ENVIRON

July 18, 2002

Linda Mackey
EnviroNet Consulting, Inc.
3645 Westwind Blvd.
Santa Rosa, CA 95403

RE: Final Report on Evaluation of the Results of Dioxin and Pentachlorophenol Testing of Oysters and Mussels from Commercial Beds in Humboldt Bay, California

Dear Ms. Mackey:

Please find attached the final report regarding the above matter. This report has been written to meet the requirements typically expected in reporting of field sampling methods, chemical testing results, and screening-level risk assessment results by the California Regional Water Quality Control Board and the Department of Toxic Substances Control and Department of Health Services.

ENVIRON's report addresses concerns raised by Coast Seafoods, Inc., and other local commercial shellfish businesses about possible contamination of commercial oysters in the bay. The report summarizes the field sampling and chemical testing results, and includes an evaluation of health risks to consumers posed by the presence of trace levels of dioxin in oysters and mussels. Pentachlorophenol was not detected in either oysters or mussels. Based on the findings presented in this report, ENVIRON has reached the following conclusions:

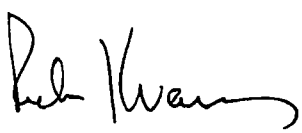
1. The occurrence of trace levels of dioxins in oyster and mussel tissues is well below the 25 pg/gram (i.e., part per trillion) benchmark for dioxins in fish or shellfish tissues that the U.S. Food and Drug Administration (U.S. FDA) has identified as a level of concern.

2. The distribution of dioxin congeners found in oyster and mussel tissues is similar to, but does not match, the dioxin profile typically associated with wood treatment products containing pentachlorophenol. This finding indicates that more than one source of dioxins contributes to the occurrence of dioxins in shellfish in Humboldt Bay.

3. The theoretical health risks associated with consumption of oysters and mussels from Humboldt Bay poses an incremental lifetime cancer risk below 1 in 1,000,000 (10^{-6} risk), which is below the 10^{-4} to 10^{-6} risk range considered acceptable by USEPA, and below the 10^{-5} risk level specified in California Proposition 65 as the threshold for communicating a potential health hazard of a consumer product to the general public. Dioxin exposure to shellfish consumers represents less than 0.1% of the typical background daily intake from all dietary sources estimated by USEPA.

Should you have any questions, I can be reached by e-mail at rjwenning@environcorp.com or phone at (510) 420-2556.

Sincerely,

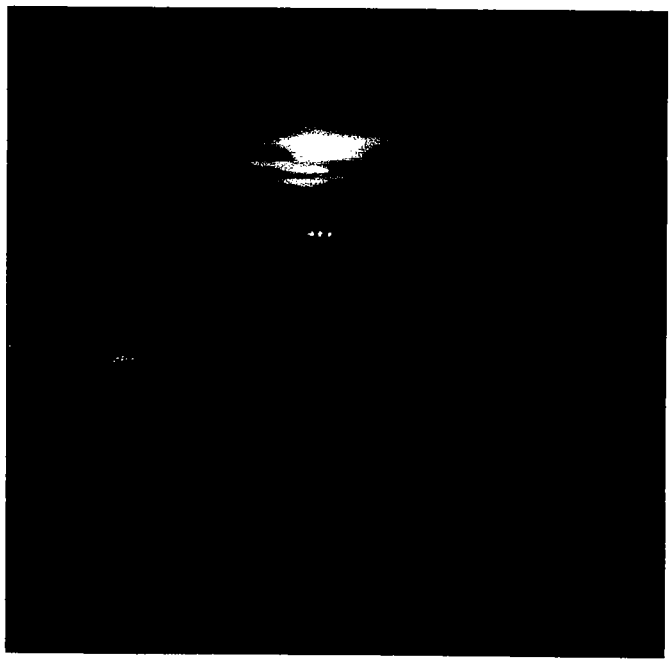


Richard J. Wenning, Senior Manager
ENVIRON Corporation

Enclosure

ENVIRON

EVALUATION OF THE RESULTS OF DIOXIN AND PENTACHLOROPHENOL TESTING OF COMMERCIAL OYSTER BEDS IN HUMBOLDT BAY, CALIFORNIA



Prepared by:

ENVIRON International Corporation
6001 Shellmound Street
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Prepared for:

Sierra Pacific Industries
Arcata, California

July 18, 2002

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I. Acronyms and Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BAAQMD	Bay Area Air Quality Management District
BW	Body weight
Cal/EPA	California Environmental Protection Agency
CDI	Chronic daily intake
CSF	Cancer slope factor
DTSC	California Department of Toxic Substances Control
HI	Hazard index
HQ	Hazard quotient
kg	Kilogram
mg	Milligram
mg/day	Milligram per day
mg/kg	Milligram per kilogram
mg/kg-day	Milligram per kilogram per day
OCDD	Octachlorinated dibenzo-p-dioxins
OCDF	Octachlorinated dibenzofurans
PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dibenzofurans
pg	Picograms
RfD	Reference dose
RfC	Reference concentration
SFRWQCB	San Francisco Regional Water Quality Control Board
TEFs	Toxic equivalency factors
TEQs	Toxic equivalents
UCL_{95}	95 percent upper confidence limit on the mean
USEPA	U.S. Environmental Protection Agency
USFDA	U.S. Food and Drug Administration
WHO	World Health Organization
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin

II. Executive Summary

Dioxin and pentachlorophenol testing in commercially grown oysters and mussels from Humboldt Bay, California, was conducted by ENVIRON International Corporation (ENVIRON) on behalf of Sierra Pacific Industries, Arcata Division Sawmill located near Arcata, California, in response to concerns raised by Coast Seafoods, Inc., and other local commercial shellfish businesses about possible contamination of commercial oyster beds located in Humboldt Bay. The field sampling, chemical testing, and screening-level exposure analysis described in this report were performed in a manner consistent with U.S. Environmental Protection Agency (USEPA) and State of California guidance for collection and chemical testing of biota (and specifically shellfish) and risk assessment.

This report summarizes the field sampling and chemical testing results, and includes an evaluation of health risks to consumers posed by the presence of trace levels of dioxin in oysters and mussels. The evaluation includes comparisons to levels in fish, oysters, and other shellfish reported in the scientific literature, comparisons to U.S. Food Drug Administration (USFDA) action levels for dioxins in fish and shellfish, and a screening-level shellfish consumption exposure analysis. As discussed below, pentachlorophenol was not detected in either oysters or mussels; and the levels of dioxins that were detected in oysters and shellfish do not pose a significant health risk.

Investigation Methods

Oysters were collected from nine (9) different commercial oyster beds in Humboldt Bay, California, on June 21, 2002. The same day, oysters and mussels were also collected from one oyster and mussel storage platform located in the Mad River Slough. In addition, sediments were collected from four (4) locations where oysters were collected. At each commercial oyster bed, approximately 12 to 24 individual oysters were collected from oyster flats located on the sediment bottom or from longlines suspended in the water column. The oysters and mussels at the Mad River Slough storage platform location were maintained in nets suspended below the water surface. Ten (10) composite samples of whole oyster tissues and one (1) composite sample of mussel tissue were assayed for total dioxins/furans and the seventeen individual 2,3,7,8-substituted polychlorinated dibenzo-p-dioxins and furans by Alta Analytical Laboratory (El Dorado Hills, California) using USEPA Method 8290. Pentachlorophenol testing was performed by Toxscan (Watsonville, California) using USEPA Method 8270.

Results

The dioxin and pentachlorophenol test results are summarized in Table ES-1. The results of laboratory testing for dioxins in ten composite samples of commercially grown oysters and one composite sample of commercially grown mussels indicated the presence of trace levels of dioxins. In ten composite whole oyster tissue samples, the total dioxin TEQ[1] concentration ranged between 0.08 and 4.3 pg dioxin TEQ/gram (or parts per trillion). The mean concentration of these ten samples was 1.8 pg dioxin TEQ/gram. The dioxin TEQ concentration in a single

[1] TEQ stands for "toxicity equivalent" and takes into account the relative toxicities of 17 individual dioxin/furan congeners recognized by USEPA and CalEPA as posing possible health concerns to humans. The method used to calculate TEQs in this report comes from the World Health Organization (1998) and has been adopted by USEPA and Cal/EPA.

composite mussel sample was 1.0 pg dioxin TEQ/gram. Pentachlorophenol was not detected in oysters or mussels.

■ **Table ES-1.** Results of dioxin and pentachlorophenol testing of composite whole oyster and mussel tissues collected from commercial beds in Humboldt Bay, California.

Chemical Tested	Mussel (1 sample)	Oyster (10 samples)
Dioxin (pg dioxin TEQ/gram wet weight)	1.0	1.8
Pentachlorophenol	Not detected	Not detected

In general, dioxin TEQ concentrations were slightly, but not statistically significantly, higher in diploid Pacific oysters than in Kumamoto oysters and triploid Pacific oysters. There was no statistical difference in the concentrations of dioxin TEQs in oysters cultivated using a longline suspended in the water and oysters cultivated in beds on the sediment bottom. The dioxin TEQ concentration in one mussel sample from the Mad River Slough was within the range of dioxin TEQ concentrations found in oysters collected in the bay. The concentrations of dioxins in oysters from two background commercial oyster beds located furthest from the Mad River Slough and close to the City of Eureka were not statistically different from the concentrations found in oysters collected elsewhere in the bay. The profile of dioxins found in oyster and mussel tissues indicated contributions from more than one source of dioxins to Humboldt Bay.

■ Comparisons to Levels in Fish and Shellfish

Few data on dioxins in oysters are available in the scientific literature. Testing for dioxins has not been included as part of local, state, or federal monitoring programs in the State of California. The few data available from the literature and from U.S. coastal monitoring programs conducted elsewhere by the National Oceanic and Atmospheric Administration (NOAA) suggests slightly lower dioxin TEQ levels than in oysters from Humboldt Bay (see Figure ES-1).

■ Comparisons to USFDA Action Levels

Dioxin levels in oysters and mussels also were compared to action levels in fish and shellfish established by the U.S. Food and Drug Administration (U.S. FDA; see Figure ES-2). The concentrations of total dioxin TEQs in oysters and mussels from Humboldt Bay are well below the 25 pg TEQ/g benchmark for dioxins in fish or shellfish tissues that U.S. FDA has identified as a level associated with no serious health effects, and well below the 50 pg TEQ/g action level at which U.S. FDA recommends against fish and shellfish consumption.

Figure ES-1. Comparison of dioxin TEQ levels in composite whole oyster and mussel tissues collected from commercial beds in Humboldt Bay, California, with levels in reported in fish and shellfish from California and elsewhere.

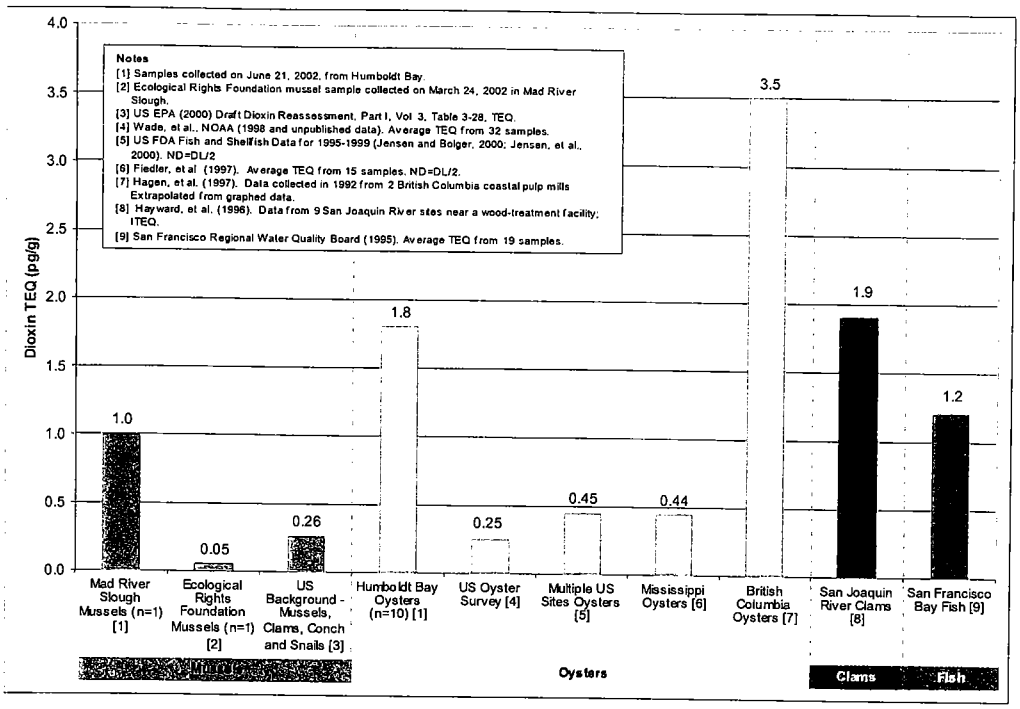
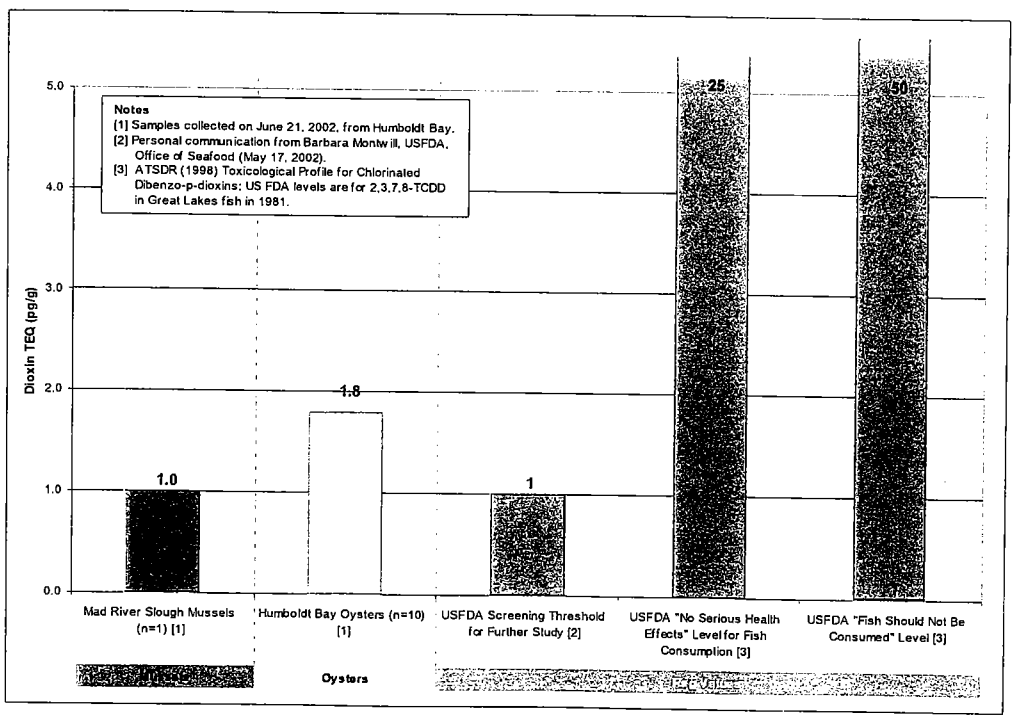


Figure ES-2. Comparison of dioxin TEQ levels in composite whole oyster and mussel tissues collected from commercial beds in Humboldt Bay, California, with U.S. Food and Drug Administration (USFDA) action levels in fish and shellfish.

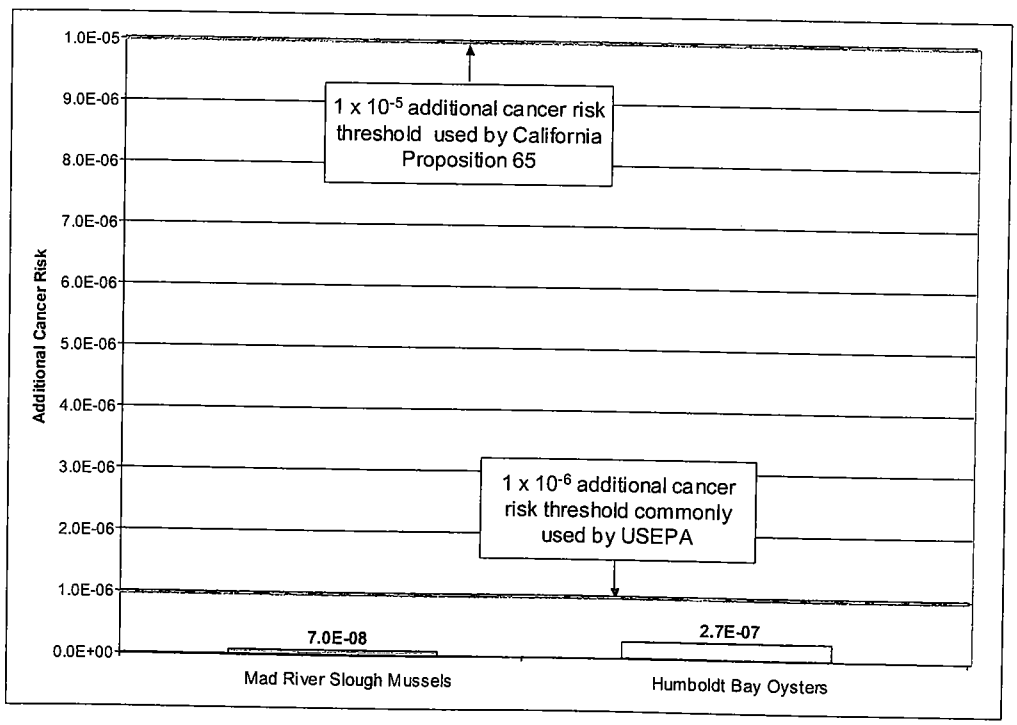


Assessment of Risks to Shellfish Consumers

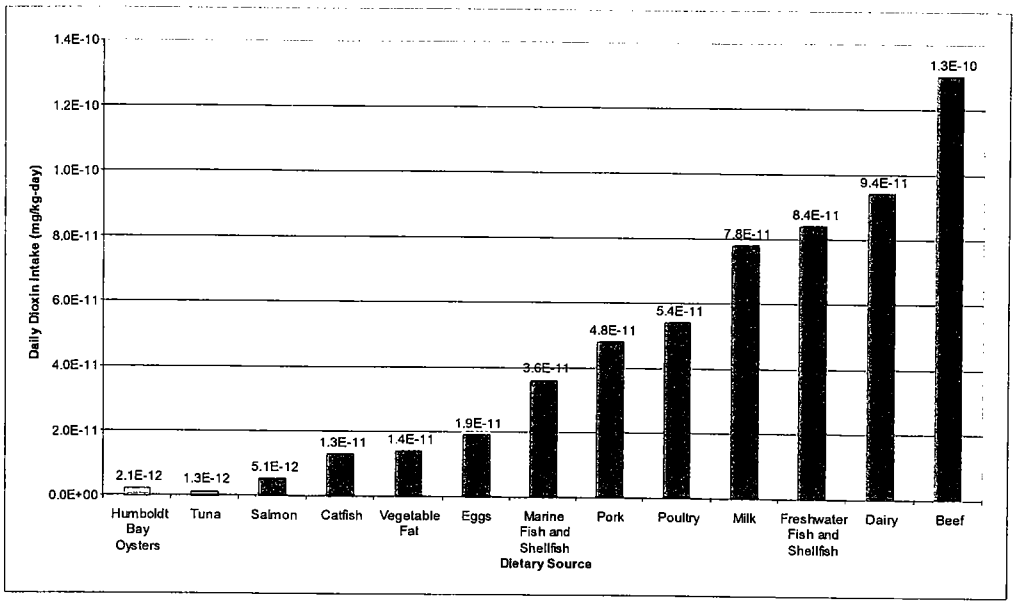
To further evaluate the potential health risks to shellfish consumers, a conservative screening-level exposure model was used to predict the theoretical daily intake of dioxin TEQs by a person who consumes oysters and mussels commercially grown in Humboldt Bay. Using conservative consumption estimates developed by USEPA and assuming the person's shellfish diet consists entirely of oysters or mussels from Humboldt Bay (and from nowhere else), the occurrence of dioxins in oysters and mussels does not pose a significant health risk to shellfish consumers. The theoretical health risks posed by exposure to dioxins assuming a daily diet of oysters and mussels from Humboldt Bay posed an incremental lifetime cancer risk below 1 in 1,000,000 (10^{-6} risk). The predicted theoretical health risks were below the 10^{-4} to 10^{-6} risk range considered acceptable by USEPA, and below the 10^{-5} risk level specified in California Proposition 65 as the threshold for communicating a potential health hazard of a consumer product to the general public (see Figure ES-3).

Furthermore, the results of the screening exposure model indicate that the consumption of Humboldt Bay oysters represents a small contribution to the total daily intake of dioxins typically encountered in the diet (see Figure ES-4). The results of the shellfish consumption assessment indicated that a person consuming oysters and mussels from Humboldt Bay would ingest approximately 0.3 and 0.07 pg TEQ/day, respectively. Exposure to dioxin in Humboldt Bay oysters by shellfish consumers represents less then 0.1% of the typical background intake associated with food consumption (53 pg TEQ/day) and exposure from all environmental sources (59 pg TEQ/day).

Figure ES-3. Theoretical additional cancer risk associated with the consumption of oysters and mussels from Humboldt Bay, California.



■ **Figure ES-4.** Comparison of the theoretical average daily intake of dioxin TEQ from consumption of Humboldt Bay oysters with total dioxin intake from all dietary sources estimated by USEPA in the Draft Dioxin Reassessment (USEPA, 2000b).



■ Conclusions of the Study

The results of this study support the following conclusions:

1. Testing of composite samples of whole oyster and mussel tissues collected from Humboldt Bay indicated the presence of low concentrations of dioxins (less than approximately 2 pg total dioxin TEQ/gram in all but one composite oyster tissue sample). The total dioxin TEQ concentration in oysters and mussels is within the range reported in fish from San Francisco Bay, and the few available data describing levels in shellfish elsewhere in the U.S.

2. The distribution of dioxin congeners found in composite whole oyster and mussel tissues suggest that more than one source of dioxins contributes to the occurrence of dioxins in shellfish in Humboldt Bay.

3. The levels of dioxins in oysters and mussels is well below the 25 pg/gram (i.e., part per trillion) benchmark for dioxins in fish or shellfish tissues that USFDA has identified as a level associated with no serious health effects.

4. Using a screening-level exposure model to evaluate intake and health risks to shellfish consumers, the occurrence of dioxins in oysters and mussels from Humboldt Bay does not pose a significant health risk to shellfish consumers. The theoretical health risks posed by exposure to dioxins assuming a daily diet of oysters and mussels from Humboldt Bay posed an incremental lifetime cancer risk below 1 in 1,000,000 (10^{-6} risk), which is below the 10^{-4} to 10^{-6} risk range considered acceptable by USEPA and the State of California, and below the 10^{-5} risk level specified in California Proposition 65 as the threshold for communicating a potential health hazard of a consumer product to the general public in the State of California.

5. The presence of dioxins in oysters and mussels from Humboldt Bay represents a negligible contribution to a person's normal background exposure to dioxins. Dioxin exposure to shellfish consumers represents less than 0.1% of the typical background daily intake estimated by the USEPA.

III. Introduction

This preliminary assessment of dioxins and pentachlorophenol in commercial oyster beds located in Humboldt Bay, California was conducted by ENVIRON International Corporation (ENVIRON) on behalf of Sierra Pacific Industries, Arcata Division Sawmill located near Arcata, California, in response to concerns raised by Coast Seafoods, Inc., and other local commercial shellfish businesses about possible contamination of commercial oyster beds in Humboldt Bay.

This report summarizes the field sampling and chemical testing methods used to determine the concentrations of dioxins and pentachlorophenol in commercially grown oysters and mussels. In addition, the purpose of this report is to describe the preliminary evaluation of the significance of the test results, including comparisons to levels in oysters and other shellfish reported in the scientific literature, comparisons to available regulatory benchmarks, and a screening-level shellfish consumption exposure analysis. This work was performed in a manner consistent with U.S. Environmental Protection Agency (USEPA) and State of California guidance for collection and chemical testing of biota (and specifically shellfish) and human health risk assessment.

Sampling and chemical testing of commercially grown oysters was performed to accomplish four objectives:

1. Collect a sufficient number of oysters from different commercial oyster beds in Humboldt Bay to obtain a statistically meaningful, representative data set describing chemical levels in whole oyster tissue.

2. Characterize the chemical content in oysters collected from each commercial oyster bed.

3. Determine whether the chemical content in oysters from each commercial bed exceeds the chemical content in oysters from commercial beds in Humboldt Bay or elsewhere that are not affected by activities associated with the Sierra Pacific Industries sawmill.

4. Develop data to support a determination of whether the chemical content in oysters from each commercial bed poses a health risk to consumers.

Dioxins

Dioxins have received considerable attention over the past two decades because of their widespread occurrence in the environment and potential health effects associated with occupational exposure in certain industrial environments (USEPA, 2000a, 2000b). The name "dioxin" commonly used for the family of structurally related chemicals called polychlorinated dibenzo-para-dioxins (sometimes referred to as PCDDs or chlorinated dioxins or dioxins) and polychlorinated dibenzofurans (sometimes referred to as PCDFs or chlorinated furans or furans). This family includes 75 individual compounds referred to as dioxin congeners and 135 individual compounds referred to as furan congeners. The most toxic chemical in this family, called 2,3,7,8-tetrachlorodibenzo-p-dioxin (typically referred to as 2,3,7,8-TCDD or "TCDD"), is widely recognized as the most toxic of the 210 individual dioxin congeners.

Both man-made and natural processes generate dioxins. Dioxins are by-products of a wide range of industrial processes and are typically formed when thermal processes involve chlorine-containing organic substances. Industrial processes identified by the USEPA (2000a, 2000b) as capable of generating dioxins include waste incineration, bleaching of paper pulp, and the manufacturing of some herbicides and pesticides. Other major sources include the production of iron and steel, backyard burning of household waste, wood burning, burning fuel for home

heating, automobile engines, and electrical power generation. In terms of dioxin release into the environment, municipal solid waste incinerators are among the largest sources. Relatively small amounts of dioxins are formed during wastewater and drinking water treatment. Dioxins also result from natural processes, such as volcanic eruptions and forest fires.

It is widely recognized by USEPA and the scientific community that dioxins are ubiquitous in the environment. Dioxins are persistent, long-lived chemicals and do not readily degrade. When released into the air bound to airborne particles, dioxins may be transported long distances, even around the globe. When released to rivers and streams through wastewater discharges, dioxins attach to particulate matter and settle to bottom sediments. When deposited to soil or bottom sediments, dioxins may accumulate in the food chain (e.g., in fish, beef cattle, chickens, dairy cows and other farm animals), resulting in measurable levels in a variety of foods and beverages.

In California, studies conducted in the San Francisco Bay Area by the Regional Water Quality Control Board and Bay Area Air Quality Management District hypothesize that the primary mechanism by which dioxins enter the environment and human diet is through atmospheric deposition and storm-water runoff (SFRWQCB, 1998; BAAQMD, 1996). Measurable levels of dioxins have been reported in fish from San Francisco Bay and in Bay Area and Central Valley lakes (OEHHA, 1999). An investigation of dioxins and their sources performed by the San Francisco Regional Water Quality Control Board (SFRWQCB) concluded that the distribution of dioxins typically found in sport fish, air, and storm water closely resembles that observed in releases from a wide variety of combustion sources (Wenning et al., 1999, 2000; SFRWQCB, 1998).

The single largest source of human exposure to dioxins is through the consumption of food, primarily meat, dairy products, and fish (Jensen and Bolger, 2001; USEPA, 2000b). According to USEPA (2000b), more than 90% of a person's average daily intake of dioxins is from the diet. Food products of animal origin (i.e., fish, meat, eggs, and dairy products), which have a high fat content, have higher concentrations of dioxins than food products that have lower fat content. Generally, of all the food products, fish and meat products are the largest source of dietary exposure to dioxins (USEPA, 2000b).

■ Dioxin Toxicity Equivalents

Throughout this report, dioxins are reported using a toxic equivalency (TEQ) scheme developed by the World Health Organization (WHO) and adopted by the USEPA and California EPA. Among the 210 congeners that comprise the family of dioxins, seventeen congeners are generally recognized by scientists as capable of eliciting a toxic response in animals and humans. The structure of each of the 17 dioxin congeners includes a basic chemical ring structure with one or more chlorine atoms attached. The toxicity of the different dioxins is largely determined by the position and number of chlorine atoms on the molecule.

Because the majority of toxicological studies have been conducted with 2,3,7,8-TCDD and relatively few studies have been conducted for most of the other dioxin congeners, the toxicity of different dioxins are calculated using the WHO's TEQ scheme. The WHO (van den Berg et al., 1998; IARC, 1997) and the USEPA (2000b) have adopted the TEQ scheme to estimate the potential effects of environmental samples that contain individual dioxin congeners. Each of the seventeen 2,3,7,8-substituted dioxin congeners has been assigned a toxicity equivalence factor (TEF) value. TEFs are estimates of the toxicity of different dioxin congeners *as compared to* the toxicity of 2,3,7,8-TCDD, which has been assigned a TEF value of one.

Laboratories report the concentrations of dioxins in environmental samples as total dioxin toxic equivalents (sometimes referred to as total TEQ or as total dioxin TEQ). A dioxin testing laboratory in three steps determines the total dioxin TEQ in an environmental sample. First, the laboratory measures the concentration of each individual dioxin congener using sophisticated analytical instruments. Second, the laboratory multiplies the measured concentration of the individual congener by its corresponding TEF value to produce a TEQ for each congener. For congeners reported as non-detect, the laboratory multiplies one-half the detection limit by the corresponding TEF value. And, third, the laboratory adds together the TEQ congeners for each of the 17 dioxin congeners to determine the total dioxin TEQ concentration in the sample.

■ Organization of this Report

In this report, the results of dioxin and pentachlorophenol testing are summarized, and the data are compared to levels in shellfish reported in the scientific literature. The results of a screening-level exposure and risk analysis also are presented to compare exposures to dioxin through consumption of oysters from Humboldt Bay to total dietary exposure, and to evaluate whether the levels found in oysters and mussels commercially-grown in Humboldt Bay pose a health threat to shellfish consumers.

The appendices to this report provide supporting documentation, including ENVIRON's field sampling and analysis plan (Appendix I), field sampling documentation (Appendix II), the laboratory data sheets for dioxin testing (Appendix III), and the screening-level exposure model and assumptions used by ENVIRON to calculate theoretical exposures and risks associated with the consumption of oysters and mussels (Appendix IV). In addition, a question and answer fact sheet on dioxin is included as Appendix V.

IV. Environmental Results and Discussion

Sampling and Chemical Testing Methods

The Sampling and Analysis Plan describing the protocols used by ENVIRON during the collection of oysters and mussels and the chemical testing methods used by Alta Analytical Laboratory for dioxins and Toxscan for pentachlorophenol is provided in Appendix I. Appendix II contains documentation of the field sampling activities, including photographs taken during field sampling activities, a sample location table and map, and chain of custody documents.

Oysters were collected from nine (9) different commercial oyster beds in Humboldt Bay, California, on June 21, 2002. The same day, oysters and mussels were also collected from one oyster and mussel storage platform located in the Mad River Slough. In addition, sediments were collected from four (4) locations where oysters were collected. A map of the sampling locations is included as Figure 1.

The locations of different commercial beds, cultivation methods, and seed dates of the different commercial oyster beds included in this study are shown in Table 1. With two exceptions, all of the commercial beds included in this study are managed by Coast Seafoods, Inc. The oyster bed at location 3 (see Figure 1) in Humboldt Bay and the oyster and mussel storage platform in the Mad River Slough (location 4) are managed by North Bay Shellfish Company. The commercial oyster beds at locations 1 and 2 (see Figure 1) were selected as representing background locations in the Bay that have not been impacted by activities associated with the Sierra Pacific Industries sawmill located near the City of Arcata at the confluence of the Mad River Slough and Humboldt Bay.

At each commercial oyster bed, between approximately 12 and 24 individual oysters were collected from oyster flats located on the sediment bottom or from longlines suspended in the water column. Oysters grown on longline beds were typically four to five feet below the water surface. Oysters grown on the bottom were approximately six feet below the water surface. The oysters and mussels at the Mad River Slough storage platform location were maintained at approximately four feet below the water surface. Mussels grown in suspended nets were collected from the storage platform in the Mad River Slough. Oysters and mussels grown in bedded flats or suspended on longlines in the water column were handled and tested separately.

Oysters were harvested in one day on June 21, 2002, by representatives of either Coast Seafoods or North Bay Shellfish Company using typical commercial harvesting methods. For bedded oysters, an oyster rake was used to detach the oysters from the sediment bottom and bring them aboard the boat. To harvest oysters from longlines, the upper portion of the longline that was assumed to be suspended in the water column was hauled aboard the boat and cut at a length sufficient to provide approximately 12 to 24 individual oysters. In the Mad River Slough, mussels grown in net bags suspended in the water column beneath a floating raft were hauled and approximately 50-60 individual mussels were collected. At four commercial oyster beds, sediment was collected from the oyster rake directly into one-liter wide-mouth amber glass bottle.

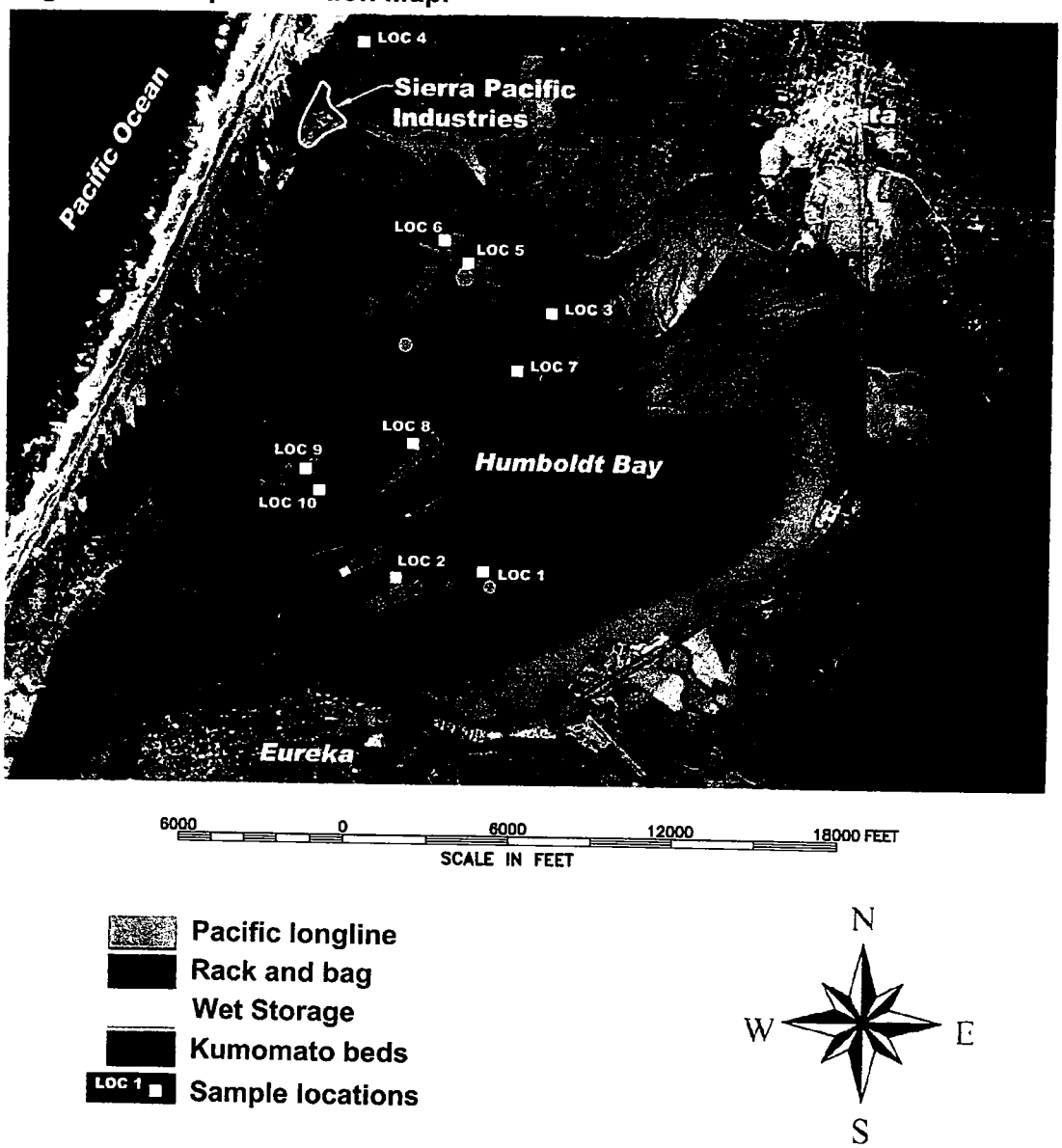
Unshucked oysters and mussels collected at each location were placed in double sealable Ziploc™ plastic storage bags, labeled, and stored with blue ice packs in coolers for shipment to Alta Analytical Laboratory (El Dorado Hills, California). The four sediment samples were handled and stored in a similar manner. Shellfish and sediment samples were shipped using a chain-of-custody protocol by courier for same-day delivery to Alta Analytical Laboratory.

Ten composite samples of whole oyster tissues and one composite sample of mussel tissue were assayed for total dioxins/furans and the individual seventeen 2,3,7,8-substituted polychlorinated dibenzo-p-dioxins and furans (dioxins) by Alta Analytical Laboratory (El Dorado Hills, California) using USEPA Method 8290 (results for lipid and percent moisture content were generated as well). Pentachlorophenol testing of the eleven composite samples was performed by Toxscan (Watsonville, California) using USEPA Method 8270. Sediment samples were stored at Alta Analytical Laboratory (El Dorado Hills, California) pending future analysis.

Table 1. Summary of Oyster, Mussel, and Sediment Sample Locations.

Sample ID	Date/Time	Location	Company	Bed Name/Location Description	Bed Age	Sample Type	Bed Type
020621-Ebay-6-2	6/21/2002 9:18	1	Coast Seafoods	East Bay Bed 6-2	Started in 1999	Pacific Triploid Oyster	Bottom
020621-Ebay-1-2	6/21/2002 9:40	2	Coast Seafoods	East Bay Bed 1-2	Started in 2000	Pacific Triploid Oyster	Longline
020621-NBSC	6/21/2002 10:12	3	North Bay Shellfish Company	North Bay Shellfish Company Bed	Started in 1999	Pacific Diploid Oyster	Longline
020621-NBSCM	6/21/2002 10:37	4	North Bay Shellfish Company	North Bay Shellfish Company Mussels	1 1/2 year old	Mussel	Rack and Bag
020621-NBSCO2	6/21/2002 10:57	4	North Bay Shellfish Company	North Bay Shellfish Company Wet Storage Oysters	2000 oysters in wet storage for 2 weeks	Pacific Diploid Oyster	Rack and Bag
020621-MR-7-1	6/21/2002 11:13	5	Coast Seafoods	Mad River Bed 7-1	Started in 1999	Pacific Diploid Oysters	Bottom
020621-MR-7-2	6/21/2002 11:17	6	Coast Seafoods	Mad River Bed 7-2	Started in 2000	Pacific Diploid Oysters	Longline
020621-SIN	6/21/2002 11:25	7	Coast Seafoods	Sand Island North Bed	Started in 2000	Pacific Diploid Oysters	Longline
020621-SIN-1-2	6/21/2002 11:32	8	Coast Seafoods	Sand Island North Bed 1-2	Started in 2000	Kumamoto Oysters	Longline
020621-BIN	6/21/2002 11:36	9	Coast Seafoods	Bird Island North Bed	Started in 2000	Pacific Diploid Oysters	Longline
020621-BIS	6/21/2002 11:44	10	Coast Seafoods	Bird Island South Bed	Started in 2000	Kumamoto Oysters	Longline
020621-Ebay-1-2-S	6/21/2002 9:40	2	--	East Bay Bed 1-2	--	Sediment	--
020621-NBSC-S	6/21/2002 10:12	3	--	North Bay Shellfish Company Bed	--	Sediment	--
020621-MR-7-1-S	6/21/2002 11:13	5	--	Mad River Bed 7-1	--	Sediment	--
020621-BIN-S	6/21/2002 11:36	9	--	Bird Island North Bed	--	Sediment	--

■ **Figure 1. Sample Location Map.**



■ Pentachlorophenol Results

Testing by Toxscan for pentachlorophenol resulted in no detectable quantities in any of the mussel or oyster samples. The detection limit was 1 part per million (after dilution).

■ Dioxin Results

Alta Analytical Laboratory's dioxin testing laboratory data sheets are provided in Appendix III. The dioxin test results are summarized in Table 2.

Table 2. Results of dioxin testing of composite whole oyster and mussel tissues collected from commercial beds in Humboldt Bay, California.

Dioxin toxic equivalency (TEQ) was calculated using World Health Organization mammalian toxic equivalency factors, which have been endorsed by both the U.S. Environmental Protection Agency and California Environmental Protection Agency and California Department of Health Services. Non-detect measurements were represented using ½ the congener-specific detection limit reported by the laboratory.

Sample Description	Dioxin Test Result (pg TEQ/gram wet weight)
Location 4, Rack and Bag Mussel	1.0
Location 1, Bottom Triploid Oyster	0.9
Location 2, Longline Triploid Oyster	1.4
Location 3, Longline Diploid Oyster	4.3
Location 4, Rack and Bag Diploid Oyster	2.2
Location 5, Bottom Diploid Oyster	1.5
Location 6, Longline Diploid Oyster	1.7
Location 7, Longline Diploid Oyster	2.2
Location 8, Longline Kumamoto Oyster	1.2
Location 9, Longline Diploid Oyster	0.8
Location 10, Longline Kumamoto Oyster	1.3
Mean Oyster Concentration (n=10)	1.8

The results of laboratory testing for dioxins in ten composite samples of commercially grown oysters and one composite sample of commercially grown mussels indicated the presence of low levels of dioxins. In ten composite whole oyster tissue samples, the total dioxin TEQ concentration (using World Health Organization mammalian toxic equivalency factors; WHO-TEQ) ranged between 0.08 and 4.3 pg dioxin TEQs/gram (mean concentration of 1.8 pg dioxin TEQ/gram). Total dioxin concentrations (the sum of all tetra- through octa-chlorinated dioxin and furan congeners) ranged between 36 and 174 pg/g (mean concentration of 85 pg/g). The concentration of dioxin in the single composite mussel sample was comparable to the levels found in oysters—the dioxin TEQ and total dioxin concentrations in mussel were 1.0 pg TEQ/g and 91 pg/g, respectively.

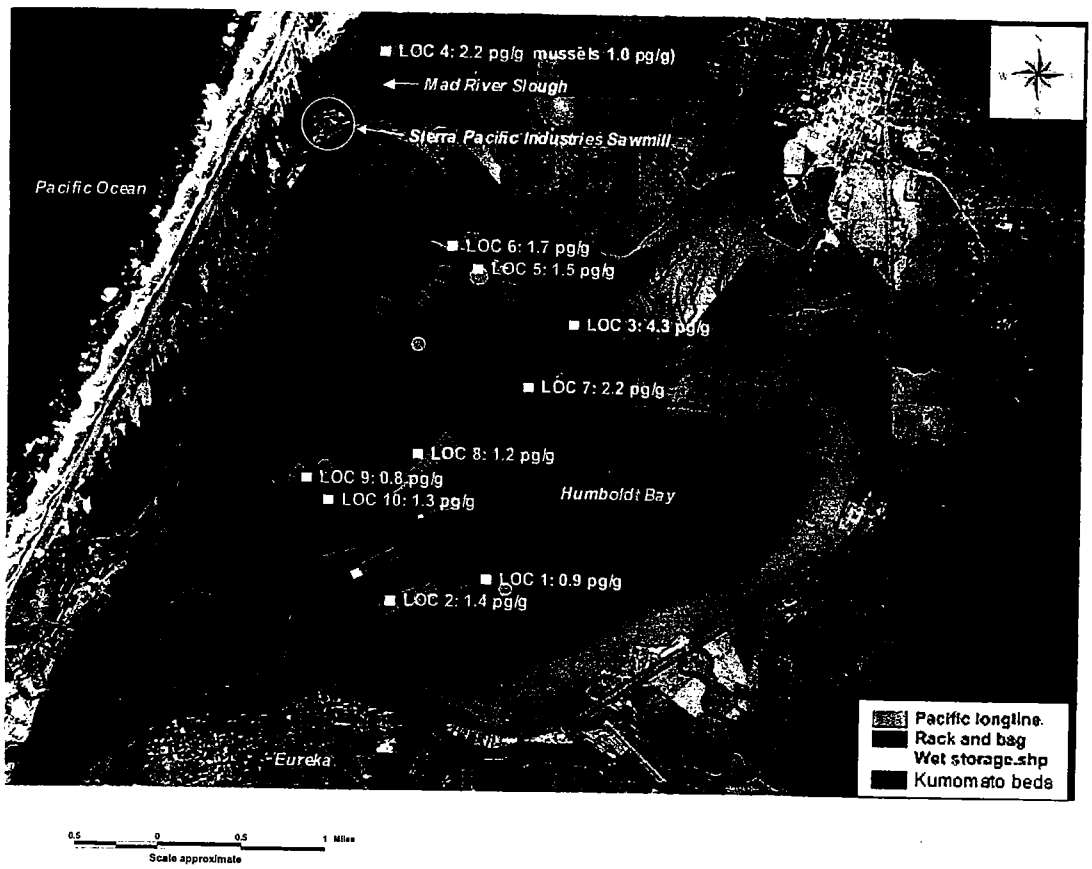
In general, dioxin concentrations were slightly, but not statistically significantly, higher in diploid Pacific oysters than in Kumamoto oysters and triploid Pacific oysters. The dioxin test results did not reveal a significant difference between oysters grown using a longline suspended in the water and oysters grown on the sediment bottom. Given that dioxins are relatively insoluble in water and typically associated with the particulate fraction in water samples, it was expected that oysters grown using longlines would be associated with lower dioxin concentrations than those grown in beds directly on the sediment bottom.

The concentrations of total dioxin TEQs in composite samples of whole oyster tissues from each sampling location are shown in Figure 2. In general, total dioxin TEQ concentrations in composite samples of whole oyster tissues in commercial beds representing background

conditions in Humboldt Bay (i.e., locations 1 and 2 shown on Figures 1 and 2) were not statistically different from dioxin TEQ concentrations in oysters collected elsewhere in the Bay. The concentrations of dioxins in the two composite samples of oysters or mussels collected from the Mad River Slough (i.e., location 4) were not the highest concentrations found in this study. The highest dioxin TEQ concentration in a composite oyster sample was found in diploid Pacific oysters grown using longlines at Location 3 (Figures 1 and 2).

Figure 2. The locations of the different commercial oyster beds included in the study and the concentrations of total dioxin TEQs in composite samples of whole oyster tissues from each sampling location.

Results shown represent the concentration reported in each individual composite sample. Dioxin toxic equivalency (TEQ) was calculated using World Health Organization mammalian toxic equivalency factors, which have been endorsed by both the U.S. Environmental Protection Agency and California Environmental Protection Agency and California Department of Health Services. Non-detect measurements were represented using ½ the congener-specific detection limit reported by the laboratory.



The occurrence of several 2,3,7,8-substituted and non-2,3,7,8-substituted congeners suggests more than one source of the dioxins found in oysters and mussels. The profile of 2,3,7,8-substituted dioxins and dioxin and furan homologues in oysters and in the single composite mussel sample is presented in Figure 3. The profile of total dioxin and furan homologues is shown in Figure 4. The pattern of dioxins found in oysters and mussels is unlike the dioxin profile described by USEPA (2000b) as typically associated with wood treatment products containing pentachlorophenol. The presence of trace concentrations of several dioxin and furan

congeners suggests that the presence of dioxins in oysters and mussels is the result of contributions from more than one source. Possible environmental sources that should be investigated further include storm water and surface water runoff, effluents from municipal sewage treatment plants, and releases from combustion sources that reach the Bay either directly through effluent or indirectly through deposition of particulates in air.

Figure 3. Average profile of 2,3,7,8-substituted dioxins in composite whole oyster and mussel tissues.

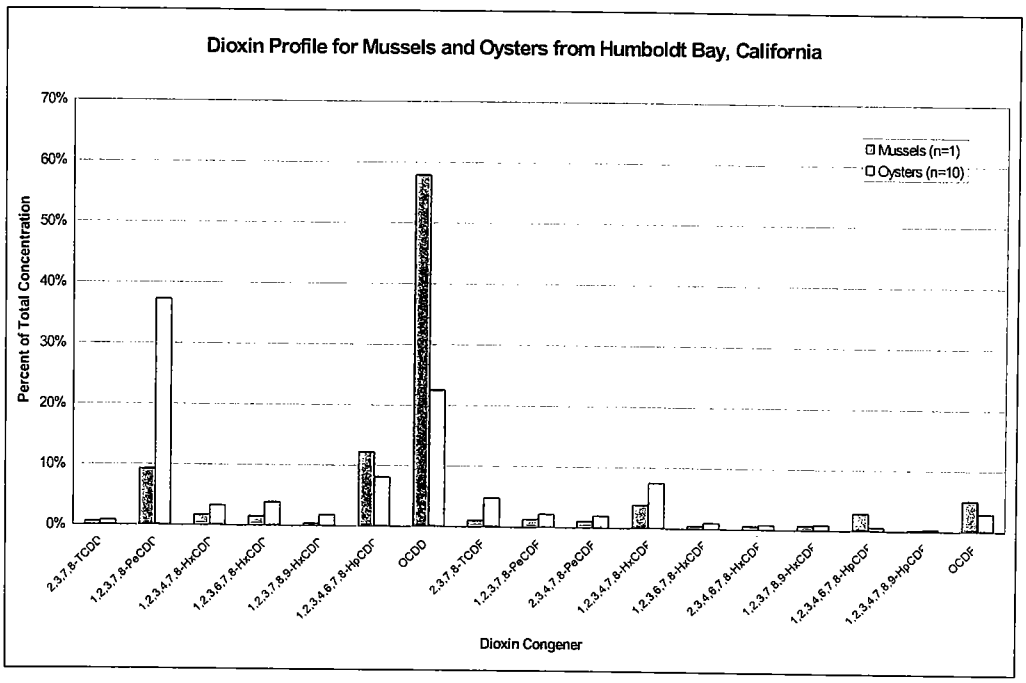
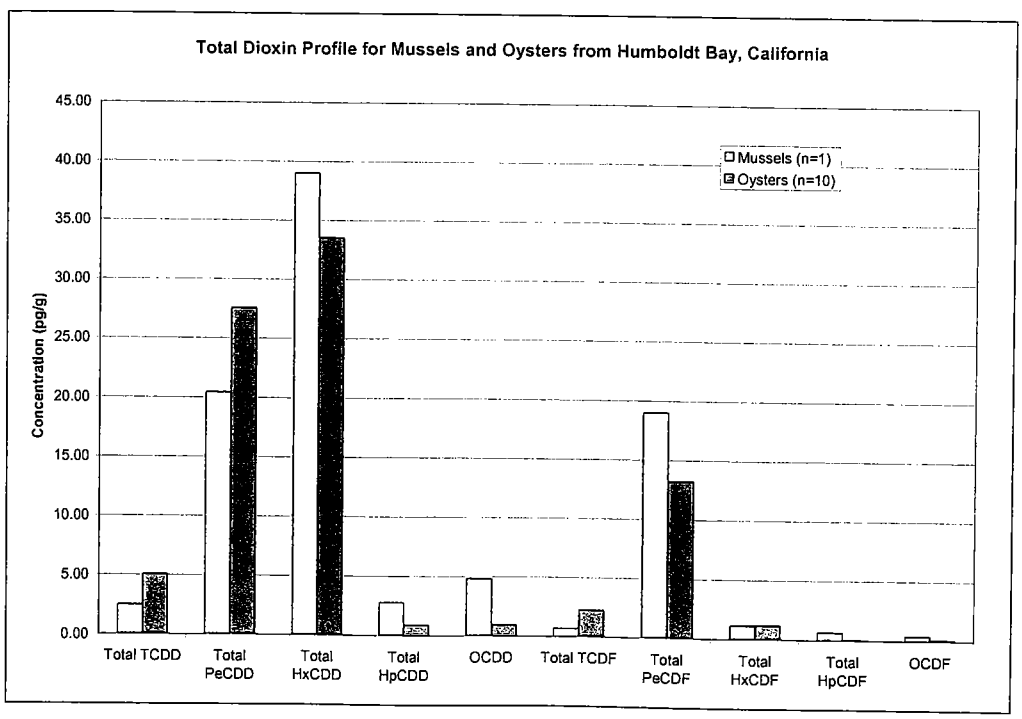


Figure 4. Average profile of total dioxin and furan homologues in composite whole oyster and mussel tissues.

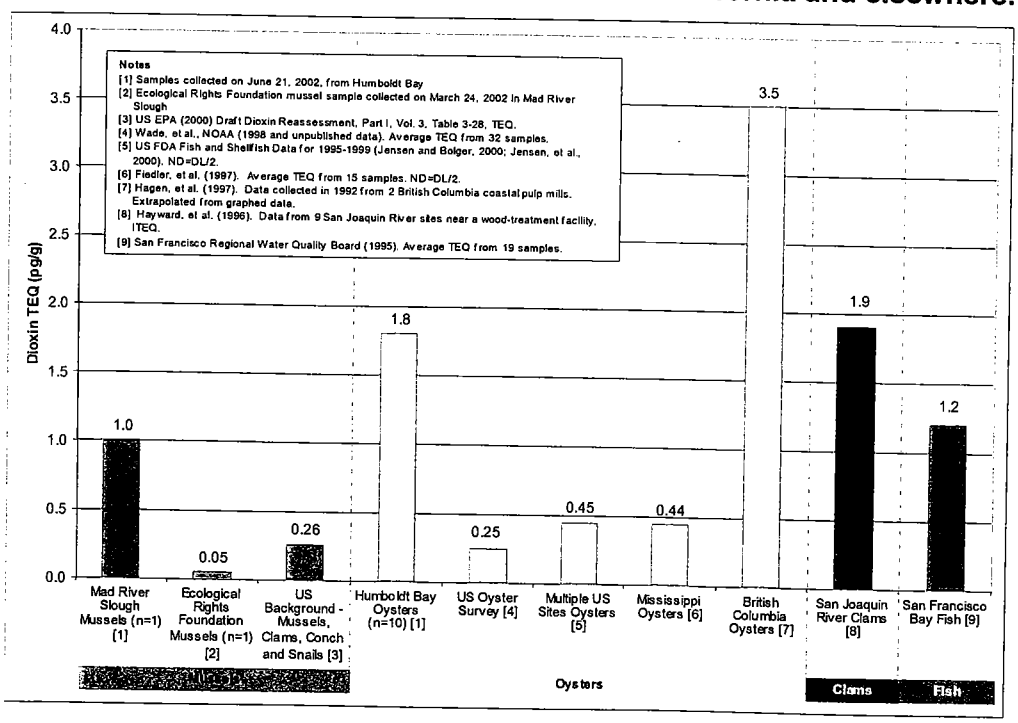


The most toxic congener among the family of dioxin compounds, 2,3,7,8-TCDD, was found at trace levels (i.e., well below one part per trillion) in four of the eleven oyster and mussel tissue samples and below detection limit in the others. At locations 4, 5, 6, and 8 (see Figure 1), the concentration of 2,3,7,8-TCDD was between 0.04 and 0.06 pg/g (or parts per trillion). At these locations, trace levels of 2,3,7,8-TCDD were measured in mussel and diploid Pacific oysters (location 4), diploid Pacific oysters (locations 5 and 6), and Kumamoto oysters (location 8).

Comparisons to Shellfish Data Reported in the Scientific Literature

The levels of dioxin TEQ measured in the mussels and oysters collected from Humboldt Bay were compared to published data in the scientific literature to evaluate the significance of the detected levels (see Figure 5). However, few data are available in the scientific literature and no monitoring of oysters has been performed by the State of California. The few data available from USEPA (2000b) describe background levels of dioxin in mussels, clams, conch, and snails as 0.26 pg TEQ/g, using WHO TEFs. One mussel sample collected by the Ecological Rights Foundation (ERF) in March, 2002, showed 0.05 pg TEQ/g, using WHO TEFs. The exact location in the Bay where the sample was collected has not been reported. The U.S. Food and Drug Administration (USFDA) and other researchers report background levels of dioxins in U.S. oysters as 0.44 and 0.45 pg TEQ/g, using WHO TEFs. The average concentration of dioxins in oysters collected from locations near pulp and paper mills in British Columbia, Canada, was 3.5 pg TEQ/g, using WHO TEFs, which is higher than the average oyster concentration from Humboldt Bay.

Figure 5. Comparison of dioxin TEQ levels in composite whole oyster and mussel tissues collected from commercial beds in Humboldt Bay, California, with levels in reported in fish and shellfish from California and elsewhere.



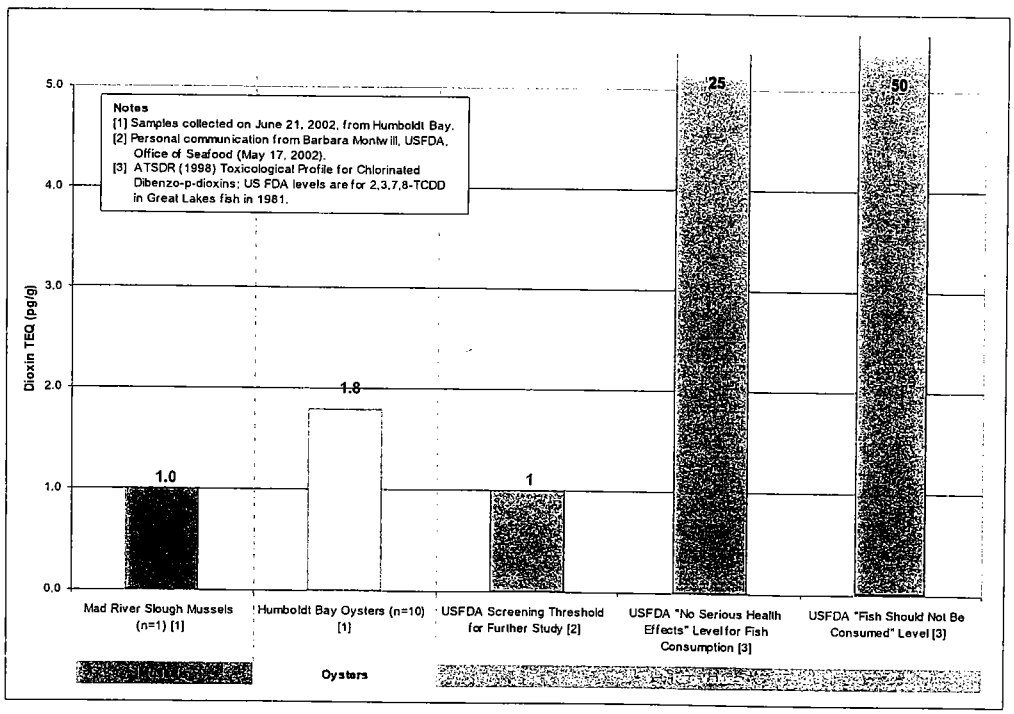
Comparisons to dioxin levels reported in fish from San Francisco Bay and lakes in the Bay Area and Central Valley indicate that dioxin levels are within the range found in Humboldt Bay oysters and mussels. In San Francisco Bay, the San Francisco Regional Water Quality Control Board (SFRWQCB, 1995) reported that dioxin TEQs in sport fish ranged between 0.22 and 2.3 pg TEQ/g wet weight. In a study of two California lakes reported in 1999, California EPA's Office of Environmental Health Hazard Assessment (OEHHA) reported dioxin TEQ concentrations in fish from both lakes ranged between 0.08 and 1.5 pg TEQ/g wet weight.

Comparison to USFDA Action Levels

The USFDA screening concentration for dioxin of 1 pg/g has been used informally to trigger further investigation and study to identify sources and to determine if the detected levels in the edible portions of fish and shellfish tissues pose a health hazard (personal communication from Barbara Montwill of the FDA by email to Scott Braithwaite of ENVIRON, May 17, 2002). The current USFDA action level for dioxin TEQs in edible fish and shellfish tissues is 25 pg TEQ/g. At 50 pg TEQ/g, USFDA recommends that fish and shellfish not be consumed.

Comparison of the dioxin TEQ concentrations in Humboldt Bay oysters and mussels to the USFDA action levels is presented in Figure 6. The levels found in both oysters and mussels from Humboldt Bay are below the USFDA threshold.

Figure 6. Comparison of dioxin TEQ levels in composite whole oyster and mussel tissues collected from commercial beds in Humboldt Bay, California, with U.S. Food and Drug Administration (USFDA) action levels in fish and shellfish.



V. Screening-Level Shellfish Consumption Assessment

Approach to Calculating Theoretical Exposure and Risk

This screening-level exposure assessment relies on the information contained in the USEPA Draft Dioxin Reassessment for both exposure and toxicity information (USEPA, 2001a, 2001b, 2001c, 2000a, 2000b). During the past decade or more, scientists from the USEPA, other federal agencies, and the scientific community have conducted a comprehensive reassessment of dioxin exposure and human health effects. The current draft report of this effort, commonly referred to by scientists as the Draft Dioxin Reassessment, is expected to be finalized within the next several months.

In this assessment, exposures to dioxin by shellfish consumers were evaluated using two methods. The first method used a standard USEPA exposure model to evaluate the shellfish consumption habits of the reasonably maximally exposed (RME) individual, similar to the description of the RME profile described in USEPA (1989) risk assessment guidance. The RME is defined by USEPA (1989) as an individual who is of typical behavior and physical characteristics and represents the upper-bound of the range of behaviors and physical characteristics in the population of interest (in this case, consumers of oysters and mussels).

The second method involved comparison of exposure levels to background exposures from dietary and other sources identified by USEPA in the Draft Dioxin Reassessment (USEPA, 2000b). In California, OEHHA has used this approach to evaluate the incremental increase in dioxin exposure from particular sources relative to the average person's normal daily exposure from background sources (OEHHA, 1995).

The exposure model used to calculate theoretical dioxin intake by a shellfish consumer was adopted from USEPA (1997), and the equation is given as follows:

$$CDI = C * IR * Abs * FI * CL * CF * 1/BW$$

Where:

CDI is the chronic daily intake averaged over a lifetime (for cancer effects) and exposure period (for noncancer effects), respectively;
C is the total dioxin TEQ concentration in oyster or mussel tissue (pg TEQ/g);
CF is a unit conversion factor (mg/pg);
IR is the shellfish ingestion rate (g/day);
FI is the fraction of shellfish consumed that originates in Humboldt Bay (unitless);
CL is the cooking loss factor that typically accounts for the reduction in dioxin levels in food as result of different cooking methods (unitless);
AFo is the oral absorption factor for dioxin (unitless); and
BW is body weight (kg).

The exposure assumptions used to predict theoretical exposure to dioxins by shellfish consumption are summarized in Table 4. Data describing shellfish consumption habits in the U.S. population reported in the USEPA (2000b) Draft Dioxin Reassessment report were used to represent the amount of shellfish typically consumed by an adult. It was assumed that the typical shellfish consumer consumed, on average, 0.15 g/day of oysters and 0.07 g/day of mussels (see Table 3-28, p. 3-147 of USEPA, 2000b). A cooking loss factor was not included in the model; that is, changes in dioxin levels due to food preparation method were not considered. According

to USEPA (2000b) only approximately one-half of ingested dioxin is absorbed in the gastrointestinal tract (54 percent; the remaining fraction of dioxin intake associated with the oral exposure route is excreted.

The typical shellfish consumer was assumed to obtain all of the oysters and mussels in his or her diet from Humboldt Bay. The typical shellfish consumer was assumed to eat oysters and mussels every day of the year. The model did not consider limitations in the supply of oysters and mussels and the duration of the harvesting season in Humboldt Bay, which would result in an average exposure frequency of approximately 6 months, rather than year-round.

Three dioxin concentrations were evaluated in the exposure model. Consistent with California DTSC (1992) risk assessment guidance, dioxin intake was evaluated using the 95th percentile of the total dioxin TEQ concentration calculated from the ten composite whole oyster tissue sample results. In addition, the mean concentration from the ten composite whole oyster tissue sample results also was evaluated using the same model. Lastly, the total dioxin TEQ concentration in the single composite whole mussel tissue sample also was evaluated using the model.

The theoretical daily intake of dioxins from shellfish consumption was calculated and averaged over an average human lifetime to evaluate theoretical cancer risks. The incremental cancer risks describing the probability of an individual developing cancer during a 70-year average human lifetime of exposure to total dioxin TEQs were calculated using USEPA recommended methods (USEPA, 2000b, 1989). The theoretical excess cancer risk is a the product of the Lifetime Average Daily Dose (LADD), which is defined as the total incremental dose of total dioxin TEQs received as a result of exposure averaged over a lifetime, and the cancer slope factor (CSF). Consistent with USEPA (1989) guidance, the theoretical cancer risk was calculated as follows:

$$Theoretical\ Cancer\ Risk = LADD * CSF$$

In accordance with USEPA (1989) risk assessment guidance, the probability of adverse non-cancer effects was evaluated using a "Hazard Quotient" (HQ) approach. Possible adverse non-cancer health effects were evaluated by comparing the predicted daily intake to the oral reference dose (RfD) established by the USEPA for dioxin. If the predicted dose was below the RfD, then the predicted dose would not be expected to pose a significant non-cancer health hazard under the conditions evaluated (USEPA, 1989). An HI less than or equal to one indicates that exposure to dioxin is unlikely to result in adverse health effects to the receptor of interest.

$$Hazard\ Quotient = \frac{ADD}{RfD}$$

Table 3. Exposure assumptions for calculation of theoretical exposures to dioxins associated with consumption of oysters and mussels from Humboldt Bay, California.

Exposure Parameter	Variable	Units	Receptor Adult	Reference
Physiological Assumptions				
Body weight	BW	kg	70	USEPA (1997) EFH
Oyster ingestion rate	IRo	g/day	0.15	USEPA (2000) DR
Mussel ingestion rate	IRm	g/day	0.07	USEPA (2000) DR
Fraction of shellfish ingested from Humboldt Bay	FI	unitless	1	Assumes all consumed shellfish originates from Humboldt Bay
Environmental Assumptions				
Absorption factor, oral route	AFo	unitless	0.54	USEPA (2000) draft Dioxin Reassessment, vol. 4, p. 2-5)
Cooking loss	CL	unitless	1	Assumes no loss during cooking (or eaten raw)
Chemical Potency Assumptions				
TCDD Cancer Slope Factor, inhalation and oral	CSF	$(mg/kg\text{-}day)^{-1}$	1.30E+05	OEHHA, ARB (2002) Table 1
TCDD Reference Dose, oral	RfDo	mg/kg-day	1.00E-08	OEHHA chronic oral reference level
Chemical Assumptions				
Conversion Factor	CF	mg/pg	1E-09	
Total Dioxin TEQ concentration, 95th percentile, oysters only	Cd1	pg TEQ/g	3.4	N=10; ND = 1/2 DL
Total Dioxin TEQ concentration, mean, oysters only	Cd2	pg TEQ/g	1.8	N=10; ND = 1/2 DL
Total Dioxin TEQ concentration, single mussel	Cd3	pg TEQ/g	1.0	N=1; ND = 1/2 DL

Key to Sources:

1. USEPA (1997) EFH - Exposure Factors Handbook, US Environmental Protection Agency, Office of Research and Development, August 1997
2. USEPA (2000) DR - Draft Dioxin Reassessment, US Environmental Protection Agency, Office of Research and Development, September 2000
3. OEHHA - Chronic Toxicity Summary, Chlorinated Dibenzo-p-dioxins and Chlorinated Dibenzofurans, California Office of Environmental Health Hazard Assessment

Evaluating Dioxin Health Effects in Humans

With regard to carcinogenicity, USEPA's Draft Dioxin Reassessment characterizes the complex mixtures of dioxin to which people are exposed to as a "likely human carcinogen" (USEPA, 2001b). This is based on USEPA's conclusion that there is not sufficient epidemiology data to confidently characterize the cancer hazard of 2,3,7,8-TCDD and conclude that 2,3,7,8-TCDD is a "human carcinogen". By combining the limited and inconclusive evidence from epidemiology studies with the unequivocal evidence from experimental animal studies, the USEPA has characterized the complex mixtures of dioxin as "likely" cancer hazards (USEPA, 2001b).

For the purposes of evaluating the theoretical incremental cancer risk associated with exposure to dioxin, this screening-level analysis relied upon the cancer potency estimate currently used by California OEHHA (2002). The USEPA has proposed 1 x 10^6 per mg 2,3,7,8-TCDD/kgBW/day in the Draft Dioxin Reassessment as the slope factor to use to estimate the upper bound cancer risk for both background intakes and incremental intakes above background (USEPA, 2001a, 2001c, 2000b). The USEPA's revised slope factor is sharply higher than the Agency's earlier

cancer slope factor of 1.56×10^5 per mg 2,3,7,8-TCDD/KgBW/day (USEPA, 1984) and California OEHHA/ARB approved oral and inhalation slope factors of 1.3×10^5 per mg 2,3,7,8-TCDD/kgBW/day (Table 1; OEHHA, 2002). The proposed slope factor has not been formally endorsed as new policy by USEPA.

With regard to health effects other than cancer, USEPA (2000b) has concluded from its evaluation of the available epidemiologic and animal data that humans, in general, are neither extremely sensitive nor insensitive to the individual effects of dioxins. The available information suggests that human response to exposure to dioxin is highly variable, although the vast majority of the research has highlighted only certain prominent, and potentially significant, effects associated with 2,3,7,8-TCDD. Relatively little information is available to independently evaluate the effects of exposure to other dioxin congeners.

Because of the relatively high background level of exposure compared to effects levels observed or calculated from animal bioassays, USEPA's Draft Dioxin Reassessment does not recommend revisions to non-cancer Reference Doses (RfDs, for evaluating oral and dermal exposures) for dioxin previously established by the Agency (USEPA, 2000b). Although RfDs are often useful because they represent a health risk benchmark below which there is likely no appreciable risk of non-cancer effects, their primary use is to evaluate increments of exposure from specific sources when background exposures are low and insignificant. In the case of dioxin, USEPA (2000b) states that any RfD recommended by the Agency under the traditional approach for setting an RfD would likely be 2 to 3 orders of magnitude (i.e., 100 to 1,000) below current background intakes and human body burdens. Consequently, USEPA (2001b, 2000b) has concluded that setting an RfD for incremental exposure when the RfD has already been exceeded in the general population by background conditions is meaningless.

Both ATSDR and USEPA (2000b) recommend characterization of average background exposures, as well as characterization of the percent increase over background of individuals or populations of interest. The USEPA states that while it would be reasonable in a risk assessment to evaluate incremental exposure relative to an RfD, since "background" exposures have already been determined to be above the RfD. The determination of the incremental increase over background exposures would provide more useful information on total dioxin exposure.

Theoretical Shellfish Consumption and Risk

A summary of the exposure modeling results is presented in Table 5. Assuming the typical shellfish consumer enjoys a diet of oysters and mussels obtained only from Humboldt Bay, the theoretical cancer risk and non-cancer hazard to a shellfish consumer associated with exposure to dioxins is below 1×10^{-6} risk and well below a hazard index of one, respectively. The predicted theoretical cancer risk to shellfish consumers was approximately five in ten million (5.1×10^{-7} risk), which is below the range of 1×10^{-4} to 1×10^{-6} risk considered acceptable by USEPA and below the 1×10^{-5} risk level considered acceptable in the State of California under Proposition 65. The hazard quotient representing the theoretical non-cancer threat posed by exposure to dioxins was three to fours orders of magnitude below one (Table 5).

Table 4. Theoretical daily intake and health risks posed by exposure to total dioxin TEQs from consumption of oysters and mussels consumed exclusively from Humboldt Bay, California.

Exposures were calculated using the mean and 95th percentile of the mean concentration of total dioxin TEQs in composite whole oyster tissues, as well as the concentration of total dioxin TEQs in the single composite whole mussel tissue collected from the Mad River Slough.

	Oysters, 95th percentile	Oysters, mean	Mussels
Theoretical daily intake (mg TEQ/kgBW-day)	3.9×10^{-12}	2.1×10^{-12}	5.4×10^{-13}
Theoretical cancer risk	5.1×10^{-7}	2.7×10^{-7}	7.0×10^{-8}
Theoretical hazard index	0.0004	0.0002	0.00005

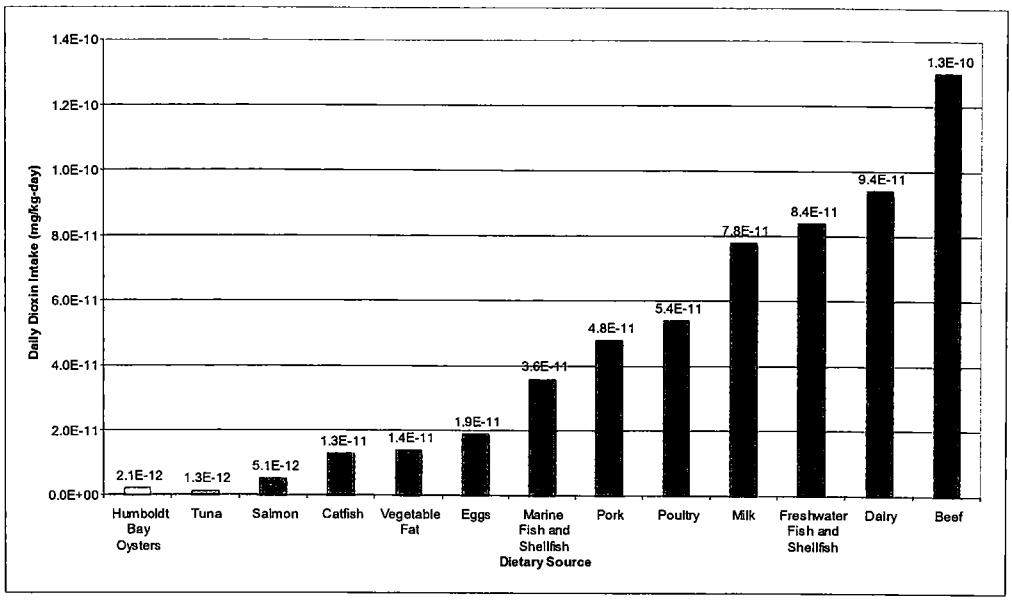
Background Exposures to Dioxin

The term "background" exposure is used by USEPA (2000b) to describe exposure of the general population that is not exposed to readily identifiable point sources. Dioxins are ubiquitous in the environment and can be found virtually everywhere. These substances work their way up the food chain by accumulating in the body fat of fish and animals. Because of this, the single largest source of exposure to dioxins is through the consumption of food, primarily meat, dairy products, and fish. More than 90% of a person's average daily intake of dioxins is from the diet (Bolger and Jensen, 2001; USEPA, 2000b).

Using the conservative assumptions described in this preliminary exposure analysis, the consumption of shellfish from Humboldt Bay is responsible for a very small fraction of a person's daily intake of dioxins. According to a recent study of store-bought fish and dairy products conducted by the U.S. Food and Drug Administration (USFDA), the mean estimated per capita daily intake of 2,3,7,8-substituted dioxins in the general U.S. population is between 12 and 29 pg dioxin TEQ/day, and may be as high as 80 pg dioxin TEQ/day at the 90th percentile of the U.S. population (Jensen and Bolger, 2001).

Comparison of the predicted theoretical daily intake of dioxins from consumption of Humboldt Bay oysters to intake from other dietary sources is presented in Figure 7.

Figure 7. Comparison of the theoretical average daily intake of dioxin TEQ from consumption of Humboldt Bay oysters with total dioxin intake from all dietary sources estimated by USEPA in the Draft Dioxin Reassessment (USEPA, 2000b).



Both USEPA's Draft Dioxin Reassessment and studies conducted in the San Francisco Bay Area by the Regional Water Quality Control Board and Bay Area Air Quality Management District hypothesize that the primary mechanism by which dioxins enter the environment and human diet is through atmospheric deposition (USEPA, 2000b; SFRWQCB, 1998; BAAQMD, 1996). For example, an investigation of dioxins and their sources performed by the San Francisco Regional Water Quality Control Board (SFRWQCB) concluded that the distribution of dioxins typically found in sport fish, air, and storm water closely resembles that observed in releases from a wide variety of combustion sources (Wenning et al., 1999, 2000; SFRWQCB, 1998). Dioxins enter the atmosphere directly through air emissions and are widely spread in the environment as a result of a number of physical processes (e.g., re-suspension of particles). At present, it is unclear whether atmospheric deposition represents primarily current contributions of dioxins from all media, or past emissions that persist and recycle in the environment.

In summary, the theoretical daily intake predicted for the typical shellfish consumer represented a very small fraction of estimates developed by USEPA in its current Draft Dioxin Reassessment of the typical average daily intake of dioxins from dietary and environmental sources of 59 pg dioxin TEQ/kg/day (USEPA, 2000b). The presence of dioxins in oysters and mussels represents a negligible contribution to a person's normal background exposure to dioxins. Dioxin exposure to shellfish consumers portrayed in this screening-level risk analysis represented less than 1% of the typical background intake of dioxins estimated by USEPA (2000b).

VI. Conclusions

Dioxin and pentachlorophenol testing of commercially grown oysters and mussels in Humboldt Bay, California, was conducted by ENVIRON International Corporation (ENVIRON) on behalf of Sierra Pacific Industries, Arcata Division Sawmill located near Arcata, California, in response to concerns raised by Coast Seafoods, Inc., and other local commercial shellfish businesses about possible contamination of commercial oyster beds located in Humboldt Bay. The field sampling, chemical testing, and screening-level exposure assessment methods used in this study were performed in a manner consistent with U.S. Environmental Protection Agency (USEPA) and State of California guidance for collection and chemical testing of biota (and specifically shellfish) and risk assessment.

The results of this study support the following conclusions:

1. Testing of composite samples of whole oyster and mussel tissues collected from Humboldt Bay indicated the presence of low concentrations of dioxins (less than approximately 2 pg total dioxin TEQ/gram in all but one composite oyster tissue sample). The total dioxin TEQ concentration in oysters and mussels is within the range reported in fish from San Francisco Bay, and the few available data describing levels in shellfish elsewhere in the U.S.

2. The distribution of dioxin congeners found in composite whole oyster and mussel tissues suggest that more than one source of dioxins contributes to the occurrence of dioxins in shellfish in Humboldt Bay.

3. The levels of dioxins in oysters and mussels is well below the 25 pg/gram (i.e., part per trillion) benchmark for dioxins in fish or shellfish tissues that USFDA has identified as a level associated with no serious health effects.

4. Using a screening-level exposure model to evaluate intake and health risks to shellfish consumers, the occurrence of dioxins in oysters and mussels from Humboldt Bay does not pose a significant health risk to shellfish consumers. The theoretical health risks posed by exposure to dioxins assuming a daily diet of oysters and mussels from Humboldt Bay posed an incremental lifetime cancer risk below 1 in 1,000,000 (10^{-6} risk), which is below the 10^{-4} to 10^{-6} risk range considered acceptable by USEPA and the State of California, and below the 10^{-5} risk level specified in California Proposition 65 as the threshold for communicating a potential health hazard of a consumer product to the general public in the State of California.

5. The presence of dioxins in oysters and mussels from Humboldt Bay represents a negligible contribution to a person's normal background exposure to dioxins. Dioxin exposure to shellfish consumers represents less than 0.1% of the typical background daily intake estimated by the USEPA.

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Appendix I:

ENVIRON Sampling and Analysis Plan

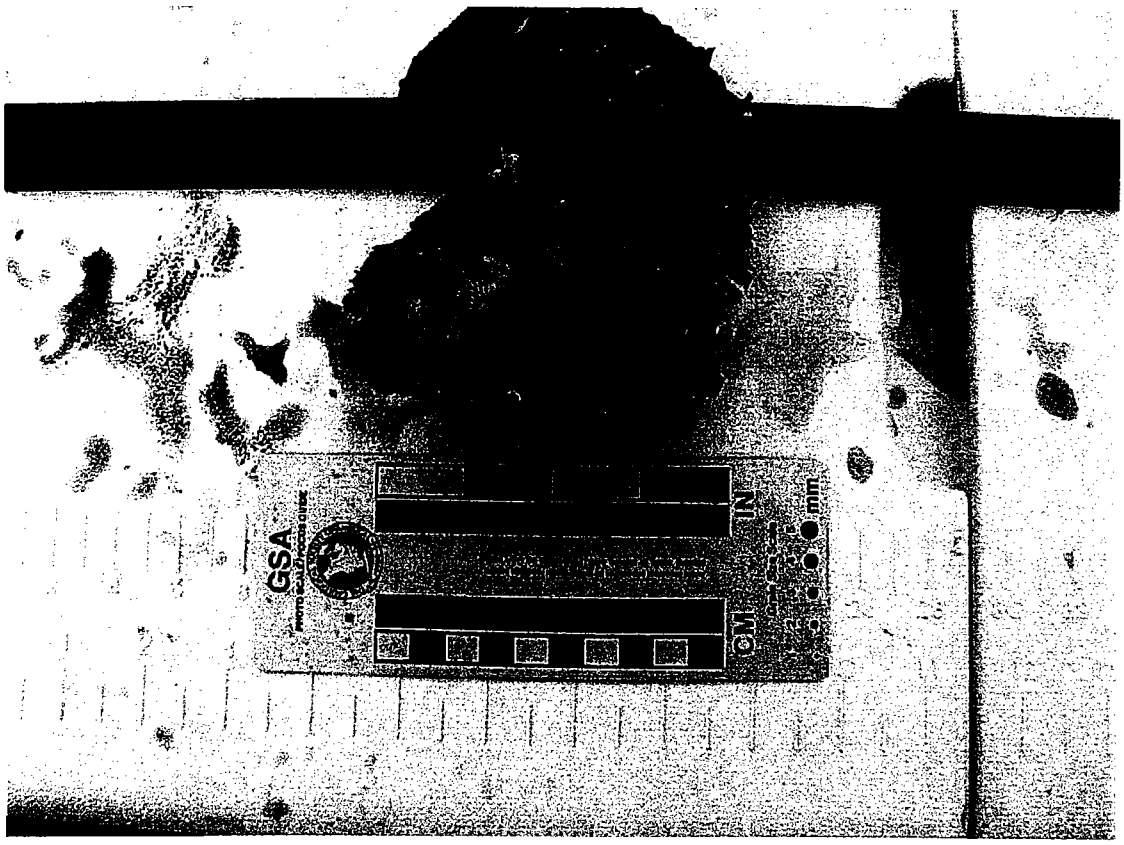

Photo 15: Example of a Pacific Oyster from Location 7.

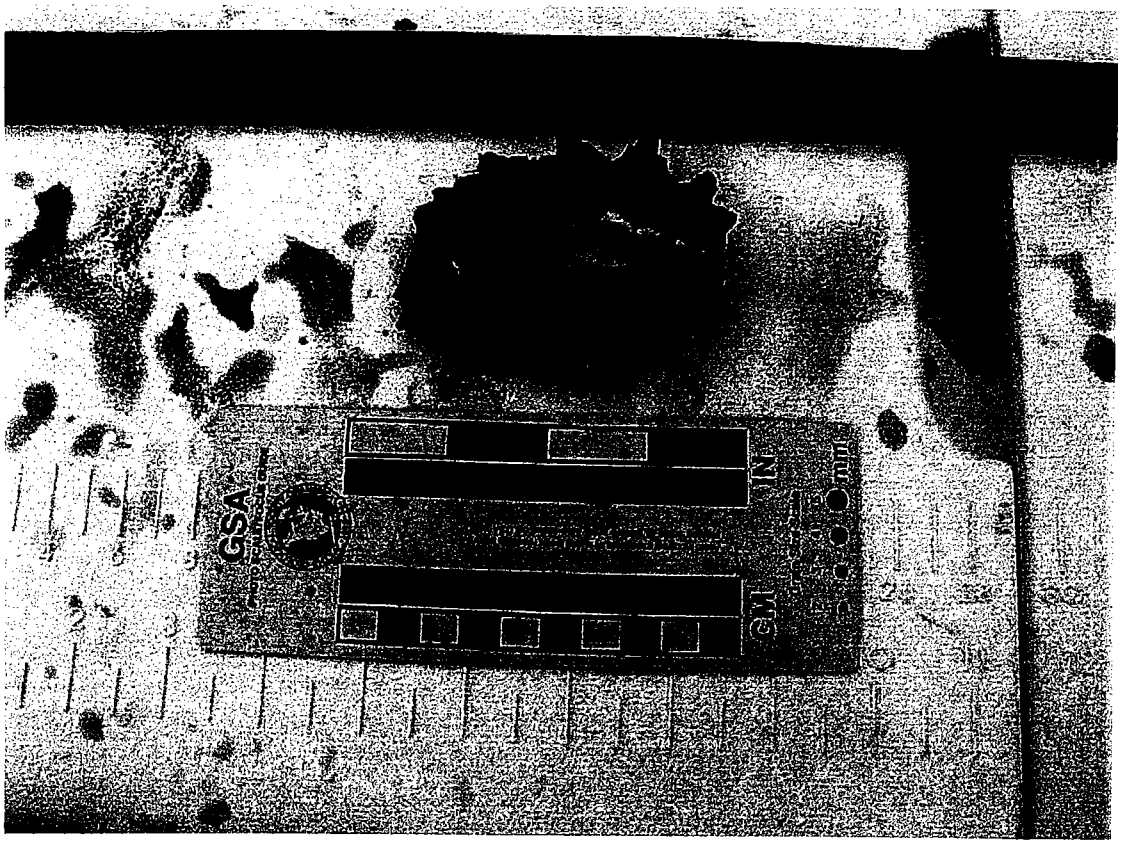

Photo 16: Example of a Pacific Oyster from Location 9.

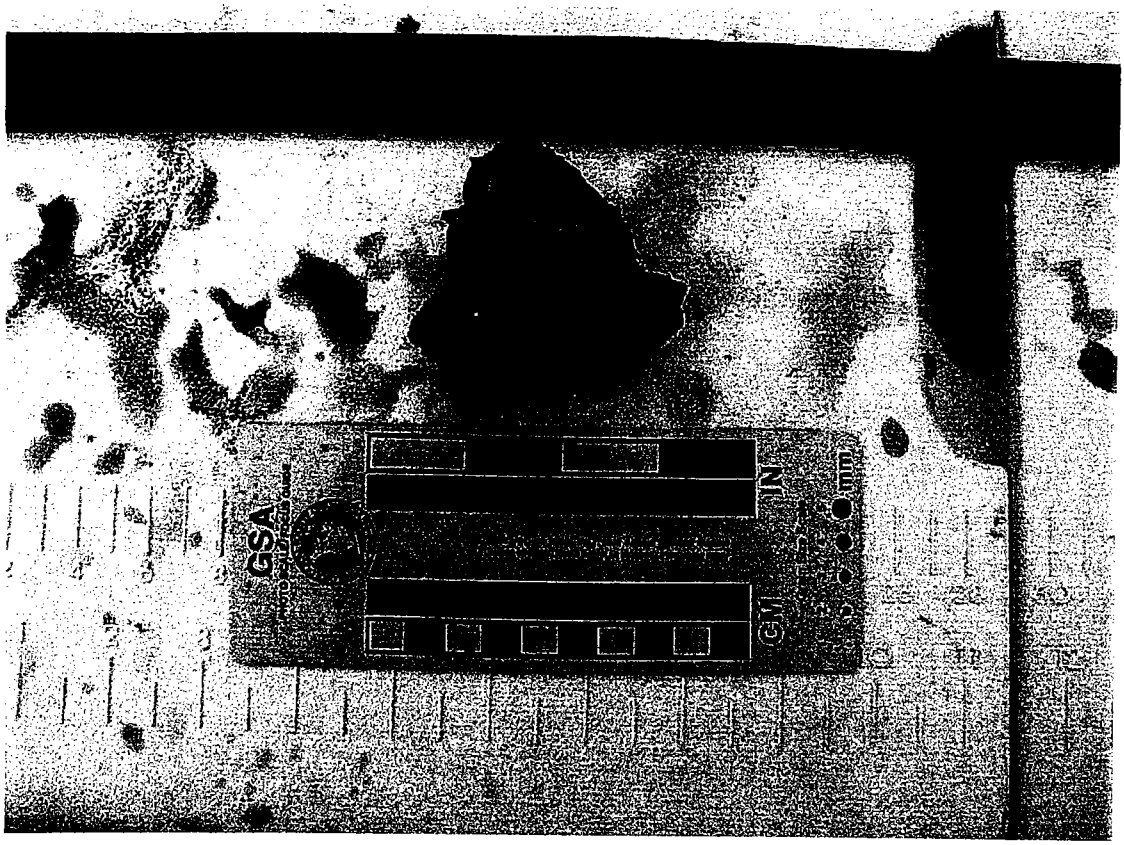

Photo 17: Example of a Kumamoto Oyster from Location 8.

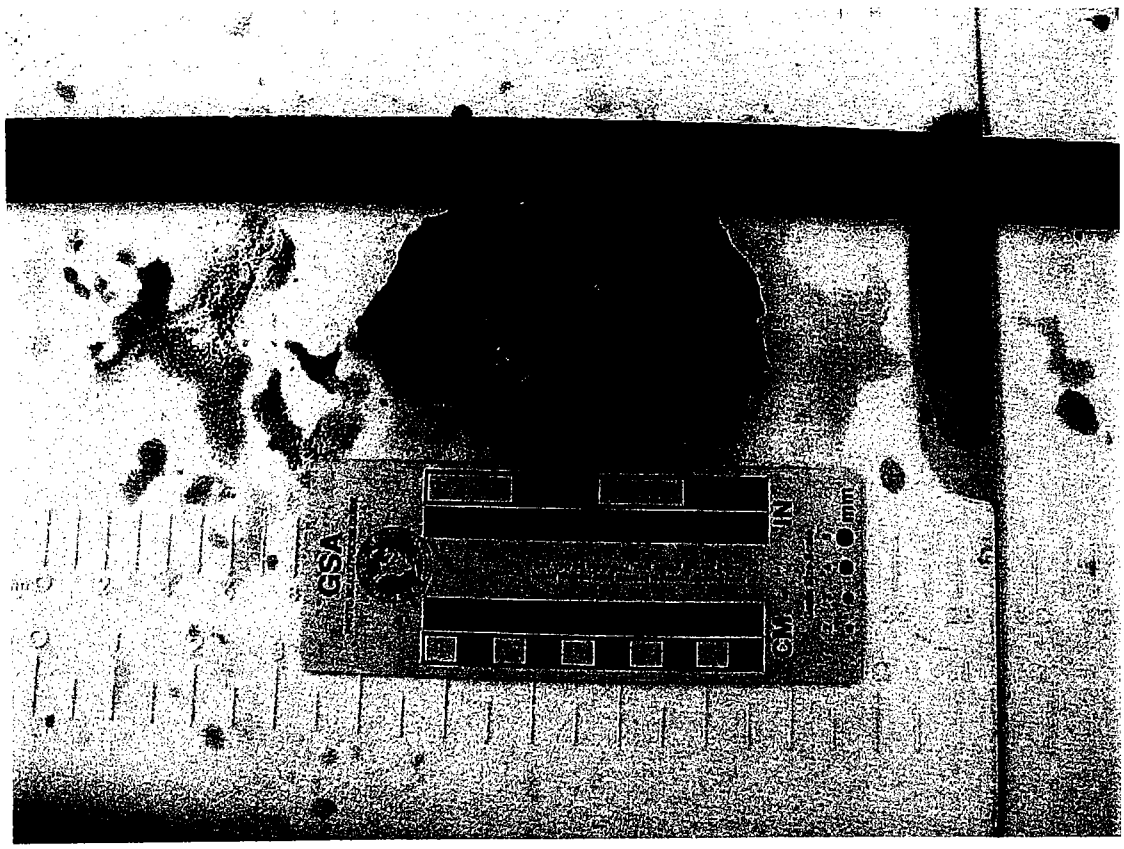

Photo 18: Example of a Pacific Triploid Oyster from Location 2.

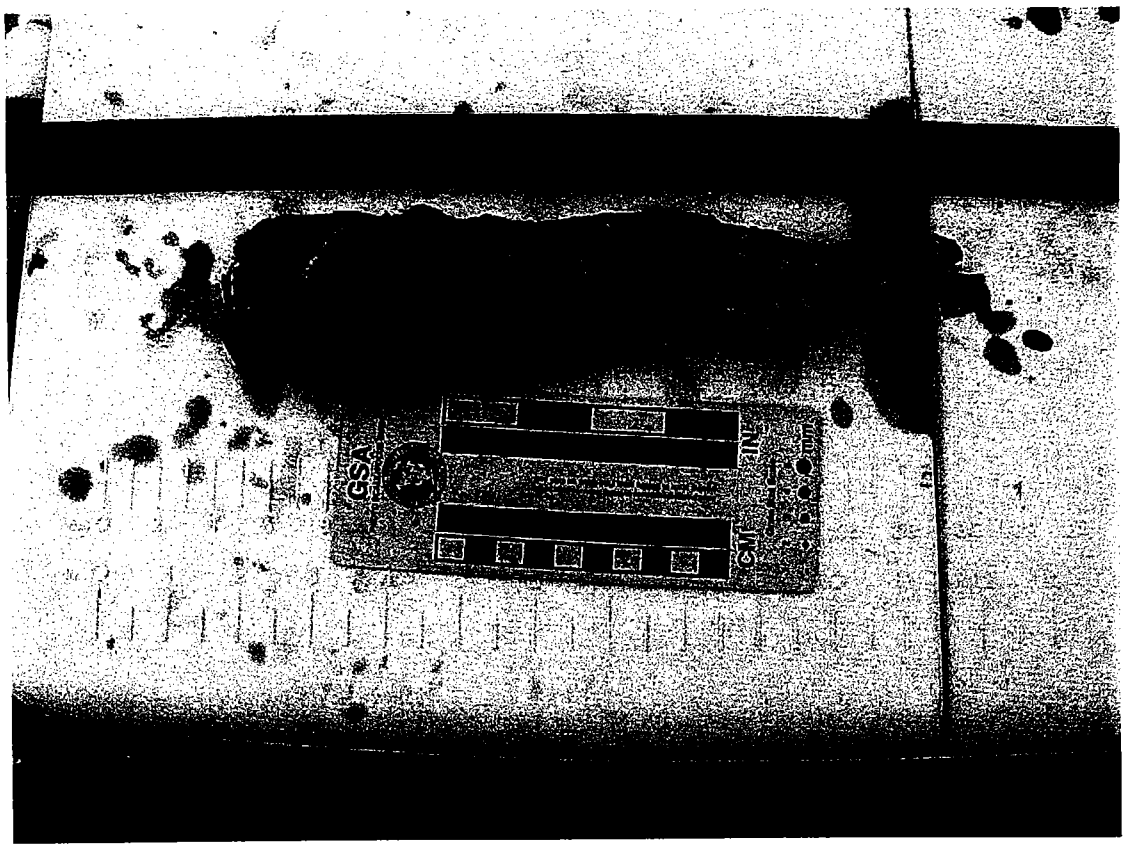

Photo 19: Example of a Pacific Triploid Oyster from Location 1.

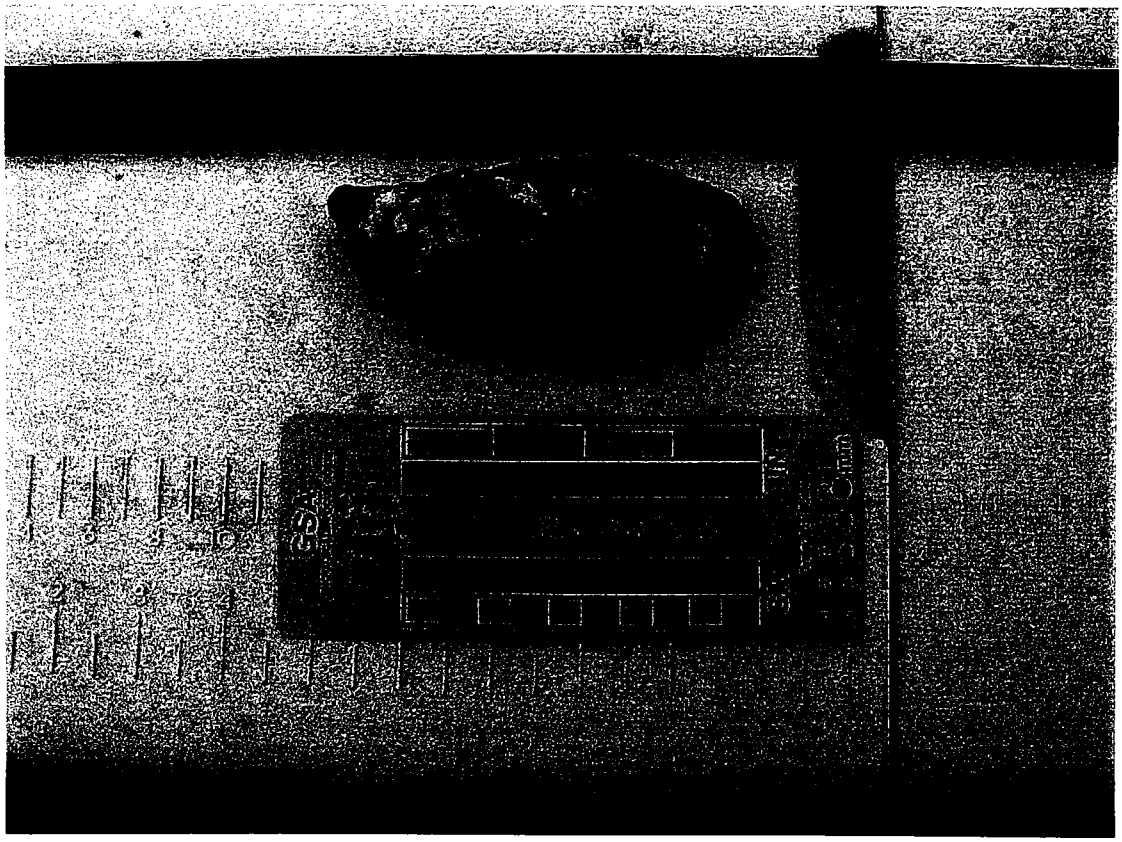

Photo 20: Example of a Kumamoto Oyster from Location 10.

Chain-of-Custody Forms

ENVIRON

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CHAIN-of-CUSTODY FORM

Sheet 1 Of 3
5820 Shellmound St., Suite 700
Emeryville, California 94608
(510) 655-7400

PROJECT NAME: Coast Seafoods

CASE NO.: 03-104226

ENVIRON SAMPLE ID.	COLLECTION DATE 2002	COLLECTED BY (Initials)	MATRIX	TOTAL NO. OF CONTAINERS	ANALYSES: Method 8270 Full	Classic Semivol. 8270	Total lipids	% moisture									COMMENTS
020621 - EBay-6-2	6/21	JK	oysters	6	X	X	X	X									Email results to
020621 - EBay-1-2	6/21	JK	oysters	7	X	X	X	X									Rick Wenning@
020621 - NBSC	6/21	JK	oysters	5	X	X	X	X									environcorp.com
020621 - NBSCM	6/21	JK	Mussels	3	X	X	X	X									
020621 - NBSC 02	6/21	JK	oysters	4	X	X	X	X									
020621 - MR-7-1	6/21	JK	oysters	4	X	X	X	X									
020621 - MR-7-2	6/21	JK	oysters	5	X	X	X	X									
020621 - SIN	6/21	JK	oysters	5	X	X	X	X									
020621 - SIN-1-2	6/21	JK	oysters	7	X	X	X	X									
TOTAL	X	X	X	46	9	9	9	9									

14 day TAT

Relinquished by:	Date:	Time:	Received by:	Company:	Date:	Time:
[signature]	6/21/02	1346	[signature]	Environ	6/21/02	13:46
[signature]	6/21/02	20:15	[signature]	ATA	6/21/02	20:15

ENVIRON

Counsel in Health and Environmental Science

CHAIN-of-CUSTODY FORM

Sheet 2 Of 3

5820 Shellmound St., Suite 700
Emeryville, California 94608
(510) 655-7400

PROJECT NAME: Coast Seafoods

CASE NO.: 03-10122C

ENVIRON SAMPLE ID.	COLLECTION DATE 2002	COLLECTED BY (Initials)	MATRIX	TOTAL NO. OF CONTAINERS	ANALYSES: Metals 8270	Dioxin / Furan Anly 8270	Total lipids	% Moisture									COMMENTS
020621 - BIN	6/21	JK	oysters	4	X	X	X	X									E-mail results to
020621 - BIS	6/21	JK	oysters	6	X	X	X	X									Rick Wenning @
																	rwenning@environcorp.com
TOTAL				10	2	2	2	2									

14 day TAT

Relinquished by:	Date:	Time:	Received by:	Company:	Date:	Time:
[signature]	6/21/02	1346	[signature]	ENVIRON	6/21/02	13:46
[signature]	6/21/02	2045	[signature]	[illegible]	6/21/02	2045

ENVIRON
Counsel in Health and Environmental Science

CHAIN-of-CUSTODY FORM

Sheet 3 Of 3
5820 Shellmound St., Suite 700
Emeryville, California 94608
(510) 655-7400

PROJECT NAME: Coast Seafoods
CASE NO.: 08-10422C

ENVIRON SAMPLE ID.	COLLECTION DATE	COLLECTED BY (Initials)	MATRIX	TOTAL NO. OF CONTAINERS	Method 8290 Full	Dioxin + Furan Anal	8270	Total lipids	% Moisture								COMMENTS
020621-WIR-7-1-S			Soil	1	X	X	X	X	HOLD ALL								E-mail results to
020621-Flag-1-2-S			Soil	1	X	X	X	X									Rick Wenning@
020621-BIN-S			Soil	1	X	X	X	X									rwenning@environcorp.com
~~020621-MR-7-1-S~~			~~Soil~~	~~1~~	~~X~~	~~X~~	~~X~~	X									
020621-NBEC-S			Soil	1	X	X	X	X									
				JK 6/21													
TOTAL	X	X	X	~~5~~ 4	~~5~~ 4	~~5~~ 4	~~5~~ 4	~~5~~ 4									

14 day TAT

Relinquished by:	Date:	Time:	Received by:	Company:	Date:	Time:
[signature]	6/21/02	13:46	[signature]	Environ	6/21/02	13:46
[signature]	6/21/02	20:35	[signature]	ALTA	6/21/02	20:35

Appendix III:

Dioxin Testing Laboratory Data Sheets from Alta Analytical Laboratory (El Dorado Hills, CA)

Sample ID: 020621-EBAY-6-2

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-001	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.19 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	40.1	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	ND		0.030	0.044	
1,2,3,7,8-PeCDD	0.77			0.026	A
1,2,3,4,7,8-HxCDD	0.084			0.083	A
1,2,3,6,7,8-HxCDD	0.094			0.093	A
1,2,3,7,8,9-HxCDD	0.073			0.065	A
1,2,3,4,6,7,8-HpCDD	0.20			0.095	A,B
OCDD	0.43			0.17	A,B
2,3,7,8-TCD	0.10			0.030	A
1,2,3,7,8-PeCD	ND	0.10		0.10	
2,3,4,7,8-PeCD	ND	0.095		0.094	
1,2,3,4,7,8-HxCD	0.19			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.052		0.077	
2,3,4,6,7,8-HxCD	ND	0.063		0.054	
1,2,3,7,8,9-HxCD	ND	0.077		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.026		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.027		0.086	
OCD	0.10			0.090	A,B
Total					
Total TCDD	2.5		2.5		
Total PeCDD	11.		13.		
Total HxCDD	18.				
Total HpCDD	0.20		0.48		B
Total TCD	0.95				
Total PeCD	0.28		6.5		
Total HxCD	0.46				B
Total HpCDF	ND	0.026			

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	77.	40 - 13	
	13C-1,2,3,7,8-PeCDD	72.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	74.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	78.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	86.	40 - 13	
	13C-OCDD	76.	40 - 13	
	13C-2,3,7,8-TCD	84.	40 - 13	
	13C-1,2,3,7,8-PeCD	74.	40 - 13	
	13C-2,3,4,7,8-PeCD	75.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	61.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	59.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	67.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	73.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	70.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	81.	40 - 13	
	13C-OCD	72.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	76.	40 - 13	

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 0.831 - 0.93

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-EBAY-1-2

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-002	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.05 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	42.4	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	ND		0.035	0.044	
1,2,3,7,8-PeCDD	1.2			0.026	
1,2,3,4,7,8-HxCDD	0.10			0.083	A
1,2,3,6,7,8-HxCDD	0.14			0.093	A
1,2,3,7,8,9-HxCDD	0.088			0.065	A
1,2,3,4,6,7,8-HpCDD	0.27			0.095	A,B
OCDD	0.87			0.17	A,B
2,3,7,8-TCD	0.24			0.030	
1,2,3,7,8-PeCD	ND	0.14		0.10	
2,3,4,7,8-PeCD	ND	0.13		0.094	
1,2,3,4,7,8-HxCD	0.27			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.047		0.077	
2,3,4,6,7,8-HxCD	ND	0.056		0.054	
1,2,3,7,8,9-HxCD	ND	0.068		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.038		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.044		0.086	
OCD	0.14			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	81.	40 - 13	
	13C-1,2,3,7,8-PeCDD	77.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	81.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	81.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	84.	40 - 13	
	13C-OCDD	87.	40 - 13	
	13C-2,3,7,8-TCD	91.	40 - 13	
	13C-1,2,3,7,8-PeCD	80.	40 - 13	
	13C-2,3,4,7,8-PeCD	82.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	67.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	64.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	72.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	79.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	76.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	79.	40 - 13	
	13C-OCD	81.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	81.	40 - 13	

Total					
Total TCDD	4.6		4.7		
Total PeCDD	20.		22.		
Total HxCDD	27.				
Total HpCDD	0.27		0.70		B
Total TCD	2.1				
Total PeCD	0.40		9.9		
Total HxCD	0.63		0.83		B
Total HpCDF	ND	0.041			

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 1.30 - 1.4

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-NBSC

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-003	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.93 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	41.3	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	ND		0.049	0.044	
1,2,3,7,8-PeCDD	4.0			0.026	
1,2,3,4,7,8-HxCDD	0.17			0.083	A
1,2,3,6,7,8-HxCDD	0.33			0.093	A
1,2,3,7,8,9-HxCDD	0.21			0.065	A
1,2,3,4,6,7,8-HpCDD	0.58			0.095	A,B
OCDD	1.3			0.17	A,B
2,3,7,8-TCD	0.36			0.030	
1,2,3,7,8-PeCD	ND	0.25		0.10	
2,3,4,7,8-PeCD	ND	0.24		0.094	
1,2,3,4,7,8-HxCD	0.56			0.080	A,B
1,2,3,6,7,8-HxCD	ND		0.068	0.077	
2,3,4,6,7,8-HxCD	ND	0.090		0.054	
1,2,3,7,8,9-HxCD	ND	0.10		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.028		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.028		0.086	
OCD	0.11			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	78.	40 - 13	
	13C-1,2,3,7,8-PeCDD	74.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	77.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	79.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	86.	40 - 13	
	13C-OCDD	77.	40 - 13	
	13C-2,3,7,8-TCD	88.	40 - 13	
	13C-1,2,3,7,8-PeCD	76.	40 - 13	
	13C-2,3,4,7,8-PeCD	77.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	63.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	61.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	70.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	76.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	70.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	75.	40 - 13	
	13C-OCD	73.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	77.	40 - 13	

Total				
Total TCDD	11.		11.	
Total PeCDD	58.		61.	
Total HxCDD	63.			
Total HpCDD	0.58		1.5	B
Total TCD	4.1			
Total PeCD	1.1		28.	
Total HxCD	2.1		2.3	B
Total HpCDF	ND		0.066	

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 4.21 - 4.4

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-NBSCM

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-004	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	24.99 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	41.0	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	0.045			0.044	A
1,2,3,7,8-PeCDD	0.76			0.026	A
1,2,3,4,7,8-HxCDD	0.13			0.083	A
1,2,3,6,7,8-HxCDD	0.12			0.093	A
1,2,3,7,8,9-HxCDD	ND	0.063		0.065	
1,2,3,4,6,7,8-HpCDD	1.0			0.095	B
OCDD	4.8			0.17	B
2,3,7,8-TCD	0.084			0.030	A
1,2,3,7,8-PeCD	ND	0.20		0.10	
2,3,4,7,8-PeCD	ND	0.17		0.094	
1,2,3,4,7,8-HxCD	0.31			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.076		0.077	
2,3,4,6,7,8-HxCD	ND	0.091		0.054	
1,2,3,7,8,9-HxCD	ND	0.11		0.068	
1,2,3,4,6,7,8-HpCDF	0.23			0.068	A
1,2,3,4,7,8,9-HpCDF	ND	0.022		0.086	
OCD	0.41			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	79.	40 - 13	
	13C-1,2,3,7,8-PeCDD	76.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	75.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	77.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	82.	40 - 13	
	13C-OCDD	79.	40 - 13	
	13C-2,3,7,8-TCD	88.	40 - 13	
	13C-1,2,3,7,8-PeCD	81.	40 - 13	
	13C-2,3,4,7,8-PeCD	82.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	62.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	59.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	69.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	75.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	71.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	76.	40 - 13	
	13C-OCD	75.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	77.	40 - 13	

Total			
Total TCDD	2.4		
Total PeCDD	18.	20.	
Total HxCDD	39.		
Total HpCDD	1.0	2.7	B
Total TCD	0.69		
Total PeCD	0.23	19.	
Total HxCD	1.0	1.1	B
Total HpCDF	0.60	0.67	

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 0.891 - 1.0

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-NBSC 02 **EPA METHOD 829**

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-005	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.88 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	41.4	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	0.051			0.044	A
1,2,3,7,8-PeCDD	2.0			0.026	
1,2,3,4,7,8-HxCDD	0.12			0.083	A
1,2,3,6,7,8-HxCDD	0.19			0.093	A
1,2,3,7,8,9-HxCDD	ND	0.082		0.065	
1,2,3,4,6,7,8-HpCDD	0.40			0.095	A,B
OCDD	1.2			0.17	A,B
2,3,7,8-TCD	0.20			0.030	
1,2,3,7,8-PeCD	ND	0.27		0.10	
2,3,4,7,8-PeCD	ND	0.21		0.094	
1,2,3,4,7,8-HxCD	0.36			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.061		0.077	
2,3,4,6,7,8-HxCD	ND	0.069		0.054	
1,2,3,7,8,9-HxCD	ND	0.087		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.034		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.019		0.086	
OCD	0.12			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	82.	40 - 13	
	13C-1,2,3,7,8-PeCDD	77.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	79.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	82.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	84.	40 - 13	
	13C-OCDD	83.	40 - 13	
	13C-2,3,7,8-TCD	93.	40 - 13	
	13C-1,2,3,7,8-PeCD	83.	40 - 13	
	13C-2,3,4,7,8-PeCD	84.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	66.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	62.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	73.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	80.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	73.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	80.	40 - 13	
	13C-OCD	78.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	81.	40 - 13	

Total			
Total TCDD	6.7	6.8	
Total PeCDD	32.	36.	
Total HxCDD	40.		
Total HpCDD	0.40	1.0	B
Total TCD	2.2	2.4	
Total PeCD	0.62	24.	
Total HxCD	0.88	1.3	B
Total HpCDF	ND	0.057	

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 2.15 - 2.3

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-MR-7-1 **EPA METHOD 829**

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-006	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.43 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	40.8	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	0.056			0.044	A
1,2,3,7,8-PeCDD	1.3			0.026	
1,2,3,4,7,8-HxCDD	0.079			0.083	A
1,2,3,6,7,8-HxCDD	0.17			0.093	A
1,2,3,7,8,9-HxCDD	0.091			0.065	A
1,2,3,4,6,7,8-HpCDD	0.47			0.095	A,B
OCDD	1.6			0.17	A,B
2,3,7,8-TCD	0.17			0.030	A
1,2,3,7,8-PeCD	ND	0.16		0.10	
2,3,4,7,8-PeCD	ND	0.14		0.094	
1,2,3,4,7,8-HxCD	0.26			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.050		0.077	
2,3,4,6,7,8-HxCD	ND	0.060		0.054	
1,2,3,7,8,9-HxCD	ND	0.072		0.068	
1,2,3,4,6,7,8-HpCDF	0.075			0.068	A
1,2,3,4,7,8,9-HpCDF	ND	0.015		0.086	
OCD	0.16			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	86.	40 - 13	
	13C-1,2,3,7,8-PeCDD	80.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	83.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	86.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	87.	40 - 13	
	13C-OCDD	89.	40 - 13	
	13C-2,3,7,8-TCD	97.	40 - 13	
	13C-1,2,3,7,8-PeCD	88.	40 - 13	
	13C-2,3,4,7,8-PeCD	88.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	69.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	65.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	75.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	83.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	77.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	83.	40 - 13	
	13C-OCD	84.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	84.	40 - 13	

Total			
Total TCDD	3.5		
Total PeCDD	20.	22.	
Total HxCDD	30.		
Total HpCDD	0.47	1.2	B
Total TCD	1.9		
Total PeCD	0.54	10.	
Total HxCD	0.93	1.1	B
Total HpCDF	0.15		

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 1.48 - 1.5

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-MR-7-2

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-007	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	27.08 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	38.4	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	0.053			0.044	A
1,2,3,7,8-PeCDD	1.4			0.026	
1,2,3,4,7,8-HxCDD	0.11			0.083	A
1,2,3,6,7,8-HxCDD	0.16			0.093	A
1,2,3,7,8,9-HxCDD	0.083			0.065	A
1,2,3,4,6,7,8-HpCDD	0.47			0.095	A,B
OCDD	1.3			0.17	A,B
2,3,7,8-TCD	0.18			0.030	A
1,2,3,7,8-PeCD	ND	0.24		0.10	
2,3,4,7,8-PeCD	ND	0.21		0.094	
1,2,3,4,7,8-HxCD	0.36			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.060		0.077	
2,3,4,6,7,8-HxCD	ND	0.070		0.054	
1,2,3,7,8,9-HxCD	ND	0.082		0.068	
1,2,3,4,6,7,8-HpCDF	0.064			0.068	A
1,2,3,4,7,8,9-HpCDF	ND	0.022		0.086	
OCD	0.15			0.090	A,B
Total					
Total TCDD	4.0				
Total PeCDD	28.		30.		
Total HxCDD	40.				
Total HpCDD	0.47		1.1		B
Total TCD	2.0				
Total PeCD	0.50		14.		
Total HxCD	0.84		1.3		B
Total HpCDF	0.14		0.18		

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	79.	40 - 13	
	13C-1,2,3,7,8-PeCDD	75.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	74.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	77.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	80.	40 - 13	
	13C-OCDD	82.	40 - 13	
	13C-2,3,7,8-TCD	88.	40 - 13	
	13C-1,2,3,7,8-PeCD	81.	40 - 13	
	13C-2,3,4,7,8-PeCD	83.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	62.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	58.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	68.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	74.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	72.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	75.	40 - 13	
	13C-OCD	76.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	80.	40 - 13	

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 1.63 - 1.7

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-SIN

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-008	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	24.69 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	43.2	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	0.063			0.044	A
1,2,3,7,8-PeCDD	1.9			0.026	
1,2,3,4,7,8-HxCDD	0.12			0.083	A
1,2,3,6,7,8-HxCDD	0.17			0.093	A
1,2,3,7,8,9-HxCDD	0.075			0.065	A
1,2,3,4,6,7,8-HpCDD	0.28			0.095	A,B
OCDD	0.73			0.17	A,B
2,3,7,8-TCD	0.23			0.030	
1,2,3,7,8-PeCD	ND	0.27		0.10	
2,3,4,7,8-PeCD	ND	0.25		0.094	
1,2,3,4,7,8-HxCD	0.33			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.062		0.077	
2,3,4,6,7,8-HxCD	ND	0.070		0.054	
1,2,3,7,8,9-HxCD	ND	0.079		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.028		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.030		0.086	
OCD	0.097			0.090	A,B

Labeled Standard		%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	84.	40 - 13	
	13C-1,2,3,7,8-PeCDD	80.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	75.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	79.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	79.	40 - 13	
	13C-OCDD	81.	40 - 13	
	13C-2,3,7,8-TCD	89.	40 - 13	
	13C-1,2,3,7,8-PeCD	79.	40 - 13	
	13C-2,3,4,7,8-PeCD	81.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	61.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	59.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	68.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	82.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	71.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	75.	40 - 13	
	13C-OCD	74.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	81.	40 - 13	

Total			
Total TCDD	6.3	6.6	
Total PeCDD	29.	33.	
Total HxCDD	33.		
Total HpCDD	0.28	0.75	B
Total TCD	2.4	2.5	
Total PeCD	0.62	15.	
Total HxCD	0.65	1.2	B
Total HpCDF	ND	0.061	

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 2.13 - 2.2

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-SIN-1-2 **EPA METHOD 829**

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-009	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.67 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	40.0	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	ND		0.049	0.044	
1,2,3,7,8-PeCDD	1.1			0.026	
1,2,3,4,7,8-HxCDD	0.11			0.083	A
1,2,3,6,7,8-HxCDD	0.12			0.093	A
1,2,3,7,8,9-HxCDD	ND	0.060		0.065	
1,2,3,4,6,7,8-HpCDD	0.21			0.095	A,B
OCDD	0.53			0.17	A,B
2,3,7,8-TCD	0.17			0.030	A
1,2,3,7,8-PeCD	ND	0.10		0.10	
2,3,4,7,8-PeCD	ND	0.091		0.094	
1,2,3,4,7,8-HxCD	0.28			0.080	A,B
1,2,3,6,7,8-HxCD	0.085			0.077	A
2,3,4,6,7,8-HxCD	ND	0.041		0.054	
1,2,3,7,8,9-HxCD	ND	0.052		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.019		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.020		0.086	
OCD	0.090			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	80.	40 - 13	
	13C-1,2,3,7,8-PeCDD	75.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	77.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	79.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	80.	40 - 13	
	13C-OCDD	84.	40 - 13	
	13C-2,3,7,8-TCD	91.	40 - 13	
	13C-1,2,3,7,8-PeCD	80.	40 - 13	
	13C-2,3,4,7,8-PeCD	81.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	64.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	60.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	70.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	76.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	71.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	77.	40 - 13	
	13C-OCD	77.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	81.	40 - 13	

Total				
Total TCDD	3.7	3.8		
Total PeCDD	17.	19.		
Total HxCDD	28.	29.		
Total HpCDD	0.21	0.54		B
Total TCD	1.7	1.8		
Total PeCD	0.65	8.5		
Total HxCD	0.77	1.0		B
Total HpCDF	ND	0.026		

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 1.19 - 1.3

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-BIN

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-010	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.94 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	39.4	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	ND		0.016	0.044	
1,2,3,7,8-PeCDD	0.67			0.026	A
1,2,3,4,7,8-HxCDD	0.11			0.083	A
1,2,3,6,7,8-HxCDD	0.090			0.093	A
1,2,3,7,8,9-HxCDD	ND	0.042		0.065	
1,2,3,4,6,7,8-HpCDD	0.24			0.095	A,B
OCDD	0.69			0.17	A,B
2,3,7,8-TCD	0.12			0.030	A
1,2,3,7,8-PeCD	ND	0.11		0.10	
2,3,4,7,8-PeCD	ND	0.10		0.094	
1,2,3,4,7,8-HxCD	0.15			0.080	A,B
1,2,3,6,7,8-HxCD	ND	0.040		0.077	
2,3,4,6,7,8-HxCD	ND	0.046		0.054	
1,2,3,7,8,9-HxCD	ND	0.057		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.020		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.021		0.086	
OCD	0.11			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	83.	40 - 13	
	13C-1,2,3,7,8-PeCDD	77.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	81.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	82.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	84.	40 - 13	
	13C-OCDD	84.	40 - 13	
	13C-2,3,7,8-TCD	92.	40 - 13	
	13C-1,2,3,7,8-PeCD	84.	40 - 13	
	13C-2,3,4,7,8-PeCD	84.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	67.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	63.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	73.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	80.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	75.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	80.	40 - 13	
	13C-OCD	79.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	80.	40 - 13	

Total					
Total TCDD	2.3		2.5		
Total PeCDD	10.		12.		
Total HxCDD	13.				
Total HpCDD	0.24		0.63		B
Total TCD	1.4				
Total PeCD	0.25		4.6		
Total HxCD	0.48				B
Total HpCDF	ND	0.021			

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 0.730 - 0.82

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Sample ID: 020621-BIS

EPA METHOD 829

Client Dat		Sample Data		Laboratory Data			
Name:	Environ	Matrix:	Tissue	Lab Sample:	22412-011	Date Received:	21-Jun-02
Project:	Coast Seafoods	Sample Size:	25.32 g	QC Batch No.:	3095	Date Extracted:	27-Jun-02
Date Collected:	21-Jun-0	%Lipids:	40.7	Date Analyzed DB-5:	1-Jul-02	Date Analyzed DB-225:	NA
Time Collected:	NA						

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	ND		0.021	0.044	
1,2,3,7,8-PeCDD	1.1			0.026	
1,2,3,4,7,8-HxCDD	0.32			0.083	A
1,2,3,6,7,8-HxCDD	0.11			0.093	A
1,2,3,7,8,9-HxCDD	ND	0.081		0.065	
1,2,3,4,6,7,8-HpCDD	0.24			0.095	A,B
OCDD	0.70			0.17	A,B
2,3,7,8-TCD	0.19			0.030	A
1,2,3,7,8-PeCD	ND	0.12		0.10	
2,3,4,7,8-PeCD	ND	0.10		0.094	
1,2,3,4,7,8-HxCD	0.33			0.080	A,B
1,2,3,6,7,8-HxCD	0.10			0.077	A
2,3,4,6,7,8-HxCD	ND	0.057		0.054	
1,2,3,7,8,9-HxCD	ND	0.066		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.023		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.024		0.086	
OCD	0.10			0.090	A,B

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	81.	40 - 13	
	13C-1,2,3,7,8-PeCDD	77.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	77.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	80.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	81.	40 - 13	
	13C-OCDD	79.	40 - 13	
	13C-2,3,7,8-TCD	91.	40 - 13	
	13C-1,2,3,7,8-PeCD	82.	40 - 13	
	13C-2,3,4,7,8-PeCD	83.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	65.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	61.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	71.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	77.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDF	71.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCDF	79.	40 - 13	
	13C-OCD	76.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	78.	40 - 13	

Total				
Total TCDD	4.3		4.5	
Total PeCDD	24.		25.	
Total HxCDD	37.			
Total HpCDD	0.24		0.65	B
Total TCD	2.6		2.7	
Total PeCD	0.85		9.3	
Total HxCD	1.1		1.5	B
Total HpCDF	ND		0.056	

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 1.26 - 1.3

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Method Blank — **EPA METHOD 829**

Matrix: Tissue | QC Batch No.: 3095 | Lab Sample: 0-MB001

Sample Size: 25 g | Date Extracted: 27-Jun-02 | Date Analyzed DB-5: 1-Jul-02 | Date Analyzed DB-225: NA

Analyte	Conc. (pg/g)	DL	EMPC[b]	MDL	Qualifiers
2,3,7,8-TCDD	ND	0.029		0.044	
1,2,3,7,8-PeCDD	ND	0.031		0.026	
1,2,3,4,7,8-HxCDD	ND	0.048		0.083	
1,2,3,6,7,8-HxCDD	ND	0.050		0.093	
1,2,3,7,8,9-HxCDD	ND	0.049		0.065	
1,2,3,4,6,7,8-HpCDD	0.031			0.095	A
OCDD	0.12			0.17	A
2,3,7,8-TCD	ND	0.021		0.030	
1,2,3,7,8-PeCD	ND	0.044		0.10	
2,3,4,7,8-PeCD	ND	0.037		0.094	
1,2,3,4,7,8-HxCD	0.042			0.080	A
1,2,3,6,7,8-HxCD	ND	0.014		0.077	
2,3,4,6,7,8-HxCD	ND	0.016		0.054	
1,2,3,7,8,9-HxCD	ND	0.021		0.068	
1,2,3,4,6,7,8-HpCDF	ND	0.021		0.068	
1,2,3,4,7,8,9-HpCDF	ND	0.016		0.086	
OCD	0.093			0.090	A

	Labeled Standard	%R	LCL-UCL	Qualifiers
I	13C-2,3,7,8-TCDD	94.	40 - 13	
	13C-1,2,3,7,8-PeCDD	85.	40 - 13	
	13C-1,2,3,4,7,8-HxCDD	88.	40 - 13	
	13C-1,2,3,6,7,8-HxCDD	92.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCDD	10	40 - 13	
	13C-OCDD	87.	40 - 13	
	13C-2,3,7,8-TCD	10	40 - 13	
	13C-1,2,3,7,8-PeCD	87.	40 - 13	
	13C-2,3,4,7,8-PeCD	88.	40 - 13	
	13C-1,2,3,4,7,8-HxCD	74.	40 - 13	
	13C-1,2,3,6,7,8-HxCD	70.	40 - 13	
	13C-2,3,4,6,7,8-HxCD	81.	40 - 13	
	13C-1,2,3,7,8,9-HxCD	89.	40 - 13	
	13C-1,2,3,4,6,7,8-HpCD	88.	40 - 13	
	13C-1,2,3,4,7,8,9-HpCD	95.	40 - 13	
	13C-OCD	81.	40 - 13	
CR	37Cl-2,3,7,8-TCDD	93.	40 - 13	

Total

Total TCDD	ND	0.029
Total PeCDD	ND	0.031
Total HxCDD	ND	0.049
Total HpCDD	0.031	
Total TCD	ND	0.021
Total PeCD	ND	0.040
Total HxCD	0.042	
Total HpCDF	ND	0.021

Toxic Equivalent Quotient (TEQ) Data

TEQ (Min-Max): 0.00460 - 0.10

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on World Health Organization Toxic Equivalent Factors (WHO-1997).

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

OPR Results **EPA METHOD 829**

Matrix:	Tissue	QC Batch No.:	3095	Lab Sample:	0-OPR001
Sample Size:	25 g	Date Extracted:	27-Jun-02	Date Analyzed DB-5:	1-Jul-02
				Date Analyzed DB-225:	NA

Analyte	Spike Conc.	Conc. (ng/mL)	OPR Limit
2,3,7,8-TCDD	10.	9.8	7 - 1
1,2,3,7,8-PeCDD	50.	51.	35 - 6
1,2,3,4,7,8-HxCDD	50.0	51.	35 - 6
1,2,3,6,7,8-HxCDD	50.	50.	35 - 6
1,2,3,7,8,9-HxCDD	50.	53.	35 - 6
1,2,3,4,6,7,8-HpCDD	50.	52.	35 - 6
OCDD	10	10	70 - 13
2,3,7,8-TCD	10.	9.8	7 - 1
1,2,3,7,8-PeCD	50.	50.	35 - 6
2,3,4,7,8-PeCD	50.	51.	35 - 6
1,2,3,4,7,8-HxCD	50.	51.	35 - 6
1,2,3,6,7,8-HxCD	50.	51.	35 - 6
2,3,4,6,7,8-HxCD	50.	50.	35 - 6
1,2,3,7,8,9-HxCD	50.	51.	35 - 6
1,2,3,4,6,7,8-HpCDF	50.	50.	35 - 6
1,2,3,4,7,8,9-HpCDF	50.	51.	35 - 6
OCD	10	10	70 - 13

	Labeled Standard	%R	LCL-UCL
I	13C-2,3,7,8-TCDD	89.	40 - 13
	13C-1,2,3,7,8-PeCDD	83.	40 - 13
	13C-1,2,3,4,7,8-HxCDD	82.	40 - 13
	13C-1,2,3,6,7,8-HxCDD	88.	40 - 13
	13C-1,2,3,4,6,7,8-HpCD	94.	40 - 13
	13C-OCDD	94.	40 - 13
	13C-2,3,7,8-TCD	98.	40 - 13
	13C-1,2,3,7,8-PeCD	86.	40 - 13
	13C-2,3,4,7,8-PeCD	86.	40 - 13
	13C-1,2,3,4,7,8-HxCD	68.	40 - 13
	13C-1,2,3,6,7,8-HxCD	67.	40 - 13
	13C-2,3,4,6,7,8-HxCD	77.	40 - 13
	13C-1,2,3,7,8,9-HxCD	83.	40 - 13
	13C-1,2,3,4,6,7,8-HpCD	81.	40 - 13
	13C-1,2,3,4,7,8,9-HpCD	92.	40 - 13
	13C-OCD	91.	40 - 13
CR	37Cl-2,3,7,8-TCDD	84.	40 - 13

Analyst: JMH

Approved By: William J. Luksemburg 02-Jul-2002 14:10

Appendix IV:

Spreadsheet Risk Assessment Calculation for the Screening-Level Shellfish Consumption Scenario

Hypothetical Exposure to Dioxin Through Consumption of Shellfish
Consumption of Shellfish
Adult

CDI = Cd * IR * AFo * FI * CL * CF * 1/BW
Risk = CDI * CSF
HI = CDI/ RfDo

Chemical	Cd Shellfish Concentration (pg/g)	IR Shellfish Ingestion Rate (g/day)	AFo Oral Absorption Factor (unitless)	FI Fraction ingested from the source (unitless)	CL Cooking Loss (unitless)	CF Conversion Factor (mg/pg)	BW Body Weight (kg)	CDI Chronic Daily Intake During Lifetime (mg/kg-day)	CSF Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Risk Theoretical Cancer Risk During Lifetime	RfDo Oral Reference Dose mg/kg-day	HI Theoretical Non-Cancer Hazard Index
Oyster, 95th Dioxin TEQ	3.4	0.15	0.54	1	1	1E-09	70.0	3.93E-12	1.30E+05	5.11E-07	1.00E-08	0.00039
Oyster, Mean Dioxin TEQ	1.8	0.15	0.54	1	1	1E-09	70.0	2.08E-12	1.30E+05	2.71E-07	1.00E-08	0.00021
Mussel, Dioxin TEQ	1.0	0.07	0.54	1	1	1E-09	70.0	5.40E-13	1.30E+05	7.02E-08	1.00E-08	0.00005

Appendix V:

Dioxin: Environmental Occurrence, Exposure, & Effects on Human Health, Fact Sheet

Dioxin: Environmental Occurrence, Potential Exposures, and Effects on Human Health

1. What are dioxins?

The name dioxin is used for the family of structurally related chemicals called polychlorinated dibenzo-para-dioxins (sometimes referred to as PCDDs or chlorinated dioxins or dioxins) and polychlorinated dibenzofurans (sometimes referred to as PCDFs or chlorinated furans or furans). This family includes 75 individual compounds referred to as dioxin congeners, and 135 individual compounds referred to as furan congeners. The most toxic chemical in this family, called 2,3,7,8-TCDD, is widely recognized as the most toxic of the dioxins.

Throughout this Fact Sheet, the term "dioxins" refers to the family of chemicals known as PCDDs and PCDFs.

2. Do all dioxins possess similar environmental and toxicological properties?

No. There is general agreement among scientists that the environmental fate of dioxins and their toxicity in humans and animals vary widely. The degree to which dioxins persist in the environment varies with the different congeners. The higher chlorinated dioxins and furans, such as those that occur in Sierra-Crete®, are generally less persistent than 2,3,7,8-TCCD and other less chlorinated dioxin congeners. Furthermore, there is a significant body of scientific information indicating that some of the most common dioxins and furans found in the environment are significantly less toxic than 2,3,7,8-TCDD. While most toxicological studies focus on 2,3,7,8-TCDD, the few studies focused on the congeners that occur in Sierra-Crete® indicate that these higher chlorinated furans are less capable of eliciting toxic effects in humans and animals.

3. What are dioxin TEQs, and why is this important?

Among the 210 congeners that comprise the family of dioxins, 17 of these congeners are generally recognized by scientists as capable of eliciting a toxic response in animals and people. The structure of each of the 17 dioxin congeners includes a basic chemical ring structure with one or more chlorine atoms attached. The toxicity of the different dioxins is largely determined by the position and number of chlorine atoms on the molecule.

Because the majority of toxicological studies have been conducted with 2,3,7,8-TCDD and relatively few studies have been conducted for most of the other congeners, the toxicity of different dioxins are calculated using a toxic equivalency (TEQ) system. The World Health Organization (WHO), and the U.S. Environmental Protection Agency (USEPA) have adopted the TEQ system to estimate the potential effects of environmental samples that contain individual dioxin congeners.

Each of the seventeen 2,3,7,8-substituted dioxin congeners has been assigned a toxicity equivalence factor (TEF) value by the WHO. TEFs are estimates of the toxicity of different dioxin congeners *as compared to* the toxicity of 2,3,7,8-TCDD, which has been assigned a TEF value of one. For example, some of the most common dioxin congeners found in Sierra-Crete®, are considered to be 10,000 times less toxic than 2,3,7,8-TCDD, and hence have a TEF value of 0.0001.

Laboratories report the concentrations of dioxins in environmental samples as total dioxin toxic equivalents (sometimes referred to as "Total TEQs"). The total TEQs in an environmental sample are determined by a dioxin testing laboratory in three simple steps. First, the laboratory measures the concentration of each individual dioxin congener using sophisticated analytical instruments. Then, the laboratory multiplies the measured concentration of the individual congener by its corresponding TEF to produce a TEQ for each congener. Finally, the laboratory adds together the TEQs for each of the 17 dioxin congeners to determine the total dioxin TEQ concentration in the sample.

4. Where do dioxins come from?

Dioxins are formed by a variety of man-made and natural processes. Dioxins are by-products of a wide range of industrial processes formed when thermal processes produce chlorine-containing organic substances. Such processes include smelting, bleaching of paper pulp and the manufacturing of some herbicides and pesticides. Other major sources include production of iron and steel, backyard burning of household waste, wood burning, burning fuel for home heating, and electrical power generation. In terms of dioxin release into the environment, municipal solid waste incinerators are among the largest sources. Dioxins are formed during wastewater and drinking water treatment. Dioxins also result from natural processes, such as volcanic eruptions and forest fires.

5. What happens to dioxins when they enter the environment?

Dioxins are persistent, long-lived chemicals and do not readily degrade in the environment. When released into the air bound to particles, dioxins may be transported long distances, even around the globe. When released to rivers and streams through wastewater discharges, dioxins attach to particulate matter and settle to bottom sediments. When deposited to soil or bottom sediments, dioxins may build up in the food chain (e.g., in fish, beef cattle, chickens, dairy cows and other farm animals), resulting in measurable levels in a variety of foods and beverages.

6. What does it take to identify and measure dioxins in the environment?

The analysis of dioxins requires sophisticated methods that are available only in a limited number of laboratories around the world. The U.S. EPA has established a laboratory testing protocol to ensure that appropriate and consistent test procedures are followed. About 100 laboratories are able to analyze dioxins in environmental samples (e.g. ashes, soil, or water) and in food, but about 20 laboratories in the world are able to reliably measure dioxins in biological materials (e.g. human blood or milk). The costs for dioxin

testing vary according to the type of sample, but costs of testing typically range between $1,200 and $2,000 per sample.

7. How might a person be exposed to dioxins?

Dioxins are ubiquitous in the environment, and can be found virtually everywhere. These substances work their way up the food chain by dissolving and remaining stored in the body fat of fish and animals. Because of this, the single largest source of exposure to dioxins is through the consumption of food, primarily meat, dairy products, and fish. According to the U.S. EPA, more than 90% of a person's average daily intake of dioxins is from the diet. Other sources include breathing dioxin-containing particles from the air and drinking unfiltered water. Skin contact with certain pesticides and herbicides can be another source of exposure. Living near solid waste incinerators releasing dioxins is another recognized sources of exposure.

8. How can dioxins affect a person's health?

The health risks from exposure to any chemical substance depends on a number of factors, including the dose, the duration of exposure, how a person is exposed, a person's general health condition, behavior and eating habits, smoking preference, and whether other chemicals are present.

According to the latest available scientific information, current levels of dioxins in the food supply, air, water and soil are so low that they pose no health threat to most people.

The most noted health effect in people exposed to large amounts of the most toxic form of dioxins, 2,3,7,8-TCDD, is chloracne. Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Other skin effects noted in people exposed to high doses of 2,3,7,8-TCDD include skin rashes, discoloration, and excessive body hair. Changes in blood and urine that may indicate liver damage also are seen in highly exposed people.

A wide range of health effects have been observed in laboratory animals that have been exposed to dioxins. However, it is widely recognized by scientists that experimental animals appear to be more seriously effected by exposure to dioxins than are people.

9. How likely are dioxins to cause cancer?

Several studies suggest that exposure to the most toxic form of dioxins, 2,3,7,8-TCDD, increases the risk of cancer in people. Animal studies have also shown an increased risk of cancer from exposure to 2,3,7,8-TCDD. To date, few studies have been conducted to determine if exposure to dioxins other than 2,3,7,8-TCDD increases the risk of cancer in people. Based on human epidemiology data, the World Health Organization (WHO) has determined that only 2,3,7,8-TCDD is a human carcinogen. In the United States, the Department of Health and Human Services (DHHS) and U.S. EPA have determined that 2,3,7,8-TCDD may reasonably be anticipated to cause cancer. However, it is widely recognized by scientists, WHO, and U.S. EPA that dioxins do not affect genetic material and there is a level of exposure below which cancer risk would be negligible.

10. How can dioxins affect children?

Very few studies have examined the effects of dioxins on children. Chloracne has been seen in children exposed for short periods of time to high levels of dioxins. Scientists don't fully understand if dioxins affect the ability of people to have children or if it causes birth defects.

11. How can families reduce the risk of exposure to dioxins?

Though speculative at best due to the variable nature of dioxin's occurrence in the environment, families may reduce their risks of exposure through trimming fat from meat, consuming low-fat dairy products, and cooking food. Limiting the amount of fish, particularly fatty fish, in the diet also may eventually decrease a person's body burden of dioxins. Eating a balanced diet (including adequate amounts of fruits, vegetables and cereals) will help to avoid excessive exposure from a single source. In addition to diet, families should discourage their children from eating dirt or putting plastic and painted toys or other objects in their mouths. Everyone should wash their hands frequently if playing or working outdoors, handling household pesticides and herbicides, paints, and other chemicals.

12. Is there a medical test to show whether a person has been exposed to dioxins?

Tests are available to measure dioxin levels in body fat, blood, and breast milk, but these tests are not routinely available and are very expensive. Most people have low levels of dioxins in their body fat and blood. According to the U.S. EPA and scientists involved in monitoring for dioxins and other several other chemicals commonly found in the human body, the concentrations of dioxins in blood and body fat in the U.S. population can be as high as 30 to 40 parts per trillion. The average background concentration of dioxins in blood in adults in the United States is 22 parts per trillion. Although dioxins stay in body fat for a long period of time, medical tests cannot be used to determine when exposure occurred.

13. Has the federal government made recommendations to protect human health?

The U.S. EPA has set a limit of 0.00003 micrograms of 2,3,7,8-TCDD per liter of drinking water (0.00003 μg/L). The Food and Drug Administration (FDA) recommends against eating fish and shellfish with levels of 2,3,7,8-TCDD greater than 50 parts per trillion (50 ppt). For residential properties where dioxin is a chemical of concern in soil, the U.S. EPA and the California Department of Toxic Substances Control (DTSC) have required cleanup when levels exceed 1,000 ppt.

14. Where can a person learn more about dioxins?

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ENVIRON

SAMPLING AND ANALYSIS PLAN

CHEMICAL TESTING OF COMMERCIAL OYSTER BEDS MAINTAINED BY COAST SEAFOODS, INC., HUMBOLDT BAY, CALIFORNIA

Prepared by:

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6001 Shellmound Street
Emeryville, California 94608

Prepared for:

SIERRA PACIFIC INDUSTRIES
Arcata, California

June 20, 2002

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I. Introduction

This Sampling and Analysis Plan (SAP) was prepared by ENVIRON International Corporation (ENVIRON) on behalf of Sierra Pacific Industries, Arcata Division Sawmill located near Arcata, California, in response to concerns raised by Coast Seafoods, Inc., about possible contamination of commercial oyster beds located in Humboldt Bay.

The SAP described herein will be performed in a manner consistent with U.S. Environmental Protection Agency (USEPA) and State of California guidance for collection and chemical testing of biota (and specifically shellfish). The following guidance on biological collection methods, chemical testing methods, and use of field data in ecological and human health risk assessments were consulted:

Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities (DTSC, 1992);

Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997);

Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities, Part A: Overview, and Part B Scoping Assessment (DTSC, 1996a,b);

Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 1, Fish Sampling and Analysis (Third edition) (USEPA, 2000a)

Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 2, Risk Assessment and Fish Consumption Limits (Third edition) (USEPA, 2000b)

Statement of Work

The work elements to be completed as part of the activities described herein include the following:

1. Documentation of commercial oyster beds of concern;
2. Selection and collection of oysters from identified commercial oyster beds;
3. Submission of unshucked whole oyster samples to two chemical testing laboratories for chemical analysis;
4. Chemical testing of oysters for dioxin and pentachlorophenol;
5. Evaluation of chemical testing results;
6. Preparation of a post-sampling report describing the field sampling activities; and,
7. Preparation of a risk evaluation report describing the results of laboratory chemical testing and the health risks associated with human consumption of oysters from sampled commercial beds.

Sampling and Chemical Testing Objectives

The objectives of the work described herein are to:

1. Collect a sufficient number of oysters from five different commercial oyster beds in Humboldt Bay to obtain a statistically meaningful representative data set describing chemical levels in whole oyster tissue.

2. Characterize the chemical content in oysters collected from each commercial oyster bed.

3. Determine whether the chemical content in oysters from each commercial bed exceeds the chemical content in oysters from commercial beds in Humboldt Bay that are not affected by activities associated with the Sierra Pacific Industries sawmill.

4. Determine whether the chemical content in oysters from each commercial bed poses a health risk to consumers.

Data Quality Objectives

The chemical and physical data collected as part of this oyster assessment will provide a foundation for human health risk assessment. The highest standards for data quality are those associated with risk assessment (USEPA, 1993); therefore, chemical and physical data will be generated to meet the risk assessment standards embodied in the following data quality objectives:

- Representative chemical analytical data sufficiently sensitive to identify chemical concentrations in oyster tissues that might pose a significant risk to human consumers;
- Data of known and sufficient precision and accuracy to meet both USEPA and State of California criteria for use in human health risk assessment;
- Sufficient representative data to statistically characterize the chemical content of oysters in different commercial oyster beds; and,
- Representative data from a sufficient number of locations at each commercial oyster bed to characterize the spatial distribution and body burden of chemicals in oysters.

Organization of Sampling & Analysis Plan

This SAP is comprised of three components: the Sampling Method (Section II), a Health and Safety Plan (HASP; Section III), the Chemical Testing Methods (Section IV).

II. Sampling Method

The activities associated with the collection of oysters from commercial beds includes:

- Specification of field sampling procedures;
- Field sampling; and,
- Preparation of post-sampling project deliverables.

The SAP is consistent with both USEPA and California Environmental Protection Agency (CalEPA) available guidance. The SAP provides detailed specifications for the sampling and chemical analyses; the level of detail provided herein is adequate for use as instructions to sampling and other field investigation personnel. The following are included:

- Sampling and observations locations;
- Sample collection equipment;
- Numbers of samples and/or observations to be made at each location;
- Sample collection depths;
- Observation protocols to be used;
- Biological sampling equipment to be used;
- Biological sample handling procedures;
- Sampling and/or observation schedules, as appropriate;
- Sampling collection, handling, preservation, and documentation protocols;
- Chemical analyses to be performed; and
- Field quality control procedures.

Sampling Locations

Oysters will be collected from five (5) different commercial oyster beds managed by Coast Seafoods, Inc., in Humboldt Bay, California. A map showing the locations of each commercial oyster bed is presented in Figure 1.[1] In addition, oysters will be collected from one (1) commercial bed at a location that is not impacted by activities associated with the Sierra Pacific Industries sawmill located near Arcata at the confluence of the Mad River Slough and Humboldt Bay.

[1] The specific locations of actual sampling (including both commercial beds and background) will established and identified using GPS during actual sampling and are not indicated on Figure 1.

■ **Figure 1. Map of Commercial Oyster Beds Managed by Coast Seafoods, Inc. in Humboldt Bay, California**

Humboldt Bay Oyster Beds

0.5 0 0.5 1 Miles

- Pacific longline.shp
- Rack and bag.shp
- Wet storage.shp
- Nursery.shp
- Flupsy.shp
- Clam rafts.shp
- Ground culture.shp
- Kumo beds.shp

N
W E
S

Numbers of Samples at Different Locations

A summary of the numbers of samples to be collected at each commercial oyster bed is presented in Table 1. At each commercial oyster bed, oysters will be collected from two locations: from oyster flats located on the sediment bottom, and oysters suspended in the water column. At each commercial oyster bed, oysters will be collected by a representative of Coast Seafoods, Inc. Oysters grown in bedded flats and suspended in the water column will be handled and tested separately.

Table 1. Number of oysters to be collected from five different commercial oyster beds and one background oyster bed in Humboldt Bay, California.

Sampling Location	Type of Oyster Bed	Number of Oysters to Collect*	Number of Samples for Chemical Testing
5 Commercial Oyster Beds	Bottom-bedded oysters	10 oysters from each bed, for a total of 50 individual oysters	1 composite sample from each oyster bed, for a total of 5 composite samples
	Suspended (water column) oysters	10 oysters from each bed, for a total of 50 individual oysters	1 composite sample from each suspended oyster colony, for a total of 5 composite samples
1 Background Oyster Bed		20 individual oysters from the background bed	2 composite samples from the background oyster bed
Total Number of Composite Oyster Samples for Chemical Testing			**12 composite samples**

* The exact number of individual oyster specimens necessary to generate a 200 gram composite sample for chemical testing will be determined by Coast Seafoods during field sampling.

Sample Collection Equipment

At each commercial oyster bed, oysters will be collected by a representative of Coast Seafoods, Inc., using collection methods typically used to harvest oysters for commercial sale.

Coast Seafoods, Inc., will provide:

- Boat;
- Oyster collection equipment; and
- A global positioning system (GPS) navigation unit to record position.

ENVIRON will provide:

- Ice coolers for storage and shipment of whole unshucked oysters to the chemical testing laboratory;
- Sealable plastic storage bags for each set of unshucked oysters collected at a sampling location; and
- Chain of custody forms to establish a record of collection and sample handling.

■ Sample Collection & Handling

Oysters will be collected at different locations in Humboldt Bay during one day of field activity. Upon collection by the representative of Coast Seafoods, Inc., oysters of the same approximate size and condition will be selected and placed in sealable plastic storage bags and stored on dry ice in ice coolers. Each plastic bag will be labeled to identify the sampling location and commercial bed.

One ice cooler will be used for each commercial oyster bed and background location. Oysters from different beds will be stored separately for shipment to the analytical laboratory. Oysters will be maintained in ice coolers containing dry ice.

ENVIRON will initiate a chain of custody protocol beginning at the time of specimen collection in order to establish the record of sample possession. The chain of custody will specify the date and time of specimen collection, location, chemical testing requirements, the designated laboratory, and identity/signature of the ENVIRON field sampling coordinator. The chain of custody will be included in the ice cooler shipped to the laboratory.

■ Field Information to be Recorded

At the time of collection, the following information will be recorded:

- Time and date of specimen collection;
- Number of specimens collected at each location;
- General weather and tide conditions;
- Water temperature;
- GPS coordinates at the location of specimen collection;
- Location of specimen collection on an appropriately scaled map of Humboldt Bay;
- Size of oyster shell using the commercial grading protocol;
- Depth to oyster bed from water surface at the collection point;
- Depth to suspended oyster colony from water surface to the collection point;
- Physical condition and anomalies, if any, of collected oysters;

Photographs will be taken of the collection procedure and oysters at each commercial bed.

■ Post-Sampling Project Deliverables

At the conclusion of sampling and after receipt of analytical reports from the chemical testing laboratories, ENVIRON will prepare a report summarizing the field activities (including all relevant documentation) and chemical test results. The report will also include an interpretation of the test results relative to the appropriate human health consumption benchmarks. A human health risk assessment will not be included as part of the post-sampling project deliverable.

III. Health and Safety Plan

The Health and Safety Plan (HASP) identifies specific preparation and field procedures to be implemented in order to prevent injuries during field operations. The HASP is consistent with state and federal Occupational Safety and Health Administration (OSHA) requirements. The HASP specifies:

- Potential chemical health and safety hazards;
- Potential non-chemical safety hazards;
- Field procedures to prevent chemical exposure and accidents;
- Implementation procedures and requirements;
- Emergency response procedures; and
- Recordkeeping requirements.

The HASP for this field sampling activity will be on file with ENVIRON and available for client review at any time.

IV. Chemical Testing Methods

This section describes the methods to be used by the chemical testing laboratory for preparation of oyster tissues for chemical testing. The following chemicals will be assayed in composite samples of whole oyster tissues:

- Seventeen 2,3,7,8-substituted polychlorinated dibenzo-p-dioxins and dibenzofurans using USEPA Method 8290; and,
- Pentachlorophenol using USEPA Method 8270.

Dioxin Testing

The laboratory address and contact person for dioxin testing are as follows:

Alta Analytical Laboratory

Billing to:	5070 Robert J. Mathews Parkway, Suite 2 El Dorado Hills, CA 95630
Dioxin samples to:	1104 Windfield Way El Dorado Hills, California 95762
Contact:	Bill Luksemburg
Phone:	916-933-1640

Dioxin testing will be performed by Alta Analytical Laboratory (El Dorado Hills, CA) using USEPA Method 8290. The analytical method reflects the approach used by Alta Analytical Laboratory for dioxin testing of environmental samples submitted for regulatory review in the State of California.

The dioxin testing protocol is provided in Appendix A. Dioxin test results will be reported as picograms per gram of wet-weight tissue tested. The lipid content and percent moisture content of each sample will also be reported by the laboratory. Dioxin toxic equivalency will be reported by Alta Analytical Laboratory using the most recent USEPA and WHO toxic equivalency factors (van den Berg et al., 1998).

ENVIRON will request dioxin testing by Alta Analytical Laboratory on a fourteen (14)-day turnaround basis.

Testing for Other Chemicals

The laboratory address and contact person for pentachlorophenol testing is as follows:

Toxscan

42 Hangar Way
Watsonville, CA 95076
Contact: Phil Carpenter
Phone: 831-724-4522

Pentachlorophenol testing will be performed by Toxscan (Watsonville, CA) using USEPA Method 8270. The analytical method reflects the approach used by Toxscan for chemical testing of biological tissue samples submitted for regulatory review in the State of California.

Pentachlorophenol test results will be reported as picograms per gram of wet-weight tissue tested. The lipid content of each sample will also be reported by the laboratory. ENVIRON will request pentachlorophenol testing by Toxscan on a fourteen (14)-day turnaround basis.

■ Sample Preparation Procedures

Unshucked whole live oysters will be shipped on ice in ice coolers by ENVIRON from Humboldt Bay to Alta Analytical Laboratory. The laboratory will be responsible for the preparation of oyster tissue prior to chemical testing for dioxins and pentachlorophenol.

The method to be used by Alta Analytical Laboratory for preparation of oysters for chemical testing is shown in Figure 2. The laboratory will receive six (6) ice coolers representing the five (5) commercial oyster beds and one (1) background oyster bed. Each of the five (5) sample ice coolers will contain two (2) sealed plastic bags of oysters (for bottom and suspended oysters, separately). The single (1) background ice cooler will contain one (1) sealed plastic bag of oysters.

From each plastic bag, the laboratory will randomly select oysters and remove the tissue from the shell until approximately 200 grams of material is collected (two such composites will be made from the single sealed plastic bag representing background oysters). The remaining oysters will be stored in their original plastic bag and ice cooler and refrigerated in the event additional testing is necessary. The collected oyster tissue will be homogenized and one aliquot of the homogenate assigned for one dioxin test. A second aliquot of homogenate will be assigned for pentachlorophenol testing. Alta Analytical Laboratory will ship a set of homogenated oyster tissue aliquots on ice to Toxscan for pentachlorophenol testing. The remaining homogenate will be stored at $\leq 20^{\circ}C$ in the event additional testing is necessary.

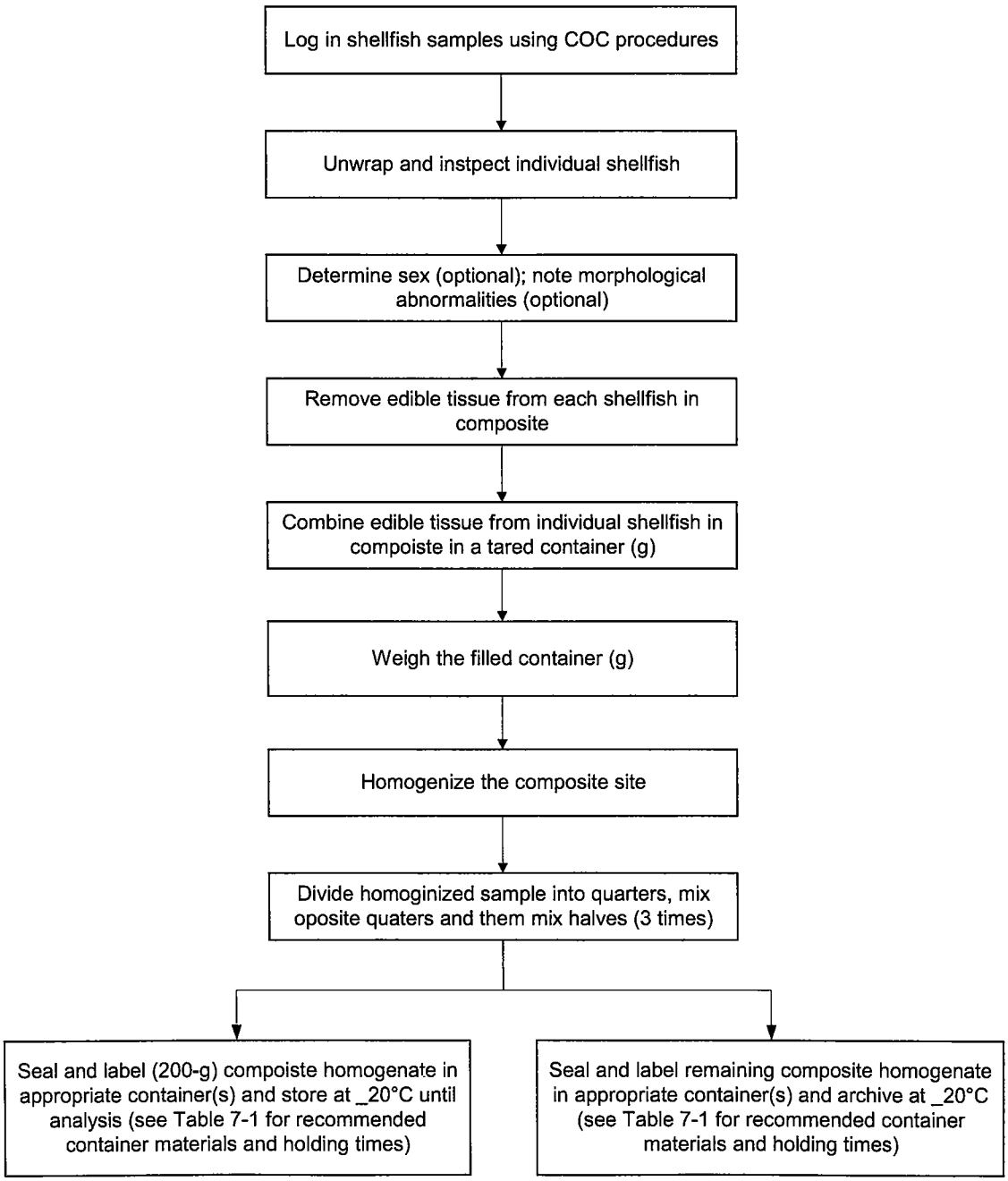
■ Laboratory Work Products

Alta Analytical Laboratory and Toxscan will each provide the following paper and electronic reports to ENVIRON at the conclusion of their work:

- Summary of chemical testing results; and,
- QA/QC documentation typically associated with "full, or complete" laboratory data reporting to USEPA and the State of California.

Figure 2. Sample Preparation by Alta Analytical Laboratory

Preparation of shellfish edible tissue compostie homogenate samples



COC= Chain of Custody

V. References

California Department of Toxic Substances Control. 1992. Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities. Human and Ecological Risk Division, Sacramento, CA. http://www.dtsc.ca.gov/ScienceTechnology/Supplemental_Guidance.html#description

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Van den Berg, M., Birnbaum, L., Bosveld, A.T.C., Brunstrom, B., Cook, P., Freely, M., Giesey, J.P., Hanberg, A., Hasegawa, R., Kennedy, S.W., Kubiak, T., Larsen, J.C., van Leeuwen, F.X.R., Liem, A.K.D., Nolt, C., Peterson, R.E., Poellinger, L., Safe, S., Schrenk, D., Tillit, D., Tysklind, M., Younes, M., Waern, F., and Zacharewski, T. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, and PCDFs for humans and wildlife. Environ. Health Persepct. 106:775-792.

Appendix A: Alta Analytical Laboratory (El Dorado Hills, CA), Dioxin Testing Method

AP No. 2M Revision: 0 Effective: 10/4/96 Replaces: NA

POLYCHLORINATED DIBENZO DIOXINS/FURANS IN FISH/SHELLFISH

EXTRACTION AND ANALYSIS OF TISSUE SAMPLES BY USEPA METHOD 8290

Author: Melanee A. Schuld

Management – Date 10/4/96

QA Officer – Date

1 PURPOSE

1.1 This analytical (AP) procedure describes the analytical techniques used for extraction and analysis of fish/tissue samples for polychlorinated dibenzo dioxin and furans (PCDD/PCDF) by EPA Method 8290.

2 SCOPE

2.1 All differences between Method 8290 and actual laboratory techniques have been developed to reduce interference and increase sensitivity.

3 APPARATUS AND MATERIALS

3.1 CTC Autosampler Model A200S.
3.2 DEC Vaxstation 3100 and 4000 with Opus Data System.
3.3 Alpha Station 255/233.
3.4 Neslab HX200 and HX500 Water Cooler.
3.5 VG 70SE and VG Autospec Magnetic Sector High Resolution Mass Spectrometer.
3.6 Berkel Scharfen Food Slicer.
3.7 Pipets, disposable, serological, 10mL.
3.8 Pipets, Pasteur.
3.9 Amber glass bottles, 1L (teflon-lined screw cap).
3.10 250mm x30mm glass chromatographic column (Column #1).

Place a glass wool plug at the bottom of the column, pack with 2cm of Na_2SO_4, 10g of silica gel, 10g acid silica gel, 10g silica gel, 30g potassium silicate, and 2cm of Na_2SO_4. Refer to Figure A1.

3.11 Organomation 24-Station N-Evaporator with teflon tubing connection to trap and gas regulator.
3.12 Conical vials, 2mL.
3.13 Pyrex fiber glass, 8μm sliver (glass wool plug).
3.14 Funnels, 100mL.
3.15 Teflon boiling chips.
3.16 300mm x 25mm carbon column preparation (Column #2).

3.16.1 Carbon column (gravity flow). Prepare either a carbon/silica gel or carbon/Celite 545 packing material by mixing 5% (by weight) active carbon AX-21, pre-washed with toluene and dried at 110°C and 95% (by weight) either silica gel or Celite 545, followed by activation of the mixture at 130°C for 6 hours.

3.16.1.1 Note: The carbon/Celite 545 packing material has a tendency to "channel and clump" when mixed with AX-21. This packing material will be used only if the carbon/silica gel is not effective.

3.16.2 Weigh 10g of the charcoal packing into a beaker and transfer to the column already containing a glass wool plug with 75mL of toluene. Allow the toluene to drain to the top of the packing.

3.16.3 Rinse with methanol and allow the solvent to drain to the top of the packing.

3.16.4 Add 2cm of cleaned silica gel and rinse with methanol. Insert a glass wool plug.

3.17 15.5mm X 160mm Acid Alumina Column (Column #3).

3.17.1 Place a glass wool plug at the bottom of the column, pack with 6g of acid alumina followed by 1cm of Na_2SO_4. Refer to figure 3.

3.18 Buchler Rotary Evaporator.

3.19 Dean-Stark Trap, condenser and flask.

3.20 Round bottom flasks, 50mL, 500mL and 2000mL.

3.21 1L Erlenmeyer Flask.

3.22 Top-Loader Balance, Fischer Scientific Model XL-3000.

3.23 Injection vial inserts, 100uL (Sun International).

3.24 Electrothermal electromantle six sample and 3000mL capacity.

Drying oven, VWR Model 1320.

4 REAGENTS, STANDARDS AND SOLVENTS

4.1 Reagents

4.1.1 Sulfuric acid, concentrated.

4.1.2 Silica gel 60 (70-230 mesh).

4.1.3 Celite 545.

4.1.4 Water, distilled.

4.1.5 Alumina, acid. (EMS, 80/100 mesh).

4.1.6 Prepurified nitrogen gas.

4.1.7 Anhydrous sodium sulfate.

4.1.8 Sodium Hydroxide, 10.00N.

4.1.9 Potassium Hydroxide Pellets (EMS).

4.2 Solvents

4.2.1 Solvent A: 1:1 $MeCl_2$:Cyclohexane

4.2.2 Methylene chloride. Highest available purity.

4.2.3 Hexane. Highest available purity.

4.2.4 Benzene. Highest available purity.

4.2.5 Tetradecane. Highest available purity.

4.2.6 Acetone. Highest available purity.

4.2.7 Ethanol. Highest available purity.

4.2.8 Methanol. Highest available purity.

4.2.9 Cyclohexane. Highest available purity.

4.2.10 Toluene. Highest available purity.

4.3 Standards

1.3.1 PCDD/PCDF Analytical Standards (CIL, Wooburn, MA).

5 CALIBRATION

5.1 Initial Calibration

5.1.1 Each calibration curve contains all 17 2,3,7,8-substituted isomers. Calibration standard solutions are presented in Table A2.

5.1.2 The calibration range for this matrix is as follows:

Fish/Tissue(ppq)

Cl_4	0.20 - 160
Cl_5-Cl_7	1.0- 800
Cl_8	2.0- 1600

5.1.3 Maximum injection of standards is 2 µL to create an initial calibration curve at least every six months or whenever the continuing calibration check falls outside the acceptable relative response factor window.

5.1.4 The chromatographic peak separation between 2,3,7,8-TCDD and the closest eluting isomers must be resolved with a valley of ≤25%.

5.1.5 The first and last PCDD/F eluters are verified to be within the eight homologue retention time windows.

5.1.6 An initial calibration curve is accepted if the following criteria are met:

5.1.6.1 The signal to noise ratio (s/n) exceeds 10:1 for all ions monitored,

5.1.6.2 The ion abundance ratio measurements are within ± 15% of the theoretical ratio, and

5.1.6.3 The relative standard deviation of the mean RRF for each standard solution does not exceed 20%.

5.2 Continuing Calibration

5.2.1 A continuing calibration check is made at the beginning of every 12 hours by injecting a mid-range standard (CS3) from the initial calibration curve as well as a column performance standard mix (CPSM).

5.2.2 The continuing calibration check is acceptable if the following criteria are met:

5.2.2.1 The relative response factors for the mid-range standard are within ±30% of the mean values established from the initial calibration curve for labeled standards and ±20% of the mean for native standards.

5.2.2.2 The ion ratios are within 15% of theoretical, and

5.2.2.3 Chromatographic resolution must be better than 25%.

5.2.3 A continuing calibration check is made at the end of every 12 hours by injecting a mid-range standard (CS3) from the initial calibration curve.

6 QUALITY CONTROL

6.1 Method Blank (MB): Method blank is a sodium sulfate preparation that is free of native analyte that has been prepared and analyzed using the same procedures followed for the rest of the analytical batch.

6.1.1 A method blank is run with every analytical batch or 20 samples (whichever is less) per matrix type.

6.1.2 For the determination of native 2,3,7,8-substituted isomers the levels measured in the method blank must be less than the method quantitation limit or ten times lower than the concentration found in any sample within the analytical batch.

6.1.3 For the determination of native hepta and octa, the levels measured in the method blank must be less than the method quantitation limit or ten times lower than the concentration found in any sample within the analytical batch.

6.1.4 All samples within an analytical batch are re-extracted and analyzed if the method blank associated with that batch does not meet the criteria described in 6.1.2 and 6.1.3 above.

6.2 Laboratory Control Samples (LCS): A laboratory control sample is prepared by adding a known quantity of native standards to an interferant free matrix and used to assess method performance (precision and accuracy).

Cl_4	0.20 - 160
Cl_5-Cl_7	1.0- 800
Cl_8	2.0- 1600

5.1.3 Maximum injection of standards is 2 µL to create an initial calibration curve at least every six months or whenever the continuing calibration check falls outside the acceptable relative response factor window.

5.1.4 The chromatographic peak separation between 2,3,7,8-TCDD and the closest eluting isomers must be resolved with a valley of ≤25%.

5.1.5 The first and last PCDD/F eluters are verified to be within the eight homologue retention time windows.

5.1.6 An initial calibration curve is accepted if the following criteria are met:

5.1.6.1 The signal to noise ratio (s/n) exceeds 10:1 for all ions monitored,

5.1.6.2 The ion abundance ratio measurements are within ± 15% of the theoretical ratio, and

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5.2.2.2 The ion ratios are within 15% of theoretical, and

5.2.2.3 Chromatographic resolution must be better than 25%.

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6.1.1 A method blank is run with every analytical batch or 20 samples (whichever is less) per matrix type.

6.1.2 For the determination of native 2,3,7,8-substituted isomers the levels measured in the method blank must be less than the method quantitation limit or ten times lower than the concentration found in any sample within the analytical batch.

6.1.3 For the determination of native hepta and octa, the levels measured in the method blank must be less than the method quantitation limit or ten times lower than the concentration found in any sample within the analytical batch.

6.1.4 All samples within an analytical batch are re-extracted and analyzed if the method blank associated with that batch does not meet the criteria described in 6.1.2 and 6.1.3 above.

6.2 Laboratory Control Samples (LCS): A laboratory control sample is prepared by adding a known quantity of native standards to an interferant free matrix and used to assess method performance (precision and accuracy).

6.2.1 A 10µl aliquot containing 200pg Cl_4 DD/DF, 1000pg Cl_5-Cl_7 DD/DF & 2000pg Cl_8 DD/DF is used for spiking.

6.2.2 A pair of LCS's is analyzed and associated with groups of client samples not to exceed 20 samples or at a frequency of two weeks, whichever comes first.

6.2.3 The LCS of each native isomer should have a relative percent difference of 50% or less.

6.2.4 Internal standard recoveries should range between 40-135%.

6.2.5 If the internal standard recovery of an isomer in the LCS and the associated sample(s) is also out of the range, than the sample and the LCS will be re-extracted and analyzed.

6.3 Matrix Spike (MS/MSD): A matrix spike sample is prepared by adding a known quantity of native standards to a sample matrix prior to extraction.

6.3.1 A 10µl aliquot containing 200pg Cl_4 DD/DF, 1000pg Cl_5-Cl_7 DD/DF & 2000pg Cl_8 DD/DF is used for spiking.

6.3.2 The relative percent difference between MS/MSD samples should be ≤25%.

6.4 Duplicate Samples: Duplicate samples are two separate aliquots taken from the same source. Duplicate samples are analyzed independently to assess laboratory precision.

6.4.1 If the relative percent difference from duplicate sample analyses is greater than 50%, then both samples will be reanalyzed.

7 COLLECTION, PRESERVATION, AND HANDLING

1.1 Samples are to be stored frozen, extracted within 30 days and completely analyzed within 45 days of collection.

8 EXTRACTION AND PERCENT LIPIDS

8.1 Extraction

8.1.1 Mix 25g of well ground fish with 60g of pre-cleaned Na_2SO_4 in a beaker. Stir frequently to remove any lumps.

8.1.2 Transfer the mixture to a thimble. Spike 10µl of internal standard into each thimble and 10µL of native spike into each LCS thimble.

8.1.3 Soxhlet extract for 16 hours with 1:1 $MeCl_2$:hexane.

8.2 % Lipids

8.2.1 Roto-evaporate the extract to less than 250mL and transfer to a 250mL mixing cylinder.

8.2.2 Adjust the extract to 250mL using 1:1 $MeCl_2$:hexane and mix well.

8.2.3 Transfer 25mL of the solution to a aluminum dish that has been pre-weighed on an analytical balance.

8.2.4 Allow the extract to air dry completely and then place in a 110 °C oven over night.

8.2.5 When the aliquot is dry, re-weigh the dish on an analytical balance and record the weight. Calculate the % lipids using the following calculation:

$$\% \text{ lipids} = \frac{\text{dry wt.}}{\text{wet wt.}} \times 100$$

8.2.6 Add 10µL of clean-up recovery standard to each extract.

9 SAMPLE CLEANUP

9.1 Column #1 (See Figure A1)

9.1.1 Depending on the lipid content, adjust the remaining extract to 250mL with 1:1 $MeCl_2$:hexane and mix.
9.1.2 Quantitatively transfer the extract to the first column described in Section 3.10 with 1:1 $MeCl_2$:hexane.
9.1.3 As the extract reaches the top of the packing material, add 500mL of 1:1 $MeCl_2$:hexane. Proceed to next cleanup.

9.2 Column #2 (See Figure 2)
9.2.1 Pre-elute the column described in section 3.16 with 75mL of methanol and allow the solvent to drain to the top of the packing.
9.2.2 Elute the column with 75mL of Solvent A and allow the solvent to drain to the top of the packing.
9.2.3 Quantitatively transfer the eluate from the first column to column #2. Allow the solvent to drain to the top of the packing.
9.2.4 Elute the column with 75mL of Solvent A.
9.2.5 Elute with 50mL of 75/20/5 $MeCl_2$/MeOH/benzene. Discard all of the eluates.
9.2.6 Turn the column over and elute with 250mL toluene into a 500mL round bottom.
9.2.7 Add 100µL of C_{14} and roto-evaporate until only the C_{14} remains. Add 100mL hexane and roto-evaporate to C_{14}. Proceed to the next cleanup.

9.3 Column #3 (See Figure 3)
9.3.1 Pre-elute the column with 20mL hexane.
9.3.2 Quantitatively transfer the sample from Column #2 onto Column #3 using hexane.
9.3.3 Elute with 40mL hexane. Discard the eluate.
9.3.4 Elute with 30mL of 20% $MeCl_2$/hexane.
9.3.5 Roto-evap to approx. 1mL, then transfer to a 2mL conical containing 10µL of C_{14} and 10µL of recovery standard in tetradecane.
9.3.6 N-evap to C_{14}, rinse with hexane and N-evap to C_{14} again (final volume is 20µL).
9.3.7 Transfer to autoinjector insert and crimp-top vial.

10 GC/MS ANALYSIS

10.1 Analyze samples with selected ion monitoring. Monitoring the M-COCl is not required with high resolution mass spectrometry.
10.2 The GC peaks must have retention times within the window established for that series by the column performance solution.
10.3 The ratio of the integrated ion currents of both the exact m/z's monitored must be within the limits of Table A1.
10.4 Quantitate the PCDD and PCDF peaks from the response relative to the appropriate internal standard. Recovery of each internal standard versus the recovery standard must be 40-120% or have a signal to noise ratio >10:1.
10.5 Report results in picogram per gram.

11 REFERENCES

11.1 USEPA Method 8290, Revision O, Dated September 1994.
11.2 Stalling's Method, Columbia National Fisheries Research Laboratory, Anal. Chem., 56, 1830-1840, 1984.

Table A1. Quality assurance / quality control (QA/QC) control limits used by Alta Analtyical Laboratory (El Dorado Hills, CA).

Number of Chlorine atoms	Ion Type	Theoretical Ratio	Control Limits[1]	
			Lower	Upper
4[2]	M/M+2	0.77	0.65	0.89
5	M+2/M+4	1.55	1.32	1.78
6	M+2/M+4	1.24	1.05	1.43
6[3]	M/M+2	0.51	0.43	0.59
7	M+2/M+4	1.05	0.88	1.20
7[4]	M/M+2	0.44	0.37	0.51
8	M+2/M+4	0.89	0.76	1.02

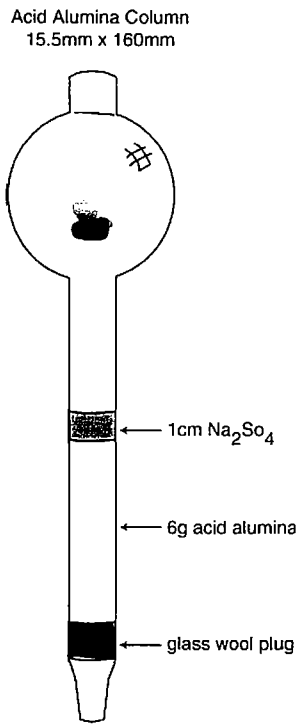
(1) Represents ± 15% windows around the theoretical ion abundance ratios.
(2) Does not apply to $^{37}Cl_4$ - 2,3,7,8-TCDD (cleanup standard).
(3) Used for ^{13}C - HxCDF only.
(4) Used for ^{13}C - HpCDF only.

Table A2. Calibration solutions used by Alta Analytical Laboratory (El Dorado Hills, CA).

Compound	Calibration Solutions (ng/mL)				
Native CDDs and CDFs	**CS1**	**CS2**	**CS3***	**CS4**	**CS5**
2,3,7,8-TCDD	0.5	2.0	10	40	200
2,3,7,8-TCDF	0.5	2.0	10	40	200
1,2,3,7,8-PeCDD	2.5	10	50	200	1000
1,2,3,7,8-PeCDF	2.5	10	50	200	1000
2,3,4,7,8-PeCDF	2.5	10	50	200	1000
1,2,3,4,7,8-HxCDD	2.5	10	50	200	1000
1,2,3,6,7,8-HxCDD	2.5	10	50	200	1000
1,2,3,7,8,9-HxCDD	2.5	10	50	200	1000
1,2,3,4,7,8-HxCDF	2.5	10	50	200	1000
1,2,3,6,7,8-HxCDF	2.5	10	50	200	1000
1,2,3,7,8,9-HxCDF	2.5	10	50	200	1000
2,3,4,6,7,8-HxCDF	2.5	10	50	200	1000
1,2,3,4,6,7,8-HpCDD	2.5	10	50	200	1000
1,2,3,4,6,7,8-HpCDF	2.5	10	50	200	1000
1,2,3,4,7,8,9-HpCDF	2.5	10	50	200	1000
OCDD	5.0	20	100	400	2000
OCDF	5.0	20	100	400	2000
Labeled Compounds					
13C-2,3,7,8-TCDD	200	200	200	200	200
13C-2,3,7,8-TCDF	200	200	200	200	200
13C-1,2,3,7,8-PeCDD	200	200	200	200	200
13C-1,2,3,7,8-PeCDF	200	200	200	200	200
13C-2,3,4,7,8-PeCDF	200	200	200	200	200
13C-1,2,3,4,7,8-HxCDD	200	200	200	200	200
13C-1,2,3,6,7,8-HxCDD	200	200	200	200	200
13C-1,2,3,4,7,8-HxCDF	200	200	200	200	200
13C-1,2,3,6,7,8-HxCDF	200	200	200	200	200
13C-1,2,3,7,8,9-HxCDF	200	200	200	200	200
13C-2,3,4,6,7,8-HxCDF	200	200	200	200	200
13C-1,2,3,4,6,7,8-HpCDD	200	200	200	200	200
13C-1,2,3,4,6,7,8-HpCDF	200	200	200	200	200
13C-1,2,3,4,7,8,9-HpCDF	200	200	200	200	200
13C-OCDD	400	400	400	400	400
Cleanup Recovery Standard					
37Cl4-2,3,7,8-TCDD	80	80	80	80	80
Recovery Standard					
13C-1,2,3,4-TCDD	200	200	200	200	200
13C-1,2,3,4-TCDF	200	200	200	200	200
13C-1,2,3,7,8,9-HxCDD	200	200	200	200	200

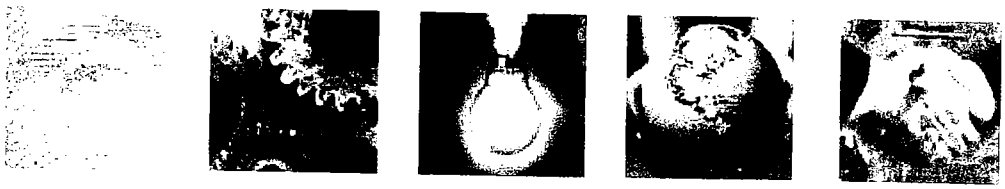
* Calibration Verification Solution

Figure A1. Acid Alumina Column



Appendix II:

Field Sampling Documentation



APPENDIX II: POST SAMPLING FIELD DOCUMENTATION ARCATA, CALIFORNIA

July 18, 2002

Prepared by:

ENVIRON International Corporation
6001 Shellmound Street
Emeryville, California 94608

Prepared for:

Sierra Pacific Industries
Arcata, California

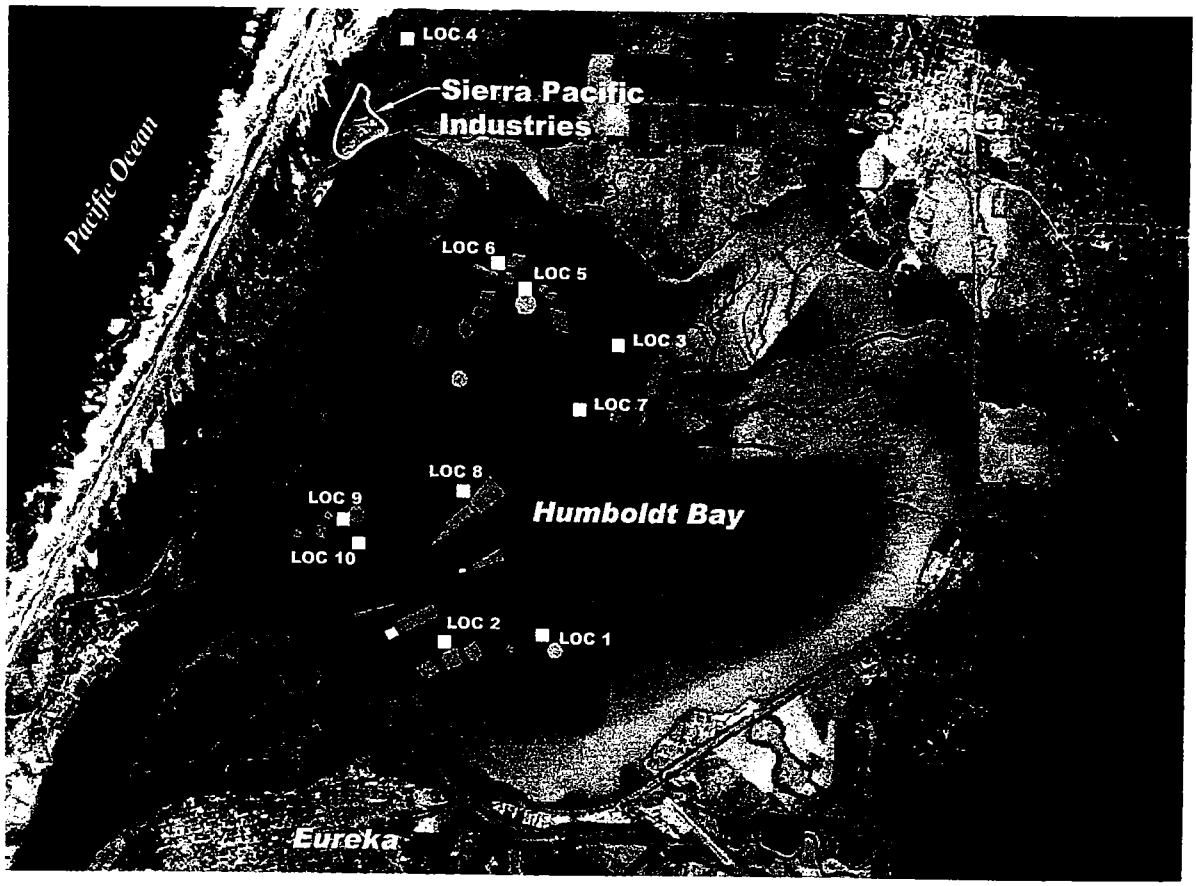
This attachment contains the following documentation from the sampling program:

- Figure II-1: Sample Location Map,
- Table II-1: Summary of Sample Locations,
- Photographs of the sampling activities and examples of oysters and mussels, and
- Chain-of-custody forms.

Table

Sample ID	Date/Time	Location	Company	Bed Name/Location Description	Bed Age	Sample Type	Bed Type
020621-Ebay-6-2	6/21/2002 9:18	1	Coast Seafoods	East Bay Bed 6-2	Started in 1999	Pacific Triploid Oyster	Bottom
020621-Ebay-1-2	6/21/2002 9:40	2	Coast Seafoods	East Bay Bed 1-2	Started in 2000	Pacific Triploid Oyster	Longline
020621-NBSC	6/21/2002 10:12	3	North Bay Shellfish Company	North Bay Shellfish Company Bed	Started in 1999	Pacific Diploid Oyster	Longline
020621-NBSCM	6/21/2002 10:37	4	North Bay Shellfish Company	North Bay Shellfish Company Mussels	1 1/2 year old	Mussel	Rack and Bag
020621-NBSCO2	6/21/2002 10:57	4	North Bay Shellfish Company	North Bay Shellfish Company Wet Storage Oysters	2000 oysters in wet storage for 2 weeks	Pacific Diploid Oyster	Rack and Bag
020621-MR-7-1	6/21/2002 11:13	5	Coast Seafoods	Mad River Bed 7-1	Started in 2000	Pacific Oysters	Bottom
020621-MR-7-2	6/21/2002 11:17	6	Coast Seafoods	Mad River Bed 7-2	Started in 1999	Pacific Oysters	Longline
020621-SIN	6/21/2002 11:25	7	Coast Seafoods	Sand Island North Bed	Started in 2000	Pacific Oysters	Longline
020621-SIN-1-2	6/21/2002 11:32	8	Coast Seafoods	Sand Island North Bed 1-2	Started in 2000	Kumamoto Oysters	Longline
020621-BIN	6/21/2002 11:36	9	Coast Seafoods	Bird Island North Bed	Started in 2000	Pacific Oysters	Longline
020621-BIS	6/21/2002 11:44	10	Coast Seafoods	Bird Island South Bed	Started in 2000	Kumamoto Oysters	Longline
020621-Ebay-1-2-S	6/21/2002 9:40	2	Not Applicable	East Bay Bed 1-2	Not Applicable	Sediment	Not Applicable
020621-NBSC-S	6/21/2002 10:12	3	Not Applicable	North Bay Shellfish Company Bed	Not Applicable	Sediment	Not Applicable
020621-MR-7-1-S	6/21/2002 11:13	5	Not Applicable	Mad River Bed 7-1	Not Applicable	Sediment	Not Applicable
020621-BIN-S	6/21/2002 11:36	9	Not Applicable	Bird Island North Bed	Not Applicable	Sediment	Not Applicable

Figure



6000 0 6000 12000 18000 FEET

SCALE IN FEET

- Pacific longline
- Rack and bag
- Wet Storage
- Kumomato beds
- LOC 1 Sample locations

N W E S

0310422C\ARCATA-OYSTER.DWG

ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Sample Location Map

Humboldt Bay, California

Figure 1

Drafter: RS Date: 7/9/02 Contract Number: 03-10422C Approved: Revised:

Photographs

Photo 1: The boat that was used for harvesting oysters supplied to ENVIRON by Coast Seafoods, Inc.

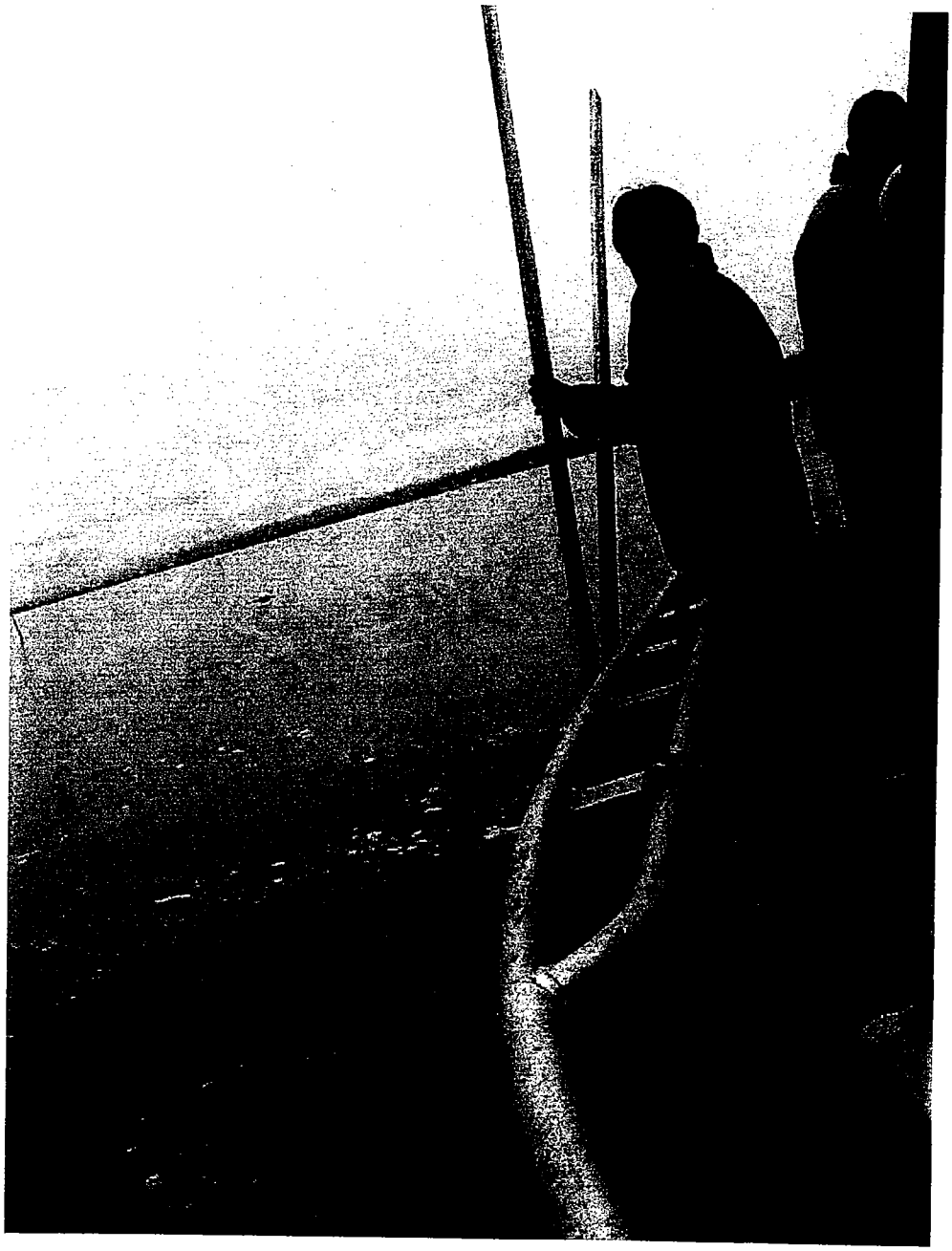


Photo 2: A Coast Seafoods, Inc. employee using the oyster rake harvesting bottom bedded oysters.

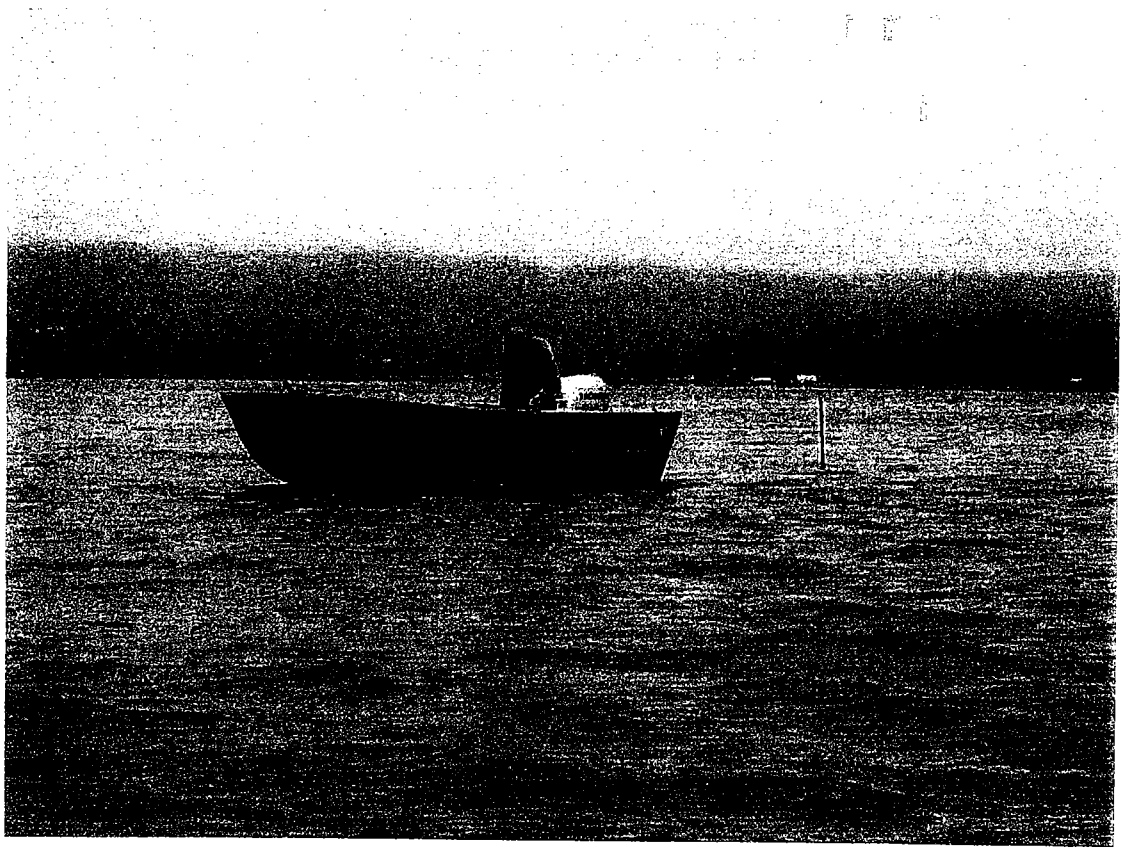


Photo 3: The North Bay Shellfish Company boat harvesting longline bedded oysters.

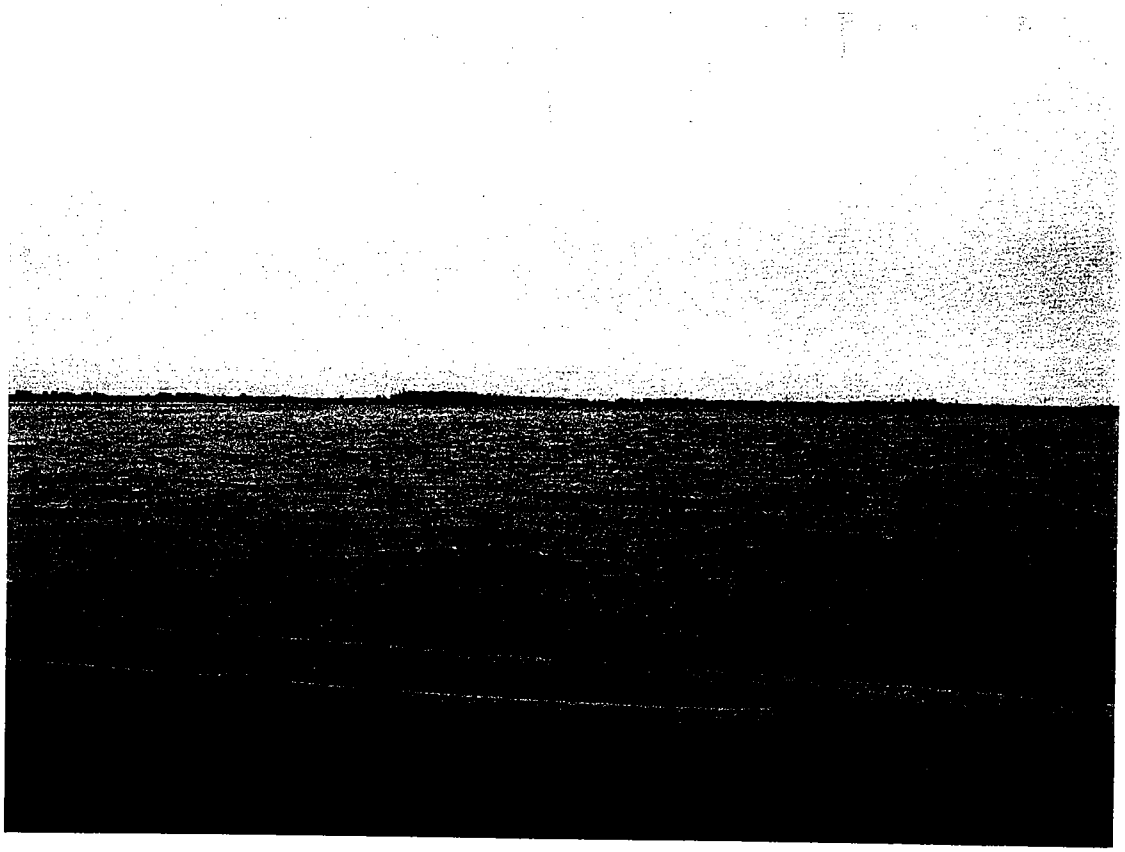


Photo 4: Looking north to shoreline from location 1.

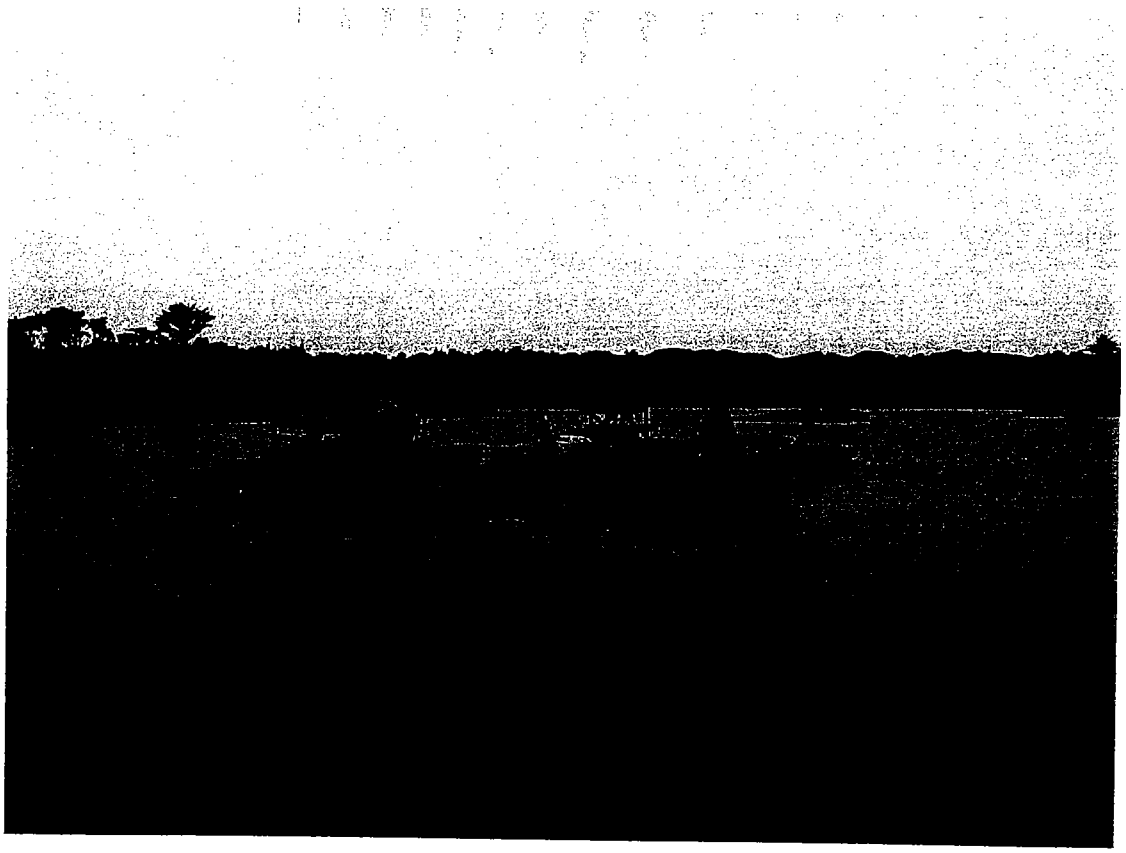


Photo 5: The North Bay Shellfish Company wet storage raft (location 4 on Figure 1). This is where the mussels and wet storage oysters were harvested.

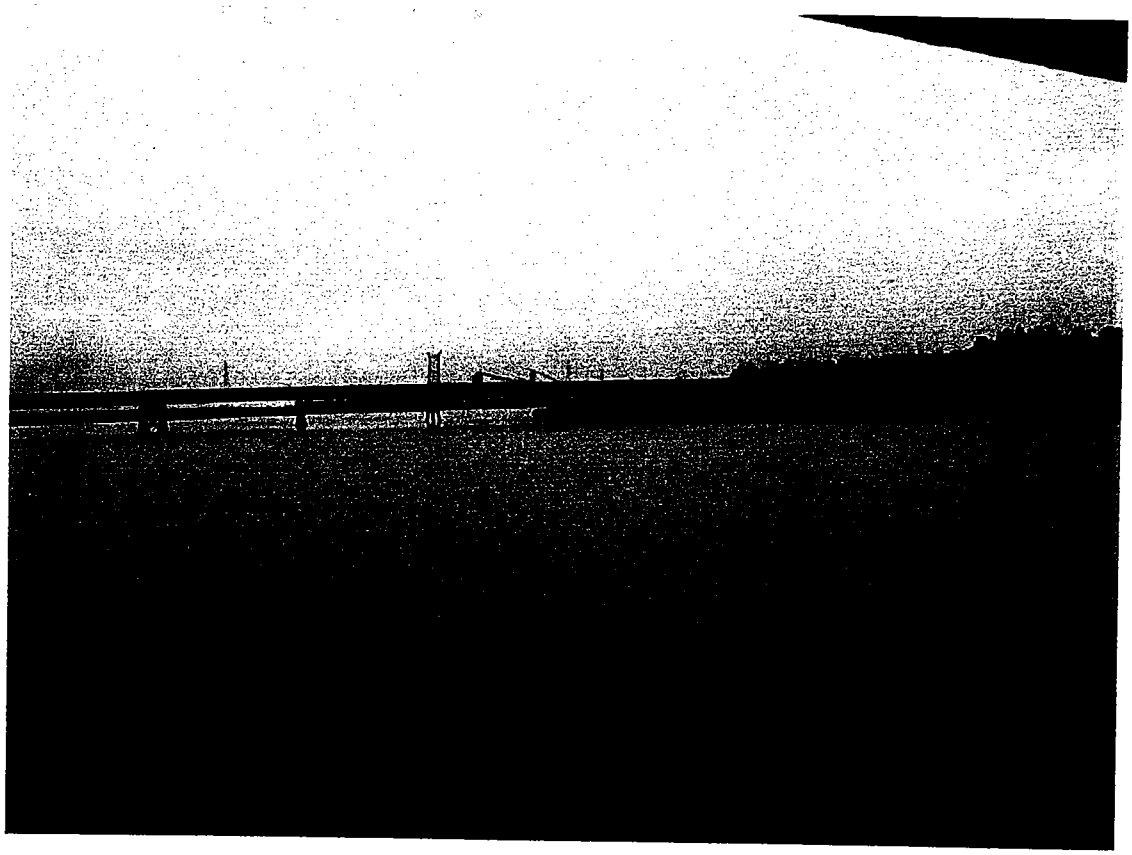


Photo 6: A view of Sierra Pacific Industries from Location 4. The black pipes are municipal water and sewer pipes.

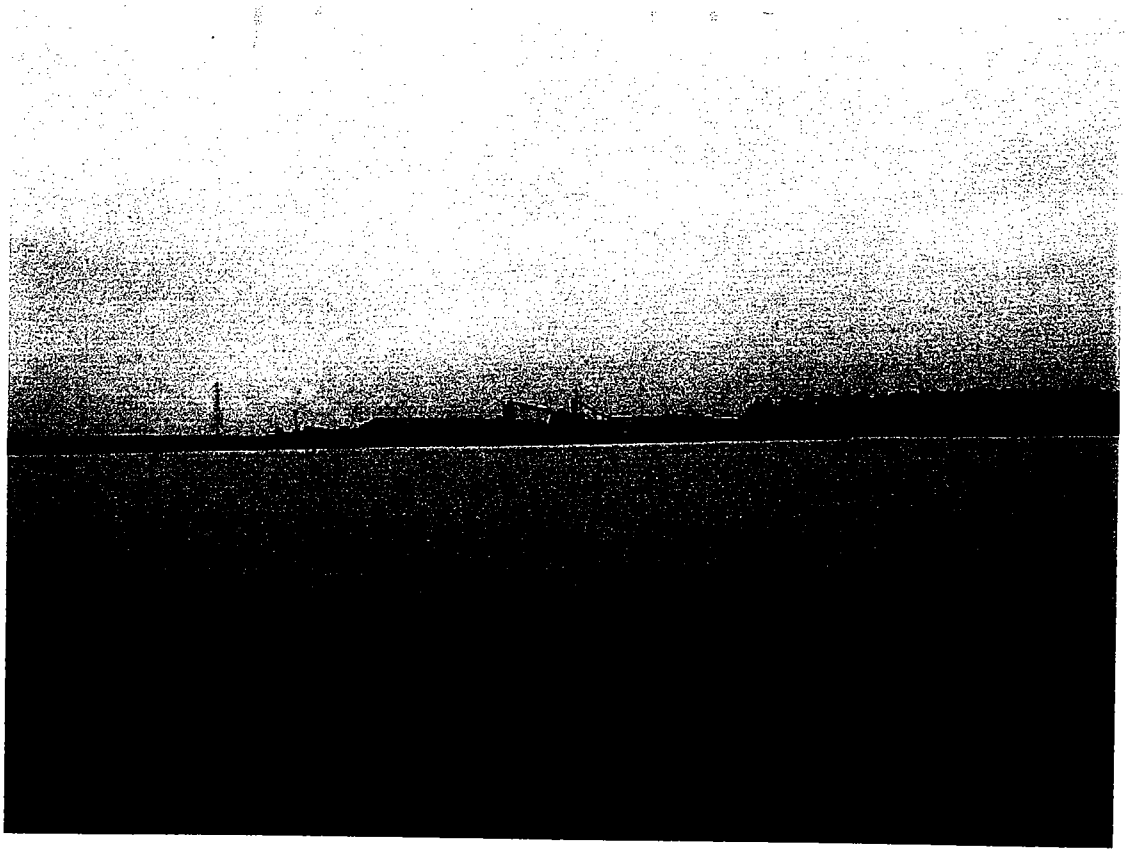


Photo 7: A view of the Sierra Pacific Industries sawmill from the Mad River.

Photo 8: Sealed coolers from oyster sampling. Sealed tape was signed by Rolf ____ from Department of Health and Safety.

6/24/02

Photo 9: Sealed coolers from oyster sampling received by the lab. Signed and dated from AAL staff.

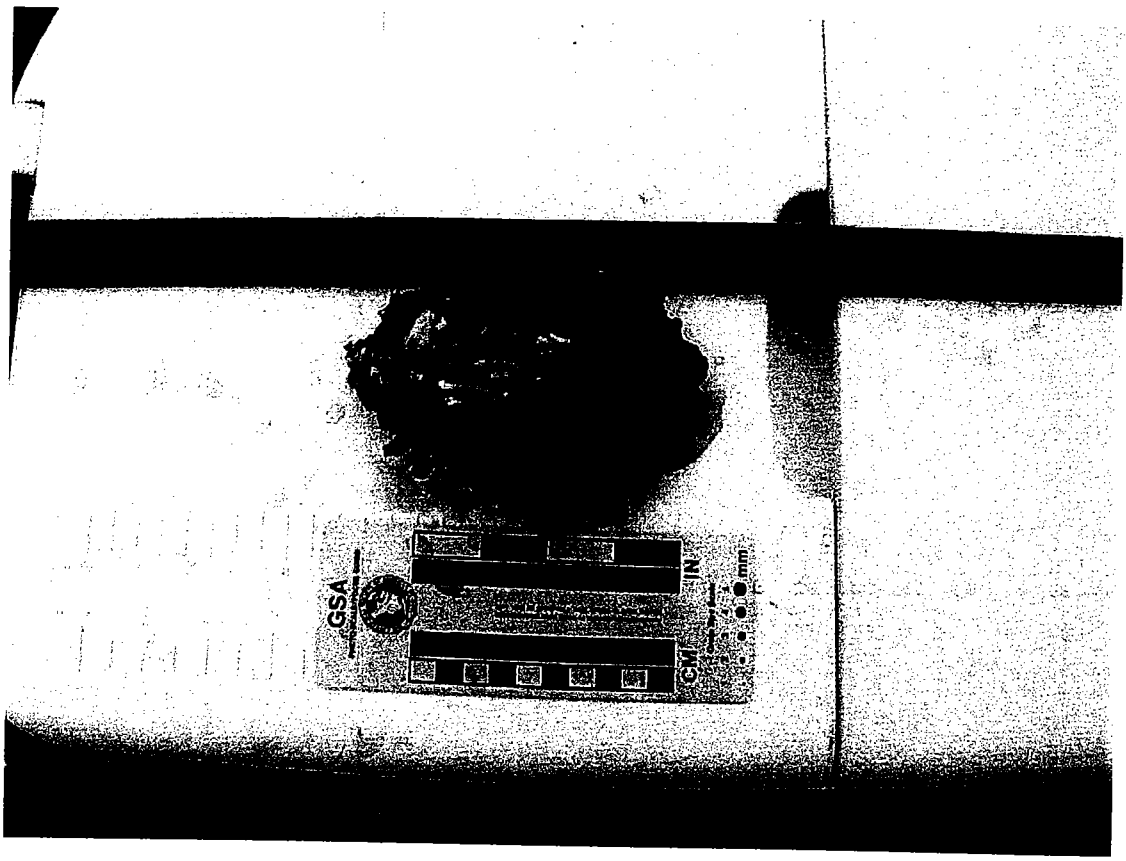


Photo 10: Example of a Diploid Pacific Oyster from Location 3.

Photo 11: Example of a Diploid Pacific Oyster from Location 4.

Photo 12: Example of a Mussel from Location 4.

Photo 13: Example of a Pacific Oyster from Location 5.

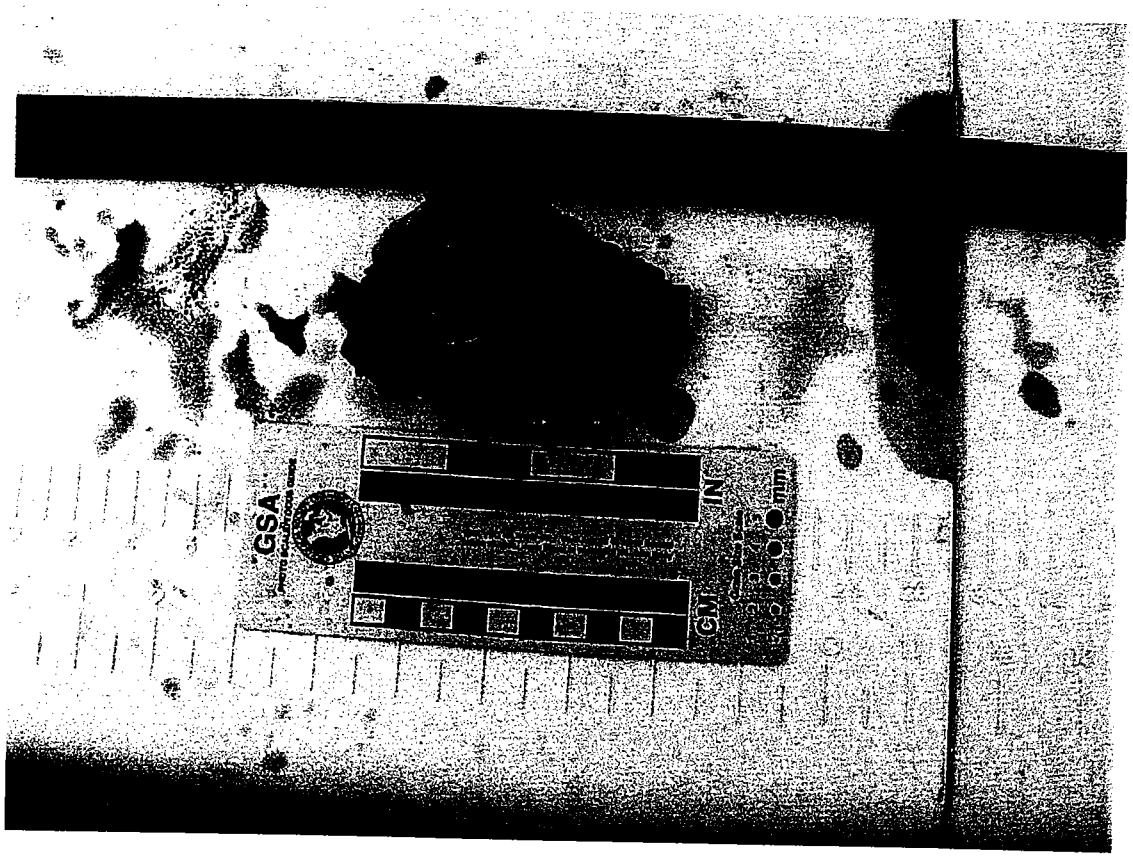


Photo 14: Example of a Pacific Oyster from Location 6.