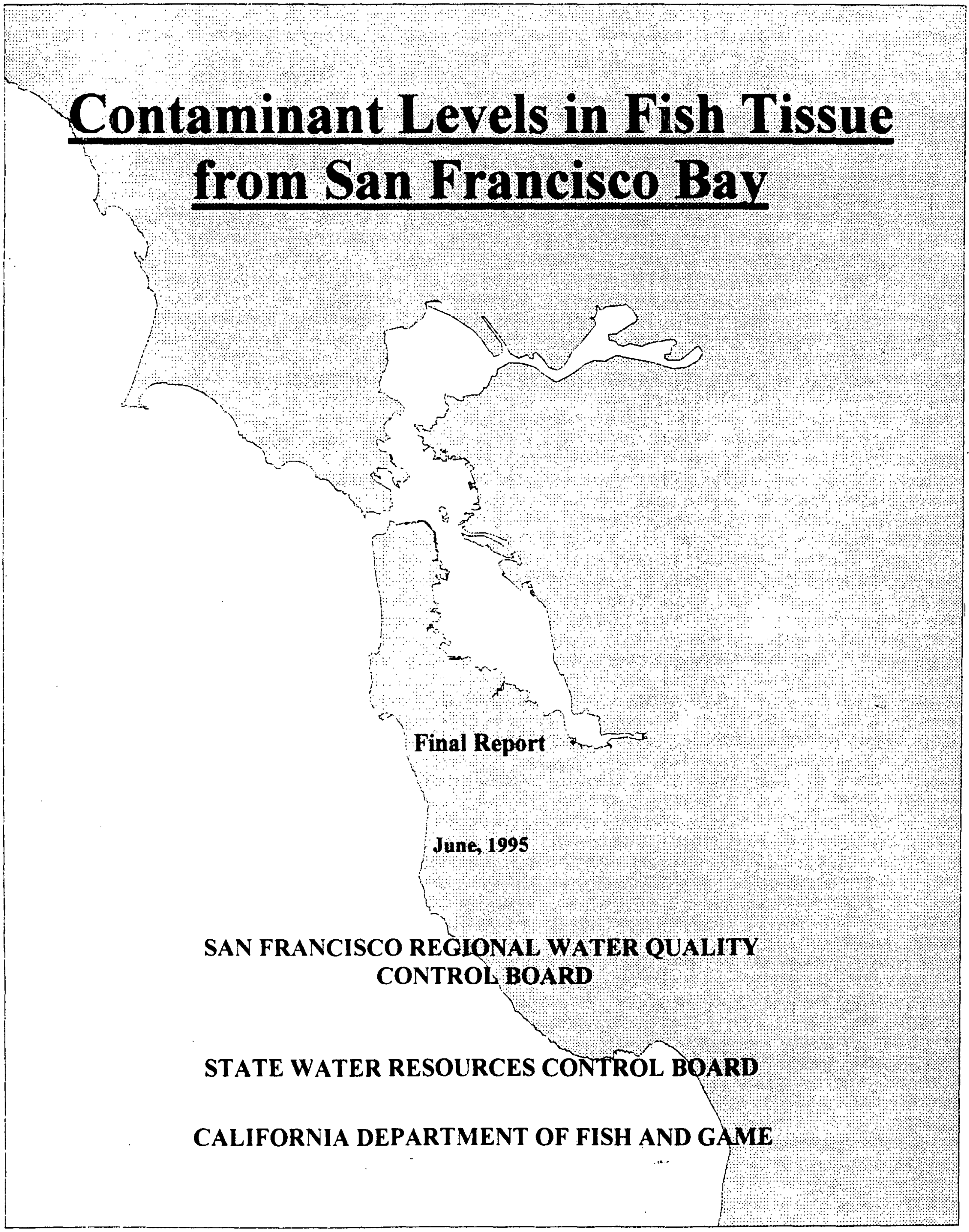

Contaminant Levels in Fish Tissue from San Francisco Bay

Final Report

June, 1995

SAN FRANCISCO REGIONAL WATER QUALITY CONTROL BOARD

STATE WATER RESOURCES CONTROL BOARD

CALIFORNIA DEPARTMENT OF FISH AND GAME

CONTAMINANT LEVELS IN FISH TISSUE

FROM SAN FRANCISCO BAY

FINAL REPORT
June, 1995

San Francisco Bay Regional Water Quality Control Board

California Department of Fish and Game
Marine Pollution Studies Laboratory

State Water Resources Control Board

EXECUTIVE SUMMARY

The main purpose of this study was to measure levels of contaminants in edible fish tissue from species caught by anglers in San Francisco Bay. The study was designed in a cooperative effort between state agencies, environmental groups and anglers. This study was managed by the San Francisco Bay Regional Water Quality Control Board, funded by the Bay Protection and Toxic Cleanup Program and conducted by the California Department of Fish and Game. Due to limited funding, the study was designed as a pilot, rather than a comprehensive survey. The main objective of the study was to identify, to the maximum extent possible, chemicals, fish species and geographic areas of concern in San Francisco Bay in order to aid in developing a more comprehensive study. The EPA guidance document, Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories- Volume 1- Fish Sampling And Analysis (EPA 823-R-93-002, 1993), was used as a model for designing the study and determining potential chemicals of concern. As the design developed, the study was expanded to provide enough information to perform a limited health risk assessment on consuming certain fish species caught in San Francisco Bay. The Office of Environmental Health Hazard Assessment will be evaluating data collected from this study to determine if health advisories should be issued. Advisories are issued to ensure that the fishing public can make informed decisions about consumption of fish caught in the Bay. The purpose of this report is to provide information on concentrations of contaminants in certain species and at certain geographic areas in the Bay, and to identify potential chemicals of concern in the Bay as a whole. It is not intended to be a health risk assessment.

A total of 16 geographic areas throughout the Bay were sampled in this study: thirteen geographically discrete "stations", and three geographically non-discrete "regions" of the Bay (for collection of sharks). Criteria used to select discrete sampling stations were: 1) good geographic representation of all areas of the Bay, 2) proximity to commonly fished shorelines or piers, 3) geographically discrete "stations" that were near contaminated areas in order to evaluate worst case conditions, and 4) geographically discrete "stations" that were thought to be physically distant from chemically-contaminated areas and, therefore, more likely to be chemically uncontaminated reference sites.

The thirteen geographically discrete "stations" which were sampled were:

1. San Mateo Bridge
2. Dumbarton Bridge
3. Fremont Forebay
4. Richmond Inner Harbor (Friendship Shamada Park)
5. Berkeley Pier
6. Oakland Inner Harbor (Fruitvale)
7. Oakland Middle Harbor Pier
8. Double Rock (Candlestick)
9. Islais Creek

10. Point Molate
11. Rodeo Pier
12. San Francisco Pier #7
13. Vallejo Pier- Mare Island Strait

The two stations thought to be least contaminated were Berkeley Pier and San Francisco Pier #7. Although these were chosen originally as reference sites, results showed that these stations were not the least contaminated for all chemicals. These two stations were chosen also because of the large amount of fishing done from these piers. Three geographically non-discrete "regions" were sampled for sharks. These were the North Bay (north of the Richmond-San Rafael Bridge), Central Bay (between the Richmond-San Rafael Bridge and the San Mateo Bridge) and South Bay (south of the San Mateo Bridge). In addition, one composite sample of sturgeon was collected from Grizzly Bay and one composite sample of striped bass was collected from the Sacramento River.

Fish species were selected and prioritized based on two criteria: 1) likelihood of catch and consumption by Bay area anglers, and 2) likelihood of contaminant accumulation based on tissue lipid content or feeding behavior. White croaker was the highest priority species at all 13 stations. Other fish species collected included: shiner surfperch, walleye surfperch, leopard sharks, brown smoothhound sharks, striped bass, sturgeon and halibut.

Fish Sample Collection

At each of the thirteen discrete stations, enough fish to prepare four composites of fillets were collected. At each station, three composites of the highest prioritized fish with sufficient numbers, and one composite of the second most abundant fish, in order of priority, were collected. Three composites of shark were collected in each region. When three composites of any fish were collected they were size-classed. Composites were comprised of fillets from a standard number of fish for each particular species. The number of fish per composite depended on fish species size, and ranged from three for sharks, sturgeon, striped bass and halibut to twenty for shiner surfperch. In total, sixty-six composite fish samples were prepared from 494 individual fish that were collected.

Fish were collected between May 2nd and June 10th, 1994 by several standard collection methods such as seines, gill nets, and hook and line. All materials with which fish came into contact were chemically cleaned via a process designed to leave materials non-contaminated with trace metals and trace organic chemicals. Once the fish were caught, they were wrapped in chemically-cleaned teflon sheeting and frozen for transport to the laboratory. Dissections and tissue sample preparations were performed in a clean room laboratory using non-contaminating techniques.

Laboratory Analyses

All sample composites were analyzed for trace metals, PAHs, PCB congeners and pesticides. The largest size-class composite at each station was analyzed for dioxins, furans and coplanar PCB congeners, in addition to standard analyses previously listed. For all chemical analyses, small fish (white croaker and surfperch) were analyzed with skin intact, and larger fish (shark, striped bass, sturgeon and halibut) were analyzed with skin removed. Although the skin generally contains higher lipid levels than muscle tissue, this approach was chosen to better represent the manner in which anglers most often cook and consume particular fish species.

Data Analysis

The EPA approach to assessing chemical contaminants in fish tissue, contained in the EPA guidance document, has been used in this report. This approach allows pilot study screening values (PS-SVs) to be calculated for identification of potential chemicals of concern. PS-SVs are more conservative (i.e.- protective with respect to human consumption) than EPA screening values because they include calculations based on a tissue consumption rate of 30 grams/day (one meal a week) rather than the 6.5 grams/day rate (one meal per month) used by the EPA. The 30 gram/day rate was chosen because it better represents recreational fisherman, the target group addressed by the pilot study. Comparisons of sample tissue levels with PS-SVs are meant to assist in guiding further investigations and focusing activities at the Regional Board. They should not be construed as regulatory action levels or be used as definitive answers to questions concerning the safety of fish consumption.

Results

Six chemicals or chemical groups exceeded their respective pilot study screening values. Therefore, for the purposes of this study, these chemicals appear to be the main chemicals of concern for consumption of fish from San Francisco Bay. These chemicals were PCBs (total Aroclors), mercury, dieldrin, total chlordanes, total DDTs, and total dioxin/furans (TEQ).

The PS-SV of 3 ppb for total PCBs, based on the sum of Aroclors, was exceeded in all sixty-six tissue composite samples analyzed in this study. Levels were highest (638 ppb) at stations nearest San Francisco and Vallejo-Mare Island, particularly in fish with higher tissue lipid contents, such as white croaker. PCBs, which were banned from production in the U.S. by the EPA in 1979, have been one of many chemicals monitored by the California Mussel Watch Program. Long-term monitoring of this contaminant in tissues of filter feeding mussels revealed that PCB concentrations have decreased dramatically since 1979. However, despite these encouraging declines, PCBs should be one of the primary chemicals of concern in the Bay, due to elevated levels of PCBs and large number of screening value exceedences found in this study.

Mercury exceeded the PS-SV of 0.14 ppm in forty of sixty-six composite samples. Mercury levels were highest in composites from large leopard sharks (1.26 ppm) and brown smoothhound sharks, regardless of where they were collected in the Bay.

Mercury was also elevated in other species, with larger fish exhibiting higher levels of mercury contamination, especially in the North Bay. Mercury is a naturally-occurring element that is assimilated by fish in its organic form, methylmercury. The major sources of mercury in the Bay area are naturally-occurring mercury deposits, many of which were historically mined. Other mining activities, urban runoff, and discharges from some industrial and agricultural processes are also mercury sources (Phillips 1987). Most of the fish consumption advisories issued in the U.S. are in response to elevated methylmercury levels. The Food and Drug Administration currently recommends that shark and swordfish be consumed no more than once a week (7 ounces) for the general population and no more than once a month for pregnant women and women of childbearing age who might become pregnant (FDA, 1994).

Thirty-five of sixty-six tissue composite samples analyzed for dieldrin exceeded the PS-SV of 1.5 ppb. Concentrations of this pesticide were highest in white croaker composites (4.2 ppb), and screening value exceedences were found at stations throughout the Bay. Striped bass and shiner surfperch composites also exceeded screening values throughout the Bay. As with PCB's, dieldrin exhibits a strong tendency to accumulate in fatty tissue and is found in highest concentrations in fish with high lipid content.

Total chlordanes exceeded the PS-SV of 18 ppb in seven of sixty-six composite samples analyzed. Of the seven, the three highest levels occurred at the Vallejo-Mare Island station, with a maximum concentration (36 ppb) found in the largest size class of white croakers. The use of chlordane was phased out beginning in 1975. Long-term data from the Mussel Watch program indicate declining concentrations of this pesticide in mussel tissues over the past 15 years.

Total DDT exceeded the PS-SV of 69 ppb for nine of sixty-six tissue composite samples analyzed. Concentrations of this pesticide were found to be highest (155 ppb) in composites prepared from white croakers caught near the north end of the Bay. DDT was banned from use in 1972. Long-term data from the Mussel Watch program indicate declining concentrations of this pesticide in mussel tissues over the past 15 years.

Due to the high cost of dioxin analysis, only nineteen of sixty-six tissue composite samples were analyzed. Sixteen of the nineteen samples exceeded the dioxin-TEQ PS-SV of 0.15 parts per trillion. The highest levels (1.3 to 1.75 parts per trillion) were found in composites from white croaker caught at stations near the San Mateo and Dumbarton Bridges. Although dioxin values from the Bay exceed the screening value, they fall well within the range of background dioxin values reported by the EPA for sixty fish samples collected from relatively clean areas across North America. However, in a draft document, EPA stated that these background levels are of health concern (EPA, 600/6-88/005Ca, 1994).

A number of chemicals measured in this study fell below the pilot study screening values. Based on the results of this report, these chemicals are not considered chemicals of concern for consuming fish from the Bay, at this time. These chemicals are cadmium, selenium, endosulfan, endrin, heptachlor epoxide, hexachlorobenzene, mirex, toxaphene and chlorpyrifos. Many chemicals measured in this study have no EPA screening values and therefore pilot study screening values could not be calculated. However, some generalizations can be made about these chemicals. The PAH analysis in this study indicated that levels were near or below method detection limits in all samples measured. Levels of other analytes measured in this study appeared to be at low levels which are not cause for concern. One exception to this may be arsenic levels in sharks which deserve further evaluation.

Additional evaluation of study results and statistical analysis of data are included in the report. The main conclusions of the study are:

1) The EPA guidance document, <u>Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories- Volume 1- Fish Sampling And Analysis</u> (EPA 823-R-93-002, 1993), was an effective tool for designing the pilot study and analyzing data collected from the San Francisco Bay study.

2) Based on calculated pilot study screening values (PS-SVs), six chemicals or chemical groups are identified as potential chemicals of concern in San Francisco Bay. They are PCBs, mercury, dieldrin, total DDT, total chlordane and the dioxin/furans.

3) High levels of the pesticides dieldrin, total DDT and total chlordane were most often found in fish from the North Bay.

4) Levels of PCBs, mercury and the dioxin/furans were found at concentrations exceeding the pilot study screening values throughout the Bay.

5) Fish with high lipid content (croaker and shiner surfperch) in their tissue samples generally exhibited higher organic contaminant levels, with the exception of methyl mercury. Fish with low lipid levels (halibut and shark) generally exhibited lower organic contaminant levels. It should be noted though that skin on/skin off sampling differences may have magnified lipid differences between species in this study.

6) Of Bay fish collected, white croaker consistently exhibited the highest tissue lipid concentrations. Lipophilic PCBs and pesticides concentrated to the highest levels in the tissue of this fish.

7) Mercury levels were found to be highest in the two shark species collected; leopard shark and brown smoothhound shark. Leopard sharks and white croaker exhibited increasing mercury concentration with increasing fish size, suggesting bioaccumulation of this metal in Bay area fish.

8) Vallejo-Mare Island is the sampling location from which fish most often exhibited high levels of chemical contaminants. Oakland Inner Harbor also exhibited a high incidence of tissue contamination.

9) A comprehensive study of potential chemicals of concern, and accumulation of these chemicals in fish and invertebrate tissues, is recommended for the San Francisco Bay area and its tributaries.

Data presented in this report will be evaluated in detail by the Office of Environmental Health Hazard Assessment (OEHHA), with input from the California Department of Health Services, in order to prepare a health risk assessment. Recommendations or advisories concerning consumption of fish caught from San Francisco Bay will be developed and issued, if necessary, as a result of that assessment. Recommendations are made in this report regarding the need for additional studies. However, after analysis of the data by OEHHA, additional recommendations will be made based on the adequacy of the data to perform human health risk assessments.

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INTRODUCTION

PURPOSE

Although health advisories for mercury have been issued on consumption of striped bass from San Francisco Bay since the early 1970's, limited information is available for contaminant levels found in tissues of other Bay fish species. It is likely that other fish, which are caught and consumed by Bay area anglers, bioaccumulate or bioconcentrate contaminants at an equal or possibly greater rate than striped bass, due to their differences in feeding behavior and tissue fat content. This data gap causes researchers to raise questions regarding the impact of contaminants on local fish species and the people and other organisms that consume fish from the Bay.

In response to these concerns, the San Francisco Bay Regional Water Quality Control Board (RWQCB) initiated a pilot study aimed at measuring contaminant levels in the tissue of a number of common San Francisco Bay fish species. The RWQCB organized a committee to assist with sample design and is grateful for the participation of representatives from the Office of Environmental Health Hazard Assessment, Department of Health Services, Department of Fish and Game, Department of Toxic Substances Control, Aquatic Habitat Institute, Save San Francisco Bay, SAFER, Baykeeper and Citizens for a Better Environment. The study was funded by the State Water Resources Control Board's Bay Protection and Toxic Cleanup Program and was managed by the RWQCB. Field work and analyses were contracted to the Department of Fish and Game. In addition, citizen volunteers were trained in sampling protocols and participated with sampling at one location.

The study was designed as a pilot study to screen for chemicals of concern in the tissue of fish caught near public fishing piers and public accesses in the San Francisco Bay area. The basic goal of any pilot study is to provide the information which is needed to design a cost-effective comprehensive study. This study was designed to enable researchers to screen a number of fish species and stations for a large number of chemical contaminants. This will allow a subsequent comprehensive study to effectively concentrate on the most elevated chemicals and impacted fish species. However, a comprehensive study may additionally include other species and chemicals not addressed in this study. Fishing areas near suspected point and non-point sources, for a variety of contaminants, were of primary concern. Most of the stations sampled addressed this concern, but for comparative purposes, fish were caught at heavily fished locations thought to be less contaminated, such as the Berkeley fishing pier and San Francisco Pier #7. Additional analyses were performed to determine which sites and species were relatively most contaminated. The study design relied on recommendations and guidelines provided in the EPA's recent publication Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories- Volume 1- Fish Sampling And Analysis (EPA 823-R-93-002, 1993).

An expansion of the pilot design, which increased the number of samples collected at each station, increased the likelihood that data collected would be useful for an interim analysis of any health risks associated with the consumption of contaminated tissues. However, it was acknowledged by the study design committee, that a more comprehensive study may be required in the future in order to provide sufficient data to undertake a complete health risk assessment for the species and locations studied.

The objectives of this document are to report the levels of contaminants found in edible tissue of fish species caught from the Bay, identify potential chemicals of concern and compare relative contaminant levels of different species and sites in the Bay. Data analyses were performed to better focus the RWQCB on design of a comprehensive study and to provide understandable information to the public. This report is not a health risk assessment and should not be interpreted as guidance for the safety of consuming fish caught from the Bay. The Office of Environmental Health Hazard Assessment will be performing a human health risk assessment with this data set and will determine if advisories will be warranted for consuming fish from the Bay.

STUDY AREA AND DESIGN

Increased inputs of anthropogenic contaminants to San Francisco Bay began soon after the discovery of gold in the Sierra Nevada during 1848 (Nichols *et al.*, 1986). Trace element contamination has continued from riverine loading, urbanization and industrialization until today, and persists extensively throughout the system. An excellent review of the distribution of trace elements and industrial contaminants in the Bay can be found in Luoma and Phillips (1988). Beginning in the 1940's, use of fertilizers, pesticides, herbicides and soil additives became widespread in the Central Valley, and began influencing the Bay waters through the San Joaquin and Sacramento Rivers and their tributaries. These synthetic organic chemicals have been produced in increasing numbers and may have found their way into Bay waters. Mass loading of these contaminants is discussed extensively in Gunther *et al.* (1987).

With widespread point and non-point source input of these contaminants to the Bay it is difficult to accurately evaluate such a complex system with a limited number of study sites. However, the pilot study design committee decided to adopt the following criteria for selecting sites and fish species. These would provide the most scientifically revealing, yet economical, data set from which to assess contaminant levels in fish.

The criteria for selection of sites were:

1. Geographical representation of all four regions of the Bay (South Bay, Central Bay, San Pablo Bay and the Carquinez Straits/Suisun Bay)
2. Proximity to known chemically contaminated areas.
3. Proximity to popular fishing areas.
4. Proximity to relatively uncontaminated areas for inclusion of a reference station.

The thirteen fishing areas that were selected and sampled were:

1. San Mateo Bridge (West shoreline near pier)
2. Dumbarton Bridge (East shoreline near pier)
3. Fremont Forebay (East of the Fremont Landfill)
4. Richmond Inner Harbor (Friendship Shamada Park)
5. Berkeley Pier
6. Oakland Inner Harbor (Fruitvale)
7. Oakland Middle Harbor Pier
8. Double Rock (Candlestick)
9. Islais Creek Channel
10. Point Molate (San Pablo Strait)
11. Rodeo Pier (Carquinez Strait)
12. San Francisco Pier #7 (Municipal Pier)
13. Vallejo Pier - Mare Island Strait (Knight Is.)

Martinez Pier originally was chosen as a study site, but after one and a half days of fishing effort, no fish were caught in sufficient quantities to complete a sample composite. It is unknown why the Martinez station lacked fish, but in an effort to adequately collect samples from the North Bay, a station at Vallejo-Mare Island was substituted in its place. Figure 1 illustrates the thirteen specific sampling stations throughout San Francisco Bay.

Fish species targeted for collection were selected and prioritized based on three criteria:

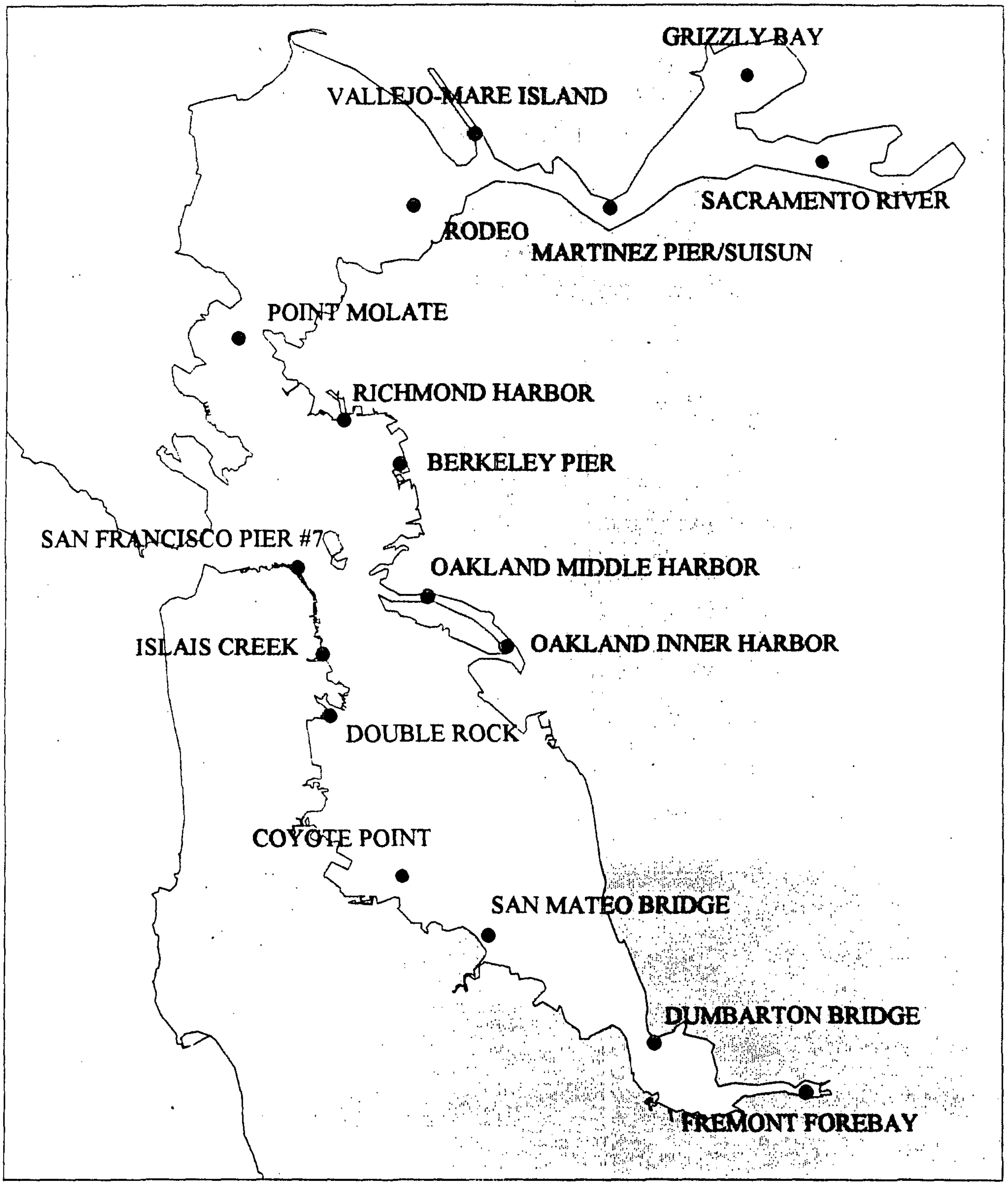
1. Relative abundance of species of interest.
2. Behavior of the species i.e. - feeding behavior and habitat range.
3. Frequency of consumption by anglers.

Fish species selected and number of fish needed to complete a composite at each station in order of priority were:

1. White Croaker *(Genyonemus lineatus)* (5 per composite)
2. Walleye *(Hyperprosopob argenteum)* or White Surfperch *(Phanerdon furcatus)* (5 per composite)
3. Shiner Surfperch *(Cymatogaster aggregata)* (20 per composite)
4. Jacksmelt *(Atherinopsis californiensis)* (5 per composite)
5. Leopard Shark *(Triakis semifasciata)* or Brown Smoothhound Shark *(Mustelus henlei)* (3 per composite)
6. Striped Bass *(Roccus saxatilis)* (3 per composite)
7. White Sturgeon *(Acipenser transmontanus)* (3 per composite)
8. Halibut *(Paralichthys californicus)* (3 per composite)

It was necessary to use composite tissue samples to maximize the number of stations and fish species on which chemical analysis could be performed. The number of fish required to complete a composite was selected as five for smaller species and three for larger species. Shiner surf perch required a composite of twenty to provide sufficient tissue for multiple chemical analyses. At each site, four composites of fish were collected. Three composites of the most abundant species and one composite of the second most abundant fish in order of priority was collected at each station.

Figure 1
San Francisco Bay Fish Contaminant Study
Station Locations



In addition to sampling in this manner at the thirteen discrete sites, shark species were regionally targeted. Sharks were collected from the South Bay (south of the Oakland Bay Bridge), Central Bay (between the Oakland and San Rafael Bridges) and North Bay (north of the San Rafael Bridge). Striped bass, halibut and sturgeon were targeted for collection at whichever location they were in sufficient quantities to meet sample size requirements. One composite sample of sturgeon was collected from Grizzly Bay and one composite sample of striped bass was collected from the Sacramento River. A total of 66 composite samples were collected over the course of the study. Sampling locations, fish species, composite number and size range are listed in APPENDIX I - Section I.

All fish species with three composites were size classed in the laboratory to yield a composite of large, medium and small sized fish. These size classes were based on the size range of fish captured at each individual station and do not necessarily represent generalized size classes from the Bay (i.e.- the large size class at a South Bay station may not have the same size fish as the large size class at a North Bay station). Size range and mean lengths of each of the size class are given in Appendix I - Section 1. Striped bass, halibut and sturgeon were targeted for collection at no less than legal sport fishing minimum lengths. Halibut and sturgeon collected met this requirement, but in order to reach the required sample size at the Fremont Forebay and the Vallejo-Mare Island location, sublegal (less than 18 inches) striped bass were kept.

Muscle tissue (i.e.- fillets) of striped bass, shark, sturgeon and halibut were analyzed with skin removed, while the smaller species were analyzed with skin on. The decision to analyze tissue with the skin on or off was based on the way the fish was most commonly cooked and eaten. The skin is known to have higher lipid concentrations than the muscle tissue so direct comparison between species must consider this sampling procedure. If data from this report is used to compare bioaccumulation or biomagnification rates between species, normalization of lipid to contaminant data is recommended to account for skin off/skin on differences. No dissections or analyses were performed on organ tissues since they are not normally consumed by anglers.

Composites of all target species were collected over the course of the sampling effort, with the exception of jacksmelt. Although jacksmelt were caught at several sampling locations, they were never caught in sufficient quantities to complete a composite. It is unknown if the poor catch rate during this study resulted from inappropriate capture techniques or absence of this species from selected stations. Feeding behavior may make jacksmelt less of a concern than other species, however, it should still be recognized as a commonly caught fish species in San Francisco Bay and should be examined in future analysis.

All sample composites were analyzed for trace metals, PAHs, PCB congeners, pesticides, percent moisture and percent lipid. The largest size composite, based on standard length, at each site was analyzed for dioxins, furans and coplanar PCB congeners. Additionally, striped bass, shark, sturgeon and halibut composites were analyzed for dioxins, furans and coplanar PCBs.

Methods
Fish were collected between May 2nd and June 10th, 1994. Collection methods included the use of a 1 1/4" size nylon stretch mesh otter trawl (towed behind an 18' Boston Whaler), trammel nets (18" & 8" nylon stretch mesh panels), gill nets (2 1/2" monofilament mesh) and hook & line. Initial sampling effort for the study relied heavily on otter trawls for the capture of smaller species (perch and croaker). During low light periods of early morning and evening, capture rates seemed to increase using this method. This was a concern because it appeared that net avoidance might be occurring. As the sampling progressed, gill nets were deployed more regularly when trawling was ineffective. Increased reliance on gill nets as sampling progressed may have created a bias toward increased size of croaker collected near the end of the sampling effort. This should be considered when comparisons of chemicals for different size classes and stations are made later in this report. A complete description of collection methods and sampling effort can be found in the Cruise Report in Appendix IV.

Once samples were collected they were wrapped in chemically cleaned teflon sheeting, to prevent trace metal and trace organic contamination during sample handling, and frozen for transportation to the laboratory. Dissections and tissue sample preparations were performed using non-contaminating techniques in a clean room environment. Fillets of muscle tissue were removed in 5 to 10 g portions with teflon forceps. Equal weight fillets were taken from each fish of the sample to composite a total of 200 grams. All samples were polytroned to provide a homogeneous material for analysis. Sample splits were taken for each analysis after homogenization was completed.

Tissue samples were prepared for trace metal analysis by digesting with concentrated 4:1 nitric:perchloric acid in a Teflon vessel. Tissue samples were first heated on hot plates for five hours. Caps were tightened and heated in a vented oven at 130° C for four hours. The liquid digestate was diluted with Type II Milli-Q® water to a final volume of 20.0 ml.

Tissue digestates were analyzed for trace metal analysis by graphite furnace atomic absorption spectrophotometry (GFAAS) on a Perkin-Elmer Model 3030 Zeeman or by flame atomic absorption spectrophotometry (FAAS) on a Perkin-Elmer Model 2280 for Ag, Al, As, Cu, Cd, Cr, Mn, Ni, Pb, Se, Sn, and Zn depending on concentration. Mercury was analyzed by cold vapor technique using the Perkin-Elmer Model 2280. Detection limits for trace metal analysis are shown in Table 1.

Table 1 - Trace Metal Wet Weight Detection Limits

Trace Metal	ug/g (ppm) wet
Aluminum	4.0
Arsenic	0.05
Cadmium	0.002
Chromium	0.02
Copper	0.03
Iron	0.03
Lead	0.02
Manganese	0.3
Mercury	0.01
Selenium	0.03
Silver	0.002
Tin	0.02
Zinc	0.02

Tissue homogenates were analyzed for detection of PCBs, pesticides and PAHs after extraction with methylene chloride. The extract was divided into three portions: one quarter of the volume for lipid weight determination, one half for aromatic and chlorinated hydrocarbon (AH/CH) analysis and one quarter for validation of the single fraction analysis. The AH/CH fraction was analyzed by capillary gas chromatography for chlorinated hydrocarbons, utilizing an electron capture detector. The AH/CH fraction was also analyzed by gas chromatography mass spectrometry (GC/MS) for aromatic hydrocarbons. Detection limits for synthetic organic analyses are shown in Tables 2-4.

Table 2 - Pesticide Wet Weight Detection Limits

PESTICIDES	ng/g(ppb), wet weight
Aldrin	0.2
cis-Chlordane	0.2
trans-Chlordane	0.2
alpha-Chlordane	0.2
gamma-Chlordane	0.2
Chlorpyrifos	0.8
Dacthal	0.2
o,p'-DDD	1
p,p'-DDD	0.6
o,p'-DDE	0.6
p,p'-DDE	0.2
p,p'-DDMS	4
p,p'-DDMU	1
o,p'-DDT	0.8
p,p'-DDT	0.8
p,p'-Dichlorobenzophenone	5
Dieldrin	0.2
Endosulfan I	0.2
Endosulfan II	0.6
Endosulfan sulfate	1
Endrin	1.2
alpha-HCH	0.2
beta-HCH	0.6
gamma-HCH	0.2

Table 2 - Pesticide Wet Weight Detection Limits (continued)

PESTICIDES	ng/g(ppb), wet weight
delta-HCH	0.4
Heptachlor	0.2
Heptachlor Epoxide	0.2
Hexachlorobenzene	0.2
Methoxychlor	3
Mirex	0.2
cis-Nonachlor	0.2
trans-Nonachlor	0.2
Oxychlordane	0.2
Toxaphene	20

Table 3 - PCB Wet Weight Detection Limits

PCB CONGENERS	ng/g(ppb), wet weight
PCB5	0.2
PCB8	0.2
PCB15	0.2
PCB18	0.2
PCB27	0.2
PCB28	0.2
PCB29	0.2
PCB31	0.2
PCB44	0.2
PCB49	0.2
PCB52	0.2
PCB66	0.2
PCB70	0.2
PCB74	0.2
PCB87	0.2
PCB95	0.2
PCB97	0.2
PCB99	0.2
PCB101	0.2
PCB105	0.2
PCB110	0.2
PCB118	0.2
PCB128	0.2
PCB132	0.2
PCB137	0.2
PCB138	0.2
PCB149	0.2
PCB151	0.2
PCB153	0.2
PCB156	0.2
PCB157	0.2
PCB158	0.2
PCB170	0.2
PCB174	0.2
PCB177	0.2
PCB180	0.2
PCB183	0.2
PCB187	0.2

Table 3 - PCB Wet Weight Detection Limits (continued)

PCB CONGENERS	ng/g(ppb), wet weight
PCB189	0.2
PCB194	0.2
PCB195	0.2
PCB201	0.2
PCB203	0.2
PCB206	0.2
PCB209	0.2
AROCLOR1248	6
AROCLOR1254	2
AROCLOR1260	2
AROCLOR5460	20

Table 4 - PAH Wet Weight Detection Limits

PAHS	ng/g(ppb), wet weight
Naphthalene	2
2-Methylnaphthalene	2
1-Methylnaphthalene	2
Biphenyl	2
2,6-Dimethylnaphthalene	2
Acenaphthylene	2
Acenaphthene	2
2,3,5-Trimethylnaphthalene	2
Fluorene	2
Phenanthrene	2
Anthracene	2
1-Methylphenanthrene	2
Fluoranthene	2
Pyrene	2
Benz[a]anthracene	2
Chrysene	2
Benzo[b]fluoranthene	2
Benzo[k]fluoranthene	2
Benzo[e]pyrene	2
Benzo[a]pyrene	2
Perylene	2
Indo[1,2,3-cd]pyrene	3
Dibenz[a,h]anthracene	3
Benzo[ghi]perylene	3

Samples were analyzed for PCDD/PCDFs and coplanar PCBs according to the HML Method 880 (Hazardous Materials Laboratory, 1992). Fish tissues were freeze dried and homogenized with sodium sulfate. ^{13}C-labeled internal standards were added and each sample cleaned through potassium silicate/silica gel/sodium sulfate, rinsed with 9:1 hexane:methylene chloride and drained under pressure through an Ax21 carbon column. Eluants were collected as fraction 1 and discarded. The carbon column was eluted with 20:80 hexane:methylene chloride and the eluant collected as fraction 2. Toluene extraction of the carbon column in the reverse direction resulted in fraction 3. Each fraction was passed through potassium silicate/40% acid silica/sodium sulfate and eluted with hexane. The extracts were transferred to vials containing ^{13}C-labeled recovery standards in tetradecane. PCDD/PCDFs and PCBs 77, 126, and 169 were determined in fraction 3. PCBs 105 and 118 were determined in fraction 2. Fractions 2 and 3 were analyzed by High Resolution Gas Chromatography/Mass Spectrometry (Varian 3400, Finnigan MAT 90) with a 60m, 0.25μm, DB-5 column, using a temperature program. The MS operated in the EI mode (50eV) with a 0.8mA emission and a minimum resolution of 8000 amu. Method detection limits are unique for each sample analyzed and are reported in Appendix I, Section VI.

Quality Assurance documents have been provided under separate cover by the analytical laboratories to the San Francisco Bay Regional Water Quality Control Board. In depth quality assurance evaluations are provided in those documents. A summary of quality assurance procedures and evaluations is provided in the detailed Laboratory Operating Procedures in Appendix III.

RESULTS AND DISCUSSION

For the purposes of this study, the EPA approach to assessing chemical contaminants in fish tissue (U.S. EPA, 1993) has been utilized. The EPA manual provides guidance for what the EPA Office of Water believes to be scientifically sound methods for sample collection, chemical analysis and data analysis of fish contaminant data. The initial study design for the pilot study relied heavily on this EPA approach, and it is reasonable that evaluation of subsequent data should adopt these procedures as well. The EPA document is not the only guidance document available for assessing contaminants in fish tissue, but it is the most complete and standardized work plan currently available to states which are performing contaminant monitoring programs. Screening values derived in the EPA document are defined as "concentrations of target analytes in fish or shellfish that are of potential public health concern and that are used as standards against which levels of contamination in similar tissue collected from the ambient environment can be compared" (U.S. EPA, 1993). Pilot study screening values were developed for this report, using the EPA approach, to help identify chemicals of concern in San Francisco Bay. Other studies and regulatory agencies have proposed screening levels which range above and below those used by this pilot study report. In Appendix II a number of these values are reported for comparative purposes. Pilot study screening values (PS-SVs) were used in this report because they were developed for the particular purposes of this study and are based on an EPA approach which has received extensive public and scientific review. PS-SVs are more conservative (i.e.-protective with respect to human consumption) than EPA screening values because they include calculations based on a tissue consumption rate of 30 grams/day (one meal a week) rather than the 6.5 grams/day rate (one meal per month) used by the EPA. The 30 gram/day rate was chosen because it better represents recreational fisherman, the target group addressed by the pilot study. Appendix II gives a complete description of the assumptions and variables which were used when calculating the PS-SVs.

Exceedence of these PS-SVs should be taken as an indication that more intensive site and species specific monitoring and/or evaluation of human health risk should be conducted. These preliminary comparisons are meant to help direct further analysis, and should not be construed as regulatory action levels or definitive answers to questions concerning the safety of fish consumption. Data presented in this report will be evaluated in detail by the Office of Environmental Health Hazard Assessment, with input from the Department of Health Services, to assess health risks. Recommendations or warnings concerning the consumption of fish caught from San Francisco Bay will be made based on the health risk assessment of the data.

Six chemicals or chemical groups exceeded the PS-SVs during analysis of the pilot study results (Table 5) and for the purposes of this report will be considered chemicals of concern. These chemicals were mercury, dieldrin, total chlordane, total DDT, PCBs (as total Aroclors) and the dioxin/furans-TEQs. Each of these six is discussed separately in the following sections of this report.

PCBs

A significant concern is the polychlorinated biphenyls (PCBs) levels found in fish throughout the Bay. This class of chemicals is comprised of 209 compounds, called congeners, each of which differ in their chlorine substitution pattern. Mixtures of various PCB congeners have been manufactured in the U.S. since 1929 (Phillips, 1987) and used commercially under the trade name Aroclor. Each Aroclor mixture is numerically designated (i.e.- Aroclor 1254) with the last two numbers indicating the percentage of chlorine in the mixture. These mixtures were used extensively in the U.S. prior to 1979 for industrial applications requiring fluids with thermal stability, fire and oxidation resistance and solubility in organic compounds (Hodges, 1977). PCBs have proven to be extremely persistent in the environment and have demonstrated a variety of adverse carcinogenic and non-carcinogenic effects (U.S.EPA, 1993c). Individual PCB congeners may differ not only in the dose at which toxicity is observed, but also in the toxic effect(s) observed. All congeners have not been tested in a complete battery of toxicity tests (e.g., acute and chronic dosing, and developmental, reproductive and cancer testing), so there are serious gaps in the toxicological database when trying to evaluate the results congener by congener. The toxicology data on Aroclor mixtures, while not perfect, is overall better. In this study, PCBs were analyzed as 48 individual congeners and as 4 Aroclor equivalents. EPA recommends that 18 specific congeners be summed to determine total PCB concentration (NOAA, 1989b) or that the Aroclors be summed to determine a total Aroclor concentration (U.S. EPA, 1993). Total PCB values were determined for 19 of the fish tissue samples and total Aroclors were determined for all samples. These two methods of congener summation are highly correlated in this study (r^2=0.98). Total Aroclor values are reported since they are the larger data set, and the EPA recommends using them to compare to screening values at this time. The PCB values presented in the remainder of this document represent a total of the Aroclors

Table 5 - S.F Bay Pilot Study Screening Value (PS-SV) Exceedences (Bolded)

IDORG #	STATION NAME	FISH TYPE	MERCURY (ppm)	TTLDDT (ppb)	DIELDRIN (ppb)	TTLCLOR (ppb)	TTLARO (ppb)	DIOXIN-TEQ (ppt)
1234	SAN MATEO BRIDGE	5 White Croaker	**0.264**	62.58	**3.28**	17.02	**451.28**	1.3
1235	SAN MATEO BRIDGE	5 White Croaker	0.112	**69.27**	**3.784**	**18.27**	**383.19**	NA
1236	SAN MATEO BRIDGE	5 White Croaker	0.0692	35.60	**1.795**	10.81	**210.22**	NA
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	0.0676	28.61	1.25	4.51	**114.00**	NA
1238	DUMBARTON BRIDGE	5 White Croaker	**0.175**	**78.92**	**3.691**	16.54	**432.98**	1.46
1239	DUMBARTON BRIDGE	5 White Croaker	0.113	36.65	**1.532**	9.86	**233.40**	NA
1240	DUMBARTON BRIDGE	5 White Croaker	0.0825	46.00	**3.464**	12.65	**228.41**	NA
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	0.124	18.48	1.177	4.61	**98.11**	NA
1242	FREMONT FOREBAY	3 Striped Bass	**0.150**	40.11	**2.971**	**18.89**	**148.55**	**0.67**
1243	FREMONT FOREBAY	3 Striped Bass	**0.286**	42.82	**2.423**	17.35	**242.27**	NA
1244	FREMONT FOREBAY	3 Striped Bass	**0.232**	42.83	**1.638**	16.09	**133.56**	NA
1245	FREMONT FOREBAY	4 Striped Bass	**0.245**	17.20	1.072	4.25	**56.98**	NA
1246	RICHMOND HARBOR	20 Shiner Surf Perch	0.130	42.49	**1.635**	4.82	**181.20**	**0.89**
1247	RICHMOND HARBOR	20 Shiner Surf Perch	0.109	36.97	**1.527**	5.26	**147.60**	NA
1248	RICHMOND HARBOR	20 Shiner Surf Perch	0.100	34.22	**1.752**	4.35	**162.93**	NA
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	**0.572**	7.31	0.341	0.50	**36.28**	NA
1250	BERKELEY PIER	20 Shiner Surf Perch	0.133	21.44	0.86	4.16	**138.74**	**0.97**
1251	BERKELEY PIER	20 Shiner Surf Perch	0.0903	15.03	ND	2.44	**88.38**	NA
1252	BERKELEY PIER	20 Shiner Surf Perch	0.0827	13.75	0.632	2.14	**89.70**	NA
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	**0.236**	6.19	ND	0.95	**38.02**	NA
1254	OAKLAND INNER HAR (FRUITVALE)	20 Shiner Surf Perch	**0.420**	**72.56**	**1.752**	15.76	**369.67**	0.85
1255	OAKLAND INNER HAR (FRUITVALE)	20 Shiner Surf Perch	**0.206**	27.41	**1.591**	14.86	**242.18**	NA
1256	OAKLAND INNER HAR (FRUITVALE)	20 Shiner Surf Perch	**0.197**	29.60	**2.586**	14.66	**240.08**	NA
1257	OAKLAND INNER HAR (FRUITVALE)	3 Striped Bass	**0.327**	30.57	**1.87**	10.03	**218.34**	NA
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	**0.327**	**70.65**	**3.227**	16.16	**638.13**	**1.75**
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.0999	34.96	1.418	8.48	**236.04**	NA
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.0871	34.71	**2.022**	10.26	**238.34**	NA
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	0.104	32.80	**2.25**	10.40	**314.50**	NA
1262	ISLAIS CREEK	5 White Croaker	0.0847	39.56	1.433	9.87	**314.50**	**0.89**
1263	ISLAIS CREEK	5 White Croaker	0.0926	41.81	1.139	10.09	**230.11**	NA
1264	ISLAIS CREEK	5 White Croaker	0.0799	22.33	ND	5.14	**138.34**	NA
1265	ISLAIS CREEK	20 Shiner Surf Perch	0.0800	20.35	ND	5.51	**100.65**	NA
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.109	59.71	**3.598**	14.36	**353.23**	**0.88**
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.110	46.01	**2.807**	13.85	**346.97**	NA
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.0800	52.23	**2.407**	13.74	**323.96**	NA
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	0.124	47.36	0.956	5.82	**166.99**	NA
1270	POINT MOLATE	5 White Croaker	**0.296**	58.44	**2.588**	13.46	**273.09**	**0.73**
1271	POINT MOLATE	5 White Croaker	**0.183**	57.91	**2.285**	12.95	**294.50**	NA
1272	POINT MOLATE	5 White Croaker	0.111	68.68	**1.722**	9.26	**212.27**	NA
1273	POINT MOLATE	5 Walleye Surf Perch	0.0865	10.44	0.491	1.99	**33.93**	NA
1274	RODEO	5 White Croaker	**0.342**	67.73	**2.226**	16.45	**279.95**	**0.57**
1275	RODEO	5 White Croaker	**0.295**	37.46	0.92	8.51	**232.56**	NA
1276	RODEO	5 White Croaker	**0.255**	**83.44**	**1.789**	**19.45**	**418.67**	NA
1277	RODEO	3 Leopard Sharks	**0.283**	4.94	ND	1.11	**41.34**	NA
1282	SAN FRANCISCO PIER #7	5 White Croaker	**0.289**	**79.63**	**2.704**	**18.39**	**613.44**	**1.00**
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	**0.162**	11.16	0.577	2.03	**88.79**	NA
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	**0.146**	9.49	ND	1.88	**119.76**	NA
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	0.102	10.19	ND	1.66	**65.43**	NA
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	**0.444**	38.35	**2.31**	10.60	**191.40**	**0.50**
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	**0.202**	33.20	**1.935**	7.41	**93.60**	NA
1288	STRIPED BASS (SACRAMENTO R.)	3 Striped Bass	**0.257**	41.14	**1.543**	8.38	**181.64**	NA
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	**0.245**	49.27	**3.057**	10.64	**71.82**	**0.51**
1292	SHARK-SOUTH BAY (S.M. COYOTE)	3 Leopard Sharks	**1.24**	8.49	ND	1.44	**41.23**	0.12
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	**0.398**	6.04	ND	1.19	**44.21**	NA
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	**0.529**	4.91	ND	0.50	**16.53**	NA
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	**1.01**	25.93	0.614	2.98	**112.40**	**0.23**
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	**0.617**	5.24	ND	0.50	**16.85**	NA
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	**0.820**	9.12	ND	1.03	**50.40**	NA
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	**1.26**	17.80	ND	2.62	**60.85**	0.13
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	**0.845**	16.18	ND	2.27	**118.33**	NA
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	**0.562**	13.22	ND	2.22	**147.75**	NA
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	**0.197**	7.58	ND	1.29	**54.47**	0.12
1336	VALLEJO-MARE ISLAND	5 White Croaker	**0.414**	**156.01**	**4.241**	**36.10**	**528.96**	**1.04**
1337	VALLEJO-MARE ISLAND	5 White Croaker	**0.280**	**128.43**	**3.502**	**30.70**	**567.18**	NA
1338	VALLEJO-MARE ISLAND	5 White Croaker	**0.255**	**82.76**	**3.243**	**20.67**	**259.42**	NA
1339	VALLEJO-MARE ISLAND	3 Striped Bass	**0.308**	51.37	1.077	11.92	**126.75**	NA
	ND - not detected NA - not analyzed							
		SCREENING VALUE (PS-SV)	**0.14 ppm**	**69 ppb**	**1.5 ppb**	**18 ppb**	**3 ppb**	**0.15 ppt**

1248, 1254 and 1260.

The PS-SV of 3 ppb for total PCBs, based on the sum of Aroclors, was exceeded in all sixty-six tissue composite samples analyzed in this study. The PS-SV was exceeded by a factor of ten in 97% of the samples and by a factor of one hundred in 20% of the samples. In contrast, only one sample (for Dioxin-TEQ) exceededthe PS-SV by a factor of ten for any of the other contaminants. Total Aroclor levels were highest (638 ppb) at stations nearest San Francisco and Vallejo-Mare Island, particularly in fish with higher tissue lipid contents, such as white croaker (Fig. 2). For comparative purposes, PCB levels (as Aroclor 1254) in tissue of white croaker from two other regional studies, in southern California and Monterey Bay are reported here. White croaker collected in a comprehensive study in southern California coastal waters had tissue concentrations of total PCBs (sum of Aroclors 1254 & 1260) that ranged from 1 ppb at Dana Point to 757 ppb at Malibu (Pollock *et al.*, 1991). White croaker collected near several wastewater outfalls in Monterey Bay exhibited no tissue levels above the detection limit of 40 ppb (Pollock *et al.*, 1992). White croaker from San Francisco Bay had measured Aroclor 1254 levels which fell between these two extremes and ranged from 16-382 ppb. Stations nearest Oakland's and San Francisco's industrial areas exhibited the highest PCB values in the Bay area, with stations in the North and South Bay following closely (Figures 3, 4 & 5), depending on fish species.

MERCURY

Mercury, in both its inorganic and organic forms, is considered to be a neurotoxicant. The screening value for mercury given in Table 5 is for the organic form, methylmercury, since most mercury in fish tissue is in this form and the compound of greatest concern for human health (NAS, 1991; Tollefson, 1989). Due to high analytical cost of measuring methylmercury, the EPA recommends that total mercury be determined for screening purposes and the conservative assumption be made that all mercury present is in the form of methylmercury (U.S. EPA, 1993).

Total mercury was analyzed in sixty-six tissue samples and forty of these exceeded the PS-SV of 0.14 ppm. Mercury levels were found to be the highest in large leopard sharks (1.2 ppm), with leopard sharks from all three regions of the Bay demonstrating mercury levels in excess of 1 ppm. Brown smoothhound sharks had mercury levels above 0.5 ppm in six of seven samples with the highest value (0.84 ppm) being reported from Pt. Molate. (Figures 6 & 7). Mercury levels in tissues of sharks are often elevated (National Fisheries Institute, 1992) and have been reported as high as 2.7 ppm in larger open ocean sharks of the Pacific (Hawaii Department of Health, 1991). Shark samples were not collected during either the southern California or the Monterey Bay fish contaminant studies, so direct comparisons with other west coast shark samples cannot be made. The Food and Drug Administration currently recommends that shark and swordfish be consumed no more than once a week (7 ounces) for the general population and no more than once a month for pregnant women and women of childbearing age who might become pregnant (FDA, 1994).

TOTAL AROCLOR IN SAN FRANCISCO BAY FISH

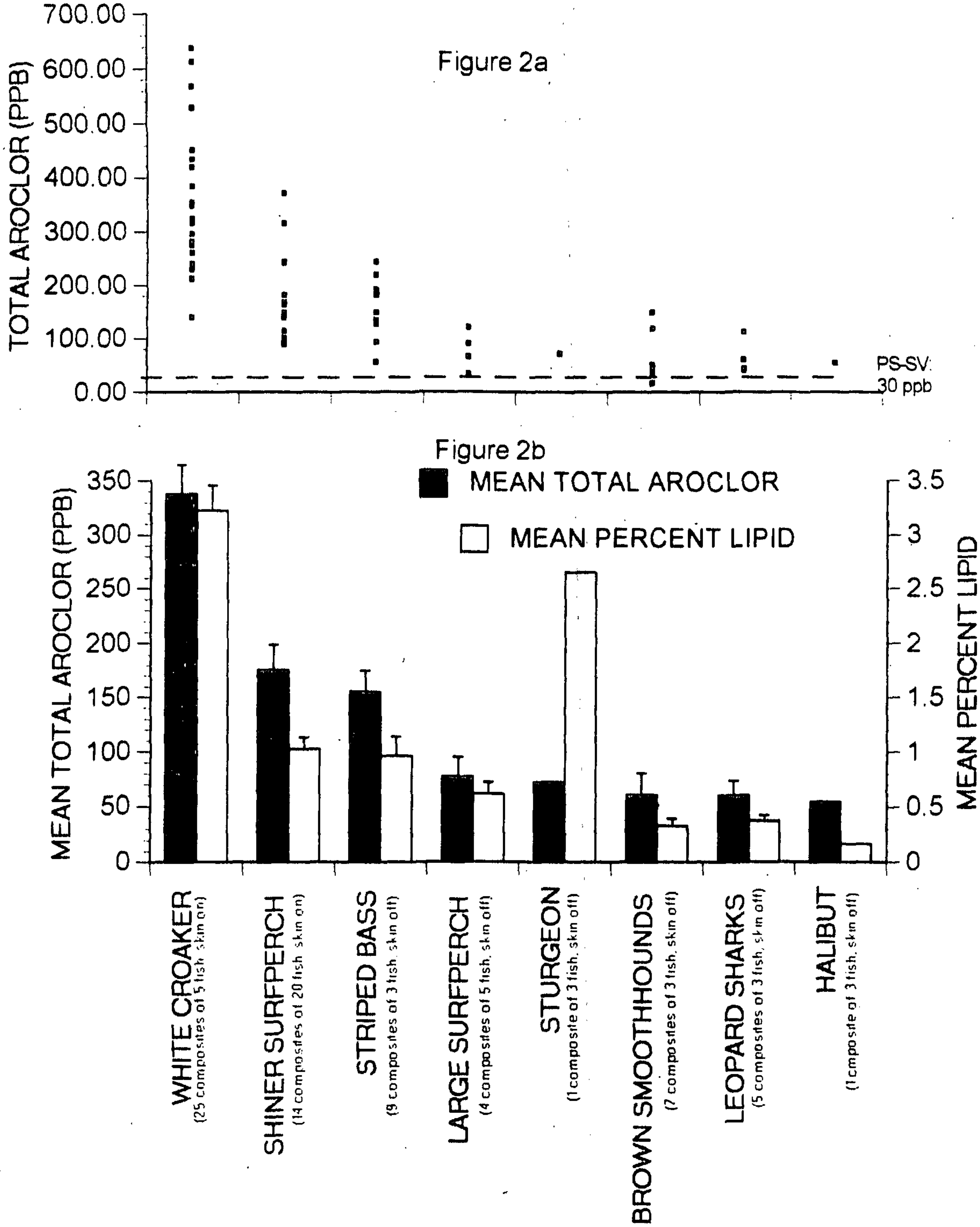
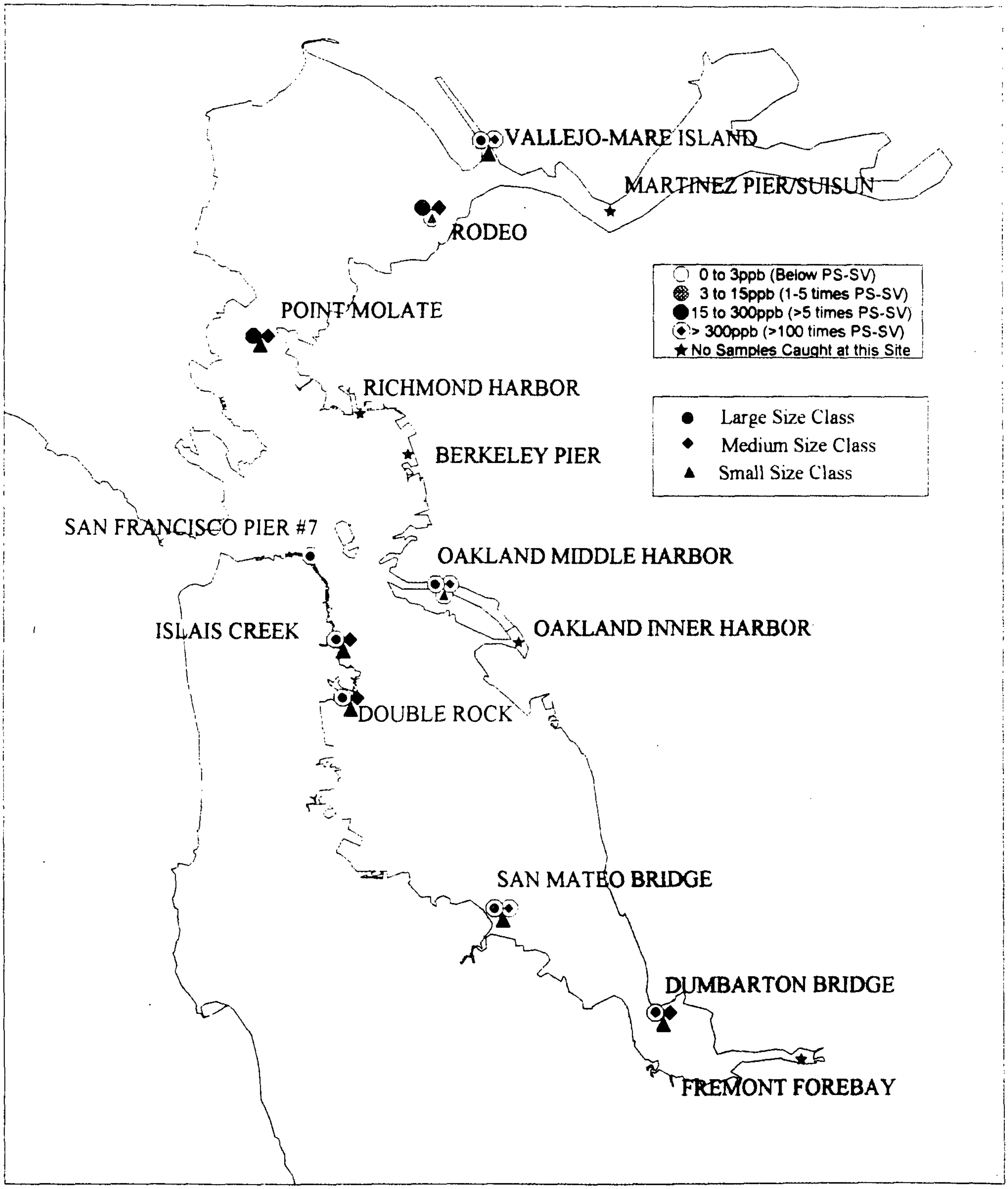


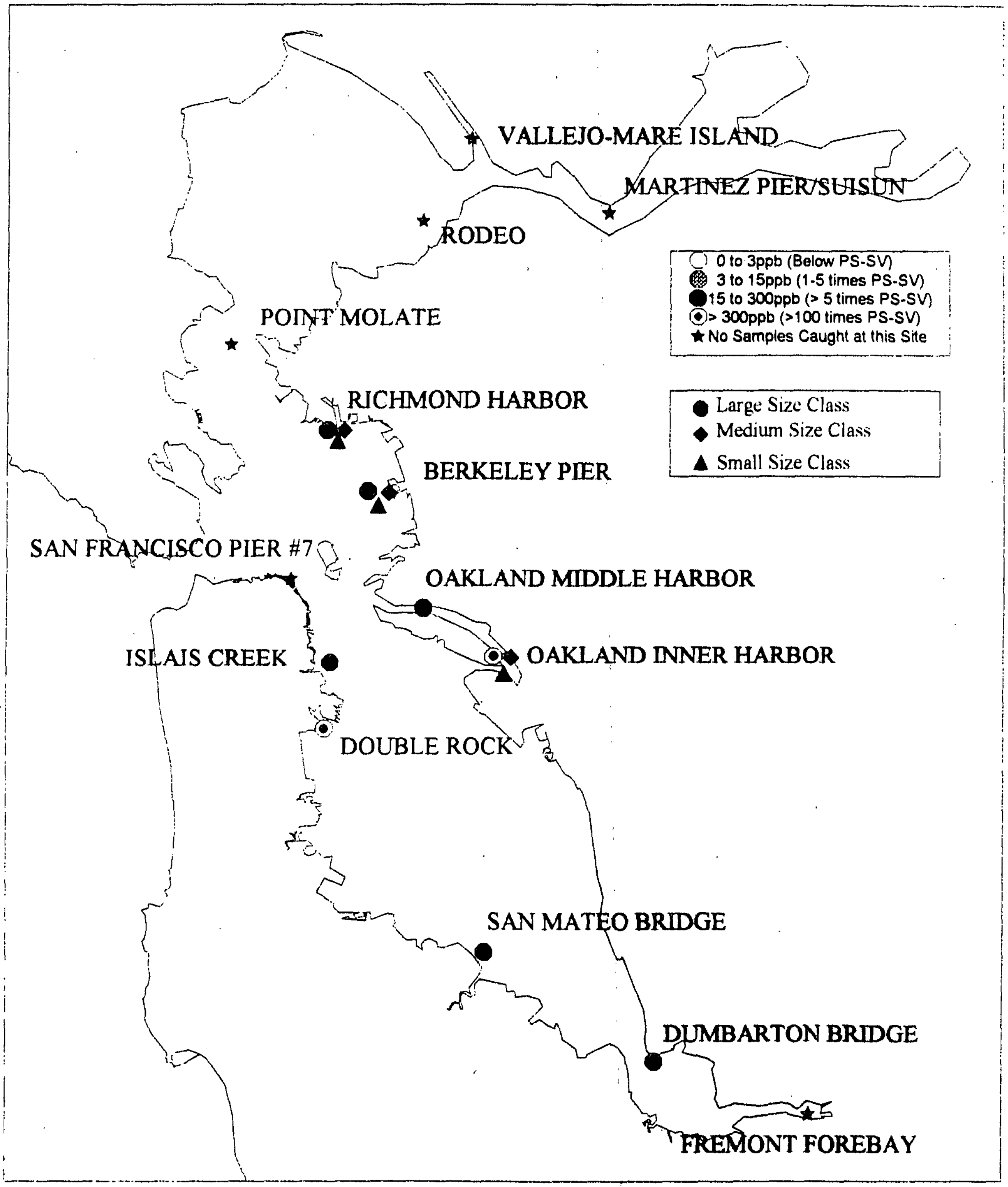
Figure 2. Total Aroclor in parts per billion in fish tissue. Figure 2a shows raw data in relation to the screening level. Each data point represents one composite of fish. Figure 2b shows mean values for total aroclor and percent lipid content for each species. Error bars reflect one standard error.

Figure 3
Total Aroclor Concentration in White Croaker from San Francisco Bay



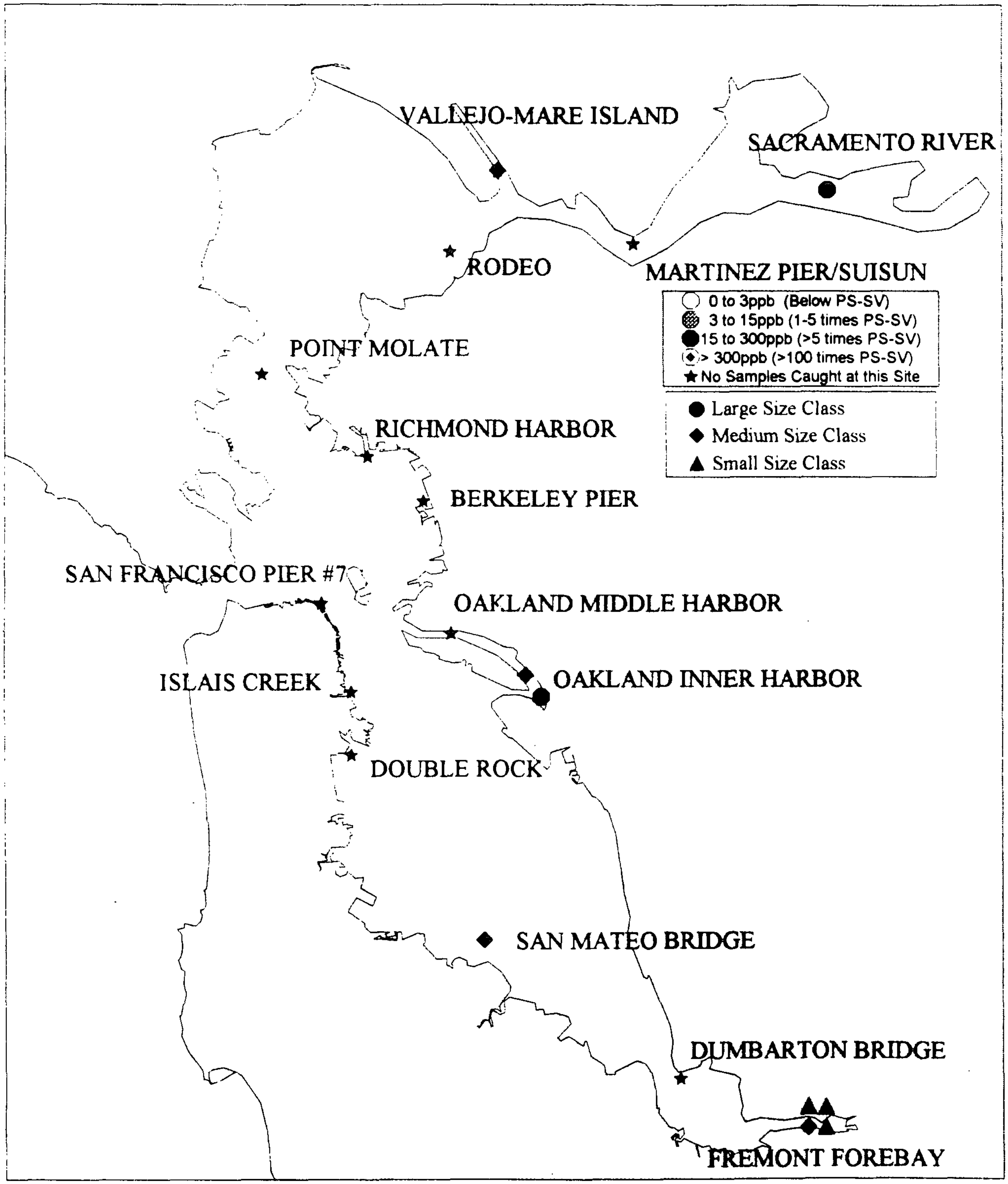
Size Classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for total aroclor is 3 ppb.

Figure 4
Total Aroclor Concentration in Shiner Surf Perch from San Francisco Bay



Size classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for total aroclor is 3 ppb.

Figure 5
Total Aroclor Concentration in Striped Bass from San Francisco Bay



Size classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for total aroclor is 3 ppb.

MERCURY IN SAN FRANCISCO BAY FISH

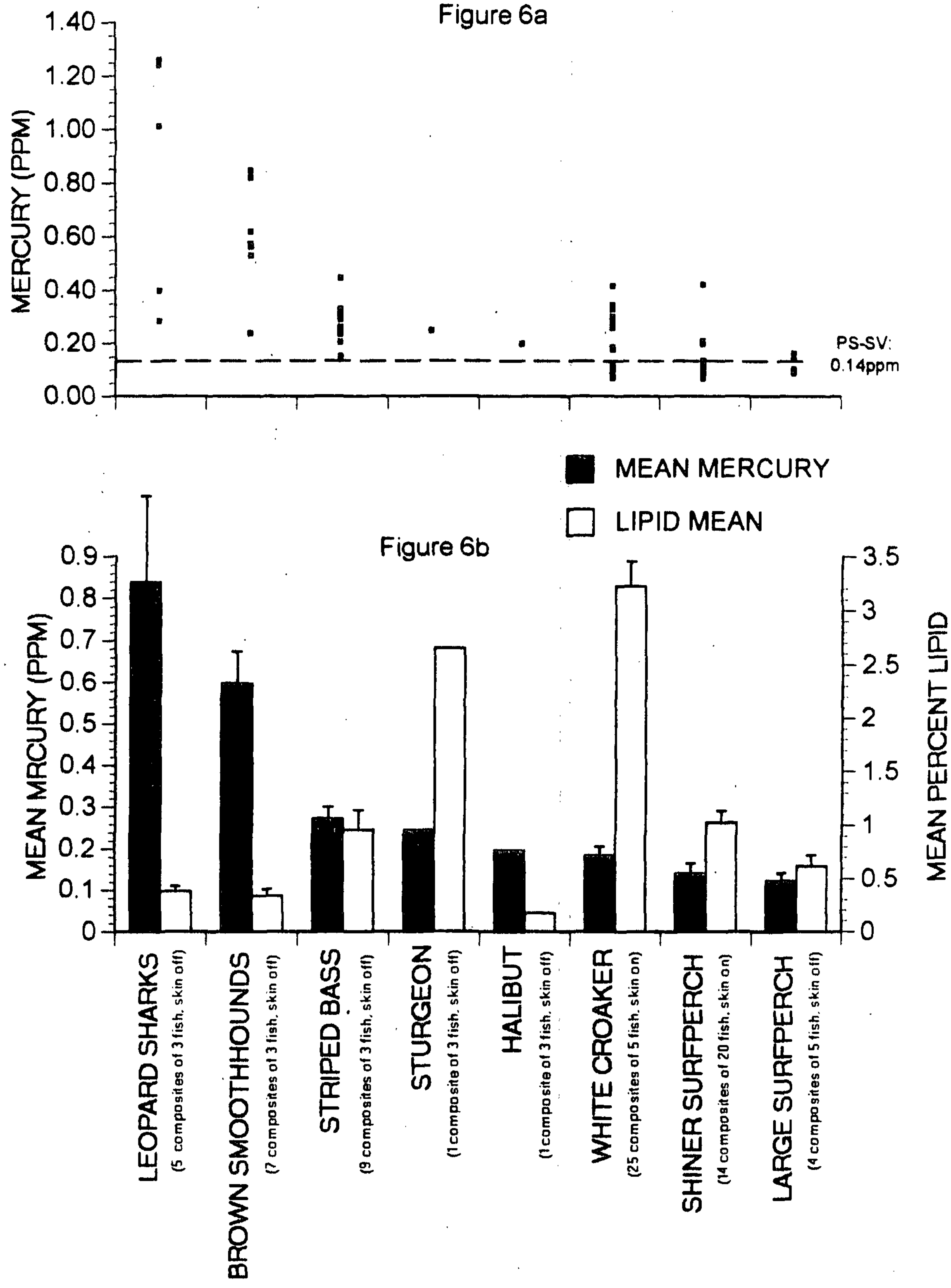
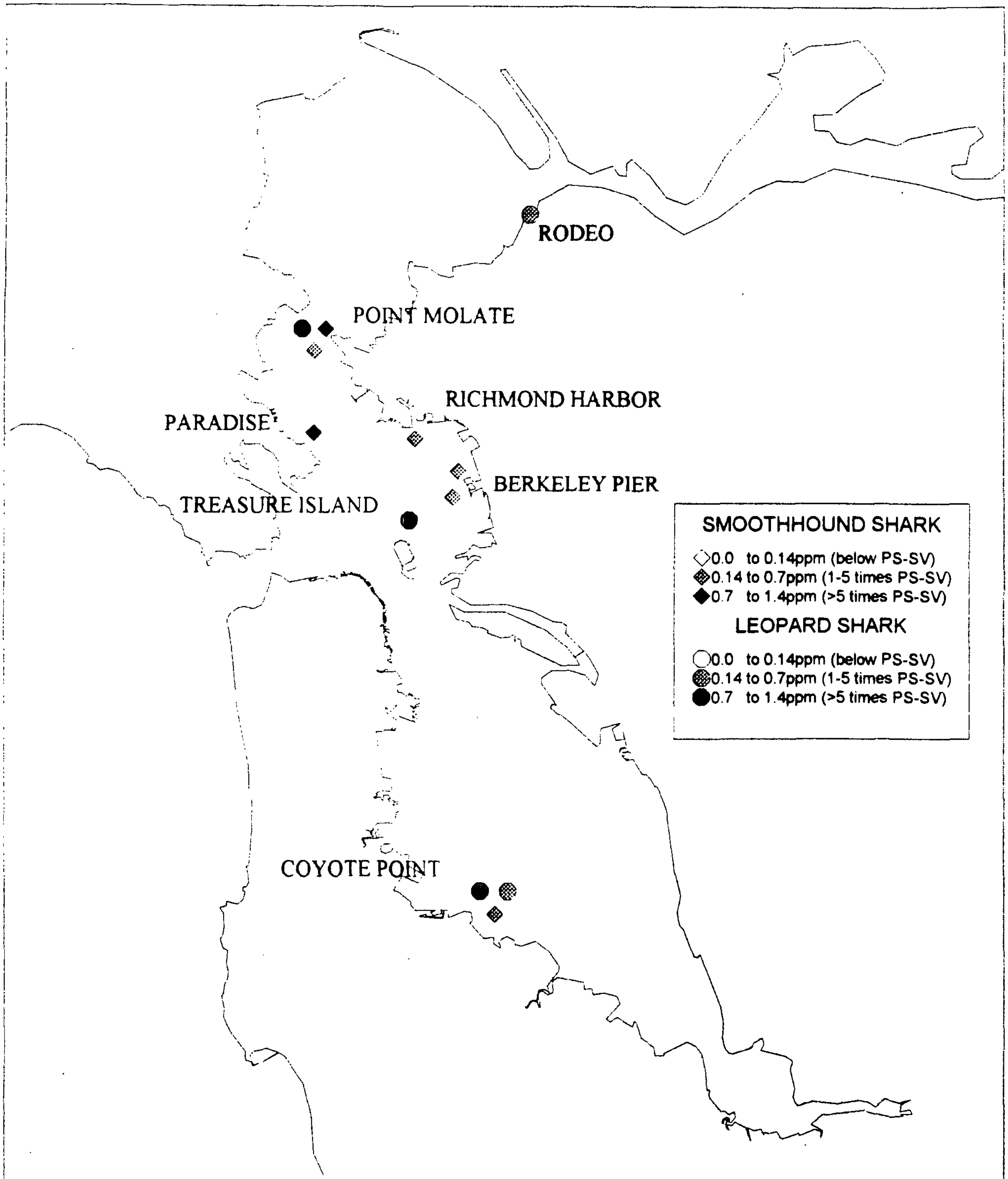


Figure 6. Mercury in parts per million in fish tissue. Figure 6a shows raw data in relation to the screening level. Each data point represents one composite of fish. Figure 6b shows mean values for mercury and percent lipid content for each species. Error bars reflect one standard error.

Figure 7
Mercury Concentration in Leopard Sharks and Smoothhound Sharks from San Francisco Bay



Species are not ranked by size classes due to low sample size. Multiple symbols for a species at a single station indicates separation of the species at that site. The pilot study screening value (PS-SV) for mercury is 0.14 ppm.

Mercury was also found to be elevated in white croakers, again with larger fish exhibiting greater contamination. The North Bay stations at Vallejo-Mare Island and Rodeo showed the highest mercury (0.4 ppm) concentrations in this species (Figure 8). Mercury levels in white croaker collected during the southern California study were lower than seen from San Francisco Bay. Only one sample collected from Dana Point (Pollock *et al.*, 1991) had mercury levels (0.44 ppm) as high as those found in white croaker from the Vallejo-Mare Island and Rodeo stations.

Mercury concentrations in striped bass were also elevated above screening levels, although at a lower level than sharks, with the Oakland Inner Harbor and Vallejo-Mare Island stations showing the highest mercury concentrations (Figure 9). A health advisory has been issued on consumption of striped bass, due to tissue mercury levels, since the early 1970s. An advisory was again issued in October, 1993, by the Office of Environmental Health Hazard Assessment, reiterating the concern regarding consumption of this species.

As opposed to other organic chemicals, methylmercury tends to bioaccumulate more as a function of age than lipid content. Although fish in this study were not aged, this relationship is inferred from the strong correlation between mercury and size in certain species (Fig. 10). It seems clear in this study that larger predatory fish are more heavily contaminated with mercury and exhibit bioaccumulation of this metal.

DIELDRIN

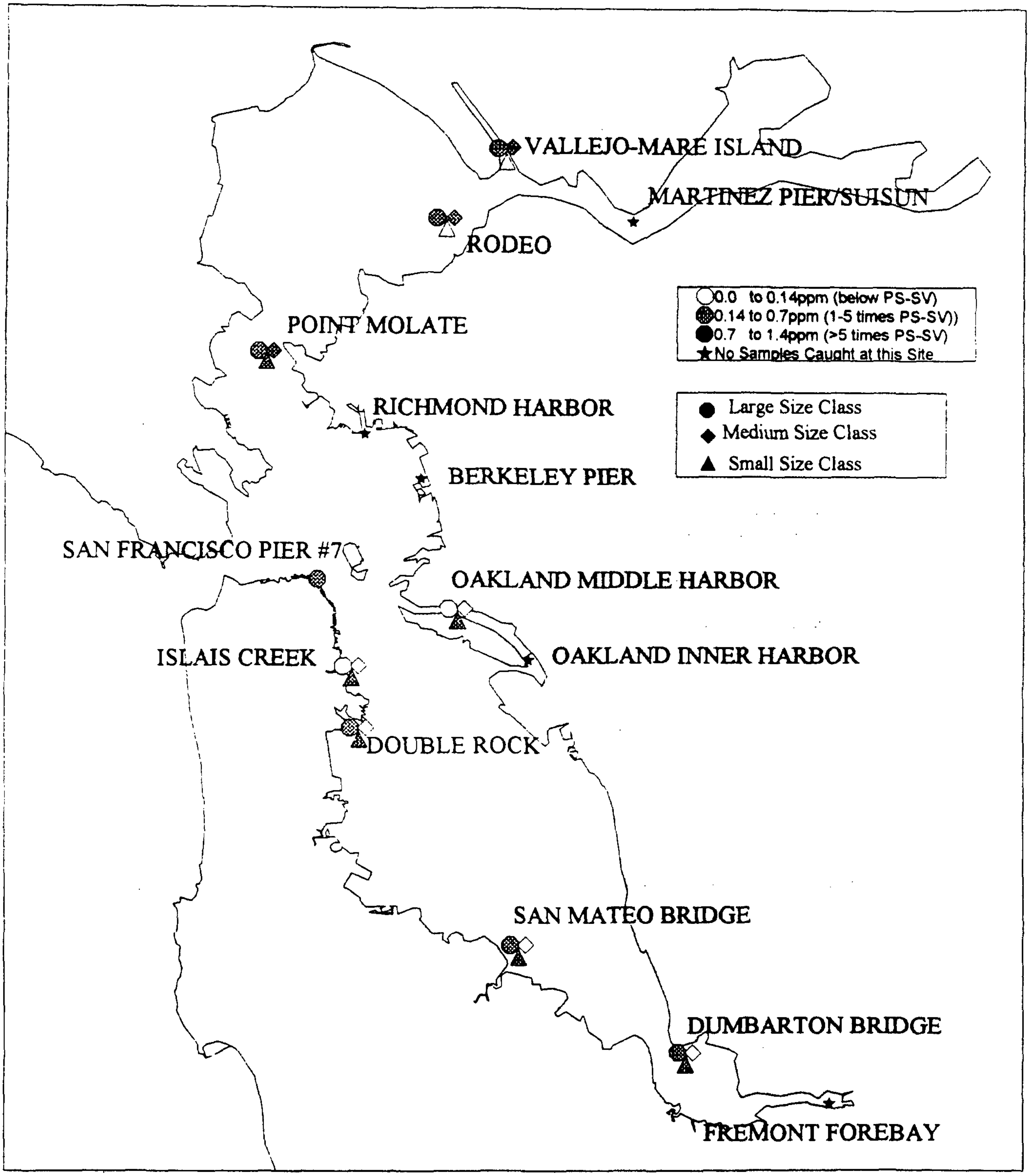
Dieldrin is a chlorinated cyclodiene pesticide used in the U.S. until 1987 for the control of soil dwelling insects. Because it is a metabolite of aldrin, environmental concentrations of dieldrin most likely represent the cumulative use of both aldrin and dieldrin. It has long term persistence in the environment and has been identified as a human neurotoxin (ATSDR, 1987a) and a probable carcinogen (IRIS, 1992). Since these lipid soluble compounds are not easily metabolized or excreted, they are easily stored in fatty tissues and can readily bioaccumulate in fish tissue with high lipid content.

Thirty-five of sixty-six tissue samples analyzed for dieldrin exceeded the PS_SV of 1.5 ppb. Concentrations of this pesticide were highest (4.2 ppb) in white croakers (Fig. 11) and exceedences were found at stations throughout the Bay (Fig. 12). Striped bass and shiner surf perch also exhibited exceedences throughout the Bay (Fig. 13). As was seen with other organic compounds, except methylmercury, the highest dieldrin levels were found in white croaker, the fish with highest lipid content. Sharks, the fish with the lowest lipid content, accumulated some of the lowest levels of dieldrin. The relationship between lipid and dieldrin is statistically significant, as will be discussed later.

DDT

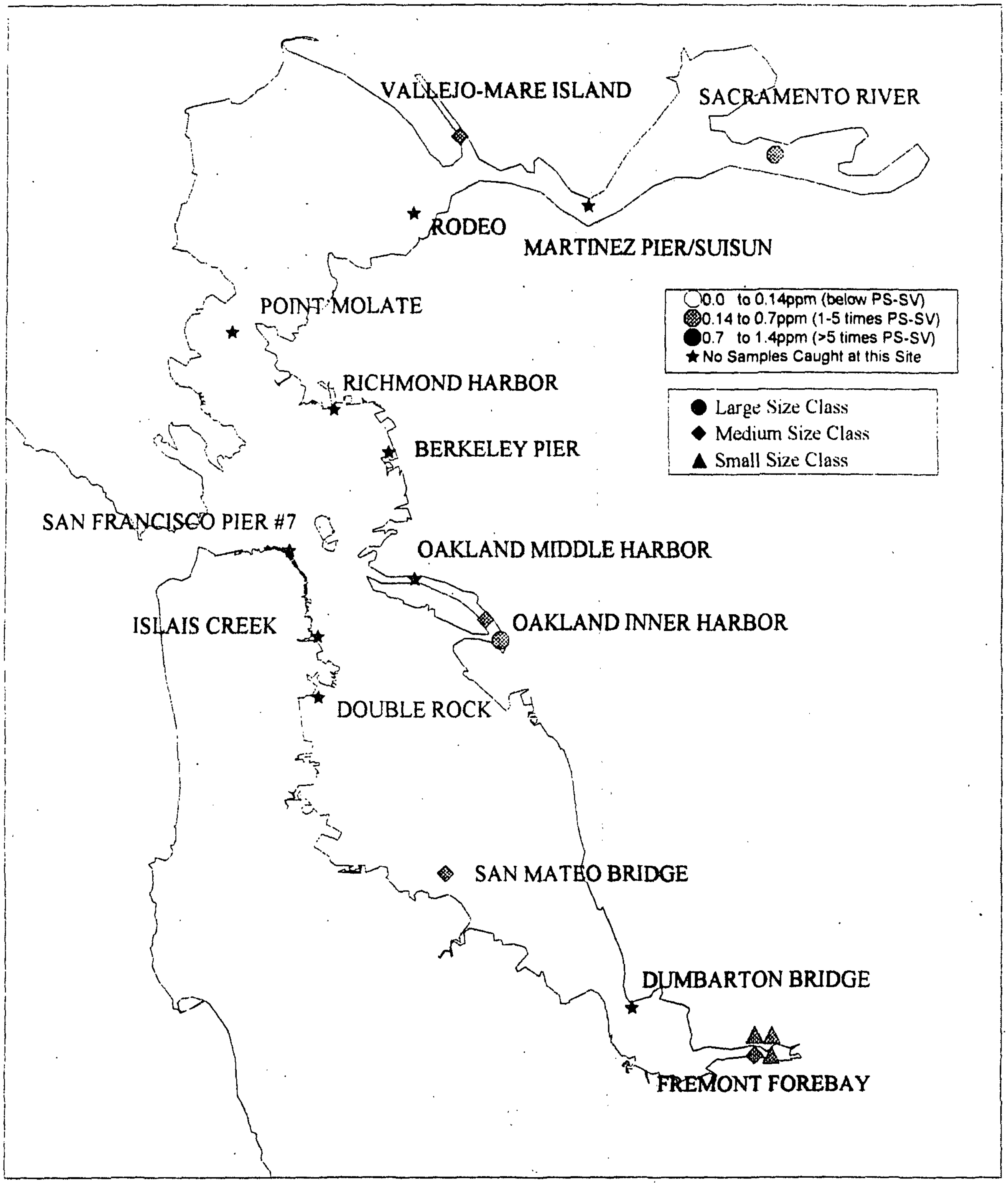
The use of the pesticide DDT ended in the U.S. by 1972, but persistence of DDT, and its DDD and DDE metabolites, in the

Figure 8
Mercury Concentrations in White Croaker of San Francisco Bay



Size classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for mercury is 0.14 ppm.

Figure 9
Mercury Concentration in Striped Bass from San Francisco Bay



Size classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for mercury is 0.14 ppm.

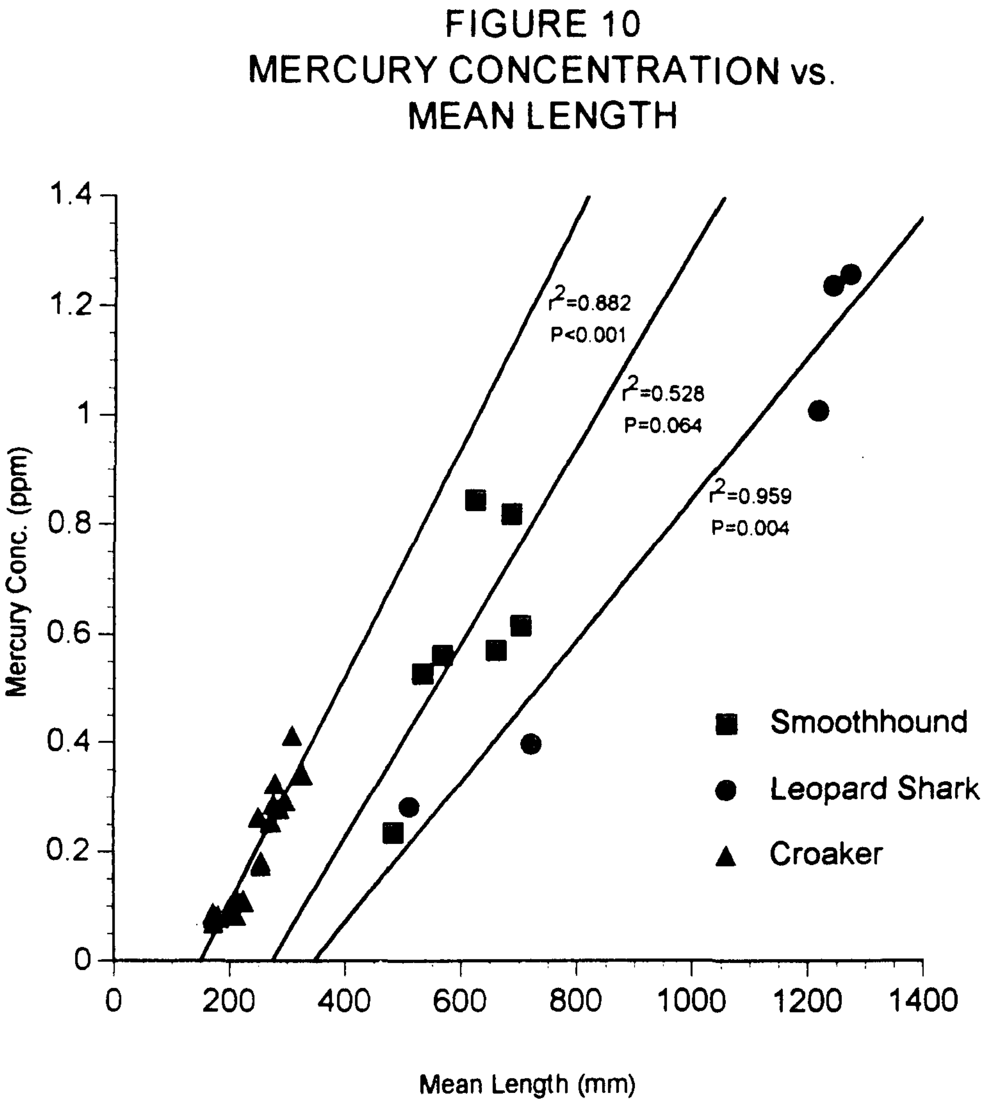


Figure 10. Mercury concentration to mean length comparison for three fish species caught in San Fransico Bay. Linear regression r^2 values presented for Smoothhound Sharks, Leopard Sharks, and White Croaker.

DIELDRIN IN SAN FRANCISCO BAY FISH

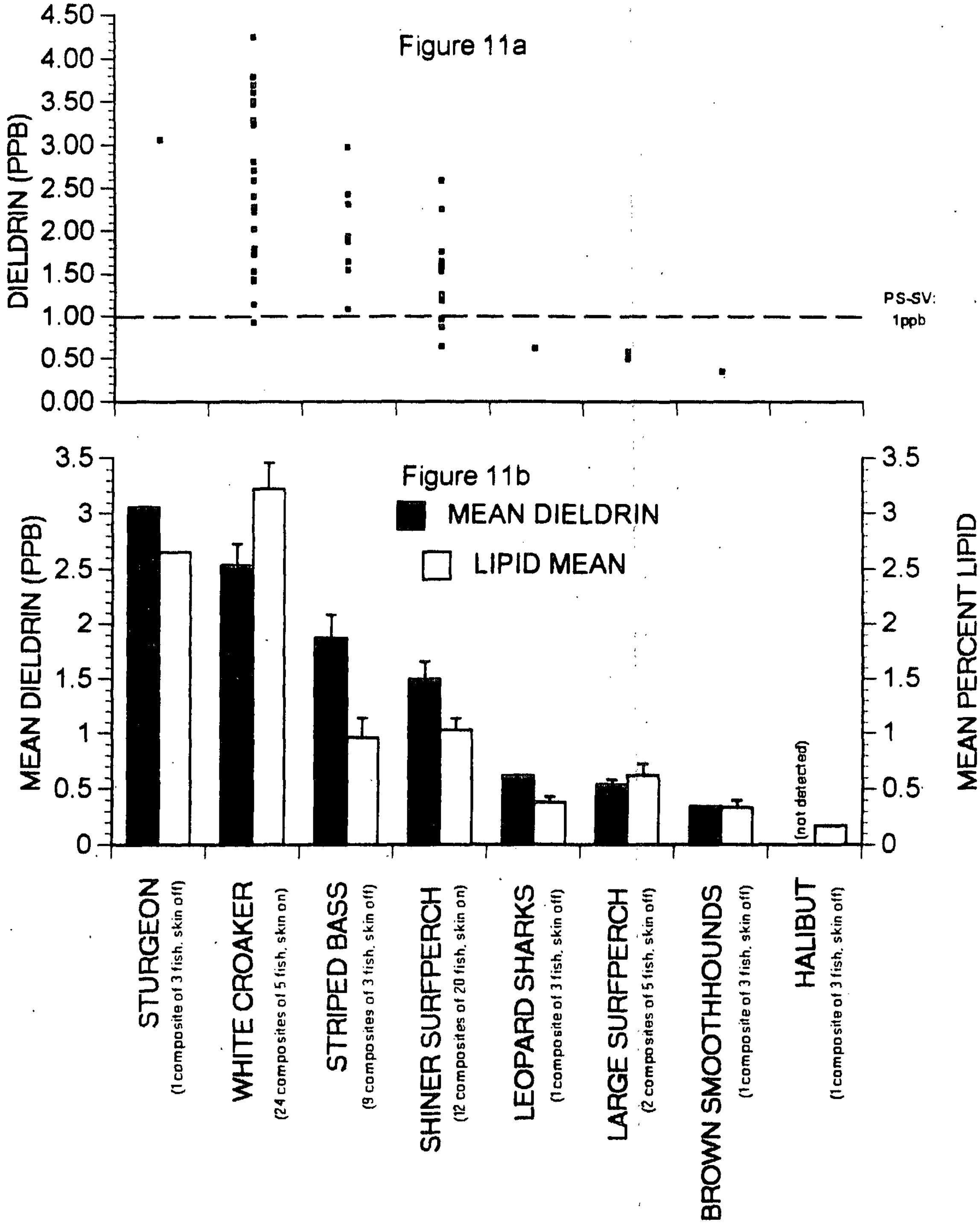
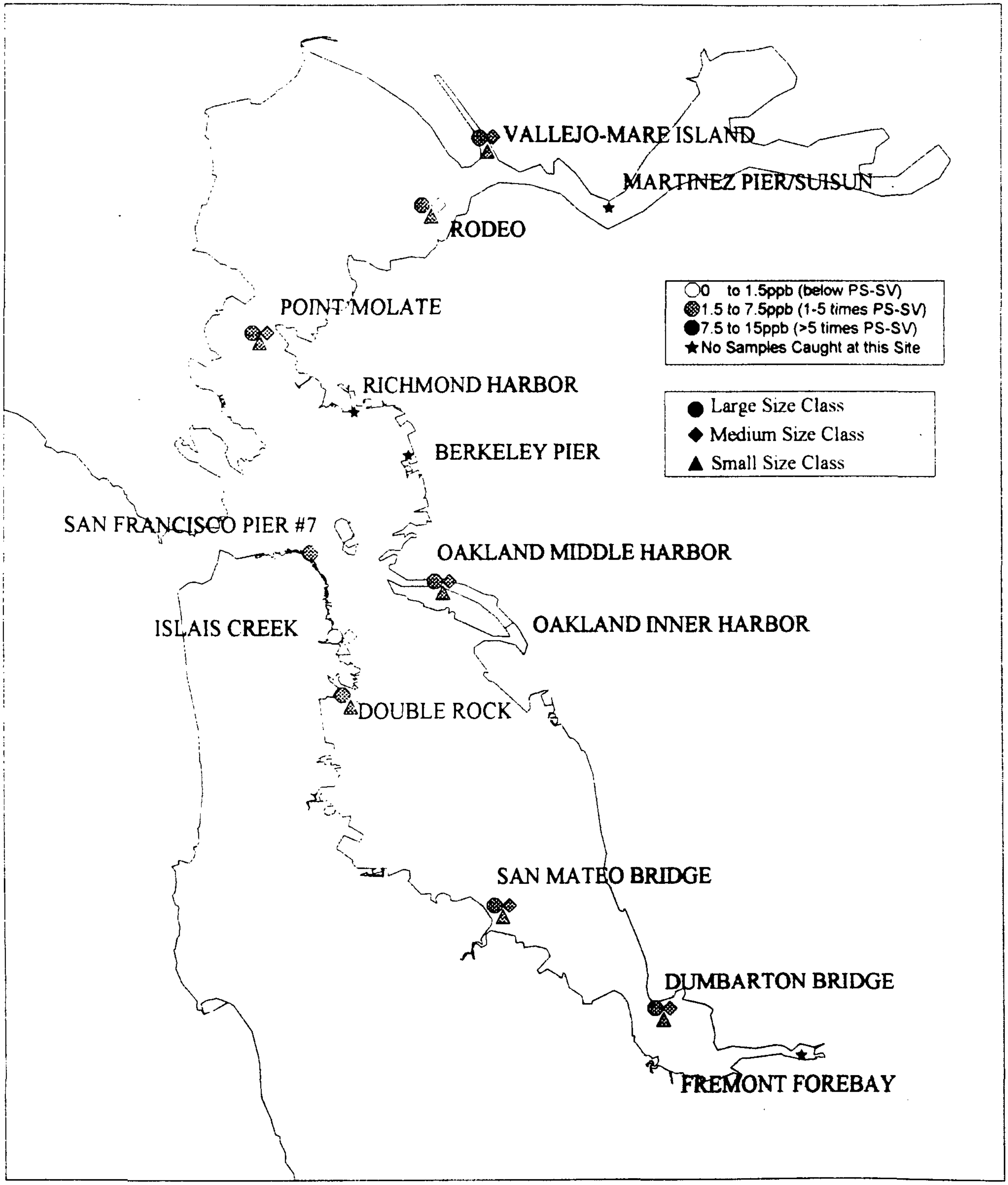


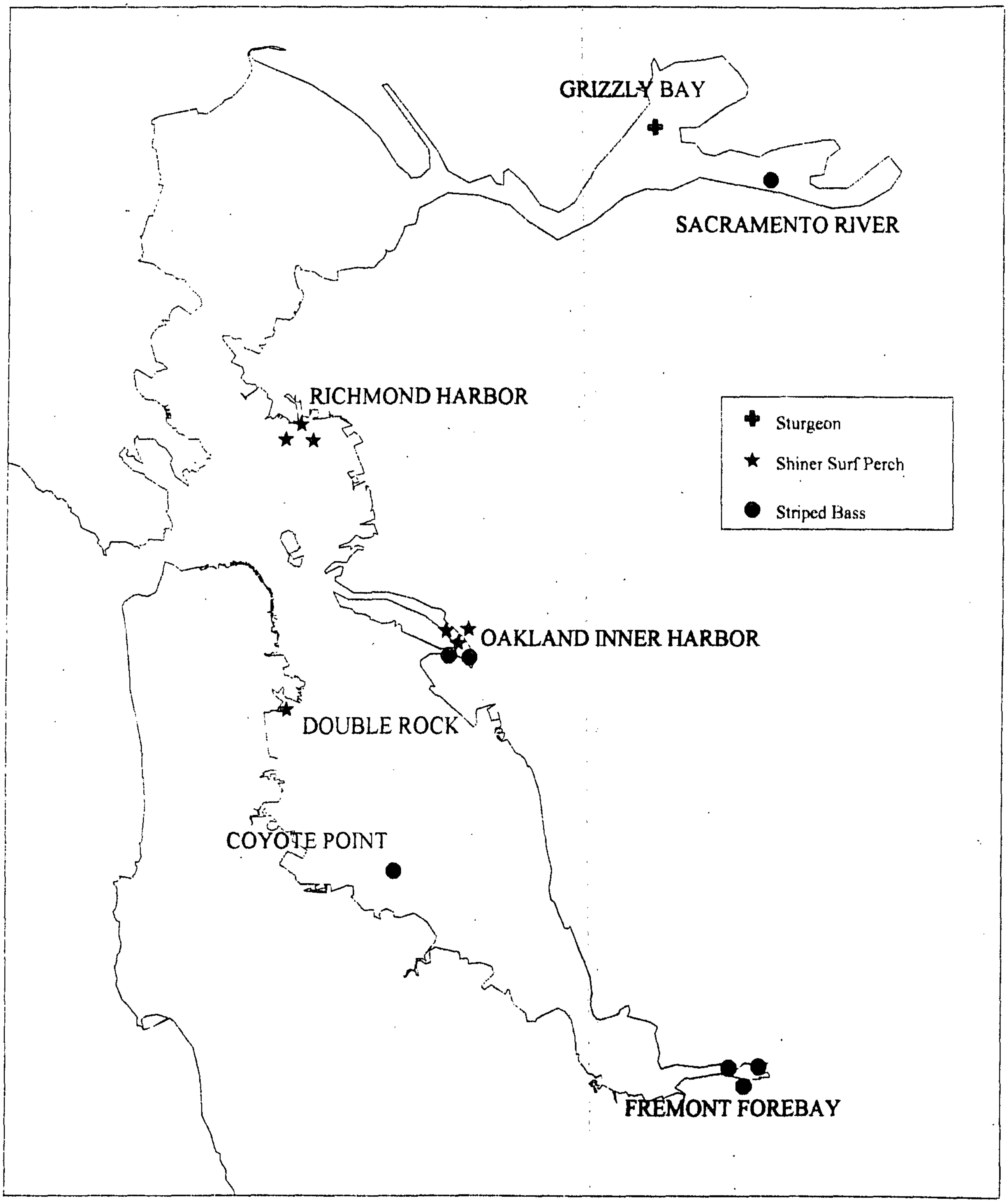
Figure 11. Dieldrin in parts per billion in fish tissue. Figure 11a shows raw data in relation to the screening level. Each data point represents one composite of fish. Figure 11b shows mean values for dieldrin and percent lipid content for each species. Error bars reflect one standard error.

Figure 12
Dieldrin Concentration in White Croaker from San Francisco Bay



Size classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for dieldrin is 1.5 ppb.

Figure 13
Sturgeon, Striped Bass & Shiner Perch with Dieldrin Concentrations that Exceed Pilot Study Screening Values



Species are not ranked by size classes due to low sample size. Multiple symbols for a species at a single station indicates separation of the species at that site. The pilot study screening value (PS-SV) for dieldrin is 1.5ppb.

environment continues to make this a common chemical of concern. These chemicals bioaccumulate and are listed as probable human carcinogens (Ware, 1978: IRIS, 1992). Total DDT reported in this study is the summation of the six isomers o,p'-DDT, p,p'- DDT, o,p'-DDE, p,p'- DDE, o,p'-DDD and p,p'- DDE. When concentrations of a particular isomer were reported as below the method detection limit (MDL - Table 2) in a sample, as was common for o,p'-DDE, a value of one half the MDL was used for the summation of total DDT for that sample.

Nine of sixty-six tissue samples analyzed for total DDT exceeded the PS-SV of 69 ppb. Concentrations of this pesticide were found to be highest (156 ppb) in white croakers (Fig. 14) from the North Bay station at Vallejo-Mare Island, although levels were also elevated in white croaker composites from Rodeo (83 ppb), Dumbarton Bridge (79 ppb), San Francisco Pier #7 (79 ppb), Double Rock (71 ppb) and San Mateo Bridge (69 ppb)(Fig. 15). Shiner surf perch collected from Oakland Inner Harbor had one composite that exceeded the screening value (73 ppb) and was significantly higher than other shiner surf perch samples taken from the Bay. Although no white croaker were collected from this station, there should still be some concern, since total DDT levels were always higher in the larger size classes of white croaker compared to shiner surf perch, when both were collected from the same station. This probably is due to higher lipid content in white croaker's tissue. The above listed stations should be examined more thoroughly in future studies which evaluate fish contaminants.

In comparison, the highest reported total DDT value in white croakers from the Monterey Bay study was 31 ppb (Pollock *et al.*, 1992). In southern California, where DDT residue levels can be extremely elevated in sediments, reported mean tissue values ranged from as low as 6 ppb at Dana Point to as high as 2641 ppb at Pt. Vicente (Pollock *et al.*, 1991), near the White's Point sewage outfall. The highest concentration for an individual composite was 8052 ppb and was reported from Cabrillo Beach, in Los Angeles Harbor. Although tissue samples from San Francisco Bay are generally much lower than samples from Southern California, the DDT levels in white croaker should be of concern, particularly from stations in the North Bay and possibly Oakland Inner Harbor, where the highest tissue levels of this pesticide are found.

CHLORDANE

Chlordane is another of the organochlorine pesticides which is not easily degraded or metabolized in the environment. It is like DDT and dieldrin in that it is lipophilic and tends to accumulate in fatty tissues. It is similar in structure to dieldrin and has been classified as a probable human carcinogen (IRIS, 1992; Worthing, 1991). Total chlordane is the summation of major constituents of technical grade chlordane (cis-chlordane, trans-chlordane, cis-nonachlor, and trans-nonachlor) and the major metabolite (oxychlordane). As with total DDT, when concentrations of a particular isomer were reported as below the method detection limit (MDL - Table 2) in a sample, a value of one half

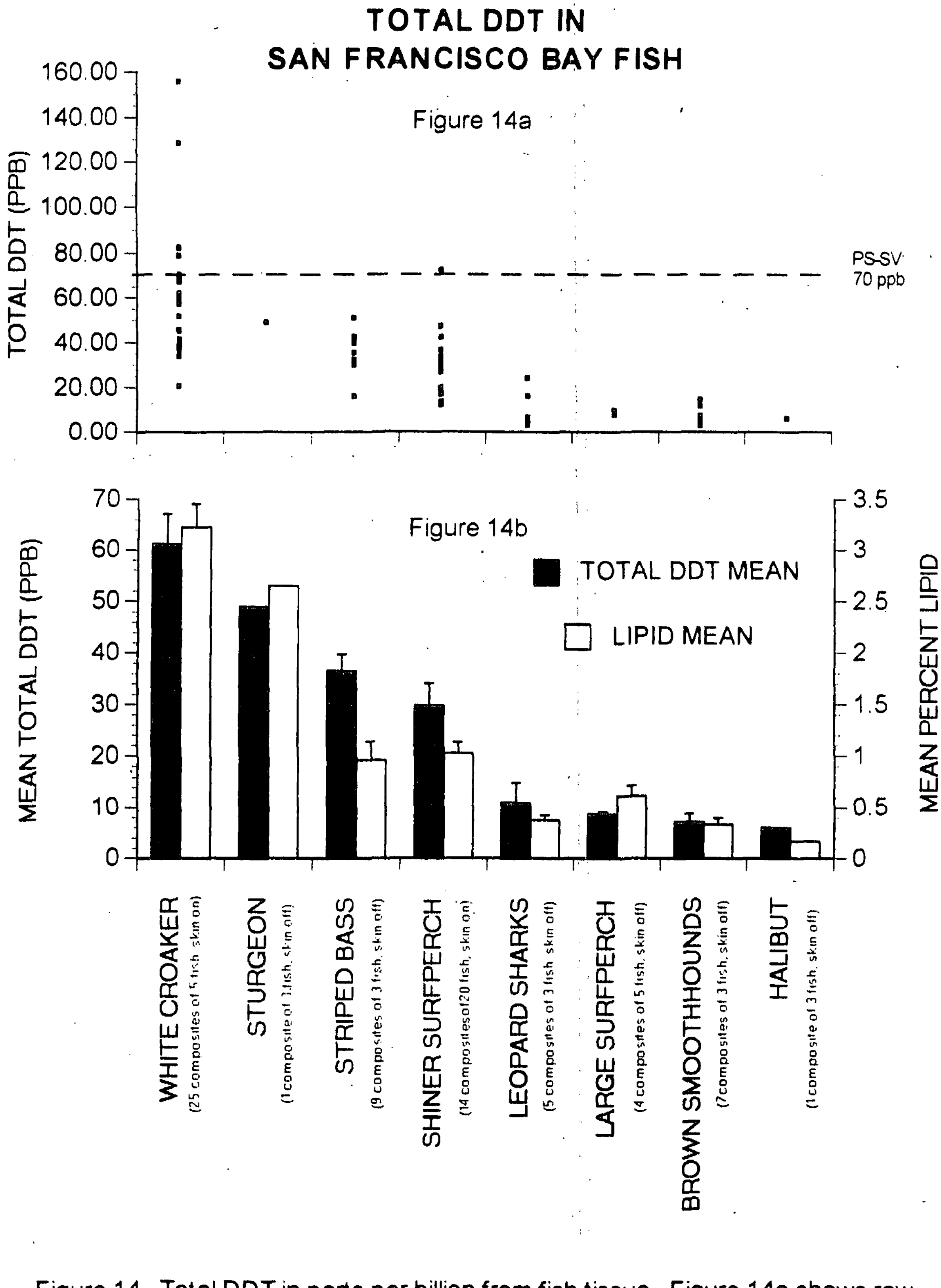
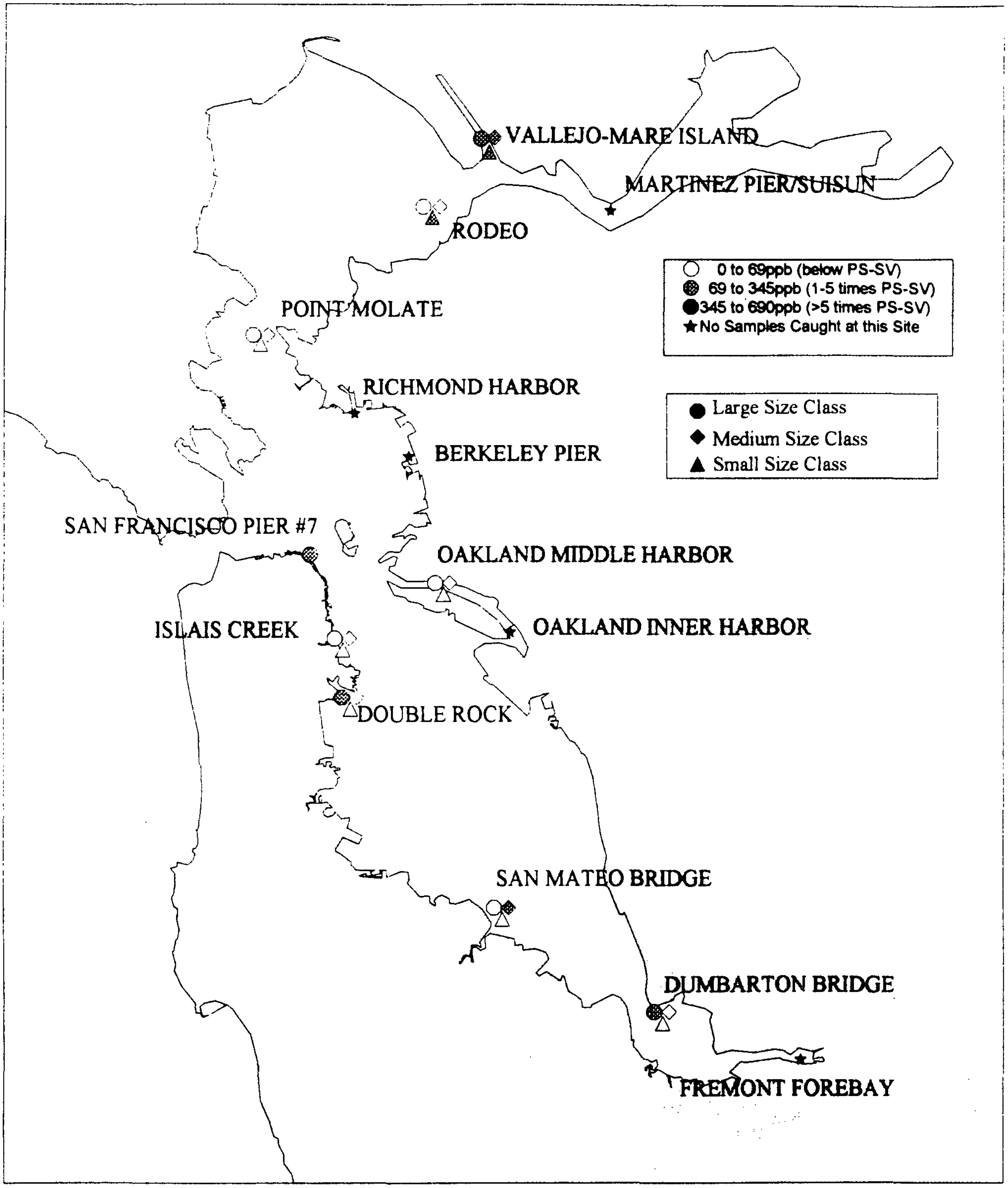


Figure 14. Total DDT in parts per billion from fish tissue. Figure 14a shows raw data in relation to the screening level. Each data point represents one composite of fish. Figure 14b shows mean values for each species for DDT and percent lipid content. Error bars reflect one standard error.

Figure 15
Total DDT Concentration in White Croaker from San Francisco Bay



Size classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for DDT is 69 ppb.

the MDL was used for the summation of total chlordane for that sample. Seven samples of sixty-six analyzed exceeded the total chlordane PS-SV of 18 ppb (Fig. 16). Of these seven, the three highest levels occurred in white croaker at the north Bay Vallejo-Mare Island station (Fig. 17) with a maximum value of 36 ppb found in the largest size class.

In comparison, white croaker caught near the Monterey Regional wastewater outfall had total chlordane tissue levels of 3.2 ppb (Pollock *et al.*, 1992), while only the Malibu station from the southern California study (Pollock *et al.*, 1991) reported a chlordane value in white croaker (30 ppb) near the higher levels seen at Vallejo-Mare Island. Most samples from the Monterey Bay and southern California studies were below the MDL (3 ppb) while over half of the samples from San Francisco Bay exceeded this level. High levels of chlordane in the sediments of streams flowing into San Francisco Bay were reported in the seventies (Law and Goerlitz, 1974) and fish tissue levels from this study illustrate its persistence today. This chemical should continue to be monitored, particularly in white croaker from the North Bay.

<u>DIOXINS/FURANS</u>

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDFs) are released into the environment primarily as by-products of thermal processes (incineration of municipal and chemical wastes and combustion of PCBs) and chemical manufacturing processes (paper pulp chlorine bleaching, oil refining and manufacturing of pesticides). Except as laboratory standards, these chemicals are not intentionally manufactured. Of 75 possible PCDDs and the 135 PCDFs, 17 congeners with chlorines at the 2,3,7 and 8 positions are considered the most important toxicologically. The dioxin isomer 2,3,7,8-TCDD is the most potent animal carcinogen evaluated by the EPA and is considered a probable human carcinogen (U.S. EPA, 1987d). International Toxic Equivalency Factors (I-TEFs) have been developed (Barnes and Bellin, 1989) to assess risks posed by mixtures of PCDD/PCDFs. This is done by converting specific congener concentrations to equivalent concentrations (I-TEQs) of 2,3,7,8-TCDD, the most toxic and extensively studied congener. In this study, all 17 2,3,7,8- substituted congeners were measured and the dioxin-TEQs calculated (Appendix I - Section VI). In addition, 5 dioxin-like coplanar PCBs were measured and a PCB-TEQ (APPENDIX III) value was calculated using the proposed PCB Toxic Equivalents (Ahlborg *et al.*, 1994). It should be acknowledged though that this method, as well as the toxicological significance of different concentrations of coplanar PCB's, is a matter of controversy at this time. Whenever any congener was below the method detection limit, one half the detection limit was used in the TEQ calculations.

Due to the high costs of the PCDD/PCDF analysis, only nineteen of sixty-six tissue samples were analyzed. The largest size class from the most abundant species at each station was analyzed, as well as the largest composite from each of the shark, striped bass, sturgeon and halibut samples. Sixteen of nineteen

TOTAL CHLORDANE IN SAN FRANCISCO BAY FISH

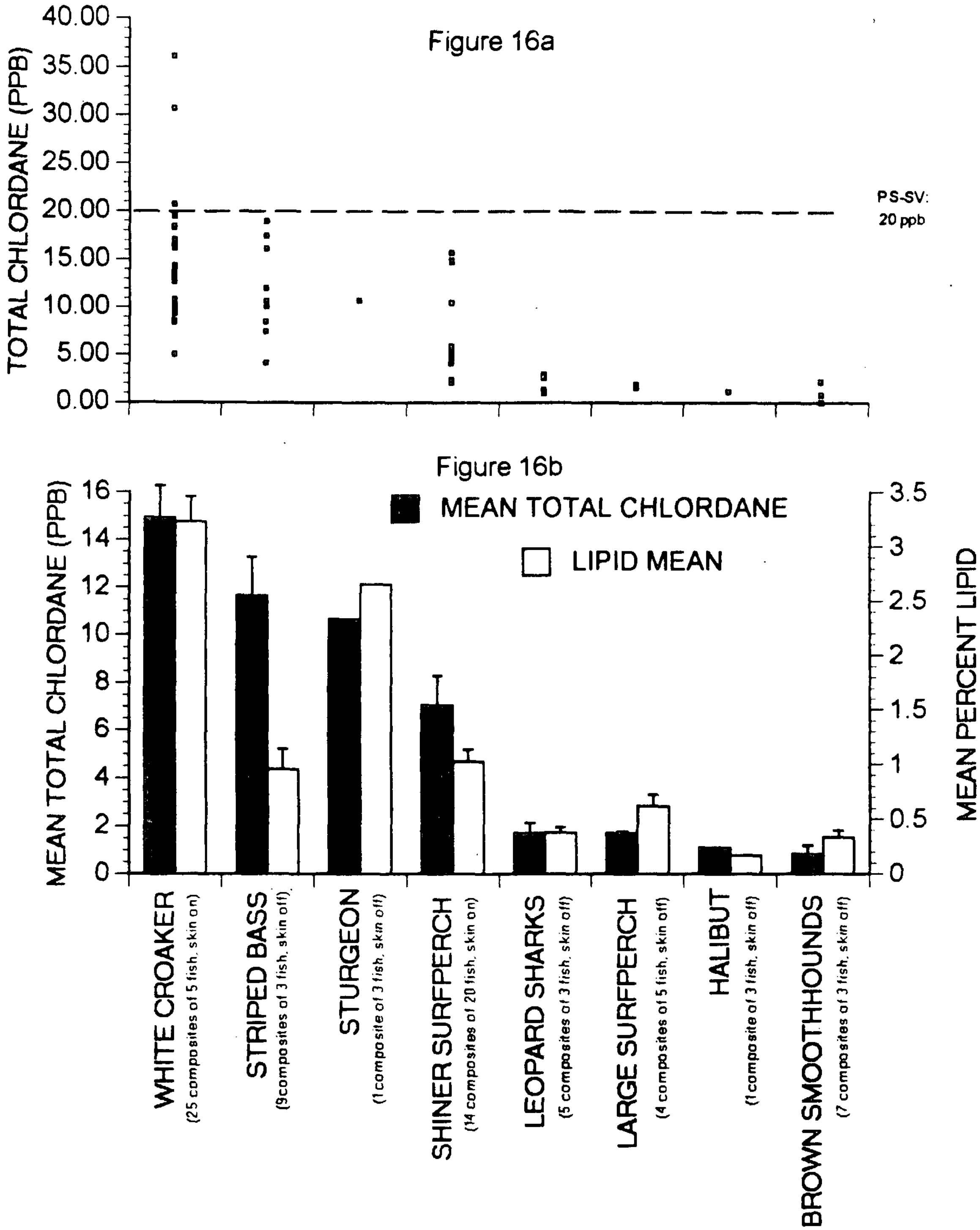
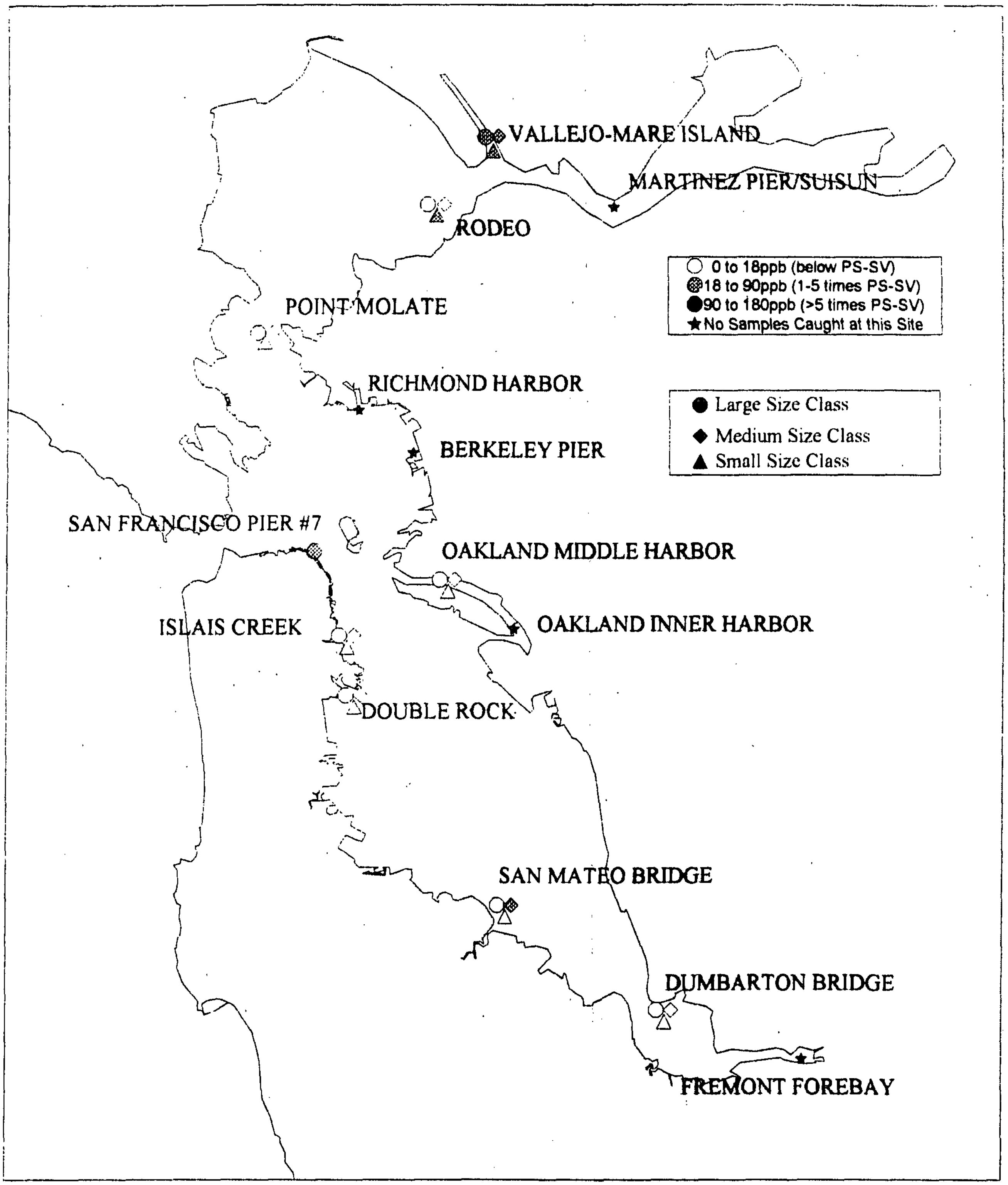


Figure 16. Total chlordane in parts per billion in fish tissue. Figure 16a shows raw data in relation to the screening level. Each data point represents one composite of fish. Figure 16b shows mean values for total chlordane and percent lipid content in each species. Error bars reflect one standard error.

Figure 17
Total Chlordane Concentration in White Croaker from San Francisco Bay



Size classes (small, medium, and large) are relative to individual station size ranges of each species and may overlap in different regions of the bay. The pilot study screening value (PS-SV) for total chlordane is 18 ppb.

samples exceeded the dioxin-TEQ PS-SV of 0.15 ppt with the highest levels (1.3 - 1.75 ppt) found in white croaker from the South Bay (Fig. 18 & 19). Interestingly, stations with high dioxin-TEQ levels corresponded to stations with high PCB levels with overall correlation between concentrations of the two groups of chemicals highly significant (r^2 = 0.72; p<0.001)(Fig. 20). PCDD/PCDFs, like other lipophilic compounds demonstrate a strong tendency to accumulate in lipid rich tissues. Correlation between lipids and dioxins in the 19 samples is highly significant (r^2 = 0.72; p=0.001). The lowest PCDD/PCDFs levels were found in two shark samples and one halibut sample, all three of which had low lipid levels in the muscle tissue.

In a recent study undertaken by the EPA, fish were sampled from over 300 sites throughout the U.S. and analyzed for dioxin concentrations (U.S.EPA, 1992). On the basis of these samples, 34 sites were considered to be uncontaminated and to represent background levels for dioxin, with a TEQ mean of 1.16 ± 1.21 parts per trillion. For consistency, the same method was used to calculate TEQs for both the EPA study and the pilot study reported here. All of the dioxin-TEQ values from the San Francisco Bay area samples fell well within the reported background range of EPA values. The EPA does express concern that even these background levels may be too high, considering the extreme toxicity these chemicals can exhibit. The EPA Office of Research and Development is currently reevaluating the potency of dioxins and the methods of calculating TEQs and screening values. When that reevaluation is complete, interpretation of the above dioxin/furan data will be more valid and scientifically based. Since the draft document (U.S.EPA, 1994-draft) that discusses this re-evaluation does not specifically address the toxicological significance of concentrations of coplanar PCBs, no conclusions can be reached at this time on the significance of levels measured in San Francisco Bay. These chemicals are suspected though of having properties similar to the dioxins and furans.

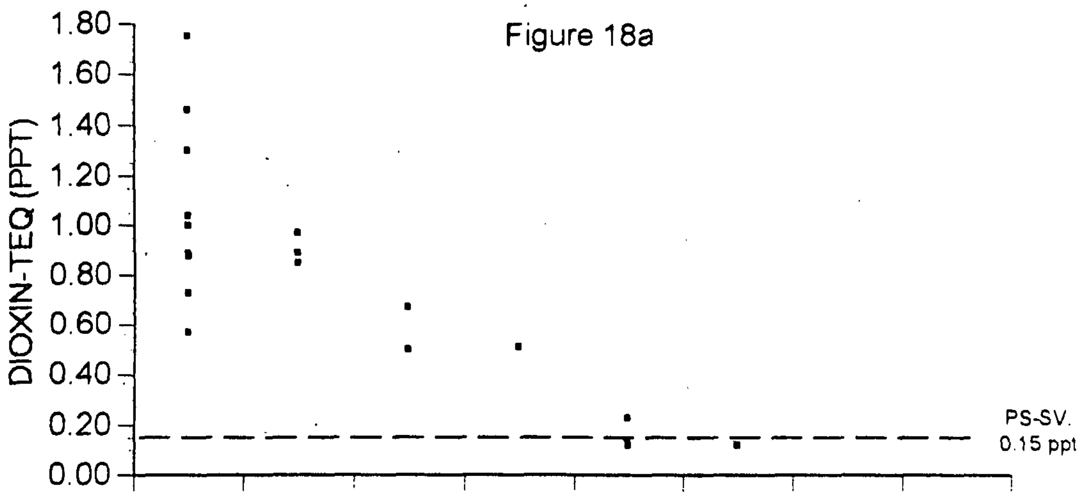
STATISTICAL ANALYSES

Statistical analyses were performed for the six chemicals of concern to identify contaminant bioaccumulation or bioconcentration trends in different species and at different stations. Chemistry values used for statistical purposes were a mean of the three composite samples, unless otherwise noted. Dioxin chemical analyses were performed on only 19 of 66 samples, so statistical comparisons were restricted to white croaker composites and excluded from the majority of statistical analyses. During statistical analysis, non-detected values (ND or -8) were given a numerical value of zero, except for dioxin/furans or unless otherwise noted.

Differences Between Sites Within a Single Species

Only white croaker and shiner surf perch were sufficiently abundant for comparisons of pesticide and PCB concentrations between sites, so data for each species were analyzed separately. For the chemical constituents, normality was tested using Kolmogorov-Smirnov goodness-of-fit analysis. Homogeneity of

DIOXIN-TEQ IN SAN FRANCISCO BAY FISH



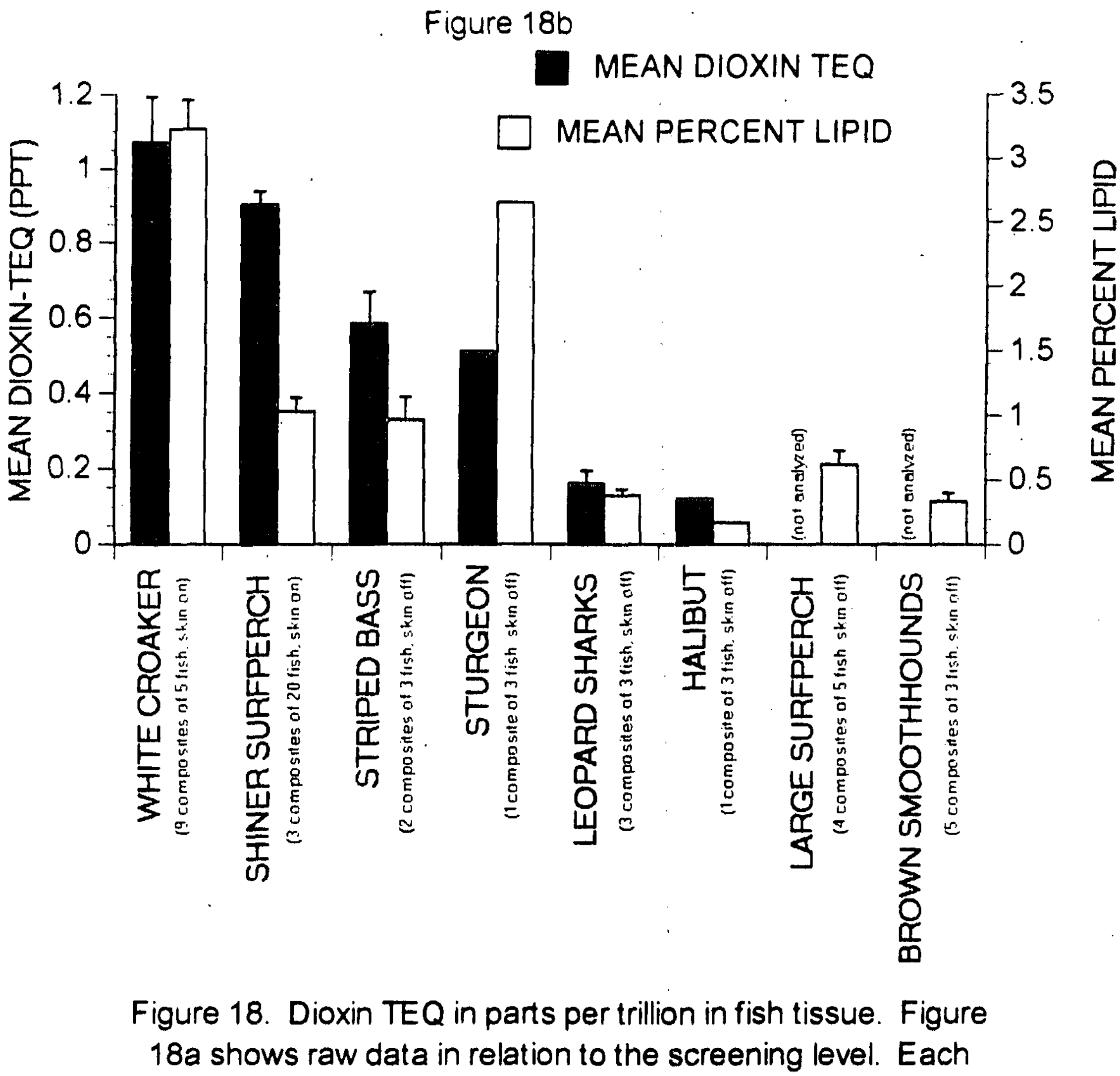
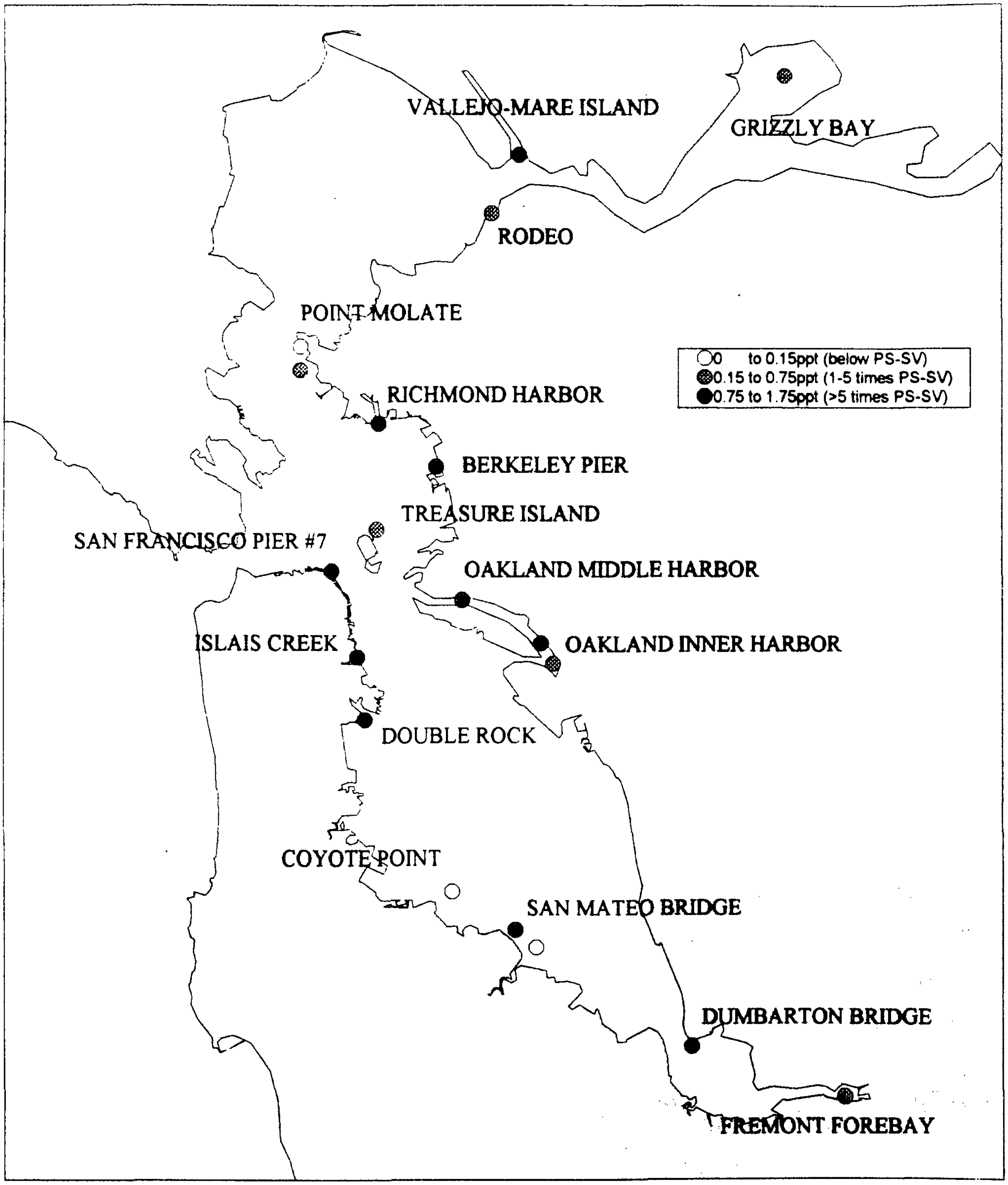


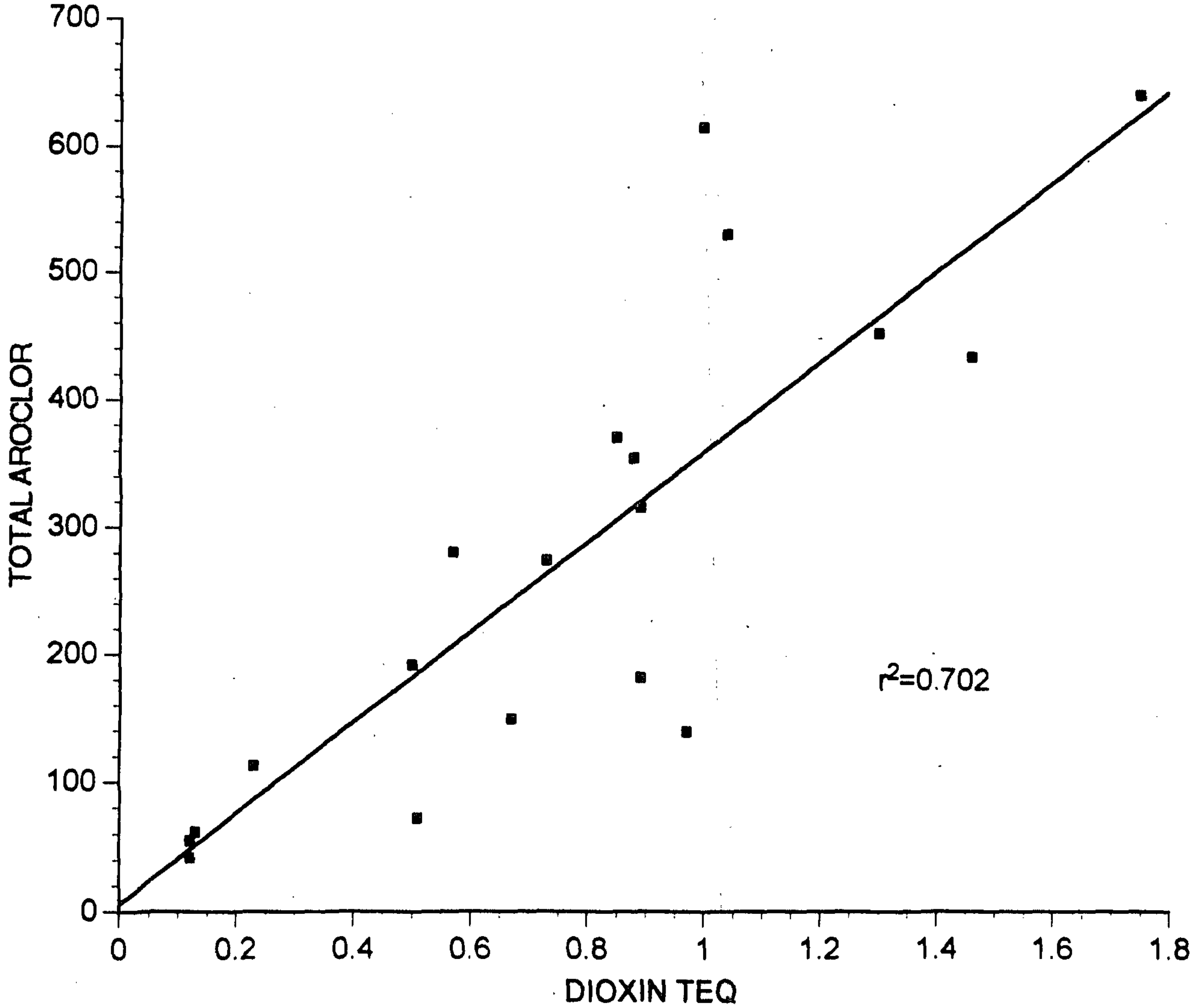
Figure 18. Dioxin TEQ in parts per trillion in fish tissue. Figure 18a shows raw data in relation to the screening level. Each data point represents one composite of fish. Figure 18b shows mean values for Dioxin TEQ and percent lipid content for each species. Error bars reflect one standard error.

Figure 19
Dioxin-TEQ in All Fish Species Throughout San Francisco Bay



Each of the nineteen samples analyzed for dioxin-TEQ is represented.
The pilot study screening value (PS-SV) for dioxin-TEQ is 0.15 ppt.

FIGURE 20
DIOXIN TEQ vs. TOTAL AROCLOR



Dioxin TEQ vs Total Aroclor. Regression is significant (p<0.001) variances was tested using Cochran's test. Variances for all levels of each measured variable were homogeneous. Differences in concentrations of lipids, mercury, PCBs, and pesticides were tested separately using single factor analysis of variance (ANOVA) for all constituents. Although mercury was not normally distributed, Zar (1984) notes that ANOVAs remain robust even with substantial deviations from normal. Using ANOVAs for all analyses allowed for a posteriori comparisons (Tukey multiple comparison tests) to isolate significant differences.

A) White Croaker
All measured variables were normally distributed with the exception of mercury and DDT. DDT was not significantly different from normal when data were transformed (log(x+1)). Sample size was three composites for all sample locations with the exception of San Francisco Pier #7 (n=1). No white croaker samples were collected from Richmond Harbor, Berkeley Pier or Oakland Inner Harbor. It is worth noting that mean length of fish was significantly different (p=0.039) between Rodeo and Islais Creek.

• Lipids p<0.001
Vallejo-Mare Island was significantly greater than Double Rock, Islais Creek, Oakland-Middle Harbor, Point Molate, and Rodeo.
San Mateo Bridge was significantly greater than Islais Creek, Point Molate, and Rodeo.
Dumbarton Bridge was significantly greater than Islais Creek, Point Molate, and Rodeo.
Point Molate was significantly greater than Islais Creek.

• Mercury p=0.017
Vallejo was significantly greater than Islais Creek and Oakland Inner Harbor.
Rodeo was significantly greater than Islais Creek.

• Total DDT p=0.016
Vallejo was significantly greater than Double Rock and Islais Creek.

• Dieldrin p=0.013
Vallejo was significantly greater than Islais Creek.

• Total Chlordane p=0.002
Vallejo was greater than all sites except San Francisco Pier #7.

• Total Aroclor p=0.395
Differences in total Aroclor among sites were not significant.

Rankings of chemical means for white croaker composites collected at each station are given in Table 6. Means were ranked in order of their concentrations so the lowest rank numbers indicate stations with highest chemical concentrations.

B) Shiner Surf Perch
Normality and homogeneity of variances were tested again with Kolomogorov-Smirnov and Cochran's tests. Differences between means were tested with single factor ANOVAs. All measured

Table 6. Mean Lipid and Chemical Concentration in White Croaker

STATION NAME	n		% Lipid	R	Hg (ppm)	R	TTLDDT (ppb)	R	Dieldrin (ppb)	R	TTLCLOR(ppb)	R	TTLARO(ppb)	R
Double Rock	3	mean	3.22	5	0.171	5	46.2	8	2.22	6	11.6	9	372.8	3
		sd	0.68		0.110		20.7		1.05		4.1		190.0	
Dumbarton Bridge	3	mean	4.26	3	0.124	7	50.5	7	2.90	4	13.0	6	299.3	6
		sd	0.45		0.047		17.4		1.19		3.4		115.8	
Islais Creek	3	mean	2.37	8	0.086	9	33.7	9	0.86	9	8.3	9	228.6	9
		sd	0.50		0.006		11.3		0.76		2.9		86.6	
Oakland Middle Harbor	3	mean	3.21	6	0.100	8	52.2	6	2.94	3	14.0	5	341.4	4
		sd	0.57		0.017		7.1		0.61		0.3		15.4	
Point Molate	3	mean	2.39	7	0.197	4	61.0	4	2.20	7	11.9	7	262.0	8
		sd	0.67		0.093		6.1		0.44		2.3		41.5	
Rodeo	3	mean	1.53	9	0.297	2	62.0	3	1.65	8	14.8	4	312.4	5
		sd	0.73		0.044		23.2		0.66		5.7		97.9	
San Francisco Pier	1	mean	3.30	4	0.289	3	78.9	2	2.70	5	18.4	2	616.4	1
		sd												
San Mateo Bridge	3	mean	4.31	2	0.148	6	55.2	5	2.95	2	15.4	3	286.3	7
		sd	0.47		0.102		17.6		1.03		4.0		231.7	
Vallejo	3	mean	4.83	1	0.316	1	122.1	1	3.66	1	29.2	1	454.9	2
		sd	0.47		0.086		37.0		0.52		7.8		167.7	

Table 7. Mean Lipid and Chemical Concentration in Surfperch

STATION NAME	n		% Lipid	R	Hg (ppm)	R	TTLDDT (ppb)	R	Dieldrin (ppb)	R	TTLCLOR (ppb)	R	TTLARO(ppb)	R
Berkeley Pier	3	mean	0.52	8	0.102	6	15.1	8	0.50	7	2.813	8	108.6	6
		sd	0.18		0.027		4.1		0.45		1.092		28.7	
Double Rock	1	mean	1.58	2	0.104	5	31.6	4	2.25	1	10.396	2	317.5	1
		sd												
Dumbarton Bridge	1	mean	1.00	6	0.124	2.5	16.9	7	1.18	5	4.505	7	101.1	8
		sd												
Islais Creek	1	mean	1.16	4	0.080	7	18.8	5	0.00	8	5.414	4	103.7	7
		sd												
Oakland Inner Harbor	3	mean	1.10	5	0.274	1	42.6	2	1.98	2	15.060	1	287.0	2
		sd	0.12		0.126		25.7		0.53		0.532		74.2	
Oakland Middle Harbor	1	mean	1.34	3	0.124	2.5	47.1	1	0.96	6	5.818	3	167.0	3
		sd												
Richmond Harbor	3	mean	0.86	7	0.113	4	37.3	3	1.64	3	4.745	5	166.9	4
		sd	0.03		0.015		4.4		0.11		0.460		16.8	
San Mateo Bridge	1	mean	1.84	1	0.068	8	17.5	6	1.25	4	4.508	6	114.0	5

Chemical concentrations represent mean values of composites. Numbers to the right of each set of values are ranking order (R) for that analyte. Lowest rank numbers indicate stations with the highest chemical concentration. See text for fish composites included in means.

variables were distributed normally with the exception of mercury and total chlordane, and total chlordane was not significantly different from normal when data were log transformed. Variances for all levels of each measured variable were homogeneous. Sample sizes were three for the Richmond Harbor, Berkeley Pier, and Oakland Inner Harbor sites. All other sample sizes were one. There was no significant difference in the mean length of fish caught at each site (p=0.207).

- Lipids p=0.001

San Mateo was significantly greater than Richmond, Oakland Inner Harbor, Dumbarton, and Berkeley Pier.
Berkeley Pier was significantly less than Double Rock, Islais Creek, Oakland Inner Harbor, Oakland Middle Harbor and San Mateo.
Double Rock was significantly less than Richmond.

- Mercury p=0.385

Differences for mercury were not significant.

- Total DDT p=0.255

Differences for total DDT were not significant.

- Dieldrin p=0.056

A posteriori tests did not indicate significant differences among sites.

- Total Chlordane p=0.001

Oakland Inner Harbor was significantly greater than all other sites except Double Rock.
Double Rock was significantly greater than Berkeley Pier.

- Total Aroclor p=0.058

A posteriori tests did not indicate significant differences among sites.

Rankings of chemical means for shiner surf perch composites collected at each station are given in Table 7. Means were ranked in order of their concentrations so lowest rank numbers indicate stations with highest chemical concentrations.

Differences Between Sites For All Species
Single factor ANOVAs were run to test for differences between species regardless of site. Species showing significant differences were dropped from analysis of site. To evaluate each site, regardless of fish species, all species showing no significant difference in the constituent of interest were grouped.

A) Differences Between Species
Fish species caught in small numbers at only one sample location were excluded from analyses (South Bay-San Mateo/Halibut, Grizzly Bay/Sturgeon, and Point Molate/Walleye Surf Perch). Normality and homogeneity of variances were tested with Kolmogorov-Smirnov goodness-of-fit analyses and Cochran's tests for multiple variances. No measured variable was distributed normally, although when log transformed, differences between distribution

of data for lipids and total Aroclor were not significantly different from normal. Single factor ANOVAs were used for all analyses despite deviations from normality.

- Lipid $p<0.001$

Lipid was significantly greater in white croaker than all other fish species.
Lipid was significantly greater in shiner surf perch than brown smoothhound sharks.

- Mercury $p<0.001$

Leopard sharks and brown smoothhounds sharks were significantly higher in mercury than shiner perch, striped bass, white croaker, and white surf perch.

- Total DDT $p<0.001$

White croaker were significantly greater than all other species.

- Dieldrin $p<0.001$

White croaker were significantly greater than all other species.

- Total Chlordane $p<0.001$

White croaker were significantly greater than shiner perch, smoothhound, leopard sharks, and white surf perch.
Striped bass were significantly greater than the two shark species.

- Total Aroclor $p<0.001$

White croaker were significantly greater than all other species.

Rankings of chemical means for species collected throughout the Bay are given in Table 8. Means were ranked in order of their concentrations so lowest rank numbers indicate the species tested with highest chemical concentrations.

B) Differences Between Sites

If a species was significantly different and dropped, analysis of differences between all thirteen sites may not have been possible. Single factor ANOVAs were conducted comparing the following chemical constituents between all possible sites:

- LIPID $p=0.062$

Lipid was not significantly different between sites

- Mercury $p=0.001$

Islais creek was significantly lower than Rodeo and Vallejo.

- Total DDT $p<0.001$

Vallejo was greater than all sites except Point Molate.

- Dieldrin $p<0.001$

Fremont Forebay was significantly greater than Berkeley Pier, San Francisco Pier #7, and Vallejo.
Oakland Inner Harbor was significantly greater than San Francisco Pier #7 and Vallejo.

Table 8. Mean Length, Lipid and Chemical Concentration by species

FISH TYPE	n		leng	% Lipid	R	Hg (ppm)	R	TTLDDT (ppb)	R	Dieldrin (ppb)	R	TTLCLOR (ppb)	R	TTLARO (ppb)
shiner perch	14	mean	96.3	1.026	2	0.141	5	29.8	3	1.283	3	7.035	3	177.9
		sd		0.397		0.090		16.3		0.753		4.755		87.2
striped bass	9	mean	453.9	0.958	3	0.272	3	36.5	2	1.871	2	11.644	2	157.1
		sd		0.539		0.084		9.9		0.627		4.916		59.0
smoothound	7	mean	607.8	0.333	6	0.597	2	7.1	6	0.049	6	0.824	6	63.9
		sd		0.165		0.203		4.4		0.129		0.962		51.3
leopard sharks	5	mean	994	0.376	5	0.838	1	10.8	4	0.123	5	1.706	4	63.0
		sd		0.108		0.467		9.0		0.275		0.922		30.4
white croaker	25	mean	238	3.266	1	0.184	4	61.1	1	2.433	1	14.913	1	331.6
		sd		1.154		0.105		29.9		1.056		6.850		147.6
white surf perch	3	mean	256.4	0.580	4	0.137	6	8.7	5	0.192	4	1.657	5	94.3
		sd		0.235		0.031		0.8		0.333		0.186		27.3

Table 9. Mean Lipid and Chemical Concentration by site

STATION NAME	n		% Lipid	R	Hg(ppm)	R	TTLDDT(ppb)	R	Dieldrin(ppb)	R	TTLCLOR(ppb)	R	TTLARO(ppb)
Berkeley Pier	63	mean	0.59	3	0.10	13	12.4	13	0.37	10	2.3	8	91.7
		sd			0.03		6.4		0.44		1.4		41.1
Double Rock	35	mean			0.15	8	42.5	7	2.25	1	10.4	3	317.5
		sd			0.12		18.5						
Dumbarton Bridge	35	mean			0.12	10	42.1	8	1.18	7	4.5	6	101.1
		sd			0.04		22.0						
Fremont Forebay	13	mean	0.98	2	0.23	4	34.9	10	2.03	2			146.8
		sd	0.17		0.06		12.7		0.84				74.7
Islais Creek	35	mean			0.17	7	43.3	6	1.75	4	15.7	1	372.7
		sd			0.17		21.4						
Oakland Inner Harbor	63	mean	1.37	1	0.29	3	39.4	9	1.95	3	15.1	2	270.6
		sd			0.11		21.9		0.44		0.5		68.9
Oakland Middle Harbor	35	mean			0.11	12	50.9	3	0.96	9	5.8	4	167.0
		sd			0.02		6.3						
Point Molate	20	mean			0.20	5	61.0	2					
		sd			0.09		6.1						
Richmond Harbor	23	mean	0.30	6	0.11	11	29.4	11	1.31	5	3.6	7	135.0
		sd			0.02		16.2		0.65		2.4		65.3
Rodeo	18	mean	0.46	5	0.29	2	47.3	4	0.00	12	0.9	10	44.3
		sd			0.04		35.0						
San Francisco Pier #7	20	mean	0.58	4	0.17	6	26.2	12	0.19	11	1.7	9	94.3
		sd	0.24		0.08		35.1		0.33		0.2		27.3
San Mateo	35	mean			0.13	9	45.8	5	1.25	6	4.5	5	114.0
		sd			0.09		23.7						
Vallejo	18	mean	0.09	7	0.31	1	104.3	1	1.08	8			129.8
		sd			0.07		46.6						

Chemical concentrations represent mean values of composites. Numbers to the right of each set of values are ranking order (R) for that analyte. Lowest rank numbers indicate stations with the highest chemical concentration. See text for fish composites included in means.

• Total Chlordane $p<0.001$
Oakland Inner Harbor was significantly greater than all sites other than Double Rock.
Double Rock was significantly greater than Berkeley Pier, Richmond, Rodeo, San Francisco Pier #7, and San Mateo Bridge.

• Total Aroclors $p=0.003$
Oakland Inner Harbor was significantly greater than Berkeley Pier and San Francisco Pier #7.We attempted to address total contaminant concentrations at different sites around the Bay. Since not all species were found at all sites, species-specific factors affecting contaminant load had to be isolated. By comparing mean contaminant concentration between species for each of the pesticides and PCBs, significant differences between species could be isolated. For example, the two shark species had significantly greater mercury concentrations than all other species collected. This is probably representative of species-specific physiological or biological processes rather than concentrations specific to the collection site. To evaluate the total contamination of a site, it was necessary to separate these biases. For each contaminant, all fish species were statistically compared. Fishes that were significantly different were excluded from comparisons among sites, and fishes that were not significantly different were pooled. White croaker were excluded from comparisons of lipids, total DDT, dieldrin, total chlordane and total Aroclors among sites. Smoothhound and leopard sharks were excluded from comparisons of mercury, shiner surf perch were excluded from comparisons of lipids, and striped bass were excluded from comparisons of total chlordane. These exclusions were necessary to make comparisons between stations, but holes are left in the data subset. These exclusions make the analysis conservative with the potential of not identifying all the differences among species. Rankings resulting from this limited comparison of stations collected from the Bay are given in Table 9. Missing standard deviations indicate only one sample for that case. Means were ranked in order of their concentrations so lowest rank mean numbers indicate species tested with highest chemical concentrations.

OTHER CHEMICALS

Although arsenic is not currently an analyte given a screening value by the EPA, there should be some mention of arsenic levels found in the tissue of San Francisco Bay sharks. Arsenic, like methylmercury, has a strong potential to biomagnify in the upper trophic levels of the food chain (Suedal *et al.*,1994). Some of the highest reported arsenic values in marine fish are from sharks (4.6 ppm-LeBlanc and Jackson, 1973 & 30 ppm-U.S. Dept. of the Interior, 1988), and may be related to specific feeding behaviors. Levels seen in this study in sharks from San Francisco Bay ranged from 1.08 to 5.95 ppm, with the highest level found in brown smoothhounds from the Central Bay. Arsenic is predominantly present in edible tissue as an organoarsenical, arsenobetaine, which is less toxic than the carcinogenic inorganic forms (U.S. Dept. of the Interior, 1988). Since speciation of arsenic was not attempted for this study there can be no assessment of the organic-inorganic relationship. It should be noted though that arsenic levels in sharks from the Bay were significantly higher than in the other species collected and deserve attention in this and future tissue contaminant studies.

The PAH analysis done in this study indicates that hydrocarbon levels were near or below method detection limits in all samples measured. The EPA guidance document does not currently recommend a screening value for these compounds. For these reasons, it is not necessary to target this group of chemicals as a special concern at this time. As more quantitative data becomes available concerning carcinogenic risks of individual PAHs, this may need to be revisited.

Although there were a number of chemicals of concern found in fish throughout the Bay, a number of chemicals measured in this study fell below the pilot study screening values and based on the results of this report these chemicals are not a concern for humans consuming fish from the Bay at this time. This is true of cadmium, selenium, endosulfan, endrin, heptaclor epoxide, hexachlorobenzene, mirex, toxaphene and chlorpyrifos. Seemingly low tissue levels observed for these and the remainder of the other analytes, for which there are currently no screening values, should serve as baseline data for future studies and should be reviewed when new screening levels are established by the EPA.

It is useful at this point to add some historical perspective to the impact these study results may have on public perception, monitoring policy and future research. The only long term monitoring program that has been implemented in the bay is the California State Mussel Watch program, which has been in existence for over 15 years. Mussels have been collected from stations at Point Pinole, Treasure Island, Oakland Inner Harbor and Dumbarton Bridge and their tissues measured for a wide range of metal and organic contaminants. Analysis of Mussel Watch data can help put our present findings in perspective. Long term trends measured for DDTs, dieldrin, chlordanes and PCBs indicate that these contaminants have steadily and significantly declined since the beginning of the program (CA. State Mussel Watch Program, 1988, CA. State Mussel Watch Program, 1994, and Stephenson *et al.*, 1994). Chlordane and DDT levels were approximately four times higher in the early 1980s while dieldrin levels were approximately twice as high as currently seen. PCB levels at the same time were four to seven times higher than those currently observed. Mercury levels in mussel tissues have remained at essentially the same level over the duration of the program. Dioxins were not measured by the Mussel Watch Program. This indicates that at least for some of the organic contaminants the water quality in the Bay has been improving. It follows that levels of contaminants in the tissues of species other than mussels, which are also influenced by bioconcentration and biomagnification factors, also would exhibit a corresponding decrease over time. If this is true, the PCB and pesticide levels seen in fish tissues from this study may represent relatively lower levels than those in the past, and can be used to assess any changes or trends we may see in the future.

CONCLUSIONS

The major conclusions of the pilot study are:
1) The EPA guidance document, Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories- Volume 1- Fish Sampling And Analysis (EPA 823-R-93-002, 1993), was an effective tool for designing the pilot study and analyzing data collected from the San Francisco Bay study.
2) Based on calculated pilot study screening values (PS-SVs), six chemicals or chemical groups are identified as potential chemicals of concern in San Francisco Bay. They are PCBs, mercury, dieldrin, total DDT, total chlordane and the dioxin/furans.
3) High levels of the pesticides dieldrin, total DDT and total chlordane were found most often in fish from the North Bay.
4) Levels of PCBs, mercury and the dioxin/furans were found at concentrations exceeding the pilot study screening values throughout the Bay.
5) Fish with high lipid content (croaker and shiner surfperch) in their tissue samples generally exhibited higher organic contaminant levels, with the exception of methyl mercury. Fish with low lipid levels (halibut and shark) generally exhibited lower organic contaminant levels. It should be noted though that skin on/skin off sampling differences may have magnified lipid differences between species in this study.
6) Of the Bay fish collected, white croaker consistently exhibited the highest tissue lipid concentrations. Lipophilic PCBs and pesticides concentrated to the highest levels in the tissue of this fish.
7) Mercury levels were found to be highest in two shark species collected; leopard shark and brown smoothhound shark. Leopard sharks and white croaker exhibited increasing mercury concentration with increasing fish size, suggesting bioaccumulation of this metal in Bay area fish.
8) Vallejo-Mare Island is the sampling location from which fish most often exhibited high levels of chemical contaminants. Oakland Inner Harbor also exhibited a high incidence of tissue contamination.
9) A comprehensive study of the potential chemicals of concern, and accumulation of these chemicals in fish and invertebrate tissues is recommended for the San Francisco Bay area and its tributaries.

Although the study design worked well in meeting the goals of the pilot study, a number of limitations and questions remain to be addressed in a more comprehensive study. When designing future studies, the following limitations in the pilot study data set should be considered:
1) Not all species which are caught and consumed from the Bay were collected in this study. This is particularly apparent with the absence of one of the prioritized species, jacksmelt, from samples collected.
2) Analyses were not performed for all chemicals for which the EPA currently has recommended screening values. Samples were not analyzed for the following eight pesticides: dicofol, lindane, carbophenothion, diazanon, disulfoton, ethion, terbufos and

oxyfluorfen. Due to the costs of the special analytical procedures, and the fact that these pesticides were not found at elevated levels in the southern California or Monterey Bay studies, these chemicals were not analyzed. Future research should evaluate these compounds. Diazanon is used extensively in California's central valley and may deserve particular attention in future studies.

3) Chemical analysis was performed on composites of fish rather than individual fish so the variability of contamination in individual fish can not be addressed.

4) The same number of fish were not used for all composites, with numbers of fish per composite ranging from 3 to 20. The small sample size of fish used to complete some composites may not accurately represent the population.

5) Size classes within species were not the same at all stations. Size differences make age/accumulation relationships difficult to assess.

6) Sampling occurred over a one month period during the spring. This design does not address changing species composition at stations throughout the year or changing contaminant load due to reproductive cycle or other variables.

7) All species of fish were not caught at all stations so rigorous statistical analysis between stations is compromised.

8) Some fish(white croaker and shiner surf perch) were analyzed with skin on while others were analyzed with skin off. Although this is the way these fish are most commonly eaten, it confounds the chemical comparisons between species.

As mentioned earlier, this report was not meant to evaluate the human health risks associated with consumption of particular fish. This question will be addressed in detail by the Office of Environmental Health Hazard Assessment, with input from the Department of Health Services. Recommendations or warnings concerning the consumption of fish caught from San Francisco Bay will be made as a result of that assessment.

SUGGESTED RESEARCH

Results of this study have raised additional questions which were not addressed in the pilot study design. These concerns involve levels of contaminants in species not sampled, seasonality of contaminant loading and additional chemical analysis.

High levels of mercury in sharks points to the need for research into bioaccumulation issues for different age groups and species. This should be expanded to include other elasmobranchs, such as bat rays, which are consumed by some fishing populations. The source of mercury to sharks is also of concern since common food items in the shark's diet such as crabs, shrimp and other fish (Russo, 1975) also are consumed by people. Trophic level transfer of mercury to other higher level marine species also may constitute a concern in the continuing movement of mercury up the food chain. Ebert (1989) found that sevengill sharks, collected in the S.F. Bay, fed heavily on brown smoothhounds. Larger species of shark may bioaccumulate mercury to more extreme levels than the two smaller species which were sampled in this study. This was evident in sharks from Hawaiian waters, weighing over

150 pounds, where mercury levels exceeded 2.5 ppm (Hawaii Dept. of Health, 1992).

Not all species which are caught and consumed from the Bay were collected in this study. Jacksmelt, which were not collected in sufficient numbers to complete a composite, need to be targeted again since this is the most commonly caught fish in San Francisco Bay, with over 10 million pounds reportedly landed in 1992 (CDFG, 1993). As mentioned earlier, there is also a need to measure the other sharks, rays and invertebrates. Considering the variability in contaminant loading for various species seen in this study, it seems clear that an evaluation of additional species which are caught and consumed from the Bay is needed.

Since white croaker were the most consistently contaminated fish from the Bay, additional analysis should be performed with this species. In particular, to assist in comparisons between different Bay species, croaker muscle tissue also should be analyzed with the skin off to eliminate biases created through skin on/skin off lipid differences. Also to better evaluate differences between sites, white croaker of similar size should be collected from all sites in the future.

One aspect of tissue biochemistry not well addressed in this pilot study is the seasonality of contaminant levels. Studies of white croaker in southern California indicate that lipid content of female liver tissue is dependent on the seasonal reproductive cycle (SCCWRP, 1986). Significantly higher levels of DDT and chlordane were found in muscle tissue of white croakers during summer months, while the highest PCB levels were found during winter months (Pollock *et al.*, 1991). This relationship between contaminant body burdens and seasonal lipid variability needs to be better understood when assessing the loading of lipid soluble contaminants such as PCBs and pesticides. A more comprehensive study should include sampling at other times of the year to address this issue.

Of additional interest is the relationship between contaminant levels in organ tissues, such as the liver and gonads, and their lipid content. These organs are very high in lipids and may be reservoirs for lipophilic compounds. Sharks which have extremely high liver lipid levels may concentrate these contaminants in the organs rather than the muscle tissue, thus explaining some of the seemingly low organic contaminant loading in these species. Gonadal tissue analysis would also help identify patterns in seasonal contaminant levels for species such as croaker and surf perch in which tissue lipid levels are influenced by reproductive cycles.

Future studies also should include the analysis for chemicals not measured in this study. This might include additional pesticides of interest, such as diazinon, or other chemicals for which screening values can be developed using EPA guidelines.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR) (1987a) Draft Toxicological Profile for Aldrin/Dieldrin. U.S. Public Health Service, Washington, DC.

Ahlborg U.G., G.C. Becking, L.S. Birnbaum *et al*. (1993) Toxic equivalency factors for dioxin-like PCBs. Report on a WHO_ECEH and IPCSA consulation. Chemosphere 28: 1049-1067, 1994.

Barnes, D.G. and J.S. Bellin (1989) Interim Procedures For Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs). Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C.

California State Mussel Watch Program (1988) Ten Year Data Summary 1977-1987. Water Quality Monitoring Report No. 87-3. Division of Water Quality. State Water Resources Control Board.

California State Mussel Watch Program (1994) 1987-93 Data Report Draft. Water Quality Monitoring Report No. 94-1WQ. State Water Resources Control Board. California Environmental Protection Agency.

Ebert, D. A. (1989) Life history of the sevengill shark, *Notorynchus depedianus* Peron, in two northern California bays. California Fish and Game 75(2): 102-112.

Food and Drug Administration (1994) Mercury in Fish; Cause for Concern?. Judith Faulke, FDA Consumer, Sept. 1994

Forsythe, B.L., F.C. Bailey and S.J. Klaine (1994) Interactive Effect of Selenium and Mercury on Development and Mortality of Brine Shrimp, *Artemia sp.* Society of Environmental Toxicology and Chemistry 15th Annual Meeting.

Hodges, L. (1977) Environmental Pollution. Holt, Rinehart and Winston, New York, NY.

Gunther, A.J., J.A. Davis and D.J.H.Phillips (1987) An Assessment of the Loading of Toxic Contaminants to the San Francisco Bay-Delta, Aquatic Habitat Institute, Richmond, CA.

Hazardous Materials Laboratory (1992) Analysis of Dioxins and Furans; Method 880.

IRIS (Integrated Risk Information System) (1992) U.S. Environmental Protection Agency, Duluth, MN.

LeBlanc, P.J. and A.L. Jackson (1973) Arsenic in Marine Fish and Invertebrates. Marine Pollution Bulletin, 4, 88-90.

Luoma, S.N. and D.J.H. Phillips (1988) distribution, Variability, and Impacts of Trace Elements in San Francisco Bay. Marine Pollution Bulletin, 19(9), 413-425.

NAS (National Academy of Sciences) (1991) Seafood Safety. Committee on Evaluation of the Safety of Fishing Products, National Academy Press, Washington, DC.

NOAA (National Oceanic and Atmospheric Administration) (1989b) Standard analytical procedures of the NOAA National Analytical Facility. 2nd ed. NOAA Tech. Mem. NMFS F/NWC-92, 1985-86. National Status and Trends Program, U.S. Department of Commerce, Rockville, MD.

Nichols F.H., J.E. Cloern, S.N. Luoma and D.H. Peterson (1986) The Modification of an Estuary. Science, 231, 561-573.

Phillips, D.J.H. (1987) Toxic Contaminants In The San Francisco Bay-Delta And Their Possible Effects. Aquatic Habitat Institute.

Pollock, G.A., I.J. Uhuaa, A.M. Fan, J.A. Wisniewski and I. Witheral (1991) A study of Chemical Contamination of Marine Fish from Southern California. II. Comprehensive Study. Office of Environmental Health hazard Assessment. Sacramento, CA

Pollock, G.A., I.J. Uhuaa, A.M. Fan, J.A. Wisniewski and I. Witheral (1992) Monterey Bay Marine Environmental Health Survey, Health Evaluation. Office of Environmental Health hazard Assessment. Sacramento, CA

Russo, R.A. (1975) Observations on the Food Habits of Leopard Sharks (*Triakas semifasciata*) and Brown Smoothhounds (*Mustelus henlei*). Cal. Fish and Game, 61(2):95-103.

SCCWRP (Southern California Coastal Water Research Project) (1986) Annual Report.

Stephenson, M.D., M. Martin and R.S. Tjeerdema (1994) Long-term Trends in DDTs, Polychlorinated Biphenyls and Chlordanes in California Mussels. Archives of Environmental Contamination & Toxicology (in press).

Suedal, B.C., J.A. Boraczek, R.K. Peddicord, P.A. Clifford and T.M. Dillon (1994) Trophic Transfer and Biomagnification Potential of Contaminants in Aquatic Ecosystems. Reviews of Environmental Contamination and Toxicology, 136, 21-89.

Tollefson, Linda (1989) Methylmercury in fish: Assessment of risk for U.S. consumers. In: The Risk Assessment of Environmental and Human Health Hazards : A Textbook of Case Studies. Dennis J. Paustenback (ed.) John Wiley & Sons, New York,NY.

U.S. Department of the Interior, Fish and Wildlife Service (1988) Arsenic Hazards to Fish, Wildlife and Invertebrates: A Synoptic Review. Biological Report 85(1.12) Contaminant Hazard Reviews Report No. 12

U.S. Environmental Protection Agency (1987d) National Dioxin Study. Tiers 3,5,6 and 7. EPA-440/4-87-003. Office of Water Regulations and Standards, Washington, DC.

U.S. Environmental Protection Agency (1990a) Exposure Factors Handbook. EPA-600/8-89/043. Office of Health and Environmental Assessment. Washington, D.C.

U.S. Environmental Protection Agency (1992) National Study of Chemical Residues in Fish. EPA-823-R-02-008. Office of Science and Technology, Washington, D.C.

U.S. Environmental Protection Agency (1993) Guidance for Assessing Chemical Contaminant Data For Use In Fish Advisories. Volume 1. Fish Sampling and Analysis. EPA 823-R-93-002. Office of Water, Washington D.C.

U.S. Environmental Protection Agency (1993c) Workshop Report on Developmental Neurotoxic Effects Associated With Exposure to PCBs. September 14-15, 1992, Research Triangle Park, NC. Risk Assessment Forum, Washington, DC.

U.S. Environmental Protection Agency (1994-draft) Estimating Exposure to Dioxin-Like Compounds. EPA-600/6-88/005Ca. Office of Research and Development, Washington, D.C.

U.S. Food and Drug Administration (1994) Shellfish Sanitation Interpretation: Action Levels for Chemical and Poisonous Substances.

Ware, G.W. (1978) The Pesticide Book. W.H. Freeman and Company, San Francisco, CA.

Worthing, C.R. (1991) The Pesticide Manual: A World Compendium. 9th edition. British Crop Protection Council, Croydon, England.

Zar, J.H. (1984) Biostatistical Analysis Second Edition, Prentice Hall, Englewood Cliffs, New Jersey .

APPENDIX I

ANALYTICAL RESULTS & DATA BASE DESCRIPTION

Analytical Results & Data Base Description

Results from the study are presented here in tabular form:
All trace metal chemistry data is presented in units of parts per million (ppm-wet weight). Organic chemistry is presented in units of part per billion (ppb-wet weight). Dioxin and furan data is presented in units of part per trillion (ppt-wet weight). Data is presented in the following sections:

Section I - Sampling Data
Section II - Trace Metal Analysis
Section III - PCB Analysis
Section IV - Pesticide Analysis
Section V - PAH Analysis
Section VI - Dioxin and Furan Analysis
Section VII - Data Base Description

Section I - Sampling Data

IDORG #	STATION NAME	FISH TYPE	STATION	DATE	SAMPLERS	COMP#	SIZE RANGE	MN LENGTH
1234	SAN MATEO BRIDGE	5 White Croaker	24001.0	5/3/94	RF,EJ,KT	1	253-242 mm	250
1235	SAN MATEO BRIDGE	5 White Croaker	24001.0	5/3/94	RF,EJ,KT	2	242-199 mm	224
1236	SAN MATEO BRIDGE	5 White Croaker	24001.0	5/3/94	RF,EJ,KT	3	180-154 mm	172
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	24001.0	5/3/94	RF,EJ,KT	4	136-103 mm	117
1238	DUMBARTON BRIDGE	5 White Croaker	24002.0	5/2/94	RF,EJ,KT	1	286-231 mm	255
1239	DUMBARTON BRIDGE	5 White Croaker	24002.0	5/2/94	RF,EJ,KT	2	230-220 mm	224
1240	DUMBARTON BRIDGE	5 White Croaker	24002.0	5/2/94	RF,EJ,KT	3	201-157 mm	179
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	24002.0	5/2/94	RF,EJ,KT	4	157-102 mm	121
1242	FREMONT FOREBAY	3 Striped Bass	24003.0	5/20/94	RF,EJ,JD,LK	1	445-406 mm	423
1243	FREMONT FOREBAY	3 Striped Bass	24003.0	5/20/94	RF,EJ,JD,LK	2	406-387 mm	396
1244	FREMONT FOREBAY	3 Striped Bass	24003.0	5/20/94	RF,EJ,JD,LK	3	362-356 mm	358
1245	FREMONT FOREBAY	4 Striped Bass	24003.0	5/20/94	RF,EJ,JD,LK	4	381-343 mm	362
1246	RICHMOND HARBOR	20 Shiner Surf Perch	24004.0	5/10/94	RF,EJ	1	121-98 mm (s.l.)	104
1247	RICHMOND HARBOR	20 Shiner Surf Perch	24004.0	5/10/94	RF,EJ	2	96-87 mm (s.l.)	91
1248	RICHMOND HARBOR	20 Shiner Surf Perch	24004.0	5/10/94	RF,EJ	3	87-77 mm (s.l.)	83
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	24004.0	5/10/94	RF,EJ	4	711-559 mm	660
1250	BERKELEY PIER	20 Shiner Surf Perch	24005.0	5/9/94	RF,EJ	1	119-98 mm (s.l.)	108
1251	BERKELEY PIER	20 Shiner Surf Perch	24005.0	5/9/94	RF,EJ	2	97-88 mm (s.l.)	92
1252	BERKELEY PIER	20 Shiner Surf Perch	24005.0	5/9/94	RF,EJ	3	87-77 mm (s.l.)	83
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	24005.0	5/9/94	RF,EJ	4	508-457 mm	483
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	24006.0	5/6/94	RF,EJ	1	119-94 mm (s.l.)	104
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	24006.0	5/6/94	RF,EJ	2	94-87 mm (s.l.)	91
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	24006.0	5/6/94	RF,EJ	3	87-81 mm (s.l.)	83
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	24006.0	5/6/94	RF,EJ	4	469-460 mm	466
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	24007.0	5/4/94	EJ,SL	1	348-227 mm	278
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	24007.0	5/4/94	EJ,SL	2	220-185 mm	202
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	24007.0	5/4/94	EJ,SL	3	184-165 mm	171
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	24007.0	5/4/94	EJ,SL	4	147-105 mm	94
1262	ISLAIS CREEK	5 White Croaker	24008.0	5/4/94	EJ,SL	1	229-202 mm	211
1263	ISLAIS CREEK	5 White Croaker	24008.0	5/4/94	EJ,SL	2	202-192 mm	197
1264	ISLAIS CREEK	5 White Croaker	24008.0	5/4/94	EJ,SL	3	183-161 mm	172
1265	ISLAIS CREEK	20 Shiner Surf Perch	24008.0	5/4/94	EJ,SL	4	116-102 mm	85
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	24009.0	5/5/94	RF,EJ	1	242-217 mm	225
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	24009.0	5/5/94	RF,EJ	2	215-202 mm	209
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	24009.0	5/5/94	RF,EJ	3	200-166 mm	180
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	24009.0	5/5/94	RF,EJ	4	147-98 mm	93
1270	POINT MOLATE	5 White Croaker	24010.0	5/11/94	RF,EJ	1	323-280 mm	297
1271	POINT MOLATE	5 White Croaker	24010.0	5/11/94	RF,EJ	2	279-233 mm	255
1272	POINT MOLATE	5 White Croaker	24010.0	5/11/94	RF,EJ	3	231-179 mm	212
1273	POINT MOLATE	5 Walleye Surf Perch	24010.0	5/11/94	RF,EJ	4	232-195 mm	215
1274	RODEO	5 White Croaker	24011.0	5/12/94	EJ,JD	1	340-300 mm	326
1275	RODEO	5 White Croaker	24011.0	5/12/94	EJ,JD	2	300-282 mm	297
1276	RODEO	5 White Croaker	24011.0	5/12/94	EJ,JD	3	275-270 mm	273
1277	RODEO	3 Leopard Sharks	24011.0	5/12/94	EJ,JD	4	559-470 mm	512
1282	SAN FRANCISCO PIER #7	5 White Croaker	24013.0	5/9/94	RF,EJ	1	305-251 mm	276
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	24013.0	5/9/94	RF,EJ	2	280-264 mm	270
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	24013.0	5/9/94	RF,EJ	3	263-255 mm	260
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	24013.0	5/9/94	RF,EJ	4	250-219 mm	238
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass		5/6/94	RF,EJ	1	501-478 mm	489
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass		5/14/94	EJ,SL	2	486-477 mm	480
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass		6/10/94	EJ,SL,JD	3	686-610 mm	644
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon		6/4/94	EJ,SL,JD	1	1346-1092 mm	1202
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks		5/3/94	RF,EJ	1	1321-1194 mm	1245
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks		5/14/94	RF,EJ	2	813-660 mm	720
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks		5/14/94	RF,EJ	3	584-457 mm	533
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks		5/9/94	RF,EJ	1	1295-1143 mm	1219
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks		5/9/94	RF,EJ	2	711-686 mm	703
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks		5/13/94	RF,EJ	3	711-635 mm	686
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks		5/11/94	RF,EJ	1	1346-1245 mm	1274
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks		5/11/94	RF,EJ	2	711-610 mm	623
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks		5/11/94	RF,EJ	3	584-533 mm	567
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut		5/3/94	RF,EJ	1	953-660 mm	758
1336	VALLEJO-MARE ISLAND	5 White Croaker	24014.0	6/1/94	EJ,SL	1	312-301 mm	307
1337	VALLEJO-MARE ISLAND	5 White Croaker	24014.0	6/1/94	EJ,SL	2	300-277 mm	288
1338	VALLEJO-MARE ISLAND	5 White Croaker	24014.0	6/1/94	EJ,SL	3	282-263 mm	271
1339	VALLEJO-MARE ISLAND	3 Striped Bass	24014.0	6/1/94	EJ,SL	4	514-425 mm	468

Section II - Trace Metal Analysis

S.F. Bay Fish Contaminant Study TM Concentrations (µg/g wet weight)

IDORG #	STATION NAME	FISH TYPE	% MOIST	ALUMINUM	ARSENIC	CADMIUM	CHROMIUM	COPPER
1234	SAN MATEO BRIDGE	5 White Croaker	70.2	-8	0.775	-8	-8	0.296
1235	SAN MATEO BRIDGE	5 White Croaker	73.7	4.65	0.722	-8	-8	0.273
1236	SAN MATEO BRIDGE	5 White Croaker	72.7	4.76	0.826	-8	-8	0.317
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	73.1	5.70	0.564	0.00219	3.84	0.265
1238	DUMBARTON BRIDGE	5 White Croaker	69.7	-8	0.723	0.00303	9.41	0.0536
1239	DUMBARTON BRIDGE	5 White Croaker	74.2	-8	0.775	0.00361	-8	0.233
1240	DUMBARTON BRIDGE	5 White Croaker	75.2	4.64	0.698	0.00248	-8	0.258
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	78.6	4.71	0.514	-8	4.43	0.332
1242	FREMONT FOREBAY	3 Striped Bass	73.7	-8	0.0788	-8	-8	0.305
1243	FREMONT FOREBAY	3 Striped Bass	73.3	5.82	0.414	-8	-8	0.321
1244	FREMONT FOREBAY	3 Striped Bass	75.8	-8	0.454	-8	-8	0.268
1245	FREMONT FOREBAY	4 Striped Bass	78.4	4.74	0.556	-8	-8	0.205
1246	RICHMOND HARBOR	20 Shiner Surf Perch	77.1	-8	0.490	-8	-8	0.226
1247	RICHMOND HARBOR	20 Shiner Surf Perch	79.0	-8	0.539	-8	10.3	0.420
1248	RICHMOND HARBOR	20 Shiner Surf Perch	77.2	4.77	0.596	0.00228	-8	0.267
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	74.0	-8	2.55	0.00390	0.0884	0.157
1250	BERKELEY PIER	20 Shiner Surf Perch	77.0	-8	0.632	-8	0.0234	0.206
1251	BERKELEY PIER	20 Shiner Surf Perch	75.9	-8	0.554	-8	-8	0.222
1252	BERKELEY PIER	20 Shiner Surf Perch	78.2	-8	0.533	-8	8.21	0.32
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	75.4	-8	2.90	-8	-8	0.169
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	77.6	-8	0.480	-8	4.24	0.251
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	76.6	-8	0.373	-8	-8	0.212
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	75.6	-8	0.584	-8	-8	0.259
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	77.8	-8	0.353	0.00289	-8	0.227
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	71.8	-8	0.823	-8	-8	0.333
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	73.6	5.64	0.609	-8	2.12	0.377
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	70.1	-8	0.784	-8	-8	0.320
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	76.3	-8	0.489	-8	0.0498	0.240
1262	ISLAIS CREEK	5 White Croaker	73.8	-8	0.527	-8	2.3	0.341
1263	ISLAIS CREEK	5 White Croaker	74.9	4.84	0.743	-8	-8	0.369
1264	ISLAIS CREEK	5 White Croaker	73.3	4.76	0.556	-8	-8	0.393
1265	ISLAIS CREEK	20 Shiner Surf Perch	75.1	-8	0.561	-8	-8	0.257
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	73.1	-8	0.716	-8	-8	0.269
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	75.2	-8	0.862	-8	-8	0.226
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	76.7	5.86	0.775	-8	-8	0.216
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	71.6	9.37	0.429	-8	15.8	0.690
1270	POINT MOLATE	5 White Croaker	76.5	4.79	1.22	-8	3.71	0.333
1271	POINT MOLATE	5 White Croaker	80.1	-8	0.878	-8	7.55	0.401
1272	POINT MOLATE	5 White Croaker	74.9	-8	0.74	-8	8.83	0.457
1273	POINT MOLATE	5 Walleye Surf Perch	75.4	-8	0.489	-8	-8	0.119
1274	RODEO	5 White Croaker	76.9	-8	1.10	-8	0.0785	0.242
1275	RODEO	5 White Croaker	75.8	-8	1.01	-8	2.15	0.256
1276	RODEO	5 White Croaker	74.4	-8	1.23	-8	-8	0.169
1277	RODEO	3 Leopard Sharks	72.3	19.7	1.76	-8	-8	0.218
1282	SAN FRANCISCO PIER #7	5 White Croaker	71.6	13.4	1.01	-8	1.82	0.403
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	78.0	-8	0.396	-8	0.0532	0.116
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	78.2	-8	0.283	-8	0.0442	0.134
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	80.0	-8	0.206	-8	-8	0.133
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	72.6	-8	0.313	-8	-8	0.378
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	73.5	-8	0.515	-8	-8	0.589
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	80.7	-8	0.697	-8	-8	0.252
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	70.6	-8	0.842	-8	0.063	0.237
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	75.0	-8	1.32	0.00974	0.802	0.287
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	75.4	-8	3.74	-8	-8	0.233
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	71.4	-8	4.43	0.00314	-8	0.226
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	67.3	-8	1.91	0.00849	-8	0.266
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	69.6	5.20	4.04	0.00486	2.65	0.104
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	73.5	-8	5.95	-8	-8	0.220
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	71.9	-8	1.08	0.00281	2.31	0.164
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	71.9	-8	4.49	-8	-8	0.264
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	73.8	5.34	3.82	0.00340	0.824	0.213
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	72.8	9.13	0.31	-8	-8	0.104
1336	VALLEJO-MARE ISLAND	5 White Croaker	68.1	4.49	0.87	0.00446	5.99	0.0328
1337	VALLEJO-MARE ISLAND	5 White Croaker	69.5	-8	0.832	-8	0.053	0.232
1338	VALLEJO-MARE ISLAND	5 White Croaker	70.3	-8	0.708	-8	-8	0.189
1339	VALLEJO-MARE ISLAND	3 Striped Bass	75.8	-8	0.725	-8	0.142	0.269

IDORG #	STATION NAME	FISH TYPE	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	SILVER	TIN
1234	SAN MATEO BRIDGE	5 White Croaker	7.54	-8	0.384	0.264	0.384	-8	-8
1235	SAN MATEO BRIDGE	5 White Croaker	5.57	-8	0.441	0.112	0.278	-8	-8
1236	SAN MATEO BRIDGE	5 White Croaker	5.06	-8	0.451	0.0692	0.426	-8	0.052
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	17.7	-8	0.708	0.0676	0.219	0.00395	0.04
1238	DUMBARTON BRIDGE	5 White Croaker	41.8	-8	1.10	0.175	0.321	-8	0.027
1239	DUMBARTON BRIDGE	5 White Croaker	5.08	-8	0.453	0.113	0.273	-8	-8
1240	DUMBARTON BRIDGE	5 White Croaker	5.56	-8	0.315	0.0825	0.340	-8	-8
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	21.8	0.021	0.831	0.124	0.242	-8	0.039
1242	FREMONT FOREBAY	3 Striped Bass	3.76	-8	0.318	0.150	0.559	-8	-8
1243	FREMONT FOREBAY	3 Striped Bass	4.51	-8	0.329	0.286	0.473	-8	-8
1244	FREMONT FOREBAY	3 Striped Bass	4.37	-8	0.445	0.232	0.534	-8	-8
1245	FREMONT FOREBAY	4 Striped Bass	2.53	-8	0.322	0.245	0.385	-8	0.0390
1246	RICHMOND HARBOR	20 Shiner Surf Perch	4.28	-8	0.375	0.130	0.238	-8	-8
1247	RICHMOND HARBOR	20 Shiner Surf Perch	41.1	-8	1.02	0.109	0.292	0.00378	0.025
1248	RICHMOND HARBOR	20 Shiner Surf Perch	5.07	-8	0.452	0.100	0.219	-8	-8
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	2.55	-8	-8	0.572	0.117	0.00260	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	4.46	-8	0.455	0.133	0.312	-8	-8
1251	BERKELEY PIER	20 Shiner Surf Perch	3.78	-8	0.323	0.0903	0.323	-8	-8
1252	BERKELEY PIER	20 Shiner Surf Perch	34.8	-8	0.823	0.0827	0.253	-8	0.026
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	3.79	-8	-8	0.236	0.231	-8	0.039
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	19.8	-8	0.779	0.420	0.285	-8	-8
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	3.75	-8	0.382	0.206	0.229	-8	-8
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	3.69	-8	0.440	0.197	0.300	-8	-8
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	3.87	-8	-8	0.327	0.289	-8	0.053
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	6.32	-8	-8	0.327	0.372	-8	-8
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	15	-8	0.509	0.0999	0.332	-8	-8
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	4.49	-8	0.326	0.0871	0.353	-8	-8
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	3.68	-8	0.313	0.104	0.187	-8	-8
1262	ISLAIS CREEK	5 White Croaker	15.6	-8	0.692	0.0847	0.315	-8	-8
1263	ISLAIS CREEK	5 White Croaker	6.17	-8	0.454	0.0926	0.351	-8	-8
1264	ISLAIS CREEK	5 White Croaker	7.29	-8	0.767	0.0799	0.358	-8	-8
1265	ISLAIS CREEK	20 Shiner Surf Perch	3.76	-8	0.396	0.0800	0.252	-8	-8
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	5.58	-8	0.391	0.109	0.312	-8	-8
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	6.13	-8	0.452	0.110	0.387	-8	0.04
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	4.98	-8	0.523	0.0800	0.367	-8	-8
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	74.1	-8	2.07	0.124	0.277	-8	-8
1270	POINT MOLATE	5 White Croaker	22	-8	0.706	0.296	0.359	-8	0.052
1271	POINT MOLATE	5 White Croaker	34.4	-8	1.05	0.183	0.409	-8	0.042
1272	POINT MOLATE	5 White Croaker	39.4	-8	1.12	0.111	0.341	-8	0.04
1273	POINT MOLATE	5 Walleye Surf Perch	2.37	-8	0.622	0.0865	0.349	-8	0.0860
1274	RODEO	5 White Croaker	6.74	-8	0.353	0.342	0.554	-8	0.095
1275	RODEO	5 White Croaker	13.0	-8	0.457	0.295	0.483	-8	0.065
1276	RODEO	5 White Croaker	4.91	-8	0.322	0.255	0.478	-8	0.09
1277	RODEO	3 Leopard Sharks	3.13	-8	-8	0.283	0.515	-8	0.091
1282	SAN FRANCISCO PIER #7	5 White Croaker	14.7	-8	0.644	0.289	0.502	-8	-8
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	2.46	-8	0.585	0.162	0.273	-8	0.04
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	1.85	-8	0.390	0.146	0.312	0.00523	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	1.81	-8	0.380	0.102	0.278	0.00260	0.0500
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	4.91	-8	-8	0.444	0.414	-8	-8
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	3.71	-8	-8	0.202	0.300	-8	-8
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	3.6	-8	-8	0.257	0.263	-8	-8
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	3.59	-8	0.315	0.245	1.04	-8	-8
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	7.74	-8	0.375	1.24	0.0874	-8	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	3.07	-8	0.322	0.398	nd	-8	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	3.03	-8	-8	0.529	nd	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	5.03	-8	-8	1.01	nd	-8	-8
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	15.1	-8	0.392	0.617	0.149	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	3.31	-8	-8	0.820	0.157	-8	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	16.4	-8	0.475	1.26	0.155	-8	-8
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	3.31	-8	-8	0.845	0.289	-8	-8
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	6.41	-8	0.332	0.562	0.165	-8	-8
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	1.98	-8	-8	0.197	0.196	-8	-8
1336	VALLEJO-MARE ISLAND	5 White Croaker	30.5	-8	0.876	0.414	0.398	-8	-8
1337	VALLEJO-MARE ISLAND	5 White Croaker	5.36	-8	0.347	0.280	0.381	-8	-8
1338	VALLEJO-MARE ISLAND	5 White Croaker	4.46	-8	0.330	0.255	0.348	-8	-8
1339	VALLEJO-MARE ISLAND	3 Striped Bass	5.21	0.027	0.337	0.308	0.298	-8	-8

IDORG #	STATION NAME	FISH TYPE	ZINC	TMDATAQC
1234	SAN MATEO BRIDGE	5 White Croaker	6.08	-4
1235	SAN MATEO BRIDGE	5 White Croaker	5.07	-4
1236	SAN MATEO BRIDGE	5 White Croaker	5.66	-4
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	8.47	-4
1238	DUMBARTON BRIDGE	5 White Croaker	5.66	-4
1239	DUMBARTON BRIDGE	5 White Croaker	5.20	-4
1240	DUMBARTON BRIDGE	5 White Croaker	5.99	-4
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	9.80	-4
1242	FREMONT FOREBAY	3 Striped Bass	5.59	-4
1243	FREMONT FOREBAY	3 Striped Bass	4.81	-4
1244	FREMONT FOREBAY	3 Striped Bass	5.12	-4
1245	FREMONT FOREBAY	4 Striped Bass	4.70	-4
1246	RICHMOND HARBOR	20 Shiner Surf Perch	11.9	-4
1247	RICHMOND HARBOR	20 Shiner Surf Perch	11.6	-4
1248	RICHMOND HARBOR	20 Shiner Surf Perch	11.3	-4
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	4.26	-4
1250	BERKELEY PIER	20 Shiner Surf Perch	12.3	-4
1251	BERKELEY PIER	20 Shiner Surf Perch	12.2	-4
1252	BERKELEY PIER	20 Shiner Surf Perch	10.2	-4
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	5.63	-4
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	12.3	-4
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	8.86	-4
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	11.0	-4
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	4.80	-4
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	7.53	-4
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	5.11	-4
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	5.75	-4
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	10.5	-4
1262	ISLAIS CREEK	5 White Croaker	4.93	-4
1263	ISLAIS CREEK	5 White Croaker	6.55	-4
1264	ISLAIS CREEK	5 White Croaker	6.44	-4
1265	ISLAIS CREEK	20 Shiner Surf Perch	11.8	-4
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	4.36	-4
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	5.79	-4
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	5.12	-4
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	12.7	-4
1270	POINT MOLATE	5 White Croaker	6.45	-4
1271	POINT MOLATE	5 White Croaker	4.43	-4
1272	POINT MOLATE	5 White Croaker	5.14	-4
1273	POINT MOLATE	5 Walleye Surf Perch	7.67	-4
1274	RODEO	5 White Croaker	5.93	-4
1275	RODEO	5 White Croaker	4.37	-4
1276	RODEO	5 White Croaker	5.06	-4
1277	RODEO	3 Leopard Sharks	6.65	-4
1282	SAN FRANCISCO PIER #7	5 White Croaker	7.21	-4
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	7.26	-4
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	7.26	-4
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	6.36	-4
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	6.50	-4
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	4.35	-4
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	2.81	-4
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	4.24	-4
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	5.59	-4
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	5.06	-4
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	5.00	-4
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	4.87	-4
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	4.86	-4
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	5.82	-4
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	6.52	-4
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	4.38	-4
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	4.24	-4
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	3.64	-4
1336	VALLEJO-MARE ISLAND	5 White Croaker	5.74	-4
1337	VALLEJO-MARE ISLAND	5 White Croaker	7.37	-4
1338	VALLEJO-MARE ISLAND	5 White Croaker	4.94	-4
1339	VALLEJO-MARE ISLAND	3 Striped Bass	5.04	-4

Section III - PCB Analysis

IDORG #	STATION NAME	FISH TYPE	PCB5	PCB8	PCB15	PCB18	PCB27	PCB28	PCB29	PCB31	PCB44
1234	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	0.614	-8	0.631	-8	1.751	1.028
1235	SAN MATEO BRIDGE	5 White Croaker	-8	2.282	-8	3.519	-8	-8	-8	7.712	0.822
1236	SAN MATEO BRIDGE	5 White Croaker	0.605	-8	-8	-8	-8	0.557	-8	-8	0.609
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	0.808	-8
1238	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	1.093	-8	1.1	-8	1.427	1.748
1239	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	0.825	-8	0.519	-8	1.364	0.698
1240	DUMBARTON BRIDGE	5 White Croaker	0.557	-8	-8	0.813	-8	0.424	-8	1.983	0.547
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8
1242	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	1.132	-8	0.83	-8	2.948	3.136
1243	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	1.093	-8	1.509	0.66	3.731	1.797
1244	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	0.561	-8	2.337	1.117
1245	FREMONT FOREBAY	4 Striped Bass	-8	-8	-8	-8	-8	0.289	-8	-8	0.317
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.885	-8	0.994	1.451
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.508	-8	1.092	1.112
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.681	-8	1.553	1.562
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.208	-8	0.644	0.549
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.83	-8	1.493	1.275
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.717	-8	1.746	0.974
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.556	-8	2.38	0.903
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	-8	-8	-8	-8	0.706	-8	1.81	0.519
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	0.693	-8	0.796	-8	4.039	2.271
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	4.103	-8	-8	-8	0.571	-8	0.735	1.028
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.783	-8	-8	1.619	-8	0.798	-8	1.381	1.062
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.378	-8	1.85	1.029
1262	ISLAIS CREEK	5 White Croaker	-8	-8	-8	1.579	-8	3.385	-8	2.577	3.101
1263	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	-8	0.334	-8	1.949	0.699
1264	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	-8	0.21	-8	-8	0.727
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.29	-8	1.707	0.511
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	-8	0.781	-8	1.845	1.652
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-6	2.254	-8	0.663	-8	3.868	1.494
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	0.988	-8	0.53	-8	1.532	1.481
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	-8	-8	1.449	-8	0.318	-8	1.485	0.412
1270	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	0.801
1271	POINT MOLATE	5 White Croaker	-8	-8	-8	0.756	-8	0.266	-8	-8	0.902
1272	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	0.342	-8	0.611	0.717
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8
1274	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	0.883
1275	RODEO	5 White Croaker	-8	-8	-8	0.848	-8	-8	-8	-8	0.351
1276	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	0.353	0.833
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	-8	-8	-8	-8	0.525	-8	1.106	1.595
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	0.533	-8	-8	-8	-8	-8
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	0.255	-8	0.429	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	-8	-8	-8	-8	0.491	-8	0.796	0.869
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	1.764	-8	-8	-8	0.234	-8	-8	0.517
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	-8	-8	0.465	-8	0.208	-8	-8	0.547
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	-8	-8	1.127	-8	-8	-8	-8	0.456
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	-8	-8	-8	-8	-8
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	0.47	-8	1.5	1.671
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	0.293	-8	1.297	1.378
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	0.377	-8	1.364	0.956
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	-8	-8	-8	-8	0.228	-8	-8	0.59

S.F. Bay Fish Contaminant Study PCB Analysis (ppb-ng/g)

IDORG #	STATION NAME	FISH TYPE	PCB49	PCB52	PCB66	PCB70	PCB74	PCB87	PCB95	PCB97	PCB99
1234	SAN MATEO BRIDGE	5 White Croaker	1.499	2.737	3.403	0.797	1.166	2.03	10.14	2.688	10.04
1235	SAN MATEO BRIDGE	5 White Croaker	0.631	2.506	3.88	0.899	1.827	2.434	9.905	2.868	9.953
1236	SAN MATEO BRIDGE	5 White Croaker	-8	2.06	2.275	0.846	1.101	1.431	6.259	1.911	5.858
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	0.798	0.746	-8	0.464	0.898	4.38	0.432	2.56
1238	DUMBARTON BRIDGE	5 White Croaker	2.674	4.33	4.732	1.706	2.011	3.36	12.66	3.336	11.03
1239	DUMBARTON BRIDGE	5 White Croaker	0.514	1.661	2.239	0.623	0.8	1.113	5.574	1.552	5.076
1240	DUMBARTON BRIDGE	5 White Croaker	0.497	2.154	2.462	0.991	1.092	1.408	6.175	1.659	5.472
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	0.619	0.609	-8	0.356	-8	1.345	0.26	2.003
1242	FREMONT FOREBAY	3 Striped Bass	1.302	2.092	2.499	1.238	1.408	0.898	2.712	1.224	3.207
1243	FREMONT FOREBAY	3 Striped Bass	2.133	3.795	3.838	2.358	1.805	1.702	5.553	1.977	5.317
1244	FREMONT FOREBAY	3 Striped Bass	1.117	1.994	2.938	1.638	1.683	0.953	3.05	1.166	3.495
1245	FREMONT FOREBAY	4 Striped Bass	0.37	0.825	0.867	-8	0.342	0.225	1.363	0.351	1.271
1246	RICHMOND HARBOR	20 Shiner Surf Perch	1.797	3.923	2.858	2.914	2.148	2.111	5.268	1.313	6.426
1247	RICHMOND HARBOR	20 Shiner Surf Perch	1.157	2.991	2.066	2.184	1.541	1.602	4.133	0.941	4.782
1248	RICHMOND HARBOR	20 Shiner Surf Perch	0.751	3.999	2.243	2.201	1.741	2.006	5.417	1.437	5.565
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	0.365	-8	-8	-8	-8	-8	0.548
1250	BERKELEY PIER	20 Shiner Surf Perch	0.335	1.064	1.045	0.745	0.616	0.436	2.676	0.396	3.151
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	0.613	0.334	0.432	0.304	0.703	1.5	-8	1.891
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	0.649	0.386	0.361	0.365	-8	1.472	-8	2.087
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	0.57
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	2.716	5.344	3.031	2.19	1.945	3.066	8.077	1.84	10.67
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	1.93	3.652	2.289	1.323	1.294	2.043	5.922	1.587	7.227
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.895	3.529	2.401	1.547	1.354	2.023	9.357	1.562	7.059
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	0.531	2.887	2.838	0.822	1.247	1.829	6.623	1.943	6.938
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	3.155	5.401	3.8	3.035	1.647	5.832	20.77	5.043	15.3
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	1.268	3.552	2.36	0.706	0.856	1.149	7.853	1.76	5.515
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	1.375	2.681	2.575	0.864	1.064	1.509	8.427	2.041	6.256
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	1.175	3.079	1.725	2.446	1.144	3.342	9.413	1.8	8.474
1262	ISLAIS CREEK	5 White Croaker	2.796	5.045	5.023	2.839	2.184	2.075	8.627	2.228	6.137
1263	ISLAIS CREEK	5 White Croaker	0.65	2.233	2.2	1.042	0.961	1.651	8.437	1.717	4.67
1264	ISLAIS CREEK	5 White Croaker	0.507	1.507	1.411	0.459	0.574	0.803	4.276	1.004	3.27
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	1.288	0.959	0.388	0.596	0.626	2.444	0.429	2.485
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	1.7	4.015	3.971	2.457	1.757	2.655	10.25	2.984	7.986
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	1.545	3.713	3.448	2.013	1.456	2.652	9.967	2.917	7.293
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	1.8	3.24	3.517	2.265	1.574	3.124	10.21	2.8	7.706
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	0.427	1.571	0.996	-8	0.72	0.994	2.465	0.69	3.28
1270	POINT MOLATE	5 White Croaker	0.993	1.549	1.818	0.801	0.683	1.286	5.768	1.431	4.993
1271	POINT MOLATE	5 White Croaker	1.046	2.156	2.17	0.815	0.813	1.765	6.691	1.955	6.291
1272	POINT MOLATE	5 White Croaker	0.747	1.332	1.64	0.97	0.721	1.408	5.047	1.323	4.505
1273	POINT MOLATE	5 Walleye Surf Perch	0.261	0.617	0.343	-8	-8	-8	1.038	-8	1.078
1274	RODEO	5 White Croaker	1.079	2.035	2.092	0.715	0.783	1.174	6.487	1.866	6.418
1275	RODEO	5 White Croaker	0.457	1.052	1.212	-8	0.354	0.746	3.232	1.053	4.429
1276	RODEO	5 White Croaker	0.929	1.455	2.652	0.708	0.984	2.28	7.584	2.017	9.031
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	0.538
1282	SAN FRANCISCO PIER #7	5 White Croaker	1.874	3.044	3.499	1.72	1.479	3.249	12.18	3.113	12.45
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	0.245	1.091	0.575	0.617	0.444	0.273	0.643	-8	2.241
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	0.409	1.13	0.737	0.906	0.603	0.637	0.892	-8	2.794
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	0.289	0.828	0.39	-8	0.318	0.262	0.582	-8	1.6
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	1.371	2.354	2.123	0.572	0.796	0.997	5.038	1.606	5.126
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	0.555	1.03	1.081	0.515	0.3	0.934	2.785	0.793	2.048
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	0.585	1.397	1.303	-8	0.469	0.774	3.553	1.325	3.812
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.287	1.098	0.704	-8	0.226	0.205	2.216	0.23	1.855
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	0.699
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	0.663
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	0.337
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	2.035
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	0.266
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	0.68
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	0.508	-8	-8	-8	-8	-8	1.18
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	1.756
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	0.593	2.57
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	-8	-8	0.553	-8	0.974
1336	VALLEJO-MARE ISLAND	5 White Croaker	2.28	4.036	4.583	1.658	1.564	2.818	12.93	3.466	12.77
1337	VALLEJO-MARE ISLAND	5 White Croaker	1.8	2.762	3.576	1.265	1.191	3.28	11.94	2.885	11.86
1338	VALLEJO-MARE ISLAND	5 White Croaker	1.167	2.167	2.474	0.689	0.745	1.167	6.557	1.727	6.245
1339	VALLEJO-MARE ISLAND	3 Striped Bass	0.568	1.501	1.479	0.902	0.406	0.857	2.383	1.208	2.941

IDORG #	STATION NAME	FISH TYPE	PCB101	PCB105	PCB110	PCB118	PCB128	PCB132	PCB137	PCB138
1234	SAN MATEO BRIDGE	5 White Croaker	14.327	3.403	10.752	12.873	4.044	5.376	0.905	25.893
1235	SAN MATEO BRIDGE	5 White Croaker	15.087	3.446	10.291	13.279	4.507	5.085	0.86	27.233
1236	SAN MATEO BRIDGE	5 White Croaker	8.385	1.757	6.448	7.251	2.296	3.449	0.404	14.574
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	4.12	1.078	2.06	3.68	0.854	0.73	0.254	6.52
1238	DUMBARTON BRIDGE	5 White Croaker	16.515	4.685	13.344	14.835	4.377	5.134	0.963	24.843
1239	DUMBARTON BRIDGE	5 White Croaker	7.365	1.799	5.325	6.526	1.885	2.583	0.381	11.942
1240	DUMBARTON BRIDGE	5 White Croaker	9.011	2.086	6.652	7.63	2.337	3.464	0.547	15.186
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	3.005	0.865	1.641	2.8	0.717	0.576	-8	5.498
1242	FREMONT FOREBAY	3 Striped Bass	4.763	1.299	5.093	3.961	0.969	1.005	-8	6.249
1243	FREMONT FOREBAY	3 Striped Bass	8.812	2.487	7.633	6.325	1.825	1.96	0.459	9.905
1244	FREMONT FOREBAY	3 Striped Bass	5.387	1.99	4.363	5.276	1.382	1.206	0.247	8.303
1245	FREMONT FOREBAY	4 Striped Bass	2.079	0.697	1.818	1.875	0.542	0.619	-8	2.998
1246	RICHMOND HARBOR	20 Shiner Surf Perch	10.237	3.512	7.79	9.602	1.696	1.055	0.56	10.069
1247	RICHMOND HARBOR	20 Shiner Surf Perch	7.301	2.814	6.101	8.069	1.429	0.968	0.612	8.207
1248	RICHMOND HARBOR	20 Shiner Surf Perch	8.951	3.47	7.872	8.993	1.513	1.162	0.592	8.845
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	1.071	0.285	-8	-8	1.654
1250	BERKELEY PIER	20 Shiner Surf Perch	4.638	1.391	2.478	4.222	1.08	0.65	0.406	7.809
1251	BERKELEY PIER	20 Shiner Surf Perch	2.553	0.921	1.42	2.435	0.597	0.438	0.21	4.635
1252	BERKELEY PIER	20 Shiner Surf Perch	2.828	1.026	1.517	2.789	0.618	0.431	0.213	4.797
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	0.623	-8	0.392	0.967	0.36	-8	-8	1.911
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	18.571	4.503	9.145	15.593	3.154	2.172	0.872	25.229
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	12.998	3.311	7.492	11.049	2.138	1.833	0.609	16.158
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	12.558	3.304	8.208	10.691	2.031	1.98	0.583	16.047
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	12.712	3.033	8.03	10.189	2.353	2.397	0.56	15.332
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	27.485	5.354	20.841	19.861	6.764	11.998	1.121	42.781
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	8.978	2.157	6.684	6.861	2.36	3.309	0.525	14.604
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	10.363	2.405	7.448	8.065	2.575	3.852	0.498	16.471
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	15.943	3.604	8.911	11.968	3.32	3.625	0.57	24.461
1262	ISLAIS CREEK	5 White Croaker	11.029	2.73	8.146	8.19	2.11	3.494	0.574	14.567
1263	ISLAIS CREEK	5 White Croaker	8.189	1.712	6.159	6.678	1.807	2.888	0.521	12.092
1264	ISLAIS CREEK	5 White Croaker	5.68	1.402	4.213	4.548	1.163	1.958	0.319	7.378
1265	ISLAIS CREEK	20 Shiner Surf Perch	4.252	1.097	2.711	3.163	0.682	0.963	-8	5.874
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	13.164	2.699	10.641	10.092	3.313	4.585	0.838	19.483
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	13.304	2.343	9.812	10.122	3.028	4.928	0.785	17.857
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	13.213	2.615	11.153	10.853	3.378	5.021	0.639	19.692
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	5.089	1.455	1.024	5.189	1.163	0.793	0.366	7.853
1270	POINT MOLATE	5 White Croaker	7.948	1.918	6.073	6.542	2.425	2.609	0.465	15.244
1271	POINT MOLATE	5 White Croaker	9.636	2.226	6.809	8.105	2.733	3.322	0.61	16.61
1272	POINT MOLATE	5 White Croaker	7.169	1.696	5.177	6.606	2.318	2.383	0.503	13.299
1273	POINT MOLATE	5 Walleye Surf Perch	1.451	0.491	0.914	1.485	0.399	0.321	-8	2.475
1274	RODEO	5 White Croaker	9.423	2.299	6.578	7.875	2.64	3.186	0.717	16.387
1275	RODEO	5 White Croaker	6.447	1.676	3.899	5.968	2.052	1.967	0.508	12.962
1276	RODEO	5 White Croaker	12.319	3.441	8.527	12.823	4.428	4.231	0.918	27.4
1277	RODEO	3 Leopard Sharks	-8	0.281	-8	0.992	0.315	-8	-8	2.313
1282	SAN FRANCISCO PIER #7	5 White Croaker	18.585	5.407	14.95	17.949	6.066	6.43	1.327	34.307
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	2.347	1.366	0.977	3.805	0.626	-8	0.353	5.031
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	3.752	2.176	0.782	5.848	1.094	-8	0.391	7.325
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	2.105	0.871	0.654	2.518	0.502	-8	-8	3.426
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	8.602	2.332	6.248	7.282	1.687	1.998	0.433	11.044
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	3.58	0.796	3.136	2.714	0.718	1.252	-8	4.797
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	6.247	1.731	4.451	5.429	2.076	1.928	0.457	11.537
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	2.483	0.642	4.042	1.303	0.886	0.932	-8	4.843
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	0.924	0.263	-8	-8	2.809
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	0.249	-8	1.168	0.258	-8	-8	2.596
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	0.567	-8	-8	-8	0.994
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	0.547	-8	3.004	0.486	-8	0.297	8.721
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	0.613	0.225	-8	-8	1.311
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	1.03	0.472	-8	-8	3.12
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	0.39	-8	1.686	0.508	-8	-8	3.915
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	0.685	0.424	0.536	2.533	0.882	-8	0.382	6.622
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	1.801	0.771	1.892	4.21	1.49	-8	0.415	8.359
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	1.44	0.487	0.904	1.391	0.37	0.246	-8	2.649
1336	VALLEJO-MARE ISLAND	5 White Croaker	17.146	4.309	13.178	16.028	5.016	5.814	1.213	30.324
1337	VALLEJO-MARE ISLAND	5 White Croaker	18.643	3.995	12.897	15.388	5.992	7.768	1.068	37.483
1338	VALLEJO-MARE ISLAND	5 White Croaker	8.311	2.267	6.606	7.807	2.618	2.978	0.658	15.925
1339	VALLEJO-MARE ISLAND	3 Striped Bass	4.867	1.342	4.276	4.157	1.284	1.136	0.345	7.014

IDORG #	STATION NAME	FISH TYPE	PCB149	PCB151	PCB153	PCB156	PCB157	PCB158	PCB170	PCB174
1234	SAN MATEO BRIDGE	5 White Croaker	19.038	7.225	46.361	1.78	1.487	3.181	8.952	4.981
1235	SAN MATEO BRIDGE	5 White Croaker	18.967	6.603	42.657	1.424	1.448	3.133	6.965	4.941
1236	SAN MATEO BRIDGE	5 White Croaker	11.078	3.614	22.226	0.694	0.673	1.727	4.039	2.433
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	2.72	1.9	13.28	0.562	0.39	0.808	2.2	0.346
1238	DUMBARTON BRIDGE	5 White Croaker	17.958	6.152	42.351	2.063	1.472	3.052	6.199	4.495
1239	DUMBARTON BRIDGE	5 White Croaker	9.109	3.082	21.278	0.678	0.603	1.477	4.124	2.515
1240	DUMBARTON BRIDGE	5 White Croaker	11.521	3.891	24.849	0.991	0.68	1.825	3.64	2.786
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	2.024	1.421	10.445	0.435	0.225	0.67	1.578	-8
1242	FREMONT FOREBAY	3 Striped Bass	3.631	1.273	11.083	0.556	-8	0.67	1.804	0.745
1243	FREMONT FOREBAY	3 Striped Bass	7.461	2.659	17.731	1.053	0.551	1.312	2.187	1.445
1244	FREMONT FOREBAY	3 Striped Bass	4.586	1.434	12.176	1.563	0.45	0.979	1.621	0.819
1245	FREMONT FOREBAY	4 Striped Bass	2.317	0.857	6.314	-8	-8	0.313	0.77	0.48
1246	RICHMOND HARBOR	20 Shiner Surf Perch	3.026	1.705	14.757	1.154	0.467	1.349	1.831	-8
1247	RICHMOND HARBOR	20 Shiner Surf Perch	2.578	1.364	11.631	1.069	0.378	1.13	1.429	-8
1248	RICHMOND HARBOR	20 Shiner Surf Perch	3.47	1.566	13.056	1.242	0.466	1.198	1.657	0.284
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	3.673	-8	-8	0.254	0.568	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	2.715	2.081	14.746	0.739	0.517	0.898	2.696	0.313
1251	BERKELEY PIER	20 Shiner Surf Perch	1.687	1.202	8.799	0.473	0.318	0.593	1.907	-8
1252	BERKELEY PIER	20 Shiner Surf Perch	1.622	1.322	9.048	0.603	0.306	0.62	1.695	-8
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	0.632	-8	4.149	-8	-8	0.241	0.583	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	9.233	5.764	42.924	2.12	1.822	3.048	7.288	0.867
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	7.19	3.387	26.488	1.538	1.13	2.081	4.579	0.878
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	7.223	3.632	26.471	1.648	1.196	2.114	4.391	0.864
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	10.383	3.275	22.61	0.856	0.997	1.951	3.954	1.803
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	37.284	13.934	87.474	3.513	2.749	5.33	16.013	7.505
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	11.802	4.015	25.59	1.335	0.966	1.754	5.581	3.64
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	13.045	4.384	27.664	1.426	0.828	1.93	5.448	3.554
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	13.235	6.639	41.278	2.337	1.055	3.014	8.146	1.594
1262	ISLAIS CREEK	5 White Croaker	12.274	4.215	25.99	1.374	0.791	1.797	5.788	3.778
1263	ISLAIS CREEK	5 White Croaker	10.784	3.61	21.364	0.866	0.715	1.581	4.647	2.865
1264	ISLAIS CREEK	5 White Croaker	6.56	2.264	13.917	0.69	0.425	1.046	2.704	1.794
1265	ISLAIS CREEK	20 Shiner Surf Perch	3.266	1.801	11.194	0.394	0.327	0.789	2.259	0.448
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	16.828	5.661	30.716	0.873	1.455	2.413	5.99	4.256
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	17.105	5.503	29.393	1.646	1.222	2.387	5.834	4.597
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	16.406	5.484	31.702	1.555	1.125	2.279	5.068	3.633
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	2.823	1.763	12.147	0.441	-8	1.101	1.962	0.334
1270	POINT MOLATE	5 White Croaker	11.148	4.035	30.366	1.586	1.747	1.594	6.032	2.751
1271	POINT MOLATE	5 White Croaker	13.217	4.948	29.686	0.589	1.107	1.92	4.877	3.228
1272	POINT MOLATE	5 White Croaker	9.487	3.119	22.526	1.215	0.901	1.393	3.726	2.134
1273	POINT MOLATE	5 Walleye Surf Perch	1.531	0.693	5.03	-8	-8	0.331	0.541	-8
1274	RODEO	5 White Croaker	12.632	4.848	32.547	1.773	1.293	1.944	4.506	2.822
1275	RODEO	5 White Croaker	8.618	3.506	26.676	0.652	0.744	1.536	4.514	2.069
1276	RODEO	5 White Croaker	16.944	6.905	53.704	2.122	1.708	3.091	7.869	4.209
1277	RODEO	3 Leopard Sharks	-8	-8	4.691	-8	-8	0.274	0.707	-8
1282	SAN FRANCISCO PIER #7	5 White Croaker	23.629	9.179	69.069	4.067	2.772	4.067	13.973	6.861
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	0.481	0.765	9.344	0.748	0.22	0.602	1.503	-8
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	0.493	0.834	10.339	1.23	0.343	0.906	1.485	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	0.491	0.588	6.254	0.287	-8	0.452	0.875	-8
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	8.162	2.794	21.296	1.047	0.766	1.399	3.63	1.729
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	4.961	1.619	10.975	0.36	0.307	0.629	1.792	1.287
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	8.283	3.154	22.156	0.509	0.711	1.347	4.172	1.996
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	4.001	1.488	10.917	0.616	0.484	0.591	0.7	0.302
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	4.94	0.233	-8	0.247	1.04	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	5.334	-8	-8	0.29	0.866	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	2.617	-8	-8	-8	0.378	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	19.38	0.391	0.289	0.766	4.361	-8
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	2.757	-8	-8	-8	0.431	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	6.14	-8	-8	0.306	0.982	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	7.112	0.271	-8	0.399	1.167	-8
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	0.666	-8	15.549	0.436	0.276	0.754	2.387	-8
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	0.882	-8	17.67	0.506	0.326	1.077	2.793	-8
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	1.491	0.869	5.554	0.248	-8	0.335	0.929	0.288
1336	VALLEJO-MARE ISLAND	5 White Croaker	23.712	9.439	58.596	0.96	2.177	3.625	10.967	4.993
1337	VALLEJO-MARE ISLAND	5 White Croaker	28.112	11.861	74.72	4.192	2.713	4.932	15.092	7.941
1338	VALLEJO-MARE ISLAND	5 White Croaker	11.722	4.66	29.304	0.673	1.153	1.847	4.131	2.344
1339	VALLEJO-MARE ISLAND	3 Striped Bass	4.833	1.876	13.588	-8	0.544	0.794	1.96	0.919

IDORG #	STATION NAME	FISH TYPE	PCB177	PCB180	PCB183	PCB187	PCB189	PCB194	PCB195	PCB201
1234	SAN MATEO BRIDGE	5 White Croaker	10.209	28.852	8.088	21.676	-8	3.995	1.194	5.203
1235	SAN MATEO BRIDGE	5 White Croaker	7.471	21.714	7.688	20.34	-8	3.591	1.123	4.555
1236	SAN MATEO BRIDGE	5 White Croaker	7.96	9.991	3.637	10.369	-8	1.755	0.446	2.121
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	2.6	6.64	1.832	4.98	-8	0.688	-8	0.87
1238	DUMBARTON BRIDGE	5 White Croaker	7.003	23.447	6.932	17.674	-8	3.052	0.88	4.022
1239	DUMBARTON BRIDGE	5 White Croaker	4.577	10.696	3.716	10.582	-8	1.824	0.508	2.243
1240	DUMBARTON BRIDGE	5 White Croaker	6.275	10.793	4.167	12.148	-8	1.898	0.472	2.42
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	2.902	4.395	1.774	4.742	-8	0.576	-8	0.76
1242	FREMONT FOREBAY	3 Striped Bass	1.087	4.339	1.37	4.009	-8	0.943	0.363	0.757
1243	FREMONT FOREBAY	3 Striped Bass	4.331	8.49	2.701	6.818	-8	0.896	0.309	1.173
1244	FREMONT FOREBAY	3 Striped Bass	-8	4.385	1.785	5.075	-8	0.659	0.278	0.799
1245	FREMONT FOREBAY	4 Striped Bass	1.191	2.254	0.853	2.679	-8	0.336	-8	0.491
1246	RICHMOND HARBOR	20 Shiner Surf Perch	1.44	5.324	1.455	3.773	-8	0.544	-8	0.65
1247	RICHMOND HARBOR	20 Shiner Surf Perch	1.824	3.68	1.269	2.972	-8	0.407	0.24	0.49
1248	RICHMOND HARBOR	20 Shiner Surf Perch	2.137	4.295	1.475	3.386	-8	0.512	-8	0.601
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	2.017	0.554	1.235	-8	-8	-8	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	2.359	8.067	2.299	6.223	-8	0.979	-8	1.177
1251	BERKELEY PIER	20 Shiner Surf Perch	1.87	5.303	1.522	4.046	-8	0.593	-8	0.821
1252	BERKELEY PIER	20 Shiner Surf Perch	1.989	4.017	1.385	3.803	-8	0.478	-8	0.725
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	0.509	1.979	0.587	1.615	-8	-8	-8	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	4.625	20.323	5.571	13.841	0.244	2.225	0.704	2.418
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	3.292	13.339	3.595	8.722	-8	1.285	0.327	1.461
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	3.94	12.763	3.345	8.372	-8	1.313	0.304	1.354
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	4.779	10.844	3.105	8.054	-8	1.172	0.323	1.48
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	17.041	47.322	13.408	32.026	0.574	5.76	2.024	6.19
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	4.368	16.986	4.522	11.559	-8	2.581	0.788	2.934
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	4.66	12.981	4.724	12.151	-8	2.149	0.585	2.681
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	7.578	20.53	5.962	13.716	0.227	2.167	0.858	1.789
1262	ISLAIS CREEK	5 White Croaker	4.412	17.734	4.717	11.335	-8	2.424	0.649	2.817
1263	ISLAIS CREEK	5 White Croaker	5.82	12.092	3.903	8.979	-8	2.145	0.575	2.346
1264	ISLAIS CREEK	5 White Croaker	3.458	6.623	2.201	4.968	-8	1.1	0.235	1.411
1265	ISLAIS CREEK	20 Shiner Surf Perch	4.457	5.607	1.99	4.231	-8	0.737	-8	0.83
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	7.569	22.379	6.034	14.941	0.239	2.896	0.823	3.686
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	9.923	21.967	5.834	13.724	0.243	2.696	0.846	3.206
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	12.935	18.697	4.998	13.259	-8	2.407	0.764	2.777
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	4.91	3.121	2.127	4.692	-8	0.712	-8	0.757
1270	POINT MOLATE	5 White Croaker	6.644	21.399	5.156	15.224	-8	3.22	0.813	4.117
1271	POINT MOLATE	5 White Croaker	6.667	20.191	5.89	15.903	-8	2.686	0.763	3.605
1272	POINT MOLATE	5 White Croaker	7.819	11.761	3.596	9.769	-8	1.975	0.539	2.231
1273	POINT MOLATE	5 Walleye Surf Perch	1.18	1.77	0.671	1.782	-8	-8	-8	0.277
1274	RODEO	5 White Croaker	6.259	19.073	5.963	16.956	-8	2.64	1.131	3.687
1275	RODEO	5 White Croaker	5.045	15.989	4.6	13.526	-8	2.001	0.634	2.462
1276	RODEO	5 White Croaker	8.636	32.222	8.834	24.331	-8	3.661	1.206	4.844
1277	RODEO	3 Leopard Sharks	0.317	2.127	0.63	1.18	-8	0.27	-8	0.278
1282	SAN FRANCISCO PIER #7	5 White Croaker	11.973	47.258	11.655	29.99	0.35	6.816	2.24	8.134
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	1.615	4.439	1.37	2.664	-8	0.59	-8	0.359
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	1.144	4.172	1.214	2.295	-8	0.611	-8	0.321
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	2.229	2.601	0.815	1.839	-8	0.341	-8	0.31
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	3.146	8.888	3.014	8.58	-8	1.192	0.251	1.61
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	1.692	5.522	1.762	5.195	-8	0.894	-8	1.165
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	4.331	10.419	3.932	11.038	0.234	1.249	0.808	2.156
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	1.892	2.811	1.566	5.171	-8	0.363	-8	0.521
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	1.723	3.008	0.787	1.359	-8	0.319	-8	0.269
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	2.454	0.754	0.915	-8	0.345	-8	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	0.276	1.478	0.396	1	-8	-8	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.234	12.132	3.023	1.847	-8	1.376	0.421	0.43
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	0.465	1.244	0.391	1.013	-8	-8	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	0.308	3.08	1.008	2.4	-8	0.368	-8	0.452
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	0.676	2.965	1.004	1.913	-8	0.395	-8	0.393
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	0.903	10.276	2.823	5.584	-8	1.163	0.367	1.219
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	0.712	8.116	2.591	5.485	-8	1.079	0.399	1.186
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.927	2.456	0.788	2.243	-8	0.389	-8	0.54
1336	VALLEJO-MARE ISLAND	5 White Croaker	10.921	36.252	11.195	30.552	0.321	4.446	1.436	6.384
1337	VALLEJO-MARE ISLAND	5 White Croaker	14.549	50.06	13.341	32.305	0.402	5.696	2.042	7.373
1338	VALLEJO-MARE ISLAND	5 White Croaker	6.509	14.1	5.405	14.748	-8	2.006	0.745	2.978
1339	VALLEJO-MARE ISLAND	3 Striped Bass	1.675	5.442	2.062	5.425	-8	0.791	-8	0.987

IDORG #	STATION NAME	FISH TYPE	PCB203	PCB206	PCB209	TTLPCB	ARO1248	ARO1254	ARO1260
1234	SAN MATEO BRIDGE	5 White Croaker	2.589	1.741	0.764	154.1	36.99	246.6	167.688
1235	SAN MATEO BRIDGE	5 White Croaker	2.253	1.417	0.617	-9	-8	236.18	147.01
1236	SAN MATEO BRIDGE	5 White Croaker	0.98	0.673	0.265	-9	-8	136.996	73.222
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	0.502	-8	-8	-9	-8	84	30
1238	DUMBARTON BRIDGE	5 White Croaker	1.855	1.218	0.587	152.2	42.588	260.26	130.13
1239	DUMBARTON BRIDGE	5 White Croaker	1.142	0.757	0.281	-9	33.99	122.364	77.044
1240	DUMBARTON BRIDGE	5 White Croaker	-8	0.761	-8	-9	-8	148.09	80.32
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	0.431	0.217	-8	-9	-8	69.496	28.616
1242	FREMONT FOREBAY	3 Striped Bass	0.927	-8	-8	45.5	37.728	75.456	35.37
1243	FREMONT FOREBAY	3 Striped Bass	0.834	0.332	-8	-9	85.76	111.488	45.024
1244	FREMONT FOREBAY	3 Striped Bass	0.83	0.245	-8	-9	-8	102.396	31.164
1245	FREMONT FOREBAY	4 Striped Bass	0.302	-8	-8	-9	-8	38.268	18.709
1246	RICHMOND HARBOR	20 Shiner Surf Perch	0.362	-8	-8	69.2	-8	155.044	26.152
1247	RICHMOND HARBOR	20 Shiner Surf Perch	0.338	-8	-8	-9	-8	125.952	21.648
1248	RICHMOND HARBOR	20 Shiner Surf Perch	0.334	-8	-8	-9	-8	139.656	23.276
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-9	-8	24.486	11.798
1250	BERKELEY PIER	20 Shiner Surf Perch	0.525	0.309	-8	48.3	-8	97.118	41.622
1251	BERKELEY PIER	20 Shiner Surf Perch	0.365	-8	-8	-9	-8	60.884	27.496
1252	BERKELEY PIER	20 Shiner Surf Perch	0.25	-8	-8	-9	-8	66.3	23.4
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-9	-8	26.572	11.446
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	1.857	0.589	0.296	150.5	-8	280.32	89.352
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.942	0.289	-8	-9	-8	187.308	54.868
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.852	0.275	-8	-9	-8	184.68	55.404
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	0.953	0.408	-8	-9	-8	164.968	53.372
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	4.422	1.747	0.719	269.4	35.85	382.4	219.88
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	1.418	0.838	0.377	-9	-8	136.772	99.27
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	1.415	0.828	0.292	-9	-8	144.704	93.632
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	1.544	0.323	-8	-9	-8	240.24	74.256
1262	ISLAIS CREEK	5 White Croaker	1.422	0.823	0.275	109.3	80.808	133.224	100.464
1263	ISLAIS CREEK	5 White Croaker	1.297	0.799	0.257	-9	33.84	110.544	85.728
1264	ISLAIS CREEK	5 White Croaker	0.681	0.386	-8	-9	-8	81.744	56.592
1265	ISLAIS CREEK	20 Shiner Surf Perch	0.501	-8	-8	-9	-8	67.782	32.864
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	2.216	1.158	0.555	120.9	50.462	177.714	125.058
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	2.157	0.877	0.469	-9	70.72	154.7	121.55
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	1.752	0.75	0.299	-9	34.71	194.376	94.874
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	0.656	-8	-8	-9	33.796	99.4	33.796
1270	POINT MOLATE	5 White Croaker	2.303	1.365	0.858	96.9	-8	142.66	130.432
1271	POINT MOLATE	5 White Croaker	1.93	1.204	0.521	-9	28.272	150.784	115.444
1272	POINT MOLATE	5 White Croaker	1.421	0.695	0.318	-9	-8	138.624	73.644
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-9	-8	33.932	-8
1274	RODEO	5 White Croaker	2.151	1.343	0.628	100.5	-8	159.32	120.628
1275	RODEO	5 White Croaker	1.56	0.826	0.354	-9	17.1	129.96	85.5
1276	RODEO	5 White Croaker	2.915	1.473	0.587	-9	-8	263.04	155.632
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-9	-8	27.846	13.495
1282	SAN FRANCISCO PIER #7	5 White Croaker	5.544	2.658	1.225	223.1	-8	340.8	272.64
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	0.541	-8	-8	-9	-8	65.534	23.254
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	0.489	-8	-8	-9	-8	95.808	23.952
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	0.312	-8	-8	-9	-8	49.536	15.893
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	0.81	0.361	0.231	71.3	-8	132	59.4
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	0.632	0.283	-8	-9	-8	56.16	37.44
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	1.597	0.699	0.273	-9	-8	111.776	69.86
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.49	0.232	-8	28	-8	49.248	22.572
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	0.235	-8	-8	13	-8	27.888	13.346
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-9	-8	28.392	15.818
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-9	-8	16.531	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.789	0.252	-8	48.6	-8	71.706	40.698
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-9	-8	16.85	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	0.334	-8	-8	-9	-8	32	18.4
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	0.353	-8	-8	18.3	-8	42.636	18.217
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	0.893	0.26	-8	-9	-8	70.584	47.748
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	0.862	0.299	-8	-9	-8	103.224	44.528
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.312	-8	-8	15.3	-8	34.176	20.292
1336	VALLEJO-MARE ISLAND	5 White Croaker	3.785	2.241	0.992	191.2	-8	319.2	209.76
1337	VALLEJO-MARE ISLAND	5 White Croaker	5.351	2.128	1.063	-9	-8	320.58	246.6
1338	VALLEJO-MARE ISLAND	5 White Croaker	1.845	1.148	0.5	-9	-8	160.934	98.482
1339	VALLEJO-MARE ISLAND	3 Striped Bass	0.798	0.368	0.174	-9	-8	87.88	38.87

IDORG #	STATION NAME	FISH TYPE	ARO5460	TTLARO	PCBBATCH
1234	SAN MATEO BRIDGE	5 White Croaker	-8	451.278	73.4
1235	SAN MATEO BRIDGE	5 White Croaker	-8	386.190	73.4
1236	SAN MATEO BRIDGE	5 White Croaker	-8	213.218	73.42
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	117.000	73.4
1238	DUMBARTON BRIDGE	5 White Croaker	-8	432.978	73.4
1239	DUMBARTON BRIDGE	5 White Croaker	-8	233.398	73.41
1240	DUMBARTON BRIDGE	5 White Croaker	-8	231.410	73.42
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	101.112	73.42
1242	FREMONT FOREBAY	3 Striped Bass	-8	148.554	73.43
1243	FREMONT FOREBAY	3 Striped Bass	-8	242.272	73.44
1244	FREMONT FOREBAY	3 Striped Bass	-8	136.560	73.45
1245	FREMONT FOREBAY	4 Striped Bass	-8	59.977	73.46
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	184.196	73.4
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	150.600	73.41
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	165.932	73.42
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	39.284	73.4
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	141.740	73.4
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	91.380	73.41
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	92.700	73.42
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	41.018	73.4
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	372.672	73.4
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	245.176	73.41
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch .	-8	243.084	73.42
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	221.340	73.4
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	638.130	73.43
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	239.042	73.41
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	241.336	73.41
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	317.496	73.45
1262	ISLAIS CREEK	5 White Croaker	-8	314.496	73.41
1263	ISLAIS CREEK	5 White Croaker	-8	230.112	73.42
1264	ISLAIS CREEK	5 White Croaker	-8	141.336	73.42
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	103.646	73.42
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	353.234	73.47
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	346.970	73.44
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	323.960	73.45
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	166.992	73.46
1270	POINT MOLATE	5 White Croaker	-8	276.092	73.43
1271	POINT MOLATE	5 White Croaker	-8	294.500	73.44
1272	POINT MOLATE	5 White Croaker	-8	215.268	73.45
1273	POINT MOLATE	5 Walleye Surf Perch	-8	37.932	73.46
1274	RODEO	5 White Croaker	-8	282.948	73.47
1275	RODEO	5 White Croaker	-8	232.560	73.44
1276	RODEO	5 White Croaker	-8	421.672	73.45
1277	RODEO	3 Leopard Sharks	-8	44.341	73.46
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	616.440	73.43
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	91.788	73.44
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	122.760	73.45
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	68.429	73.46
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	194.400	73.41
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	96.600	73.41
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	184.636	73.44
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	74.820	73.44
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	44.234	73.43
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	47.210	73.47
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	20.531	73.41
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	115.404	73.43
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	20.850	73.44
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	53.400	73.45
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	63.853	73.45
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	121.332	73.46
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	150.752	73.45
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	57.468	73.46
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	531.960	73.47
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	570.180	73.43
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	262.416	73.46
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	129.750	73.44

Section IV - Pesticide Analysis

IDORG #	STATION NAME	FISH TYPE	SOWEIGHT	SOMOIST	SOLIPID	ALDRIN	CCHLOR	TCHLOR
1234	SAN MATEO BRIDGE	5 White Croaker	2.58	75.34	4.29	-8	4.463	1.763
1235	SAN MATEO BRIDGE	5 White Croaker	2.59	75.9	4.79	-8	4.507	2.229
1236	SAN MATEO BRIDGE	5 White Croaker	2.73	76.38	3.85	-8	2.716	1.441
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	2.73	80	1.84	-8	1.102	0.454
1238	DUMBARTON BRIDGE	5 White Croaker	2.79	76.34	4.52	-8	4.614	2.056
1239	DUMBARTON BRIDGE	5 White Croaker	2.8	77.34	3.74	-8	2.515	1.464
1240	DUMBARTON BRIDGE	5 White Croaker	2.59	74.9	4.52	-8	3.338	1.729
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	2.56	79.56	1	-8	1.212	0.519
1242	FREMONT FOREBAY	3 Striped Bass	2.72	76.42	0.87	-8	5.494	2.033
1243	FREMONT FOREBAY	3 Striped Bass	2.51	78.56	1.19	-8	4.781	1.685
1244	FREMONT FOREBAY	3 Striped Bass	2.58	77.74	1.03	-8	4.385	1.46
1245	FREMONT FOREBAY	4 Striped Bass	2.72	78.74	0.81	-8	1.195	0.391
1246	RICHMOND HARBOR	20 Shiner Surf Perch	2.8	81.32	0.89	-8	1.302	0.506
1247	RICHMOND HARBOR	20 Shiner Surf Perch	2.71	80.32	0.87	-8	1.029	0.547
1248	RICHMOND HARBOR	20 Shiner Surf Perch	2.66	78.84	0.83	-8	1.248	0.586
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	2.75	77.74	0.3	-8	-8	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	2.83	80.18	0.57	-8	1.124	0.545
1251	BERKELEY PIER	20 Shiner Surf Perch	2.8	80.36	0.67	-8	0.613	0.247
1252	BERKELEY PIER	20 Shiner Surf Perch	2.76	80.5	0.32	-8	0.478	0.207
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	2.7	79.56	0.59	-8	0.229	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	2.73	82.48	0.96	-8	4.608	1.91
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	2.68	81.08	1.13	-8	4.049	2.327
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	2.52	79.48	1.2	-8	4.207	2.586
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	2.51	75.74	1.37	-8	2.693	0.614
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	2.63	76.1	2.92	-8	4.302	2.438
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	2.62	77.94	3.33	-8	2.647	1.326
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	2.58	78.72	3.41	-8	2.66	1.877
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	2.62	78.16	1.58	-8	2.708	1.981
1262	ISLAIS CREEK	5 White Croaker	2.61	78.16	2.48	-8	2.861	1.662
1263	ISLAIS CREEK	5 White Croaker	2.95	77.44	2.8	-8	2.662	2.213
1264	ISLAIS CREEK	5 White Croaker	2.66	79.04	1.82	-8	1.377	0.843
1265	ISLAIS CREEK	20 Shiner Surf Perch	2.63	79.46	1.16	-8	1.541	1.074
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	2.73	78.06	3.77	-8	4.52	2.13
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	2.53	77.9	3.23	-8	3.823	2.077
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	2.59	76.86	2.64	-8	3.795	2.249
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	2.62	80.12	1.34	-8	1.423	0.618
1270	POINT MOLATE	5 White Croaker	2.54	79.62	2.41	-8	2.975	1.706
1271	POINT MOLATE	5 White Croaker	2.75	76.44	3.04	-8	3.157	1.482
1272	POINT MOLATE	5 White Croaker	2.68	78.34	1.71	-8	2.253	1.115
1273	POINT MOLATE	5 Walleye Surf Perch	2.6	80.04	0.73	-8	0.503	-8
1274	RODEO	5 White Croaker	2.52	77.24	2.03	-8	3.824	1.413
1275	RODEO	5 White Croaker	2.63	82.9	0.69	-8	1.693	0.554
1276	RODEO	5 White Croaker	2.57	78.08	1.87	-8	4.121	1.688
1277	RODEO	3 Leopard Sharks	2.52	78.58	0.46	-8	0.304	-8
1282	SAN FRANCISCO PIER #7	5 White Croaker	2.72	77.28	3.3	-8	3.885	1.624
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	2.64	78.86	0.59	-8	0.395	-8
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	2.54	80.04	0.34	-8	0.373	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	2.54	79.36	0.81	-8	0.4	-8
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	2.55	78	0.82	-8	2.838	0.62
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	2.66	76.6	1.98	-8	2.08	0.517
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	2.59	80.04	0.46	-8	1.768	0.375
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	2.56	79.48	2.65	-8	2.75	1.847
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	2.64	80.08	0.4	-8	0.374	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	2.62	79.72	0.44	-8	0.341	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	2.51	80.32	0.35	-8	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	2.66	80.62	0.19	-8	0.859	0.306
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	2.5	82.98	0.33	-8	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	2.53	80	0.2	-8	-8	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	2.61	80.62	0.39	-8	0.61	0.227
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	2.57	79.24	0.47	-8	0.581	0.222
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	2.52	79.76	0.09	-8	0.484	0.239
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	2.71	78.64	0.17	-8	0.312	-8
1336	VALLEJO-MARE ISLAND	5 White Croaker	2.6	77.2	4.59	-8	8.276	3.26
1337	VALLEJO-MARE ISLAND	5 White Croaker	2.61	75.34	4.53	-8	6.461	2.984
1338	VALLEJO-MARE ISLAND	5 White Croaker	2.55	75.98	5.38	-8	5.044	2.546
1339	VALLEJO-MARE ISLAND	3 Striped Bass	2.61	83.1	0.09	-8	2.501	0.492

S.F. Bay Fish Contaminant Study Pesticide Analysis (ppb-ng/g)

IDORG #	STATION NAME	FISH TYPE	ACDEN	GCDEN	CLPYR	DACTH	OPDDD	PPDDD	OPDDE	PPDDE
1234	SAN MATEO BRIDGE	5 White Croaker	-8	0.326	-8	0.584	2.187	17.829	-8	39.456
1235	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	0.557	2.82	15.496	-8	47.718
1236	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	0.52	1.774	13.369	-8	17.951
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	1.032	5.5	-8	18.98
1238	DUMBARTON BRIDGE	5 White Croaker	-8	0.445	-8	0.665	-8	29.102	-8	44.481
1239	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	0.73	1.822	10.288	-8	22.66
1240	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	0.796	2.131	14.232	-8	26.355
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	4.395	-8	12.489
1242	FREMONT FOREBAY	3 Striped Bass	-8	1.061	4.48	1.962	1.721	10.776	-8	25.231
1243	FREMONT FOREBAY	3 Striped Bass	-8	0.71	2.444	1.081	1.917	14	-8	24.227
1244	FREMONT FOREBAY	3 Striped Bass	-8	0.757	2.582	1.442	-8	13.178	-8	27.157
1245	FREMONT FOREBAY	4 Striped Bass	-8	-8	2.169	0.617	-8	4.528	-8	10.545
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	2.559	20.361	-8	16.196
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	4.015	18.106	-8	11.847
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	2.264	17.753	-8	11.744
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	0.79	-8	4.919
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	6.501	-8	13.339
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	4.38	-8	9.054
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	3.705	-8	8.444
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	4.292
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	0.296	-8	-8	1.295	11.861	-8	55.889
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	0.454	-8	-8	1.43	9.895	-8	13.585
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	0.741	-8	-8	1.937	11.163	-8	14.015
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	0.427	-8	-8	1.519	9.17	-8	17.71
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	4.063	21.701	0.868	41.108
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	0.225	-8	-8	1.793	11.493	-8	19.391
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	0.304	-8	-8	2.213	10.853	-8	19.748
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	12.34	-8	18.367
1262	ISLAIS CREEK	5 White Croaker	-8	0.227	-8	-8	1.876	14.152	-8	20.792
1263	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	1.475	14.032	-8	23.011
1264	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	-8	6.77	-8	13.959
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	-8	-8	-8	-8	6.491	-8	12.262
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	1.022	-8	1.836	22.159	-8	30.277
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	1.456	0.451	1.375	21.106	-8	20.354
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	1.168	-8	1.689	21.196	-8	25.685
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	-8	-8	-8	1.932	21.272	-8	18.488
1270	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	1.449	18.342	-8	35.461
1271	POINT MOLATE	5 White Croaker	-8	-8	1.065	-8	1.934	19.013	-8	33.691
1272	POINT MOLATE	5 White Croaker	-8	-8	1.282	-8	1.178	16.397	-8	47.435
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-8	-8	2.914	-8	5.928
1274	RODEO	5 White Croaker	-8	-8	-8	-8	2.595	21.827	-8	38.92
1275	RODEO	5 White Croaker	-8	-8	0.768	-8	1.448	9.405	-8	24.111
1276	RODEO	5 White Croaker	-8	-8	0.993	0.445	-8	16.374	-8	62.691
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	3.042
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	-8	1.029	-8	2.976	19.38	-8	53.619
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	3.023	-8	6.532
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	0.822	-8	-8	2.156	-8	5.729
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	2.559	-8	6.027
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	0.244	-8	-8	-8	9.174	-8	24.2
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	-8	-8	0.51	-8	6.716	-8	24.102
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	-8	1.076	-8	1.299	9.8	-8	26.746
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	0.228	1.012	0.614	1.543	15.349	-8	29.549
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	6.594
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	4.137
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	3.011
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	24.031
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	0.722	-8	-8	-8	-8	3.336
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	7.22
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	-8	-8	-8	1.221	-8	14.981
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	0.963	-8	13.619
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	0.755	-8	10.869
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	-8	0.852	-8	5.126
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	0.502	-8	0.923	3.671	54.264	-8	89.148
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	0.409	1.018	1.004	4.414	36.25	-8	80.638
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	0.442	-8	1.117	2.21	26.422	-8	49.241
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	-8	1.482	-8	1.078	10.512	-8	36.335

IDORG #	STATION NAME	FISH TYPE	PPDDMS	PPDDMU	OPDDT	PPDDT	TTLDDT	DICLB	DIELDRIN
1234	SAN MATEO BRIDGE	5 White Croaker	-8	5.77	-8	2.412	62.58	-8	3.28
1235	SAN MATEO BRIDGE	5 White Croaker	-8	6.82	-8	2.531	69.27	-8	3.784
1236	SAN MATEO BRIDGE	5 White Croaker	-8	5.031	1.136	1.065	35.60	-8	1.795
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	1.268	-8	-8	26.61	-8	1.25
1238	DUMBARTON BRIDGE	5 White Croaker	11.144	8.991	-8	4.141	78.92	-8	3.691
1239	DUMBARTON BRIDGE	5 White Croaker	-8	5.166	-8	1.183	36.65	-8	1.532
1240	DUMBARTON BRIDGE	5 White Croaker	-8	4.769	1.365	1.621	46.00	-8	3.464
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	1.351	-8	-8	18.48	-8	1.177
1242	FREMONT FOREBAY	3 Striped Bass	5.188	8.347	-8	1.681	40.11	-8	2.971
1243	FREMONT FOREBAY	3 Striped Bass	5.146	3.345	0.913	1.46	42.82	-8	2.423
1244	FREMONT FOREBAY	3 Striped Bass	4.897	7.257	-8	1.291	42.83	-8	1.638
1245	FREMONT FOREBAY	4 Striped Bass	-8	1.193	-8	0.927	17.20	-8	1.072
1246	RICHMOND HARBOR	20 Shiner Surf Perch	4.95	4.016	0.889	2.186	42.49	-8	1.635
1247	RICHMOND HARBOR	20 Shiner Surf Perch	4.015	3.562	-8	2.303	36.97	-8	1.527
1248	RICHMOND HARBOR	20 Shiner Surf Perch	5.1	3.491	-8	1.756	34.22	-8	1.752
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-8	7.31	-8	0.341
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	1.936	-8	-8	21.44	-8	0.86
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	1.055	-8	-8	15.03	-8	-8
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	1.098	-8	-8	13.75	-8	0.632
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	6.19	-8	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	2.978	0.862	2.348	72.56	-8	1.752
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	1.712	-8	1.801	27.41	-8	1.591
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	3.878	-8	1.787	29.60	-8	2.586
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	3.324	-8	1.473	30.57	-8	1.87
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	5.401	7.242	-8	2.51	70.65	-8	3.227
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	3.155	-8	1.606	34.98	-8	1.418
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	4.022	-8	1.192	34.71	-8	2.022
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	2.905	-8	0.891	32.80	-8	2.25
1262	ISLAIS CREEK	5 White Croaker	-8	4.761	-8	2.038	39.56	-8	1.433
1263	ISLAIS CREEK	5 White Croaker	-8	4.512	1.415	1.581	41.81	-8	1.139
1264	ISLAIS CREEK	5 White Croaker	-8	2.494	-8	-8	22.33	-8	-8
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	1.875	-8	-8	20.35	-8	-8
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	7.591	1.492	3.642	59.71	-8	3.598
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	6.276	-8	2.475	46.01	-8	2.807
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	6.873	1.076	2.279	52.23	-8	2.407
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	4.95	1.189	4.175	47.36	-8	0.956
1270	POINT MOLATE	5 White Croaker	5.482	6.196	-8	2.486	58.44	-8	2.588
1271	POINT MOLATE	5 White Croaker	-8	5.772	-8	2.568	57.91	-8	2.285
1272	POINT MOLATE	5 White Croaker	-8	5.307	-8	2.967	68.68	-8	1.722
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-8	10.44	-8	0.491
1274	RODEO	5 White Croaker	-8	5.644	-8	3.687	67.73	-8	2.226
1275	RODEO	5 White Croaker	-8	2.77	-8	1.796	37.46	-8	0.92
1276	RODEO	5 White Croaker	-8	6.116	-8	3.178	83.44	-8	1.789
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	4.94	-8	-8
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	7.657	-8	2.954	79.63	-8	2.704
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	11.16	-8	0.577
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	9.49	-8	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	10.19	-8	-8
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	2.354	-8	1.78	36.35	-8	2.31
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	2.057	-8	1.182	33.20	-8	1.936
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	3.333	-8	2.595	41.14	-8	1.543
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	2.216	0.868	1.66	49.27	-8	3.057
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	8.49	-8	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	6.04	-8	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	4.91	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	25.93	-8	0.614
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	5.24	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	9.12	-8	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	-8	-8	17.80	-8	-8
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	16.18	-8	-8
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	13.22	-8	-8
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	7.58	-8	-8
1336	VALLEJO-MARE ISLAND	5 White Croaker	8.732	12.677	1.737	6.886	156.01	-8	4.241
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	9.198	1.255	5.573	128.43	-8	3.502
1338	VALLEJO-MARE ISLAND	5 White Croaker	8.095	5.981	1.081	3.507	82.76	-8	3.243
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	2.856	0.715	2.434	51.37	-8	1.077

IDORG #	STATION NAME	FISH TYPE	ENDO_I	ENDO_II	ESO4	ENDRIN	HCHA	HCHB	HCHG	HCHD
1234	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	0.35	-8	0.298	-8
1235	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	1.133	-8	0.376	-8
1236	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1238	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	0.613	-8	0.835	-8
1239	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	0.301	-8	0.746	-8
1240	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	0.517	-6
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1242	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	-8	2.061	-8
1243	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	-8	1.855	-8
1244	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	-8	0.922	-8
1245	FREMONT FOREBAY	4 Striped Bass	-8	-8	-8	-8	-8	-8	1.537	-8
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	0.6	-8	0.609	-8
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	0.583	-8	0.349	-8
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	0.717	-8	-8	-8
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	-8	-8	-8	0.273	-8	-8	-8
1262	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	0.568	-8	0.234	-8
1263	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8
1264	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	0.531	-8	-8	-8
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	0.358	0.723	-8	-8
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	0.278	-8	-8	-8
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	-8	-8	-8	0.306	-8	-8	-8
1270	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	0.43	-8	-8	-8
1271	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	0.565	-8	-8	-8
1272	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-8	0.371	-8	-8	-8
1274	RODEO	5 White Croaker	-8	-8	-8	-8	0.385	-8	-8	-8
1275	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8
1276	RODEO	5 White Croaker	-8	-8	-8	-8	0.381	-8	0.272	-8
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	-8	-8	-8	0.645	-8	0.373	-8
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	-8	-8	-8	0.321	-8	0.379	-8
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	-8	-8	-8	0.772	-8	0.632	-8
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	-8	-8	-8	-8
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	0.444	-8	0.392	-8
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	0.663	-8	0.574	-8
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8

IDORG #	STATION NAME	FISH TYPE	HEPTACHLOR	HE	HCB	METHOXY	MIREX	CNONA	TNONA
1234	SAN MATEO BRIDGE	5 White Croaker	-8	0.271	0.298	-8	-8	5.302	4.957
1235	SAN MATEO BRIDGE	5 White Croaker	-8	0.296	0.417	-8	-8	4.916	6.001
1236	SAN MATEO BRIDGE	5 White Croaker	-8	0.283	-8	-8	-8	3.023	3.212
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	-8	0.244	-8	-8	1.34	1.372
1238	DUMBARTON BRIDGE	5 White Croaker	-8	0.303	0.341	-8	-8	4.141	5.087
1239	DUMBARTON BRIDGE	5 White Croaker	-8	0.292	-8	-8	-8	2.379	3.059
1240	DUMBARTON BRIDGE	5 White Croaker	-8	0.341	-8	-8	-8	3.64	3.464
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	1.21	1.564
1242	FREMONT FOREBAY	3 Striped Bass	-8	0.58	0.38	-8	-8	4.103	6.06
1243	FREMONT FOREBAY	3 Striped Bass	0.3	0.242	0.285	-8	-8	4.352	5.532
1244	FREMONT FOREBAY	3 Striped Bass	-8	0.378	0.416	-8	-8	3.05	5.543
1245	FREMONT FOREBAY	4 Striped Bass	-8	-8	-8	-8	-8	1.14	1.42
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	1.506	1.207
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	2.637	0.951
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	1.373	1.045
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	1.243	1.15
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.823	0.66
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	0.714	0.636
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	0.278	0.239
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	3.486	5.659
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	2.933	5.033
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	0.234	-8	-8	-8	2.77	4.679
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	-8	0.357	-8	-8	2.572	3.663
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.349	-8	0.268	-8	-8	4.732	4.039
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	0.245	-8	-8	2.138	2.272
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	-8	2.426	3
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	-8	0.251	-8	-8	3.167	1.946
1262	ISLAIS CREEK	5 White Croaker	0.341	-8	0.251	-8	-8	2.315	2.73
1263	ISLAIS CREEK	5 White Croaker	-8	-8	0.336	-8	-8	2.164	2.82
1264	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	-8	1.276	1.545
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	-8	0.279	-8	-8	1.226	1.573
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	0.265	0.25	-8	-8	3.576	3.708
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.223	-8	0.327	-8	-8	4.398	3.072
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	0.268	-8	-8	4.073	3.101
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	2.008	1.489
1270	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	3.75	4.239
1271	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	3.887	3.958
1272	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	2.599	2.621
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-8	-8	0.559	0.729
1274	RODEO	5 White Croaker	-8	-8	-8	-8	-8	5.235	5.394
1275	RODEO	5 White Croaker	-8	-8	-8	-8	-8	2.924	3.01
1276	RODEO	5 White Croaker	-8	-8	-8	-8	-8	5.918	7.036
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	-8	0.287	0.317
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	-8	0.236	-8	-8	6.452	5.453
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	0.769	0.67
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	0.727	0.575
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	0.543	0.52
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	-8	0.231	-8	-8	2.662	3.982
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	-8	-8	-8	-8	1.835	2.644
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	-8	0.206	-8	-8	2.735	3.134
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	-8	0.663	-8	-8	2.729	2.832
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	0.317	0.546
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	0.292	0.359
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	-8	0.64	1.074
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	0.314	0.418
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	-8	-8	-8	0.684	0.994
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	0.679	0.687
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	0.684	0.716
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	-8	0.412	0.363
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	0.235	0.306	-8	-8	10.374	12.608
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	8.828	10.752
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	0.307	-8	-8	5.284	6.87
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	-8	0.188	-8	-8	3.296	5.07

IDORG #	STATION NAME	FISH TYPE	TTLCLOR	OXAD	OCDAN	TOXAPH	PESBATCH
1234	SAN MATEO BRIDGE	5 White Croaker	17.02	-9.0	0.535	-8	73.4
1235	SAN MATEO BRIDGE	5 White Croaker	18.27	-9.0	0.617	-8	73.4
1236	SAN MATEO BRIDGE	5 White Croaker	10.81	-9.0	0.413	-8	73.42
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	4.51	-9.0	0.24	-8	73.4
1238	DUMBARTON BRIDGE	5 White Croaker	16.54	-9.0	0.644	-8	73.4
1239	DUMBARTON BRIDGE	5 White Croaker	9.86	-9.0	0.44	-8	73.41
1240	DUMBARTON BRIDGE	5 White Croaker	12.65	-9.0	0.482	-8	73.42
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	4.61	-9.0	-8	-8	73.42
1242	FREMONT FOREBAY	3 Striped Bass	18.89	-9.0	1.198	-8	73.43
1243	FREMONT FOREBAY	3 Striped Bass	17.35	-9.0	0.995	-8	73.44
1244	FREMONT FOREBAY	3 Striped Bass	16.09	-9.0	1.649	-8	73.45
1245	FREMONT FOREBAY	4 Striped Bass	4.25	-9.0	-8	-8	73.46
1246	RICHMOND HARBOR	20 Shiner Surf Perch	4.82	-9.0	0.297	-8	73.4
1247	RICHMOND HARBOR	20 Shiner Surf Perch	5.26	-9.0	-8	-8	73.41
1248	RICHMOND HARBOR	20 Shiner Surf Perch	4.35	-9.0	-8	-8	73.42
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	0.50	-9.0	-8	-8	73.4
1250	BERKELEY PIER	20 Shiner Surf Perch	4.16	-9.0	-8	-8	73.4
1251	BERKELEY PIER	20 Shiner Surf Perch	2.44	-9.0	-8	-8	73.41
1252	BERKELEY PIER	20 Shiner Surf Perch	2.14	-9.0	-8	-8	73.42
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	0.95	-9.0	-8	-8	73.4
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	15.76	-9.0	-8	-8	73.4
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	14.86	-9.0	0.518	-8	73.41
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	14.66	-9.0	0.415	-8	73.42
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	10.03	-9.0	0.483	-8	73.4
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	16.16	-9.0	0.648	-8	73.43
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	8.48	-9.0	-8	-8	73.41
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	10.26	-9.0	0.3	-8	73.41
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	10.40	-9.0	0.594	-8	73.45
1262	ISLAIS CREEK	5 White Croaker	9.87	-9.0	0.301	-8	73.41
1263	ISLAIS CREEK	5 White Croaker	10.09	-9.0	0.226	-8	73.42
1264	ISLAIS CREEK	5 White Croaker	5.14	-9.0	-8	-8	73.42
1265	ISLAIS CREEK	20 Shiner Surf Perch	5.51	-9.0	-8	-8	73.42
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	14.36	-9.0	0.423	-8	73.47
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	13.85	-9.0	0.482	-8	73.44
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	13.74	-9.0	0.518	-8	73.45
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	5.82	-9.0	0.28	-8	73.46
1270	POINT MOLATE	5 White Croaker	13.46	-9.0	0.787	-8	73.43
1271	POINT MOLATE	5 White Croaker	12.95	-9.0	0.466	-8	73.44
1272	POINT MOLATE	5 White Croaker	9.26	-9.0	0.676	-8	73.45
1273	POINT MOLATE	5 Walleye Surf Perch	1.99	-9.0	-8	-8	73.46
1274	RODEO	5 White Croaker	16.45	-9.0	0.587	-8	73.47
1275	RODEO	5 White Croaker	8.51	-9.0	0.325	-8	73.44
1276	RODEO	5 White Croaker	19.45	-9.0	0.688	-8	73.45
1277	RODEO	3 Leopard Sharks	1.11	-9.0	-8	-8	73.46
1282	SAN FRANCISCO PIER #7	5 White Croaker	18.39	-9.0	0.972	-8	73.43
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	2.03	-9.0	-8	-8	73.44
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	1.88	-9.0	-8	-8	73.45
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	1.66	-9.0	-8	-8	73.46
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	10.60	-9.0	0.493	-8	73.41
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	7.41	-9.0	0.33	-8	73.41
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	8.38	-9.0	0.365	-8	73.44
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	10.64	-9.0	0.482	-8	73.44
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	1.44	-9.0	-8	-8	73.43
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	1.19	-9.0	-8	-8	73.47
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	0.50	-9.0	-8	-8	73.41
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	2.98	-9.0	-8	-8	73.43
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	0.50	-9.0	-8	-8	73.44
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	1.03	-9.0	-8	-8	73.45
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	2.62	-9.0	-8	-8	73.45
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	2.27	-9.0	-8	-8	73.46
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	2.22	-9.0	-8	-8	73.45
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	1.29	-9.0	-8	-8	73.46
1336	VALLEJO-MARE ISLAND	5 White Croaker	36.10	-9.0	1.582	-8	73.47
1337	VALLEJO-MARE ISLAND	5 White Croaker	30.70	-9.0	1.677	-8	73.43
1338	VALLEJO-MARE ISLAND	5 White Croaker	20.67	-9.0	0.922	-8	73.46
1339	VALLEJO-MARE ISLAND	3 Striped Bass	11.92	-9.0	0.564	-8	73.44

Section V - PAH Analysis

IDORG #	STATION NAME	FISH TYPE	ACY	ACE	ANT	BAA	BAP	BBF	BKF	BGP	BEP	BPH	CHR	DBA
1234	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1235	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1236	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1238	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.745	-8	-8
1239	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1240	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.453	-8	-8
1242	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1243	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	9.498	-8	-8
1244	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1245	FREMONT FOREBAY	4 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	3.792	-8	-8
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.48	-8	-8
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.708	-8	-8
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.299	-8	-8
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	2.09	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1262	ISLAIS CREEK	5 White Croaker	-8	3.71	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1263	ISLAIS CREEK	5 White Croaker	-8	4.81	-8	-8	-8	-8	-8	-8	-8	2.391	-8	-8
1264	ISLAIS CREEK	5 White Croaker	-8	2.37	-8	-8	-8	-8	-8	-8	-8	2.494	-8	-8
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	10.2	-8	-8	-8	-8	-8	-8	-8	2.506	-8	-8
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	2.63	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	2.7	-8	-8	-8	-8	-8	-8	-8	2.785	-8	-8
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.545	-8	-8
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	4.83	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1270	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1271	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.497	-8	-8
1272	POINT MOLATE	5 White Croaker	-8	2.34	-8	-8	-8	-8	-8	-8	-8	6.801	-8	-8
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1274	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1275	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.223	-8	-8
1276	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.408	-8	-8
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	2.31	-8
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8

IDORG #	STATION NAME	FISH TYPE	DMN	FLA	FLU	IND	MNP1	MNP2	MPH1	NPH	PHN	PER
1234	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	2.565	3.206	-8	4.168	-8	-8
1235	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	5.856	9.23	-8	5.688	-8	-8
1236	SAN MATEO BRIDGE	5 White Croaker	-8	-8	-8	-8	4.417	6.354	-8	4.606	-8	-8
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	2.62	2.88	-8	5.06	-8	-8
1238	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	-8	2.626	-8	5.229	-8	-8
1239	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	3.603	6.345	-8	3.558	-8	-8
1240	DUMBARTON BRIDGE	5 White Croaker	-8	-8	-8	-8	4.317	6.15	-8	5.271	-8	-8
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	-8	-8	-8	4.987	5.948	-8	6.582	-8	-8
1242	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	2.665	3.301	-8	4.74	-8	-8
1243	FREMONT FOREBAY	3 Striped Bass	-8	5	2.337	-8	-8	3.002	-8	4.974	7.247	-8
1244	FREMONT FOREBAY	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	4.074	-8	-8
1245	FREMONT FOREBAY	4 Striped Bass	-8	-8	-8	-8	-8	-8	-8	3.444	-8	-8
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	3.33	-8	-8	2.242	2.634	-8	4.932	2.335	-8
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	3.21	-8	-8	3.562	5.51	-8	3.365	-8	-8
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	2.73	-8	-8	3.322	5.269	-8	4.507	2.328	-8
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	2.76	-8	4.229	-8	-8
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	2.596	2.933	-8	5.53	-8	-8
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	3.142	4.439	-8	2.73	-8	-8
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	-8	-8	3.783	5.363	-8	4.017	-8	-8
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	-8	-8	2.514	2.719	-8	4.497	-8	-8
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	2.86	-8	-8	2.032	2.821	-8	4.187	2.295	-8
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	2.67	-8	-8	3.67	5.298	-8	2.914	2.819	-8
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	3.06	-8	-8	5.089	6.915	-8	5.356	2.996	-8
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	-8	-8	-8	3.566	4.537	-8	6.55	-8	-8
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	-8	2.677	-8	4.374	-8	-8
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	3.463	-8	-8	2.89	-8	-8
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	-8	-8	3.66	5.788	-8	3.724	-8	-8
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	2.21	-8	-8	-8	-8	-8	4.128	2.512	-8
1262	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	3.997	6.661	-8	4.215	3.975	-8
1263	ISLAIS CREEK	5 White Croaker	-8	-8	2.752	-8	3.925	6.836	-8	5.595	5.053	-8
1264	ISLAIS CREEK	5 White Croaker	-8	-8	-8	-8	4.716	6.77	-8	5.533	2.536	-8
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	4.42	4.704	-8	6.224	9.325	-8	6.901	9.859	-8
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	4.937	-8	-8
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	2.365	4.42	-8	5.79	-8	-8
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	-8	-8	-8	2.638	-8	6.687	-8	-8
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	5.03	2.405	-8	-8	-8	-8	2.883	4.572	-8
1270	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	2.181	-8	5.013	-8	-8
1271	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	2.898	-8	6.997	-8	-8
1272	POINT MOLATE	5 White Croaker	-8	-8	-8	-8	-8	2.556	-8	5.87	-8	-8
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	-8	-8	-8	-8	-8	2.934	-8	-8
1274	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	4.165	-8	-8
1275	RODEO	5 White Croaker	-8	-8	-8	-8	-8	1.761	-8	4.959	-8	-8
1276	RODEO	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	4.45	-8	-8
1277	RODEO	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	2.57	-8	-8
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	-8	-8	-8	2.34	3.204	-8	6.543	-8	-8
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	4.926	-8	-8
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	5.21	2.315	-8
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	-8	-8	-8	-8	-8	2.456	-8	-8
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	-8	-8	-8	5.126	7.238	-8	4.026	-8	-8
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	-8	-8	-8	4.118	6.131	-8	3.37	-8	-8
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	-8	-8	-8	-8	2.375	-8	4.611	-8	-8
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	-8	-8	-8	-8	-8	-8	5.356	-8	-8
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	4.223	-8	-8
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	2.616	-8	-8
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	3.188	4.723	-8	2.775	-8	-8
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	-8	-8	2.597	2.907	-8	5.64	-8	-8
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	1.838	-8	4.425	-8	-8
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	4.54	-8	-8
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	-8	-8	-8	-8	-8	4.089	-8	-8
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	2.491	-8	-8
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	-8	-8	-8	-8	-8	4.675	-8	-8
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	-8	-8	-8	-8	-8	2.307	-8	-8
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	2.85	-8	-8
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	3.477	-8	-8
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	-8	-8	-8	-8	-8	3.171	-8	-8
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	-8	-8	-8	-8	-8	-8	2.704	-8	-8

IDORG #	STATION NAME	FISH TYPE	PYR	TMN	PAHBATCH	SODATAQC
1234	SAN MATEO BRIDGE	5 White Croaker	-8	-8	73.4	-4
1235	SAN MATEO BRIDGE	5 White Croaker	-8	-8	73.4	-4
1236	SAN MATEO BRIDGE	5 White Croaker	-8	-8	73.42	-4
1237	SAN MATEO BRIDGE	20 Shiner Surf Perch	-8	-8	73.4	-4
1238	DUMBARTON BRIDGE	5 White Croaker	-8	-8	73.4	-4
1239	DUMBARTON BRIDGE	5 White Croaker	-8	-8	73.41	-4
1240	DUMBARTON BRIDGE	5 White Croaker	-8	-8	73.42	-4
1241	DUMBARTON BRIDGE	20 Shiner Surf Perch	-8	-8	73.42	-4
1242	FREMONT FOREBAY	3 Striped Bass	-8	-8	73.43	-4
1243	FREMONT FOREBAY	3 Striped Bass	4.2	-8	73.44	-4
1244	FREMONT FOREBAY	3 Striped Bass	-8	-8	73.45	-4
1245	FREMONT FOREBAY	4 Striped Bass	-8	-8	73.46	-4
1246	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	73.4	-4
1247	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	73.41	-4
1248	RICHMOND HARBOR	20 Shiner Surf Perch	-8	-8	73.42	-4
1249	RICHMOND HARBOR	3 Brown Smoothhound Sharks	-8	-8	73.4	-4
1250	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	73.4	-4
1251	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	73.41	-4
1252	BERKELEY PIER	20 Shiner Surf Perch	-8	-8	73.42	-4
1253	BERKELEY PIER	3 Brown Smoothhound Sharks	-8	-8	73.4	-4
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	73.4	-4
1255	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	73.41	-4
1256	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	-8	-8	73.42	-4
1257	OAKLAND INNER HAR. (FRUITVALE)	3 Striped Bass	-8	-8	73.4	-4
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	73.43	-4
1259	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	73.41	-4
1260	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	-8	-8	73.41	-4
1261	DOUBLE ROCK (CANDLESTICK)	20 Shiner Surf Perch	-8	-8	73.45	-4
1262	ISLAIS CREEK	5 White Croaker	-8	-8	73.41	-4
1263	ISLAIS CREEK	5 White Croaker	-8	-8	73.42	-4
1264	ISLAIS CREEK	5 White Croaker	-8	-8	73.42	-4
1265	ISLAIS CREEK	20 Shiner Surf Perch	-8	-8	73.42	-4
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	73.47	-4
1267	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	73.44	-4
1268	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	-8	-8	73.45	-4
1269	OAKLAND MIDDLE HARBOR PIER	20 Shiner Surf Perch	-8	-8	73.46	-4
1270	POINT MOLATE	5 White Croaker	-8	-8	73.43	-4
1271	POINT MOLATE	5 White Croaker	-8	-8	73.44	-4
1272	POINT MOLATE	5 White Croaker	-8	-8	73.45	-4
1273	POINT MOLATE	5 Walleye Surf Perch	-8	-8	73.46	-4
1274	RODEO	5 White Croaker	-8	-8	73.47	-4
1275	RODEO	5 White Croaker	-8	-8	73.44	-4
1276	RODEO	5 White Croaker	-8	-8	73.45	-4
1277	RODEO	3 Leopard Sharks	-8	-8	73.46	-4
1282	SAN FRANCISCO PIER #7	5 White Croaker	-8	-8	73.43	-4
1283	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	73.44	-4
1284	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	73.45	-4
1285	SAN FRANCISCO PIER #7	5 White Surf Perch	-8	-8	73.46	-4
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	-8	-8	73.41	-4
1287	STRIPED BASS (COYOTE POINT)	3 Striped Bass	-8	-8	73.41	-4
1288	STRIPED BASS (SACRAMENTO. R.)	3 Striped Bass	-8	-8	73.44	-4
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	-8	-8	73.44	-4
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	-8	-8	73.43	-4
1293	SHARK-SOUTH BAY (COYOTE)	3 Leopard Sharks	-8	-8	73.47	-4
1294	SHARK-SOUTH BAY (COYOTE)	3 Brown Smoothhound Sharks	-8	-8	73.41	-4
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	-8	-8	73.43	-4
1296	SHARK-MID BAY (BERKELEY)	3 Brown Smoothhound Sharks	-8	-8	73.44	-4
1297	SHARK-MID BAY (PARADISE)	3 Brown Smoothhound Sharks	-8	-8	73.45	-4
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	-8	-8	73.45	-4
1299	SHARK-NORTH BAY (PT. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	73.46	-4
1300	SHARK-NORTH BAY (Pt. MOLATE)	3 Brown Smoothhound Sharks	-8	-8	73.45	-4
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	-8	-8	73.46	-4
1336	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	73.47	-4
1337	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	73.43	-4
1338	VALLEJO-MARE ISLAND	5 White Croaker	-8	-8	73.46	-4
1339	VALLEJO-MARE ISLAND	3 Striped Bass	-8	-8	73.44	-4

Section VI - Dioxin and Furan Analysis

IDORG	STATION NAME	FISH TYPE	2,3,7,8-Cl4DD		1,2,3,7,8-Cl5DD		1,2,3,4,7,8-Cl6DD	
			pg/g	DQ	pg/g	DQ	pg/g	DQ
1234	SAN MATEO BRIDGE	5 White Croaker	0.23	B	0.39	*	0.13	*
1238	DUMBARTON BRIDGE	5 White Croaker	0.36	B	0.36	*	0.17	*
1242	FREMONT FOREBAY	3 Striped Bass	0.37	*	0.55	*	0.19	*
1246	RICHMOND HARBOR	20 Shiner Surf Perch	0.23	*	0.73	*	0.44	*
1250	BERKELEY PIER	20 Shiner Surf Perch	0.22	*	0.92	*	0.53	*
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.19	*	0.58	*	0.49	*
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.42	B	0.39	*	0.42	*
1262	ISLAIS CREEK	5 White Croaker	0.45	*	0.71	*	0.76	*
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.27	B	0.08	*	0.10	*
1270	POINT MOLATE	5 White Croaker	0.23	B	0.07	*	0.33	B
1274	RODEO	5 White Croaker	0.14	B	0.11	*	0.13	*
1282	SAN FRANCISCO PIER #7	5 White Croaker	0.17	B	0.05	*	0.10	*
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	0.15	B	0.08	*	0.09	*
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.07	B	0.09	*	0.06	B
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	0.04	*	0.07	*	0.07	*
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.10	*	0.14	*	0.13	*
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	0.06	*	0.08	*	0.07	*
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.05	*	0.08	*	0.13	*
1336	VALLEJO-MARE ISLAND	5 White Croaker	0.26		0.05	*	0.09	*

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L Indicates that an analyte detected in the sample was also detected in the blanks, and the amount in the sample was less than ten times the amount in the blank. The value reported is the upper limit of the concentration that could be in the sample. The blank is not subtracted

C Same as L but the sample was corrected for the blank

I Indicates that the analyte was detected, but interferences were present in the quantitation ion or the confirmation ion. The value reflects the upper limit of the concentration that could be in the sample. The blank is not subtracted

IDORG	STATION NAME	FISH TYPE	1,2,3,6,7,8-Cl6DD		1,2,3,7,8,9-Cl6DD		1,2,3,4,6,7,8-Cl7DD	
			pg/g	DQ	pg/g	DQ	pg/g	DQ
1234	SAN MATEO BRIDGE	5 White Croaker	0.15	*	0.22	*	0.33	*
1238	DUMBARTON BRIDGE	5 White Croaker	0.21	*	0.24	*	0.51	*
1242	FREMONT FOREBAY	3 Striped Bass	0.18	*	0.45	*	0.58	*
1246	RICHMOND HARBOR	20 Shiner Surf Perch	0.44	*	0.64	*	0.57	*
1250	BERKELEY PIER	20 Shiner Surf Perch	0.53	*	0.69	*	0.62	*
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.45	*	0.40	*	0.54	*
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.51	*	0.62	*	1.18	*
1262	ISLAIS CREEK	5 White Croaker	0.76	*	1.13	*	1.57	*
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.07	*	0.12	*	0.12	*
1270	POINT MOLATE	5 White Croaker	0.06	*	0.09	*	0.17	*
1274	RODEO	5 White Croaker	0.11	*	0.15	*	0.07	*
1282	SAN FRANCISCO PIER #7	5 White Croaker	0.15	B	0.20	*	0.17	*
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	0.07	*	0.11	*	0.15	*
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.18	B	0.09	*	0.19	B
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	0.06	*	0.08	*	0.10	*
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.11	*	0.16	*	0.18	*
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	0.06	*	0.10	*	0.19	B
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.11	*	0.15	*	0.18	*
1336	VALLEJO-MARE ISLAND	5 White Croaker	0.23	B	0.12	*	0.16	*

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C Same as L but the sample was corrected for the blank

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IDORG	STATION NAME	FISH TYPE	1,2,3,4,6,7,8,9-Cl8DD		2,3,7,8-Cl4DF		1,2,3,7,8-Cl5DF	
			pg/g	DQ	pg/g	DQ	pg/g	DQ
1234	SAN MATEO BRIDGE	5 White Croaker	0.30	•	1.85		0.42	B
1238	DUMBARTON BRIDGE	5 White Croaker	0.48	•	1.79		0.46	B
1242	FREMONT FOREBAY	3 Striped Bass	0.45	•	0.18	•	0.24	•
1246	RICHMOND HARBOR	20 Shiner Surf Perch	0.60	•	0.48	B	0.44	•
1250	BERKELEY PIER	20 Shiner Surf Perch	0.97	•	0.37	B	0.39	•
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.31	•	1.48		0.27	•
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	1.38	•	2.14		0.56	B
1262	ISLAIS CREEK	5 White Croaker	2.26	•	0.52	B	0.47	•
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	1.02		1.10		0.23	B
1270	POINT MOLATE	5 White Croaker	1.03		0.94		0.14	B
1274	RODEO	5 White Croaker	0.67	B	0.72		0.16	B
1282	SAN FRANCISCO PIER #7	5 White Croaker	1.02	B	1.33		0.40	
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	0.97		0.83		0.09	B
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.77		1.44		0.27	B
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	0.67	B	0.15		0.10	B
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.98	B	0.10	•	0.13	•
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	2.22		0.18	B	0.05	•
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.21	•	0.05	•	0.06	•
1336	VALLEJO-MARE ISLAND	5 White Croaker	0.51	B	1.69		0.29	

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IDORG	STATION NAME	FISH TYPE	2,3,4,7,8-Cl5DF		1,2,3,4,7,8-Cl6DF		1,2,3,6,7,8-Cl6DF	
			pg/g	DQ	pg/g	DQ	pg/g	DQ
1234	SAN MATEO BRIDGE	5 White Croaker	0.83	B	1.70		1.01	
1238	DUMBARTON BRIDGE	5 White Croaker	0.91	B	1.72		1.06	
1242	FREMONT FOREBAY	3 Striped Bass	0.47	*	1.05	B	0.12	*
1246	RICHMOND HARBOR	20 Shiner Surf Perch	1.10	*	0.96	B	0.06	*
1250	BERKELEY PIER	20 Shiner Surf Perch	1.10	*	1.15	B	0.14	*
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.78	*	0.81	B	0.43	B
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	1.47	B	0.24	*	0.76	B
1262	ISLAIS CREEK	5 White Croaker	0.25	*	0.50	*	0.45	*
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.78		0.17	B	0.32	
1270	POINT MOLATE	5 White Croaker	0.56		0.23	B	0.19	
1274	RODEO	5 White Croaker	0.44	B	0.21	C	0.30	
1282	SAN FRANCISCO PIER #7	5 White Croaker	1.10		0.00	C	0.71	
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	0.33	B	0.27	B	0.22	
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.28	B	0.45	C	0.04	*
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	0.07	*	0.04	C	0.03	*
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.14	*	0.35	C	0.06	*
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	0.08	*	0.00	C	0.04	*
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.09	*	0.00	C	0.19	B
1336	VALLEJO-MARE ISLAND	5 White Croaker	1.02		0.00	C	0.31	

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IDORG	STATION NAME	FISH TYPE	1,2,3,7,8,9-Cl6DF		2,3,4,6,7,8-Cl6DF		1,2,3,4,6,7,8-Cl7DF	
			pg/g	DQ	pg/g	DQ	pg/g	DQ
1234	SAN MATEO BRIDGE	5 White Croaker	0.29	*	0.25	*	0.86	B
1238	DUMBARTON BRIDGE	5 White Croaker	0.30	*	0.24	*	0.82	*
1242	FREMONT FOREBAY	3 Striped Bass	0.53	*	0.42	*	0.55	*
1246	RICHMOND HARBOR	20 Shiner Surf Perch	0.55	*	0.60	*	0.98	*
1250	BERKELEY PIER	20 Shiner Surf Perch	0.76	*	0.83	*	1.08	*
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	0.54	*	0.49	*	0.65	*
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.14	*	1.32	*	0.37	*
1262	ISLAIS CREEK	5 White Croaker	0.26	*	3.15	*	0.79	*
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.12	*	0.08	*	0.40	B
1270	POINT MOLATE	5 White Croaker	0.09	*	0.07	*	0.30	B
1274	RODEO	5 White Croaker	0.15	*	0.12	*	0.95	
1282	SAN FRANCISCO PIER #7	5 White Croaker	0.15	*	0.11	*	0.18	C
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	0.10	*	0.09	*	0.30	B
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.10	*	0.15	B	1.21	
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	0.09	*	0.06	*	1.12	
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.15	*	0.12	*	1.73	
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	0.10	*	0.07	*	0.96	
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.21	*	0.17	*	0.00	C
1336	VALLEJO-MARE ISLAND	5 White Croaker	0.16	*	0.10	*	0.00	C

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IDORG	STATION NAME	FISH TYPE	1,2,3,4,7,8,9-Cl7DF		1,2,3,4,6,7,8,9-Cl8DF		PCB-77	
			pg/g	DQ	pg/g	DQ	pg/g	DQ
1234	SAN MATEO BRIDGE	5 White Croaker	1.58	•	0.77	B	107	
1238	DUMBARTON BRIDGE	5 White Croaker	1.79	•	0.70	•	151	
1242	FREMONT FOREBAY	3 Striped Bass	2.10	•	0.45	•	87	
1246	RICHMOND HARBOR	20 Shiner Surf Perch	1.97	•	0.53	•	103	
1250	BERKELEY PIER	20 Shiner Surf Perch	2.21	•	0.94	•	32	
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	1.55	•	0.47	•	213	
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	0.62	•	0.73	•	180	
1262	ISLAIS CREEK	5 White Croaker	0.92	•	1.78	•	142	
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	0.13	•	0.14	•	148	
1270	POINT MOLATE	5 White Croaker	0.03	•	0.14	•	42	
1274	RODEO	5 White Croaker	0.32	B	0.55	B	32	
1282	SAN FRANCISCO PIER #7	5 White Croaker	0.00	C	0.10	C	82	
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	0.04	•	0.13	•	99	
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	0.41	B	0.77		19	
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	0.40	B	0.67		6	
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	0.69	B	1.04	B	9	
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	0.39	B	0.56	B	8	
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	0.00	C	0.00	C	1	C
1336	VALLEJO-MARE ISLAND	5 White Croaker	0.00	C	0.00	C	111	

• Indicates that an analyte was below the MDL (Method Detection Limit). The number reported is the MDL for that particular sample. The MDL is based on three times the standard deviation of the noise (background of the average blank).

B Indicates that an analyte was detected above the MDL but below the Quantitation Limit (QL). The measured value is reported. The QL is based on ten times the standard deviation of the noise (background of the average blank).

L Indicates that an analyte detected in the sample was also detected in the blanks, and the amount in the sample was less than ten times the amount in the blank. The value reported is the upper limit of the concentration that could be in the sample The blank is not subtracted

C Same as L but the sample was corrected for the blank

I Indicates that the analyte was detected, but interferences were present in the quantitation ion or the confirmation ion. The value reflects the upper limit of the concentration that could be in the sample. The blank is not subtracted.

IDORG	STATION NAME	FISH TYPE	PCB-126		PCB-169		PCB-105	
			pg/g	DQ	pg/g	DQ	pg/g	DQ
1234	SAN MATEO BRIDGE	5 White Croaker	66		0.19	*	6600	
1238	DUMBARTON BRIDGE	5 White Croaker	64		0.17	*	10600	
1242	FREMONT FOREBAY	3 Striped Bass	34		0.23	*	1080	
1246	RICHMOND HARBOR	20 Shiner Surf Perch	11		0.25	*	1600	
1250	BERKELEY PIER	20 Shiner Surf Perch	8.74		0.30	*	460	
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	38		0.29	*	2900	
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	135		7.61		7900	
1262	ISLAIS CREEK	5 White Croaker	50		2.05		4500	
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	35		2.69		5400	
1270	POINT MOLATE	5 White Croaker	22		2.58		3050	
1274	RODEO	5 White Croaker	32		2.06		5300	
1282	SAN FRANCISCO PIER #7	5 White Croaker	54		4.82		9400	
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	27.60		2.32		3300	
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	2		1.91		1700	
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	1		0.16		420	
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	2		0.36		540	
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	3.09		0.42	B	760	
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	3		0.21	B	247	
1336	VALLEJO-MARE ISLAND	5 White Croaker	57		4.78		15300	

* Indicates that an analyte was below the MDL (Method Detection Limit). The number reported is the MDL for that particular sample. The MDL is based on three times the standard deviation of the noise (background of the average blank).

B Indicates that an analyte was detected above the MDL but below the Quantitation Limit (QL). The measured value is reported The QL is based on ten times the standard deviation of the noise (background of the average blank)

L Indicates that an analyte detected in the sample was also detected in the blanks, and the amount in the sample was less than ten times the amount in the blank The value reported is the upper limit of the concentration that could be in the sample. The blank is not subtracted.

C Same as L but the sample was corrected for the blank

I Indicates that the analyte was detected, but interferences were present in the quantitation ion or the confirmation ion The value reflects the upper limit of the concentration that could be in the sample. The blank is not subtracted

IDORG	STATION NAME	FISH TYPE	PCB-118		I-TEQ	PCB-TEQ
			pg/g	DQ		
1234	SAN MATEO BRIDGE	5 White Croaker	24000		1.30	9.71
1238	DUMBARTON BRIDGE	5 White Croaker	30000		1.46	10.49
1242	FREMONT FOREBAY	3 Striped Bass	4500		0.67	4.02
1246	RICHMOND HARBOR	20 Shiner Surf Perch	6200		0.89	1.95
1250	BERKELEY PIER	20 Shiner Surf Perch	2200		0.97	1.18
1254	OAKLAND INNER HAR. (FRUITVALE)	20 Shiner Surf Perch	16800		0.85	5.89
1258	DOUBLE ROCK (CANDLESTICK)	5 White Croaker	31000		1.75	17.56
1262	ISLAIS CREEK	5 White Croaker	13900		0.89	6.91
1266	OAKLAND MIDDLE HARBOR PIER	5 White Croaker	17500		0.88	5.89
1270	POINT MOLATE	5 White Croaker	10100		0.73	3.57
1274	RODEO	5 White Croaker	17000		0.57	5.50
1282	SAN FRANCISCO PIER #7	5 White Croaker	34000		1.00	9.83
1286	STRIPED BASS (OAKLAND INNER)	3 Striped Bass	11300		0.50	4.29
1289	STURGEON (GRIZZLY BAY)	3 Sturgeon	3100		0.51	0.73
1292	SHARK-SOUTH BAY (S.M., COYOTE)	3 Leopard Sharks	1800		0.12	0.35
1295	SHARK-MID BAY (TREASURE IS.)	2 Leopard Sharks	2500		0.23	0.54
1298	SHARK-NORTH BAY (PT. MOLATE)	3 Leopard Sharks	2800		0.13	0.67
1301	HALIBUT-SOUTH BAY (SAN MATEO)	3 Halibut	1030		0.12	0.43
1336	VALLEJO-MARE ISLAND	5 White Croaker	53000		1.04	12.63

* Indicates that an analyte was below the MDL (Method Detection Limit). The number reported is the MDL for that particular sample. The MDL is based on three times the standard deviation of the noise (background of the average blank).

B Indicates that an analyte was detected above the MDL but below the Quantitation Limit (QL). The measured value is reported. The QL is based on ten times the standard deviation of the noise (background of the average blank)

L Indicates that an analyte detected in the sample was also detected in the blanks, and the amount in the sample was less than ten times the amount in the blank. The value reported is the upper limit of the concentration that could be in the sample. The blank is not subtracted.

C Same as L but the sample was corrected for the blank

I Indicates that the analyte was detected, but interferences were present in the quantitation ion or the confirmation ion. The value reflects the upper limit of the concentration that could be in the sample. The blank is not subtracted.

All flags are disregarded in the calculation of I-TEQs (Toxic Equivalents). Therefore , I-TEQs of flagged data represent a maximum possible value. Whenever a congener is below the detection limit, one half the detection limit is used in the I-TEQ calculation.

Section VII - Data Base Description

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I. LABORATORY ACTIVITIES

Actual field and laboratory work was completed under contract by the California Department of Fish and Game (CDFG). The CDFG contracted the majority of the sample collection activities to Dr. John Oliver of San Jose State University at the Moss Landing Marine Laboratories in Moss Landing. CDFG personnel performed the trace metals analyses at the trace metals facility at Moss Landing Marine Laboratories in Moss Landing. The synthetic organic pesticides, PAHs and PCBs, were contracted by CDFG to Dr. Ron Tjeerdema at the UCSC trace organics facility at Long Marine Laboratory in Santa Cruz. Myrto Petreas at the California EPA Hazards Material Laboratory was responsible for the dioxin and additional coplanar PCB analysis. CDFG and Moss Landing Marine Lab personnel were responsible for synthesis and final QA of the full data set, and currently maintains the database for the RWQCB. Described below is a description of that database system.

II. DESCRIPTION OF COMPUTER FILES

The sample collection/field information, dissection and chemical data are stored on a 486DX PC at Moss Landing Marine Laboratories. Access is limited to only Russell Fairey. Contact Russell Fairey at (408) 633-6035 for copies of data. The data are stored in a dBase 4 and EXCEL formats and can be exported to any number of other formats. There are two backups of this database stored in two different laboratories. The dBase database structure follows, showing chemical name abbreviations and precise characteristics of each field.

Field Data

IDORG This numeric field is 7 characters wide with 1 decimal place and contains the unique i.d. organizational number for the sample. For each station collected on a unique date, an idorg sample number is assigned. This should be the field that links the collection, toxicity, chemical, and other data bases.

STATION This character field is 30 characters wide and contains the exact name of the station.

FISH TYPE This character field is 12 characters wide and contains the common name of the type of fish collected for that particular sample.

STATION # This numeric field is 7 characters wide with 1 decimal place and contains the CDFG station numbers that are used statewide. The format is YXXXX.Z where Y is the Regional Water Quality Control Board Region number, XXXX is the number that corresponds to a given location or site and Z is the number of the station within that site. An example is San Mateo Bridge in South San Francisco Bay where the Station # is 24001.0 The 2 indicates Region 2 of California. The 0001 indicates that it is Site 1 and the .0 indicates there were no replicate samples.

DATE This date field is 8 characters long and is the date that each sample was collected in the field. It is listed as MM/DD/YY.

SAMPLERS This character field is 12 characters wide and contains the initials of the scientific personnel aboard the sampling vessel on that particular date.

COMP # This numeric field is 3 characters wide and contains the composite number of the fish sample at a particular station or area. Numbers will range from one to four.

SIZE RANGE This is a character field 10 characters wide and contains the range of sizes (in millimeters) of fish from each composite.

MN LENGTH This is a numeric field 5 characters wide and contains the mean value of lengths from the size range of the composite.

LATITUDE This character field is 12 characters wide and contains the longitude of the center of the station sampled. The format is a character field as follows: XX,YY,ZZ, where XXX is in degrees, YY is in minutes, and ZZ is in seconds or hundreds.

LONGITUDE This character field is 14 characters wide and contains the longitude of the center of the station sampled. The format is a character field as follows: XX,YY,ZZ, where XXX is in degrees, YY is in minutes, and ZZ is in seconds or hundreds.

Trace metals

Trace metals are presented in the following fields. All sediment trace metal results are reported on a wet weight basis in parts per million (ppm).

A. When the value is missing or not analyzed, the value is reported as "-9.0" = not analyzed.
B. When the value is less than the detection limit of the analytical test, the value is reported as "-8.0" = not detected.

% MOIST This is a numeric field 6 characters wide that is the percentage of moisture in the tissue used for trace metal analysis.

Tissue trace metals are numeric fields of varying character width, and include the following elements, listed by field number, then field name as it appears in the database, then numeric character width and number of decimal places:

ALUMINUM 7.0
ARSENIC. 5.2
CADMIUM. 6.3
CHROMIUM. 6.1
COPPER. 6.1
IRON. 7.0
LEAD. 5.2
MANGANESE. 5.0
MERCURY. 6.3
SELENIUM. 5.2
SILVER. 6.3
TIN. 6.2
ZINC. 4.0

TMDATAQC Data qualifier codes are notations used by data reviewers to briefly describe, or qualify data and the systems producing data, numeric character width 3. Data qualifier codes are as follows:

A. When the sample meets or exceeds the control criteria requirements, the value is reported as "-4".
B. When the sample has minor exceedences of control criteria but is generally usable for most assessments and reporting purposes, the value is reported as "-5". For samples coded "-5" it is recommended that if assessments are made that are especially sensitive or critical, the QA evaluations should be consulted before using the data.
C. When the QA samples have major exceedences of control criteria requirements and the data was not usable for most assessments and reporting purposes, the value is reported as "-6".
D. When the sample has minor exceedences of control criteria and is unlikely to affect assessments, the value is reported as -3.

Synthetic organics are presented in the following fields. All synthetic organic results are reported on a wet weight basis in parts per billion (ppb or ng/g).

A. When the value is missing or not analyzed, the value is reported as "-9.0" = not analyzed.
B. When the value is less than the detection limit of the analytical test, the value is reported as "-8.0" = not detected.

Synthetic organics are reported on a wet weight basis in parts per billion (ppb or ng/g) and are numeric fields of varying character width, and include the following compounds, listed by field number, then field name as it appears in database (and followed by the compound name if not obvious), and then finally, the numeric character width and number of decimal places is given:

Polychlorinated Biphenyls(PCBs)

PCB5.	7.3	
PCB8.	7.3	
PCB15.	7.3	
PCB18.	7.3	
PCB27.	7.3	
PCB28.	7.3	
PCB29.	7.3	
PCB31.	7.3	
PCB44.	7.3	
PCB49.	7.3	
PCB52.	7.3	
PCB66.	7.3	
PCB70.	7.3	
PCB74.	7.3	
PCB87.	7.3	
PCB95.	7.3	
PCB97.	7.3	
PCB99.	7.3	
PCB101.	8.3	
PCB105.	7.3	
PCB110.	7.3	
PCB118.	8.3	
PCB128.	7.3	
PCB132.	7.3	
PCB137.	7.3	
PCB138.	8.3	
PCB149.	8.3	
PCB151.	7.3	
PCB153.	8.3	
PCB156.	7.3	
PCB157.	7.3	
PCB158.	7.3	
PCB170.	7.3	
PCB174.	7.3	
PCB177.	7.3	
PCB180.	7.3	
PCB183.	7.3	
PCB187.	7.3	
PCB189.	7.3	
PCB194.	7.3	
PCB195.	7.3	
PCB201.	7.3	
PCB203.	7.3	
PCB206.	7.3	
PCB209.	7.3	
TTLPCB.	7.3	The sum of 18 individual congeners (NOAA)
ARO1248.	7.3	
ARO1254.	7.3	
ARO1260	7.3	
ARO5460.	7.3	
TTLPCB.	7.3	The sum of Aroclors 1248, 1254 & 1260

Pesticides

PCBBATCH This is the batch number during which the sample was extracted. The numeric field is 6 characters wide with 2 decimal places.

SOWEIGHT This numeric field is 6 characters wide with 2 decimal places and contains the weight of the sample extracted for analysis.

SOMOIST This numeric field is 6 characters wide with 2 decimal places and contains the percent moisture of the sample extracted.

SOLIPD This numeric field is 6 characters wide with 2 decimal places and contains the percent lipid of the sample extracted.

ALDRIN. 7.3
CCHLOR. cis-Chlordane. 7.3
TCHLOR. trans-Chlorane. 7.3
ACDEN. alpha-Chlordane. 7.3
GCDEN. gamma-Chlordane. 7.3
CLPYR. Chlorpyrifos. 7.2
DACTH. Dacthal. 7.3
OPDDD. o,p'-DDD. 7.2
PPDDD. p,p'-DDD. 8.3
OPDDE. o,p'-DDE. 7.2
PPDDE. p,p'-DDE. 8.3
PPDDMS. p,p'-DDMS. 7.2
PPDDMU. p,p'-DDMU. 7.2
OPDDT. o,p'-DDT. 7.2
PPDDT. p,p'-DDT. 7.2
TTLDDT. The sum of the six DDD, DDE and DDT isomers. 7.2
DICLB. p,p'-Dichlorobenzophenone. 7.2
DIELDRIN. 7.3
ENDO_I. Endosulfan I. 7.3
ENDO_II. Endosulfan II. 7.2
ESO4. Endosulfan sulfate. 7.2
ENDRIN. 7.2
HCHA. alpha-HCHA 7.3
HCHB. beta-HCHA 7.2
HCHG. gamma-HCHA 7.3
HCHD. delta-HCHA 7.3
HEPTACHLOR. 7.3
HE. Heptachlor Epoxide. 7.3
HCB. Hexachlorobenzene. 7.3
METHOXY. Methoxychlor. 7.2
MIREX. 7.3
CNONA. cis-Nonachlor. 7.3
TNONA. trans-nonachlor. 7.3
TTLCLOR. The sum of the six chlordane, nonachlor and oxychlordane isomers 7.3
OXAD. Oxadiazon. 7.2

OCDAN. Oxychlordane. 7.3
TOXAPH. Toxaphene. 7.1

PESBATCH This is the batch number during which the sample was extracted. The numeric field is 6 characters wide with 2 decimal places.

Polycyclic Aromatic Hydrocarbons

ACY. Acenaphthylene. 7.2
ACE. Acenaphthene. 7.2
ANT. Anthracene. 9.2
BAA. Benz[a]anthracene. 8.2
BAP. Benzo[a]pyrene. 8.2
BBF. Benzo[b]fluoranthene. 8.2
BKF. Benzo[k]fluoranthene. 8.2
BGP. Benzo[ghi]perylene. 8.2
BEP. Benzo[e]pyrene. 8.2
BPH. Biphenyl. 7.2
CHR. Chrysene. 8.2
DBA. Dibenz[a,h]anthracene. 8.2
DMN. 2,6-Dimethylnaphthalene. 7.2
FLA. Fluoranthene. 8.2
FLU. Fluorene. 8.2
IND. Indo[1,2,3-cd]pyrene. 7.2
MNP1. 1-Methylnaphthalene. 7.2
MNP2. 2-Methylnaphthalene. 7.2
MPH1. 1-Methylphenanthrene. 7.2
NPH. Naphthalene. 7.2
PHN. Phenanthrene. 8.2
PER. Perylene. 7.2
PYR. Pyrene. 8.2
TMN. 2,3,4-Trimethylnaphthalene. 7.2

PAHBATCH The batch number in which the sample was extracted; numeric character width 6, with 2 decimal places.

SODATAQC Data qualifier codes are notations used by data reviewers to briefly describe, or qualify data and the systems producing data, numeric character width 3. Data qualifier codes are as follows:

A. When the sample meets or exceeds the control criteria requirements, the value is reported as "-4".
B. When the sample has minor exceedences of control criteria but is generally usable for most assessments and reporting purposes, the value is reported as "-5". For samples coded "-5" it is recommended that if assessments are made that are especially sensitive or critical, the QA evaluations should be consulted before using the data.
C. When the QA samples has major exceedences of control criteria requirements and the data is not usable for most assessments and reporting purposes, the value is reported as "-6".

D. When the sample has minor exceedences of control criteria and is unlikely to affect assessments, the value is reported as -3.

Dioxins and Furans

2,3,7,8 TCDD 7.3
1,2,3,7,8 PeCDD 7.3
1,2,3,4,7,8 HxCDD 7.3
1,2,3,6,7,8 HxCDD 7.3
1,2,3,7,8,9 HxCDD 7.3
1,2,3,4,6,7,8 HpCDD 7.3
1,2,3,4,6,7,8,9 OCDD 7.3
2,3,7,8 TCDF 7.3
1,2,3,7,8 PeCDF 7.3
2,3,4,7,8 PeCDF 7.3
1,2,3,4,7,8 HxCDF 7.3
1,2,3,6,7,8 HxCDF 7.3
2,3,4,6,7,8 HxCDF 7.3
1,2,3,7,8,9 HxCDF 7.3
1,2,3,4,6,7,8 HpCDF 7.3
1,2,3,4,7,8,9 HpCDF 7.3
1,2,3,4,6,7,8,9 OCDF 7.3
Dioxin-TEQ 7.3

DEFINITIONS OF DATA QUALIFIER (DQ) SYMBOLS USED IN THE DIOXIN AND FURAN DATA:
Results tabulated in the Report are often flagged to alert the data user to exercise caution in interpreting the significance of these results. An analyte reported without a flag indicates that the measurement was above the Quantitation Level (QL) and that no interferences were present. In any other case the reported values will be accompanied by one of the following symbols (flags):

***** Indicates that an analyte was below the Method Detection Limit (MDL). **The number reported is the MDL for that particular sample.** The MDL is based on three times the standard deviation of the noise (background) of the (average) blank.

B Indicates that an analyte was detected above the MDL but below the QL. The measured value is reported. The QL is based on ten times the standard deviation of the noise (background) of the (average) blank.

L Indicates that an analyte detected in the sample was also detected in the blank, and the amount in the sample was less than ten times the amount in the blank. The value reported is the upper limit of the concentration that could be in the sample. The blank is not subtracted.

C Same as L but the sample was corrected for the blank

I Indicates that the analyte was detected, but interferences were present in the quantitation ion or in the confirmation ion. The value reflects the upper limit of the concentration that could be in the sample. The blank is not subtracted.

NA Not Applicable. This flag is used when Total Congener concentrations cannot be calculated because individual congeners are below the MDL.

ND Not Determined

All flags are disregarded in the calculation of I-TEQs (Toxic Equivalents). Therefore, I-TEQs of flagged data represent a maximum possible value. Whenever a congener is below the detection limit, one-half the detection limit is used in the I-TEQ calculations.

APPENDIX II
GUIDELINES FOR EVALUATING CONTAMINANT LEVELS IN FISH TISSUE

Guidelines For Evaluating Contaminant Levels In Fish Tissue

Several national, regional and state agencies have developed guidelines for evaluating contaminant levels in fish tissue. However, each set of values was developed for a specific purpose and has its own set of assumptions. Pilot study screening values used to evaluate data in this study are given in Table 1. Values developed by other agencies are listed for information. Pilot study screening values (see Table 1) were developed using the approach of th EPA guidance document, Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories- Volume 1- Fish Sampling And Analysis (EPA 823-R-93-002, 1993), to identify potential chemicals of concern. This approach was chosen because it has the following advantages: 1) it was designed for use in screening fish contamination data, 2) it has received extensive public and scientific review and 3) it uses updated toxicologic and exposure information in the calculations. Pilot study screening values (PS-SVs) differ from listed EPA screening values because consumption rates of fish tissue were assumed to be approximately one meal a week for the PS-SV calculations while EPA calculations were based on consumption rates of one meal a month. The EPA calculations are based on the average consumption of fish and shellfish from estuarine and fresh waters by the general U.S. population. The more conservative PS-SV calculation is based on the estimate of the average consumption of fish and shellfish from marine, estuarine and fresh waters by the 50th percentile of recreational fisheman. The Great Lakes PCB screening value is current and has been extensively reviewed, but was developed to be used for a uniform health advisory and not for initial screening of chemicals of concern. Maximum Tissue Residue Levels (MTRLs) were developed by staff at the California State Water Resources Control Board (SWRCB) to screen fish tissue data. These values were developed based on the water quality criterion for protection of public health presented in Title 40 CFR 131.36 (USEPA. 1993. Water Quality Standards Regulation). These values were calculated based on a risk level of 10^{-6} and the consumption rate of 6.5 grams per day. These values use up-to-date information, however, they have not yet received public review and have not been adopted by the SWRCB. National Academy of Science (NAS) criteria were developed to protect both the fish containing the toxic substance and any animals that prey on contaminated fish. The disadvantages of using these values are that they do not use up-to-date information (they were last published in 1973) and they are based on whole body concentrations, not on fillets. The use of FDA Action Levels to screen fish tissue data in this report has several disadvantages stemming from the fact that these standards were developed for purposes other than those of this study. FDA Action Levels are used as limits at or above which USFDA will take legal action to remove contaminated fish from the market. These values contain economic, as well as other assumptions that are not based on health risk. The USFDA states that these limits are set "... based on the unavoidability of the poisonous or deleterious substance and do not represent permissible levels of contamination where it is avoidable".

TABLE 1 - CONTAMINANT SCREENING VALUES FROM SELECTED SOURCE

ANALYTES (ppm)	PS-SV(a)	EPA(b)	Great Lakes (c)	MTRLs (d)	NAS (e)	FDA (f)
Metals						
Arsenic						
Cadmium	2.33	10				
Lead						
Mercury	0.14	0.6		1		1
Selenium	11.67	50				
Organic Pesticides						
Total Chlordane	0.0179	0.08		0.008		
Total DDT	0.0686	0.3		0.032	0.05	5
Aldrin						0.3
Dieldren	0.0015	0.007		0.0007		0.3
Endosulfan (total)	3.5	20		1.1		
Endrin	0.7	3		3.2		0.3
Heptachlor				0.0023		0.3
Heptachlor Epoxide	0.0026	0.01		0.0012		0.3
Hexachlorobenzene	0.0146	0.07		0.0067		
Mirex	0.47	2				
Toxaphene	0.0212	3		0.009		
Chlorpyrifos	7	30				
PCBs						
Total Aroclors	0.003	0.01	0.21-1.0		0.5	2
Total Dioxins & Furans	0.15 ppt	0.7ppt				

All values are reported in parts per million, except dioxins which are in parts per trillion

(a) Pilot Study Screening Values developed using the EPA Guidance document approach
Values reported are for carcinogens or non-carcinogens
Values based on consumption of 30 g/d of fish (one meal per week) for a 70 kg adult

(b) Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories
Volume 1 Fish Sampling and Analysis
EPA 823-R-93-002 August 1993
Values reported are for carcinogens or non-carcinogens
Values based on consumption of 6.5 g/d of fish (one meal per month) for a 70 kg adult

(c) Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory
Great Lakes Sport Fish Advisory Task Force Draft -June 1993
Values based on consumption of 7.4 g/d of fish (one meal per month) for a 70 kg adult

(d) Maximum Tissue Residue Levels (MTRLs)
California Enclosed Bays and Estuaries Plan
State Water Resources Control Board 1993b
Values reported are for carcinogens or non-carcinogens

(e) National Academy of Sciences (NAS) - National Academy of Engineering
Water Quality Criteria, 1972 (Blue Book)
USEPA, Ecological Research Series

(f) U.S. Food and Drug Administration. 1984.
Shellfish Sanitation Interpretation: Action Levels for Chemical and Poisoness Substances

Pilot Study Screening Value Calculations

The EPA document that was used to design the study, Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories-Volume 1-Fish Sampling and Analysis (EPA 823-R-93-002, 1993), was also used to develop the screening values used in this report. In developing the pilot study screening values (PS-SVs) for a number of noncarcinogenic and carcinogenic compounds, risk based dose response variables were used (U.S. EPA, 1993). These variables were used in the following equations to calculate the PS-SVs used in this report:

For Noncarcinogens:

PS-SV = (RfD * BW)/CR

where
PS-SV = Screening Value (mg/kg:ppm)
RfD = Oral reference dose (mg/kg/d)
BW = Body Weight (kg)
CR = Consumption rate of tissue(g/d)

For Carcinogens:

PS-SV = [(RL/SF)*BW]/CR

where
PS-SV = Screening Value (mg/kg:ppm)
Rl = Maximum acceptable risk level (dimensionless)
SF = Oral slope factor $(mg/kg/d)^{-1}$
BW = Body Weight (kg)
CR = Consumption rate of tissue(g/d)

Body weight (BW), consumption rate (CR) and risk level (RL) have been held constant for all calculations in this document. Body weight was chosen at 70 kg which is the mean body weight for the average male adult population (U.S. EPA, 1990a). Consumption rate was chosen at 30 grams per day (≈ one meal a week) which is the estimate of the average consumption of fish and shellfish from marine, estuarine and fresh waters by the 50th percentile of recreational fishermen (U.S. EPA, 1990a). These constants were chosen to represent "average" recreational fisherman. The risk level (RL) was chosen at 10^{-5} as recommended by the EPA Office of Water for the calculation of screening values. In simple terms, this means that if a person weighing 70 kg consumed 30 grams of fish per day with the same concentration of contaminant, for 70 years, the increased risk would be at most one additional cancer death per 100,000 persons. The pilot study screening values calculated from the constants selected above are used to help identify potential chemicals of concern and are not meant to address health risk concerns. In order to address health risk concerns the characteristics of certain fishing populations should be studied in order to provide more relevant information.

Values are given in Table 2 for oral RfD and SF values suggested for use by the EPA (U.S. EPA, 1993). Appropriate references and methods to determine these values for each analyte can be found in that document.

Screening values (PS-SVs) reported in Table 5 are target analyte concentrations in fish tissue that equal exposure levels at either the RfD for noncarcinogens, or the SF and a $RL=10^{-5}$ for carcinogens, given the above constants. When PS-SVs were calculated for both carcinogenic and noncarcinogenic risks only the carcinogenic value was reported since it was lower and presented a more conservative approach.

Table 2 - Reference Doses(RfD) and Slope Factors(SF) (U.S.EPA, 1993)

Target Analyte	RfD(mg/kg/d)	$SF(mg/kg/d)^{-1}$
Cadmium	1×10^{-3}	N/A
Mercury	6×10^{-5}	N/A
Selenium	5×10^{-3}	N/A
Total Chlordane	6×10^{-5}	1.3
Total DDT	5×10^{-4}	0.34
Dieldrin	5×10^{-5}	16
Endosulfan (I & II)	1.5×10^{-3}	N/A
Endrin	3×10^{-4}	N/A
Heptachlor Epoxide	1.3×10^{-5}	9.1
Hexachlorobenzene	8×10^{-4}	1.6
Mirex	2×10^{-4}	N/A
Toxaphene	2.5×10^{-4}	1.1
Total Aroclor	2×10^{-5}	7.7
Dioxin-TEQ	N/A	1.56×10^{5}

PS-SVs could not be calculated for all 142 chemicals analyzed in this study since reliable information on the toxicity or carcinogenic potency of chemicals is not available for all analytes. RfD and SF information that has been developed to date is available in the EPA's Integrated Risk Information System (IRIS, 1992). This system is continuously updated, as information becomes available, so calculations of screening values for additional chemicals may be possible in the future.

APPENDIX III
LABORATORY OPERATING PROCEDURES

Collection and Preparation of Fish for Trace Metal and Synthetic Organic Analysis

1.0 SCOPE AND APPLICATION

1.1 The following methods are for collection, transportation and preparation of fish flesh for analysis of synthetic organics and trace elements.

2.0 SUMMARY OF METHOD

2.1 Fish are collected by any of several standard collection methods such as seines, gill nets and hook and line.

2.2 Once the samples are collected, they are wrapped in trace metal and trace organically cleaned teflon sheeting, and frozen for transportation to the laboratory.

2.3 The frozen samples are prepared under non-contaminating techniques in a clean room environment.

3.0 CONTAMINATION

3.1 Potential sources of contamination during sample collection and handling are innumerable. Sampling gear, sample containers, solvents, reagents and other sample processing hardware may yield artifacts and/or elevated baseline, causing misinterpretation of inorganic and organic analyses. Extreme care must be exercised by personnel experienced in ultra-clean techniques during sample collection and handling.

4.0 APPARATUS AND MATERIALS

4.1 Sample collection

- 4.1.1 Gill nets (various sizes)
- 4.1.2 Seines or trawls (various size mesh and lengths as appropriate)
- 4.1.3 Boats (for setting and retrieving nets)
- 4.1.4 Rods and reels
- 4.1.5 Teflon sheeting
- 4.1.6 Dry ice chest

4.2 Sample Preparation

- 4.2.1 Sartorius balance capable of weighing 300.00g
- 4.2.2 Measuring board capable of 600 mm
- 4.2.3 #3, and #4 Bard Parker scalpel handles
- 4.2.4 24 x 24 x 1/4 inch glass or Teflon sheet
- 4.2.5 Freezer
- 4.2.6 Type II water purification system capable of providing water to 18 megohms-cm resistance equipped with prefilter cartridge, carbon cartridge, 2 ion-exchange cartridges and 0.22 post filter unit (Milli-Q® water).
- 4.2.7 Willems Polytron with sound suppressor on a stand with a Corian foundation equipped with a titanium

shaft, power control unit, teflon bearings and spatter shield housed in a hood.

4.2.8 Drying oven

4.2.9 Desiccator

4.2.10 Laminar flow grade hepa filter installed with a magnahelix differential pressure gauge.

5.0 REAGENTS

5.1 1N Nitric acid - 150 mL (69.0-71.0 nitric acid)/2 L Type II water).

5.2 Petroleum ether - Baker Resi-analyzed

5.3 Methanol - Baker Resi-analyzed

5.4 Dry ice

6.0 SAMPLE COLLECTION, PRESERVATION AND HANDLING

6.1 Fish are collected using the appropriate gear for the desired species and existing water conditions.

6.2 As a general rule, five fish of medium size or three fish of larger size are collected and composited for analysis. This provides sufficient quantities of fish for the dissection of 200 grams of fish flesh for organic and inorganic analysis.

6.3 When only small fish are available sufficient numbers are collected to provide the needed 200 grams of fish flesh. In this study 20 of the smaller fish (shiner surf perch) were collected.

6.4 Species of fish collected are chosen based on their priority as target species, importance as indicator species, availability and the type of analysis desired.

6.5 Fish samples are transported from the collection site to the preservation site after being frozen in teflon sheeting. The fish are frozen in dry ice and then transported to the laboratory where they are kept frozen until processing for chemical analysis.

7.0 PROCEDURE FOR SAMPLE EXTRACTION

7.1 All the surfaces that the samples and instruments may come in contact with are wiped down with Type II water and cleanroom wipes, and covered.

7.1.1 Each day or every 10 samples the 250 mL Wheaton solvent rinse bottles (1N nitric acid, methanol, and petroleum ether) are changed.

7.1.2 The same procedure is followed for cleaning solvent bottles as for cleaning glassware, instruments and polytron shaft (as described below), except that these bottles are cleaned only to the extent of the solvent which they will hold.

7.1.3 Glassware is soaked 20 minutes and washed in D.I. water with Micro®. It is then rinsed again in D.I. water and drained onto teflon grids.

7.1.4 Under hood chemical cleaning is accomplished by adding 25 mL 1N nitric acid to each bottle. To ensure all surfaces are exposed to solvents rotate the bottle while pouring the solvents onto the ground glass stoppers. Repeating the above procedure with B through E below and allow to dry.

A. 25 mL of 6N nitric acid
B. 25 mL Type II water
C. Repeat step B.
D. 25 mL methanol
E. 25 mL petroleum ether

7.2 Large fish requiring dissection are thawed under D.I. water. They may be brushed with a tooth brush to remove mucous, rinsed and placed on a Teflon lined tray.

7.2.1 They are measured on the measuring board to the nearest millimeter, placed on a teflon lined tray on the balance (Sartorius or double beam) and weighed. All lengths and weights are recorded.

7.2.2 The fish are placed on the Teflon tray. Clean all dissection instruments in the same manner as for glassware.

7.2.3 A "U" shaped incision is made just posterior to the operculum with a #11 scalpel; the upper leg of the incision runs the length of the fish just ventrally of the dorsal fin and the lower leg just below the midline; cutting just through the epidermis.

7.2.4 The skin is peeled back using the "v" shaped forceps and the flesh exposed. With a fresh #3 or #4 blade (cutting approximately 1 cm inside the original cut to avoid contamination, providing the size of the fish allows) a fillet is cut from the entire length of the fish.

7.2.5 The fillet is removed in 5 to 10 g portions with tefzel forceps. Equal weight fillets are taken from each fish of the sample to composite 200.0 g. (ideally 5 fish/40.0 g for 200.0 g total weight).

7.2.6 The beginning bottle weight, each fillet weight and end bottle weight are recorded.

7.3 All samples are refrozen after dissection and maintained at 0° C until homogenization and/or analyses.

7.4 All samples are polytroned to provide a homogeneous material for analysis.

7.4.1 Flesh samples are removed from the freezer.

7.4.2 Prior to and after homogenization the titanium shaft of the polytron is cleaned by running in 1000 mL beakers of D.I. water until a minimum of 3-5 washes are clear.

7.4.3 The shaft is then chemically cleaned by running the shaft in a 400 mL beaker of Type II water, 250 mL Wheaton bottle of 1N nitric acid, 400 ml of Type II water, and rinsed with methanol from a 500 mL teflon squeeze bottle, and petroleum ether from a 500 mL teflon squeeze bottle.

7.4.4 Flesh samples require the addition of an equal weight of Type II water.

7.4.5 Homogenization is performed by inserting the polytron shaft into the sample material. Operate the polytron at the lowest speed possible to avoid heating the sample or spattering.

8.0 QUALITY CONTROL

8.1 Flesh samples are corrected for moisture loss. Dry the outside of the bottle with a Kimwipe and weigh the bottle with sample.
8.2 Determine the difference in the total weight at dissection and total weight just prior to homogenization. Add an equal weight of Type II water (plus any required for moisture correction).
8.3 The Sartorius balance and double beam balance are checked for accuracy with calibration weights.
8.4 Equipment Blanks: All equipment used in collection and preparation of samples is periodically checked for contamination. Before any new or different equipment is used it must be checked for contamination.
8.5 Sample Archive: All remaining sample homogenates and extracts are archived at -20° C for future analysis.
8.6 A record of sample transport, receipt and storage is maintained and available for easy reference.
8.7 All samples are prepared in a clean room to avoid airborne contamination.
8.8 A clean room blank is prepared at the beginning of each dissection session following standard clean room dissection and homogenization procedures. 50 g of Type II water is added to a chemically clean 250 mL Wheaton jar.

9.0 METHOD PERFORMANCE

9.1 Chemically cleaned instruments: Bard-Parker handles and blades, and tefzel forcep are dipped into the sample water.
9.2 An equal weight of Type II Milli- Q water is added and then polytroned to simulate normal sample procedure.

10.0 REFERENCES

10.1 U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, SW-486 Third Ed., Revision 1, December, 1987.

10.2 Guidance for Assessing Chemical Contaminant Data For Use In Fish Advisories. Volume 1. Fish Sampling and Analysis. 1993 EPA 823-R-93-002

Digestion And Analysis Of Trace Elements In Tissue Using Teflon Vessels

11.0 SCOPE AND APPLICATION

11.1 This procedure describes an acid pressure digestion using a closed Teflon vessel for the determination of: aluminum (Al); arsenic (As); cadmium (Cd); chromium (Cr); copper (Cu); iron (Fe); lead (Pb); manganese (Mn); mercury (Hg); selenium (Se); silver (Ag); tin (Sn); and zinc (Zn); flame (FAAS) and graphite furnace (GFAAS) atomic absorption spectrophotometry.

12.0 SUMMARY OF METHODS

12.1 Tissue samples are prepared for analysis by digesting with concentrated 4:1 nitric:perchloric acid in a Teflon vessel. Tissue samples are first heated on hot plate for five hours. Then caps are tightened and heated in vented oven at 130° C for four hours. The liquid digestate is diluted with Type II Milli-Q water to a final volume of 200.0 ml.

12.2 Tissue digestates are analyzed by GFAAS on a Perkin-Elmer Model 3030 Zeeman or by FAAS on a Perkin-Elmer Model 2280 for Ag, Al, As, Cu, Cd, Cr, Fe, Mn, Pb, Se, Sn, and Zn depending on concentration. Mercury is analyzed by cold vapor using the Perkin-Elmer Model 2280 for tissues.

12.3 The detection limits for this method are as follows:

Tissue	ug/g (ppm) wet
Aluminum	4.0
Arsenic	0.05
Cadmium	0.002
Chromium	0.02
Copper	0.03
Iron	0.03
Lead	0.02
Manganese	0.3
Mercury	0.01
Selenium	0.03
Silver	0.002
Tin	0.02
Zinc	0.02

13.0 METHOD PROCEDURES AND INTERFERENCES

13.1 Tissue Digestion

13.1.1 White plastic knives are used to aliquot 3 ± 0.1 g of homogenized tissue or 0.5 ± 0.02 g of an SRM into each Teflon vessel. Note: With each set of tissue, two replicates of two different SRM's and four blanks are analyzed. Reference materials are used with a matrix as close as possible to that of the samples. The blank Teflon vessels are left empty.

13.1.2 The Teflon vessel with sample is then reweighed and recorded.

13.1.3 Add 3.0 ml of 4:1 HNO_3:$HClO_4$ to the sample and the caps are loosely hand tightened.
13.1.4 The Teflon vessels are placed on a warm(65°C) hot plate in the hood for 5 hours to allow nitric fumes to vent in the hood prior to placement in the oven. Because hot plates often heat unevenly teflon vessels are rotated on the hot plates frequently.
13.1.5 The Teflon vessels are then removed from the hot plates. The caps are tightened with a capping station. The Teflon vessels are placed in 130°C oven for four hours. (Note: The Teflon vessels vent fumes in the oven therefore this needs to be done in a well vented hood). After four hours the oven is turned off and the samples allowed to cool overnight.
13.1.6 The next morning the Teflon vessels are removed from the oven. The caps are removed in the hood. Approximately 15 ml of Type II water are added to the Teflon vessels. The Teflon vessels are hand tightened and shaken. The solution is then quantitatively transferred to preweighed 30 ml HDPE bottles. The solution is taken to a total final weight of 20 g with Type II Milli-Q water.
13.1.7 Sample digestion and dilution steps should result in an extract that is clear and free of undissolved solid materials. If the sample solution is cloudy or has solid materials suspended in solution at the time of analysis, it is noted in the laboratory note book under a "comments" column.
13.1.8 Tissue samples can cause various problems, especially with GFAAS, due to the complex matrices involved. The matrix problems can be addressed by using standard reference materials and by using the method of standard additions.
13.1.9 Special care must be used in selecting the acid used for the digestion. Only redistilled HNO_3 and redistilled $HClO_4$ should be used because reagent grade acids are frequently contaminated with trace levels of metals, especially chromium. Prior to use all acids used in the digestion should be checked for contamination.

13.2 Direct aspiration flame AAS: Differences between the various makes and models of atomic absorption spectrophotometers prevent the formulation of detailed instructions applicable to every instrument, from being included in this document. Good laboratory practice is to have detailed instructions for the operation of each instrument kept with the instrument for the analyst to use during operation. These instructions should follow the manufacturer's operating instructions for a particular instrument. In general, after choosing the proper lamp for the analysis, allow the lamp to warm up for a minimum of 15 minutes, unless operated in a double-beam mode. During this period, align the instrument, position the monochronometer at the correct wavelength, select the proper monochronometer slit width, and adjust the current according to the manufacturer's recommendation. Some or all of these parameters may be done by the instrument automatically. Subsequently, light the flame and regulate the flow of fuel and oxidant. Adjust the burner and nebulizer flow rate for maximum percent absorption and stability. Balance the photometer. Run a series of standards of the element under analysis. Construct a calibration curve by plotting the concentrations of the standards against absorbances or have the data system construct it. Aspirate the samples and determine the concentrations, either directly or from the calibration curve. Standards must be run each time a sample or series of samples is run.

13.2.1 The most troublesome type of interference in atomic absorption spectrophotometry is usually termed "chemical", and is caused by lack of absorption of atoms bound in molecular combination in the flame. This phenomenon can occur when the flame is not sufficiently hot to dissociate the molecule, as in the case of phosphate interference with magnesium, or when the dissociated atom is immediately oxidized to a compound that will not dissociate further at the temperature of the flame. Addition of lanthanum will overcome phosphate interference in magnesium, calcium, and barium determinations. Similarly, silica interference in the determination of manganese can be eliminated by the addition of calcium.

13.2.2 Chemical interferences may also be eliminated by separating the metal from the interfering material. Although complexing agents are employed primarily to increase the sensitivity of the analysis, they may also be used to eliminate or reduce interferences.

13.2.3 The presence of high dissolved solids in the sample may result in an interference from nonatomic absorbance such as light scattering. If background correction is not available, a nonabsorbing wavelength should be used. Preferably, samples containing high solids should be extracted.

13.2.4 Ionization interferences occur when the flame temperature is sufficiently high to generate the removal of an electron from a neutral atom, giving a positively charged ion. This type of interference generally can be controlled by the addition, to both standard and sample solutions, of a large excess (1000mg/ L) of an easily ionized element such as K, NA, Li, and Cs.

13.2.5 Spectral interference can occur when an absorbing wavelength of an element present in the sample, but not being determined, falls within the width of the absorption line of the element of interest. Results of the determination will then be erroneously high, due to the contribution of the interfering element to the atomic absorption signal. Interference can also occur when resonant energy from another element in a multi-element lamp, or from a metal impurity in the lamp cathode, falls within the bandpass of the slit setting when that other metal is present in the sample. This type of interference may sometimes be reduced by narrowing the slit width.

13.2.6 Samples and standards should be monitored for viscosity differences that may alter the aspiration rate.

13.2.7 Some sample solutions may have solids suspended in them from incomplete digestion. These solids can plug the nebulizer tubing and slow or stop the aspiration of sample.

13.2.8 All metals are not equally stable in the digestate, especially if it contains only HNO_3, not HNO_3 and HCl. The digestate should be analyzed as soon as possible with preference given to Ag, Cd and Pb.

13.3 Furnace procedure - Furnace devices (flameless atomization) are the most useful means of extending detection limits. Because of differences between various makes and models of instruments, no detailed operating instructions can be given for each instrument in this document. Detailed operating instructions by the manufacturer of each instrument are kept with each instrument for the analyst to use during the analysis.

13.3.1 Although the problem of oxide formation is greatly reduced with furnace procedures because atomization occurs in an inert atmosphere, the technique is still subject to chemical interferences. Composition of the sample matrix can have a major effect on the analysis. It is those effects which must be determined and taken into consideration in the analysis of each different matrix encountered. To help verify the absence of matrix or chemical interference, the serial dilution technique may be used. Those samples which indicate the presence of interference should be treated in one or more of the following ways:

1) Successively dilute and reanalyze the samples to eliminate interferences.

2) Modify the sample matrix either to remove interferences or to stabilize the analyte. Examples are the addition of ammonium nitrate to remove alkali chlorides and the addition of ammonium phosphate to retain cadmium. The mixing of hydrogen with the inert purge gas has also been used to suppress chemical interference. Hydrogen acts as a reducing agent and aids in molecular dissociation.

3) Analyze the sample by method of standard additions while noticing the limitations of its use.

13.3.2 Gases generated in the furnace during atomization ion may have molecular absorption bands encompassing the analytical wavelength. When this occurs, use either background correction or choose an alternate wavelength. Background correction may also compensate for nonspecific broad-band absorption interference.

13.3.3 Continuum background correction cannot correct for all types of background interference. When the background interference cannot be compensated for, chemically remove the analyte or use an alternate form of background correction, e.g., Zeeman background correction.

13.3.4 Interference from a smoke-producing sample matrix can sometimes be reduced by extending the charring time at a higher temperature or utilizing an ashing cycle in the presence of air. Care must be taken, however, to prevent loss of the analyte.

13.3.5 Samples containing large amounts of organic materials should be oxidized by conventional acid digestion before being placed in the furnace. In this way, broad-band absorption will be minimized.

13.3.6 Anion interference studies in the graphite furnace indicate that, under conditions other than isothermal, the nitrate anion is preferred. Therefore, nitric acid is preferable for any digestion or solubilization step. If another acid in addition to HNO_3 is required, a minimum amount should be used. This applies particularly to hydrochloric and, to a lesser extent, to sulfuric and phosphoric acids.

13.3.7 Carbide formation resulting from the chemical environment of the furnace has been observed. Molybdenum may be cited as an example. When carbides form, the metal is released very slowly from the resulting metal carbide as atomization continues. Molybdenum may require 30 sec or more atomization time before the signal returns to baseline levels. Carbide formation is greatly reduced and the sensitivity increased with the use of pyrolytically coated graphite. Elements that readily form carbides are: Ba, Mo, Ni, and V.

13.3.8 For comments on spectral interference, see Paragraph 13.2.5

13.3.9 Cross-contamination and contamination of the sample can be major sources of error because of the extreme sensitivities achieved with the furnace. The sample preparation work area should be kept scrupulously clean. All glassware should be cleaned as directed earlier. Pipet tips are a frequent source of contamination. If suspected, they should be acid soaked with 1:5 HNO_3 and rinsed thoroughly with tap and Type II water. The use of a better grade of pipet tip can greatly reduce this problem. Special attention should be given to reagent blanks in both analysis and in the correction of analytical results. Pyrolytic graphite, because of the production process and handling, can become contaminated. As many as five to ten high-temperature burns may be required to clean the tube before use.

14.0 APPARATUS AND MATERIALS

14.0 APPARATUS AND MATERIALS

14.1 Hot plates: Low temperature(65°C)
14.2 Teflon Vessel: Savillex Teflon Digestion Vessel Part #561R2.
14.3 Capping Station: CEM Capping Station Part #920030.
14.4 Polyethylene High Density (HDPE) bottles: Nalgene part No. B7501-1, 30 ml polyethylene (HDPE) bottles.
14.5 Pipetors: Preferably all plastic/Teflon of various sizes from 1000uL to 5000uL with polyethylene tips. Do not use yellow pipet tips, they are commonly contaminated with cadmium.
14.6 Oven: Must be able to maintain 130° C for 12 hours. It is preferable to eliminate any metal in the interior of the oven to avoid potential contamination. It is also useful to have a programmable timer on the oven.
14.7 Atomic absorption spectrophotometer

14.7.1 FAAS Varian Spectra 300 with data system and Mark VI burners for air- and nitrous oxide-acetylene flames or a Perkin-Elmer Model 2280 spectrophotometer with deuterium arc background corrector and digital display.

14.7.2 GFAAS Perkin-Elmer Model 3030 spectrophotometer with Zeeman effect background correction, HGA-60 furnace controller, AS-60 autosampler, EDL power supply and PR-800 printer.

14.8 Hollow cathode lamps: Single-element lamps are used and are preferred over multi-element lamps which may be used occasionally. Electrodeless discharge lamps may also be used for certain elements.
14.9 Perkin-Elmer Graphite furnace parts:

Pyrolytic coated graphite tubes	091504
Pyrolytic coated graphite tubes(grooved)	109322
L'vov platforms	109324

14.10 Pressure-reducing valves: The supplies of fuel and oxidant should be maintained at pressures somewhat higher than the controlled operating pressure of the instrument by suitable valves. (See manufacturer's specifications.)

15.0 REAGENTS

15.1 Reagent grade chemicals, unless otherwise specified, shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.
15.2 Type II water (ASTM D1193): Use Type II water for the preparation of all reagents and as dilution water.
15.3 Nitric Acid (HNO_3), Concentrated Redistilled.
15.4 Perchloric Acid ($HClO_4$), Concentrated Redistilled.
15.5 Hydrofluoric Acid(HF), Concentrated Redistilled.

15.6 Boric Acid(H_3BO_3), 99.99% pure.
15.7 Boric Acid 2.5%. Add 2.5g 99.99% pure Boric Acid Dilute to final weight of 100g.
15.8 Nitric Acid (HNO_3). 1%. Prepare by adding 1 part acid per 100 parts Type II water.
15.9 Micro detergent (International Products)
15.10 HNO_3:$HClO_4$. 4:1 Four parts of concentrated nitric acid are added to one part concentrated perchloric acid.
15.11 Fuel and oxidant: Commercial grade acetylene is generally acceptable. Air may be supplied from a compressed air line, a laboratory compressor, or a cylinder of compressed air. Reagent grade nitrous oxide is also required for certain determinations. Standard commercially available argon and nitrogen are required for furnace work.
15.12 Stock standard metal solutions: Stock standard solutions are prepared from high purity metals, oxides, or nonhydroscopic reagent-grade salts, using Type II water and redistilled nitric or hydrochloric acids. (See individual methods for specific instructions.) Sulfuric or phosphoric acids should be avoided as they produce an adverse effect on many elements. The stock solutions are prepared at concentrations of 1,000 mg of the metal per liter. Commercially available standard solutions may also be used if standards from two different vendors are checked against one another and are in agreement. Standards available from the U.S. National Institute of Standards and Technology (NIST) are also acceptable and do not have to be verified. Where the sample viscosity, surface tension, and components cannot be accurately matched with standards, the method of standard additions may be used.
15.13 Calibration standards: For those instruments which do not read out directly in concentration, a calibration curve is prepared to cover the appropriate concentration range. Usually, this means the preparation of standards which produce an absorbance of 0.0 to 0.7. Calibration standards are prepared by diluting the stock metal solutions at the time of analysis. For best results, calibration standards should be prepared fresh each time a batch of samples is analyzed, or demonstrate that the standards are still good by comparing the standard absorbances with those of SRM 1643b "Trace Elements in Water". The expiration date on the SRM 1643b should be used to validate its use for this purpose. If the standards cannot be validated using the SRM 1643b then the following can be used as a guideline:

less than 0.1 ppm - prepare daily
0.1 to 1.0 ppm - prepare weekly
1.0 to 10 ppm - prepare monthly
10 to 100 ppm - prepare quarterly
100+ ppm - prepare yearly (at a minimum)

Prepare a blank and at least three calibration standards in graduated amounts in the appropriate range of the linear part of the curve. Calibration standards should be prepared using the same type of acid or combination of acids and at the same concentration as will result in the samples following processing, 1% HNO_3 (14 ml concentrated

HNO_3/L) for tissues. Beginning with the blank and working toward the highest standard, aspirate the solutions and record the readings. Repeat the operation with both the calibration standards and the samples a sufficient number (minimum of two) of times to secure a reliable average reading for each solution. Calibration standards for furnace procedures should be prepared as described on the individual sheets for that metal.

16.0 QUALITY CONTROL

16.1 All quality control data should be maintained and available for easy reference or inspection.

16.2 A calibration curve must be prepared at least twice each day (one at the beginning and one at the end of each set of samples) for each element analyzed with a minimum of a reagent blank and three standards. The calibration curve should be verified by the use of at least a reagent blank and one quality control check standard at or near the mid-range every 15 samples. Checks throughout the day must be within 20% of the original curve.

16.3 If 20 or more samples per day are analyzed, the working standard curve must be verified by running an additional standard at or near the mid-range every 10 samples. Checks must be within ± 20% of the true value.

16.4 Employ a minimum of one reagent blank per sample batch to determine if contamination or any memory effects are occurring.

16.5 At least one spiked matrix and one replicate sample should be run every 10 samples or per analytical batch, whichever is greater. At least one spiked replicate sample should also be run with each matrix type to verify precision of the method.

16.6 Where the sample matrix is so complex that viscosity, surface tension, and components cannot be accurately matched with standards, the method of standard addition may be used.

16.7 Method of standard additions - The standard addition technique involves adding known amounts of standard to one or more aliquots of the processed sample solution. This technique compensates for a sample constituent that enhances or depresses the analyte signal, thus producing a different slope from that of the calibration standards. It will not correct for additive interferences which cause a baseline shift.

16.8 Serial dilution - Withdraw from the sample two equal aliquots. To one of the aliquots add a known amount of analyte and dilute both aliquots to the same predetermined volume. (The dilution volume should be based on the analysis of the undiluted sample. Preferably, the dilution should be 1:4, while keeping in mind that the diluted value should be at least 5 times the instrument detection limit. Under no circumstances should the dilution be less than 1:1.). The diluted aliquots should then be analyzed, and the un-spiked results, multiplied by the dilution factor, should be compared to the original determination. Agreement of the results (within 10%) indicates the absence of interference. Comparison of the actual signal from the spike with the expected response from the analyte in an aqueous standard should help confirm the finding from the dilution analysis.

16.9 Dilute samples if they are more concentrated than the highest standard or if they fall on the plateau of a calibration curve.

16.10 Duplicates, spiked samples, standard reference materials, and check standards should be routinely analyzed.

16.11 Atomic absorption spectrophotometers (AAS) should be serviced on a regular basis by qualified technicians as part of a regularly scheduled preventive maintenance program.

16.12 A log book should be kept for each AAS that includes: Standard absorbances, photomultiplier voltages, detection limits, maintenance information, and any problems that might occur each time the instrument is used.

17.0 REFERENCES

17.1 Batelle Northwest. Unpublished Method. 439 W. Squim Bay Rd. Squim, Wa., 98382.

Analytical method for PCDD/PCDFs and Coplanar PCBs in fish tissue

18.0 SCOPE AND APPLICATION

18.1 The following analytical method is for the detection of PCDD/PCDFs and Coplanar PCBs in fish tissue.

19.0 SUMMARY OF METHOD

19.1 Samples were analyzed according to HML Method 880. In brief, wet fish tissues were kept frozen until time of preparation for extraction and clean-up. Fish tissues were transferred to freeze-drying flasks (Virtis) with liquid nitrogen (Liquid Carbonic), attached to a Virtis freeze mobile, and freeze-dried. Freeze-dried material was then transferred to 500 ml wide mouth teflon bottles. To each sample and blank, 150 ml of 9:1 hexane:methylene chloride were added and allowed to soak overnight. Fish tissues were then homogenized with a Brinkmann Polytron with approximately 15 g of sodium sulfate. Homogenization was completed when fish tissues were powdery in appearance. Internal standards were added to each sample. Fish tissues were then added to a 4.8 cm ID Kontes column containing 20 g of potassium silicate over 20 g of silica gel, with sodium sulfate added above and below the silicate and silica gel. Fish tissue residues were rinsed twice in 500 ml teflon bottles with 15 ml of 9:1 hexane:methylene chloride, then added to a Kontes column, followed by 50 ml of the same solvent mixture; drained under pressure through the carbon column. Eluants were collected as fraction 1.

19.2 Fifty milliliters of 20:80 hexane:methylene chloride were added to each carbon column via the reservoir. Eluants were collected as fraction 2.

19.3 The direction of flow was then reversed through the carbon columns and eluted with 50 ml of hot toluene. This was collected as fraction 3. Fractions 2 and fractions 3 were rotary evaporated to dryness. Each fraction 2 was applied in 1 ml hexane to a 10 ml pipet containing 1 cc potassium silicate over 2 cc 40% acid silica, with sodium sulfate above and below the silicate and silica. Three 1 ml hexane flask rinses were then added, followed by 8 ml of hexane. The clean-up procedure for fraction 3 was the same as for fraction 2, but instead of eluting with 8 ml of hexane, 16 ml of hexane was used. Fractions 2 and fractions 3 were then concentrated to approximately 1 ml using a Nitrogen-evaporator. The extracts were then transferred with appropriate rinsings to vials containing 200 pg of ^{13}C-labeled recovery standard and 8 ul of tetradecane. PCDD/Fs and PCBs 77, 126,169 were determined in fraction 3. PCBs 105, 118 were determined in fraction 2.

20.0 APPARATUS

20.1 The samples (Fractions 2 and 3) were analyzed by High

Resolution Gas Chromatography/ High Resolution Mass Spectrometry (HRGC/HRMS) (Varian 3400, Finnigan MAT 90) with a 60m, 0.25μm, DB-5 column, using a temperature program (220°C for 2 min, then 5°C/min to 260°C, followed by 1°C/min to 300°C). The MS operated in the EI mode (50 eV) with a 0.8 mA emission and a minimum resolution of 8000 amu.

21.0 DATA REPORTING

21.1 Analysis was conducted on freeze-dried material and the data converted to whole fish (fresh weight) using percent moisture content values provided by the Department of Fish & Games dissection and prep laboratory. Results are presented in units of pg/g (wet weight).

21.2 As specified in HML Method 880, if a congener concentration is below the detection limit, the detection limit is reported, flagged by an asterisk (*). When an flagged by the symbol "B" the analyte was detected above the detection limit, but below the quantitation limit. The symbol "I" indicates possible interference, and as such, the reported value represents a maximum value for that analyte. The symbol "L" indicates that an analyte detected in the sample was also detected in the blank, and that the amount in the sample was less than ten times the amount in the blank. The reported value is the upper limit of the concentration that could be in the sample when the blank is not subtracted. When the blank is subtracted, the corrected value is flagged by a "C". If a congener was not determined, the symbol "ND" is used. In the calculation of total congener concentrations, the symbol NA (not applicable) is used whenever a 2,3,7,8-substituted congener belonging to that congener group was "ND" or was flagged by "*", "B", "I" or "L", and would lead to erroneous calculations of total congener concentrations. All symbols are defined in the Data Base Description.

21.3 Toxic Equivalents (TEQs) were calculated on the basis of the International Toxic Equivalent Factors (I-TEF) (NATO, 1988). In addition, the proposed PCB Toxic Equivalents (Ahlborg *et al.*, 1994) were used to generate the PCB-TEQ. The I-TEFs and PCB-TEFs used for these calculations are shown in Section 20.3.1. In cases of flagged data, a conservative approach was taken, i.e., all flags were disregarded in the calculation of the TEQs, and as such, the calculated TEQs represent a maximum value. Whenever a congener is below the detection limit, one-half the detection limit is used in the I-TEQ calculations.

21.3.1 International Toxic Equivalency Factors (I-TEFs) for PCDD/PCDFs and WHO-sponsored TEFs for PCBs.

COMPOUND		TEF
3,3',4,4'-TCB	(PCB- 77)	0.0005
3,3',4,4',5-PeCB	(PCB-126)	0.1
3,3',4,4',5,5'-HxCB	(PCB-169)	0.01
2,3,3',4,4'-PeCB	(PCB-105)	0.0001

2,3',4,4',5-PeCB	(PCB-118)	0.0001
2,3,7,8 TCDD		1.0
1,2,3,7,8 PeCDD		0.5
1,2,3,4,7,8 HxCDD		0.1
1,2,3,6,7,8 HxCDD		0.1
1,2,3,7,8,9 HxCDD		0.1
1,2,3,4,6,7,8 HpCDD		0.01
1,2,3,4,6,7,8,9 OCDD		0.001
2,3,7,8 TCDF		0.1
1,2,3,7,8 PeCDF		0.05
2,3,4,7,8 PeCDF		0.5
1,2,3,4,7,8 HxCDF		0.1
1,2,3,6,7,8 HxCDF		0.1
2,3,4,6,7,8 HxCDF		0.1
1,2,3,7,8,9 HxCDF		0.1
1,2,3,4,6,7,8 HpCDF		0.01
1,2,3,4,7,8,9 HpCDF		0.01
1,2,3,4,6,7,8,9 OCDF		0.001

21.4 One method blank was analyzed with each of the four batches of samples. The highest background appeared in PCB 118 ranging from 35 to 200 pg/g. These background levels did not affect the measured levels of PCB 118 which ranged from 2200 to 31200 pg/g. Similarly, PCB 105 in the blanks ranged from 9 to 48 pg/g and did not affect the measured concentrations. Levels of 123478 HxCDF, 1233789 HpCDF and 1234678 HpCDF in the blanks two batches (flagged by "C") comprised the measurements of these two congeners. To remove this bias the background contamination measured in the blank was subtracted from each measurement.

22.0 QUALITY CONTROL

22.1 The effectiveness of a QA program is measured by the quality of data generated by the laboratory. Data quality is judged in terms of precision, accuracy and completeness.
22.2 Precision is the degree to which the measurement is reproducible and is determined by comparison of replicates. In the case of duplicates, the Relative Percent Difference (RPD) between the two samples may be used to estimate precision.

$$RPD = \frac{|D_1 - D_2|}{(D1 + D_2)/2} \times 100$$

where: RPD = relative percent difference
D_1 = first sample value
D_2 = second sample value (duplicate)

Two of the nineteen samples were analyzed as replicates in separate batches, i.e., processing and analysis performed on different days to capture the maximum variability of the system. Relative percent differences (RFD) ranged from less than 4% to 51% with an average of 23.5% for congeners above detection.

22.3 Accuracy is a determination of how close the measurement is to the true value. The determination of the accuracy of a measurement requires a knowledge of the true or accepted value for the signal being measured. With methods using isotope dilution, accuracy may be calculated in terms of percent recovery of the labeled internal standard added for each congener as follows:

$$\text{Percent Recovery} = \frac{\text{Measured value}}{\text{Amount of internal std}} \times 100$$

Percent recoveries of the internal standards were within the 40% to 120% window specified in the HML Method 880 and the USEPA SW-846 Method 8280. The only exception was encountered with the first batch of samples where slightly higher percent recoveries were attributed to a defective electronic board in the HRMS. External calibration confirmed the accuracy of the measurements.

22.4 Completeness- To be considered complete, the data must contain all QC check analyses verifying precision and accuracy for the analytical protocol. The percent completeness for each set of samples is calculated as:

$$\text{Completeness} = \frac{\text{Valid data obtained}}{\text{Total data planned}} \times 100$$

No samples or data were lost or invalidated and, therefore, the completeness of this study was 100%.

23.0 METHOD PERFORMANCE

23.1 Each batch of 4 to 6 samples was analyzed along with a method blank. Every other batch included one sample analyzed in duplicate. Precision was expressed as the Percent Relative Difference (RPD) and accuracy as the % recovery of the labeled internal standard. All samples were spiked with a mixture of all seventeen ^{13}C-labeled PCDD/PCDF and four PCB internal standards prior to clean up, and the final extract was made up in a tetradecane solution containing a mixture of three $^{13}C_6$-labeled recovery standards. The percent recovery of the internal standards was calculated relative to the recovery standards.

23.1.1 ^{13}C-labeled internal standards and $^{13}C_6$-labeled recovery standards are used with all samples.

^{13}C-3,3',4,4' TCB	(PCB #77)
^{13}C-3,3',4,4',5 PeCB	(PCB #126)
^{13}C-3,3',4,4',5,5' HxCB	(PCB #169)

^{13}C-2,3',4,4',5 PeCB (PCB #118)
^{13}C-2,3,7,8 TCDD
^{13}C-1,2,3,7,8 PeCD
^{13}C-1,2,3,4,7,8 HxCDD
^{13}C-1,2,3,6,7,8 HxCDD
^{13}C-1,2,3,7,8,9 HxCDD
^{13}C-1,2,3,4,6,7,8 HpCDD
^{13}C-1,2,3,4,6,7,8,9 OCDD
^{13}C-2,3,7,8 TCDF
^{13}C-1,2,3,7,8 PeCDF
^{13}C-2,3,4,7,8 PeCDF
^{13}C-1,2,3,4,7,8 HxCDF
^{13}C-1,2,3,6,7,8 HxCDF
^{13}C-1,2,3,7,8,9 HxCDF
^{13}C-2,3,4,6,7,8 HxCDF
^{13}C-1,2,3,4,6,7,8 HpCDF
^{13}C-1,2,3,4,7,8,9 HpCDF
^{13}C-1,2,3,4,6,7,8,9 OCDF

23.1.2 Recovery Standards

$^{13}C_6$-2,3,4,7,8 PeCDF
$^{13}C_6$-1,2,3,4,7,8 HxCDF
$^{13}C_6$-1,2,3,4,7,8,9 HpCDF

24.0 REFERENCES

24.1 Ahlborg UG, GC Becking, LS Birnbaum et al. Toxic equivalency factors for dioxin-like PCBs. Report on a WHO_ECEH and IPCSA consulation, December 1993. Chemosphere 28: 1049-1067, 1994.

24.2 Hazardous Materials Laboratory. Analysis of PCDD/PCDFs, Method 880, 1991.

24.3 NATO, Committee on the challenges of Modern Society. Pilot Study on International Information Exchange on Dioxins and Related Compounds. International Toxicity Equivalency Factor (I-TEF) Method of Risk Assessment for Complex Mixtures of Dioxins and Related Compounds, Report # 176, 1988.

ANALYSIS OF TRACE ORGANICS

25.0 SCOPE AND APPLICATION

25.1 The following method describes fish tissue analysis for the detection of PCBs, Pesticides and PAHs.

26.0 SUMMARY OF METHOD: TOF SOP #9302 rev 6/94

26.1 A 5 gram sample of tissue is extracted 2 times with 35 mL of methylene chloride using a Tekmar Tissumizer®. Prior to extraction, sodium sulfate and extraction surrogates are added to the sample and methylene chloride.
26.2 After combining the two extraction aliquots and a 10 mL rinse, the extract is divided into three portions; one quarter for lipid weight determination and one half for aromatic and chlorinated hydrocarbon (AH/CH) analysis. The remaining aliquot is set aside in the event that analysis is required separating the PCBs from the more polar pesticides.
26.3 The AH/CH portion is eluted through a silica/alumina column for pre-HPLC cleanup. One half of the AH/CH portion undergoes additional cleanup using size-exclusion High Performance Liquid Chromatography (HPLC/SEC) (TOF SOP #9321). The post-HPLC AH/CH fraction is concentrated to 125 μL using a combination of tube heater and nitrogen gas evaporation. This fraction is utilized for both CH and AH analysis as described below.
26.4 The AH/CH fraction is analyzed by capillary gas chromatography for chlorinated hydrocarbons utilizing an electron capture detector (GC/ECD; TOF SOP #9332). A single 2 μL splitless injection is directed onto two columns of different polarity (DB-17 & DB-5) to provide two dimensional confirmation of each analyte.
26.5 The AH/CH fraction is also analyzed by gas chromatography mass spectrometry (GC/MS) for aromatic hydrocarbons (TOF SOP #9333). A 2 μL splitless injection is chromatographed on a 0.25 i.d. x 60m DB-5ms column (J & W Scientific) and analyzed in a single ion monitoring (SIM) mode.
26.6 Quality Assurance measures include the use of dual column chromatography, calibration check solutions, inspection and verification of internal standard and surrogate recoveries. Tracking of analytical precision and accuracy is accomplished through the use of method duplicates and standard reference materials. Samples are extracted and analyzed in sets of 10-12. Standard Reference Materials and method blanks are analyzed with each analytical set. Method duplicates are analyzed at a frequency of one sample every other set.

27.0 QUALITY CONTROL

27.1 Accuracy - Certified Standard Reference Materials (SRM) are utilized to verify the accuracy of analytical methods. SRMs are analyzed at a minimum of once monthly, however when sufficient supplies are available one SRM sample is analyzed with each set of 10-12 samples.

27.1.1 Mussel Tissue SRM 1974a was purchased in January 1994 from the National Institute of Standards and Technology (NIST) through their Intercalibration Exercise Program as QA93TIS5 Mussel Tissue V. To date the official certificate of analysis has not been released from NIST, so this report has been generated using the consensus values from the 1993 intercalibration exercise.

27.1.2 Using the intercalibration consensus values and their standard deviations as confidence interval ranges, the results of the 8 SRM 1974a samples extracted for this project met the accuracy requirements outlined in the BPTCP Quality Assurance Project Plan (BPTCP QAPP). Accuracy control charts were generated for all analytes with values greater than 10 times the method detection limit (MDL).

27.2 Precision - SRMs and method duplicates are utilized to determine methodological precision. When available, one SRM is analyzed with every set of 10-12 samples. Method duplicates are analyzed with a frequency of one in 20-24 samples (i.e. 5%). Duplicates are scheduled in such a manner that they are not included in the same extraction set or analytical run.

27.2.1 SRM analyses showed acceptable precision for both PAHs and chlorinated organics. As outlined in the BPTCP QAPP, analytical precision is acceptable if duplicate analyses of SRMs yield replicate results with less than 30% relative standard deviation for analytes with certified values greater than 10x the MDL. Since the data set revealed extremely low PAH levels, SRM values were used to calculate precision estimates at both 5x MDL and 1x MDL.

27.2.2 Method duplicates also provide a strong analytical assurance in the precision of the reported data. The control criteria for the analysis of method duplicates is based on a relative percent difference (RPD) of less than 30% for analyte results greater than 10 times the MDL. Eighty percent of all analytes within an analytical class, i.e. PAHs or chlorinated organics, must meet this control criterion. For the purpose of creating control charts the analytes were divided into three main classes of compounds: PAHs, PCBs, and pesticides. Four of the sixty-six analyzed samples were treated as method duplicates to provide precision estimates for the reported data set. All of the chosen samples had chlorinated organics results which were greater than 10x MDL. No sample provided

PAH values greater than 10x MDL. The method duplicate precision results were considered acceptable with 99% of the 73 independent chlorinated organic measurements having RPDs of less than 30%.

27.3 Blanks - One procedural blank was analyzed with each set of 10-12 samples. While no analytical interference greater than or equal to the control limit of 3 times the MDL was found, naphthalene, 1-methyl naphthalene, and 2-methyl naphthalene were in many of the method blanks at levels similar to those reported in the samples. These low boiling semi-volatile are common laboratory contaminants. Considering the low PAH results obtained in the reported data set, all results less than 3x MDL, the reported naphthalene values may be significantly influenced by the laboratory contaminants.

27.4 Continuing Calibration Checks - Instrument calibration is verified every 10 - 16 hours to allow for the control of instrumental drift and resulting quantitation errors. The analysis of calibration check solutions must result in "recoveries" of 100 ± 25% and "mean % differences" (MPDs) for all analytes not to exceed ± 15% of expected. If any one analyte or the MPD of all analytes exceed these control limits the test fails and corrective action is taken.

27.4.1 Dilutions of certified NIST solutions were prepared and analyzed with each set of samples to verify instrumental calibration stability over the length of the analytical run. The PAH and Pesticide calibration solutions were prepared from NIST SRMs 2260 and 2261, respectively. The PCB calibration solutions were prepared from the NIST solution presently being certified; draft values were utilized for the generation of the PCB results.

27.4.2 Since the reported analyte list included many non-NIST analytes, we also analyzed our mid-level standards to augment the NIST derived calibration solutions and to provide calibration verification for compounds not found in these solutions.

27.4.3 PAH CCCs: The calibration checks resulting from each analytical set were in control for all analytes.

27.4.4 CH CCCs: Chlorinated Pesticides and PCBs. The calibration checks resulting from each analytical set were in control for most analytes. HCB, Heptachlor, and Aldrin revealed problems in our standards ability to attain values which were comparable to NIST Certified values. This problem affected no data in the reported data set and we are in the process of making new analytical standards. The calibration check procedures also highlighted an intermittent problem with the quantitation of gamma-HCH which was also not seen in either the field duplicates or the method duplicates of the affected sample.

Therefore, the calibration checks show that the analytical system was stable for all of the reported results.

28.0 METHOD PERFORMANCE

28.1 Analytical Method Validation - In the past, our laboratory has performed the bulk of our analyses through the fractionation of sample extracts by polarity. Previous analyses of bivalves from the San Francisco Bay led us to believe that biological samples from this region would be relatively uncomplicated and could be accurately analyzed in a single fraction. Therefore we proceeded with the current analyses using a single analytical fraction and an extended chromatographic program. In order to document if any consistent bias was introduced into the data set, a simple validation exercise was performed.

28.1.1 During the course of this project, 10% of the samples analyzed and 2 SRMs were subjected to a full fractionation procedure to determine if analytical bias was introduced into the data set by analyzing these samples in a single fraction. The results of this analysis revealed no consistent problems and indicate that fractionation is not necessary to produce acceptable results for the present analyte list in fish muscle from the geographical region studied.

28.2 Holding Time Verification - All samples met the holding time criterion of 40 days from extraction to analysis. CH analyses were performed within 9 ± 4 days while AH analyses were performed within 17 ± 6 days.

28.3 Surrogate Recovery Verification - All surrogate recoveries were well within the QA/QC criterion of 30 to 150%. Aromatic hydrocarbon surrogate recoveries ranged from 65 to 120% with d8-Napthalene showing the lowest recoveries. Chlorinated hydrocarbon surrogate recoveries ranged from 77 to 103%.

28.4 Completeness - The delivered samples were analyzed for all of the requested analytes. Therefore the completeness of this data set was 100%.

29.0 METHOD DETECTION LIMITS

29.1 Chlorinated Organic Pesticides and Their Wet Weight Detection Limits in Tissue

Analytes	Database Abbreviation	MDL, ng/g
Aldrin	ALDRIN	0.2
cis-Chlordane	CCHLOR	0.2
trans-Chlordane	TCHLOR	0.2
alpha-Chlordane	ACDEN	0.2

gamma-Chlordane	GCDEN	0.2
Chlorpyrifos	CLPYR	0.8
Dacthal	DACTH	0.2
o,p'-DDD	OPDDD	1
p,p'-DDD	PPDDD	0.6
o,p'-DDE	OPDDE	0.6
p,p'-DDE	PPDDE	0.2
p,p'-DDMS	PPDDMS	4
p,p'-DDMU	PPDDMU	1
o,p'-DDT	OPDDT	0.8
p,p'-DDT	PPDDT	0.8
p,p'-Dichlorobenzophenone	DICLB	5
Dieldrin	DIELDRIN	0.2
Endosulfan I	ENDO_I	0.2
Endosulfan II	ENDO_II	0.6
Endosulfan sulfate	ESO4	1
Endrin	ENDRIN	1.2
alpha-HCH	HCHA	0.2
beta-HCH	HCHB	0.6
gamma-HCH	HCHG	0.2
delta-HCH	HCHD	0.4
Heptachlor	HEPTACHLOR	0.2
Heptachlor Epoxide	HE	0.2
Hexachlorobenzene	HCB	0.2
Methoxychlor	METHOXY	3
Mirex	MIREX	0.2
cis-Nonachlor	CNONA	0.2
trans-Nonachlor	TNONA	0.2
Oxychlordane	OCDAN	0.2
Toxaphene	TOXAPH	20

29.2 NIST PCB Congeners and Their Wet Weight Detection Limits in Tissue

NIST PCB Analytes	Database Code	MDL,ng/g
2,4'-dichlorobiphenyl	PCB8	0.2
2,2',5-trichlorobiphenyl	PCB18	0.2
2,4,4'-trichlorobiphenyl	PCB28	0.2
2,2',3,5'-tetrachlorobiphenyl	PCB44	0.2
2,2',5,5'-tetrachlorobiphenyl	PCB52	0.2
2,3',4,4'-tetrachlorobiphenyl	PCB66	0.2
2,2',3,4,5'-pentachlorobiphenyl	PCB87	0.2
2,2',4,5,5'-pentachlorobiphenyl	PCB101	0.2
2,3,3',4,4'-pentachlorobiphenyl	PCB105	0.2

2,3',4,4',5-pentachlorobiphenyl	PCB118	0.2
2,2',3,3',4,4'-hexachlorobiphenyl	PCB128	0.2
2,2',3,4,4',5'-hexachlorobiphenyl	PCB138	0.2
2,2',4,4',5,5'-hexachlorobiphenyl	PCB153	0.2
2,2',3,3',4,4',5-heptachlorobiphenyl	PCB170	0.2
2,2',3,4,4',5,5'-heptachlorobiphenyl	PCB180	0.2
2,2',3,4',5,5',6-heptachlorobiphenyl	PCB187	0.2
2,2',3,3',4,4',5,6-octachlorobiphenyl	PCB195	0.2
2,2',3,3',4,4',5,5',6-nonachlorobiphenyl	PCB206	0.2
2,2',3,3',4,4',5,5',6,6'-decachlorobiphenyl	PCB209	0.2

29.3 Additional PCB Congeners and Their Wet Weight Detection Limits in Tissue

PCB Analytes	Database Code	MDL, ng/g
2,3-dichlorobiphenyl	PCB5	0.2
4,4'-dichlorobiphenyl	PCB15	0.2
2,3',6-trichlorobiphenyl	PCB27	0.2
2,4,5-trichlorobiphenyl	PCB29	0.2
2,4',4-trichlorobiphenyl	PCB31	0.2
2,2,'4,5'-tetrachlorobiphenyl	PCB49	0.2
2,3',4',5-tetrachlorobiphenyl	PCB70	0.2
2,4,4',5-tetrachlorobiphenyl	PCB74	0.2
2,2',3,5',6-pentachlorobiphenyl	PCB95	0.2
2,2',3',4,5-pentachlorobiphenyl	PCB97	0.2
2,2',4,4',5-pentachlorobiphenyl	PCB99	0.2
2,3,3',4',6-pentachlorobiphenyl	PCB110	0.2
2,2',3,3',4,6'-hexachlorobiphenyl	PCB132	0.2
2,2',3,4,4',5-hexachlorobiphenyl	PCB137	0.2
2,2',3,4',5',6-hexachlorobiphenyl	PCB149	0.2
2,2',3,5,5',6-hexachlorobiphenyl	PCB151	0.2
2,3,3',4,4',5-hexachlorobiphenyl	PCB156	0.2
2,3,3',4,4',5'-hexachlorobiphenyl	PCB157	0.2
2,3,3',4,4',6-hexachlorobiphenyl	PCB158	0.2
2,2',3,3',4,5,6'-heptachlorobiphenyl	PCB174	0.2
2,2',3,3',4',5,6-heptachlorobiphenyl	PCB177	0.2
2,2',3,4,4',5',6-heptachlorobiphenyl	PCB183	0.2
2,3,3',4,4',5,5'-heptachlorobiphenyl	PCB189	0.2
2,2',3,3',4,4',5,5'-octachlorobiphenyl	PCB194	0.2
2,2',3,3',4,5',6,6'-octachlorobiphenyl	PCB201	0.2
2,2',3,4,4',5,5',6-octachlorobiphenyl	PCB203	0.2
AROCLOR1248		6
AROCLOR1254		2
AROCLOR1260		2

29.4 Wet Weight Detection Limits of Polychlorinated Terphenyls in Tissue

Analyte	Database Code	MDL,ng/g
Polychlorinated Terphenyl Aroclor 5460	ARO5460	20

29.5 Polycyclic Aromatic Hydrocarbons and Their Wet Weight Detection Limits in Tissue

Analyte	Database Code	MDL, ng/g
Naphthalene	NPH	2
2-Methylnaphthalene	MNP2	2
1-Methylnaphthalene	MNP1	2
Biphenyl	BPH	2
2,6-Dimethylnaphthalene	DMN	2
Acenaphthylene	ACY	2
Acenaphthene	ACE	2
2,3,5-Trimethylnaphthalene	TMN	2
Fluorene	FLU	2
Phenanthrene	PHN	2
Anthracene	ANT	2
1-Methylphenanthrene	MPH1	2
Fluoranthene	FLA	2
Pyrene	PYR	2
Benz[a]anthracene	BAA	2
Chrysene	CHR	2
Benzo[b]fluoranthene	BBF	2
Benzo[k]fluoranthene	BKF	2
Benzo[e]pyrene	BEP	2
Benzo[a]pyrene	BAP	2
Perylene	PER	2
Indo[1,2,3-cd]pyrene	IND	3
Dibenz[a,h]anthracene	DBA	3
Benzo[ghi]perylene	BGP	3

30.0 AROCLOR ANALYTICAL METHODS

30.1 All SO data is acquired and analyzed using a Hewlett-Packard DOS based ChemStation system.

30.2 Instruments are calibrated with PCB congener standards prepared from neat materials in house. The calibration range is approximately 0.001 - 500 pg/uL per component.

30.3 Previously, a compositional analysis was performed on all in house Aroclor mixtures providing conversion factors for PCB congener concentrations to Aroclor concentrations.

30.4 Aroclor 1260 values were generated from congeners 194, 195, 201 and 203.

30.5 Aroclor 1248 values were generated from congeners 18, 31, and 28.

30.6 After correcting for positive biases due to calculated values of Aroclor 1260 and/or Aroclor 1248, Aroclor 1254 is quantitated from congeners 99, 118, 128, and 138.

30.7 In all cases the mean value of the listed congeners is considered valid and reported if the associated relative standard deviation is less than 50%. The values generated by this approach compared well with values calculated using classical approaches, as shown by in house tests and round robin exercises with the CDFG Water Pollution Control Laboratory in Rancho Cordova.

30.8 Quality assurance associated with this analysis consisted of precision measurements through the analysis of samples in duplicate. Certified Aroclor values are not available for the SRM utilized during this project.

APPENDIX IV
CRUISE REPORT

CRUISE REPORT FOR THE
SAN FRANCISCO BAY HEALTH RISK ASSESSMENT STUDY

Sampling for the San Francisco Bay Fish Health Risk Assessment Study began on **Monday, 5-2-94**. The sampling crew mobilized from Moss Landing and arrived at the Redwood City Marina at 1130. The boat (18' Boston Whaler) was launched and equipment set up for otter trawls (1 1/4" size nylon stretch mesh), with the crew under way by 1300. The crew for the day consisted of Karen Taberski (RWQCB), Russell Fairey (CDFG) and Eric Johnson (CDFG). The initial sampling site was **24002.0 Dumbarton Bridge Pier**. Weather conditions were clear but windy with waves hindering sampling work. Approximately eight-fifteen minute otter trawls were made within one mile of the pier. Fifteen white croaker were selected from the trawls and grouped to three size class composites (five fish each). A fourth composite of five shiner surfperch was also collected. Gravid female surfperch were abundant in the trawls but were selectively excluded from the composites at this and all subsequent sites. Total length for the croaker ranged from 157-286 mm and from 102-157 mm for the surfperch. All composites were stored in teflon and frozen on dry ice. Sampling was concluded and the boat trailered by 1900.

Tuesday, 5-3-94 Sampling was begun at 0730 with the boat being launched from the Coyote Point Marina. The crew for the day consisted of Karen Taberski (RWQCB), Russell Fairey (CDFG) and Eric Johnson (CDFG). Weather conditions were clear, but windy, with waves hindering sampling work. Approximately 600' of trammel net (2 outer panels with 18" & one inner panel with 8" nylon stretch mesh size) was deployed 2 miles north of the San Mateo Bridge in an effort to capture sharks from the southern region of S.F. Bay. After the trammel net deployment, approximately six fifteen minute otter trawls were done within one mile of the site **24001.0 San Mateo Bridge Pier**. Fifteen white croaker were selected from the trawls and grouped to three size class composites (five fish each). A fourth composite of twenty shiner surfperch was also collected. Gravid female surfperch were abundant in the trawls but were selectively excluded from the composites. Total length for the croaker ranged from 154-254 mm and from 103-136 mm for the surfperch. A single halibut (660 mm) was captured in one of the trawls and saved for a composite of this species. After concluding work at the San Mateo Bridge Pier site, the crew returned to the Dumbarton Bridge Pier to collect additional shiner surfperch. This was deemed necessary to insure sufficient fish tissue available from these small species for all chemical analysis. Three trawls were needed to obtain the fifteen fish required to make a total composite of twenty, counting the five fish from the previous day. The crew returned to the trammel nets north of the San Mateo Bridge and collected one leopard shark (1194 mm) and two halibut(660 & 953 mm) during retrieval. Approximately eighty bat rays were also captured in the nets but released since they were not a target species. The halibut caught during the day were subsampled to make a south Bay composite of three. All composites were stored in teflon and frozen on dry ice. Sampling was concluded and the boat trailered by 1930.

Wednesday 5-4-94 Sampling personnel included Eric Johnson (CDFG) and Stewart Lamerdin (CDFG) and James Sundu (RWQCB). The Whaler was launched from the Oyster Point Marina at 0730 hrs. The sampling crew proceeded to site # **24007.0 Double Rock (Candlestick)**. The trammel net was set at 4 meters depth across the center of the small bay at this site prior to trawling. Approximately seven otter trawls were conducted between 3 and 10 meter depth at the site yielding 3 composites of white croaker and one composite of shiner surfperch. Total length for the croaker ranged from 165-254 mm and from 105-147mm for the surfperch. The trammel net was set for 2 hours and yielded no target species though bat rays and a sublegal halibut were captured.

After completing site 24007.0, the sampling crew proceeded to site# **24008.0 Islais Creek**. Prior to sampling at site 24008.0, the sampling crew set a 300 ft. trammel net in a small bay off the northeast corner of the San Francisco Airport at 2.5 meters depth. Approximately 10 trawls were conducted at site 24008.0 between 11 and 15 meters depth, yielding 3 composites of white croaker and 1 composite of shiner surfperch. Total length for the croaker ranged from 161-229 mm and from 106-116 mm for the surfperch. The trammel net off San Francisco yielded 1 leopard shark (1321 mm). Also captured were 15 bat rays and 2 legal halibut, all which were released. The trammel net was reset in this same location, and checked again at the completion of collection at site 24008.0. This second trammel net set yielded a leopard shark (1219 mm) and approximately 10 bat rays.

The sampling crew proceeded back to Oyster Point Marina, arriving at 1930 hrs. Fish samples were prepared and all composites were stored in teflon and frozen on dry ice. The sampling crew departed Oyster Point Marina at 2300 hrs.

Thursday, 5-5-94 Sampling was begun at 0830 with the boat being launched from Pier 56 launch ramp in San Francisco. The crew for the day consisted of Russell Fairey (CDFG) and Eric Johnson (CDFG). The sampling crew proceeded to **24013.0 San Francisco Pier #7**. Weather conditions were clear, but windy. This in conjunction with very strong tide movement made trawling ineffective, so work at this station was ended and the crew moved across the Bay to **24009.0 Oakland Middle Harbor Pier**. Approximately 10 trawls were conducted at site 24009.0 between 4 and 10 meters depth, yielding 3 composites of white croaker and 1 composite of shiner surfperch. Total length for the croaker ranged from 166-242 mm and from 98-147 mm for the surfperch. After completion of this site, the crew returned to sample the 24013.0 San Francisco Pier #7 site. A 300' gill net (2 1/2" monofilament mesh) was deployed and several trawls were attempted. No fish were caught in the trawls so hook and line was attempted. Again, no fish were caught. The gill net was retrieved and 4 croaker (251-305 mm) were captured. The crew again attempted trawling this site, after dark, without success, so the crew returned to the launch ramp. Fish samples were prepared and all composites were stored in teflon and frozen on dry ice. The sampling crew departed the Pier #56 launch ramp at 2200 hrs.

Friday, 5-6-94 Sampling was begun at 0730 with the boat being launched from the Alameda launch ramp and the crew proceeding to **24006.0 Oakland Harbor (Fruitvale)**. The crew for the day consisted of Russell Fairey (CDFG) and Eric Johnson (CDFG). Weather conditions were windy and cloudy with heavy rain at times.

Several otter trawls were made with the only species captured being three composites of shiner surf perch. The gill net was set for two hours and six legal size striped bass (460-501 mm) and three sublegal striped bass (370-375 mm) were captured. Three of the intermediate sized legal striped bass (460-468) were selected for the fourth composite at this site. The remainder were used for two composites of the separate striped bass samples. Fish samples were prepared and all composites were stored in teflon and frozen on dry ice. The sampling crew departed the Alameda launch ramp at 1700 hrs.

Saturday, 5-7-94 This date was the scheduled interagency cooperative sampling effort involving CDFG, SWRCB, DHS and SAFER. Several representatives from each government group were present at the **24003.0 Fremont Forebay** site to assist private fisherman from SAFER with the handling of hook and line caught fish. Approximately twenty fisherman began fishing at 0830 from the bank of the forebay. Weather conditions were cloudy and rainy with excessive freshwater runoff entering the forebay. Fishing continued until 1430 with only two immature striped bass being caught in that time period. Lack of success brought an early end to this effort and plans were made to return at a later date and sample this site with gill nets and trammel nets.

Monday, 5-9-94 Sampling was begun at 1030 with the boat being launched from Pier 56 launch ramp in San Francisco. The crew for the day consisted of Russell Fairey (CDFG) and Eric Johnson (CDFG). The sampling crew proceeded to **24013.0 San Francisco Pier #7** and set the 300' gill net. The crew then proceeded across the Bay to just north of the Berkeley Fishing Pier and set the 300' trammel net. Trawls were begun at **24005.0 Berkeley Pier** with the only species captured being three composites of shiner surf perch (100-150 mm). The crew returned to the Pier #7 site and retrieved the gill net capturing three composites of white surf perch (219-280 mm) and one white croaker (279 mm). These fish along with those caught on 5-5-94 were enough to complete sampling at the Pier #7 site. The crew trailered the boat across the Bay and launched again at the Berkeley Marina. The crew returned to the Berkeley Pier and deployed the 300' gill net. The trammel net which was deployed earlier in the day was retrieved next, though only bat rays were captured. The trammel net was moved to deeper water, near Treasure Island, and redeployed. The trammel was checked after one hour and one leopard shark (1143 mm) was caught. The trammel was deployed again at the same location and the crew returned to the gill net at Berkeley Pier where six brown smoothhound sharks were captured. Three of the smaller sharks (457-508 mm) were used as composite #4 at the Berkeley Pier and the larger three (686-711) were used as composite #2 of the Mid-Bay Sharks. Weather conditions deteriorated and the crew was unable to return to the trammel net set at Treasure Island due to rough water. The crew returned to the marina and fish samples were prepared. All composites were stored in teflon and frozen on dry ice. The sampling crew departed the Berkeley Marina launch ramp at 2200 hrs.

Tuesday, 5-10-94 The sampling crew of Russell Fairey (CDFG) and Eric Johnson (CDFG) launched from the Berkeley Marina at 0800 and retrieved the trammel net from the overnight deployment at Treasure Island. The net was heavily fouled with algae and required several hours to retrieve and clean. One leopard shark (1259 mm) was caught as well as a legal halibut which was released. The crew then returned to the launch ramp and trailered to the Richmond Marina. The boat was launched and sampling was begun at **24004.0 Richmond Harbor** at 1230. Weather conditions were clear, but windy. The gill net and trammel net were set and then several trawls were made. Shiner surf perch were the only species caught in the trawls so three composites were taken (100-161 mm). The gill net was retrieved and three brown smoothhounds were caught to make the fourth composite (559-711 mm). The trammel net was retrieved and one legal sized halibut was captured and released. The crew returned to the marina and fish samples were prepared. All composites were stored in teflon and frozen on dry ice. The sampling crew departed the Richmond Marina at 2000 hrs.

Wednesday, 5-11-94 The sampling crew of Russell Fairey (CDFG) and Eric Johnson (CDFG) launched from the Richmond Marina at 0800 and traveled north to **24010.0 Point Molate**. Weather conditions were clear and slightly windy. The gill net was deployed in 2-4 meters of water and then the crew moved north into San Pablo Bay and deployed the 300' trammel net. The crew returned to Point Molate and made several trawls capturing numerous white croaker and a legal halibut. The gill net was retrieved with a catch of white croaker, brown smoothhounds and walleye surf perch.

Three composites of white croaker were selected and the walleye surf perch were chosen for the fourth composite. Two composites of brown smoothhounds were chosen for north Bay shark samples. The crew retrieved the trammel net from San Pablo Bay and found no fish captured, so the trammel was redeployed at the Point Molate site. The crew used hook and line for approximately one hour at Point Molate, catching one Leopard Shark (1346 mm).

At approximately 1500 hrs. Russell Fairey left and James Downing arrived. The sampling crew, now Eric Johnson and James Downing, returned to sampling at site #24010.0 Point Molate to complete sampling. Concurrent trammel net sets at 12 to 14 meters depth yielded 1 additional leopard shark (1247 mm). The sampling crew proceeded back to the Richmond Marina at 2000 hrs. Fish samples were prepared at the marina and placed in dry ice. The sampling crew departed at 2145 hrs.

Thursday, 5-12-94 The sampling crew consisted of Eric

Johnson and James Downing. The Rodeo public launch ramp was dry with the low tide, thus the boat was launched from a public launch ramp in Vallejo and proceeded to the **24011.0 RODEO** site. Otter trawls were initiated in several areas with no yield of target species, so both trammel and gill nets were set. The trammel net was set in 8 meters depth while the gill net was set at 4 meters depth. A total of 12 otter trawls were completed yielding no target species. The trammel net was set for four hours and yielded nothing. It was then reset near the "Mothball Fleet" at 7 meters depth for 3 hours. This set also yielded nothing. The gill net was set for 3 hours and yielded 10 white croaker and 12 brown smoothhounds. The net was reset in the same location for 2 hours yielding 8 white croaker and 15 brown smoothhounds. This site yielded 3 composites of white croaker (270-340 mm) and one composite of brown smoothhound (470-559 mm). After completing the composites for this site, the sampling crew proceeded to site **24012.0 Martinez Pier/ Suisin** and conducted otter trawls there between approximately 1700 and 1900 hours yielding no target species. The sampling crew returned to the public launch at Vallejo at 2030 hours. Fish samples were prepared at the launch in Vallejo and placed in dry ice. The sampling crew departed at 2200 hours.

Friday, 5-13-94 The sampling crew attempted to launch out of Benecia but the boat launch was dry. Thus the boat was launched from the Martinez public boat launch at 0945 hours and the sampling crew proceeded to the **24012.0 Martinez Pier/ Suisin** site. Both the 300 ft. trammel and the 300 ft. gill nets were set in or near the shallow bench just adjacent and west of the harbor. Four otter trawls were also conducted in this area. All yielded nothing. Sampling was then shifted to the other side of the Carquinez Straits Bridge where the water averaged a shallower depth. Two 150 ft. trammel nets, a 300 ft. trammel net, and a 300 ft. gill net were set around the "Mothball Fleet". These nets were allowed to fish while otter trawls were conducted (approximately 3 hours). The net sets and otter trawls yielded no target species. Interviews with locals on the pier and at the bait shop suggest that croaker, perch, smelt and shark are not commonly caught at this location. The only potential catch at this location is striped bass and sturgeon, neither of which appeared to be there at that time. Sampling was terminated at this site with no target species captured.

Saturday, 5-14-94 The sampling crew on this date was Eric Johnson and Stewart Lamerdin. The boat was launched from the public launch ramp in Sausalito at 0930. The boat proceeded to the paradise cove area and set 2-150' trammel nets, a 300' trammel net, and a 300' gill net proceeding progressively towards the San Rafael Bridge. The trammel nets were set between 7 and 11 meters depth, while the gill net was set in 4 meters of water. After two hours the trammel nets yielded 2 sublegal sturgeon, a bat ray, and two sublegal halibut. The two small trammel nets were reset in the original area while the large trammel net was reset in the Pt. Molate area to capture the final north Bay shark. Hook and line fishing was also used while the net was set to capture a large shark. The hook and line fishing and trammel netting yielded only three spiny dogfish. The two small trammel nets were retrieved after two hours and yielded 5 sublegal sturgeon, 2 sublegal and 2 legal halibut, and a long nosed skate. The gill net was retrieved after approximately 5.5 hours yielding white croaker, brown smoothhound sharks and sublegal striped bass. Three brown smoothhounds (635-711 mm) were used as the third composite of Mid Bay Sharks. The boat was loaded on the trailer at Sausalito at 1545 hours and was trailered to Coyote Point Launch Facility to attempt to catch the remainder of the South Bay Shark samples. The boat was launched at 1800 hours and proceeded 0.5 miles south from the harbor to a shallow mud flat area. A 300' gill net was set in 3 meters depth there and fished for 2.5 hours. this set yielded a composite of brown smoothhound sharks (457-584 mm), a composite of medium sized leopard shark (660-813 mm), the final large leopard shark (1219 mm) needed to complete the large composite and 3 striped bass (477-486 mm). The fish were prepared and placed on dry ice. The boat was placed on the trailer and the crew departed at 2200 hours.

Friday, 5-20-94 This field day was used to re-sample **24003.0 FREMONT FOREBAY**. The sampling crew for the day was Russell Fairey, Eric Johnson, James Downing and Lisa Kerr. This area is inaccessible by boat so nets were set by the sampling crew swimming them into position across narrow channels. High tide was at approximately 1030 hrs. and a 300' gill net and a 300' trammel were set during slack tide. The nets fished throughout the out-going tide and were retrieved during slack low tide. The trammel net caught no target species. The gill net caught numerous sublegal striped bass and three composites were selected (356-445 mm). A fourth composite was selected from striped bass (343-381 mm) exhibiting large open wound lesions along their sides. Sampling was concluded and the crew departed by 1700 hrs. Samples were transported to the Moss Landing lab, prepared and frozen.

Wednesday, 5-25-94 The sampling crew consisting of Eric Johnson and Stewart Lamerdin left Moss Landing Marine Laboratories at 1230 hrs. and arrived at the Vallejo Public Launch at 1525 hrs. The Mare Island Strait was surveyed for potential trawl and net set sites until 1630 hrs. A 300' gill net and a 300' trammel net were set at 1645 hrs. in the channel north of the fishing pier and main bridge at 5 meters depth. Several trawls were conducted during the 2 hrs. that the nets were set yielding only shrimp and anchovies. While the trammel net yielded nothing, the gill net yielded 2 white croaker and approximately 10 sublegal striped bass. The nets were reset at 1930 hrs. and retrieved at 2130 hrs. Again the trammel net was empty, while the gill net yielded 6 white croaker and several striped bass including one of legal size. The gill net was reset and left for the night. The sampling crew left at 2300 hrs.

Thursday, 5-26-94 The sampling crew met Karen Taberski of the SRWQCB at 0900 hrs. at the Vallejo Public Launch. The boat proceeded to the net which was left overnight and retrieved it at 1015 hrs. This set yielded approximately 12 white croakers, 25 striped bass of which 2 were legal size, 6 brown smoothhounds, and a very small sturgeon. The crew returned to shore, prepped the fish samples (3 composites white croaker and one composite striped bass), and placed the samples in dry ice. The crew then departed Vallejo for Richmond at 1215 hrs. The crew arrived at Richmond Public Launch at 1310 hrs. and proceeded to untangle and clean three trammel nets which were fouled quite badly. After cleaning the nets were reloaded nd the boat proceeded to Pt. Molate to attempt to capture the last large leopard shark for the North Bay composite. The nets were set at Pt. Molate from 1600 to 1830 hrs. The trammel nets yielded 7 large brown smoothhounds. As the wind was quite strong and the water choppy, the crew retired for the day and left at 1930 hrs.

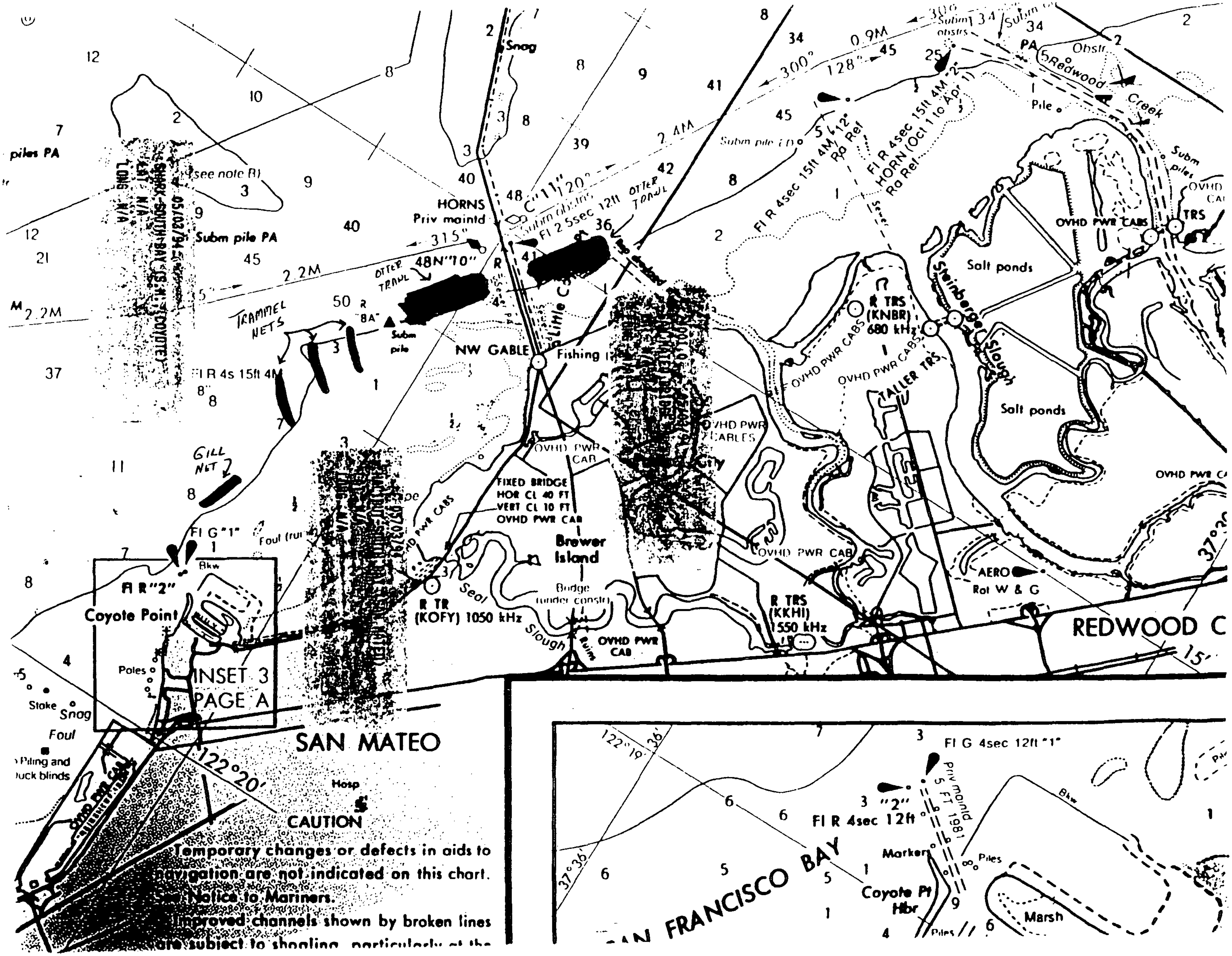
Friday, 5-27-94 Wardens of the CDF&G had obtained the remnants of a legal sized leopard shark from a local commercial fisherman and placed this in the freezer of the patrol boat "Albacore" in the Berkeley Marina. Wardens of this vessel were contacted agreeing to meet prior to 0930 hrs to deliver the sample. When the sample crew arrived at 0900 hrs. the vessel had already left. The wardens were contacted via cellular phone and agreed to meet between 1500 and 1700 hrs. The sampling crew left for Richmond at 1015 hrs. and arrived at the Richmond Public Launch facility at 1100 hrs. The boat proceeded to the area beyond Pt. San Pablo to set nets along the edge of the channel to the north of Castro Cove. Three trammel nets were set around the "4" red day mark from 1145 to 1400 hrs. The nets yielded several brown smoothhounds and a California bat ray. The nets were then reset in the same place from 1445 to 1745 hours. The set yielded several brown smoothhounds and 1 legal leopard shark, completing the North Bay shark composite. The sampling crew prepared the shark and returned to Berkeley to pick up the shark sample from the "Albacore". The crew then left for Benecia arriving at 2100 hrs.

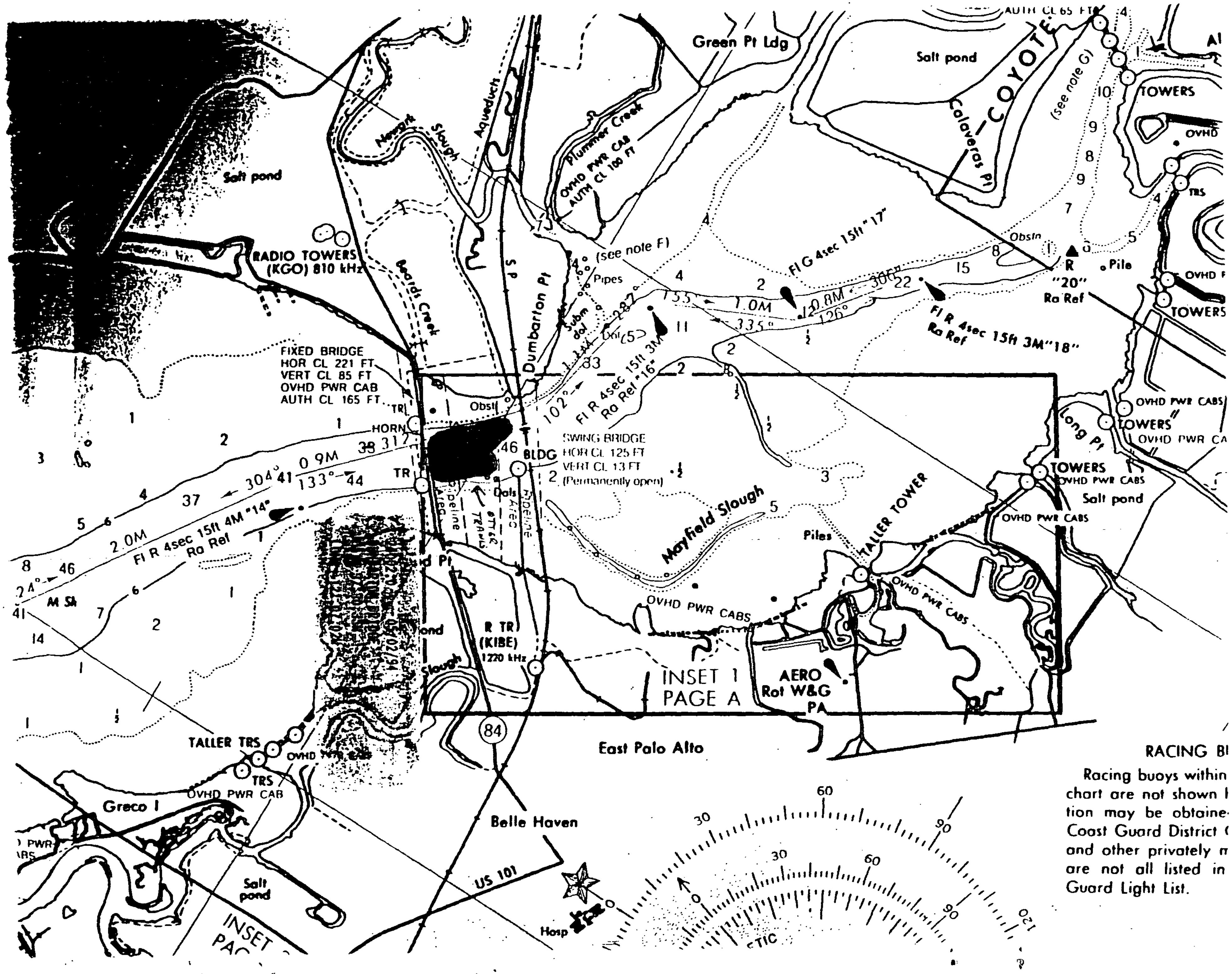
Saturday, 5-28-94 The sampling crew left Benecia for Martinez, arriving at 0945 hrs. The boat proceeded from Martinez toward Roe and Ryer Islands in Suisun Bay. Three trammel nets were set; one between the islands, one off Garnet Pt. of Ryer Is., and one in the entrance to Montezuma Slough. These were left from 1030 to 1230 hrs. and yielded nothing. The nets were reset with: one in deeper water off Garnet Pt., one approximately 0.5 miles up Montezuma Slough and one 0.25 mi. up Suisun Slough. These yielded a 53" and a 46" sturgeon. The nets were set again with two nets in deeper water off Garnet Pt. and one near the entrance to Suisun Slough. These were retrieved after two hrs. yielding a 43" sturgeon. The fish were packed in ice and the crew departed Martinez for Moss Landing Marine Laboratories, arriving at 2200 hrs. The fish were prepped and placed in the freezer and the crew left at 2345 hrs.

Wednesday, 6-8-94 Eric Johnson left Moss Landing Marine Laboratories at 1530 hrs. for Sacramento to obtain a composite of "large" striped bass. These fish were collected the same day in traps in the Sacramento river near Knights Landing by a CDF&G biologist. The fish were transported on ice to Moss Landing, then prepared and frozen. Eric was finished with the collection phase at 2230 hrs.

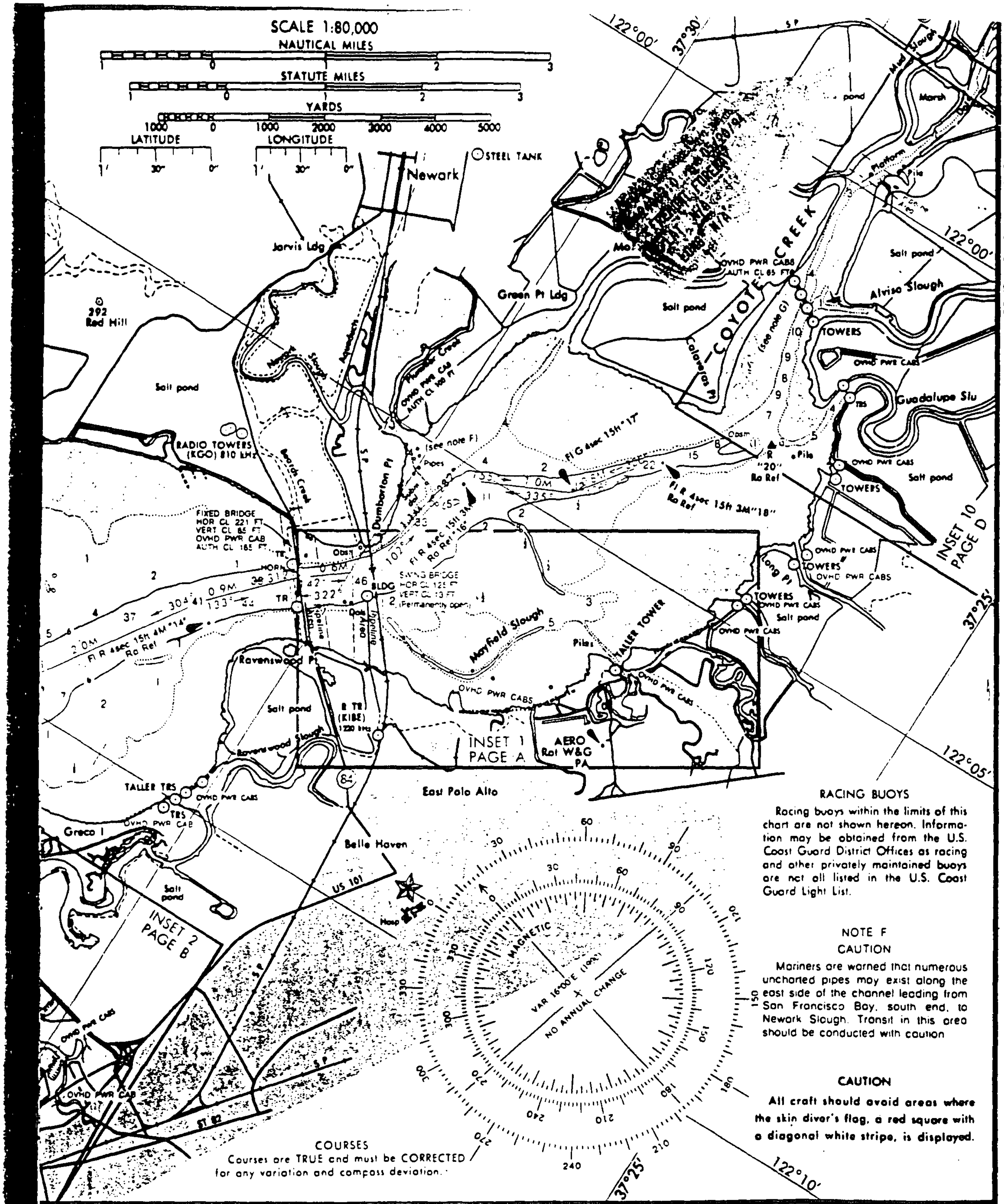
Navigational Maps of Sampling Locations

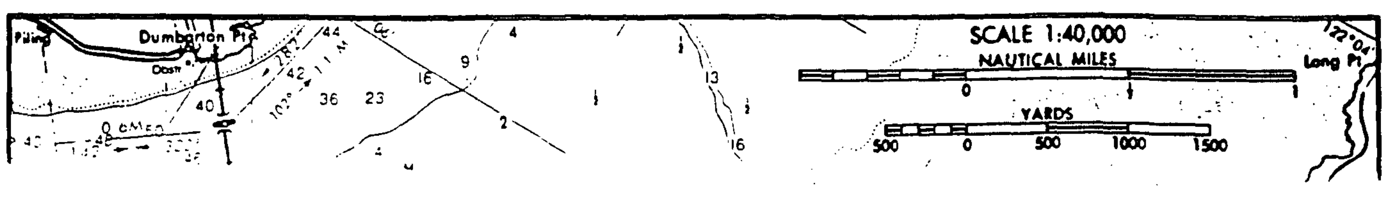
The following maps are copies of the navigational maps used in the field to indicate exact locations of the samples collected. The original maps were color coded to indicate the type of sampling technique used at that location to collect the sample. For the purposes of this report the following copies have been modified by the addition of a description of the sampling device that was used at each of the shaded sampling locations.

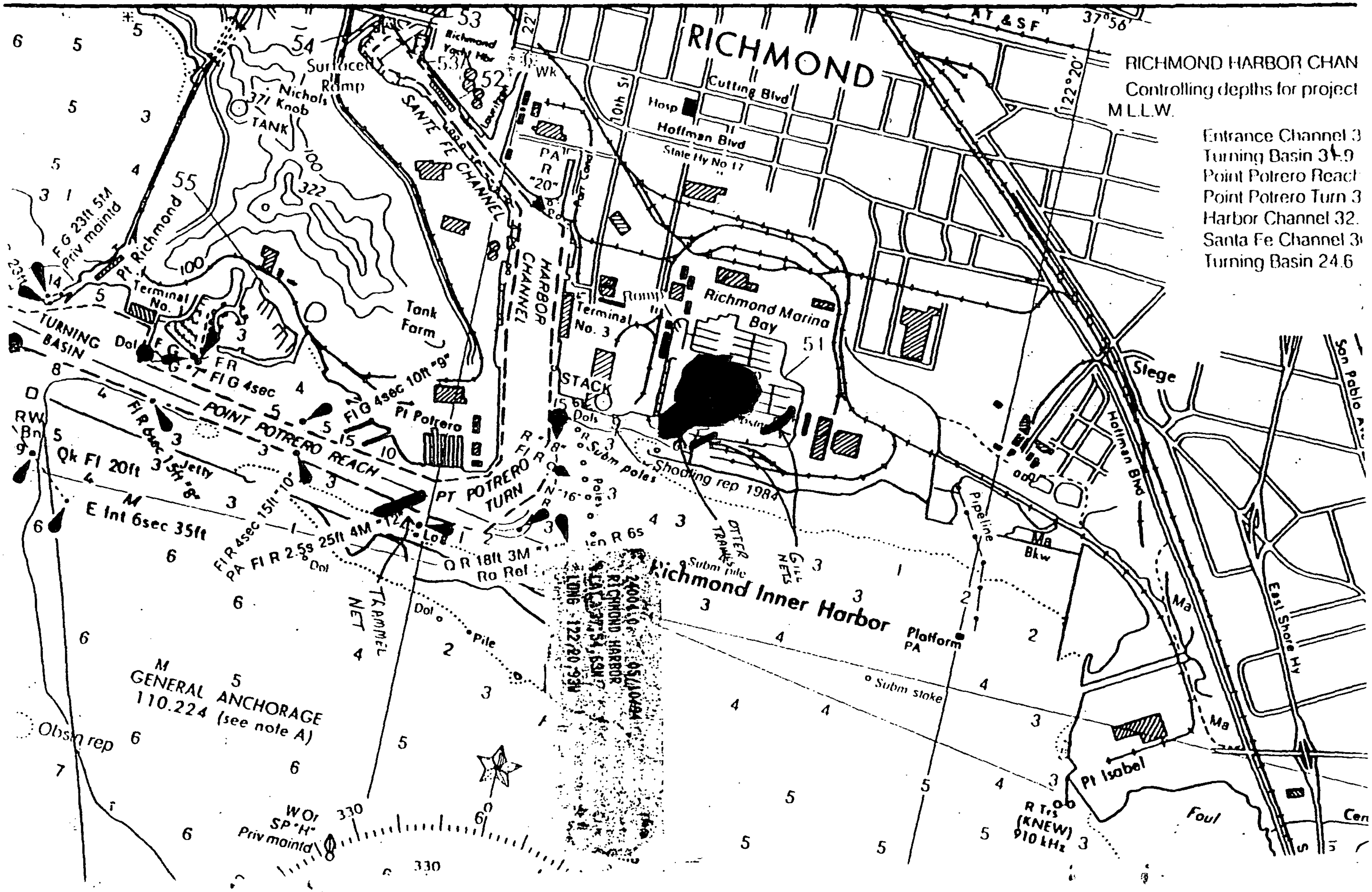

piles PA
(see note B)
Subm pile PA
HORNS
Priv maintd
NW GABLE
Fishing
TRAMMEL NETS
OTTER TRAWL
48N"10"
GILL NET
Fl G "1"
Fl R "2"
Coyote Point
Poles
Stake
Snag
Foul
Piling and
duck blinds
INSET 3
PAGE A
SAN MATEO
122°20'
Hosp
R TR
(KOFY) 1050 kHz
Seal Slough
FIXED BRIDGE
HOR CL 40 FT
VERT CL 10 FT
OVHD PWR CAB
Brewer Island
Bridge
(under constr)
OVHD PWR CAB
OVHD PWR CABLES
R TRS
(KNBR)
680 kHz
R TRS
(KKHI)
1550 kHz
TALLER TRS
Salt ponds
Salt ponds
Steinberger Slough
Redwood Creek
Fl R 4sec 15ft 4M "12" Ra Ref
Fl R 4sec 15ft 4M "2"
HORN (Oct 1 to Apr 1)
Ra Ref
Fl 2.5sec 12ft
Subm obstrs
Subm piles
AERO
Rot W & G
REDWOOD C
OVHD PWR CABS
CAUTION
Temporary changes or defects in aids to navigation are not indicated on this chart. See Notice to Mariners.
Improved channels shown by broken lines are subject to shoaling, particularly at the
Fl G 4sec 12ft "1"
"2"
Fl R 4sec 12ft
Priv maintd
5 FT 1981
Markers
Piles
Coyote Pt
Hbr
Marsh
SAN FRANCISCO BAY
122°19'36'
37°36'

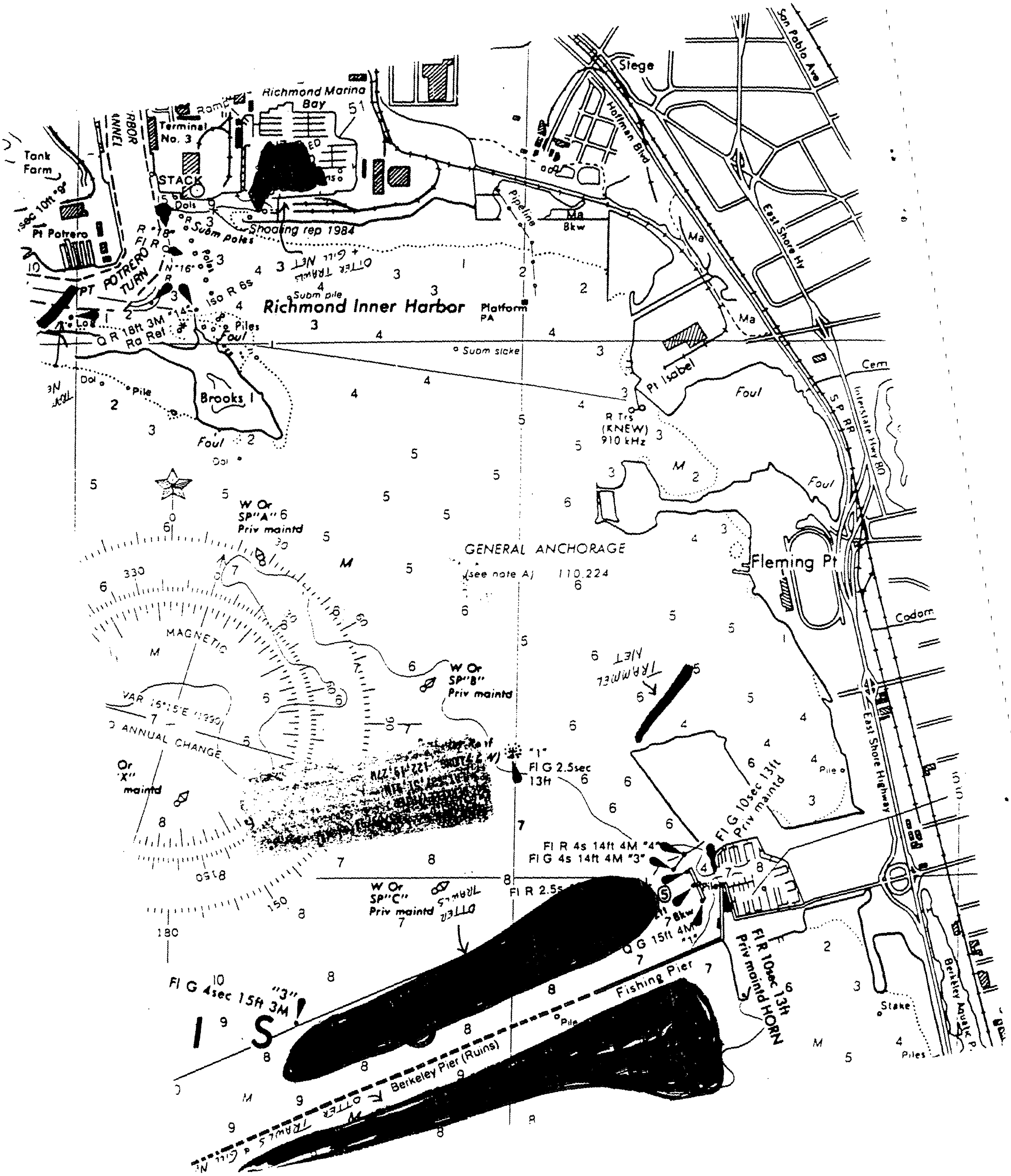


Green Pt Ldg
Salt pond
COYOTE
Calaveras Pt
(see note G)
TOWERS
OVHD
TRS
Newark Slough
Aqueduct
Plummer Creek
OVHD PWR CAB AUTH CL 100 FT
Salt pond
RADIO TOWERS (KGO) 810 kHz
Beards Creek
S P
Dumbarton Pt
(see note F)
Pipes
Obstn
R "20" Ra Ref
Pile
Fl G 4sec 15ft "17"
Fl R 4sec 15ft 3M "18" Ra Ref
OVHD PWR CABS
FIXED BRIDGE
HOR CL 221 FT
VERT CL 85 FT
OVHD PWR CAB
AUTH CL 165 FT
TR
HORN
Obstl
Fl R 4sec 15ft 3M Ra Ref "16"
SWING BRIDGE
HOR CL 125 FT
VERT CL 13 FT
(Permanently open)
BLDG
Long Pt
TOWERS
OVHD PWR CABS
Salt pond
Mayfield Slough
TALLER TOWER
Piles
Fl R 4sec 15ft 4M "14" Ra Ref
M Sh
Pipeline Area
OVHD PWR CABS
R TR (KIBE) 1220 kHz
Slough
INSET 1
PAGE A
AERO
Rot W&G
PA
84
East Palo Alto
TALLER TRS
TRS
OVHD PWR CAB
Greco I
Belle Haven
US 101
Salt pond
Hosp
INSET
RACING B
Racing buoys within
chart are not shown
tion may be obtaine
Coast Guard District
and other privately
are not all listed in
Guard Light List.


SCALE 1:80,000
NAUTICAL MILES
STATUTE MILES
YARDS
LATITUDE
LONGITUDE
STEEL TANK
Newark
Jarvis Ldg
292
Red Hill
Green Pt Ldg
Salt pond
RADIO TOWERS (KGO) 810 kHz
FIXED BRIDGE HOR CL 221 FT VERT CL 85 FT OVHD PWR CAB AUTH CL 185 FT
SWING BRIDGE HOR CL 125 FT VERT CL 13 FT (Permanently open)
Dumbarton Pt
Ravenswood Pt
Ravenswood Slough
Mayfield Slough
TALLER TOWER
INSET 1 PAGE A
AERO Rot W&G PA
East Palo Alto
Belle Haven
TALLER TRS
OVHD PWR CABS
Greco I
US 101
INSET 2 PAGE B
COYOTE CREEK
Alviso Slough
Guadalupe Slu
Mud Slough
Marsh
TOWERS
Long Pt
INSET 10 PAGE D
CONTINUED ON CHART 18651
122°00'
37°30'
122°05'
37°25'
122°10'
MAGNETIC
VAR 16°00'E (1992)
NO ANNUAL CHANGE
RACING BUOYS
Racing buoys within the limits of this chart are not shown hereon. Information may be obtained from the U.S. Coast Guard District Offices as racing and other privately maintained buoys are not all listed in the U.S. Coast Guard Light List.
NOTE F
CAUTION
Mariners are warned that numerous uncharted pipes may exist along the east side of the channel leading from San Francisco Bay, south end, to Newark Slough. Transit in this area should be conducted with caution
CAUTION
All craft should avoid areas where the skin diver's flag, a red square with a diagonal white stripe, is displayed.
COURSES
Courses are TRUE and must be CORRECTED for any variation and compass deviation.


Dumbarton Pt
SCALE 1:40,000
NAUTICAL MILES
YARDS
Long Pt
122°04'


RICHMOND
RICHMOND HARBOR CHAN
Controlling depths for project
M.L.L.W.
Entrance Channel 3
Turning Basin 3
Point Potrero Reac
Point Potrero Turn 3
Harbor Channel 32.
Santa Fe Channel 3
Turning Basin 24.6
AT & SF
37°56'
122°20'
Cutting Blvd
Hosp
Hoffman Blvd
State Hy No 17
10th St
Richmond Yacht Hbr
Surfaced Ramp
Nichols Knob
TANK
SANTE FE CHANNEL
HARBOR CHANNEL
Pt Richmond
F G 23ft 5M Priv maintd
Terminal No.
TURNING BASIN
Tank Farm
Pt Potrero
POINT POTRERO REACH
PT POTRERO TURN
Terminal No. 3
STACK
Richmond Marina Bay
Shoaling rep 1984
Subm poles
Qk Fl 20ft
E Int 6sec 35ft
Fl R 4sec 15ft 10
Fl R 2.5s 25ft 4M
Q R 18ft 3M
Ra Ref
Richmond Inner Harbor
OTTER TRAWLS
GILL NETS
TRAMMEL NET
Pipeline
Platform PA
Subm stake
Stege
Hoffman Blvd
East Shore Hy
San Pablo Av
Pt Isabel
Foul
R Trs (KNEW) 910 kHz
GENERAL ANCHORAGE
110.224 (see note A)
Obstn rep
W Or SP "H" Priv maintd
330
RICHMOND HARBOR
LONG 122 20 93W


San Pablo Ave
Stege
Richmond Marina Bay
Terminal No. 3
Tank Farm
STACK
Pt Potrero
PT POTRERO TURN
Shoaling rep 1984
Subm poles
OTTER TRAWLS + GILL NET
Subm pile
Richmond Inner Harbor
Platform PA
Pipeline
Hoffman Blvd
East Shore Hy
Q R 18ft 3M Ra Ref
Piles
Foul
Subm stake
Brooks I
Pt Isabel
R Trs (KNEW) 910 kHz
S P RR
Interstate Hwy 80
W Or SP"A" Priv maintd
GENERAL ANCHORAGE
(see note A) 110.224
Fleming Pt
MAGNETIC
VAR 15°15'E (1990)
ANNUAL CHANGE
W Or SP"B" Priv maintd
TRAMMEL NET
Codorn
East Shore Highway
Or "X" maintd
"1" Fl G 2.5sec 13ft
Fl G 10sec 13ft Priv maintd
Fl R 4s 14ft 4M "4"
Fl G 4s 14ft 4M "3"
W Or SP"C" Priv maintd
OTTER TRAWLS
Fl R 2.5s
Q G 15ft 4M "1"
Fl R 10sec 13ft Priv maintd HORN
Fl G 4sec 15ft 3M "3"
Fishing Pier
Berkeley Pier (Ruins)
Berkeley Aquatic P.
Stake
OTTER TRAWLS & GILL NETS

TABULATED FROM SURVEYS BY THE CORPS OF ENGINEERS - SURVEYS TO DEC 1990

CONTROLLING DEPTHS FROM SEAWARD IN FEET AT MEAN LOWER LOW WATER (MLLW)

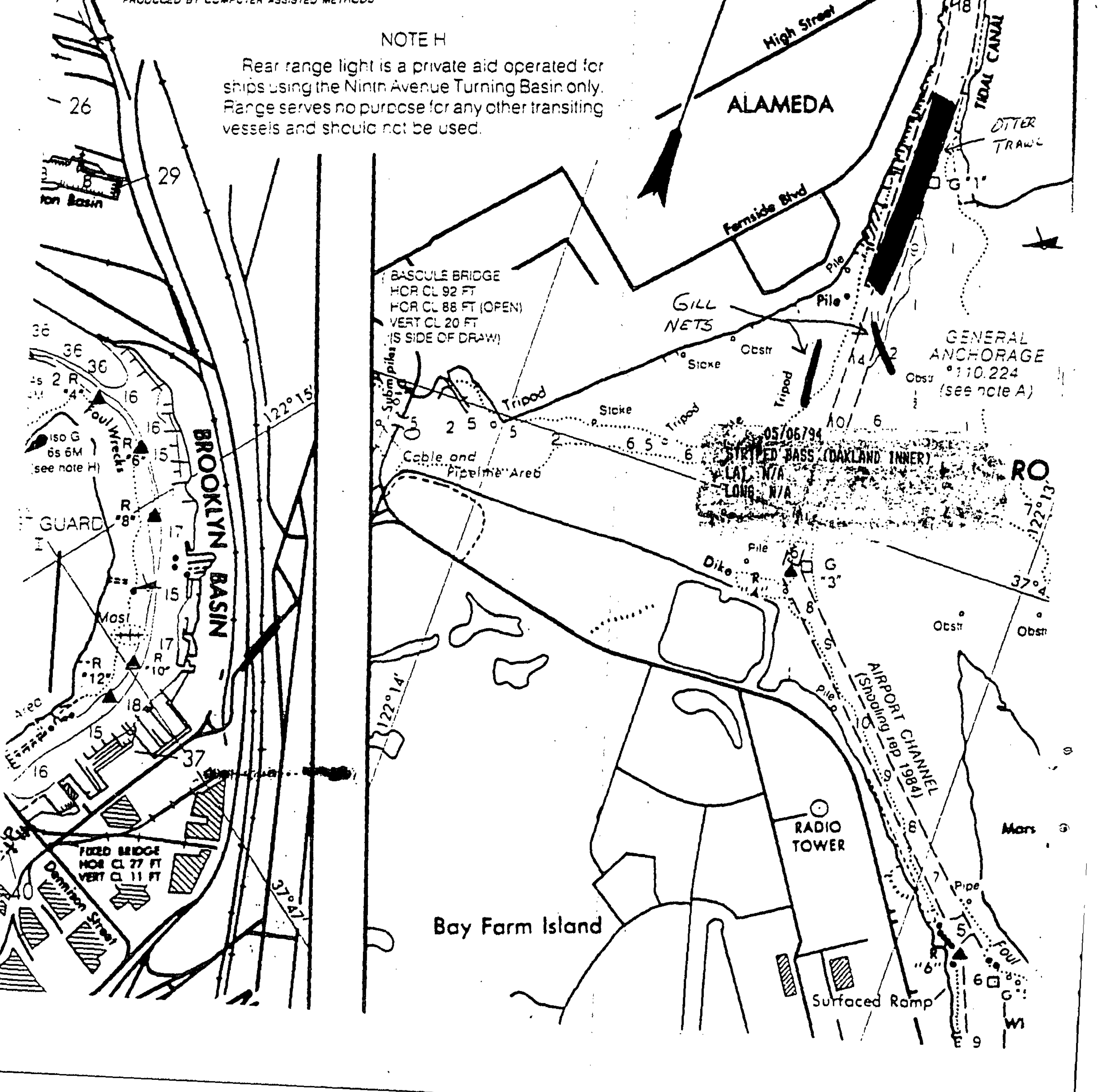
NAME OF CHANNEL	DEPTH MLLW (FEET)	WIDTH (FEET)	DATE OF SURVEY
INNER HARBOR:			
GROVE ST. PIER TO BROOKLYN BASIN	23.7	600	
BROOKLYN BASIN SOUTH CHANNEL	14.9	600-500	
BROOKLYN BASIN NORTH CHANNEL	6.5	300	
PARK ST. BRIDGE REACH	11.3	500-275	

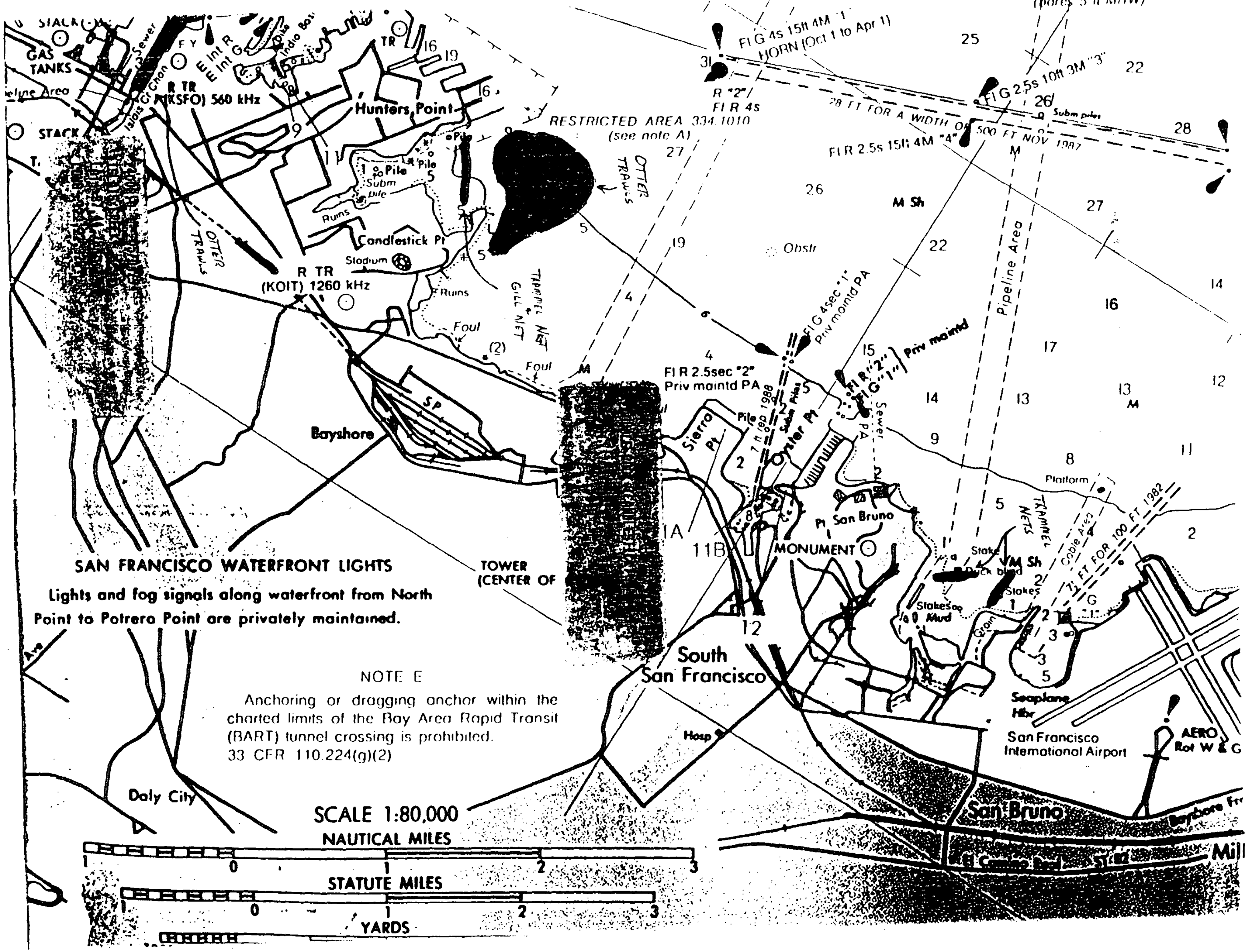
NOTE - CONSULT THE CORPS OF ENGINEERS FOR CHANGING CONDITIONS SUBSEQUENT TO THE ABOVE

PRODUCED BY COMPUTER ASSISTED METHODS

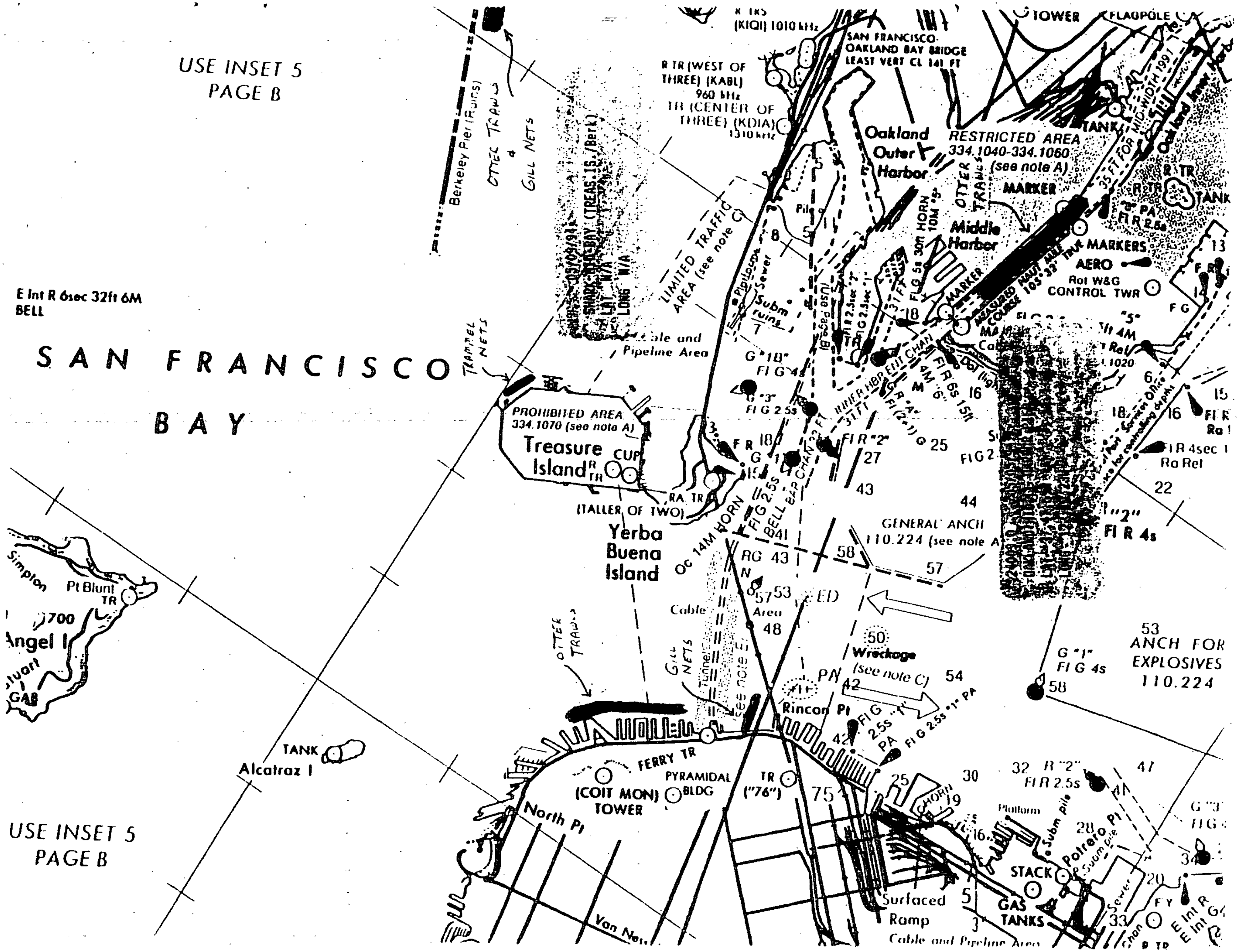
NOTE H

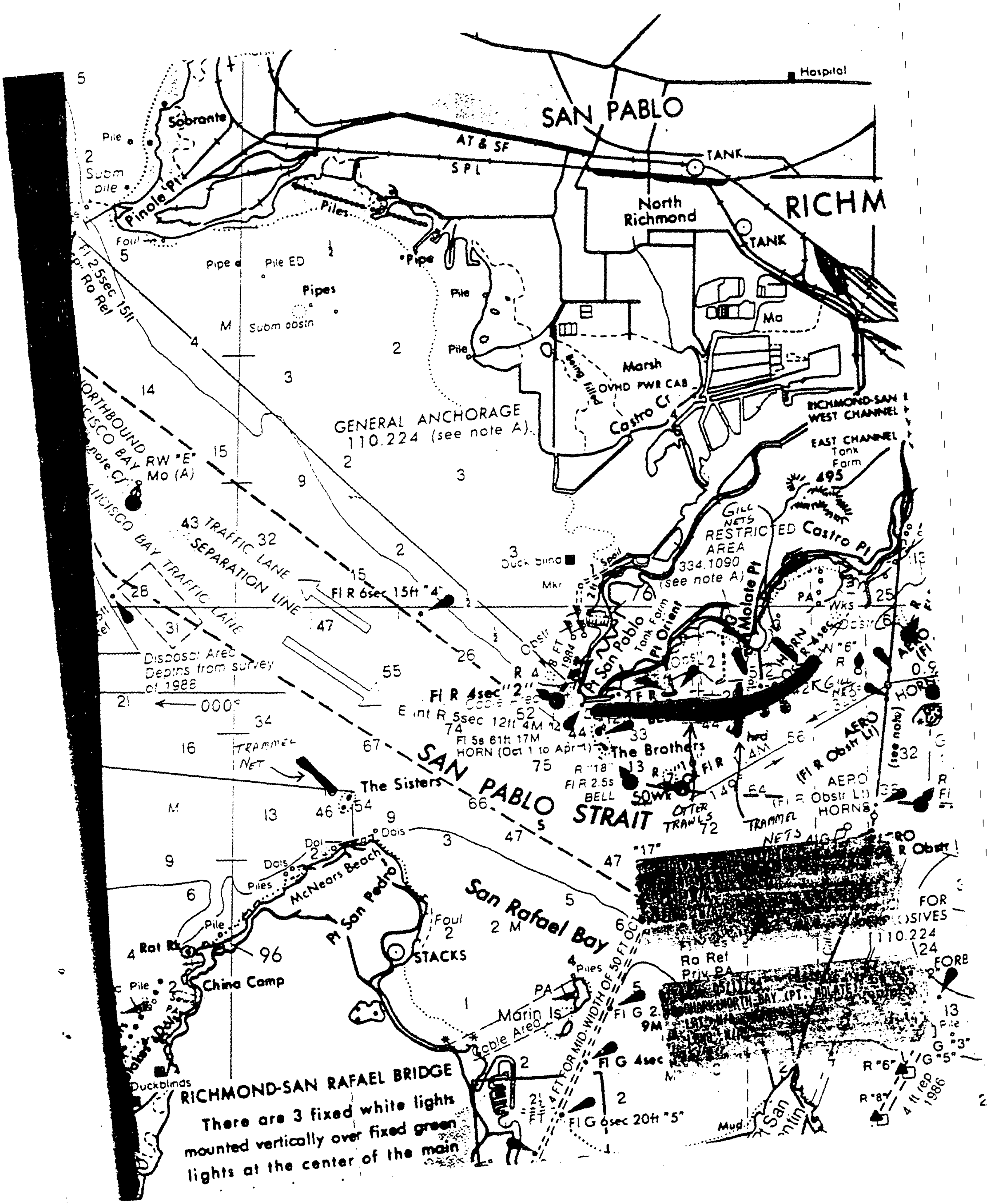
Rear range light is a private aid operated for ships using the Ninth Avenue Turning Basin only. Range serves no purpose for any other transiting vessels and should not be used.



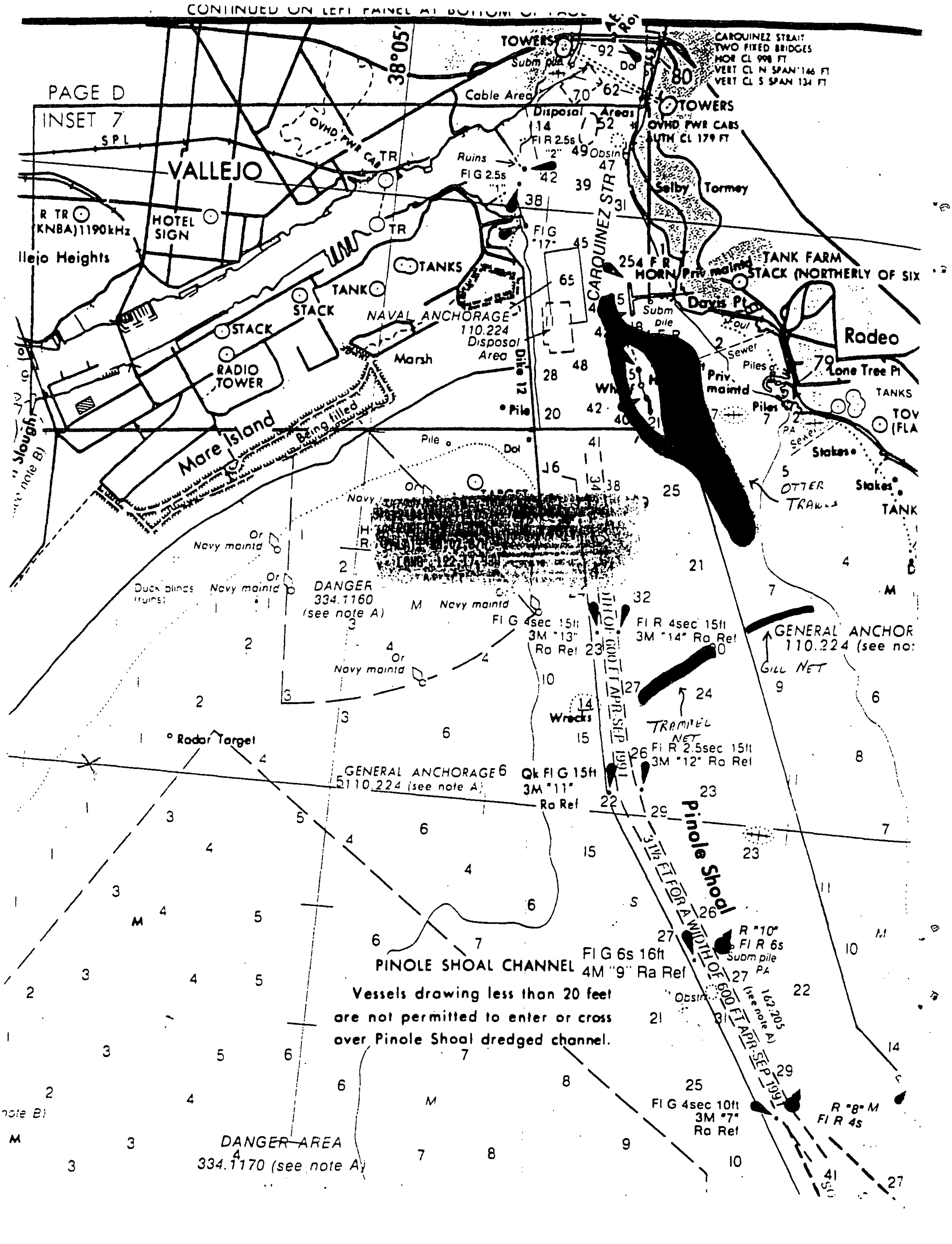


SAN FRANCISCO WATERFRONT LIGHTS
Lights and fog signals along waterfront from North Point to Potrero Point are privately maintained.
NOTE E
Anchoring or dragging anchor within the charted limits of the Bay Area Rapid Transit (BART) tunnel crossing is prohibited.
33 CFR 110.224(g)(2)
SCALE 1:80,000
NAUTICAL MILES
STATUTE MILES
YARDS
RESTRICTED AREA 334.1010
(see note A)
28 FT FOR A WIDTH OF 500 FT NOV 1987
Fl G 4s 15ft 4M "1"
HORN (Oct 1 to Apr 1)
Fl G 2.5s 10ft 3M "3"
Fl R 2.5s 15ft 4M "4"
R "2"
Fl R 4s
GAS TANKS
STACK
R TR (KSFO) 560 kHz
Hunters Point
Candlestick Pt
Stadium
R TR
(KOIT) 1260 kHz
Bayshore
Ruins
Foul
OTTER TRAWLS
TRAMMEL NET GILL NET
Pipeline Area
Obstr
Fl G 4sec "1"
Priv maintd PA
Fl R 2.5sec "2"
Priv maintd PA
Priv maintd
Sierra Pt
Oyster Pt
Sewer
Pt San Bruno
MONUMENT
TOWER
(CENTER OF
South San Francisco
Hosp
Platform
Cable Area
7 FT FOR 100 FT 1982
Duck blind
Stakes
Mud
Seaplane Hbr
San Francisco International Airport
AERO
Rot W & G
San Bruno
El Camino Real
Bayshore Fwy
Daly City

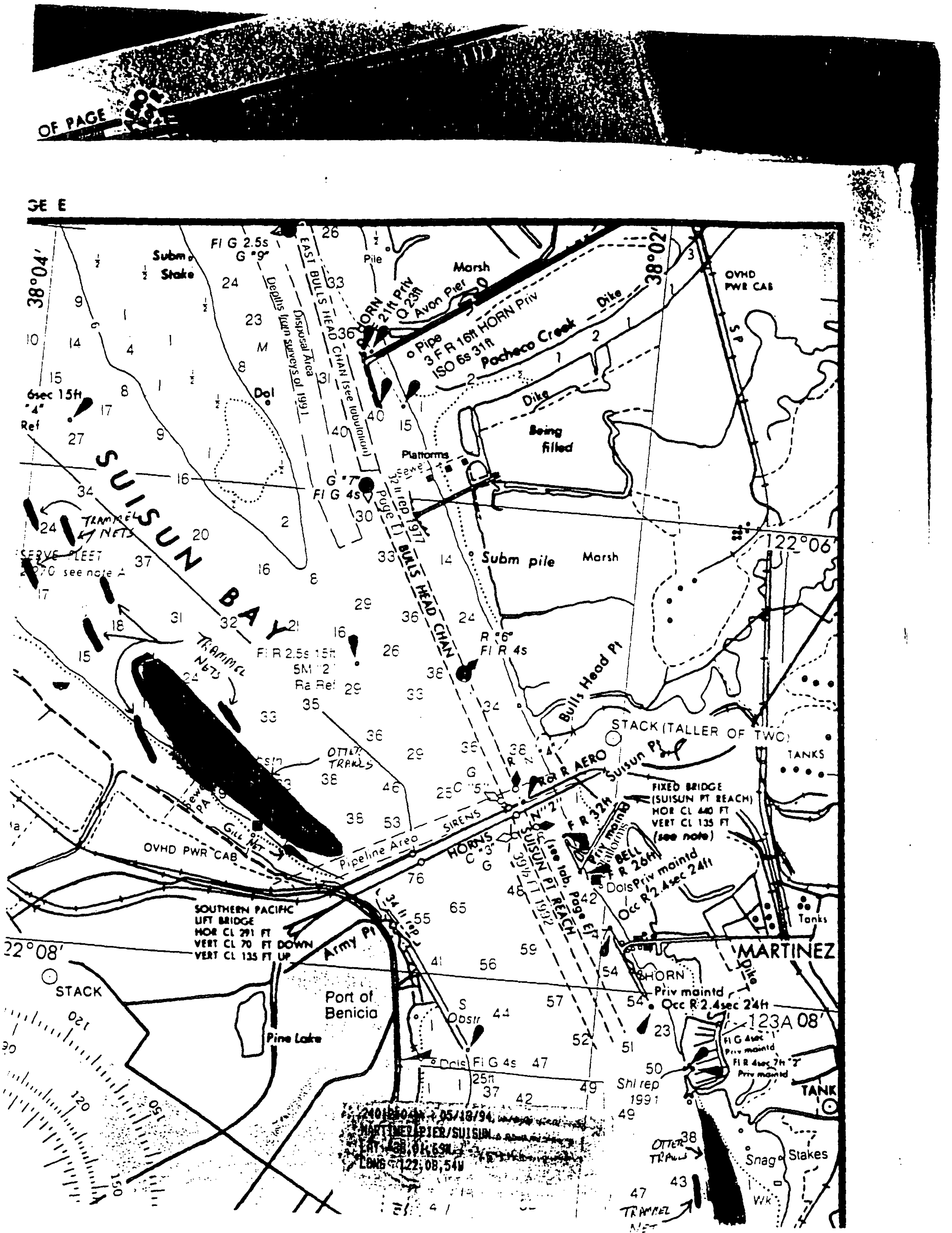

USE INSET 5
PAGE B
SAN FRANCISCO
BAY
E Int R 6sec 32ft 6M
BELL
Berkeley Pier (Ruins)
OTTER TRAWLS
GILL NETS
TRAMMEL NETS
R TR (WEST OF THREE) (KABL) 960 kHz
TR (CENTER OF THREE) (KDIA) 1310 kHz
(KIQI) 1010 kHz
SAN FRANCISCO-OAKLAND BAY BRIDGE
LEAST VERT CL 141 FT
TOWER
FLAGPOLE
TANK
Oakland Outer Harbor
RESTRICTED AREA
334.1040-334.1060
(see note A)
MARKER
Middle Harbor
MARKERS
AERO
Rot W&G
CONTROL TWR
MEASURED NAUT MILE
COURSE 103°32' True
LIMITED TRAFFIC AREA (see note C)
Cable and Pipeline Area
PROHIBITED AREA
334.1070 (see note A)
Treasure Island
CUP
(TALLER OF TWO)
Yerba Buena Island
Oc 14M HORN
BELL
INNER HARBOR ENT CHAN
GENERAL ANCH
110.224 (see note A)
Cable Area
Wreckage
(see note C)
Rincon Pt
ANCH FOR
EXPLOSIVES
110.224
G "1"
Fl G 4s
"2"
Fl R 4s
Fl R 4sec
Ra Ref
Simpton
Pt Blunt
TR
Angel I
GAB
TANK
Alcatraz I
FERRY TR
PYRAMIDAL BLDG
(COIT MON) TOWER
TR ("76")
North Pt
Van Ness
Surfaced Ramp
Cable and Pipeline Area
STACK
Potrero Pt
GAS TANKS
Platform
Subm pile
Sewer
32 R "2"
Fl R 2.5s



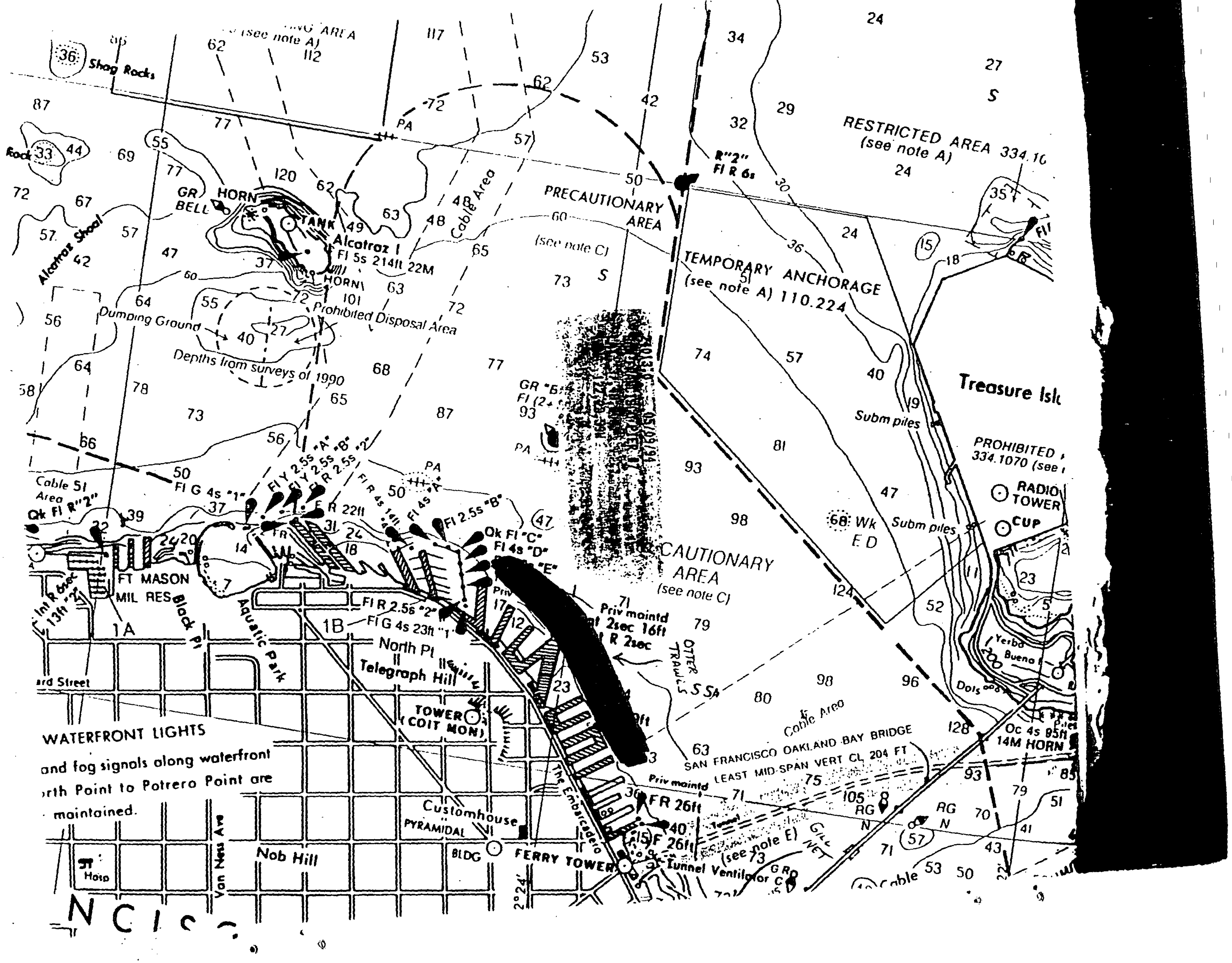
SAN PABLO
RICHM
Hospital
AT & SF
SPL
TANK
North Richmond
Sobrante
Pinole Pt
Piles
Pipe
Pile ED
Pipes
Subm obstn
Pile
Marsh
OVHD PWR CAB
Castro Cr
GENERAL ANCHORAGE
110.224 (see note A)
RICHMOND-SAN RAFAEL WEST CHANNEL
EAST CHANNEL
Tank Farm
RW "E"
Mo (A)
TRAFFIC LANE
SEPARATION LINE
SAN FRANCISCO BAY TRAFFIC LANE
Disposal Area
Depths from survey of 1988
Fl R 6sec 15ft "4"
RESTRICTED AREA
334.1090
(see note A)
Castro Pt
Molate Pt
Pt Orient
Pt San Pablo
Duck blind
Fl R 4sec "2"
E int R 5sec 12ft 4M
Fl 5s 61ft 17M
HORN (Oct 1 to Apr 1)
The Brothers
The Sisters
TRAMMEL NET
SAN PABLO STRAIT
OTTER TRAWLS
TRAMMEL NETS
GILL NETS
R "18"
Fl R 2.5s
BELL
AERO
HORNS
McNears Beach
Pt San Pedro
San Rafael Bay
STACKS
Rat Rk
China Camp
Marin Is
Cable Area
Ro Ref
Priv PA
Fl G 4sec
Fl G 6sec 20ft "5"
FT FOR MID-WIDTH OF 50 FT OC
Duckblinds
FOR EXPLOSIVES
110.224
R "6"
G "3"
G "5"
R "8"
4 ft rep 1986
San Quentin
Mud
RICHMOND-SAN RAFAEL BRIDGE
There are 3 fixed white lights mounted vertically over fixed green lights at the center of the main

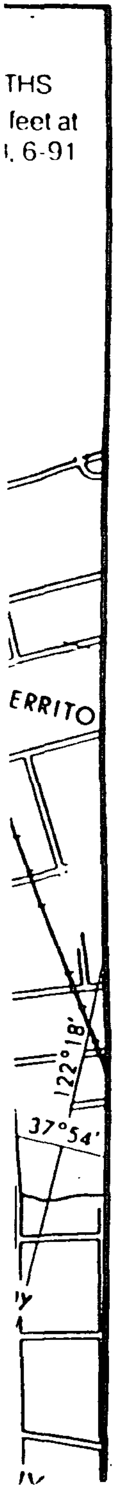


PAGE D
INSET 7
VALLEJO
R TR (KNBA) 1190 kHz
HOTEL SIGN
Vallejo Heights
SPL
OVHD PWR CAB
TR
TANKS
TANK
STACK
RADIO TOWER
NAVAL ANCHORAGE 110.224
Disposal Area
Marsh
Dike 12
Mare Island
Being filled
38°05'
TOWERS
Subm pile
Dol
Cable Area
Disposal Areas
Fl R 2.5s "2"
Obstn
Ruins
Fl G 2.5s "1"
Fl G "17"
CARQUINEZ STR
CARQUINEZ STRAIT TWO FIXED BRIDGES HOR CL 998 FT VERT CL N SPAN 146 FT VERT CL S SPAN 134 FT
OVHD PWR CABS AUTH CL 179 FT
Selby
Tormey
TANK FARM
STACK (NORTHERLY OF SIX
F R HORN
Priv maintd
Davis Pt
Subm pile
Sewer
Piles
Lone Tree Pt
Radeo
TANKS
Priv. maintd
Stakes
TANK
OTTER TRAWLS
Pile
Navy
Or Navy maintd
Duck blinds (ruins)
DANGER 334.1160 (see note A)
Fl G 4sec 15ft 3M "13" Ra Ref
Fl R 4sec 15ft 3M "14" Ra Ref
GENERAL ANCHOR 110.224 (see no
GILL NET
TRAMMEL NET
Wrecks
Fl R 2.5sec 15ft 3M "12" Ra Ref
Radar Target
GENERAL ANCHORAGE 110.224 (see note A)
Qk Fl G 15ft 3M "11" Ra Ref
Pinole Shoal
31½ FT FOR A WIDTH OF 600 FT APR-SEP 1991
R "10" Fl R 6s
Subm pile
PA
Fl G 6s 16ft 4M "9" Ra Ref
PINOLE SHOAL CHANNEL
Vessels drawing less than 20 feet are not permitted to enter or cross over Pinole Shoal dredged channel.
162.205 (see note A)
Fl G 4sec 10ft 3M "7" Ra Ref
R "8" Fl R 4s
DANGER AREA 334.1170 (see note A)



OF PAGE
GE E
38°04'
38°02'
122°06'
22°08'
123A 08'
SUISUN BAY
EAST BULLS HEAD CHAN (see tabulation)
BULLS HEAD CHAN
Disposal Area
Depths from surveys of 1991
Fl G 2.5s G "9"
Subm Stake
Pile
Marsh
Avon Pier
HORN 21ft Priv Q 23ft
Pipe
3 F R 16ft HORN Priv
ISO 6s 31ft
Pacheco Creek
Dike
OVHD PWR CAB
SP
Being filled
Platforms
Sewer
G "7" Fl G 4s
Page E1 32 ft rep 1977
Subm pile
Marsh
R "6" Fl R 4s
Bulls Head Pt
Fl R 2.5s 15ft 5M "2" Ra Ref
6sec 15ft "4" Ref
Dol
TRAMMEL NETS
see note A
OTTER TRAWLS
GILL NET
STACK (TALLER OF TWO)
TANKS
Suisun Pt
R AERO
FIXED BRIDGE (SUISUN PT REACH) HOR CL 440 FT VERT CL 135 FT (see note)
F R 32ft
BELL R 26ft
Dols Priv maintd
Occ R 2.4sec 24ft
SIRENS
HORNS C "3" G
SUISUN PT REACH (see tab, Page E1)
39½ FT 1992
Pipeline Area
OVHD PWR CAB
SOUTHERN PACIFIC LIFT BRIDGE HOR CL 291 FT VERT CL 70 FT DOWN VERT CL 135 FT UP
Army Pt
34 ft rep
MARTINEZ
Tanks
HORN Priv maintd Occ R 2.4sec 24ft
STACK
Port of Benicia
Pine Lake
Obstr
Dols Fl G 4s
25ft
Fl G 4sec "1" Priv maintd
Fl R 4sec 7ft "2" Priv maintd
TANK
Shl rep 1991
Snag
Stakes
Wk
OTTER TRAWL
TRAMMEL NET
240I2504 05/18/94
MARTINEZ PIER/SUISUN
LONG 122,08,54W


Shag Rocks
RESTRICTED AREA 334.10
(see note A)
R "2" Fl R 6s
PRECAUTIONARY AREA
(see note C)
TEMPORARY ANCHORAGE
(see note A) 110.224
Alcatraz Shoal
GR BELL
HORN
TANK
Alcatraz I
Fl 5s 214ft 22M
Cable Area
Dumping Ground
Prohibited Disposal Area
Depths from surveys of 1990
Treasure Isl
Subm piles
PROHIBITED
334.1070 (see
RADIO TOWER
CUP
Cable Area
Qk Fl R "2"
Fl G 4s "1"
Fl Y 2.5s "A"
Fl Y 2.5s "B"
Fl R 2.5s "2"
Fl R 22ft
Fl 2.5s "B"
Qk Fl "C"
Fl 4s "D"
FT MASON
MIL RES
Black Pt
Aquatic Park
Fl R 2.5s "2"
Fl G 4s 23ft "1"
North Pt
Telegraph Hill
CAUTIONARY AREA
(see note C)
Priv maintd
2sec 16ft
R 2sec
OTTER TRAWLS
Cable Area
SAN FRANCISCO OAKLAND BAY BRIDGE
LEAST MID-SPAN VERT CL 204 FT
Yerba Buena
Oc 4s 95ft
14M HORN
WATERFRONT LIGHTS
and fog signals along waterfront
orth Point to Potrero Point are
maintained.
TOWER (COIT MON)
Customhouse
PYRAMIDAL BLDG
FERRY TOWER
The Embarcadero
Priv maintd
F R 26ft
F 26ft
(see note E)
GILL NET
Tunnel Ventilator
Van Ness Ave
Nob Hill
Hosp
NCISC



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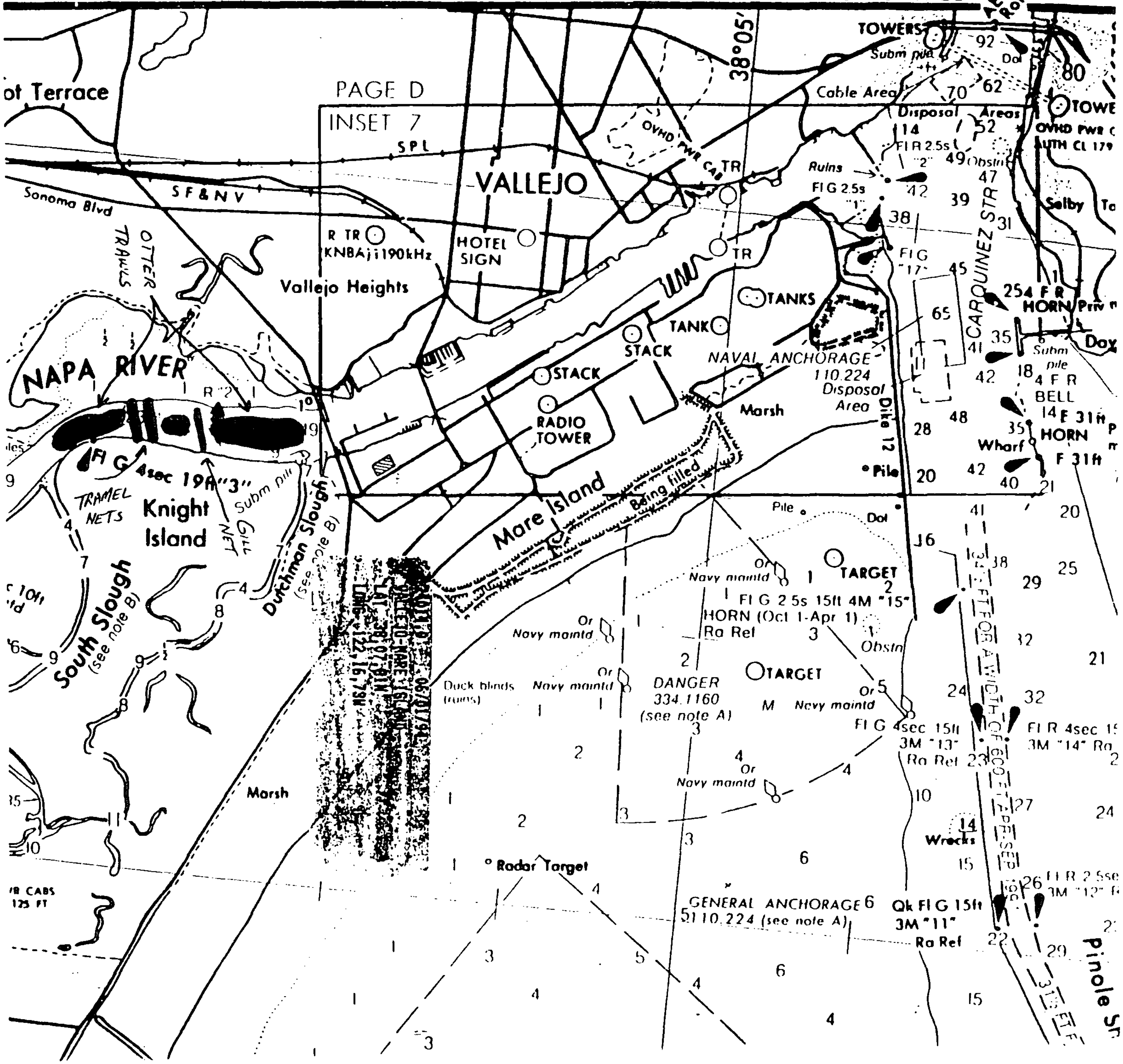

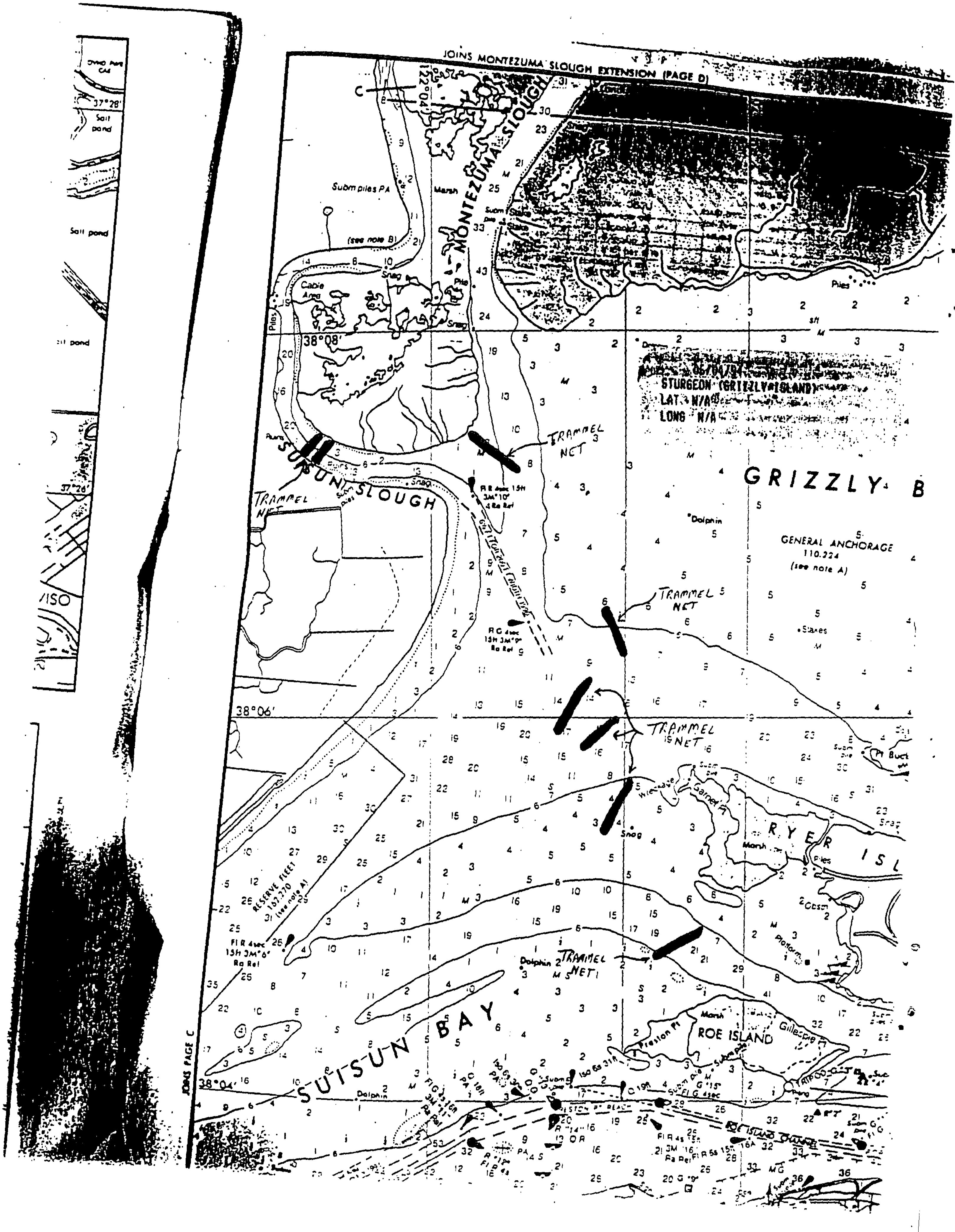

JOINS MONTEZUMA SLOUGH EXTENSION (PAGE D)
MONTEZUMA SLOUGH
Subm piles PA
(see note B)
Marsh
Snag
Cable Area
Piles
38°08'
STURGEON (GRIZZLY ISLAND)
LAT. N/A
LONG N/A
TRAMMEL NET
SUISUN SLOUGH
GRIZZLY B
Dolphin
GENERAL ANCHORAGE
110.224
(see note A)
Stakes
38°06'
Pt Buck
Garnet Pt
RYER ISL
Snag
RESERVE FLEET
162.270
(see note A)
Platform
Preston Pt
ROE ISLAND
Gillespie Pt
SUISUN BAY
38°04'
Dolphin
ROE ISLAND CHANNEL
JOINS PAGE C
Salt pond
37°28'
37°26'

USE INSET 5
PAGE B
North Richmond
RICHMOND
TANK
Point Richmond
SAN FRANCISCO
RICHMOND-SAN RAFAEL BRIDGE
WEST CHANNEL HOR CL 1000 FT
VERT CL 185 FT
EAST CHANNEL HOR CL 970 FT
VERT CL 135 FT
Tank Farm
Marsh
OVHD PWR CAB
Castro Cr
RESTRICTED AREA
334.1090
(see note A)
Castro Pt
Molate Pt
Pt Orient
San Pablo
BELL
Priv maintd
SIREN
Southampton Shoal
E Int R 6sec 32ft 6M BELL
Red Rock
The Brothers
GENERAL ANCH
FORBIDDEN ANCH
GENERAL ANCHORAGE
RW "B"
Mo (A)
Pt Chauncey
TRAMMEL NETS
PIPE
Bluff Pt
Pt Tiburon
TIBURON PENINSULA
RACCOON STR
Angel
Pt Simpton
Paradise Cay
75A
Corte Madera Creek
All lights are 9 feet above water, equipped with radar reflectors and are privately maintained.
GILL NET
Pt San Quentin
SECURITY ZONE
San Quentin
Hosp
RICHARDSON BAY
OVHD PWR CAB
AUTH CL 120 FT
STACK
Marsh
Meadowsweet
ABAND RR
US 101
Marin City
Cable and Pipeline Area
FIXED BRIDGES
HOR CL 40 FT
VERT CL 21 FT
BASCULE BRIDGE
HOR CL 46 FT
HOR CL 15 FT (OPEN)
VERT CL 10 FT
Corte
INSET 5
PAGE B