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THE DENNY WAY SEDIMENT CAP

1996 DATA

FINAL REPORT

by:

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COMMON ABBREVIATIONS AND ACRONYMS

<MDL- less than Method Detection Limit
<RDL- Detected below the Reporting Detection Limit
Aroclor-Industrial name for Polychlorinated Biphenyl (PCB)
B- Method Blank Contamination
BNA- Base/Neutral/Acid
CLP- EPA's Contract Lab Program
CSL- Cleanup Screening Levels
CSO- Combned Sewer Overflow
CVAA- Cold Vapor Atomic Absorption
EPA- U.S. Environmental Protection Agency
G- low SRM recovery/low surrogate recovery/low MS recovery
HPAH- High Molecular Weight Polynuclear Aromatic Hydrocarbons
ICP- Inductively Coupled Plasma, a laboratory method
IGR- Individual Growth Rate
KCEL- King County Environmental Laboratory
KCDNR- King County Department of Natural Resources
KCWLRD- King County Water and Land Resources Division
L- high SRM, matrix spike, or surrogate recovery
LPAH- Low Molecular Weight Polynuclear Aromatic Hydrocarbons
MDL- Method Detection Limit
Metro- Municipality of Metropolitan Seattle
MS- Matrix Spike
NTIS- National Technical Information Service
PAH- Polynuclear Aromatic Hydrocarbons
PCB- Polychlorinated Biphenyl
PSDDA- Puget Sound Dredge Disposal Analysis
PSEP- Puget Sound Estuary Program
QA- Quality Assurance
QAR- Quality Assurance Review
QC- Quality Control
Qual- Data Qualifier Codes
RDL- reporting detection limit
REMOTS- Remote Environmental Monitoring of the Seafloor
RVR- Reference Value Ranges
SMS- Sediment Management Standard
SQS- Sediment Quality Standards
SRM- Standard Reference Materials
TOC- Total Organic Carbon
USACE- United States Army Corps of Engineers
WDOE- Washington State Department of Ecology
WPCD- King County Water and Land Resources, Water Pollution Control Division

EXECUTIVE SUMMARY

In 1996, monitoring activities were conducted at the Denny Way Sediment Cap as part of the monitoring program, which has been established through the year 2000. This report documents the results of this monitoring effort in 1996. The Denny Way Sediment Cap is on a three acre site offshore of the Denny Way combined sewer overflow in Myrtle Edwards Park, north of Pier 70 on the Seattle Waterfront, Figure 1. The sediment cap is a three foot thick layer of clean sand placed on contaminated sediments located near the mouth of the sewer overflow.

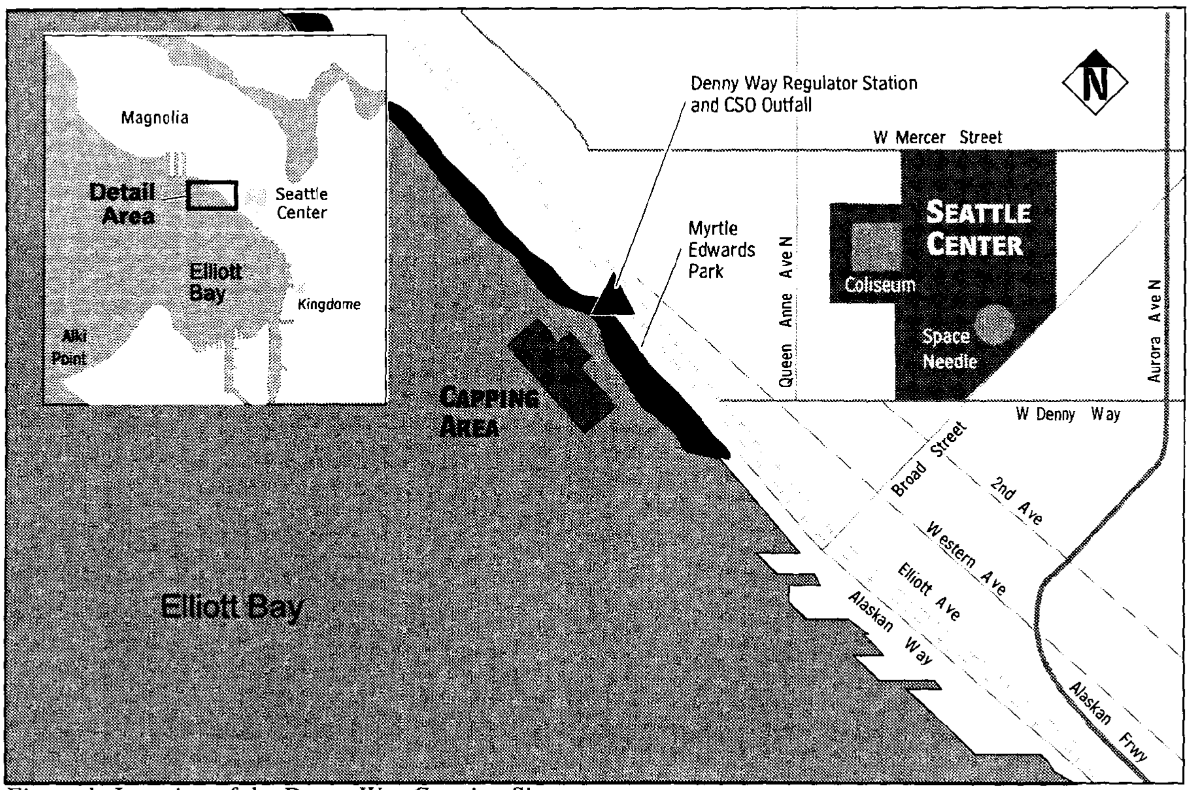

Figure 1: Location of the Denny Way Capping Site

Sampling consisted of 2 centimeter and 10 centimeter grab samples at Stations J, K, L and M which are on the sediment cap, and at Stations S and T which are on the original bottom material, Figure 2. Biological and chemical testing of these samples were performed. Two additional samples from Stations J and M were taken with a 0.1 m^2 Van Veen grab sampler for benthic invertebrate sampling.

Chemical testing included analysis for trace metals, volatile organics, base/neutral/acid extractable organics, pesticides, polychlorinated biphenyls, total organic carbon, and particle size distribution. The biological testing included toxicity testing with *Rhepoxynius abronius*, using the acute 10 day mortality test; *Dendraster excentricus*, using the acute embryo mortality/abnormality test; and *Neanthes arenaceodentata*, using the chronic 20 day juvenile polychaete growth rate test.

RESULTS

Station K, closest to the outfall, has the highest level of contamination, the highest TOC, and the finest grained sediment on the cap. Station K is the only station to exceed the SMS in both the 0-

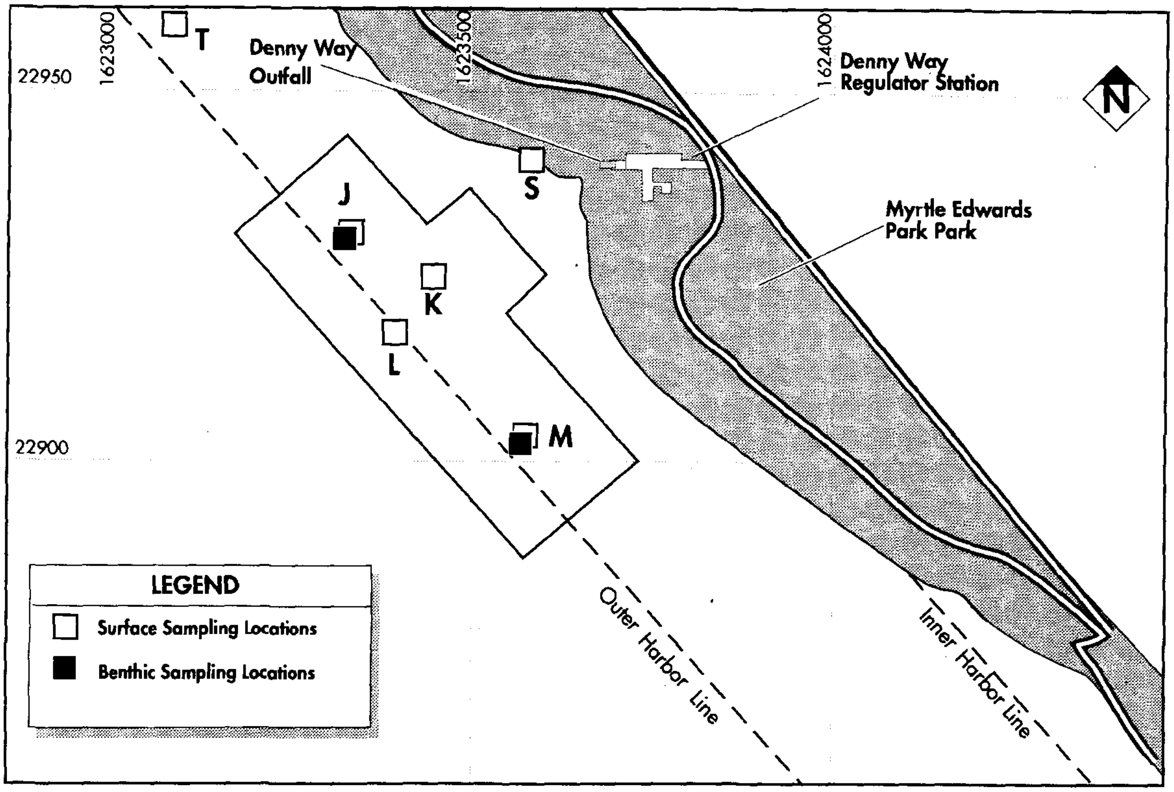

Figure 2: Denny Way Sampling Stations

2 and 0-10 cm deep sampling during this sampling period: benzyl butyl phthalate exceeds the SQS, and bis(2-ethylhexyl) phthalate exceeds the CSL. Indeno(1,2,3-Cd)pyrene, benzo(g,h,i)perylene, and mercury are about half the SQS, all other contaminant organics and metals are typically one third of the SQS or less in concentration.

Stations J, L and M are farther away from the outfall and have much lower concentrations than Station K. The 0-2 cm surface sample from most of these stations exceeded the SQS for either bis(2-ethylhexyl)phthalate or benzyl butyl phthalate, while the levels of other chemicals were far below the SQS.

The 0-2cm, 2-10cm and 0-10cm sampling at K and L showed that concentrations were similar both on the cap surface and to a depth of 10cm. This suggests vertical sediment distribution is occurring, possibly due to bioturbation at these sampling sites, which may also be occurring over the rest of the cap surface.

The toxicity testing gave mixed results. Station K, closest to the outfall, passed all three bioassay tests. However, at this station, as noted above, there were exceedances of the SMS chemical criteria for both benzyl butyl phthalate and bis(2-ethylhexyl) phthalate.

Station L, which is located farther offshore from Station K, and which had no SMS chemical exceedances, passed both the amphipod acute test, and the polychaete chronic test, but exceeded the CSL for the larval echinoderm acute test. Larval echinoderm protocols were deviated from with regard to holding time and temperature; however, no deviations were specific to the Station L sample, and consequently the toxicity response is surprising and remains unexplained.

Benthic species monitored at Stations J and M decreased in abundance by about 55% from 1994 to 1996, and have decreased in total biomass. These reductions occurred across all taxonomic groups. However, despite the large reductions in abundance, three indices of ecological community structure, Shannon-Weiner diversity index, Swartz's dominance index, and Pielou's evenness index, all indicate that a healthy and diverse, community is present at these two stations. The reduced abundance may be due to changes in the physical makeup of the sediment and other influences such as predation, evolution of the benthic community, or other external forces.

A benthic taxonomy reference station was added for the first time in 1996, but it appears the station has limited value for comparison to Denny Way samples because some of the reference station values fall outside the expected range of values determined for Puget Sound. Despite an acceptable match for sediment grain size at both sites, the hydraulic conditions differ between sites: the reference station is in an erosional environment and the Denny Way cap is in a depositional environment.

Conclusions

The overall conclusion is that the Denny Way cap is performing much as expected after 6 years. The sand cap is isolating the new, diverse and changing benthic community from the highly contaminated historic sediments under the cap. Except for the 2 phthalate chemicals, the cap surface is being recontaminated at a slow rate and still has concentrations that are much lower than the sediments beyond the cap. The station closest to the outfall exceeds the CSL value for bis(2-ethylhexyl)phthalate, but showed no toxicity with bioassay tests. The sources for recontamination are the continuing discharges from the Denny Way CSO and some redistribution of the uncapped sediments that still remains inshore of the cap. The need for future monitoring of the Denny Way cap will be influenced by the plans to begin construction of 2 outfall pipes in the year 2000 as part of the Denny Way CSO control project which is now underway. Extensive bottom sediment sampling conducted in 1997 outside the cap will be used to determine how much additional area will require sediment remediation.

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CHAPTER 1: INTRODUCTION

In March 1990, contractors for the Seattle district U.S. Army Corps of Engineers (USACE) carefully placed clean sand offshore of the Denny Way combined sewer overflow (CSO), capping 3 acres of chemically contaminated bottom sediment. The sediments were capped to minimize exposure to benthic organisms, fish, and, ultimately, humans. This project, known as the Denny Way Sediment Cap was the result of several years of research by many agencies and a cooperative effort between the USACE and the Municipality of Metropolitan Seattle (Metro)[1].

The purpose of this report is to document the methods, results, and conclusions of the monitoring conducted on the Denny Way sediment cap in 1996 as part of the monitoring program established for the project. For further background information, see *The Denny Way Sediment Cap* (King County Department of Metropolitan Services, 1995) and *The Denny Way Sediment Cap: 1994 Data* (WPCD1996).

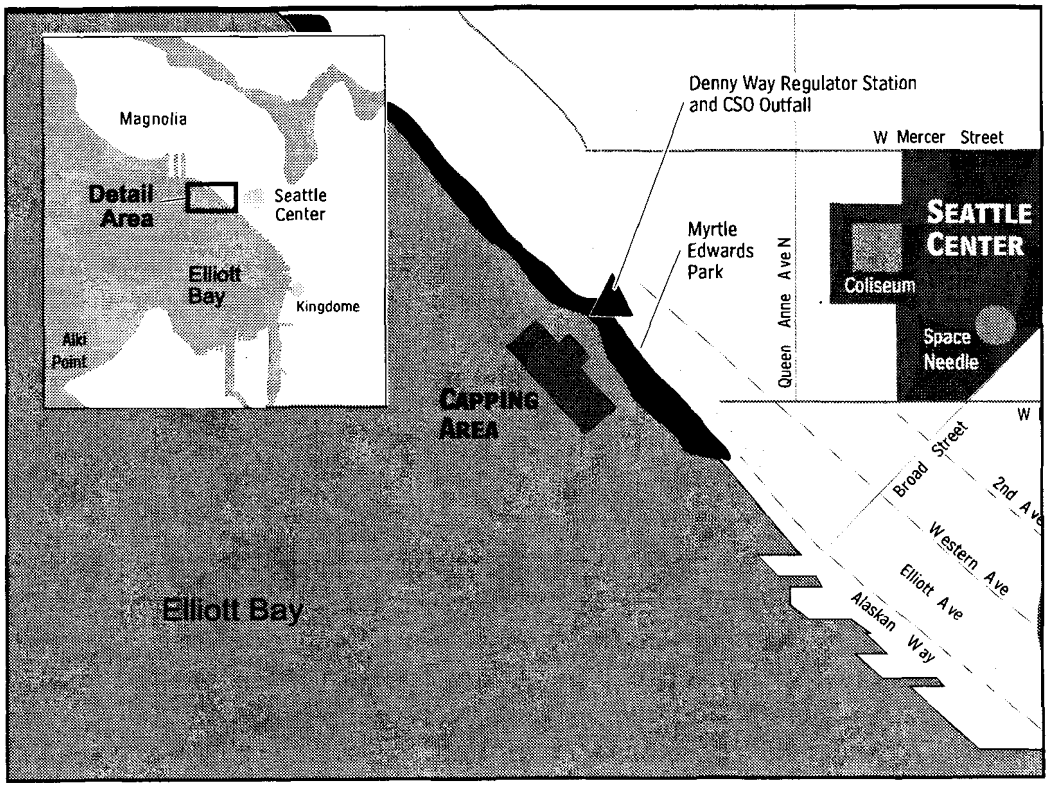


Figure 1-1: Location of Denny Way Capping Site

PROJECT SITE

The cap is a northwest-southeast-trending rectangular area located approximately 150 feet offshore of the Denny Way CSO. The CSO is located at the foot of Denny Way in Myrtle Edwards Park, at the north end of Seattle's downtown waterfront (Figure 1-1).

1 The Municipality of Metropolitan Seattle (Metro) became the Water Pollution Control Division (WPCD) of the King County Department of Natural Resources (DNR) and is incorporated under various divisions of DNR. The maintence of the sediment remediation is currently handled within the Modelling Assessments and Analysis section of the Water and Land Resources Division of DNR.

PROJECT BACKGROUND

Metro began planning the Denny Way project after a 1987 study recommended capping these sediments (Romberg, et al., 1987). The project is now part of WLR's Sediment Remediation and Assessments Program, which was developed to administer this project and any future sediment remediation projects. The program was designed to help coordinate and plan multi-agency efforts to clean up contaminated sediments in Elliott Bay and the lower Duwamish Estuary prior to the establishment of state sediment standards.

Under the 1972 federal Clean Water Act, the former WPCD was designated a regional water quality planning agency. As such, one of the agency's goals is to protect the region's marine water resources from pollution. Accordingly, sites that were known to be contaminated near CSOs were investigated with the intention of improving environmental conditions.

The Denny Way site was chosen as an experimental demonstration cleanup project for three reasons. First, it is located near the largest-volume and most active CSO that discharges into Elliott Bay. During a wet year, it can overflow up to 60 times, producing a total average volume of 500 million gallons. Second, previous studies, including the Metro toxicant pretreatment planning study (Romberg et al., 1984; Comiskey et al., 1984), found contaminated sediments at the site. Moreover, third, because construction activities to reduce the frequency and volume of CSOs were not scheduled to be completed until after 2000, an interim measure was considered appropriate.

The capped area lies in water depths between 20 and 60 feet (mean lower low datum). It is composed of two adjacent rectangular sections measuring 200 by 600 feet and 150 by 70 feet. The objective was to cover this 3-acre area with a uniform 3-foot-thick blanket of clean sand. (It is generally considered that 3 feet is sufficient to prevent burrowing organisms from entering the underlying contaminated sediments.) The USACE, under the direction of Alex Sumeri, dredged clean sand from the upper Duwamish River during routine maintenance of the navigable waterway and transported it to the Denny Way site. Thirteen barge loads, each carrying about 1,600 cubic yards of sand, were spread in a systematic manner. The total volume of sand was greater than 20,000 cubic yards.

MONITORING PROGRAM

Environmental monitoring for the project included short-term activities needed for cap placement and long-term activities documenting how well the cap functions. The long-term strategy called for intensive sampling and observation during the first few years after capping, followed by less frequent monitoring as appropriate. A 5-year monitoring review meeting was held in 1996 and monitoring through the year 2000 was planned. Both the *Monitoring Plan for Denny Way Sediment Capping* and an addendum listing planned monitoring activities through 2000 appear in Appendix A.

Monitoring Plan

The monitoring plan lists six objectives and provides an outline for the periodic monitoring report. The monitoring objectives are the following:

- Ensure that water quality standards for dissolved oxygen are maintained during cap Status Report on Monitoring Program
- Guide and document the sediment cap placement and thickness.

- Document how well the cap functions to prevent contaminated sediments from migrating upwards into the cap.
- Determine whether chemicals accumulate on the surface of the cap in a way that indicates a need for additional toxicant source control upstream in the Denny Way collection system.
- Determine the amount and type of benthic recolonization that occurs in the capping area.
- Review and evaluate the monitoring data to determine whether the cap is functioning as expected and whether further actions are warranted in the capped area.

To meet these objectives, the monitoring plan required the establishment of bottom stakes for measuring cap thickness, surface sediment Stations for taking samples for chemical and benthic taxonomic analysis, and core sediment Stations for taking samples for chemical analysis (Figure 1-2). Sediment chemistry data collected during monitoring were normalized for total organic carbon (TOC) and compared to the state Sediment Management Standards (SMS) (Ecology, 1991), which were under development when the cap was placed. The SMS include the Cleanup Screening Levels (CSL) and the more conservative Sediment Quality Standards (SQS).

Monitoring activities have been conducted in 1990, 1991, 1992, 1994 and 1996. Baseline chemical monitoring took place in 1990, soon after capping. Monitoring was also conducted in 1991, 1992, 1994 and 1996. A report that documents cap construction and the baseline, 1991, and 1992 monitoring data was issued by King County in 1995. The report that documents monitoring in 1994 was finalized in a 1996 King County document.

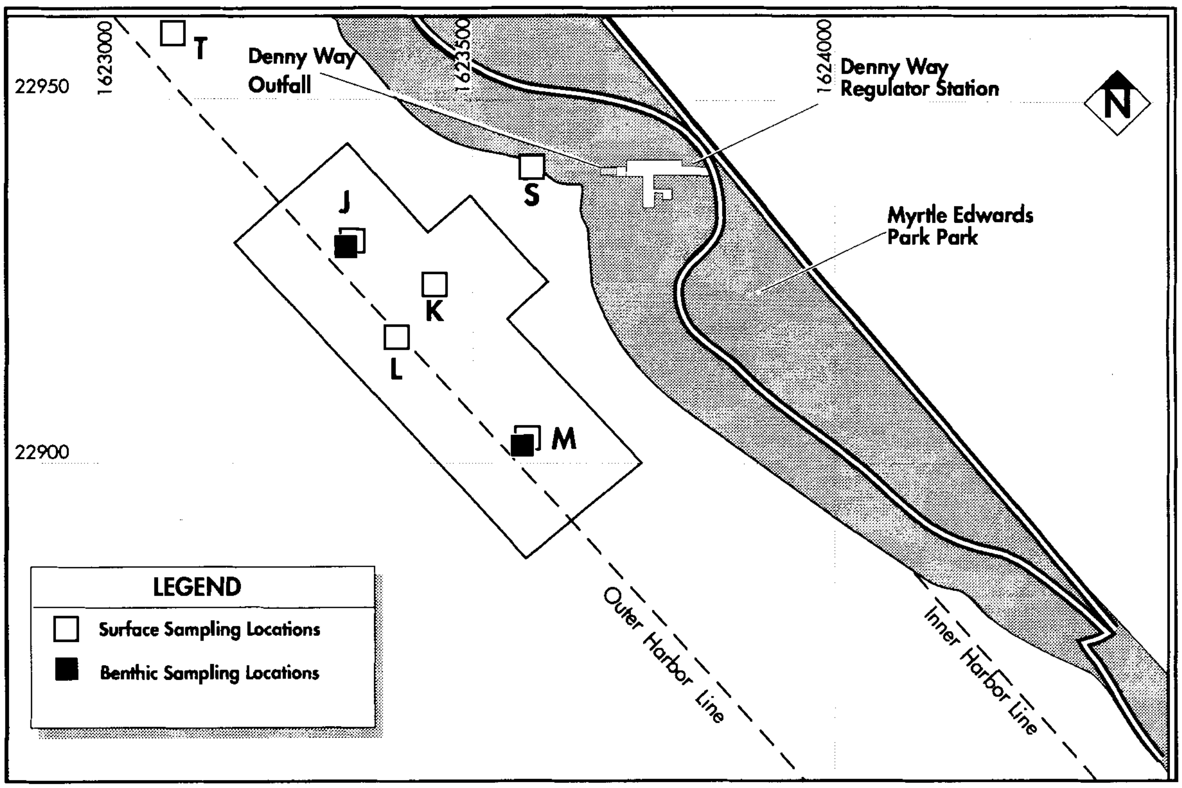


Figure 1-2 Denny Way Sampling Stations

Results of baseline, 1991, 1992 and 1994 monitoring indicated the following:

- The cap has been successfully isolating the underlying contaminated bottom sediments. Sediment samples taken from cores drilled vertically through the cap and into the underlying contaminated bottom sediments, showed that the cap material remained clean, in contrast to the under-cap sediments.
- The cap has been stable and has not been eroding. Measuring stakes installed before the cap was placed showed little change from year to year.
- Concentrations of chemicals on part of the surface of the cap have increased between 1990 and 1994, although they were still considerably less than those under the cap and most chemicals were below the SQS. The recontamination has most likely been the result of contributions from CSOs and the redistribution of remaining contaminated sediments from the intertidal area to the inshore edge of the cap.
- The benthic community has continued to increase in biomass and numbers of species since the cap was placed in 1990. At the same time, the number of individuals decreased significantly in 1994 from 1992. These results showed that fewer, larger, and more mature individuals from a greater number of species were making up the benthic community on the cap in 1994. In addition, species known to be sensitive to pollution appeared on the cap in 1994. The transition of the benthic organisms from an initial recolonization phase toward a stable community and the appearance of species that are known to be sensitive to pollution clearly indicate improved sediment quality.

FIVE YEAR MONITORING REVIEW

A review of the first 5 years of the 10-year monitoring program for the Denny Way capping project was held in March 1996. The meeting was attended by representatives from Ecology, the USACE, the State Department of Natural Resources, the Muckleshoot Tribe, State Department of Fish and Wildlife, Environmental Protection Agency, the City of Seattle, and WPCD. Monitoring results from 1990 to 1995 were reviewed and a plan for monitoring during 1996 to 2000 was agreed upon. It was decided that some monitoring activities that were conducted in the past would not be conducted in 1996 and that some new activities would be added. The following is a summary of background issues and a discussion of monitoring activities that will be conducted between 1996 and 2000. An addendum to the monitoring plan and a schedule for monitoring through 2000 appear in Appendix A.

Stake Measurements. Stake measurements have shown little or no change in cap thickness or cap settlement between 1990 and 1994. Consequently, stakes were not measured in 1996. Stakes will be measured again at the end of the 10-year monitoring period.

Core Samples. Core samples have shown no migration up into the cap from the contaminated under-cap sediments. Consequently, core samples were not taken in 1996. Core samples will be taken again at the end of the 10-year monitoring period.

Surface Samples. Samples from the 0 to 2 cm depth were taken from the surface of the cap at four Stations and from inshore of the cap at one intertidal Station as in previous years.

Surface Sample Depth. Previous studies at the Pier 53-55 cap (Hart Crowser, 1994 and EBDRP 1995) have shown significant differences between the results of samples taken from the 0 to 2 cm depth and the 0 to 10 cm depth. The results were likely caused by cleaner cap sand in the deeper 10-cm sample diluting higher concentration of recently deposited contaminants in the top 2 cm.

At Denny Way in 1994, the top 2 cm at K and L exceeded the CSL for bis(2-ethy-hexyl)phthalate. Results from the top 10 cm will determine whether K and L exceed the CSL in the top 10-cm biologically active zone. Therefore, samples that represent the top 10 cm were taken at K and L in addition to 0 to 2 cm samples.

Surface Sample Bioassays. Due to the bis(2-ethyhexyl)phthalate exceedances at K and L, bioassays were conducted on sediments from these Stations to determine if the elevated concentrations of phthalates are causing biological toxicity.

Surface Samples Surrounding the Cap. In 1994, monitoring included surface chemistry Stations that surrounded the cap. Results from these Stations showed contamination. Further investigation of these areas will probably be part of a future cleanup project conducted in coordination with the Denny Way CSO control project, which is scheduled to be completed after 2000. Therefore, the Stations surrounding the cap were not monitored in 1996, except for T, which will be used for modeling purposes.

Benthic Taxonomy Samples. Four years of benthic taxonomy samples have been collected from the cap. The results of these samples have shown that the benthic community has recolonized the cap and has increased each year since capping. In addition to taxonomy samples on the cap in 1996, a taxonomy reference sample was collected from Richmond Beach. The reference sample enables a comparison of the cap benthic community to a reference community that represents normal and stable conditions.

REMOTS Sediment-Profile Survey. After capping, the REMOTS sediment-profile survey was used to determine how far capping sand drifted off site during construction. The sediment-profile survey was also used for an initial assessment of the benthic community during the first stages of recolonization. However, further information is not needed on capping sand location, and benthic recolonization is being evaluated using benthic taxonomy studies. Therefore, no further sediment-profile surveys will be conducted during this monitoring program.

Video Camera Survey. Four years of video camera surveys have been conducted on the cap. The video surveys were able to show the actual surface of the cap. Video surveys have also shown the progression from year to year of a surface organic layer, an increase of marine plants and organisms, and a buildup of litter. However, the information is not easily quantifiable and other methods of determining the organic content of the sediments and of evaluating the benthic community are being used. Therefore, no further video camera surveys will be conducted.

CHAPTER 2:

CAP THICKNESS AND SETTLEMENT

At the March 19th, 1996 monitoring review meeting it was decided that due to little or no change in the cap thickness or settlement in the first 4 years of monitoring, bottom stakes would not be measured again until the 10 year monitoring. Consequently, cap thickness and settlement, which required contract divers, were not monitored.

At the 1996 meeting it was also agreed that all REMOTS sediment profiling (Vertical Image Profile Survey) would be ended for the remainder of this monitoring program. The initial REMOTS monitoring provided needed information on the spatial distribution of the cap material. Benthic recolonization of the cap is to be determined directly by collection of the benthic taxonomy samples.

CHAPTER 3

CORE CHEMISTRY

Agencies attending the Denny Way 5 year monitoring review meeting on March 19, 1996 agreed to not require core sampling in 1996. This decision was based on the fact that all previous studies showed that there was no migration of contamination into the bottom of the cap occurring at this site. The next time that sediment coring will occur is during the 10 year monitoring event. This section of the report was included to provide clarification and consistency.

CHAPTER 4

SURFACE SEDIMENT CHEMISTRY

Surface sediment samples were collected from the Denny Way cap and surrounding area in August and September of 1996. The samples were analyzed for trace metal, organic, and conventional parameters. Two of the samples were analyzed for toxicity using sediment bioassay tests. This section describes the surface sampling methods, reports the results of the chemistry analyses and compares the results to the state Sediment Management Standards (SMS).

METHODS

Surface sediment samples were taken from six Stations in 1996 (Figure 4-1). The four Stations J, K, L, and M are on the cap, and have been sampled a total of five times since 1990. Two Stations,

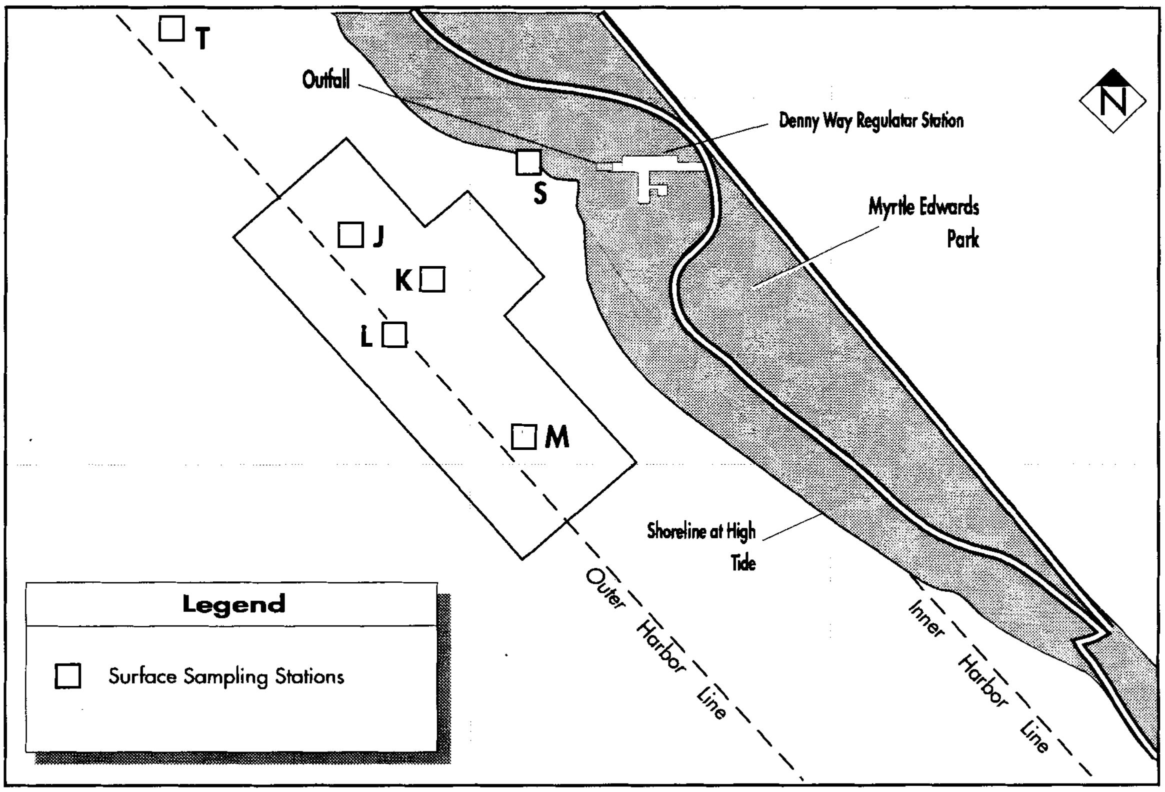


Figure 4-1: Surface Sampling Station

S and T, are located off the cap. Station S, located inshore of the cap in a sandy, intertidal area near the outfall, has been sampled since 1990. Station T is located northwest of the cap in an area of interest for future modeling of sediment dispersion. Station T was sampled once before in 1994.

Three types of surface samples were collected in 1996: 0-2 cm deep (a 2 cm sample), 2-10 cm deep, and 0-10 cm deep (a 10 cm sample). The 2-cm deep samples were taken to evaluate recent changes and for comparison to previous results. In 1994, two 2-cm-deep samples exceeded the SMS Cleanup Screening Level (CSL) for bis(2-ethylhexyl)phthalate at Stations K and L. Due to this, it was decided at the Denny Way 5-year monitoring meeting that 10 cm deep sediment samples, which represent the biologically active zone, would be collected in 1996 at the two stations.

In 1996, 0-2 cm and 2-10 cm samples were collected from the same grab sample at Stations K and L by taking an 0-2 cm sample from the top of the 0-10 cm grab sample. During interpretation, the results from the 0-2 cm sample and 2-10 cm sample were numerically combined after chemical analysis to create combined results for the 0-10 cm sample.

An additional 0-10 cm samples was collected from Stations K and L for bioassay analysis because bis(2-ethylhexyl)phthalate exceeded the CSL. However, scheduling limitations did not allow sediment bioassay samples to be collected at the same time as the chemistry samples described above. Chemistry analyses were performed on the bioassay samples so direct comparisons could be made between bioassay and chemistry results.

There were four surface grab-sample collecting events in 1996:

1) **August 6**
   - 0-2 cm collected at Stations J, K, L, M,
   - 2-10 cm sections collected from Stations K and L, and
   - 0-10 cm collected from Station T.
2) **August 12**
   - 0-2 cm collected from Station T.
3) **August 27**
   - 0-2 cm collected from Station S.
4) **September 10**
   - 0-10 cm collected from Stations K and L for bioassays, and chemical analysis.

Subtidal samples at Stations J, K, L, M and T, were collected with a 0.1 m^2 van Veen grab sampler operated from King County's *R/V Liberty*. A stainless steel square "cookie cutter" with 2 cm deep edges and a bent stainless steel spatula were used to remove 2 cm deep subsamples from the top of each grab sample. Stainless steel spatulas and spoons were used to acquire the 2-10 cm and 0-10 cm deep samples. Three individual grab samples were made into one composite sample. A clean set of utensils and stainless steel bowls were used for each sample to avoid cross-contamination.

The intertidal sample, Station S, was collected at low tide with a stainless steel cookie cutter and bent spatula. Eight 2 cm deep subsamples within a few feet of each other were combined for the composite sample.

The King County Environmental Laboratory analyzed the samples for trace metals, volatile organics, base/neutral/acid extractable organics, pesticides, polychlorinated biphenyls, percent solids and total organic carbon, as in previous years. AmTest, Incorporated performed particle size distribution analyses under contract to the Environmental Lab. Analytical methods are noted in the applicable analytical section of the quality assurance review (Appendix B).

RESULTS

Summarized dry-weight and TOC-normalized data for Stations J, K, L, and M on the cap and Stations S and T off the cap appear in Tables 4-2 through 4-5 respectively. Dry weight concentrations of selected parameters in 1994 and 1996 are plotted in Figures 4-2 to 4-6. Trend plots of dry weight concentrations since 1990 appear in Appendix D, and a subset is shown in Figure 4-7. Comprehensive data results are in Appendix C. Results from years 1990 to 1994 were included in previous reports (King County, 1995a; King County, 1996a).

When the sediment cap was placed in 1990, it was suspected that recontamination might occur because the large Denny Way CSO outfall had not been completely controlled at that time. One objective of this report is to determine whether chemicals of concern are increasing on the cap and would be expected to exceed the SMS by the end of the 10 year monitoring program.

0-2 cm Sampling on the Sediment Cap

Results of the 2-cm samples are intended to show the recent change in conditions on the cap over time and whether these new sediments exceed SMS. The 1996 samples taken from the area on the cap were analyzed for 136 organic compounds, of which 24 were detected. Nineteen of the 38 SMS organic compounds were detected. Twenty-one of the 22 metals analyzed for were detected. All eight of the SMS metals were detected.

The highest dry weight-based concentrations on the cap are generally found at Station K, the Station closest to the outfall, as shown in Figures 4-2 to 4-6. Station J has the second highest concentrations and is located northwest from Station K. Stations L and M have sediment chemistries that are quite similar; each are respectively located to the west and south of Station K, and have somewhat lower concentrations than that Station.

Thirteen of the twenty-four compounds detected are polynuclear aromatic hydrocarbons (PAHs). The highest dry weight concentrations of PAHs are found at Station K. Station M has the highest organic carbon normalized values for PAHs due to the low total organic carbon (TOC) content at that Station.

The remaining eleven organic compounds detected are composed of four phthalates, two Aroclors (PCBs), the pesticide Endosulfan, benzoic acid, carbazole, coprostanol and acetone. The highest dry-weight values for nine of these eleven compounds are found at Station K. Detected concentrations of one phthalate, the Aroclors, Endosulfan, carbazole, and acetone are below the Reporting Detection Limit (RDL). The presence of acetone is believed to be due to laboratory contamination.

The SMS criteria were exceeded for the two parameters bis(2-ethylhexyl)phthalate and benzyl butyl phthalate. Bis(2-ethylhexyl)phthalate concentrations exceed the CSL at Station K and the SQS at Station J. Unlike the 1994 data, Station L did not have a CSL or SQS exceedance for bis(2-ethylhexyl)phthalate. The concentration of 2670 µg/kg-dry weight for bis(2-ethylhexyl)phthalate at Station K is the highest yet detected on the cap, but this value is still lower than was measured at some of the Stations off the sediment cap that were sampled in 1994.

Benzyl butyl phthalate exceeds the SQS at Stations J, K, L-replicate and M. This compound is not detected in the regular sample from Station L but the detection limit exceeds the SQS. The multiple exceedances in 1996 are an increase over the one exceedance observed in 1994. The highest organic carbon normalized concentration of benzyl butyl phthalate observed on the cap in 1996 was 10.7 mg/kg-OC at Station L. This value is slightly higher than the SQS (4.9 mg/kg) but is far below the CSL (64 mg/kg).

No detected concentrations of polynuclear aromatic hydrocarbons (PAHs), chlorinated benzenes, polychlorinated biphenyls (PCBs) or metals exceed the SQS in 1996 samples.

There are no SMS criteria for the insecticide Endosulfan I, which is a member of the cyclodiene class of pesticides, all are quite toxic and persistant in the enviroment. There is a lack of empirical evidence on this chemical, but the other cyclodiene pesticides aldrin, chlordane, dieldrin and heptachlor have published amphipod AETs which vary from 1.5 to 9.5 ppb and echinoderm AETs that vary from 1.9 to 9.5 ppb (W.S.D.O.E., 1996b). Endosulfan is likely to have amphipod and echinoderm AETs which are close to these due to their chemical similarity, consequently the concentration reported at **Station K is potentially significant, however the bioassay done at the station appears** to **rule out any problem.**

A noteworthy observation is a value of 626 µg/kg-dry weight for benzoic acid at Station J, approaching the SQS/CSL of 650 µg/kg-dry weight. Benzoic acid is also found at Station M (481 µg/kg-dry weight). These concentrations are higher than previously detected on or off the cap. Quality assurance results indicate that the sample matrix is causing a high bias for benzoic acid, meaning the measured results are significantly higher than the true concentrations (Elliott, pers. comm.). This is discussed further in the Quality Assurance Summary at the end of this chapter. Benzoic acid should not be of concern unless future monitoring finds higher or unbiased concentrations.

Station K differs from the other Stations on the cap, in particle size distribution and organic carbon content. Station K has more fines (20%) and more organic carbon (1.4%) than the other Stations on the cap, which have ranges of 7-12% fines and 0.33-0.90% total organic carbon. The particle size distribution and organic carbon results for all the Stations on the cap sampled in 1996 are generally comparable to 1994 results.

Particular results from the 0-2 cm samples on the sediment cap are as follows:

- Two parameters, bis(2-ethylhexyl)phthalate and benzyl butyl phthalate, already routinely exceed the SQS and sometimes the CSL.

- Organic-carbon normalized concentrations for one PAH, benzo(g,h,i)perylene are over 60% of the SQS in the low organic carbon samples. Some of the other PAHs exceed one half of the SQS, suggesting they may exceed the SQS in about 12 years. However, since PAH concentrations tend to be closely associated with the amount of total organic carbon, it is probable that the TOC-normalized concentrations of PAHs will not exceed the SMS criteria in four more years. The lower organic carbon normalized concentrations of PAHs at Stations K and T support this prospect.

- In 1996, benzoic acid exceeded 60% of the SQS/CSL at two Stations. However, the results may be biased due to matrix effects. These concentrations may not persist.

- In the past mercury sporadically exceeded the SQS and CSL at varying Stations. None of the metals, including mercury or silver, exceed one-half of the SQS this year. Most on-cap concentrations do not exceed one-tenth of the SQS. Assuming similar rates of increase for the next four years, no metals concentration should exceed the SQS at the 10-year milestone of the cap.

- Several samples taken on the cap we found to have total organic carbon content that is less than 0.5 percent. These samples have been compared to LAET in Table 4-6, as suggested in Michelsen, 1993.

- Detection limits for five additional parameters exceed the CSL and SQS at times. The detection limit for 2,4-dimethylphenol exceeds the CSL at all Stations. Most other detection limit exceedances are at Stations L and M where the amount of total organic carbon is less than 0.4 percent. Hexachlorobutadiene detection limits exceed the CSL at Stations L (regular and replicate), M and S and exceed the SQS at Station J. The detection limit for N-nitrosodiphenylamine exceeds the CSL at Station M. SQS exceedances for dibenzo(a,h)anthracene at Stations L, M and S and for benzyl butyl phthalate at Station L complete the SMS exceedances by detection limits.

2-cm Surface Samples from outside the Sediment Cap

The samples from the Stations S and T, which are off the sediment cap, were analyzed for the same 136 organic compounds as the Stations located on the sediment cap. At Station S, ten organic compounds, including eight SMS compounds, were detected. At Station T, twenty-eight organic compounds, including twenty-four SMS compounds, were detected. Twenty and nineteen metals were analyzed at Stations S and T, respectively. Sixteen metals were detected at Station S, with arsenic being the only SMS metal not detected. A slightly different set of sixteen metals was detected at Station T, including all SMS metals.

Dry-weight concentrations at Station S are lower than values at other Stations located on the cap for most parameters. Only six PAHs were detected, and these had concentrations about one-half the lowest concentrations of any other site located on the cap. Only two phthalates were detected. Dimethyl phthalate was detected below the RDL. Bis(2-ethylhexyl)phthalate was detected at a concentration higher than Stations L and M, and comparable to Station J. No carbazole, coprostanol, Aroclors, or pesticides were detected at Station S. The presence of methylene chloride is likely due to laboratory contamination. The concentrations of all metals except silver are comparable to values at Stations L and M. Silver was found at a concentration of 1.3 mg/kg, which is similar to that found at Stations J and K.

The 2-cm deep sample taken at Station T in 1996 allows a direct comparison with 2-cm samples collected on the cap in 1996. The Station T 2-cm sample has more detected contaminants than the on-cap Stations. Eight compounds not detected on the cap are present at Station T. One additional PAH (dibenzo(a,h)anthracene) was detected. Three chlorinated benzenes were detected, including two not found in the 1994 expanded study area. Di-N-Butyl Phthalate was also detected. Aroclor 1248 and the pesticide 4,4'-DDD are present at concentrations that are orders of magnitude higher than the detection limit. The concentration of 4,4'-DDD is more than an order of magnitude higher than measured in the 1994 10-cm off-cap samples. Benzyl alcohol was detected below the RDL but well above the Method Detection Limit (MDL). Dimethyl phthalate, di-N-octyl phthalate, benzoic acid and Endosulfan were not detected at Station T despite occasionally being detected on the cap.

Dry-weight concentrations for many compounds and metals are higher in the 2-cm Station-T sample than on the cap. The PAH concentrations are slightly higher than those found at Station K. Benzyl butyl phthalate is higher than previously detected on or off the cap. The PCBs Aroclor 1254 and 1260 and all of the SMS metals, especially mercury and silver, are higher at Station T than on the cap. Of the non-SMS metals, nickel appears particularly elevated. Bis(2-ethylhexyl)phthalate, carbazole and coprostanol values are similar to values at Station K.

Concentrations in the 2-cm sample from Station T exceed the CSL for mercury and possibly benzyl alcohol (below RDL value) and exceed the SQS for total PCBs, benzyl butyl phthalate, and bis(2-ethylhexyl)phthalate. Station T has a higher TOC content (3 percent) and a much greater percentage of fine sediments (57 percent) than the other sediment cap Stations.

The potential CSL exceedance for benzyl alcohol at Station T is the first time during this study that this compound has been detected. Benzyl alcohol is used as a textile dye additive, a solvent, a preservative in drugs, and as a contact lens cleaner. It is also used in color photography, and as a raw material in the production of perfume esters (B.F. Goodrich-Kalama, 1997).

0-10 cm Samples On and Off the Sediment Cap

The SMS require 10-cm-deep samples to evaluate sites for potential remediation. It was decided at the 5-year Denny Way monitoring review meeting that 10-cm samples would be taken from Stations K and L because the 1994 top 2-cm samples exceeded the CSL for bis(2-ethylhexyl)phthalate. It was also decided that the 10-cm sample should be repeated from the off-cap Station T.

The 10-cm deep sediment samples taken at Station T and other Stations surrounding the cap in 1994 allow comparison with SMS values and determine whether additional sediment remediation may be needed beyond the existing cap. In 1994, Station T concentrations were similar to Station K concentrations and were somewhat lower than values at three other Stations surrounding the cap: R, U and Y.

The 0-10 cm numerically combined samples (0 to 2-cm sample combined with the 2 to 10-cm sample) are labeled as K-1 and L-1. The 0-10 cm samples taken a month later during bioassay sampling are labeled K-2 and L-2. All 2-10 cm and 0-10 cm samples were analyzed for the same parameters as the top 2-cm samples. Summarized data appear in Tables 4-6 and 4-7 at the end of this section. Comprehensive results are in Appendix C.

Specific results of the 10-cm samples are as follows:

- Both 10-cm samples from Station K exceed SMS criteria for bis(2-ethylhexyl)phthalate.

The combined sample K-1 exceeds the CSL due to a very high concentration in the top 2-cm and an SQS exceedance in the 2-10 cm section. Sample K-2 exceeds the SQS and is only about 76 percent of the CSL.

- Sample K-1 also exceeds the SQS for benzyl butyl phthalate, with a concentration slightly above the SQS. Sample K-2 approaches but does not exceed the SQS for benzyl butyl phthalate. Neither sample exceeds the criteria for any other parameters. Detection limits exceed SMS criteria for one and two parameters in K-1 and K-2, respectively.
- Neither sample from Station L has detected concentrations exceeding the SQS. Detection limits for up to five parameters exceed the SQS and CSL due to the low organic carbon, 0.25 to 0.40 percent, found in these samples.
- Station T exceeds the CSL for mercury and the SQS for benzyl butyl phthalate, bis(2-ethylhexyl)phthalate and Total PCBs.
- Concentrations in the 1996 sample from Station T are slightly higher than 1994 concentrations. These higher concentrations are likely due to the normal spatial and analytical variability demonstrated by sediments.

2-cm and 10-cm Sample Comparison

The 0-2 cm and 2-10 cm samples comprising the combined sample K-1 are very similar. Thirteen PAHs, three phthalates, two PCBs, eighteen trace metals, carbazole and coprostanol were detected in the 2-10 cm sample at Station K. Two additional parameters, endosulfan and antimony, were detected at low concentrations in the top 2-cm of the same sample. The concentrations of high molecular weight PAHs, benzyl butyl phthalate, carbazole, coprostanol, and most metals are virtually identical in the 0- to 2- and 2-10 cm samples. Anthracene, bis(2-ethylhexyl)phthalate and di-N-octyl phthalate are noticeably higher in the top 2-cm, while PCBs and the low molecular weight PAHs acenaphthene, fluorene, phenanthrene are higher in the 2-10 cm section.

Nearly identical parameters were detected in the combined samples K-1 and K-2; K-2 had a chlorobenzene but lacked a phthalate, a PCB and antimony. The combined K-1 sample and the K-2 sample have comparable concentrations for most organics and metals. Sample K-2 has lower concentrations of low molecular weight PAHs, phthalates, Aroclor 1260, and silver. However, the 1,4-dichlorobenzene detected in K-2 is high compared to all other samples but still well below the SQS.

The 0-2 cm and 2-10 cm sections comprising the combined sample L-1 is also similar. Lower concentrations of PAHs were detected in the 2-10 cm section of L-1 than the top 2-cm. The relative difference in PAHs between sections often appears to be large, but the absolute differences are quite small. The relative differences are accentuated when concentrations are low, as they are in both of these samples. Mercury is slightly higher in the 2-10 cm section. Otherwise, the two sections are nearly identical, with low dry weight concentrations throughout.

The 0-10 cm L-2 sample has an essentially identical composition to the combined L-1 sample. The same eleven PAHs, one phthalate, coprostanol and metals were detected in L-2 as in the top 2-cm of L-1, which has two more PAHs and one fewer metal, thallium, than the 2-10 cm section. Most PAH concentrations are slightly higher in L-2 than the combined L-1 sample, but the absolute and relative differences are minor. On the other hand, the bis(2-ethylhexyl)phthalate and mercury concentrations at L-2 are low compared to the other samples.

Table 4-1: Total Organic Carbon and Particle Size Distribution at Stations K, L and T.

Station ID	K	K	K-1	K-2	L	L	L-1	L-2	T	T
Depth	0-2 cm	2-10 cm	0-10 cm	0-10 cm	0-2 cm	2-10 cm	0-10 cm	0-10 cm	0-2 cm	0-10 cm
% TOC	1.4	1.37	1.38	1.06	0.37	0.41	0.4	0.25	3	2.96
Gravel	1.6	1.3	1.4	0.9	4.1	1.2	1.8	0.9	1.6	1
Sand	78.4	78.7	78.6	81	88.6	90.6	90.2	95.1	41.2	34
Silt	12.3	13.4	13.2	13.5	5.2	7.2	6.8	3.9	41.9	49.7
Clay	7.8	6.5	6.8	4.6	2.2	1	1.2	0.1	15.5	15.4

The 10-cm sample at Station T has fifteen PAHs, two chlorobenzenes, four phthalates, three PCBs, benzoic acid, carbazole, coprostanol and nineteen metals. In comparison, the 0-2-cm sample has benzyl alcohol, 4,4-DDD, and an additional chlorobenzene but lacked one PAH, one phthalate, benzoic acid and antimony. The top 2-cm was much higher in di-N-butyl phthalate and 4,4'-DDD and notably higher in acenaphthene, fluorene, hexachlorobenzene and benzyl alcohol. Benzoic acid was the only compound notably higher in the 0-10-cm sample.

More compounds and slightly higher concentrations are found in the 1996 Station T sample than the 1994 sample. The 1996 10-cm sample has one more LPAH, chlorobenzene, phthalate, four more metals, benzoic acid and carbazole. It does not have 4,4'-DDD, which is present in the 1994 sample. The concentrations of benzyl butyl phthalate, three PCBs and silver are significantly higher in the 1996 sample. Three HPAHs, bis(2-ethylhexyl)phthalate, benzoic acid, copper and lead are notably (1.5 to 2 times) higher in the 1996 sample.

The amount of total organic carbon was consistent within samples. **The two first-round samples at Station K had 1.4 percent TOC. The two first-round samples at Station L had about 0.4 percent TOC. Both second-round samples, taken one month later, had lower TOC. Station K had 1.1 percent TOC and Station L had 0.25 percent. It can not be determined whether this is seasonal,** spatial or **analytical variability.** The Station T samples taken within one week had TOCs of 3 percent, however this Station also has a higher amount of fine particles.

The particle size distribution is very consistent for 1996 samples collected at Station K but is slightly less consistent at Station L. At Station K, all samples are 80-82 percent sand and gravel, and predominantly sand (78-81 percent). Station L samples are 92-96 percent sand and gravel, with sand representing 89-95 percent. The 10-cm sample at Station T has more silt and less sand (7-8% difference) than the 2-cm sample.

DISCUSSION

Top-2-cm and Top-10-cm Samples

The distribution of contaminants, total organic carbon and particle sizes within the samples shows that each Station is reasonably homogenous to at least the 10-cm depth. The parameters and concentrations detected are very similar for the 0-2 cm, 2-10 cm, and 0-10 cm samples taken at each on-cap Station. Likewise, the 0-2 cm and 0-10 cm samples at Station T are quite similar. The fine particles that are settling on top are being incorporated into the sand by the burrowing of benthic organisms or by other mechanisms mixing the sediments. Also, there were no major differences between samples taken one month apart.

The 10-cm samples at Stations K and J exceed SMS values for a few chemicals, indicating the potential need for future sediment remediation. Future construction activities for two proposed new outfall pipes for Denny Way CSO could have the potential to result in some further recontamination of the cap and surrounding area. Care will need to be taken during construction of the new outfalls to avoid or minimize recontamination of the cap.

When recontamination occurs on a clean sand cap, it has been theorized that concentrations of chemicals would be higher in a 0-2-cm sample than a 0-10-cm sample due to dilution by the larger sand volume. As the cap ages and chemicals are mixed down to the 10-cm depth, the concentrations should be similar in the surface and deeper samples.

After six years, chemicals on the Denny Way cap are mixed down to at least 10-cm. However, during the first year of sampling at the Pier 53-55 cap, also along the Seattle waterfront, there appeared to be higher concentrations in the 0-2-cm samples.

The Pier 53-55 cap was extensively recontaminated by nearby construction activities shortly after placement. The 1993 studies at the Pier 53-55 cap showed significant chemistry differences between the 0-2 cm and 0-10 cm samples. The 10-cm samples have much lower concentrations than the top 2-cm samples. It is suspected that clean cap sands in the deeper 10-cm samples diluted recently deposited contaminants in the top 2-cm (Hart Crowser, 1994; King County, 1995b).

Recontamination of the Denny Way cap measured 6 years after placement was not as extreme as the values measured at Pier 53-55 cap in 1993, one year after capping. All four stations at Denny Way have been recontaminated to some extent, but concentrations at the most contaminated Stations on the Pier 53-55 cap are up to 100 times higher than the most contaminated Denny Way Station, Station K. Station K concentrations are comparable to the least contaminated Stations (VG3, VG4, VG7) at Pier 53-55. Unlike Pier 53-55, the contamination is not confined to the top 2-cm. **All three 10-cm samples taken at Denny Way are similar to their 2-cm deep counterparts.**

When the Denny Way cap was placed in 1990 it was determined to have a particle size distribution of approximately 93 percent sand. Fine sediments have been deposited at Station K since then. Less fine sediment has been deposited elsewhere. **These results demonstrate that either the fine sediment is being mixed into the top 10 centimeters, or that a layer of at least 10-cm deep with a composition of approximately 80 percent sand has accumulated at Station K.** While not impossible, **the latter alternative seems unlikely since cap thickness did not appear to increase** in previous years. Mixing of the sediments could be occurring through physical or other means, but is most likely to be through bioturbation.

Benthic taxonomy analyses of 10-cm deep samples at Stations J and M, on the cap, and Station S, off the cap, were performed in 1996, which is similar to analyses made in previous years. Benthic taxonomy data does not exist for Stations K, L and T. Therefore, direct comparisons between benthos and the homogenous 10-cm deep samples can not be made, but generalizations may be made from the samples collected at Stations J, M and S:

- Among the six most numerically abundant species at the two Stations on the cap are two bivalves, three polychaetes and an ostracod. Most species present are suspected to burrow at least shallowly (Barnes, 1980; Kozloff, 1990). One family, *Lumbrineridae*, is known to burrow several centimeters into the substrate.

- Many of the less numerically abundant species are capable of burrowing several centimeters. Cumulatively, they may be capable of mixing large amounts of sediment.

- More species and a larger biomass are present at Station J, the more contaminated of the two on cap Stations evaluated. It is possible that more are present due to organic enrichment from the outfall. Despite high concentrations of contaminants, Stations K and T may provide an environment suitable for large bioturbating animals. Sufficient organic material (as evidenced by high TOC values) is present. This may explain why the sediments at Stations K and T are well mixed.

- Different species are found at the intertidal Station S than at the on-cap Stations. The most dominant species at this Station is *Capitella capitata*, a burrowing deposit feeder. *Capitella* is also an indicator of a stressed environment, in this case, the stressors are not necessarily chemical; large fluctuations in salinity and tide stage may be responsible.

Year to Year Comparisons

Figures 4-2 through 4-6 show that the 1996 concentrations of several chemicals have changed noticeably at Stations J and L compared to 1994 values. Station K has had some increases and continues to have the highest concentration on the cap. Station J has the next highest values on the cap, followed by Stations L and M that are approximately equal.

At Station K there was little change in total LPAHs and HPAHs values, but there was a large increase in both bis(2-ethylhexyl)phthalate and benzyl butyl phthalate. At Station J there was a large increase in both LPAH and HPAH plus both phthalates. At Station L there was a large decrease in most parameters, resulting in lower values than at Station J. At Station M there were small increases resulting in values similar to those at Station L. The replicate sample collected at Station L in 1996 also had lower contamination levels than in 1994. These lower values are more consistent with the anticipated gradient of decreasing concentrations moving away from the CSO outfall.

Compared to previous results, the 1996 sample from Station S experienced sharp drops in concentrations for most parameters. Bis(2-ethylhexyl)phthalate was the only parameter that exceeds the SQS in 1996, compared to twelve parameters in 1994 and three in 1992. No parameter exceeds the CSL at Station S in 1996. The drop is likely the result of coarser sediments being present in the 1996 sample than in previous years. The 1996 sample is composed of 76 percent gravel and 21 percent sand, compared to 24 percent gravel and 73 percent sand in 1994. The organic carbon content is within the range observed in previous years. While it is possible that the intertidal beach composition has changed, it is also possible that the sample was taken closer to the shoreline where gravel has been observed for several years.

While the above discussion focuses largely on changes at individual Stations, it is also worthwhile to evaluate how the cap is functioning as a whole over a longer period. Figure 4-7 illustrates the range of dry weight concentrations found on the cap for the years samples were collected (1990, 1991, 1992, 1994 and 1996). These are compared to the concentration at Station S, located off the cap in the intertidal zone. Dry-weight concentrations were chosen to exclude the effects of TOC variability. The crosses linked by dashed lines in these figures represent the concentration at Station S in each year. The open dots linked by a solid line represent the average concentration of the four on-cap stations for that year. The solid dots represent the annual range of values for all stations on the cap. Maximum values are usually for Station K and minimum values for Station M.

On the cap, the concentrations of most PAHs gradually increase between 1990 and 1994, and then flatten or decline between 1994 and 1996. Most metals have slight, gradual increases over the entire time. The two most common phthalates, benzyl butyl phthalate and bis(2-ethylhexyl)phthalate, continue to increase in either average or maximum concentration. Some parameters like benzoic acid, PCBs and mercury, show little overall increase despite occasional, unusually high concentrations. Overall, it appears that the cap is being slowly recontaminated.

Station S shows a different trend than the Stations on the cap. Concentrations of most parameters tended to be higher the first couple years and have lower variable values the last 3 years. The lowest values occur in 1996, but this sample may be lower because it had a much higher percentage of gravel and less sand than previous years.

As noted above and in previous years, dry-weight concentrations of PAHs, phthalates, coprostanol, mercury and silver appear to be related to the amount of fine sediments and organic carbon. Station K has the highest concentrations, highest organic carbon, and highest percentage of fine sediments of the Stations on the cap. Station T, off the cap, has more organic carbon and more fine sediments, and usually higher concentrations than Station K. Generally, concentrations decrease as the amount of TOC and fine sediments decrease. The nearshore sediments between the cap and outfall tend to be sands and gravels. Analysis of contaminants and particle size of sediments from within the sewer system, and preferably suspended sediments during flow events, would be necessary to investigate further. It is possible but unlikely that another source of fine contaminated sediments is in the vicinity. The most likely alternative source would be the redistribution of contaminated sediments surrounding the cap.

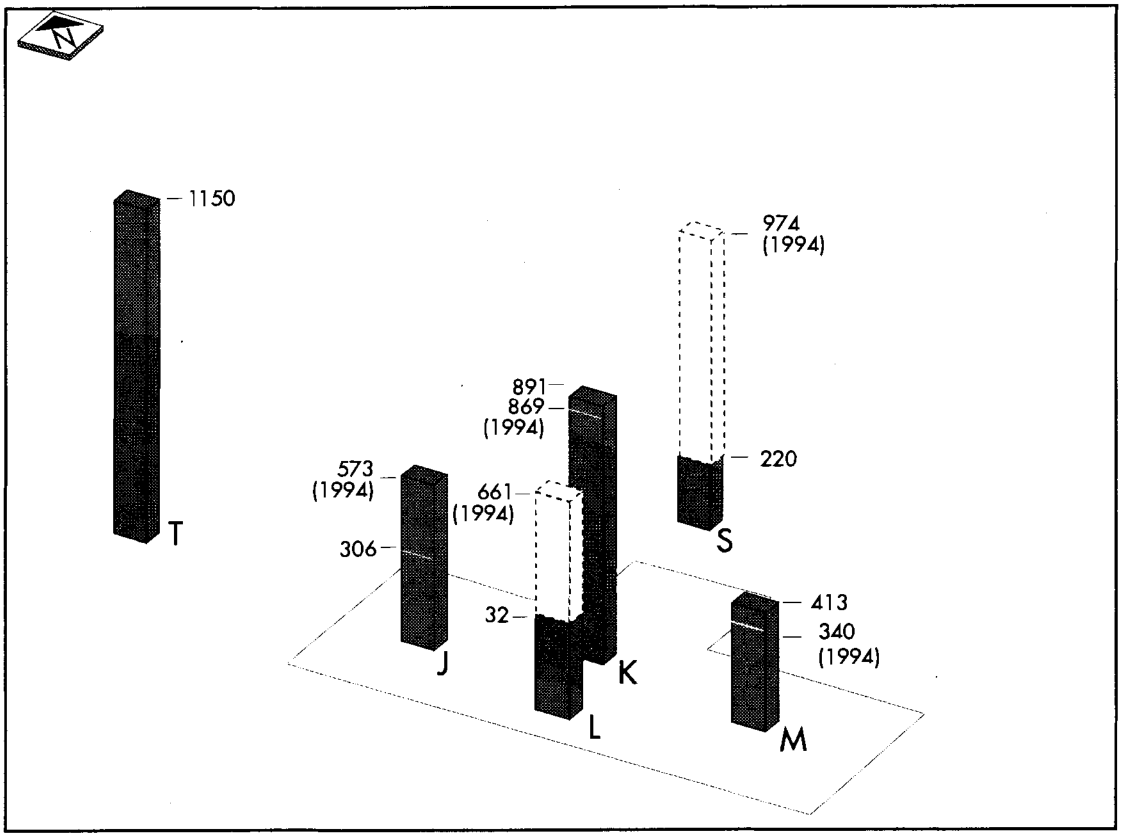


Figure 4-2: Spatial Concentrations of LPAHs on and off the cap in ug/kg dry weight

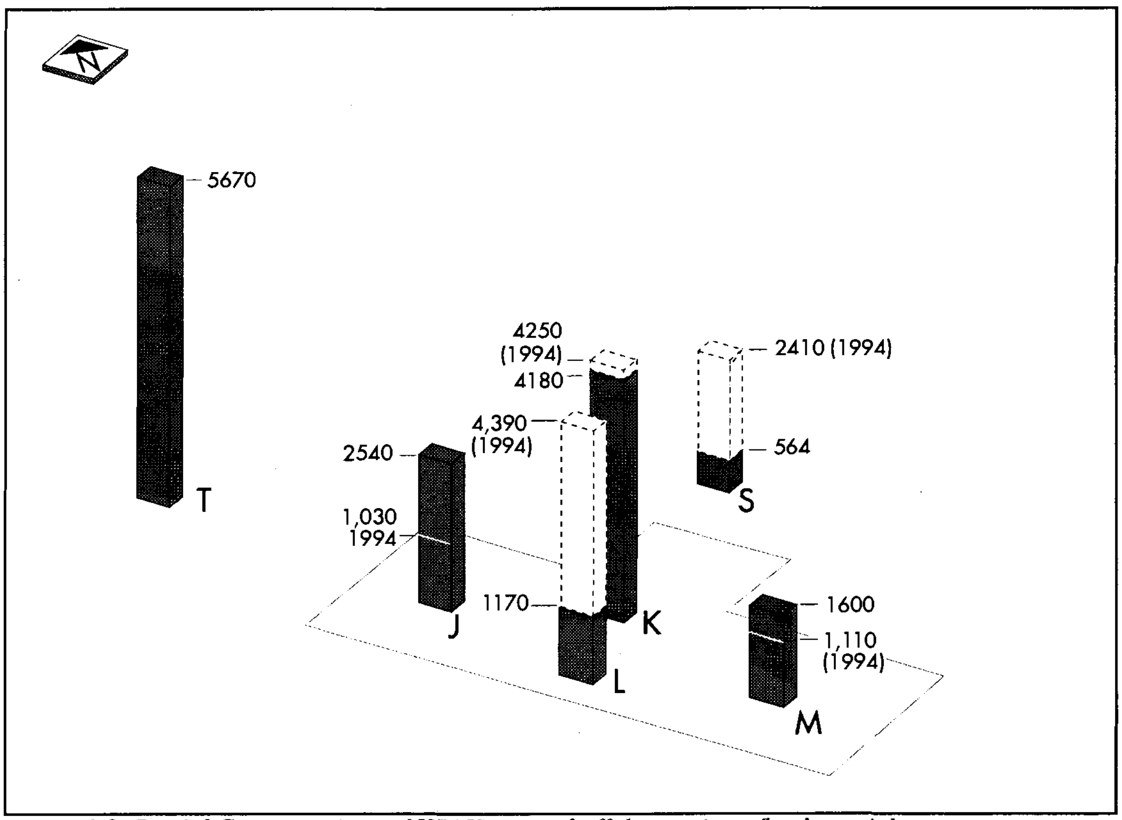


Figure 4-3: Spatial Concentrations of HPAHs on and off the cap in ug/kg dry weight

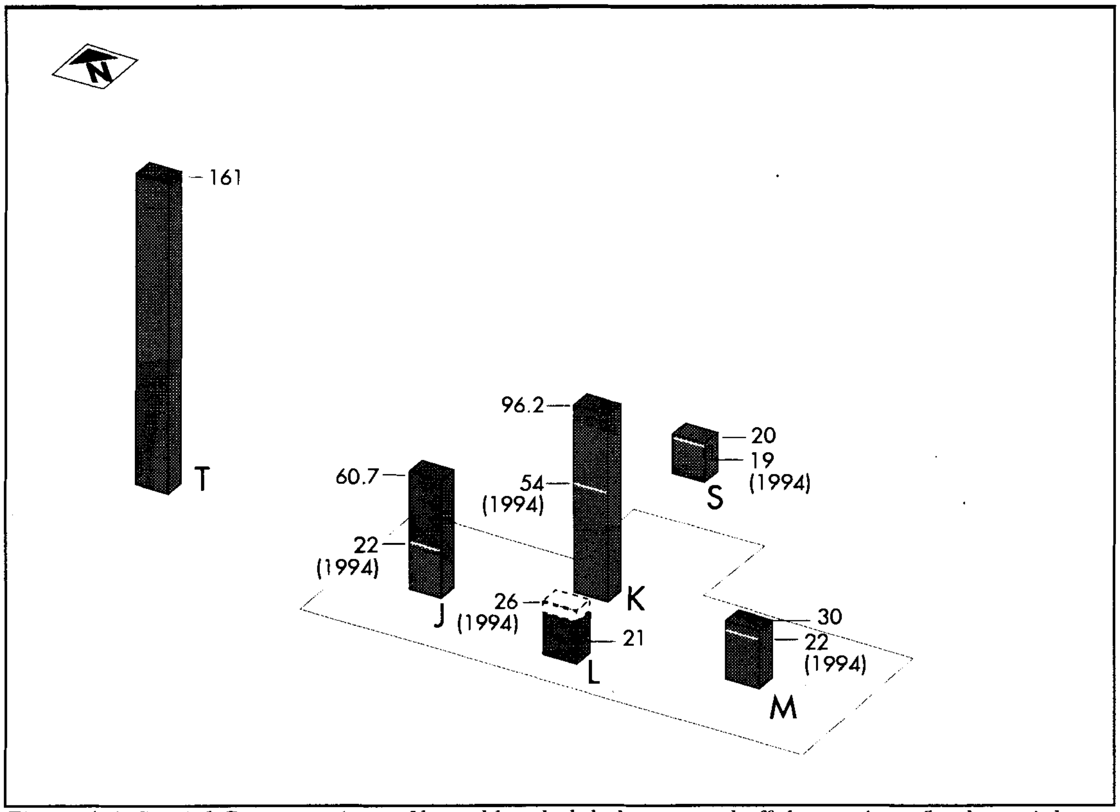


Figure 4-4: Spatial Concentrations of benzyl butyl phthalate on and off the cap in ug/kg dry weight

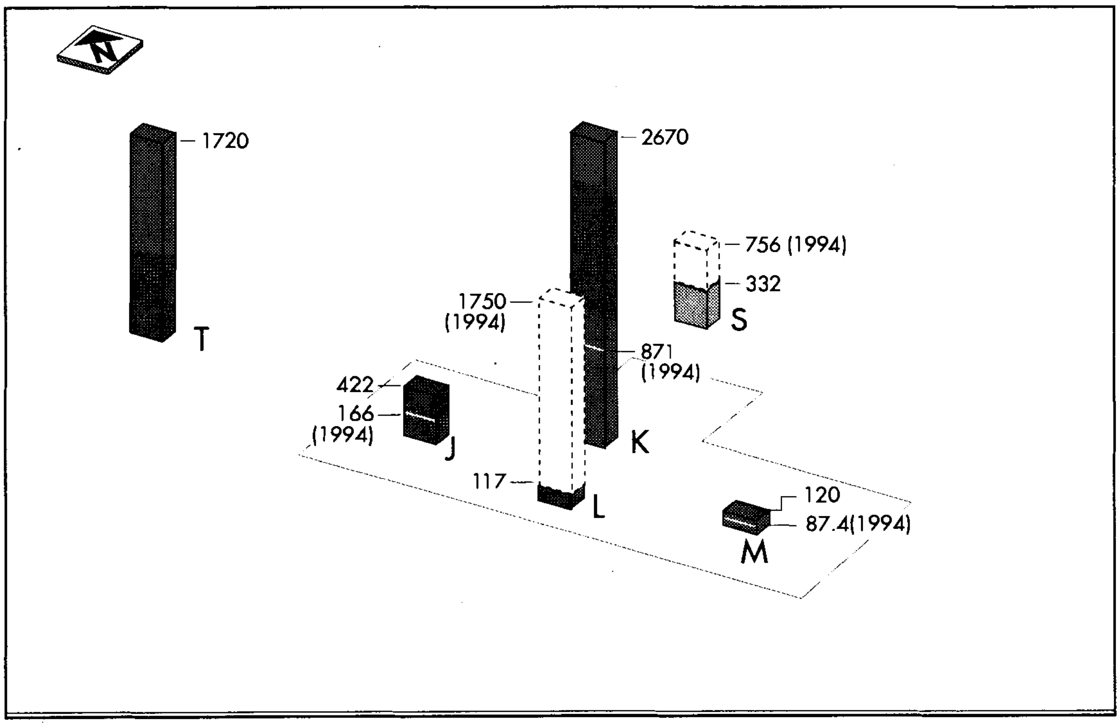


Figure 4-5: Spatial Concentrations of Bis(2-ethylhexyl) phthalate on and off the cap in ug/kg dry weight

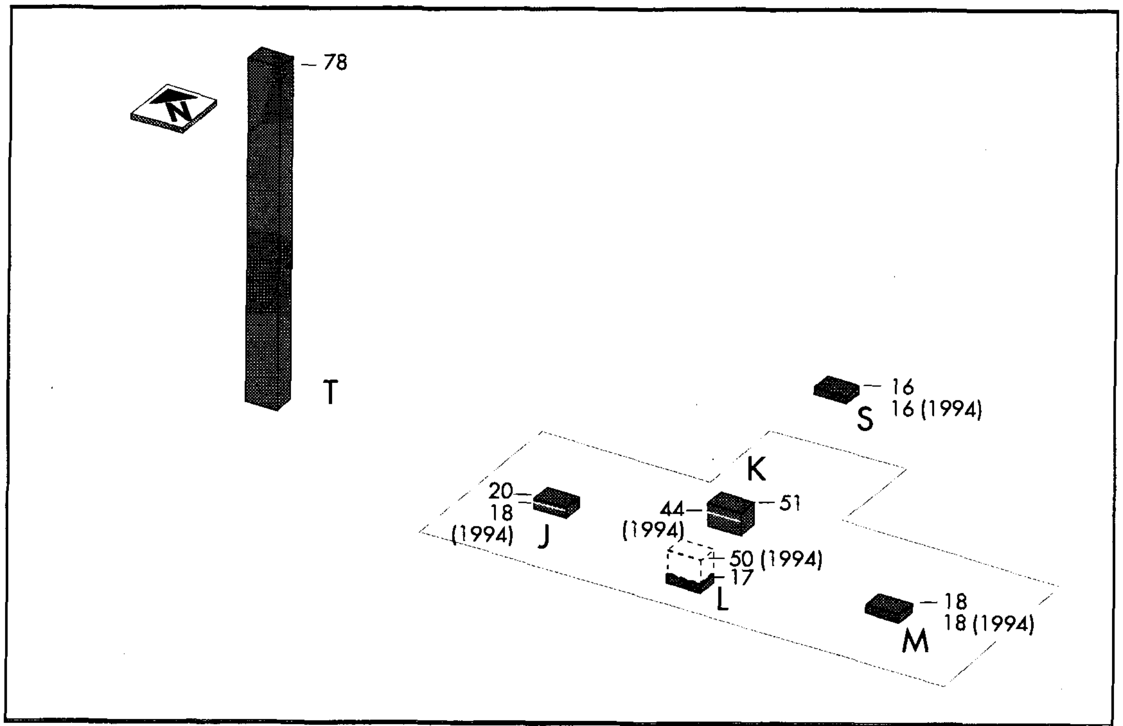


Figure 4-6: Spatial Concentrations of PCBs on and off the cap in ug/kg dry weight

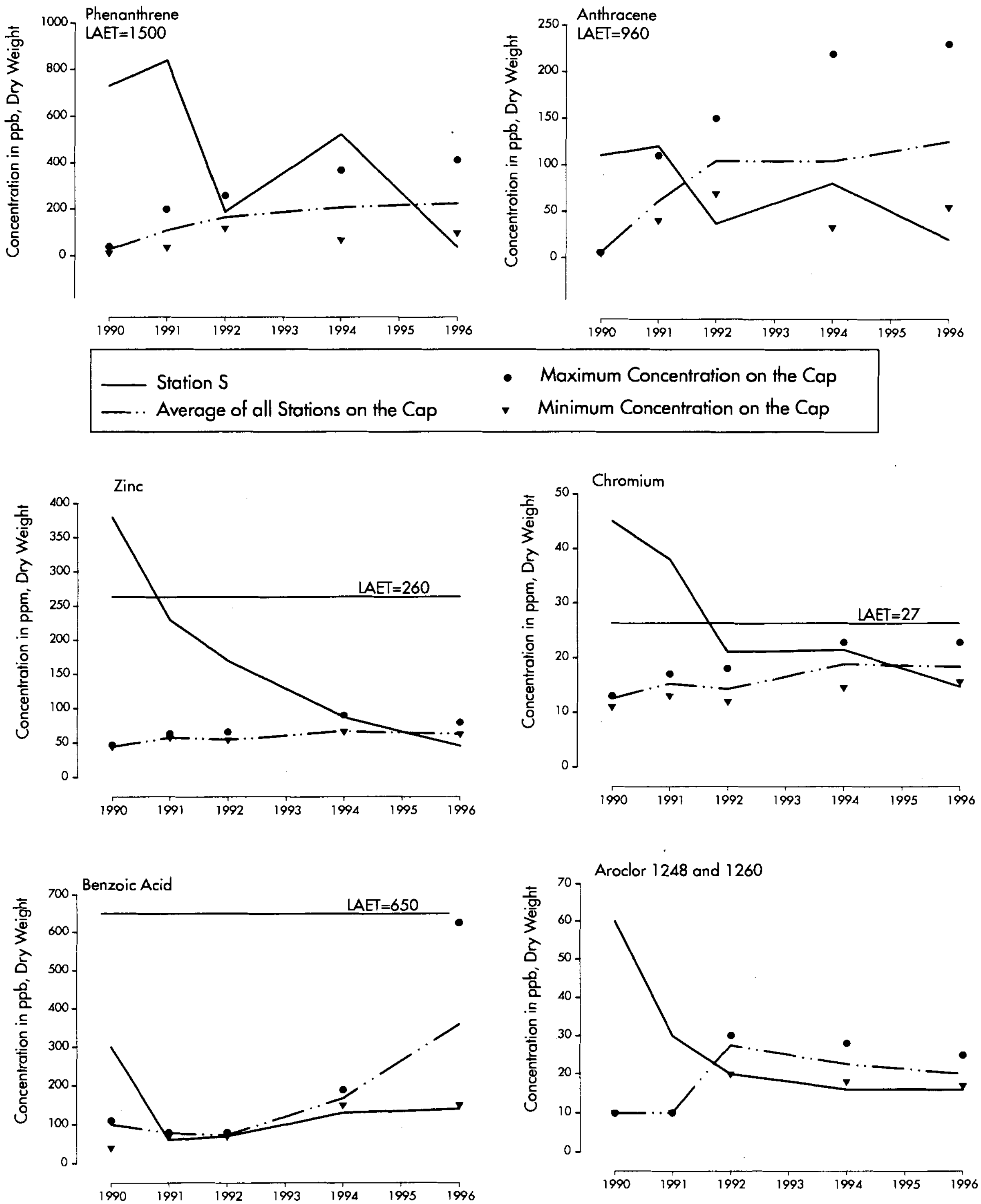


Figure 4-7: Trend Charts for Selected Dry Weight Contaminants.

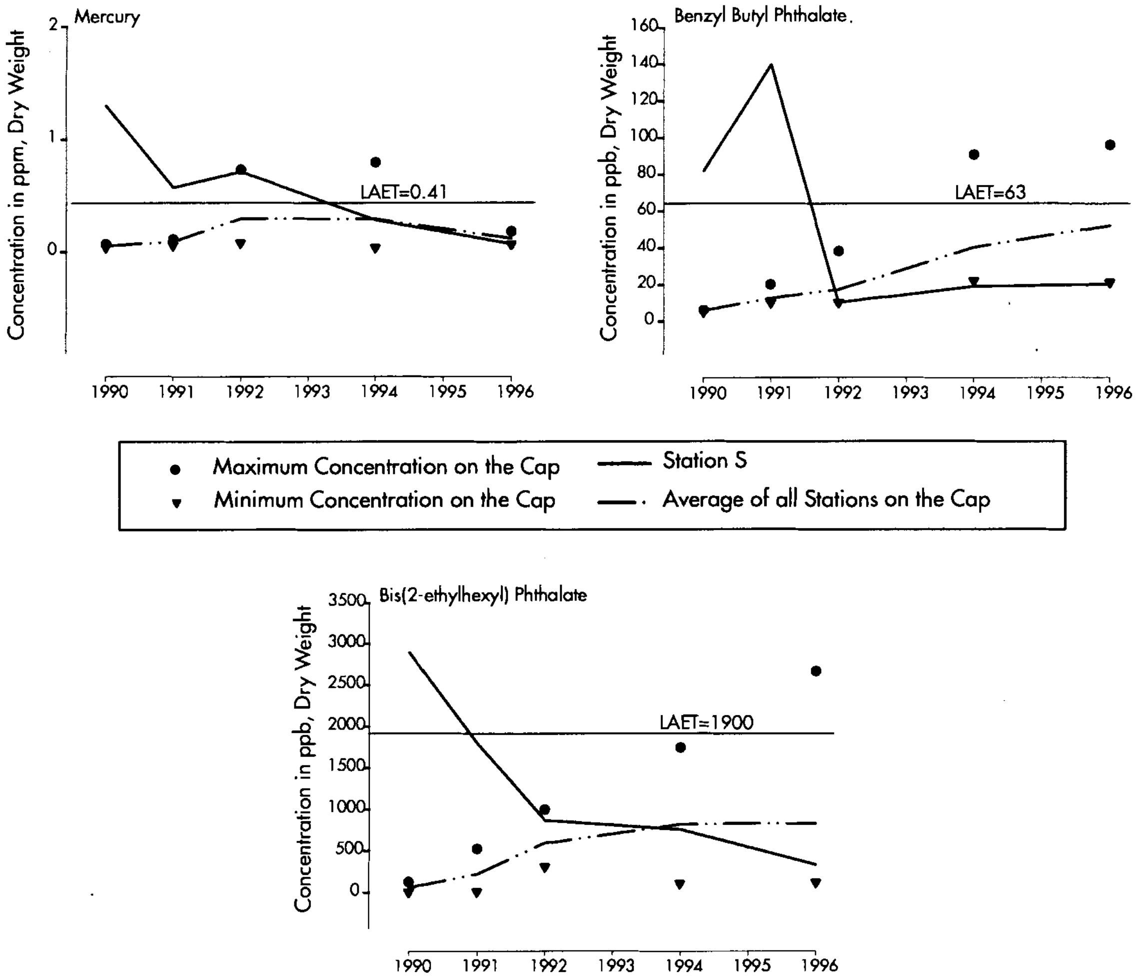


Figure 4-7: Trend Charts for Selected Dry Weight Contaminants (con't).

Table 4-2: 0-2 cm Detected Chemicals (Dry Weight)

Station Locator	J LTBC20		K LTBC21		L LTBC22		L Rep LTBC22	
Date Sampled	Aug 06, 96		Aug 06, 96		Aug 06, 96		Aug 06, 96	
Depth Sampled	Top 2 cm		Top 2 cm		Top 2 cm		Top 2 cm	
Sample Number	*L9208-1*		*L9208-5*		*L9208-6*		*L9208-9*	
% Solids	66.1		60.4		74.5		71.8	
% TOC	0.903		1.4		0.374		0.577	
	Qual	Value	Qual	Value	Qual	Value	Qual	Value
ORGANICS (mg/kg dry weight)								
LPAHs								
Acenaphthylene	<MDL	24	<MDL	26	<MDL	21	<MDL	22
Acenaphthene	<MDL	17	<RDL	25	<MDL	15	<MDL	15
Fluorene	<RDL,G	33	G	57.3	<MDL,G	21	<MDL,G	22
Phenanthrene	G	216	G	411	G	98.3	G	87.7
Anthracene	G	153	G	230	G	54.5	G	40.8
HPAHs								
Fluoranthene	G	431	G	773	G	199	G	187
Pyrene	G	396	G	714	G	180	G	319
Benzo(a)anthracene	G	247	G	358	G	94.9	G	101
Chrysene		339		546		138		180
Benzo(b)fluoranthene		359		599		164		201
Benzo(k)fluoranthene	G	143	G	283	<RDL,G	64	<RDL,G	71
Benzo(a)pyrene	G	265	G	422	G	126	G	216
Indeno(1,2,3-Cd)Pyrene	G	148	G	217	G	73.4	G	94.2
Dibenzo(a,h)anthracene	<MDL	65	<MDL	71	<MDL	58	<MDL	60
Benzo(g,h,i)perylene	G	146	G	195	G	76.6	G	110
Other BNA								
1,2-Dichlorobenzene	<MDL,G	1	<MDL,G	1.1	<MDL,G	0.93	<MDL,G	0.96
1,4-Dichlorobenzene	<MDL,G	1	<MDL,G	1.1	<MDL,G	0.93	<MDL,G	0.96
Hexachlorobenzene	<MDL,G	1	<MDL,G	1.1	<MDL,G	0.93	<MDL,G	0.96
Dimethyl Phthalate	<MDL	17	<MDL	18	<MDL	15	<RDL	15
Di-N-Butyl Phthalate	<MDL	41	<MDL	45	<MDL	36	<MDL	38
Benzyl Butyl Phthalate		60.7		96.2	<MDL	21		62
Bis(2-Ethylhexyl)Phthalate		422		2670		117		152
Di-N-Octyl Phthalate	<MDL	24		146	<MDL	21	<MDL	22
Benzyl Alcohol	<MDL,G	41	<MDL,G	45	<MDL,G	36	<MDL,G	38
Benzoic Acid	L	626	<MDL,L	180	<MDL,L	150	<MDL,L	150
Carbazole <RDL	54	<RDL	88	<MDL	36	<MDL	38	
Coprostanol		802		808		271		260
Pesticides and PCBs								
Aroclor 1248	<MDL	20	<MDL	22	<MDL	17	<MDL	18
Aroclor 1254	<MDL	20	<RDL	26	<MDL	17	<MDL	18
Aroclor 1260	<MDL	20	<RDL	25	<MDL	17	<MDL	18
4,4'-DDD	<MDL	2	<MDL	2.2	<MDL	1.7	<MDL	1.8
Endosulfan I	<RDL	2.4	<RDL	4	<MDL	1.7	<MDL	1.8
Volatiles								
Acetone	<RDL,B	890	<RDL,B	980	<RDL,B	700	<RDL,B	530
Methylene Chloride	<MDL	150	<MDL	170	<MDL	130	<MDL	140
METALS (mg/kg dry weight)								
Mercury, Total, CVAA	<RDL	0.13	<RDL	0.18	<RDL	0.064	<RDL	0.11
Aluminum, Total, ICP	L	13100	L	15600	L	11400	L	12700
Antimony, Total, ICP	<MDL,G	2.3	<RDL,G	2.8	<MDL,G	2	<RDL,G	2.2
Arsenic, Total, ICP	<RDL	4.8	<RDL	5	<RDL	3.8	<RDL	4.3
Barium, Total, ICP		31.3		46.5		26		30.1
Beryllium, Total, ICP	<RDL	0.29	<RDL	0.36	<RDL	0.26	<RDL	0.26
Cadmium, Total, ICP	<RDL	0.47	<RDL	0.3	<MDL	0.2	<MDL	0.21
Calcium, Total, ICP		4610		5170		3990		4650
Chromium, Total, ICP		18.2		22.8		15.6		20.3
Copper, Total, ICP		24.5		32.6		16.2		20.2
Iron, Total, ICP		20600		23500		19200		19100
Lead, Total, ICP		17.1		26.7		10.2		11.7
Magnesium, Total, ICP		5040		5990		4580		5250
Manganese, Total, ICP		198		235		207		203
Molybdenum, Total, ICP	<MDL	1.5	<RDL	1.6	<MDL	1.3	<MDL	1.4
Nickel, Total, ICP		16.8		19.4		14.5		17.7
Potassium, Total, ICP		1490		1890		1130		1320
Silver, Total, ICP	<RDL	1.5	<RDL	1.5	<MDL	0.27	<MDL	0.26
Sodium, Total, ICP								
Thallium, Total, ICP	<MDL	15	<MDL	16	<MDL	13	<MDL	14
Zinc, Total, ICP		63.8		79.8		53.6		57.2

Table 4-2: 0-2 cm Detected Chemicals (Dry Weight)

Station Locator	M LTBD23		S LTBD25		T LTBC38	
Date Sampled	Aug 06, 96		Aug 27, 96		Aug 12, 96	
Depth Sampled	Top 2 cm		Top 2 cm		Top 2 cm	
Sample Number	L9208-2		L9317-1		L9281-1	
% Solids	73.2		79.7		55	
% TOC	0.331		0.457		3	
	Qual	Value	Qual	Value	Qual	Value
ORGANICS (mg/kg dry weight)						
LPAHs						
Acenaphthylene	<MDL	22	<MDL	20	<MDL	29
Acenaphthene	<MDL	15	<MDL	14		73.3
Fluorene	<MDL,G	22	<MDL,G	20	G	76
Phenanthrene	G	175	G	38.3	G	589
Anthracene	G	60.9	<MDL,G	20	G	222
HPAHs						
Fluoranthene	G	294	G	115	G	805
Pyrene	G	301	G	95	G	1080
Benzo(a)anthracene	G	150	G	37.9	G	513
Chrysene		191		50.2		689
Benzo(b)fluoranthene		206	<MDL	54		785
Benzo(k)fluoranthene	<RDL,G	96	<MDL,G	54	G	411
Benzo(a)pyrene	G	150	<RDL,G	36	G	651
Indeno(1,2,3-Cd)Pyrene	G	79.5	<MDL,G	34	G	331
Dibenzo(a,h)anthracene	<MDL	59	<MDL	54	<RDL	93
Benzo(g,h,i)perylene	G	73.2	<MDL,G	34	G	313
Other BNA						
1,2-Dichlorobenzene	<MDL,G	0.94	<MDL,G	0.87	<RDL,G	1.7
1,4-Dichlorobenzene	<MDL,G	0.94	<MDL,G	0.87	G	5.24
Hexachlorobenzene	<MDL,G	0.94	<MDL,G	0.87	<RDL,G	2.2
Dimethyl Phthalate	<MDL	15	<RDL	19	<MDL	20
Di-N-Butyl Phthalate	<MDL	37	<MDL	34		218
Benzyl Butyl Phthalate	<RDL	30	<MDL	20		161
Bis(2-Ethylhexyl)Phthalate		120		332		1720
Di-N-Octyl Phthalate	<MDL	22	<MDL	20	<MDL	29
Benzyl Alcohol	<MDL,G	37	<MDL	34	<RDL	85
Benzoic Acid	L	481	<MDL	140	<MDL	200
Carbazole <MDL	37	<MDL	34	<RDL	73	
Coprostanol		346	<MDL,E	140		725
Pesticides and PCBs						
Aroclor 1248	<MDL	18	<MDL	16		216
Aroclor 1254	<MDL	18	<MDL	16		360
Aroclor 1260	<MDL	18	<MDL	16		211
4,4'-DDD	<MDL	1.8	<MDL	1.6		645
Endosulfan I	<MDL	1.8	<MDL	1.6	<MDL	2.4
Volatiles						
Acetone	<RDL,B	810	<RDL,B	460	<RDL,B	1000
Methylene Chloride	<MDL	140	<RDL,B	940	<MDL	180
METALS (mg/kg dry weight)						
Mercury, Total, CVAA	<RDL	0.081	<RDL	0.066		0.622
Aluminum, Total, ICP	L	10900	L	6270	L	16400
Antimony, Total, ICP	<MDL,G	1.9	<MDL,G	2	<MDL,G	2.7
Arsenic, Total, ICP	<RDL	6.4	<MDL	3.3	<RDL	6.5
Barium, Total, ICP		39.2		15.6		
Beryllium, Total, ICP	<RDL	0.27	<RDL	0.14	<RDL	0.24
Cadmium, Total, ICP	<MDL	0.19	<RDL	0.23	<RDL	0.87
Calcium, Total, ICP		3880				4980
Chromium, Total, ICP		16.7		14.7		43.1
Copper, Total, ICP		16.4		18.7		59.5
Iron, Total, ICP		20800		10800	G	22500
Lead, Total, ICP		11		13		86.5
Magnesium, Total, ICP		4630		3760		8690
Manganese, Total, ICP		202				
Molybdenum, Total, ICP	<MDL	1.3	<RDL	1.5	<RDL	3.3
Nickel, Total, ICP		13.9		17.1		42
Potassium, Total, ICP		1260	<RDL	390		2380
Silver, Total, ICP	<MDL	0.26	<RDL	1.3		4.38
Sodium, Total, ICP				3740		
Thallium, Total, ICP	<RDL	16	<MDL	13	<MDL	18
Zinc Total ICP		53		45.4		107

Table 4-3: 0-2 cm Comparison to Sediment Standards

Station Locator	Sediment		J Rep LTBC21				K LTBC21				L LTBC22			
Date Sampled	Management		Aug 06, 96				Aug 06, 96				Aug 06, 96			
Depth Sampled	Standards		Top 2 cm				Top 2 cm				Top 2 cm			
Sample Number			L9208-1				L9208-5				L9208-6			
% Solids			66.1				60.4				74.5			
% TOC			0.903				1.4				0.374			
	SQS	CSL		Qual	Value	MDL		Qual	Value	MDL		Qual	Value	MDL
Naphthalene	99	170		<MDL,G		7.2		<MDL,G		5.1		<MDL,G		16
Acenaphthylene	66	66		<MDL		2.7		<MDL		1.9		<MDL		5.6
Acenaphthene	16	57		<MDL		1.9		<RDL	1.79	1.3		<MDL		4
Fluorene	23	79		<RDL,G	3.65	2.7		G	4.09	1.9		<MDL,G		5.6
Phenanthrene	100	480		G	23.9	2.7		G	29.4	1.9		G	26.3	5.6
Anthracene	220	1200		G	16.9	2.7		G	16.4	1.9		G	14.6	5.6
2-Methylnaphthalene	38	64		<MDL,G		7.2		<MDL,G		5.1		<MDL,G		16
Total LPAHs	370	780			44.5				51.7				40.9	0
Fluoranthene	160	1200		G	47.7	2.7		G	55.2	1.9		G	53.2	5.6
Pyrene	1000	1400		G	43.9	2.7		G	51	1.9		G	48.1	5.6
Benzo(a)anthracene	110	270		G	27.4	2.7		G	25.6	1.9		G	25.4	5.6
Chrysene	110	460			37.5	2.7			39	1.9			36.9	5.6
Total BenzoFluoranthenes	230	450			55.6				63				61	
Benzo(a)pyrene	99	210		G	29.3	4.5		G	30.1	3.2		G	33.7	9.6
Indeno(1,2,3-Cd)Pyrene	34	88		G	16.4	4.5		G	15.5	3.2		G	19.6	9.6
Dibenzo(a,h)anthracene	12	33		<MDL		7.2		<MDL		5.1	*	<MDL		16
Benzo(g,h,i)perylene	31	78		G	16.2	4.5		G	13.9	3.2		G	20.5	9.6
Total HPAHs	960	5300			274				293				298	
1,2-Dichlorobenzene	2.3	2.3		<MDL,G		0.11		<MDL,G		0.08		<MDL,G		0.25
1,4-Dichlorobenzene	3.1	9		<MDL,G		0.11		<MDL,G		0.08		<MDL,G		0.25
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G		0.11		<MDL,G		0.08		<MDL,G		0.25
Hexachlorobenzene	0.38	2.3		<MDL,G		0.11		<MDL,G		0.08		<MDL,G		0.25
Dimethyl Phthalate	53	53		<MDL		1.9		<MDL		1.3		<MDL		4
Diethyl Phthalate	61	110		<MDL		4.5		<MDL		3.2		<MDL		9.6
Di-N-Butyl Phthalate	220	1700		<MDL		4.5		<MDL		3.2		<MDL		9.6
Benzyl Butyl Phthalate	4.9	64	*		6.72	2.7	*		6.87	1.9	*	<MDL		5.6
Bis(2-Ethylhexyl)Phthalate	47	78	*		46.7	2.7	**		191	1.9			31.3	5.6
Di-N-Octyl Phthalate	58	4500		<MDL		2.7			10.4	1.9		<MDL		5.6
Dibenzofuran	15	58		<MDL		4.5		<MDL		3.2		<MDL		9.6
Hexachlorobutadiene	3.9	6.2	*	<MDL,G		4.5		<MDL,G		3.2	**	<MDL,G		9.6
N-Nitrosodiphenylamine	11	11		<MDL		4.5		<MDL		3.2		<MDL		9.6
Total PCB	12	65		<MDL		2.2		<RDL	3.64			<MDL		4.5
Phenol	420	1200		<MDL,G		170		<MDL,G		180		<MDL,G		150
2-Methylphenol	63	63		<MDL,G		41		<MDL,G		45		<MDL,G		36
4-Methylphenol	670	670		<MDL,G		41		<MDL,G		45		<MDL,G		36
2,4-Dimethylphenol	29	29	**	<MDL,G		41	**	<MDL,G		45	**	<MDL,G		36
Pentachlorophenol	360	690		<MDL,E,G		41		<MDL,E,G		45		<MDL,E,G		36
Benzyl Alcohol	57	73		<MDL,G		41		<MDL,G		45		<MDL,G		36
Benzoic Acid	650	650		L	626	170		<MDL,L		180		<MDL,L		150
Arsenic, Total, ICP	57	93		<RDL	4.8	3.9		<RDL	5	4		<RDL	3.8	3.4
Cadmium, Total, ICP	5.1	6.7		<RDL	0.47	0.23		<RDL	0.3	0.25		<MDL		0.2
Chromium, Total, ICP	260	270			18.2	0.39			22.8	0.4			15.6	0.34
Copper, Total, ICP	390	390			24.5	0.32			32.6	0.31			16.2	0.27
Lead, Total, ICP	450	530			17.1	2.3			26.7	2.5			10.2	2
Mercury, Total, CVAA	0.41	0.59		<RDL	0.13	0.03		<RDL	0.18	0.03		<RDL	0.06	0.03
Silver, Total, ICP	6.1	6.1		<RDL	1.5	0.32		<RDL	1.5	0.31		<MDL		0.27
Zinc, Total, ICP	410	960			63.8	0.39			79.8	0.4			53.6	0.34

Table 4-3: 0-2 cm Comparison to Sediment Standards

Station Locator	Sediment			L Rep LTBC22				M LTBD23				S LTBD25		
Date Sampled	Management			Aug 06, 96				Aug 06, 96				Aug 27, 96		
Depth Sampled	Standards			Top 2 cm				Top 2 cm				Top 2 cm		
Sample Number				L9208-9				L9208-2				L9317-1		
% Solids				71.8				73.2				79.7		
% TOC				0.577				0.331				0.457		
	SQS	CSL		Qual	Value	MDL		Qual	Value	MDL		Qual	Value	MDL
Naphthalene	99	170		<MDL,G		10		<MDL,G		18		<MDL,G		12
Acenaphthylene	66	66		<MDL		3.8		<MDL		6.6		<MDL		4.4
Acenaphthene	16	57		<MDL		2.6		<MDL		4.5		<MDL		3.1
Fluorene	23	79		<MDL,G		3.8		<MDL,G		6.6		<MDL,G		4.4
Phenanthrene	100	480		G	15.2	3.8		G	52.9	6.6		G	8.38	4.4
Anthracene	220	1200		G	7.07	3.8		G	18.4	6.6		<MDL,G		4.4
2-Methylnaphthalene	38	64		<MDL,G		10		<MDL,G		18		<MDL,G		12
Total LPAHs	370	780			22.3				71.3				8.38	
Fluoranthene	160	1200		G	32.4	3.8		G	88.8	6.6		G	25.2	4.4
Pyrene	1000	1400		G	55.3	3.8		G	90.9	6.6		G	20.8	4.4
Benzo(a)anthracene	110	270		G	17.5	3.8		G	45.3	6.6		G	8.29	4.4
Chrysene	110	460			31.2	3.8			57.7	6.6			11	4.4
Total BenzoFluoranthenes	230	450			47.1				91.2			<MDL		12
Benzo(a)pyrene	99	210		G	37.4	6.6		G	45.3	11		<RDL,G	7.88	7.4
Indeno(1,2,3-Cd)Pyrene	34	88		G	16.3	6.6		G	24	11		<MDL,G		7.4
Dibenzo(a,h)anthracene	12	33		<MDL		10	*	<MDL		18	*	<MDL		12
Benzo(g,h,i)perylene	31	78		G	19.1	6.6		G	22.1	11		<MDL,G		7.4
Total HPAHs	960	5300			256				465				73.1	
1,2-Dichlorobenzene	2.3	2.3		<MDL,G		0.17		<MDL,G		0.28		<MDL,G		0.19
1,4-Dichlorobenzene	3.1	9		<MDL,G		0.17		<MDL,G		0.28		<MDL,G		0.19
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G		0.17		<MDL,G		0.28		<MDL,G		0.19
Hexachlorobenzene	0.38	2.3		<MDL,G		0.17		<MDL,G		0.28		<MDL,G		0.19
Dimethyl Phthalate	53	53		<RDL	2.6	2.6		<MDL		4.5		<RDL	4.16	3.1
Diethyl Phthalate	61	110		<MDL		6.6		<MDL		11		<MDL		7.4
Di-N-Butyl Phthalate	220	1700		<MDL		6.6		<MDL		11		<MDL		7.4
Benzyl Butyl Phthalate	4.9	64	*		10.7	3.8	*	<RDL	9.06	6.6		<MDL		4.4
Bis(2-Ethylhexyl)Phthalate	47	78			26.3	3.8			36.3	6.6	*		72.6	4.4
Di-N-Octyl Phthalate	58	4500		<MDL		3.8		<MDL		6.6		<MDL		4.4
Dibenzofuran	15	58		<MDL		6.6		<MDL		11		<MDL		7.4
Hexachlorobutadiene	3.9	6.2	**	<MDL,G		6.6	**	<MDL,G		11	**	<MDL,G		7.4
N-Nitrosodiphenylamine	11	11		<MDL		6.6	**	<MDL		11		<MDL		7.4
Total PCB	12	65		<MDL		3.1		<MDL		5.4		<MDL		3.5
Phenol	420	1200		<MDL,G		150		<MDL,G		150		<MDL		140
2-Methylphenol	63	63		<MDL,G		38		<MDL,G		37		<MDL		34
4-Methylphenol	670	670		<MDL,G		38		<MDL,G		37		<MDL		34
2,4-Dimethylphenol	29	29	**	<MDL,G		38	**	<MDL,G		37	**	<MDL		34
Pentachlorophenol	360	690		<MDL,E,G		38		<MDL,E,G		37		<MDL,G		34
Benzyl Alcohol	57	73		<MDL,G		38		<MDL,G		37		<MDL		34
Benzoic Acid	650	650		<MDL,L		150		L	481	150		<MDL		140
Arsenic, Total, ICP	57	93		<RDL	4.3	3.3		<RDL	6.4	3.3		<MDL		3.3
Cadmium, Total, ICP	5.1	6.7		<MDL		0.21		<MDL		0.19		<RDL	0.23	0.2
Chromium, Total, ICP	260	270			20.3	0.33			16.7	0.33			14.7	0.33
Copper, Total, ICP	390	390			20.2	0.26			16.4	0.26			18.7	0.26
Lead, Total, ICP	450	530			11.7	2.1			11	1.9			13	2
Mercury, Total, CVAA	0.41	0.59		<RDL	0.11	0.02		<RDL	0.08	0.03		<RDL	0.07	0.03
Silver, Total, ICP	6.1	6.1		<MDL		0.26		<MDL		0.26		<RDL	1.3	0.26
Zinc, Total, ICP	410	960			57.2	0.33			53	0.33			45.4	0.33

Table 4-3: 0-2 cm Comparison to Sediment Standards

Station Locator	Sediment			T LTBC38		
Date Sampled	Management			Aug 12, 96		
Depth Sampled	Standards			Top 2 cm		
Sample Number				L9281-1		
% Solids				55		
% TOC				3		
	SQS	CSL		Qual	Value	MDL
Naphthalene	99	170		<MDL,G		2.6
Acenaphthylene	66	66		<MDL		0.97
Acenaphthene	16	57.			2.44	0.67
Fluorene	23	79		G	2.53	0.97
Phenanthrene	100	480		G	19.6	0.97
Anthracene	220	1200		G	7.4	0.97
2-Methylnaphthalene	38	64		<MDL		2.6
Total LPAHs	370	780			32	
Fluoranthene	160	1200		G	26.8	0.97
Pyrene	1000	1400		G	36	0.97
Benzo(a)anthracene	110	270		G	17.1	0.97
Chrysene	110	460			23	0.97
Total BenzoFluoranthenes	230	450			39.9	
Benzo(a)pyrene	99	210		G	21.7	1.6
Indeno(1,2,3-Cd)Pyrene	34	88		G	11	1.6
Dibenzo(a,h)anthracene	12	33		<RDL	3.1	2.6
Benzo(g,h,i)perylene	31	78		G	10.4	1.6
Total HPAHs	960	5300			189	
1,2-Dichlorobenzene	2.3	2.3		<RDL,G	0.06	0.04
1,4-Dichlorobenzene	3.1	9		G	0.18	0.04
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G		0.04
Hexachlorobenzene	0.38	2.3		<RDL,G	0.07	0.04
Dimethyl Phthalate	53	53		<MDL		0.67
Diethyl Phthalate	61	110		<MDL		1.6
Di-N-Butyl Phthalate	220	1700			7.27	1.6
Benzyl Butyl Phthalate	4.9	64	*		5.37	0.97
Bis(2-Ethylhexyl)Phthalate	47	78	*		57.3	0.97
Di-N-Octyl Phthalate	58	4500		<MDL		0.97
Dibenzofuran	15	58		<MDL		1.6
Hexachlorobutadiene	3.9	6.2		<MDL		1.6
N-Nitrosodiphenylamine	11	11		<MDL		1.6
Total PCB	12	65	*		26.2	
Phenol	420	1200		<MDL		200
2-Methylphenol	63	63		<MDL		49
4-Methylphenol	670	670		<MDL		49
2,4-Dimethylphenol	29	29	**	<MDL		49
Pentachlorophenol	360	690		<MDL,G		49
Benzyl Alcohol	57	73	**	<RDL	85	49
Benzoic Acid	650	650		<MDL		200
Arsenic, Total, ICP	57	93		<RDL	6.5	4.7
Cadmium, Total, ICP	5.1	6.7		<RDL	0.87	0.27
Chromium, Total, ICP	260	270			43.1	0.47
Copper, Total, ICP	390	390			59.5	0.38
Lead, Total, ICP	450	530			86.5	2.7
Mercury, Total, CVAA	0.41	0.59	**		0.62	0.04
Silver, Total, ICP	6.1	6.1			4.38	0.38
Zinc, Total, ICP	410	960			107	0.47

Table 4-4: 0-10 cm Detected Chemicals

Station Locator	K LTBC21		L LTBC22		K-1 LTBC21		L-1 LTBC22	
Date Sampled	Aug 06, 96		Aug 06, 96		Aug 06, 96		Aug 06, 96	
Depth Sampled	2-10 cm		2-10 cm		Combined 0-10		Combined 0-10	
Sample Number	L9208-7		L9208-8					
% Solids	62.2		73.8		61.84		73.94	
% TOC	1.37		0.412		1.376		0.4044	
	Qual	Value	Qual	Value	Qual	Value	Qual	Value
ORGANICS (mg/kg dry weight)								
LPAHs								
Acenaphthylene	<MDL	26	<MDL	22	<MDL	26	<MDL	21.8
Acenaphthene		99.5	<MDL	15		84.6	<MDL	15
Fluorene	G	111	<MDL,G	22	G	100.3	<MDL,G	21.8
Phenanthrene	G	601	G	47.2	G	563	G	57.42
Anthracene	G	155	<MDL,G	22	G	170	G	28.5
HPAHs								
Fluoranthene	G	770	G	100	G	770.6	G	119.8
Pyrene	G	749	G	111	G	742	G	124.8
Benzo(a)anthracene	G	375	G	58.8	G	371.6	G	66.02
Chrysene		540		103		541.2		110
Benzo(b)fluoranthene		635	<RDL	100		627.8		112.8
Benzo(k)fluoranthene	G	293	<MDL,G	58	G	291	G	59.2
Benzo(a)pyrene	G	453	G	91.2	G	446.8	G	98.16
Indeno(1,2,3-Cd)Pyrene	G	220	<RDL,G	41	G	219.4	G	47.48
Dibenzo(a,h)anthracene	<MDL	69	<MDL	58	<MDL	69.4	<MDL	58
Benzo(g,h,i)perylene	G	215	<RDL,G	47	G	211	G	52.92
Other BNA								
1,2-Dichlorobenzene	<MDL,G	1.1	<MDL,G	0.93	<MDL,G	1.1	<MDL,G	0.93
1,4-Dichlorobenzene	<MDL,G	1.1	<MDL,G	0.93	<MDL,G	1.1	<MDL,G	0.93
Hexachlorobenzene	<MDL,G	1.1	<MDL,G	0.93	<MDL,G	1.1	<MDL,G	0.93
Dimethyl Phthalate	<MDL	18	<MDL	15	<MDL	18	<MDL	15
Di-N-Butyl Phthalate	<MDL	43	<MDL	37	<MDL	43.4	<MDL	36.8
Benzyl Butyl Phthalate		94.9	<MDL	22		95.16	<MDL	21.8
Bis(2-Ethylhexyl)Phthalate		921		109		1271		110.6
Di-N-Octyl Phthalate	<RDL	40	<MDL	22		61.2	<MDL	21.8
Benzyl Alcohol	<MDL,G	43	<MDL,G	37	<MDL,G	43.4	<MDL,G	36.8
Benzoic Acid	<MDL,L	180	<MDL,L	150	<MDL,L	180	<MDL,L	150
Carbazole	<RDL	74	<MDL	37	<RDL	76.8	<MDL	36.8
Coprostanol		815		294		813.6		289.4
Pesticides and PCBs								
Aroclor 1248	<MDL	21	<MDL	18	<MDL	21.2	<MDL	17.8
Aroclor 1254	<RDL	40	<MDL	18	<RDL	37.2	<MDL	17.8
Aroclor 1260		45.5	<MDL	18		41.4	<MDL	17.8
4,4'-DDD	<MDL	2.1	<MDL	1.8	<MDL	2.12	<MDL	1.78
Endosulfan I	<MDL	2.1	<MDL	1.8		2.48	<MDL	1.78
Volatiles								
Acetone	<RDL,B	760	<RDL,B	500	<RDL,B	804	<RDL,B	540
Methylene Chloride	<MDL	160	<MDL	140	<MDL	162	<MDL	138
METALS (mg/kg dry weight)								
Mercury, Total, CVAA	H	0.23	<RDL	0.12		0.22	<RDL	0.109
Aluminum, Total, ICP	L	15000	L	11700	L	15120	L	11640
Antimony, Total, ICP	<MDL,G	2.4	<MDL,G	2	G	2.48	<MDL,G	2
Arsenic, Total, ICP	<RDL	5.1	<RDL	3.7	<RDL	5.08	<RDL	3.72
Barium, Total, ICP		48.1		31.6		47.78		30.48
Beryllium, Total, ICP	<RDL	0.34	<RDL	0.26	<RDL	0.344	<RDL	0.26
Cadmium, Total, ICP	<RDL	0.43	<MDL	0.2	<RDL	0.404	<MDL	0.2
Calcium, Total, ICP		4790		4320		4866		4254
Chromium, Total, ICP		24.1		15.2		23.84		15.28
Copper, Total, ICP		38.1		14.9		37		15.16
Iron, Total, ICP		21400		19200		21820		19200
Lead, Total, ICP		31.5	<RDL	9.6		30.54		9.72
Magnesium, Total, ICP		5760		4620		5806		4612
Manganese, Total, ICP		214		206		218.2		206.2
Molybdenum, Total, ICP	<RDL	2.4	<MDL	1.3	<RDL	2.24	<MDL	1.3
Nickel, Total, ICP		19.9		14.4		19.8		14.42
Potassium, Total, ICP		1860		1260		1866		1234
Silver, Total, ICP	<RDL	1.4	<MDL	0.26	<RDL	1.42	<MDL	0.262
Sodium, Total, ICP								
Thallium, Total, ICP	<MDL	16	<RDL	14	<MDL	16		13.8
Zinc, Total, ICP		85.9		55		84.68		54.72

Table 4-4: 0-10 cm Detected Chemicals

Station Locator	K-2 LTBC21		L-2 LTBC22		T LTBC38	
Date Sampled	Sep 10, 96		Sep 10, 96		Aug 06, 96	
Depth Sampled	Top 10 cm		Top 10 cm		Top 10 cm	
Sample Number	L9445-1		L9445-2		L9208-4	
% Solids	63.3		75.3		58.1	
% TOC	1.06		0.254		2.96	
	Qual	Value	Qual	Value	Qual	Value
ORGANICS (mg/kg dry weight)						
LPAHs						
Acenaphthylene	<MDL	25	<MDL	21	<RDL	29
Acenaphthene	<RDL	21	<MDL	15		42.2
Fluorene	<RDL,G	30	<MDL,G	21	G	47.3
Phenanthrene	G	265	G	64	G	449
Anthracene	G	118	G	47.3	G	160
HPAHs						
Fluoranthene	G	504	G	171	G	737
Pyrene	G	528	G	113	G	1050
Benzo(a)anthracene	G	310	G	96.5	G	420
Chrysene		449		154		544
Benzo(b)fluoranthene		562		187		833
Benzo(k)fluoranthene	G	216	<RDL,G	61	G	324
Benzo(a)pyrene	G	379	G	120	G	592
Indeno(1,2,3-Cd)Pyrene	G	243	<RDL,G	64	G	286
Dibenzo(a,h)anthracene	<MDL,G	68	<MDL,G	57	<RDL	77
Benzo(g,h,i)perylene	G	223	<RDL,G	62	G	272
Other BNA						
1,2-Dichlorobenzene	<MDL,G	1.1	<MDL,G	0.92	<RDL,G	1.5
1,4-Dichlorobenzene	G	5.06	<MDL,G	0.92	G	6.25
Hexachlorobenzene	<MDL,G	1.1	<MDL,G	0.92	<MDL,G	1.2
Dimethyl Phthalate	<MDL	17	<MDL	15	<MDL	19
Di-N-Butyl Phthalate	<MDL,G	43	<MDL,G	36	<RDL	52
Benzyl Butyl Phthalate		42.7	<MDL	21		158
Bis(2-Ethylhexyl)Phthalate		626		81.1		1440
Di-N-Octyl Phthalate	<MDL	25	<MDL	21	<RDL	40
Benzyl Alcohol	<MDL	43	<MDL	36	<MDL,G	46
Benzoic Acid	<MDL	170	<MDL	150	L	360
Carbazole	<RDL	44	<MDL	36	<RDL	60
Coprostanol		852		239		1060
Pesticides and PCBs						
Aroclor 1248	<MDL	21	<MDL	17		182
Aroclor 1254		44.4	<MDL	17		287
Aroclor 1260	<MDL	21	<MDL	17		212
4,4'-DDD	<MDL	2.1	<MDL	1.7	<MDL	2.2
Endosulfan I	<MDL,L	2.1	<MDL,L	1.7	<MDL	2.2
Volatiles						
Acetone	<RDL,B	430	<MDL,B	330	<RDL,B	760
Methylene Chloride	<RDL,B	1400	B	1300	<MDL	170
METALS (mg/kg dry weight)						
Mercury, Total, CVAA	<RDL,H	0.19	<RDL,H	0.036		0.683
Aluminum, Total, ICP	G	14000	G	10000	L	19300
Antimony, Total, ICP	<MDL,G	2.4	<MDL,G	2	<RDL,G	4.1
Arsenic, Total, ICP	<RDL	5.8	<RDL	4	<RDL	7.9
Barium, Total, ICP		40.9		28.7		78
Beryllium, Total, ICP	<RDL	0.35	<RDL	0.24	<RDL	0.41
Cadmium, Total, ICP	<RDL	0.3	<MDL	0.2	<RDL	1.3
Calcium, Total, ICP					5610	
Chromium, Total, ICP		24.2		15.9		48.2
Copper, Total, ICP		34.6		13.4		65.7
Iron, Total, ICP	G	20200	G	19000		22900
Lead, Total, ICP		26.7	<RDL	7.4		100
Magnesium, Total, ICP		5860		4500		8730
Manganese, Total, ICP		209		189		262
Molybdenum, Total, ICP	<RDL	2.1	<MDL	1.3	<RDL	4.6
Nickel, Total, ICP		19.6		14.3		45.1
Potassium, Total, ICP					2320	
Silver, Total, ICP	<RDL	0.81	<MDL	0.27		4.78
Sodium, Total, ICP		6750		3780		
Thallium, Total, ICP	<MDL	16	<MDL	13	<MDL	17
Zinc, Total, ICP		80.4		50.6		124

Table 4-5: 0-10 cm Comparison to Sediment Standards

Station Locator				K LTBC21				L LTBC22				K-1 LTBC21		
Date Sampled	Sediment			Aug 06, 96				Aug 06, 96				Aug 06, 96		
Depth Sampled				2-10 cm				2-10 cm				Combined 0-10		
Sample Number	Management			L9208-7				L9208-8						
% Solids				62.2				73.8				61.84		
% TOC	Standards			1.37				0.412				1.376		
	SQS	CSL		Qual	Value	MDL		Qual	Value	MDL		Qual	Value	MDL
Naphthalene	99	170		<MDL,G		5		<MDL,G		14		<MDL,G		5
Acenaphthylene	66	66		<MDL		1.9		<MDL		5.3		<MDL		1.9
Acenaphthene	16	57			7.26	1.3		<MDL		3.6			6.17	1.3
Fluorene	23	79		G	8.1	1.9		<MDL,G		5.3		G	7.3	1.9
Phenanthrene	100	480		G	43.9	1.9		G	11.5	5.3		G	41	1.9
Anthracene	220	1200		G	11.3	1.9		<MDL,G		5.3		G	12.3	1.9
2-Methylnaphthalene	38	64		<MDL,G		5		<MDL,G		14		<MDL,G		5
Total LPAHs	370	780			70.5				11.5				66.8	
Fluoranthene	160	1200		G	56.2	1.9		G	24.3	5.3		G	56	1.9
Pyrene	1000	1400		G	54.7	1.9		G	26.9	5.3		G	53.9	1.9
Benzo(a)anthracene	110	270		G	27.4	1.9		G	14.3	5.3		G	27	1.9
Chrysene	110	460			39.4	1.9			25	5.3			39.3	1.9
Total BenzoFluoranthenes	230	450			67.7				24.3				66.8	
Benzo(a)pyrene	99	210		G	33.1	3.1		G	22.1	9		G	32.5	3.2
Indeno(1,2,3-Cd)Pyrene	34	88		G	16.1	3.1		<RDL,G	9.95	9		G	15.9	3.2
Dibenzo(a,h)anthracene	12	33		<MDL		5	*	<MDL		14		<MDL		5
Benzo(g,h,i)perylene	31	78		G	15.7	3.1		<RDL,G	11.4	9		G	15.3	3.2
Total HPAHs	960	5300			310				158				307	
1,2-Dichlorobenzene	2.3	2.3		<MDL,G		0.08		<MDL,G		0.23		<MDL,G		0.08
1,4-Dichlorobenzene	3.1	9		<MDL,G		0.08		<MDL,G		0.23		<MDL,G		0.08
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G		0.08		<MDL,G		0.23		<MDL,G		0.08
Hexachlorobenzene	0.38	2.3		<MDL,G		0.08		<MDL,G		0.23		<MDL,G		0.08
Dimethyl Phthalate	53	53		<MDL		1.3		<MDL		3.6		<MDL		1.3
Diethyl Phthalate	61	110		<MDL		3.1		<MDL		9		<MDL		3.2
Di-N-Butyl Phthalate	220	1700		<MDL		3.1		<MDL		9		<MDL		3.2
Benzyl Butyl Phthalate	4.9	64	*		6.93	1.9	*	<MDL		5.3	*		6.92	1.9
Bis(2-Ethylhexyl)Phthalate	47	78	*		67.2	1.9			26.5	5.3	**		91.9	1.9
Di-N-Octyl Phthalate	58	4500		<RDL	2.92	1.9		<MDL		5.3		<RDL	4.42	1.9
Dibenzofuran	15	58		<MDL		3.1		<MDL		9		<MDL		3.2
Hexachlorobutadiene	3.9	6.2		<MDL,G		3.1	**	<MDL,G		9		<MDL,G		3.2
N-Nitrosodiphenylamine	11	11		<MDL		3.1		<MDL		9		<MDL		3.2
Total PCB	12	65			6.24			<MDL		4.4			5.72	
Phenol	420	1200		<MDL,G		180		<MDL,G		150		<MDL,G		180
2-Methylphenol	63	63		<MDL,G		43		<MDL,G		37		<MDL,G		43
4-Methylphenol	670	670		<MDL,G		43		<MDL,G		37		<MDL,G		43
2,4-Dimethylphenol	29	29	**	<MDL,G		43	**	<MDL,G		37	**	<MDL,G		43
Pentachlorophenol	360	690		<MDL,E,G		43		<MDL,E,G		37		<MDL,E,G		43
Benzyl Alcohol	57	73		<MDL,G		43		<MDL,G		37		<MDL,G		43
Benzoic Acid	650	650		<MDL,L		180		<MDL,L		150		<MDL,L		180
Arsenic, Total, ICP	57	93		<RDL	5.1	4		<RDL	3.7	3.3		<RDL	5.08	4
Cadmium, Total, ICP	5.1	6.7		<RDL	0.43	0.24		<MDL		0.2		<RDL	0.4	0.24
Chromium, Total, ICP	260	270			24.1	0.4			15.2	0.33			23.8	0.4
Copper, Total, ICP	390	390			38.1	0.32			14.9	0.26			37	0.32
Lead, Total, ICP	450	530			31.5	2.4		<RDL	9.6	2			30.5	2.4
Mercury, Total, CVAA	0.41	0.59		H	0.23	0.06		<RDL	0.12	0.02		H	0.22	0.06
Silver, Total, ICP	6.1	6.1		<RDL	1.4	0.32		<MDL		0.26		<RDL	1.42	0.32
Zinc, Total, ICP	410	960			85.9	0.4			55	0.33			84.7	0.4

* exceeds SQS

* exceeds CSL

Table 4-5: 0-10 cm Comparison to Sediment Standards

Station Locator	Sediment			L-1 LTBC22				K-2 LTBC21				L-2 LTBC22		
Date Sampled	Management			Aug 06, 96				Sep 10, 96				Sep 10, 96		
Depth Sampled	Standards			Combined 0-10				Top 10 cm				Top 10 cm		
Sample Number								L9445-1				L9445-2		
% Solids				73.94				63.3				75.3		
% TOC				0.4044				1.06				0.254		
	SQS	CSL		Qual	Value	MDL		Qual	Value	MDL		Qual	Value	MDL
Naphthalene	99	170		<MDL,G		14		<MDL,G		6.4		<MDL,G		22
Acenaphthylene	66	66		<MDL		5.4		<MDL		2.4		<MDL		8.3
Acenaphthene	16	57		<MDL		3.7		<RDL	1.98	1.6		<MDL		5.9
Fluorene	23	79		<MDL,G		5.4		<RDL,G	2.83	2.4		<MDL,G		8.3
Phenanthrene	100	480		G	14.4	5.4		G	25	2.4		G	25.2	8.3
Anthracene	220	1200		<MDL,G	2.91	5.4		G	11.1	2.4		G	18.6	8.3
2-Methylnaphthalene	38	64		<MDL,G		14		<MDL		6.4		<MDL		22
Total LPAHs	370	780			17.3				40.9				43.8	
Fluoranthene	160	1200		G	30.1	5.4		G	47.5	2.4		G	67.3	8.3
Pyrene	1000	1400		G	31.2	5.4		G	49.8	2.4		G	44.5	8.3
Benzo(a)anthracene	110	270		G	16.5	5.4		G	29.2	2.4		G	38	8.3
Chrysene	110	460			27.4	5.4			42.4	2.4			60.6	8.3
Total BenzoFluoranthenes	230	450			31.6				73.4				97.6	
Benzo(a)pyrene	99	210		G	24.4	9.1		G	35.8	4.1		G	47.2	14
Indeno(1,2,3-Cd)Pyrene	34	88		<RDL,G	11.9	9.1		G	22.9	4.1		<RDL,G	25.2	14
Dibenzo(a,h)anthracene	12	33	*	<MDL		14		<MDL,G		6.4	*	<MDL,G		22
Benzo(g,h,i)perylene	31	78		<RDL,G	13.2	9.1		G	21	4.1		<RDL,G	24.4	14
Total HPAHs	960	5300			186				322				405	
1,2-Dichlorobenzene	2.3	2.3		<MDL,G		0.23		<MDL,G		0.1		<MDL,G		0.36
1,4-Dichlorobenzene	3.1	9		<MDL,G		0.23		G	0.48	0.1		<MDL,G		0.36
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G		0.23		<MDL,G		0.1		<MDL,G		0.36
Hexachlorobenzene	0.38	2.3		<MDL,G		0.23		<MDL,G		0.1		<MDL,G		0.36
Dimethyl Phthalate	53	53		<MDL		3.7		<MDL		1.6		<MDL		5.9
Diethyl Phthalate	61	110		<MDL		9.1		<MDL		4.1		<MDL		14
Di-N-Butyl Phthalate	220	1700		<MDL		9.1		<MDL,G		4.1		<MDL,G		14
Benzyl Butyl Phthalate	4.9	64	*	<MDL		5.4			4.03	2.4	*	<MDL		8.3
Bis(2-Ethylhexyl)Phthalate	47	78			27.4	5.4	*		59.1	2.4			31.9	8.3
Di-N-Octyl Phthalate	58	4500		<MDL		5.4		<MDL		2.4		<MDL		8.3
Dibenzofuran	15	58		<MDL		9.1		<MDL		4.1		<MDL		14
Hexachlorobutadiene	3.9	6.2	**	<MDL,G		9.1	*	<MDL		4.1	**	<MDL		14
N-Nitrosodiphenylamine	11	11		<MDL		9.1		<MDL		4.1	**	<MDL		14
Total PCB	12	65		<MDL		4.4			4.19			<MDL		6.7
Phenol	420	1200		<MDL,G		150		<MDL		170		<MDL		150
2-Methylphenol	63	63		<MDL,G		37		<MDL		43		<MDL		36
4-Methylphenol	670	670		<MDL,G		37		<MDL		43		<MDL		36
2,4-Dimethylphenol	29	29	**	<MDL,G		37	**	<MDL		43	**	<MDL		36
Pentachlorophenol	360	690		<MDL,E,G		37		<MDL		43		<MDL		36
Benzyl Alcohol	57	73		<MDL,G		37		<MDL		43		<MDL		36
Benzoic Acid	650	650		<MDL,L		150		<MDL		170		<MDL		150
Arsenic, Total, ICP	57	93		<RDL	3.72	3.3		<RDL	5.8	3.9		<RDL	4	3.3
Cadmium, Total, ICP	5.1	6.7		<MDL		0.2		<RDL	0.3	0.24		<MDL		0.2
Chromium, Total, ICP	260	270			15.3	0.33			24.2	0.39			15.9	0.33
Copper, Total, ICP	390	390			15.2	0.26			34.6	0.32			13.4	0.27
Lead, Total, ICP	450	530		<RDL	9.72	2			26.7	2.4		<RDL	7.4	2
Mercury, Total, CVAA	0.41	0.59		<RDL	0.11	0.03		<RDL,H	0.19	0.03		<RDL,H	0.04	0.02
Silver, Total, ICP	6.1	6.1		<MDL		0.26		<RDL	0.81	0.32		<MDL		0.27
Zinc, Total, ICP	410	960			54.7	0.33			80.4	0.39			50.6	0.33

* exceeds SQS

* exceeds CSL

Table 4-5: 0-10 cm Comparison to Sediment Standards

Station Locator	Sediment			T LTBC38		
Date Sampled	Management			Aug 06, 96		
Depth Sampled	Standards			Top 10 cm		
Sample Number				L9208-4		
% Solids				58.1		
% TOC				2.96		
	SQS	CSL		Qual	Value	MDL
Naphthalene	99	170		<MDL,G		2.5
Acenaphthylene	66	66		<RDL	0.98	0.95
Acenaphthene	16	57			1.43	0.64
Fluorene	23	79		G	1.6	0.95
Phenanthrene	100	480		G	15.2	0.95
Anthracene	220	1200		G	5.41	0.95
2-Methylnaphthalene	38	64		<MDL,G		2.5
Total LPAHs	370	780			24.6	
Fluoranthene	160	1200		G	24.9	0.95
Pyrene	1000	1400		G	35.5	0.95
Benzo(a)anthracene	110	270		G	14.2	0.95
Chrysene	110	460			18.4	0.95
Total BenzoFluoranthenes	230	450			39.1	
Benzo(a)pyrene	99	210		G	20	1.6
Indeno(1,2,3-Cd)Pyrene	34	88		G	9.66	1.6
Dibenzo(a,h)anthracene	12	33		<RDL	2.6	2.5
Benzo(g,h,i)perylene	31	78		G	9.19	1.6
Total HPAHs	960	5300			173	
1,2-Dichlorobenzene	2.3	2.3		<RDL,G	0.05	0.04
1,4-Dichlorobenzene	3.1	9		G	0.21	0.04
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G		0.04
Hexachlorobenzene	0.38	2.3		<MDL,G		0.04
Dimethyl Phthalate	53	53		<MDL		0.64
Diethyl Phthalate	61	110		<MDL		1.6
Di-N-Butyl Phthalate	220	1700		<RDL	1.76	1.6
Benzyl Butyl Phthalate	4.9	64	*		5.34	0.95
Bis(2-Ethylhexyl)Phthalate	47	78	*		48.6	0.95
Di-N-Octyl Phthalate	58	4500		<RDL	1.35	0.95
Dibenzofuran	15	58		<MDL		1.6
Hexachlorobutadiene	3.9	6.2		<MDL,G		1.6
N-Nitrosodiphenylamine	11	11		<MDL		1.6
Total PCB	12	65	*		23	
Phenol	420	1200		<MDL,G		190
2-Methylphenol	63	63		<MDL,G		46
4-Methylphenol	670	670		<MDL,G		46
2,4-Dimethylphenol	29	29	**	<MDL,G		46
Pentachlorophenol	360	690		<MDL,E,G		46
Benzyl Alcohol	57	73		<MDL,G		46
Benzoic Acid	650	650		L	360	190
Arsenic, Total, ICP	57	93		<RDL	7.9	4.5
Cadmium, Total, ICP	5.1	6.7		<RDL	1.3	0.26
Chromium, Total, ICP	260	270			48.2	0.45
Copper, Total, ICP	390	390			65.7	0.36
Lead, Total, ICP	450	530			100	2.6
Mercury, Total, CVAA	0.41	0.59	**		0.68	0.03
Silver, Total, ICP	6.1	6.1			4.78	0.36
Zinc, Total, ICP	410	960			124	0.45

* exceeds SQS

* exceeds CSL

Table 4-6: Comparison of Low TOC Stations to LAET

Station Locator		L LTBC22		M LTBD23		S LTBD25		L LTBC22		L-1 LTBC22		L-2 LTBC22	
Date Sampled		Aug 06, 96		Aug 06, 96		Aug 27, 96		Aug 06, 96		Aug 06, 96		Sep 10, 96	
Depth Sampled		Top 2 cm		Top 2 cm		Top 2 cm		2-10 cm		Combined 0-10		Top 10 cm	
Sample Number		L9208-6		L9208-2		L9317-1		L9208-8		L9208-8		L9445-2	
% Solids		74.5		73.2		79.7		73.8		73.94		75.3	
% TOC		0.374		0.331		0.457		0.412		0.4044		0.254	
		Qual	Value	Qual	Value	Qual	Value	Qual	Value	Qual	Value	Qual	Value
ORGANICS (mg/kg dry weight)	LAET												
LPAHs													
Acenaphthylene	560	<MDL	21	<MDL	22	<MDL	20	<MDL	22	<MDL	22	<MDL	21
Acenaphthene	500	<MDL	15	<MDL	15	<MDL	14	<MDL	15	<MDL	15	<MDL	15
Fluorene	540	<MDL,G	21	<MDL,G	22	<MDL,G	20	<MDL,G	22	<MDL,G	22	<MDL,G	21
Phenanthrene	1500	G	98	G	180	G	38	G	47	G	58	G	64
Anthracene	960	G	55	G	61	<MDL,G	20	<MDL,G	22	G	29	G	47
Total LPAH	5200		210		290		110		130		150		170
HPAHs													
Fluoranthene	1700	G	200	G	290	G	120	G	100	G	120	G	170
Pyrene	2600	G	180	G	300	G	95	G	110	G	120	G	110
Benzo(a)anthracene	1300	G	95	G	150	G	38	G	59	G	66	G	97
Chrysene	1400		140		190		50.2		103		110		150
Total Benzofluoranthenes	3200		230		300		110		160		170		250
Benzo(a)pyrene	1600	G	130	G	150	<RDL,G	36	G	91	G	98	G	120
Indeno(1,2,3-C,D)Pyrene	600	G	74	G	80	<MDL,G	34	<RDL,G	41	G	47	<RDL,G	64
Dibenzo(a,h)anthracene	230	<MDL	58	<MDL	59	<MDL	54	<MDL	58	<MDL	58	<MDL,G	57
Benzo(g,h,i)perylene	670	G	77	G	73	<MDL,G	34	<RDL,G	47	G	53	<RDL,G	62
Total HPAH	12000		1200		1600		560		770		850		1100
Other BNA													
1,2-Dichlorobenzene	35	<MDL,G	0.93	<MDL,G	0.94	<MDL,G	0.87	<MDL,G	0.93	<MDL,G	0.93	<MDL,G	0.92
1,4-Dichlorobenzene	110	<MDL,G	0.93	<MDL,G	0.94	<MDL,G	0.87	<MDL,G	0.93	<MDL,G	0.93	<MDL,G	0.92
1,2,4-Trichlorobenzene													
Hexachlorobenzene	70	<MDL,G	0.93	<MDL,G	0.94	<MDL,G	0.87	<MDL,G	0.93	<MDL,G	0.93	<MDL,G	0.92
Dimethyl Phthalate	71	<MDL	15	<MDL	15	<RDL	19	<MDL	15	<MDL	15	<MDL	15
Diethyl Phthalate													
Di-N-Butyl Phthalate	1400	<MDL	36	<MDL	37	<MDL	34	<MDL	37	<MDL	37	<MDL,G	36
Benzyl Butyl Phthalate	63	<MDL	21	<RDL	30	<MDL	20	<MDL	22	<MDL	22	<MDL	21
Bis(2-Ethylhexyl)Phthalate	1900		120		120		330		110		110		81
Di-N-Octyl Phthalate		<MDL	21	<MDL	22	<MDL	20	<MDL	22	<MDL	22	<MDL	21
Benzyl Alcohol	57	<MDL,G	36	<MDL,G	37	<MDL	34	<MDL,G	37	<MDL,G	37	<MDL	36
Benzoic Acid	650	<MDL,L	150	L	480	<MDL	140	<MDL,L	150	<MDL,L	150	<MDL	150
Carbazole		<MDL	36	<MDL	37	<MDL	34	<MDL	37	<MDL	37	<MDL	36
Coprostanol			270		350	<MDL,E	140		290		290		240
Total PCB	130		51		54		48		54		53		51
4,4'-DDD		<MDL	1.7	<MDL	1.8	<MDL	1.6	<MDL	1.8	<MDL	1.8	<MDL	1.7
Endosulfan I		<MDL	1.7	<MDL	1.8	<MDL	1.6	<MDL	1.8	<MDL	1.8	<MDL,L	1.7
Volatiles													
Acetone		<RDL,B	700	<RDL,B	810	<RDL,B	460	<RDL,B	500	<RDL,B	540	<MDL,B	330
Methylene Chloride		<MDL	130	<MDL	140	<RDL,B	940	<MDL	140	<MDL	140	B	1300
METALS (mg/kg dry weight)													
Mercury, Total, CVAA	0.41	<RDL	0.064	<RDL	0.081	<RDL	0.066	<RDL	0.12	<RDL	0.11	<RDL,H	0.036
Antimony, Total, ICP	3.2	<MDL,G	2.0	<MDL,G	1.9	<MDL,G	2.0	<MDL,G	2.0	<MDL,G	2.0	<MDL,G	2.0
Arsenic, Total, ICP	85	<RDL	3.8	<RDL	6.4	<MDL	3.3	<RDL	3.7	<RDL	3.7	<RDL	4.0
Cadmium, Total, ICP	5.8	<MDL	0.20	<MDL	0.19	<RDL	0.23	<MDL	0.2	<MDL	0.2	<MDL	0.2
Chromium, Total, ICP	27		16		17		15		15		15		16
Copper, Total, ICP	310		16		16		19		15		15		13
Lead, Total, ICP	300		10		11		13	<RDL	9.6		9.7	<RDL	7.4
Nickel, Total, ICP	28		15		14		17		14		14		14
Silver, Total, ICP	5.2	<MDL	0.27	<MDL	0.26	<RDL	1.3	<MDL	0.26	<MDL	0.26	<MDL	0.27
Zinc, Total, ICP	260		54		53		45		55		54		51

* exceeds LAET

CHAPTER 5

SURFACE SEDIMENT TOXICITY

The Sediment Management Standards (SMS) use chemical criteria to assess the potential for a sediment to cause adverse biological effects. Biological testing, toxicity or bioassay testing, is used to confirm chemical designations of sediments (W.S.D.O.E., 1996a). Two Stations, K and L, had chemical exceedances of the CSL in 1994. It was decided at the Denny Way 5-year Monitoring Review Meeting that toxicity analyses would be conducted on samples from these two Stations in addition to chemistry analyses.

The purpose of this chapter is to provide a case summary consistent with Ecology requirements, consequently, this chapter will:

- summarize the testing methods,
- describe control and reference selection and performance, and
- compare test response to control/reference response and SMS values.

Summaries of the raw data, statistical analyses, statistical transformations and quality assurance review are provided at the end of this section. Other supporting documentation is available upon request.

METHODS

Two acute effects and one chronic effects tests were performed on two 10 cm deep test sediments, samples 9445-1 and 9445-2 from Stations K and L respectively. These tests were also performed on two reference sediments (samples 9446-1 and 9446-2) from Carr Inlet and two control sediments (Control A and Control B) from Whidbey Island.

The three toxicity tests performed were:

- *Rhepoxynius abronius* - amphipod 10-day mortality (acute test),
- *Dendraster excentricus* - echinoderm embryo mortality/abnormality (acute test),
- *Neanthes arenaceodentata* - juvenile polychaete 20-day growth rate (chronic test).

These species were selected based on sediment and organism characteristics, including sediment grain size and organism availability. MEC Analytical Systems Inc. of Carlsbad, California performed toxicity analyses. The King County Environmental Laboratory (KCEL) collected both test and reference sediment samples. The consultant laboratory either collected or purchased test animals and the control sediment samples. The MEC Analytical Systems testing protocols (#P014.1, #P024.1, and #P042.0) follow procedures established by the EPA and Ecology in effect at the time of sampling. Deviations from the protocol and other problems are noted in the quality assurance review at the end of this section.

All larval echinoderm results in this chapter have been seawater normalized by KCEL, per PSEP guidance. Values in the MEC report were not seawater normalized.

The Denny Way samples were collected at the same time and tested in the same batch as King County samples from the Duwamish River and the Seattle waterfront. Sampling and Analysis Plans were prepared for the river and waterfront projects (King County, 1996b; Seattle, 1996). Consequently, throughout this document sample numbers and data may be found that do not correspond to this project; in the interest of completeness and clarity the information is not deleted.

CONTROL AND REFERENCE SEDIMENT PERFORMANCE AND SELECTION

Negative and Positive Controls

Two types of control tests were performed – negative and positive. Negative controls determine whether the organisms have an adverse response to clean sediments or water. Positive controls use a range of concentrations of reference toxicants to determine whether a specific batch of organisms are more or less sensitive than normal to contaminant exposure.

Negative controls are clean sediment samples for the amphipod and juvenile polychaete tests and clean seawater for the echinoderm test. Sediment negative controls were performed for the echinoderm test but, in conformance with the SMS, the results were not used for statistical comparisons. Two negative control samples were tested, Control A and Control B. Both were from the West Beach of Whidbey Island.

Table 5-1 Negative Control Performance[1]

	Amphipod *Rhepoxynius abronius*	Larval Echinoderm *Dendraster excentricus*	Juvenile Polychaete *Neanthes arenaceodentata*	
Performance Standard	Mortality <10%	Effective mortality <30%	Mortality <10%	Mean IGR[2] > 0.72 mg/ind/day
Control A	3%	23.4%	0%	0.81 mg/ind/day
Control B	1%	5.9%	0%	0.77 mg/ind/day
Seawater		10.0%		

[1] Seawater is used as the negative control for the larval echinoderm test. The Control A and Control B results are not used for statistical comparison purposes. They are provided as information only.
[2] IGR-Individual Growth Rate

Table 5-2: Postive Control Performance

Organism	Amphipod *Rhepoxynius abronius*	Larval Echinoderm *Dendraster excentricus*	Juvenile Polychaete *Neanthes arenaceodentata*
Criteria	LC50 = 0.79 +/- 0.48 mg/L cadmium	EC50 = 10.1 +/- 6.5 mg/L cadmium	LC50 = 12.5 +/- 5.4 mg/L cadmium
Positive Control Test Results	0.68 mg/L cadmium Pass	6.20 mg/L cadmium Pass	8.44 mg/L cadmium Pass

The negative controls must meet certain performance standards for the test sediment comparison to be valid under the SMS. These performance standards are found in Figure 5-1 on the next page.

A secondary PSEP protocol endpoint for the amphipod test is failure to rebury. Control A had a higher percentage (9 $\pm$ 2%) failing to rebury than Control B (1 $\pm$ 2%). In addition, Control A had one replicate with a mortality of 10%. While this is within the PSEP individual replicate limit of 20%, Control B is the preferred control sediment for the amphipod test.

Both negative controls met the performance standards, but Control B performed better overall. Staff from Ecology and the KCEL agreed that Control B should be used for statistical comparisons for all three tests.

Positive controls use a dilution series of a known toxicant to determine a lethal concentration. The toxicant used by MEC was cadmium chloride. All positive control test results were within ranges specified in the July 1995 revision of the PSEP protocols, which references data from the Army Corps of Engineers database.

Reference Sediments

Physical and chemical characteristics (e.g., grain size, interstitial salinity) may have adverse effects on organisms unrelated to the toxicants within test sediments. Reference sediments (nontoxic sediments with characteristics similar to the test sediments) are collected to separate these effects from toxicity effects. Two reference sediments were collected from Carr Inlet in south Puget Sound. Interstitial salinity was tested and found comparable between test and reference sediments.

Table 5-3 Reference Sediment Performance

Organism	Amphipod *Rhepoxynius abronius*	Larval Echinoderm *Dendraster excentricus*	Juvenile Polychaete *Neanthes arenaceodentata*
Performance Criteria	Mortality < 25%	Effective mortality <35%, w/o high variability	Mean IGR > 80% of control mean IGR
9446-1	Mortality = 6 +/- 8.9%	Effective mortality = 19.1 +/- 27.5%	Mean IGR = 62% of control mean IGR
Result	Acceptable	Conditional	Failed

One of the reference samples is not comparable to the test sediments, as it was chosen to be comparable to test sediments from other King County projects. This reference sample (9446-2) had 55% fines; too high for comparison to the cap sands.

Reference sample 9446-1 had 21% fines, comparable to sample 9445-1 from Station K (LTBC21) with 18% fines. Sample 9445-2 from Station L (LTBC22) contained 4% fines. This sample is comparable to Control B from the West Beach of Whidbey Island, which is where the bioassay test amphipods are collected, and has been sampled many times in the past by the US Army Corps of Engineers. West Beach sands are known to contain approximately 5% fines (King County, 1997).

Reference sediments must meet certain performance standards, as described in the following table. The reference sediment 9446-1 failed SMS performance criteria for the juvenile polychaete test and high variability was measured among the five replicates of the larval echinoderm test. Therefore, reference sediment 9446-1 was rejected and all test sediments will be compared directly to Control B.

Table 5-4 Summary of Bioassay Results

Station	Reference Match	Amphipod *Rhepoxynius abronius* Mean Mortality (%)	Amphipod SMS Status	Larval Echinoderm *Dendraster excentricus* Mortality/ Abnormality (%)	Larval Echinoderm SMS Status	Juvenile Polychaete *Neanthes arenaceodentata* Individual Growth Rate (mg/day)	Juvenile Polychaete SMS Status
K (LTBC21)	Control B	6	Pass	11.5	Pass	0.66	Pass
L (LTBC22)	Control B	10	Pass	36.4	>CSL	0.57	Pass
Control B		1		5.9		0.77	
Seawater				10			

RESULTS

Summary

The sample from Station L exceeds the CSL for the larval echinoderm test and passes the other two tests. The sample from Station K passes all three tests. These biological test results contradict the toxicity predicted by the chemistry results.

The sample from Station L did not exceed the SQS or CSL for any chemical parameter. A field replicate from Station L did exceed the SQS for benzyl butyl phthalate but no chemical parameter exceeded the CSL. The sample from Station K exceeded the chemical CSL for bis(2-ethylhexyl)phthalate and the SQS for benzyl butyl phthalate.

There is no apparent explanation for why Station L had a CSL exceedance for the echinoderm bioassay when there was no corresponding exceedances of the chemical criteria. Deviations from the larval echinoderm protocols for holding time and temperature affected all samples. No deviations from the protocol specific to the sample from Station L were noted. Unionized ammonia and sulfide concentrations in the test sediments were acceptable.

The lack of a toxic bioassay response at Station K is less surprising since the principal chemicals that exceed the SMS values at Station K are bis(2-ethylhexyl)phthalate and benzyl butyl phthalate, which have not always produce toxicity at concentrations greater that the SQS or CLS limits at other locations.

At the Duwamish and Diagonal CSO sediment remediation investigations, the four bioassay stations (201, 202, 203, 204) gave conflicted results when sediment chemistry was compared to bioassay response. No toxicity was found in the suite of three bioassay tests (amphipod, echinoderm larvae, and polychaete) that were performed at Stations 201, 202, and 203 even though the concentration of bis (2-ethylhexyl) phthalate exceeded the CSL value at station 202 and the SQS value at 201 and 203. However, at Station 204, the amphipod bioassay exceeded the SQS criteria, while the chemistry data exceeded the CSL for both bis (2-ethylhexyl) phthalate and 4-methylphenol and the SQS for both benzyl butyl phthalate and total PCB (King County, 1997).

These results for both the Denny Way and the Duwamish/Diagonal sites suggest that both bis(2-

ethylhexyl) phthalate and butyl benzyl phthalate have a less predictable toxic response at concentrations that exceed the SMS standards. It appears that more work is needed to clarify the environmental significance of high phthalate concentrations in sediments. Phthalates have become ubiquitous chemicals in urban waterways so it is important that standards are sufficently protective, but not unreasonably overprotective.

CHAPTER 6:

BENTHIC RECOLONIZATION

In August 1996, a KCWLRD research team collected sediment samples for benthic analysis from the surface of the cap, from an intertidal Station inshore of the cap, and a reference Station. This section reports the methods and results of the benthic taxonomy study. Complete data for the benthic taxonomy samples are included in Appendix E.

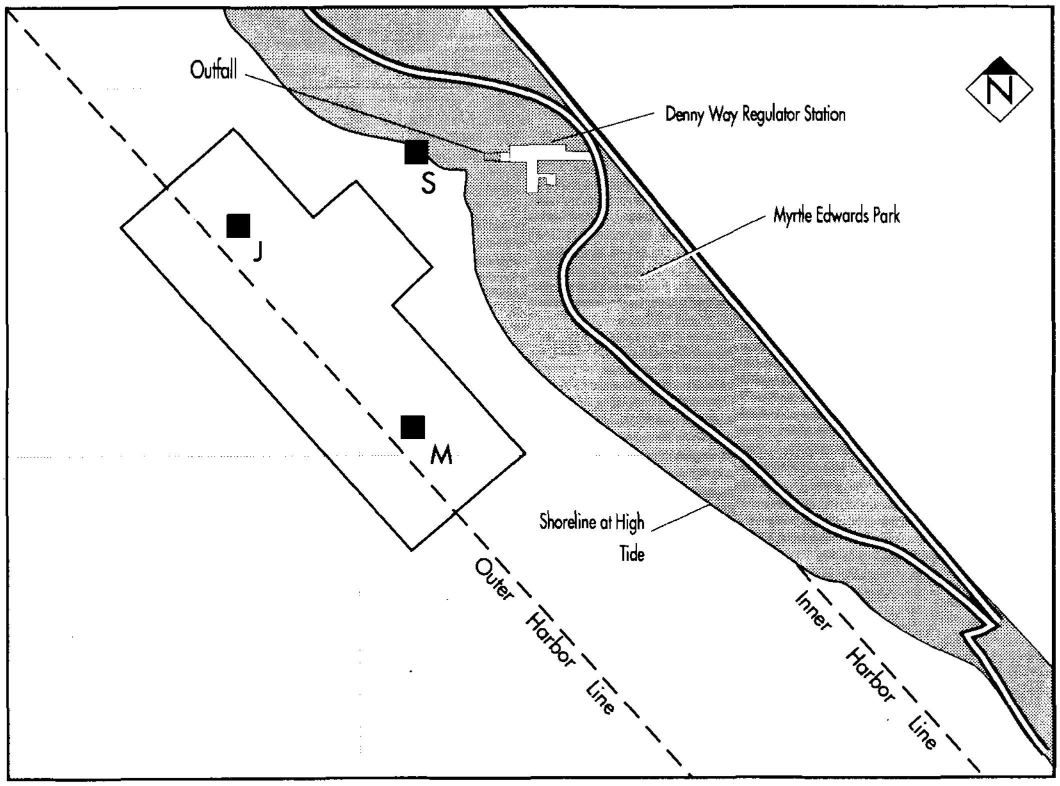


Figure 6-1, Benthic Sampling Stations

METHODS

Benthic taxonomy samples were taken at two on-cap Stations: J, at the north end of the cap, and M, at the south end, and one off-cap Station:'S in the intertidal zone inshore of the cap (Figure 6-1). Five replicate samples were taken at each Station.

In 1996, a benthic taxonomic reference Station was sampled for the first time for comparisons with the Denny Way benthic Stations on the sediment cap. The reference Station was located just offshore of Richmond Beach. Reference Stations are used to represent background or undisturbed conditions for comparison to the Stations in the areas being studied. In addition, reference Stations allow a comparison to the SMS (WDOE, 1991).

The reference Station was chosen from a list of several potential reference Stations that were studied as part of the Puget Sound Ambient Monitoring Program (WDOE, 1990). These potential reference Stations were analyzed for chemical and physical parameters, sediment toxicity, benthic community, and whether the sediment had been anthropogenically altered. If a Station was deemed acceptable in all of these categories, it was listed as a potential reference Station.

A reference Station for Denny Way was chosen from this list with the further criteria that sediment grain size, water depth, total organic carbon content of the sediment, and the general geographic area were similar to the Denny Way sediment cap. Based on this, the Richmond Beach Station was determined to be the most suitable as a reference.

During sampling at Richmond Beach, a field test of the sediment at the Station was conducted to estimate percent fines to further aid in determining the suitability of the Station as a reference for the Denny Way cap. The percent fines were estimated by the standard wet sieving process using a 63μm standard sieve. A known quantity of the sampled sediment was placed in the sieve, the fines were then washed through the screen using water from a hose. The sediment that was retained on the screen was weighed and the percentage of the fines were calculated.

Subtidal benthic taxonomy samples were collected using a 0.1-m^2 Van Veen grab sampler operated from the *RV Liberty.* Five replicate samples were taken at each Station. Samples were screened onboard by Fukuyama and Hironaka Taxonomic and Environmental Services. When a sample was collected and brought onboard, the sampler was set into a screening tray. The sediment sample thickness was measured to ensure a minimum depth penetration of 10 cm. If a sample was acceptable, it was emptied into the screening tray where fine material was carefully washed through the 1-mm mesh screen with water from a hose. Each sample was screened to remove as much sediment and debris as possible. Material retained in the screen was put into a jar, labeled with the Station name and replicate number, and preserved with buffered formalin. The sample was transferred at least a week later from formalin to alcohol. Taxonomic analysis was conducted by Marine Taxonomic Services.

Intertidal benthic taxonomic samples were collected at Station S during low tide while the Station was above water. Permanent beach markers were used for location. A 0.1 m^2 sample 10-cm deep was measured using a stainless steel ruler and collected using a stainless steel spoon. Screening and taxonomic analysis was the same as subtidal samples.

Some taxonomic names have changed since the last time the remediation area was sampled in 1994. When comparing 1996 data to previous studies, the new name is used and the old one is noted. Additionally, *Leptochelia savignyi* and *Leptochelia dubia* have been shown to be the same species with confusion as to which name is the more senior (Ishimaru, 1985). For analytical purposes in this report, we will only refer to the genus *Leptochelia.*

RESULTS

In 1996, 2,556 individual organisms were collected from J and M on the Denny Way cap, averaging 256 organisms per replicate sample. The total number of organisms decreased by 55 percent from 5,683 in 1994. 1,614 organisms were counted at J, which was a decrease of 58 percent from the 3,860 counted in 1994. At M, 942 organisms were counted, which was a decrease of 48 percent from the 1,823 counted in 1994 (Table 6-1).

Table 6-1, Total Abundance, and Total Species found on the Denny Way Cap

Abundances				
Annual Totals	J	M	Total	Reference
1990	1511	2349	3860	
1991	2620	3150	5770	
1992	4092	4276	8368	
1994	3860	1823	5683	
1996	1614	942	2556	2066
Number of Taxa Identifiable to Species				
Annual Totals	J	M	Total	Reference
1990	92	117	138	
1991	121	131	159	
1992	112	132	160	
1994	141	151	200	
1996	126	119	164	156

Table 6-2: Station S, Abundance, Taxa and Biomass

Group	Abundance	Number of Taxa	Biomass (grams)
Polychaetes	1836	27	1.87
Mollusks	106	15	0.67
Crustaceans	815	19	1.1
Miscellaneous	386	4	0.0612
Totals	3143	65	3.7012

Table 6-3: Dominant Species at Station S

Taxa	Average Number of Individuals	% of Population	% Total
Capitella capitata 'hyperspecies'	334	57.4	57.4
Nemertinea sp.	75.6	13	70.4
Solidobalanus hesperius	61.4	10.5	80.9
Desdimelita californica	19.8	3.4	84.3
Leptochelia dubia	17	2.92	87.2
Cirratulus robustus	15	2.58	89.8

Overall, 164 species were counted in 1996, which also was a decrease from the 200 species counted in 1994. The number of polychaete species decreased at both Stations. Mollusks decreased at J by five species but remained roughly the same at M, and crustacean species remained the same at J, but decreased by 14 species at M. At the reference Station, a total of 2066 individuals were counted, averaging 413 per replicate and 156 species were counted.

At the intertidal Station S, 2910 individual were counted, averaging 582 per sample. In addition, 65 species were identified (Table 6-2). Because S is from an intertidal beach, it is not directly compared to the subtidal Stations on the cap or to the reference Station. The community at S is dominated by *Capitella capitata 'hyperspecies'* (Table 6-3). In addition, only three species make up over

Table 6-4: Dominant Species

Station J 1996, 12 dominant species	Average number of individuals	% of population
Parvalucina tenuisculpta	66.6	20.6
Axinopsida serricata	46.4	14.4
Euphilomedes carcharodonta	37	11.5
Lumbrineridae sp. Indet.	26	8.05
Prionospio jubata	19.2	5.95
Aphelochaeta sp. N-1	9.8	3.04
Spiochaetopterus costarum	9.4	2.91
Nephtys ferruginea	7.6	2.35
Leitoscoloplos pugettensis	6.8	2.11
Nephtys cornuta	6	1.86
Macoma sp. Juv.	4.6	1.43
Mediomastus sp. Indet.	4	1.24
Total Percentage of Dominant Species		**75.4**
Station M 1996, 22 Dominant Species		
Euphilomedes carcharodonta	28.2	15
Parvilucina tenuisculpta	24	12.7
Axinopsida serricata	19.4	10.3
Lumbrineridae sp. Indet.	10.4	5.52
Prionospio jubata	10.2	5.41
Aphelochaeta sp. N-1	6	3.18
Mediomastus sp. Indet.	5	2.65
Leitoscoloplos pugettensis	4.6	2.44
Exogone lourei	4	2.12
Nephtys ferruginea	3.4	1.8
Lumbrineris limicola	3.2	1.7
Psephidia lordi	2.8	1.49
Spiochaetopterus costarum	2.4	1.27
Aphelochaeta sp. Indet.	2.4	1.27
Macoma yoldiformis	2.4	1.27
Caulleriella pacifica	2	1.06
Ehlersia heterochaeta	2	1.06
Eumida longicornuta	2	1.06
Astyris gausapata	1.8	0.955
Macoma sp. Juv.	1.8	0.955
Cancer gracilis	1.8	0.955
Diopatra ornata	1.8	0.955
Total Percentage of Dominant Species		**75.1**

80 percent of the total population. This appears to show that the CSO is having an effect on the benthic community in the intertidal area in front of the outfall.

Table 6-5: Biomass Average per Station

Group	Station J 1996	Station J 1994	Station M 1996	Station M 1994	Reference
Polychaetes	1.42	4.45	1.01	2.5	0.654
Mollusks	2.21	3.2	0.747	1.37	2.38
Crustaceans	0.145	0.63	0.238	0.436	0.742
Miscellaneous	0.046	1.63	0.0516	0.0354	7.30
Totals	3.821	9.87	2.0466	4.34	*11.1

Average of 5 replicates per 0.1 m^2 *5.99 reference average without high miscellaneous replicate.

Numerically Dominant Species

Both Stations on the Denny Way cap contained many of the same species. The numerically dominant species at both Stations were a diverse group and included the ostracod crustacean *Euphilomedes carcharodonta*, the deposit feeding mollusks *Parvilucina tenuisculpta* and *Axinopsida serricata*. Dominant polychaetes included the motile carnivore or subsurface deposit feeding Lumbrineridae, the surface deposit feeding *Prionospio jubata* (formerly *Prionospio steenstirupi*) and *Aphelochaeta sp. N-1* (formerly *Aphelochaeta multifilis*), the tube-dwelling pumping filter feeder or tenticulate deposit feeder *Spiochaetopterus costarum*, the motile predators *Nephtys ferruginea* and *Nephtys cornuta*, and the deposit feeders *Lietoscoloplos pugettensis* and *Mediomastus sp.*(Table 6-4).

Biomass

Overall, biomass decreased at both Stations from 1994 (Table 6-5). In addition, each major taxonomic group decreased in biomass from 1994. The decrease in biomass was probably the result of the decrease in abundance. The decrease in polychaete biomass was in a large part probably the result of the decrease in *Exogone lourei*, a motile surface deposit feeder that can also feed as a carnivore as the opportunity arises (Fauchald and Jumars 1979). In 1994 *E. Lourei* was dominant but decreased significantly in 1996 and was no longer dominant. Other polychaetes that decreased significantly from 1994 to 1996 included *Pectinaria granulata* and *Scoletoma luti. Spiochaetopterus costarum* and *Nephtys ferruginea* decreased but remained among the dominant species.

Mollusk biomass decreased at both Stations, although the decrease was not as great as other major taxonomic groups. Mollusks are now the taxonomic group with the highest biomass when both stations are combined. *Astrysis gausapata* (formerly *Nitidella gouldi*), a predator, was dominant in 1994, but decreased in 1996 and was no longer dominant. *Axinopsida serricata* and *Parvilucina tenuisculpta* both decreased numerically in 1996 but both made up a greater percentage of the population.

The decrease in crustacean biomass was probably caused mostly by the decrease of the tube-dwelling predator *Leptochelia.* At J, crustaceans decreased in percentage of the total biomass since 1994, but remained roughly the same at M.

Table 6-6: Comparisons to Reference Station and Puget Sound Reference Values

Benthic Endpoint	Station J	Station M	Richmond Beach Reference	Significantly Different? Station J	Significantly Different? Station M	Puget Sound Reference Value Ranges (RVR)
Average Polychaete Abundance*	135	84	65+	Y	N	72 -322
Average Mollusk Abundance*	54	43	45	N	N	26 - 150
Average Crustacean Abundance*	131	58	295+	Y	Y	43 - 198
Average Total Abundance*	323	188+	413	N	Y	295 - 983
Average Polychaete Taxa	34	31	28	N	N	21 - 47
Average Mollusk Taxa	10	10	13	N	N	12 - 21
Average Crustacean Taxa	11	9	22+	N	Y	8 -17
Average Total Taxa	57	53	67	N	N	47 - 90
Total Biomass (grams)	3.82	2.04	5.5512	N	Y	Not an endpoint
Shannon-Wiener's Diversity Index	4.22	4.73	3.36+			3.72 - 5.22 **
Pielou's Evenness Index	0.73	0.83	0.55+			0.65 - 0.83
Swartz's Dominance Index	12	22	15			6.8 - 21.6
% fines	11.5	8.6	5.4			0 - 20

* SMS Endpoints, ** Diversity index converted to Log base 2, + Value outside Puget Sound Reference Value Range.

Comparisons to the Reference Station and the Reference Value Ranges for Puget Sound

For comparing abundance and number of taxa, the average of the five replicates was used for each Station. Comparisons were made between the cap Stations, the Richmond Beach reference Station, and the Reference Value Ranges (RVR) for Benthic Infauna Assessment Endpoints in Puget Sound (WDOE, 1996). The RVR is a compilation of chemical and biological data that was used to calculate benthic community reference values that are representative of a variety of uncontaminated Puget Sound soft bottom habitats (WDOE, 1996). Comparisons are shown in Table 6-6.

A t-test was used to determine whether a significant difference existed between the on-cap Stations (test Stations) and the reference Station for the benthic endpoints listed. The SMS endpoints are also listed. The SMS endpoints compare polychaete, mollusk, crustacean, and total abundance from a test Station to a suitable reference Station. If one of these endpoints is significantly lower ($p=.05$) at the test Station than the reference Station, then the test Station fails the SQS comparison.

If a test Station is significantly lower for two of these endpoints, then the test Station fails the CSL comparison.

For the Shannon-Weiner diversity index, log base 2 was used. This endpoint for the RVR was converted from log base 10 to log base 2 for comparisons using a multiplication factor (Zar, 1984).

- For average polychaete abundance, both J and M were higher than the reference Station and J was significantly higher. In addition, the reference Station was below the RVR, causing doubt about the suitability of the reference Station for this endpoint.
- For molluskan abundance, neither J nor M were significantly different than the reference Station, and all three Stations were within the RVR.
- For crustacean abundance, both J and M were significantly lower than the reference Station. According to the SMS, this is an SQS failure. However, the reference Station was much higher than the RVR, causing doubt about the suitability of the reference Station for this endpoint. Both J and M were within the RVR for this endpoint.
- For total abundance, M was significantly lower than the reference Station, causing an SQS failure for this endpoint. M was also lower than the RVR. J was not significantly different from the reference Station and was within the RVR.
- For average number of molluskan taxa, J and M were not significantly different than the reference, but both were below the RVR.
- For average number of crustacean taxa, J and M were lower than the reference Station and M was significantly lower. However, both J and M were within the RVR. In addition, the reference Station was 30 percent higher than the RVR.
- Biomass was lower at both J and M than the reference Station, and M was significantly lower.
- The diversity and evenness indexes were both higher at J and M than at the reference Station. In addition, both of these indexes were lower at the reference Station than the RVR.
- The dominance index was highest at M, lowest at J and the reference Station was in between. The reference Station and J were within the RVR, while M was slightly higher than the RVR.

The comparisons of polychaete and crustacean abundance and taxa show that the benthic community is quite different between the cap Stations and the reference Station. The reference Station is dominated by crustaceans whereas the cap Stations are mostly comprised of polychaetes. The lower diversity and evenness indexes at the reference Station reflect that *Euphilomedes carcharodonta* makes up over 55 percent of the benthic population. In contrast, the most dominant species at M makes up 15 percent of the population, and the most dominant species at L makes up 20 percent. The evenness index is most affected by this situation. It is theorized in habitats with no pollution or environmental stress, evenness numbers should approach 1.0 where no one species dominates the benthic community and abundance are distributed evenly among many species.

A previous study did not detect contamination at the reference Station (WDOE, 1990). It is not likely that the reference station benthic community is stressed by the presence of toxicants as evidenced by most benthic parameters and the presence at the Station of sensitive taxa that are intolerant of organic pollution. The dominance of crustaceans is more likely a function of the Station's geographical location and its grain-size makeup. The low percentage of fines (5.4 percent) indicated an erosive environment where water currents do not allow fine material to settle. The lack of fine material apparently favors crustaceans and not polychaetes.

Locating a suitable reference Station for the study caused some difficulty. The native bottom in the Denny Way area is composed of mostly fine-grain muds. The cap, however, is composed of mostly medium-grain sands. Studies have determined that the makeup of a benthic community is mostly dependent on grain size (WDOE, 1990) but geographic location also plays a role. Larval recruitment onto the cap is most likely to come first from nearby fine-grain areas surrounding the cap. Over time, the sandy conditions on the cap would favor organisms that are suited to sandy areas. At the same time, deposition is continually making the cap grain-size finer. An environment where sand is the predominant grain size means that currents are eroding the finer particles that would otherwise settle on the bottom. These currents have an additional effect on the type of benthic community that would develop in the area. The Denny Way cap is unique in that it contains coarse sediments in a depositional area where there are no strong currents or other attributes associated with a coarse-grain area. The continual dynamics of shifting grain size on the cap made it difficult to duplicate exact conditions for a reference Station.

DISCUSSION

Decreases in abundance were apparent at both Stations on the cap. All major taxonomic groups decreased from 1994 to 1996. In addition, all major taxonomic groups decreased in biomass from 1994 to 1996. The decreases were probably the result of changes in sediment parameters. However, the number of species did not decline to the same degree as abundance. The Shannon-Weiner diversity index and Swartz's dominance index showed that the diversity of the benthic community has remained stable (either decreasing or increasing slightly). Pielou's evenness index (from Valiela 1984) has also been increasing, showing that the benthic community is not being dominated by a few species but by even abundance of many species (Table 6-7).

The decreases in abundance do not necessarily mean that the overall health of the benthic community on the cap has declined, especially since diversity has remained high. It has been shown that stable and undisturbed benthic communities are characterized by greater numbers of species, higher biomass, and lower number of individuals than areas that have been enriched organically or recently disturbed (e.g. capping) (Pearson and Rosenberg, 1978). If the overall health of the benthic community on the cap were declining, one would expect a decrease in diversity. Because the diversity of the cap has remained high, the decreases in abundance appear to correspond to changes in physical parameters of the sediment and the dynamics of an evolving benthic community.

Possible reasons for the decline in abundance include grain size change, increased predation, decrease in available food, chemical toxicity, and for some species such as *Leptochelia,* inherent population variability.

Table 6-7: Benthic Indices, 1990 to 1996

Station J Indices	1990	1991	1992	1994	1996
Average Shannon-Wiener	3.03	4.71	3.88	4.62	4.22
standard deviation	1.43	0.10	0.36	0.22	0.41
Average Evenness	0.55	0.79	0.65	0.74	0.73
standard deviation	0.26	0.03	0.05	0.03	0.07
Number of Dominant Species	10	16	10	15	12
Individuals					
Average Percent Composition					
Polychaetes	36.27	68.11	36.93	46.52	47.60
Crustaceans	6.07	18.30	43.35	21.60	16.57
Mollusks	56.15	12.66	18.80	31.30	34.70
Misc.	1.51	0.93	0.92	0.58	1.12
Species					
Average Percent Composition					
Polychaetes	61.85	61.46	61.52	58.66	59.58
Crustaceans	14.39	16.89	14.95	17.93	17.88
Mollusks	19.74	18.90	18.65	20.47	18.27
Misc.	4.02	2.75	4.88	2.94	4.27
Station M Indices	**1990**	**1991**	**1992**	**1994**	**1996**
Average Shannon-Wiener	4.09	4.82	3.95	4.96	4.73
standard deviation	0.24	0.12	0.31	0.26	0.21
Average Evenness	0.69	0.77	0.65	0.81	0.83
standard deviation	0.03	0.01	0.06	0.04	0.03
Number of Dominant Species	16	18	9	21	22
Individuals					
Average Percent Composition					
Polychaetes	41.02	62.72	40.18	46.28	44.53
Crustaceans	4.75	24.67	41.89	28.75	22.29
Mollusks	52.47	12.04	17.62	23.20	31.70
Misc.	1.76	0.57	0.31	1.78	1.49
Species					
Average Percent Composition					
Polychaetes	61.73	60.25	60.98	52.50	59.16
Crustaceans	9.57	16.98	16.39	22.98	17.27
Mollusks	25.26	19.72	20.43	20.07	19.83
Misc.	3.44	3.04	2.21	4.45	3.74

Population Variability

The population of the tube-dwelling tanaid crustacean *Leptochelia* plummeted between 1994 and 1996. *Leptochelia's* population have been previously shown to be highly variable (Mendoza 1982). *Leptochelia's* population variability has also been apparent at the Denny Way cap. *Leptochelia* was not present on the cap in 1990 or 1991. However, in 1992 *Leptochelia* became the second most abundant species at J and the third most abundant at M. In 1994, *Leptochelia* was still dominant but had declined by almost 65 percent. The reasons for the variability are not clear but one possibility includes increased predation.

Predation

Shadowing the rise of abundance of the tube-dwelling *Leptochelia* on the Denny Way Sediment Cap are the crabs of the genus *Cancer.* These motile predators have been shown to significantly alter benthic communities (Shimek, 1983) and to possibly prey selectively on tube-dwelling species and favor burrowing organisms (Woodin, 1974). The species *Cancer magister, Cancer gracilis,* and *Cancer productus* have all been present on the cap. In addition, Crangonid shrimp (*Crangon sp.*), which are also present on the cap, have also been shown to be an opportunistic predators and important to the structure of benthic communities (Wahle, 1985). The *Crangon alaskensis* population has increased or remained stable since capping. Further evidence that predators may be altering the benthic community by selecting out the tube-dwelling species like *Leptochelia.* Such selection favors burrowing organisms like *Parvilucina tenuisculpta* and *Axinopsida serricata*, both burrowing clams. Consequently, the clams have become among the top three dominant species on the cap. Predation by both *Cancer* and *Crangon* could be a factor effecting the change in dominant species. However, other tube dwelling species have not reacted in quite the same way as *Leptochelia.* In addition, other predators such as *Exogone lourei, Astrysis gausapata, Nephtys ferruginea,* and *Nephtys cornuta* have decreased. This suggests that as abundance has decreased, the competition among predators has increased and the better adapted preda-

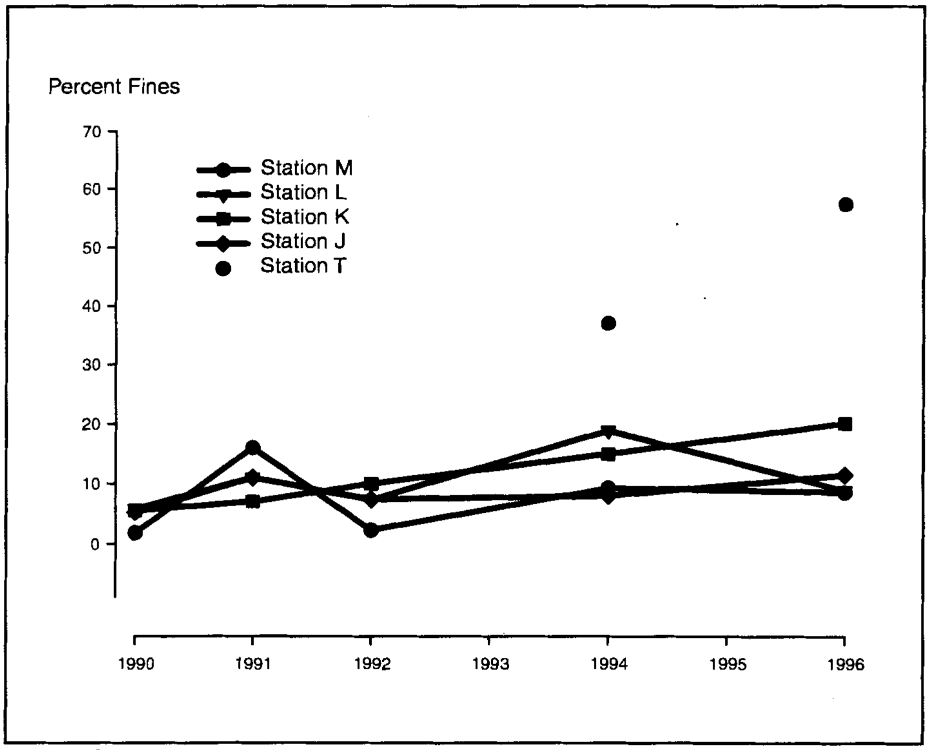


Figure 6-2: Percent Fines on and adjacent to the Denny Way Cap

tors have out competed lesser adapted predators. The extent of *Cancer* and *Crangon's* effect on the benthic community of the sediment cap remains to be determined.

Chemical Contamination

The Denny Way CSO remains one of the largest CSOs in the Puget Sound. Because the construction project to control the overflows at the Denny Way CSO is not scheduled to be completed until after the year 2000, chemical contamination continues to increase on the cap. However, the rate of recontamination has been gradual and most chemicals and metals remain well below the SQS. One chemical, butyl benzyl phthalate, exceeded the SQS at both J and M in 1996. The effect of butyl benzyl phthalate on the benthic communities at J and M is not known. However, butyl benzyl phthalate narrowly exceeded the SQS. Significant chronic effects on the benthic community from chemical concentrations above the SQS have not become apparent yet. If chemicals continue to increase beyond the SQS in the future, it is expected that the diversity of the benthic community will begin to decline.

Grain Size

Another possible reason for the decline in abundance and the change in dominant species is the decrease in the grain-size makeup of the cap since it was placed. This change is occurring because the sand cap is being covered by fine grain sediment from the sedimentation processes present along the waterfront and from the Denny Way CSO. Eventually, sedimentation will cause the cap to become more like the native bottom muds. The percentage of fines at J has increased from 5.18 percent in 1990 to 11.5 percent in 1996. At M, fines have increased from 1.76 percent in 1990 to 8.6 percent in 1996.

Grain size is important to *Leptochelia's* tube building activities. The fastest rate of tube building for *Leptochelia* has been observed in a substrate grain size of 0.250-0.177 mm or medium sands (Mendoza, 1982). Before the cap was placed, samples taken near the CSO showed that *Leptochelia* was present but was not dominant (Armstrong, et al., 1979). It is possible that the sand cap temporarily favored *Leptochelia* but the changing grain size caused the population of this tanaid to revert to it's former numbers. Exogone has also been associated with coarser sediments (Comiskey, et al. 1984). The increasing percentage of fine-grain sediments accumulating on the cap may inhibit the feeding habits of *E. lourei*.

At the same time, *Parvilucina tenuisculpta* has increased to become the most dominant species, comprising over 15 percent of the total population in 1996. *Axinopsida serricata* has steadily increased as a percent of the population since capping. Both of these species have been associated with fine-grain sediments in Puget Sound (Comiskey, et al., 1984; Word, et al., 1984). It is likely that because the cap is becoming finer grained, species that were favored by the coarser sand cap will be replaced by species that are favored by fine-grained sediment. Species such as *P. tenuisculpta* and *A. serricata* are increasing in dominance and will likely continue to dominate in the future.

Total Organic Carbon

One of the more probable reasons for the decline in abundance is the decline in the available food source in the sediments as measured in total organic carbon (TOC). TOC increased the first two years after capping and was at its highest level in 1992, which corresponds to the highest abundance recorded on the cap. TOC then decreased in 1994 and again in 1996 and, in the case of J, was lower in 1996 than the baseline measurements taken five months after capping. Between 1990 and 1996, an inverse relation with diversity developed: when abundance and TOC were at their highest, diversity, evenness, and dominance were all at or near the lowest recorded levels.

Organic enrichment has been shown to result in increased abundance and decreased diversity and that fluctuations in organic input may be considered to be one of the principal causes of faunal change in nearshore benthic environments (Pearson and Rosenberg, 1978). There are two predominant sources of TOC on the cap, one is the Denny Way CSO, and the other is the kelp growing on and adjacent to the cap.

CSO volumes were at the highest point in 1990, and nearly as high again in 1996, with the intervening period having lower flows. A low point was reached in 1992 when 334 million gallons were released (Table 6-8).

With the exception of 1992, the TOC in the sediments on the cap has not greatly changed over the years. One of the lowest overflow volumes recorded during this time was 1992, the year of the highest TOC in the sediments. It is not exactly clear why a high TOC would correspond with low CSO volumes. In years with lower rainfall, the overflow volumes might be more concentrated. In addition to higher organic carbon concentrations, dry year overflows may have less water to disperse organic material into the receiving waters. Although the trend is apparent, it is difficult to discern why there is an apparent inverse relationship between TOC in the sediments and CSO discharge.

Table 6-8: Denny Way CSO Volumes Compared to TOC, 1990 to 1996

Water Year	1990	1991	1992	1994	1996
CSO Volume (In Millions of Gallons)	666	417	334	379	581
% TOC, Station J	1.2	.81	2.5	.307	.903
% TOC, Station K	.97	.52	2.8	1.14	1.4
% TOC, Station L	.63	.78	3.7	.703	.374
% TOC, Station M	.13	.69	1.3	.55	.331

CHAPTER 7

CONCLUSIONS

Specific conclusions from the 1996 monitoring are as follows:

- Station K, closest to the outfall, has the highest level of contamination, the highest TOC, and the highest percentage of fines. Station K is the only station to exceed the SMS in this sampling period. Two phthalates exceed the SMS: benzyl butyl phthalate which exceeds the SQS, and bis(2-ethylhexyl) phthalate, which exceeds the CSL. Indeno(1,2,3-Cd)pyrene, benzo(g,h,i)perylene, and mercury are at or just less than half the SQS, all other contaminant organics and metals are typically one third of the SQS or less in concentration.

- Station T, which is located north of the cap on older historic sediments, has higher levels of contamination than any area on the cap, except for the phthalates at Station K. At Station T, total PCBs, benzyl butyl phthalate, and bis(2-ethylhexyl) phthalate continued to exceed the SQS. Mercury exceeded the CSL at this location and exceeds the sampling done in 1994, however, the difference can be accounted for in normal spatial and analytical varibility in sediment sampling. Silver is additionally within 70% of the SQS, typically the remaining organics and metals are one third of the SQS at this location.

- The cap appears to have been moderately recontaminated from the Denny Way outfall, with 2 cm sampling showing measurable concentrations of benzyl butyl phthalate and/or bis(2-ethylhexyl) phthalate at Stations J, K, L and M. All of the surface (0-2cm) samples on the cap were greater than the SQS for either or both chemicals.

- The 0-2cm, 2-10cm and 0-10cm sampling at K and L showed that concentrations were similar both on the cap surface and to a depth of 10cm. This suggests vertical sediment distribution is occurring, possibly due to bioturbation at these sampling sites, which may also be occurring over the rest of the cap surface.

- The toxicity testing gave mixed results. Station K, closest to the outfall, passed all three bioassay tests. However, at this station, there were exceedances of the SMS chemical criteria for both benzyl butyl phthalate (SQS) and bis(2-ethylhexyl) phthalate (CSL).

- Station L, which is located farther offshore from Station K, and which had no SMS chemical exceedances, passed both the amphipod acute test, and the polychaete chronic test, but exceeded the CSL for the larval echinoderm acute test. Larval echinoderm protocols were deviated from with regard to holding time and temperature;

however, no deviations were specific to Station L, therefore, the toxicity response is unexplained.

- Benthic species monitored at Stations J and M decreased in abundance by about 55% from 1994 to 1996, and have decreased in total biomass. These reductions occurred across all taxonomic groups. However, despite the large reductions in abundance the three indices of ecological community structure, Shannon-Weiner diversity index, Swartz's dominance index, and Pielou's evenness index, all indicate a healthy, diverse, community is present at these two stations. The reduced abundance may be due to changes in the physical makeup of the sediment and other influences such as predation, evolution of the benthic community, or other external forces.

In light of these conclusions, taken from throughout this report, it appears that the Denny Way cap remains stable, and continues to appear to be successful in achieving its primary purpose: providing a clean sand surface and containing the contaminated sediments.

Possibly, the single biggest threat to the cap at this time is the recontamination of the cap surface. Benzyl butyl phthalate and bis(2-ethylhexyl)phthalate, are prevalent over the cap, both in excess of the SMS at some stations, or at a point near 50% of the SMS at others. Additionally, phenanthrene, fluoranthene, chrysene, indeno(1,2,3-Cd)pyrene, benzo(g,h,i)perylene, benzoic acid, total PCBs, silver and mercury all are near 50% of the SMS and have a potential to recontaminate one or more stations on the cap.

APPENDIX A

MONITORING PLAN AND LIST OF ACTIVITIES THROUGH 2000

1996 MONITORING AT THE DENNY WAY SEDIMENT CAP

Agencies attending the Denny Way 5-year monitoring review meeting, held on March 19, 1996, agreed to the following monitoring during 1996 at the Denny Way cap site:

Surface Chemistry Samples

Surface chemistry samples will be taken at subtidal Stations J, K, L, M, and at the intertidal Station S as in previous years. These samples will be from the top 2 cm of sediment.

Additionally, samples will be taken at K and L from the 2 to 10 cm depth. During interpretation, the results from the 0 to 2 cm sample will be combined proportionally with the results of the 2 to 10 cm sample to assess the chemical concentrations in the top 10 cm biologically active zone.

Additionally, one 10 cm sample will be taken at the subtidal Station T from outside the capping area. The sample will be used in future modeling of the outfall.

Bioassay Samples

Bioassay samples will be taken for the first time at K and L. A reference Station will be taken from Carr Inlet. The three standard tests (amphipod, echinoderm, and neanthes) of the sediment management standards will be performed.

Benthic Taxonomy Samples

Benthic taxonomy samples will be taken again, as in previous years, on the cap at J, M, and in the intertidal area inshore of the cap at S. A benthic taxonomy reference sample will be taken for the first time to provide a comparison value.

DGPS Mapping

Concern has been expressed about the kelp bed inshore of the cap. From observations from field crews, it may be possible that the kelp bed has decreased in size over time. To help determine if the kelp bed is decreasing in size, the field crew will survey the outside edge of the kelp bed using a differential global positioning system. Using the survey, the kelp bed will be mapped. Future periodic monitoring will also include a survey of the kelp bed to determine trends.

Report

A report is scheduled to be completed in 1997.

A report review meeting is scheduled to be held in 1998.

BACKGROUND ISSUES

Denny Way CSO Control Project. Construction of the control project for the Denny Way CSO may possibly include new offshore outfalls. However, construction will take place after the 10-year monitoring program for the cap has ended. As such, CSO construction will not interfere with the 10-year monitoring plan.

Stake Measurements. Stake measurements have shown little or no change in cap thickness or cap settlement during the first four years of study. Because of this, stakes will not be measured in 1996. Stakes will be measured again at the end of the 10-year monitoring period.

Core Samples. Core samples have shown no migration up into the cap from the contaminated under-cap sediments. Because of this, core samples will not be taken in 1996. Core samples will be taken again at the end of the 10-year monitoring period.

Surface Stations Surrounding the Cap. In 1994, monitoring included surface chemistry Stations that surrounded the cap. Results from these Stations showed contamination. Farther investigation of these areas will probably be part of a future cleanup project conducted in coordination with the Denny Way CSO control project, which is scheduled to be completed in 2003. Therefore, the Stations surrounding the cap will not be monitored—except for T, which will be used for modeling purposes.

Sample Depth. Previous studies at the Pier 53-55 cap (Hart Crowser, 1994 and Metro 1995) have shown significant differences between the results of samples taken from the 0 to 2 cm depth and the 0 to 10 cm depth. The results were likely caused by cleaner cap sand in the deeper 10 cm sample diluting higher concentration of recently deposited contaminants in the top 2 cm.

At Denny Way, the top 2 cm at K and L exceeded the CSL for bis(2-ethyhexyl)phthalate. Results from the top 10 cm will determine whether K and L exceed the CSL in the top 10 cm biologically active zone. Therefore, samples will be taken at K and L that represent the top 10 cm.

Bioassays. At K and L, bis(2-ethyhexyl)phthalate exceeded the CSL, while all other contaminants were below the SQS. Bioassays will be conducted on sediments from K and L to determine if the sediments show biological toxicity because of the phthalate CSL exceedance.

Benthic Taxonomy. Four years of benthic taxonomy samples have been collected from the cap. The results of these samples have shown that the benthic community has recolonized the cap and has increased each year since capping. Now it would be useful to compare the cap benthic community to a reference community that represents normal and stable conditions. This comparison would show differences between the cap and an undisturbed environment and also help determine how long it takes for a stable benthic community to reestablish itself after capping.

REMOTES Sediment Profile Survey. After capping, the REMOTES study was used to determine how far capping sand drifted offsite during construction. The REMOTES study was also used for an initial assessment of the benthic community during the first stages of recolonization. However, farther information is not needed on capping sand location, and benthic recolonization is being evaluated using benthic taxonomy studies. Therefore, no farther REMOTS surveys will be conducted during this monitoring program.

Video Camera Survey. Four years of video camera surveys have been conducted on the cap. The video surveys were able to show the actual surface of the cap. Video surveys have also shown the progression from year to year of a surface organic layer, an increase of marine plants and organisms, and a buildup of litter. However, the information is not easily quantifiable and other methods of determining the organic content of the sediments and of evaluating the benthic community are being used. Therefore, no farther video camera surveys will be conducted.

ATTACHMENT B

MONITORING PLAN
FOR DENNY WAY SEDIMENT CAPPING

Objectives

Environmental monitoring for the project involves both short term activities needed for cap placement plus longer term activities needed to document how well the cap functions. The strategy for long term monitoring is to do more intensive monitoring the first few years after capping and then decrease the frequency over time as appropriate. It is proposed that a five year monitoring plan be adopted at this time and that future monitoring requirements be finalized as part of a five year review process.

There are six main objectives associated with the monitoring program as listed below. A summary of the sampling activities and schedule are provided in Table 1 and sampling stations are shown in Figure 1.

OBJECTIVE 1: Insure that water quality standards for dissolved oxygen are maintained during cap placement.

OBJECTIVE 2: Guide and document the sediment cap placement and thickness.

OBJECTIVE 3: Document how well the cap functions to isolate contaminated sediments from migrating upwards into the cap.

OBJECTIVE 4: Identify whether chemicals accumulate in the surface of the cap such that they indicate a need for any additional specific toxicant source control work upstream in the Denny Way collection system.

OBJECTIVE 5: Determine the amount and type of benthic recolonization that occurs in the capping area.

OBJECTIVE 6: Review and evaluate the monitoring data to determine that (1) the cap is functioning as expected and (2) whether further actions are warranted in the capped area..

Water Column Dissolved Oxygen Level

Water column samples will be collected immediately before and after spreading the first barge load of sand to insure that dissolved oxygen levels are above the lower limit of 5.0 mg/liter. The sampling site will be located down current from the capping site and at the edge of a 300 foot dilution zone. Samples will be taken at the surface, at mid-depth, and at one meter above the bottom. Water column sampling will continue for the first three barge loads and this data will be evaluated to see if there is need to continue further monitoring. If there is no indication of a potential dissolved oxygen problem due to cap placement then monitoring will be suspended.

Cap Placement and Thickness

Bathymetric surveys will be used to document cap placement and thickness. These surveys will be conducted by the Army Corps of Engineers using electronic depth recording and navigation equipment. Surveys will be made before, during, and shortly after cap placement. The differences in water depth measurements will be translated into cap thickness. In addition, a diver survey will be performed to help verify cap thickness through the use of bottom stakes. An independent check on cap thickness will also be obtained when sediment cores are collected and processed during the post-cap monitoring discussed in the next section.

Three follow-up surveys of cap thickness will be conducted within the first five years as summarized in Table 1. These may be either electronic bathymetric surveys or diver surveys. The first two follow-up surveys will be conducted at approximately 12 and 24 months after cap placement to see if there are any obvious differences in cap thickness. The third survey will be conducted either after 60 months or perhaps sooner if there are exceptionally large storms that occur prior to 60 months. An analysis of each years data will be included in a report and discussed during both the annual review and the 5 year review. Decisions about when to conduct further bathymetric or diver surveys beyond 60 months will be made in conjunction with Ecology, DNR, EPA, and the Corps of Engineers during the five year review process.

Isolation of Contaminants

Sediment cores will be used to determine if there is any vertical migration of chemicals up into the cap material. A total of three coring stations will be established as shown in Figure 1. These coring stations provide spatial coverage across the cap and are intentionally located away from other sampling stations so that any potential release of contaminated sediment from the cores will not effect other surface sediment sampling stations.

One core will be collected from each of the three stations. Each core will extend completely through the sand cap and into the underlying contaminated sediments at least one foot. As shown in Figure 2, a total of five (5) 6-inch long sections will be retained as samples for chemical analysis.

Four (4) of the 6-inch sections will be taken from above the interface and one (1) 6-inch section will be taken below the interface. Because mixing can occur around the interface due to the physical process of capping, it is important to leave a space of at east one inch above the interface before taking the first sample. The exact distance will be determined after inspecting the interface of each baseline core, but will remain the same for future cores.

Sediment cores required to establish baseline data will be collected as soon as practical within one to two months after cap placement. All five sections of each baseline core will be analyzed for metal and organic priority pollutants including all of the routine Ecology sediment quality chemicals. Future core samples will be collected adjacent to the baseline stations to allow comparison of data. Five sample sections will be collected for each core, but initially only the first section above and below the interface will be analyzed for those chemicals found in the underlying contaminated sediments to determine whether any migration is evident. If migration appears evident then sections further up the core will be analyzed to determine how far chemical migration extends into the cap. Decisions about whether to analyze additional sections will be made within the storage times established under the Puget Sound Protocols.

Evaluation of vertical migration in the bottom of the cap will be limited to only chemicals that were present in the underlying sediments. Data will be normalized to dry weight to allow comparisons. Vertical migration from the cap surface downward will be evaluated if there is evidence of significant chemical accumulation on top of the cap based on surface sediment samples. Also, a direct measure of cap thickness will be made and compared to the thickness indicated by the bottom depth surveys.

The schedule for core sampling will be every year for the first three years, which yields samples at about 1-2 months (baseline), 14 months, and 26 months after cap placement. Sampling frequency beyond 26 months will be extended to alternate years and yield a sample about 50 months after cap placement. An analysis of each years data will be included in a monitoring report and the results discussed during an annual review plus a 5 year review. Decisions regarding the frequency of core sampling beyond 50 months will be made in conjunction with Ecology, DNR, EPA, and the Corps during the five year review process scheduled for 1995.

<u>Surface Contamination of Cap</u>

Accumulation of surface sediment contamination will be evaluated by collecting and analyzing samples from the five stations shown in Figure 1. Samples from the four subtidal stations will be collected with a Van Veen grab sampler. A stainless steel "cookie cutter" will be used to collect the top 2 cm of sediment from three replicate samples per station. These subsamples will be composited, and then analyzed for priority pollutant metals and organics including all the routine Ecology sediment quality chemicals.. The intertidal sample will be collected with a surface sampler at low tide. Data for all stations will be normalized to dry weight for comparison between stations and years.

Chemistry data will be compared to the baseline data and each previous years data to determine whether a change has occurred. If significant accumulation has occurred there will be an evaluation of upstream sources to identify sources that need to be reduced. Data from the intertidal sample will provide a link between conditions on the cap and those immediately in front of the outfall.

The schedule for surface sediment sampling will be every year for the first three years which will yield samples at about one to two months, 17 months, and 29 months after cap placement. It is anticipated that subsequent sampling for surface chemistry would be extended to alternate years which would yield a sample at about 53 months. An analysis of each years data will be included the monitoring report and discussed at both the annual review and the 5 year review. Decisions about the frequency and extent of surface sediment sampling beyond 53 months will be made in conjunction with Ecology, DNR, EPA, and the Corps of Engineers during the five year review process in 1995.

<u>Benthic Recolonizaton</u>

The primary method of evaluating recolonization of the sediment cap will be to obtain taxonomy data from surface grabs collected at the two north and south stations shown in Figure 1. These stations were selected to provide a general representation for the type of recolonization that occurs over the majority of the capping site. The first sampling will occur in August 1990, which is about five months after cap placement. Size of biota is expected to be small the first year so these samples will only be collected and stored at first and a decision about analysis made later. A Van Veen sampler will be used to collect five replicates per station and samples will be processed according to Puget Sound protocols. In the second year, benthic taxonomy samples will be screened through a standard 1.0 mm mesh and all organisms identified to the lowest practical taxonomic level (preferably to species). The single intertidal station will be sampled using standard intertidal methods.

Table 1 shows the schedule for benthic taxonomy sampling at yearly intervals for the first three years which will yield samples at about 5 months, 17 months, and 29 months after cap placement. Subsequent taxonomy sampling is anticipated to be extended to alternate years for a period and would yield a sample at about 53 months. Decisions about taxonomy sampling beyond 53 months will be determined in conjunction with Ecology, DNR, EPA, and the Corps of Engineers during the five year review process in 1995. An analysis of each years data will be included a monitoring report and then discussed at both the annual review plus the 5 year review. This recolonization analysis will involve comparing each years data to the previous years data and at the end of 5 years to an appropriate reference station.

A video camera survey (either diver operated or remote control) will be performed during the first year as a test to aid in the collection of supplemental biological information. This video camera survey will be conducted to inspect the cap surface to identify the presence of larger biological organisms, including presence of shrimp holes. A series of video transacts will be run parallel to shore to provide biological information on various depth contours in the range from 20 to 60 feet of water depth. Also, observations of the physical shape of the cap can provide information on the proficiency of the capping operation. Results of the preliminary video survey will be used to decide whether the video survey should be continued in future years.

The REMOTS photo sampler will be tested during the second year in place of the video camera survey as a method for obtaining supplemental biological information. The REMOTS survey will consist of taking sediment profile photographs over a grid of stations. Each photograph is about 15 cm wide and may be up to 15 cm high depending on how deep the camera prism penetrates into the surface of the sediment cap. Photographs will be analyzed for the following: 1) Uniformity of capping material across the site, 2) Presence and depth of any apparent "Redox Potential Discontinuity", 3) Infaunal successional stage, 4) Organism-sediment index, and 5) Other biological information such as the linear density of polycheate and/or amphipod tubes at the interface, plus signs of bioturbation. Results of the initial REMOTS survey will be used to decided whether REMOTS should be continued in subsequent years.

Review and Evaluation Process

A review process will be conducted on a regular basis to evaluate the monitoring data and determine if the cap is functioning as expected. To help facilitate this review, a monitoring report will be prepared that presents and analyzes the data. The monitoring report will be produced once each year that new monitoring data is obtained. Table 2 provides an outline of the topics to be addressed in the monitoring report.

Each monitoring report will be distributed to DNR, Ecology, EPA, the Corps of Engineers, and other interested groups. An annual meeting will be held to discuss and evaluate the report and conclusions. A major monitoring review will be conducted after 5 years and will include discussions about monitoring needs beyond 5 years. These discussions will consider whether the cap is functioning as expected and what contingency actions might be warranted if the cap is not functioning as expected, including whether resulting conditions at the cap surface warrant further action.

Table I. Summary Schedule of Monitoring Activities for Denny Way Capping

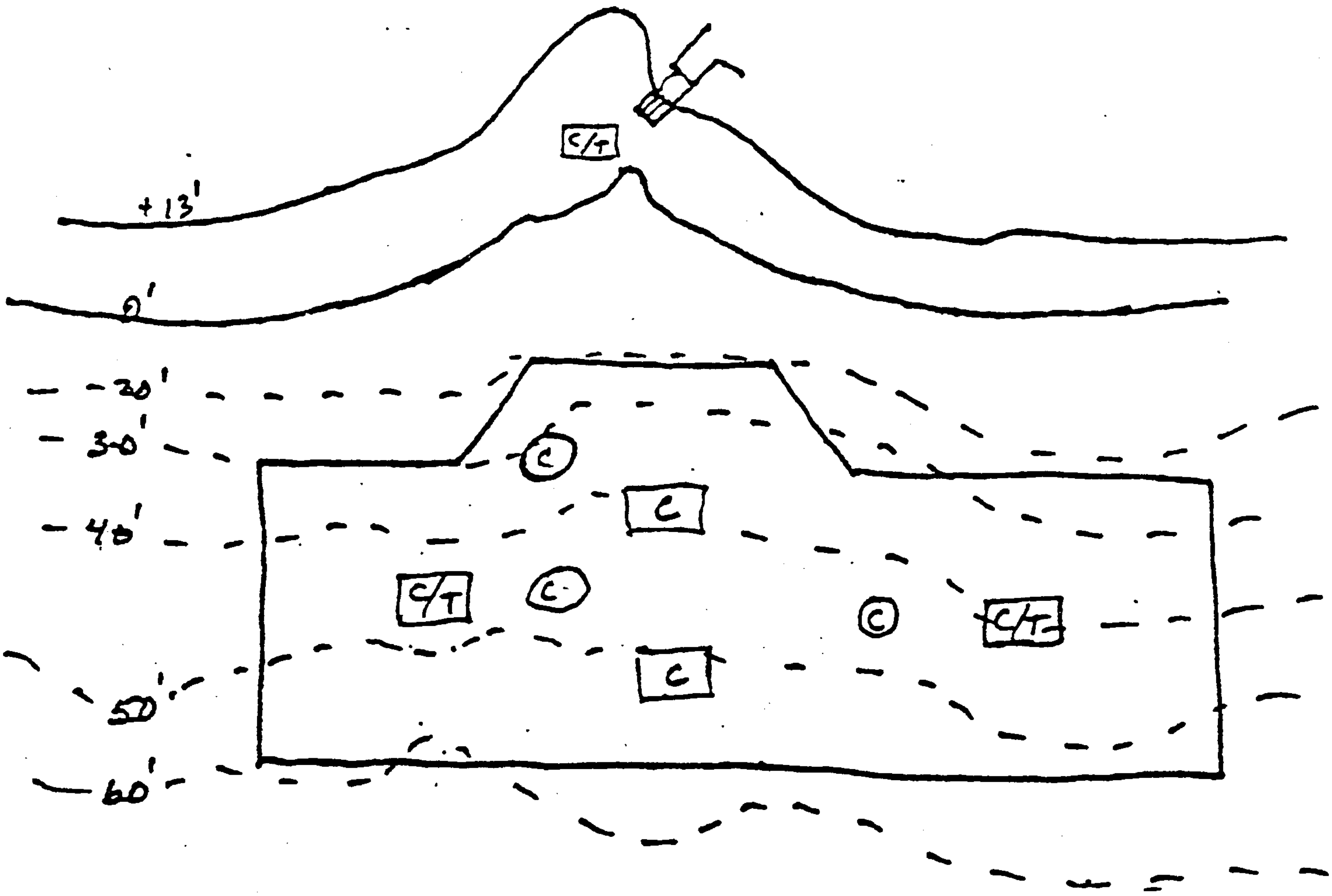
	Construction	Post Cap Monitoring										
		Five Year Plan Confirmed						To Be Established				
	1990	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
•Water Column Samples 1-station (3 dumps min)	X											
•Bathymetric Surveys	X		X[c]	X[c]		X——	——X[c]					
Diver Survey	X											
•Sediment Cores for Chemistry 3-stations (5 depth segments)		X[a]	X	X		X					?	
•Surface Grabs for Chemistry 5-stations (top 2 cm)		X[a]	X	X		X					?	
•Surface Grabs for Taxonomy 3-stations (5 replicates)		X[b]	X	X		X					?	
•REMOTES Photographic Survey (evaluation			X									
•Video Camera Survey		X										
•Monitoring report for given year		X	X	X		X						
•Monitoring review meetings		X[d]	X[d]	X[d]		X[d]						
•Five year project review							X					X

a) Baseline sampling will be conducted as soon as practical within the first two months after cap placement.

b) First year taxonomy samples will only be stored and a decision about the need fc analysis made at a later date.

c) One of the survey methods will be used within the indicated time period.

d) Meetings may be held within the first two months of subsequent year.



C = Core sample station for chemistry analysis.

C = Grab sample station for surface sediment chemistry.

C/T = Grab sample station for surface sediment chemistry and taxonomy of benthic organisms.

Figure1. Sampling station locations for sediment cores and for surface grab samples.

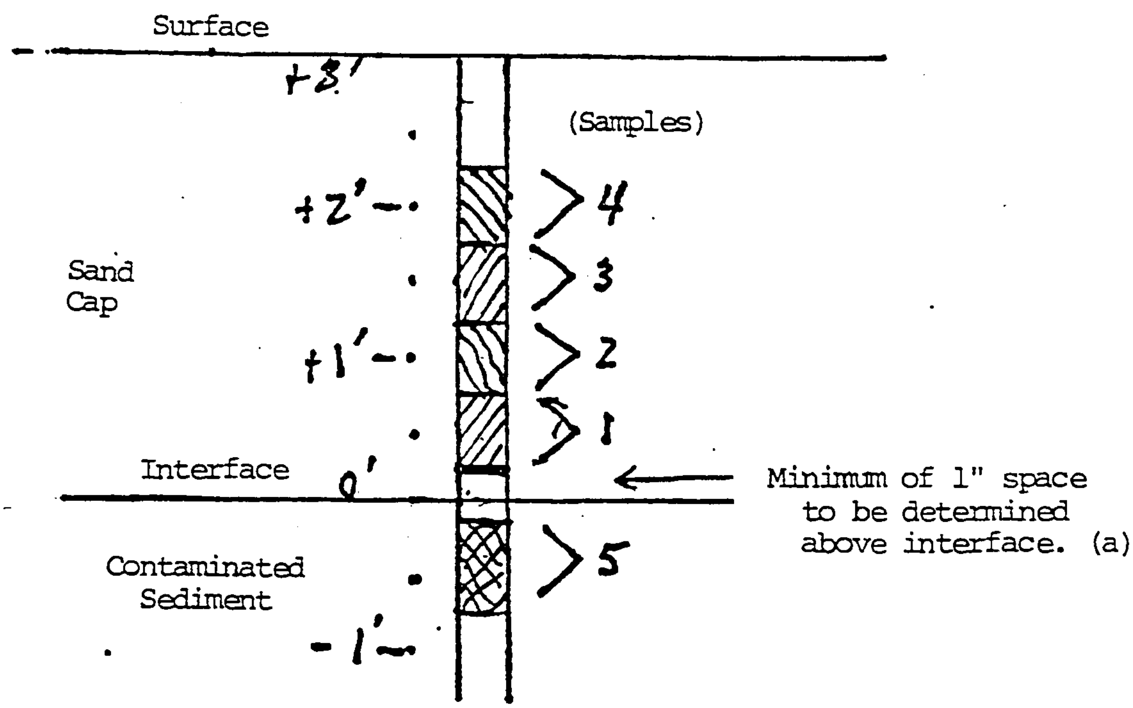


Figure 2. Cross section of sediment core showing the 5 sections that will be taken for chemical analysis.

(a) Determination based on degree of mixing apparent at the interface.

TABLE 2

MONITORING REPORT OUTLINE

Section 1: Background

- Provide information on when and how the sediment cap was placed, including amount of sediment used.

- List permits and licenses obtained and existing permit conditions.

Section 2: Cap placement and thickness

- Provide map showing position and thickness of sediment cap as determined by bathymetric survey and barge dumping records.

- Provide a corrected map of cap thickness based on data from bottom stakes and sediment cores.

- Compare each subsequent survey with the previous survey and discuss whether the cap appears to be remaining stable.

Section 3: Isolation of Contaminants

- Chemical data from baseline cores will be presented in tables and discussed regarding the following:

    - Identify exact sampling locations on cap.
    - Identify presence of chemicals in the existing cap.
    - Compare observed chemistry to pre-dredge data.
    - Check uniformity of chemistry between core sections.
    - Display profile plots of representative chemicals.

- Subsequent core data will be added to the tables to allow comparisons and then discussed regarding the following:.

    - Identify apparent chemical increases in cap.
    - Compare to chemicals in underlying sediments.
    - Display profile plots of representative chemicals.
    - If chemical levels in the cap become significantly elevated, these values will be compared to available Puget Sound Sediment Standards.

Section 4: Surface Contamination of Cap

- Chemistry data from baseline surface grab samples will be presented in tables and discussed regarding the following:

    - Identify exact sampling location on cap.
    - Identify chemicals present on cap surface.
    - Compare chemistry to pre-dredge data and new cores.
    - Identify spatial differences in concentrations.

TABLE 2 (continued)

- Subsequent surface chemistry data will be added to the tables to allow comparisons and discussed regarding the following:

  - Identify chemicals that appear to increase.
  - Display plots of representative chemicals showing change over time.
  - Identify spatial differences and implication to possible sources.
  - If certain chemicals show a trend of significantly increasing concentrations, then potential sources in the collection system will be evaluated for source control actions.
  - If chemical levels in the cap become significantly elevated, the values will be compared to available Puget Sound Sediment Standards.

SECTION 5: Benthic Recolonization

- Detailed taxonomy data will be presented in tables and discussed regarding the following:

  - Identify exact sampling location on cap.
  - Develop summary data regarding number of taxa and biomass.
  - Display plots showing changes over time in numbers of taxa and biomass.
  - Compare the population resulting in the cap after five years to populations found in similar type habitats as determined from previously collected data or a resent sample from an appropriate reference area.

- Video camera survey information will be summarized and discussed relative to the following:

  - Identify location of survey track relative to cap.
  - Assess uniformity of the cap surface.
  - Identify presence of larger biota and shrimp holes

-REMOTS photographs will be presented and discussed regarding the following:

  - Identify location of sample stations on cap.
  - Assess uniformity of capping material across site.
  - Determine infaunal successional stage.
  - Determine organism-sediment index.
  - Quantify linear density of abundant biota.
  - Identify any Redox Potential Discontinuity.
  - Assess indications of bioturbation.

TABLE 2 (continued)

- A comparison of the Video Camera Survey and the REMOTS survey data will be conducted and a recommendation made regarding the preferred approach for obtaining supplemental biological information.

SECTION 6: Conclusions

- Regarding stability of cap
- Regarding isolation of contaminants
- Regarding contamination of cap surface
- Regarding status of benthic recolonization
- Regarding findings of video camera and REMOTS survey
- Regarding recommendations for future actions

APPENDIX B:

SEDIMENT CHEMISTRY

QUALITY ASSURANCE REVIEW

QUALITY ASSURANCE SUMMARY

Background Information

The King County Environmental Laboratory analyzes sediments in accordance with Puget Sound Dredge Disposal Analysis (PSDDA) and Puget Sound Estuary Program (PSEP) guidelines. Under these guidelines, Quality Assurance and Quality Control (QA/QC) procedures are necessary to ensure that the data achieve an acceptable level of quality and that the level of quality is properly documented (PSEP, 1997a).

Quality Control (QC) samples are used to evaluate the performance of analytical methods and instruments. Standard Reference Materials, Matrix Spikes, replicates, method blanks, and surrogate spike compounds were analyzed to evaluate this data set. Table 2 of the KCEL Quality Assurance Review found later in this appendix lists the frequency of QC sample analysis. Table 3 of the Quality Assurance Review (QAR) summarizes the QC limits and associated data qualifier codes. Data qualifier codes are notations based on quality control test results that are used by laboratories and data reviewers to impart qualitative information about the associated data or the systems producing data (EPA, 1994a). These codes are letters in the "Qual" column of the summary and comprehensive tables in this report.

Standard Reference Materials (SRM) are materials with values (e.g., contaminated sediments) certified by an official source using technically valid procedures (PSEP, 1997b). If used as a standard in the laboratory, they can provide information about accuracy of the values measured.

Matrix spike (MS) samples are used to indicate the bias of analytical measurements due to interfering substances or matrix effects (PSEP, 1991). Duplicate matrix spike samples provide information about precision of results.

Surrogates evaluate analytical recovery of target compounds from individual samples (USEPA, 1991). Surrogates are compounds chemically similar to the target compounds. They are added to each sample in a known amount prior to extraction or purging (USEPA, 1997b). The recovery of a surrogate compound is indicative of target compound recovery.

SRM, matrix spike and surrogate recovery results need to be evaluated carefully when determining the impact of unacceptable QC results. Surrogate results may be the best measure of quality for individual samples. SRM recoveries are a good measure of the quality of sample results but only if the sediment matches the physical characteristics of the SRM. Matrix spike results may not be applicable to all samples in a set, depending on the comparability of the matrix characteristics. Accurate estimation of data quality requires that matrix spike levels must also be appropriately relative to the background sample concentrations.

The acceptance limits for sediment projects are defined by the PSEP guidelines. These limits may not always match the expected performance limits of particular methods for particular parameters. The acceptance limits for the EPA Contract Lab Program (CLP) are based on the performance characteristics of the methods for particular parameters. Comparing the QC results to the EPA CLP limits can indicate if the results are within the expected performance limits of the method.

Explanation of Qualified Data

Table B-1: Reasons for the 'G' Qualifier

	Stations J, M 0-2 cm	Station S 0-2 cm	Station T 0-2 cm	Stations K,L 2-10 cm	Stations K, L 0-10 cm	Station T 0-10 cm
PAHs	Low SRM	Low SRM	Low SRM	Low SRM	Low SRM	Low SRM
Chlorobenzenes	Low MS and low surrogate	Low MS and low surrogate	Low MS and low surrogate	Low MS and low surrogate	Low surrogate	Low MS and low surrogate
Di-N-butyl phthalate					Low MS	
Phenols, benzyl alcohol	Low MS			Low MS		Low MS
Aluminum					Low MS	
Antimony	Low SRM and Low MS	Low SRM and Low MS	Low SRM and Low MS	Low SRM and Low MS	Low SRM and Low MS	Low SRM and Low MS
Iron			Low MS		Low MS	

SRM= Standard Reference Material MS=Matrix Spike

Much of the data is qualified "G" for low SRM recoveries, low surrogate recoveries, and low MS recoveries. Low MS, SRM and surrogate recoveries may mean that the data is biased downward; i.e., the measured concentration is possibly lower than the expected true value. Table B-1 provides a summary of the QC failures that prompted the use of the "G" qualifier.

Two aliquots of a sediment SRM were analyzed during BNA analysis of all samples. Percent recoveries for PAHs were generally between 30 and 70 percent except for naphthalene, which was 12-13%. The SRM has different characteristics (i.e., silty and higher TOC) than the cap sands, and may be expected to have different performance. The true value of most PAHs could be higher than the values measured, but it remains unlikely that any would exceed the SMS. Most 1994 PAH results were similarly qualified.

Chlorobenzenes suffered both low matrix spike (33-48%) and low surrogate recoveries (<50%). A chlorobenzene with a deuterated (isotopic) form of hydrogen is used as a surrogate, so the surrogate is a reliable indicator of chlorobenzene recovery. Chlorobenzenes are often lost during the sample preparation process because they are more volatile than most semivolatiles - this volatility is the likely cause of the poor recoveries. Although below the PSEP acceptance limits, these recoveries are within EPA CLP limits (EPA, 1994b).

Phenols and benzyl alcohol tend to extract poorly from a sediment matrix, causing low matrix spike recoveries. The matrix spike associated with many of the samples had a 42 percent recovery for phenol, within the 26-90% range acceptable by EPA CLP limits (EPA, 1994c).

The benzoic acid data for samples 9208-1,2,4,5,6,7,8,9 (top 2-cm at Stations J, K, L, M; 2-10-cm at Stations K and L; 0-10-cm at Station T) are qualified "L" due to a matrix spike recovery of 165 percent, which is above the 150% acceptance limit. High matrix spike results suggest that the data may be biased due to variability in analytical precision or as a result of matrix effects or interference. The duplicate matrix spike recovery was 147% and the Relative Percent Difference (RPD) between the matrix spike and duplicate matrix spike was 12% (Elliott, personal communication). The spiked method blank result was 65%.

The unspiked sample and the method blank showed no detectable response for benzoic acid. The low RPD and other quality control results indicate that the analytical precision appears to be very good, suggesting that the sample matrix is causing a high bias for benzoic acid (measured values to be higher than the true value).

Matrix spike recoveries greater than 125% were reported for aluminum for samples 9208-1,2,4-9, 9281-1, 9317-1 (all samples except Stations K and L, 0-10-cm). These samples were analyzed in 3 batches, with matrix spike recoveries between 223 and 282 percent. A low matrix spike recovery was reported for a fourth batch, which included samples 9445-1 and 9445-2 (Stations K and L, 0-10-cm). Laboratory analysts reported for all four batches that the amount of spike (approx. 12ppm) was low compared to sample concentrations (6000ppm to 19000ppm). As a result, the spike was masked by the sample concentrations, and normal variability within sample concentrations was measured as high and low matrix spike recoveries. Matrix spike acceptance limits should not be applied when the spike level is less than 25% of the background sample concentration (EPA, 1994d). Aluminum values are naturally high in bottom sediment samples but aluminum is not one of the eight Sediment Management Standards metals that have much lower concentrations.

Low SRM and MS recoveries occur because the sample preparation process (PSEP sediment method) poorly digests antimony. More tedious and costly methods would be necessary for more complete digestion relative to antimony. The recoveries for antimony that were observed during this project are typical for the PSEP sediment method. Antimony is not one of the eight metals listed in the State Sediment Management Standards and is not necessarily indicative of how well those metals are digested.

Two volatile compounds, acetone and methylene chloride, were often qualified "B" for method blank contamination. Acetone was detected in all but one sample but was also detected in all laboratory method blanks associated with these samples. Concentrations in the method blanks ranged from 320 µg/kg-dry weight to 650 µg/kg-dry weight. Methylene chloride was detected at Station S and the 0-10-cm samples at K and L but was also in the method blank associated with these samples. The concentration of methylene chloride in the method blank was 420 µg/kg. Methylene chloride and acetone are common volatile laboratory contaminants. For methylene chloride and acetone, the *National Functional Guidelines for Organic Data Review* (EPA, 1994a) do not consider concentrations less than ten times the amount in a method blank to be positive sample results. All reported concentrations of acetone and methylene chloride are less than ten times the amount in their respective method blanks. Therefore, the reported concentrations are likely to be the result of laboratory contamination and not representative of concentrations in the environment.

KING COUNTY ENVIRONMENTAL LABORATORY

QUALITY ASSURANCE REVIEW

for

DENNY WAY SEDIMENT CAP MONITORING PROJECT

November 17, 1996

King County Environmental Laboratory
322 West Ewing Street
Seattle, Washington 98119-1507

INTRODUCTION

This Quality Assurance (QA) review accompanies data submitted in connection with marine sediment sampling at the Denny Way Sediment Cap. The QA review is organized into the four sections listed below.

- General Comments
- Conventionals Chemistry
- Metals Chemistry
- Organics Chemistry

An overview of the approach used for this QA review is detailed in the General Comments section. Additional information specific to each analysis is included in the appropriate analytical section.

This QA review has been primarily conducted in accordance with guidelines established through the Puget Sound Dredged Disposal Analysis (PSDDA) program, outlined in *Puget Sound Dredged Disposal Analysis Guidance Manual, Data Quality Evaluation for Proposed Dredged Material Disposal Projects*. Other approaches incorporated in this QA review have been established through collaboration between the King County Environmental Laboratory (KC Laboratory) and the Washington State Department of Ecology (Ecology) Sediment Management Unit.

GENERAL COMMENTS

Scope of Samples Submitted

This QA review is associated with marine sediment samples collected in August/September 1996 at the Denny Way Sediment Cap. The samples collected and the proposed analytical scheme are summarized in Table 1. Except where noted in the subcontracting sections of this QA review, all analyses have been conducted by the KC Laboratory. The data are reported with associated data qualifiers and have undergone QA1 review, as summarized in this narrative report.

Completeness

Completeness has been evaluated for this data submission and QA review by considering the following criteria:

- Comparing available data with the planned project analytical scheme summarized in Table 1.
- Compliance with storage conditions and holding times.
- Compliance with the complete set of quality control(QC) samples outlined in Table 2.

Methods

Analytical methods are noted in the applicable analytical sections of this QA review.

Target Lists

The reported target lists have been compared to the target analytes listed in *Table 1- Marine Sediment Quality Standards Chemical Criteria* contained in Chapter 173-204 WAC and the PSDDA *Chemicals of Concern* list.

Detection Limits

The KC Laboratory distinguishes between the Reporting Detection Limit (RDL) and the Method Detection Limit (MDL).

- The RDL is defined as *the minimum concentration of a chemical constituent that can be reliably quantified.*
- The MDL is defined as *the minimum concentration of a chemical constituent that can be detected.*

Some subcontractor laboratory data is available with an MDL only, in accordance with the subcontracting laboratory policies. All analytical data are reported with either a result and/or detection limit(s).

Storage Conditions and Holding Times

Storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The approach used to evaluate Total Organic Carbon for holding time has been established between KC Laboratory and Ecology during previous QA1 review efforts.

Method Blanks

Method blanks have been evaluated for the presence of positive analyte results at or greater than the MDL.

Standard Reference Material
Data have been qualified based on available standard reference material (SRM) results. Instances of data reported without associated SRM analysis are noted in the narrative.

Matrix Spikes
Matrix spike results have been used to qualify data for both organics and metals analyses. Matrix spikes are not required for Conventionals parameters.

Replicate Samples
Data have been qualified based on replicate results. However, not all replicate data have been used as an indicator for data qualification. Only sets of replicate results which contain at least one result significantly greater than the MDL have been considered for data qualification. Where an RDL is present, only replicate data that contains at least one result greater than the RDL have been considered for data qualification. These guidelines have been used to account for the fact that precision obtained near the MDL is not representative of precision obtained throughout the entire analytical range.

Data Qualifiers
The data qualification system used for this data submission is presented in Table 3. These data qualifiers address situations which require qualification according to QA1 guidance. The exact qualifiers used generally conform to QA1 guidance. King County qualifiers indicating <MDL and <RDL have been used as replacements for the *T* and *U* specified under QA1 guidance. Changes made to SRM data qualification criteria have been discussed with and approved by the Sediment Management Unit of Ecology.

Units and Significant Figures
Data have been reported in accordance with laboratory policy at the time of data generation. When an RDL and MDL are reported, data have been reported to three significant figures above the RDL, and two significant figures equal to or below the RDL. Data with only an MDL have been reported to two significant figures.

Data are stored in a wet weight basis on King County's data base and converted to dry weight during the reporting process. Should only one reported digit be available, rounding error can be significant. This rounding error can occur during the conversion from wet to dry weight.

Subcontracted Analyses
Analyses which have been subcontracted, and the issues associated with these subcontracted analyses are noted in this narrative.

CONVENTIONALS CHEMISTRY

Completeness

Conventionals data are reported for samples 9208-1, 9208-2, 9208-4 through 9208-9, 9281-1, 9317-1, 9445-1, and 9445-2. These samples were analyzed for total solids, total organic carbon (TOC) and particle size distribution (PSD) in association with the complete set of QC samples outlined in Table 2. Additionally, sample 9261-1 was analyzed only for PSD.

Subcontracted Analyses

PSD analysis was subcontracted to AmTest, Inc. in Redmond, Washington.

Methods

Total solids analysis was performed in accordance with Standard Method (SM) 2540-B. TOC analysis was performed in accordance with SM5310-B. PSD analysis was performed in accordance with ASTM and Puget Sound Protocols methodologies (*Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound* - page 9 - PSEP, 1986).

Detection Limits, Units, and Significant Figures

Data are reported in accordance with laboratory policy at the time the data were generated. A positive result and/or MDL and RDL have been reported for all conventionals parameters analyzed by the KC Laboratory. A positive result and/or MDL has been reported for subcontracted analyses. Sample results are reported in units of mg/Kg on a dry weight basis for TOC. Sample results are reported in percent for total solids and PSD. Data are reported to three significant figures for results greater than the RDL and two significant figures for results equal to or less than the RDL. For results reported with less than two or three significant figures, significant zeroes are implied.

Storage Conditions and Holding Times

Sample storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The criteria used to evaluate storage conditions and holding times for conventionals analyses are listed in the table below.

Parameter	Frozen Holding Time	Refrigerated Holding Time
PSD	Not Recommended	6 Months
Solids	6 Months	14 Days
TOC	6 Months	14 Days

Sample storage conditions and holding times were met for all samples in this data submission.

Method Blanks

Method blanks were analyzed in connection with TOC and total solids analyses. All method blank results were less than the MDL.

Standard Reference Material

The SRM analyzed in association with TOC analysis is Buffalo River Sediment. All SRM recoveries were within the 80 to 120% QC limits.

Laboratory Replicate Samples

Laboratory triplicate samples were analyzed in association with all conventionals parameters. Percent relative standard deviation (%RSD) for laboratory triplicate results was less than the 20% QC limit for all triplicate analyses for TOC and total solids.

The average %RSD over all grain size fractions for each of four triplicate analyses peformed in association with PSD analysis ranged from 21 to 26%. Laboratory triplicate results were reviewed to determine if a consistent difference in occurred over all grain size fractions. Variations in triplicate results appear to be random and a function of inherent variations in samples rather than QC problems. As a result, PSD data have not been qualified based on laboratory triplicate analysis.

METALS CHEMISTRY

Completeness

Metals data are reported for samples 9208-1, 9208-2, 9208-4 through 9208-9, 9281-1, 9317-1, 9445-1, and 9445-2. These samples were analyzed for mercury and other metals in association with the complete set of QC samples outlined in Table 2.

Methods

Mercury analysis was performed in accordance with EPA Method 7471. All other metals analyses were performed in accordance with EPA Method 3050/6010.

Target List

The reported target list includes all metals specified in *Table 1 - Marine Sediment Quality Standards Chemical Criteria* contained in Chapter 173-204 WAC and the PSDDA *Chemicals of Concern* list. Additional metals have been reported as available.

Detection Limits, Units, and Significant Figures

Data are reported in accordance with laboratory policy at the time the data were generated. A positive result and/or MDL and RDL have been reported for all metals. Sample results are reported in units of mg/Kg on a dry weight basis. Data are reported to three significant figures for results greater than the RDL and two significant figures for results equal to or less than the RDL. For results reported with less than two or three significant figures, significant zeroes are implied.

Storage Conditions and Holding Times

Sample storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The criteria used to evaluate storage conditions and holding times for metals analyses are listed in the table below.

Parameter	Frozen Holding Time	Refrigerated Holding Time
Mercury	28 Days	Not Recommended
Metals	2 Years	6 Months

Samples 9445-1 and 9445-2 were analyzed out of holding time. Associated sample results have been qualified with the *H* flag. Sample storage conditions and holding times were met for all other samples in this data submission.

Method Blank

All metals and mercury method blank results were less than the MDL.

Standard Reference Material
The SRM analyzed in association with samples included in this data submission is PACS 1 certified by the National Research Council of Canada. This SRM does not contain silver. An SRM recovery less than 80% has not been used alone to qualify data because the digestion technique used for sample analysis is different from the technique used during analysis to determine the SRM certified values. Only those metals for which the SRM recovery was less than 80% and the matrix spike recovery was less than 75% have been qualified.

An SRM recovery less than 80% and a matrix spike recovery less than 75% were reported for antimony for each QC batch in this data submission. Associated antimony results for all samples have been qualified with the *G* flag.

Matrix Spike
For samples 9208-1, 9208-2, 9208-4 through 9208-9, a matrix spike recovery less than 75% was reported for antimony. Associated sample results for antimony have been qualified with the *G* flag. A matrix spike recovery greater than 125% was reported for aluminum. Associated sample results for aluminum have been qualified with the *L* flag.

Samples 9445-1 and 9445-2 had matrix spike recoveries less than 75% reported for iron and antimony. The associated sample results for iron and antimony have been qualified with the *G* flag. A matrix spike recovery greater than 125% was reported for aluminum. Associated sample results for aluminum have been qualified with the *L* flag.

Samples 9317-1 had a matrix spike recovery less than 75% reported for antimony. Associated sample results for antimony have been qualified with the *G* flag. Sample 9317-1 had a matrix spike recovery greater than 125% reported for aluminum. Associated sample results for aluminum have been qualified with the *L* flag.

Sample 9281-1 had matrix spike recoveries less than 75% reported for iron and antimony. Associated sample results for iron and antimony have been qualified with the *G* flag. A matrix spike recovery greater than 125% was reported for aluminum. Associated sample results for aluminum have been qualified with the *L* flag.

Laboratory Duplicate Samples
Sample 9281-1 had a laboratory duplicate RPD result greater than 20% for arsenic. However, because the concentrations were less than the RDL, sample data were not flagged. All other metals RPD results were less than the QC limit of 20%.

ORGANICS CHEMISTRY

Completeness

Organics data are reported for samples 9208-1, 9208-2, 9208-4 through 9208-9, 9281-1, 9317-1, 9445-1 and 9445-2. These samples were analyzed for chlorinated pesticides, volatile organic compounds (VOAs), polychlorinated biphenyls (PCBs), and base/neutral/acid extractable semivolatile compounds (BNAs) in association with the complete set of QC samples outlined in Table 2.

Methods

Analysis of chlorinated pesticides and PCBs was performed in accordance with EPA method 8080 (SW-846). Analysis of VOAs was performed in accordance with EPA method 8260 (SW-846). Analysis of BNAs was performed in accordance with EPA method 8270 (SW-846). BNA extracts were also analyzed by selected ion monitoring (SIM) to attain lower detection limits for chlorinated benzene compounds.

Target List

The reported BNA target list includes all compounds specified in *Table 1 - Marine Sediment Quality Standards Chemical Criteria* contained in Chapter 173-204 WAC, with the exception of benzo(j)fluoranthene. The KC Laboratory has verified that analytical conditions are sufficient to calculate a total benzofluoranthenes result using the reported *b* and *k* isomers. Reported PCB data include Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260. The reported chlorinated pesticides target list includes all compounds found on the PSDDA *Chemicals of Concern* list. DDT, DDE and DDD have been reported as 4,4' isomers.

Detection Limits, Units, and Significant Figures

Data are reported in accordance with laboratory policy at the time the data were generated. A positive result and/or MDL and RDL have been reported for all organic compounds. Sample results are reported in units of ug/Kg on a dry weight basis. Data are reported to three significant figures for results greater than the RDL and two significant figures for results equal to or less than the RDL. For results reported with less than two or three significant figures, significant zeroes are implied.

Storage Conditions and Holding Times

Sample storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The criteria used to evaluate storage conditions and holding times for organics analyses are listed in the table below.

Parameter	Frozen Holding Time	Refrigerated Holding Time
Pest/PCBs	1 Year to Extract 40 Days to Analyze	14 Days to Extract 40 Days to Analyze
BNAs	1 Year to Extract 40 Days to Analyze	14 Days to Extract 40 Days to Analyze
VOAs	Not Recommended	14 Days to Analyze

Sample storage conditions and holding times were met for chlorinated pesticide/PCB, BNAs, and VOAs for all samples in this data submission.

Method Blanks
All chlorinated pesticide/PCB, chlorobenzene, and BNA method blank results were less than the MDL. Acetone was detected in the VOA method blank associated with samples 9208-1, 9208-2, 9208-4 through 9208-9, and 9281-1. Associated acetone sample data have been qualified with the *B* flag. Methylene chloride and acetone were detected in the VOA method blank associated with samples 9317-1, 9445-1, and 9445-2. Associated acetone and methylene chloride sample data have been qualified with the *B* flag.

Surrogate Recoveries
All surrogate recoveries were within acceptable QC limits for BNAs, chlorinated pesticides/PCBs, and VOAs. Samples 9208-1, 9208-2, 9208-4 through 9208-9, 9281-1, 9317-1, 9445-1 and 9445-2 had surrogate recoveries less than 50% for d4-1,2-dichlorobenzene. Associated chlorobenzene sample data have been qualified with the *G* flag.

Standard Reference Material
The marine sediment SRM analyzed in association with the chlorinated pesticide/PCB analysis normally is 1941a, certified by the National Institute of Standards and Technology. There was no SRM associated with this data submission. An SRM is not included during SIM analysis of chlorobenzene compounds. An SRM is not included during VOA analysis.

The marine sediment SRM analyzed in association with the reported BNA analytical results is HS4, certified by the National Research Council of Canada. HS4 contains a partial list of compounds for BNA analysis. BNA data for samples 9208-1, 9208-2, 9208-4 through 9208-9, 9281-1, and 9317-1 have been qualified based on the SRM recoveries summarized in the following table.

Compound	% Recovery	Flag
Napthalene	12	G
Fluorene	42	G
Phenanthrene	40	G
Anthracene	31	G
Fluoranthene	45	G
Pyrene	50	G
Benzo(a)anthracene	56	G
Benzo(k)fluoranthene	66	G
Benzo(a)pyrene	47	G
Indeno(1,2,3-cd)pyrene	47	G
Benzo(g,h,i)perylene	45	G

BNA data for samples 9445-1 and 9445-2 have been qualified based on the SRM recoveries summarized in the following table.

Compound	% Recovery	Flag
Napthalene	13	G
Fluorene	26	G
Phenanthrene	39	G
Anthracene	37	G
Fluoranthene	43	G
Pyrene	48	G
Benzo(a)anthracene	56	G
Benzo(k)fluoranthene	72	G
Benzo(a)pyrene	50	G
Indeno(1,2,3-cd)pyrene	31	G
Dibenzo(a,h)anthracene	66	G
Benzo(g,h,i)perylene	26	G

Matrix Spike

BNA data for samples 9208-1, 9208-2, 9208-4 through 9208-9 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
Phenol	42	G
bis(2-Chloroethyl) Ether	41	G
2-Chlorophenol	40	G
2-Methylphenol	43	G
bis(2-Chloroisopropyl) Ether	39	G
4-Methylphenol	45	G
N-Nitroso-di-n-propylamine	37	G
Hexachloroethane	37	G
Nitrobenzene	41	G
Isophorone	39	G
2-Nitrophenol	40	G
2,4-Dimethylphenol	29	G
2,4-Dichlorophenol	49	G
Napthalene	41	G
4-Chloroaniline	17	G
bis(2-Chloroethoxy) methane	40	G
Hexachlorobutadiene	39	G
2-Methylnapthalene	44	G
Hexachlorocyclopentadiene	17	G
2-Chloronapthalene	49	G
3-Nitroaniline	33	G
2,4-Dinitrophenol	36	G
Pentachlorophenal	27	G
Compound	**% Recovery**	**Flag**
Benzidine	0	X
3,3'-Dichlorobenzidine	24	G

N-Nitrosodimethylamine	40	G
Aniline	12	G
Benzyl alcohol	40	G
Benzoic acid	165	L

BNA data for sample 9281-1 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
bis(2-Chloroethyl) Ether	34	G
Hexachloroethane	48	G
4-Chloroaniline	20	G
Hexachlorocyclopentadiene	35	G
3-Nitroaniline	49	G
Pentachlorophenal	42	G
Benzidine	0	X
3,3'-Dichlorobenzidine	37	G
N-Nitrosodimethylamine	42	G
Aniline	46	G

BNA data for samples 9317-1 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
N-Nitrosodimethylamine	35	G
Hexachloroethane	44	G
Hexachlorobutadiene	49	G
Hexachlorocyclopentadiene	43	G
Benzidine	0	X
Pentachlorophenal	20	G
Aniline	22	G
3,3'-Dichlorobenzidine	32	G
4-Chloroaniline	30	G

BNA data for samples 9445-1 and 9445-2 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
Hexachlorocyclopentadiene	15	G
Di-N-Butyl Pthalate	16	G
Benzidine	0	X
3,3'-Dichlorobenzidine	18	G
4-Chloroaniline	17	G
3-Nitroaniline	45	G

Chlorobenzene data for samples 9208-1, 9208-2, 9208-4 through 9208-9 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
1,3-Dichlorobenzene	42	G
1,4-Dichlorobenzene	38	G
1,2-Dichlorobenzene	33	G
1,2,4-Trichlorobenzene	42	G

Chlorobenzene data for samples 9281-1 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
1,3-Dichlorobenzene	48	G
1,4-Dichlorobenzene	41	G
1,2-Dichlorobenzene	47	G

Chlorobenzene data for samples 9317-1 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
1,3-Dichlorobenzene	45	G
1,4-Dichlorobenzene	39	G
1,2-Dichlorobenzene	44	G

Chlorinated pesticide/PCB data for sample 9317-1 have been qualified based on the matrix spike recovery of less than 10% for Endrin aldehyde. Associated Endrin aldehyde data have been qualified with the *X* flag.

Chlorinated pesticide/PCB data for samples 9445-1 and 9445-2 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
Endosulfan 1	171	L
4,4'-DDT	155	L
Endrin aldehyde	16	G

VOA data for samples 9208-1, 9208-2, 9208-4 through 9208-9, and 9281-1 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
Chloromethane	36	G
Vinyl Chloride	0	X

Bromomethane	26	G
Chloroethane	41	G
Acrolein	0	X
Vinyl Acetate	14	G

VOA data for samples 9317-1, 9445-1 and 9445-2 have been qualified based on the matrix spike recoveries summarized in the following table.

Compound	% Recovery	Flag
Vinyl Chloride	27	G
Bromomethane	31	G
Chloroethane	45	G
Acrolein	16	G
Vinyl Acetate	0	X

Laboratory Replicate Samples

The RPD results for all chlorinated pesticide/PCBs and chlorobenzene laboratory duplicate samples were less than the QC limit of 100%.

Pentachlorophenol data for samples 9208-1, 9208-2, 9208-4 through 9208-9 have been qualified with the *E* flag based on laboratory duplicate sample results with an RPD greater than 100%.

Coprostanol data for sample 9317-1 has been qualified with the E flag based on a laboratory duplicate result with an RPD greater than 100%.

For samples 9208-1, 9208-2, 9208-4 through 9208-9, and 9281-1, the RPD results for all VOA laboratory duplicate samples were less than the QC limit of 100%. Samples 9317-1, 9445-1 and 9445-2 had an RPD result greater than 100% for methylene chloride. Sample data were not qualified with an *E* flag however because both values were less than the RDL.

TABLE 1
DENNY WAY SEDIMENT CAP STUDY
SAMPLE INVENTORY

Sample	BNAs	Pesticides and PCBs	Chloro Benzenes	VOAs	Metals	Mercury	TOC	Total Solids	PSD	Comments
9208-1	X	X	X	X	X	X	X	X	X	
9208-2	X	X	X	X	X	X	X	X	X	
9208-4	X	X	X	X	X	X	X	X	X	
9208-5	X	X	X	X	X	X	X	X	X	
9208-6	X	X	X	X	X	X	X	X	X	
9208-7	X	X	X	X	X	X	X	X	X	
9208-8	X	X	X	X	X	X	X	X	X	
9208-9	X	X	X	X	X	X	X	X	X	Field Replicate
9261-1									X	
9281-1	X	X	X	X	X	X	X	X	X	
9317-1	X	X	X	X	X	X	X	X	X	
9445-1	X	X	X	X	X	X	X	X	X	
9445-2	X	X	X		X	X	X	X	X	

TABLE 2
QC SAMPLE FREQUENCY FOR SEDIMENT CHEMISTRY PARAMETERS

Parameter	Blank	Duplicate	Triplicate	Matrix Spike	SRM	Surrogate
Particle Size Distribution	NA	10% of Samples	10% of Samples	NA	NA	NA
Total Solids	NA	5% Minimum, 1 Per Batch	5% Minimum, 1 Per Batch	NA	NA	NA
Total Organic Carbon	1 Per Batch	5% Minimum, 1 Per Batch	5% Minimum, 1 Per Batch	NA	1 Per Batch	NA
Mercury	1 Per Batch	5% Minimum, 1 Per Batch	NA	5% Minimum, 1 Per Batch	1 Per Batch	NA
Metals	1 Per Batch	5% Minimum, 1 Per Batch	NA	5% Minimum, 1 Per Batch	1 Per Batch	NA
BNAs	1 Per Batch	5% Min., 1 Per Extr. Batch	1 Per Batch of > 20 Samples	5% Min., 1 Per Extr. Batch	1 Per Extraction Batch	Yes
Chlorinated Pesticides and PCBs	1 Per Batch	5% Min., 1 Per Extr. Batch	1 Per Batch of > 20 Samples	5% Min., 1 Per Extr. Batch	1 Per Extraction Batch	Yes
VOAs	1 Per Batch	5% Min., 1 Per Extr. Batch	1 Per Batch of > 20 Samples	5% Min., 1 Per Extr. Batch	NA	Yes
Chlorobenzenes	1 Per Batch	5% Min., 1 Per Extr. Batch	1 Per Batch of > 20 Samples	5% Min., 1 Per Extr. Batch	NA	Yes

TABLE 3
SUMMARY OF DATA QUALIFIERS

Condition to Qualify	METRO Data Qualifier	Organics QC Limits	Metals QC Limits	Conventionals QC Limits	Comment
very low matrix spike recovery	X	< 10 %	< 10 %	NA	
low matrix spike recovery	G	< 50%	< 75%	NA	
high matrix spike recovery	L	> 150%	>125%	NA	
low SRM recovery	G	< 80%*	NA	< 80%*	
high SRM recovery	L	>120%*	>120%	>120%*	
high duplicate RPD	E	>100 %	>20%	> 20 %	use duplicate as routine QC for organics
high triplicate RSD	E	> 100%	NA	> 20 %	use triplicate as routine QC for conventionals
less than the reporting detection limit	< RDL	NA	NA	NA	
less than the method detection limit	< MDL	NA	NA	NA	
contamination reported in blank	B	> MDL	> MDL	> MDL	
very biased data, based on surrogate recoveries	X	all fraction surrogates are <10%	NA	NA	use average surrogate recovery for BNA
biased data, based on low surrogate recoveries	G	all fraction surrogates are < 50%	NA	NA	use average surrogate recovery for BNA
biased data, based on high surrogate recoveries	L	all fraction surrogates are >150%	NA	NA	use average surrogate recovery for BNA
estimate based on presumptive evidence	J# used to indicate the presence of TIC's	NA	NA	NA	
rejected, unusable for all purposes	R	NA	NA	NA	
a sample handling criteria has been exceeded	H	NA	NA	NA	includes container, preservation, hold time, sampling technique

*Note that PSDDA guidance uses a 95% confidence window for this parameter/qualification.

APPENDIX C:

GRAB SAMPLE CHEMISTRY DATA

Data qualifiers were assigned as necessary. They include:

<MDL - Undetected at Method Detection Limit.
<RDL - Detected below Reporting Detection Limit.
G - low SRM, matrix spike, or surrogate recovery.
L - high SRM, matrix spike, or surrogate recovery.
B - Blank Contamination.

The RDL is defined as 'the minimum concentration of a chemical constituent that can be reliably quantified' (see Appendix B).

King County Environmental Lab Analytical Report

PROJECT: 421252

	Sample 1	Sample 2	Sample 3
Locator:	LTBC20 J	LTBD23 M	LTBC38 T
Sampled:	Aug 06, 96 0-2	Aug 06, 96 0-2	Aug 06, 96 0-10
Lab ID:	L9208-1	L9208-2	L9208-4
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	66.1	73.2	58.1

MDL RDL - Dry Weight Basis

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
ORGANICS															
M.Code=SW-846 8080															
4,4'-DDD		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
4,4'-DDE		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
4,4'-DDT		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Aldrin		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Alpha-BHC		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Aroclor 1016		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg		<MDL	22	46	ug/Kg
Aroclor 1221		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg		<MDL	22	46	ug/Kg
Aroclor 1232		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg		<MDL	22	46	ug/Kg
Aroclor 1242		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg		<MDL	22	46	ug/Kg
Aroclor 1248		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg	182		22	46	ug/Kg
Aroclor 1254		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg	287		22	46	ug/Kg
Aroclor 1260		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg	212		22	46	ug/Kg
Beta-BHC		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Chlordane		<MDL	10	20.1	ug/Kg		<MDL	9.2	18.2	ug/Kg		<MDL	12	22.9	ug/Kg
Delta-BHC		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Dieldrin		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Endosulfan I	2.4	<RDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Endosulfan II		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Endosulfan Sulfate		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Endrin		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Endrin Aldehyde		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Gamma-BHC (Lindane)		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Heptachlor		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Heptachlor Epoxide		<MDL	2	4.04	ug/Kg		<MDL	1.8	3.65	ug/Kg		<MDL	2.2	4.6	ug/Kg
Methoxychlor		<MDL	10	20.1	ug/Kg		<MDL	9.2	18.2	ug/Kg		<MDL	12	22.9	ug/Kg
Toxaphene		<MDL	20	40.4	ug/Kg		<MDL	18	36.5	ug/Kg		<MDL	22	46	ug/Kg
M.Code=SW-846 8260															
1,1,1-Trichloroethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
1,1,2,2-Tetrachloroethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
1,1,2-Trichloroethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
1,1,2-Trichloroethylene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
1,1-Dichloroethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
1,1-Dichloroethylene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
1,2-Dichloroethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
1,2-Dichloropropane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
2-Butanone (MEK)		<MDL	760	1510	ug/Kg		<MDL	680	1370	ug/Kg		<MDL	860	1720	ug/Kg
2-Chloroethylvinyl ether		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
2-Hexanone		<MDL	760	1510	ug/Kg		<MDL	680	1370	ug/Kg		<MDL	860	1720	ug/Kg
4-Methyl-2-Pentanone (MIBK)		<MDL	760	1510	ug/Kg		<MDL	680	1370	ug/Kg		<MDL	860	1720	ug/Kg
Acetone	890	<RDL,B	380	1510	ug/Kg	810	<RDL,B	340	1370	ug/Kg	760	<RDL,B	430	1720	ug/Kg
Acrolein		<MDL,X	760	1510	ug/Kg		<MDL,X	680	1370	ug/Kg		<MDL,X	860	1720	ug/Kg
Acrylonitrile		<MDL	760	1510	ug/Kg		<MDL	680	1370	ug/Kg		<MDL	860	1720	ug/Kg
Benzene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Bromodichloromethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Bromoform		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Bromomethane		<MDL,G	150	303	ug/Kg		<MDL,G	140	273	ug/Kg		<MDL,G	170	344	ug/Kg
Carbon Disulfide		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Carbon Tetrachloride		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Chlorobenzene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Chlorodibromomethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Chloroethane		<MDL,G	150	303	ug/Kg		<MDL,G	140	273	ug/Kg		<MDL,G	170	344	ug/Kg
Chloroform		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Chloromethane		<MDL,G	150	303	ug/Kg		<MDL,G	140	273	ug/Kg		<MDL,G	170	344	ug/Kg
Chloromethane		<MDL,G	150	303	ug/Kg		<MDL,G	140	273	ug/Kg		<MDL,G	170	344	ug/Kg
Cis-1,3-Dichloropropene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Ethylbenzene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Methylene Chloride		<MDL	150	1510	ug/Kg		<MDL	140	1370	ug/Kg		<MDL	170	1720	ug/Kg
Styrene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Tetrachloroethylene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Toluene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Total Xylenes		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Trans-1,2-Dichloroethylene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Trans-1,3-Dichloropropene		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Trichlorofluoromethane		<MDL	150	303	ug/Kg		<MDL	140	273	ug/Kg		<MDL	170	344	ug/Kg
Vinyl Acetate		<MDL,G	760	1510	ug/Kg		<MDL,G	680	1370	ug/Kg		<MDL,G	860	1720	ug/Kg
Vinyl Chloride		<MDL,X	150	303	ug/Kg		<MDL,X	140	273	ug/Kg		<MDL,X	170	344	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 421252			
Locator:	LTBC20 J	LTBD23 M	LTBC38 T
Sampled:	Aug 06, 96 0-2	Aug 06, 96 0-2	Aug 06, 96 0-10
Lab ID:	L9208-1	L9208-2	L9208-4
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	66.1	73.2	58.1

Parameters	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units
M.Code=SW-846 8270															
1,2-Diphenylhydrazine		<MDL	80	162	ug/Kg		<MDL	72	146	ug/Kg		<MDL	91	184	ug/Kg
2,4,5-Trichlorophenol		<MDL	170	322	ug/Kg		<MDL	150	291	ug/Kg		<MDL	190	367	ug/Kg
2,4,6-Trichlorophenol		<MDL	170	322	ug/Kg		<MDL	150	291	ug/Kg		<MDL	190	367	ug/Kg
2,4-Dichlorophenol		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
2,4-Dimethylphenol		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
2,4-Dinitrophenol		<MDL,G	80	162	ug/Kg		<MDL,G	72	146	ug/Kg		<MDL,G	91	184	ug/Kg
2,4-Dinitrotoluene		<MDL	17	32.2	ug/Kg		<MDL	15	29.1	ug/Kg		<MDL	19	36.7	ug/Kg
2,6-Dinitrotoluene		<MDL	17	32.2	ug/Kg		<MDL	15	29.1	ug/Kg		<MDL	19	36.7	ug/Kg
2-Chloronaphthalene		<MDL,G	24	40.4	ug/Kg		<MDL,G	22	36.5	ug/Kg		<MDL,G	28	46	ug/Kg
2-Chlorophenol		<MDL,G	80	162	ug/Kg		<MDL,G	72	146	ug/Kg		<MDL,G	91	184	ug/Kg
2-Methylnaphthalene		<MDL,G	65	121	ug/Kg		<MDL,G	59	109	ug/Kg		<MDL,G	74	138	ug/Kg
2-Methylphenol		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
2-Nitroaniline		<MDL	170	242	ug/Kg		<MDL	150	219	ug/Kg		<MDL	190	275	ug/Kg
2-Nitrophenol		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
3,3'-Dichlorobenzidine		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
3-Nitroaniline		<MDL,G	170	242	ug/Kg		<MDL,G	150	219	ug/Kg		<MDL,G	190	275	ug/Kg
4,6-Dinitro-O-Cresol		<MDL	80	162	ug/Kg		<MDL	72	146	ug/Kg		<MDL	91	184	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	17	24.2	ug/Kg		<MDL	15	21.9	ug/Kg		<MDL	19	27.5	ug/Kg
4-Chloro-3-Methylphenol		<MDL	80	162	ug/Kg		<MDL	72	146	ug/Kg		<MDL	91	184	ug/Kg
4-Chloroaniline		<MDL,G	80	162	ug/Kg		<MDL,G	72	146	ug/Kg		<MDL,G	91	184	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	24	40.4	ug/Kg		<MDL	22	36.5	ug/Kg		<MDL	28	46	ug/Kg
4-Methylphenol		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
4-Nitroaniline		<MDL	170	242	ug/Kg		<MDL	150	219	ug/Kg		<MDL	190	275	ug/Kg
4-Nitrophenol		<MDL	80	162	ug/Kg		<MDL	72	146	ug/Kg		<MDL	91	184	ug/Kg
Acenaphthene		<MDL	17	32.2	ug/Kg		<MDL	15	29.1	ug/Kg	42.2		19	36.7	ug/Kg
Acenaphthylene		<MDL	24	40.4	ug/Kg		<MDL	22	36.5	ug/Kg	29	<RDL	28	46	ug/Kg
Aniline		<MDL,G	80	162	ug/Kg		<MDL,G	72	146	ug/Kg		<MDL,G	91	184	ug/Kg
Anthracene	153	G	24	40.4	ug/Kg	60.9	G	22	36.5	ug/Kg	160	G	28	46	ug/Kg
Benzidine		<MDL,X	970	1940	ug/Kg		<MDL,X	870	1750	ug/Kg		<MDL,X	1100	2200	ug/Kg
Benzo(a)anthracene	247	G	24	40.4	ug/Kg	150	G	22	36.5	ug/Kg	420	G	28	46	ug/Kg
Benzo(a)pyrene	265	G	41	80.6	ug/Kg	150	G	37	72.8	ug/Kg	592	G	46	91.7	ug/Kg
Benzo(b)fluoranthene	359		65	121	ug/Kg	206		59	109	ug/Kg	833		74	138	ug/Kg
Benzo(g,h,i)perylene	146	G	41	80.6	ug/Kg	73.2	G	37	72.8	ug/Kg	272	G	46	91.7	ug/Kg
Benzo(k)fluoranthene	143	G	65	121	ug/Kg	96	<RDL,G	59	109	ug/Kg	324	G	74	138	ug/Kg
Benzoic Acid	626	L	170	242	ug/Kg	481	L	150	219	ug/Kg	360	L	190	275	ug/Kg
Benzyl Alcohol		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
Benzyl Butyl Phthalate	60.7		24	40.4	ug/Kg	30	<RDL	22	36.5	ug/Kg	158		28	46	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	24	40.4	ug/Kg		<MDL,G	22	36.5	ug/Kg		<MDL,G	28	46	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	80	162	ug/Kg		<MDL,G	72	146	ug/Kg		<MDL,G	91	184	ug/Kg
Bis(2-Ethylhexyl)Phthalate	422		24	40.4	ug/Kg	120		22	36.5	ug/Kg	1440		28	46	ug/Kg
Carbazole	54	<RDL	41	80.6	ug/Kg		<MDL	37	72.8	ug/Kg	60	<RDL	46	91.7	ug/Kg
Chrysene	339		24	40.4	ug/Kg	191		22	36.5	ug/Kg	544		28	46	ug/Kg
Coprostanol	802		170	242	ug/Kg	346		150	219	ug/Kg	1060		190	275	ug/Kg
Di-N-Butyl Phthalate		<MDL	41	80.6	ug/Kg		<MDL	37	72.8	ug/Kg	52	<RDL	46	91.7	ug/Kg
Di-N-Octyl Phthalate		<MDL	24	40.4	ug/Kg		<MDL	22	36.5	ug/Kg	40	<RDL	28	46	ug/Kg
Dibenzo(a,h)anthracene		<MDL	65	121	ug/Kg		<MDL	59	109	ug/Kg	77	<RDL	74	138	ug/Kg
Dibenzofuran		<MDL	41	80.6	ug/Kg		<MDL	37	72.8	ug/Kg		<MDL	46	91.7	ug/Kg
Diethyl Phthalate		<MDL	41	80.6	ug/Kg		<MDL	37	72.8	ug/Kg		<MDL	46	91.7	ug/Kg
Dimethyl Phthalate		<MDL	17	24.2	ug/Kg		<MDL	15	21.9	ug/Kg		<MDL	19	27.5	ug/Kg
Fluoranthene	431	G	24	48.4	ug/Kg	294	G	22	43.7	ug/Kg	737	G	28	55.1	ug/Kg
Fluorene	33	<RDL,G	24	40.4	ug/Kg		<MDL,G	22	36.5	ug/Kg	47.3	G	28	46	ug/Kg
Hexachlorobutadiene		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
Hexachlorocyclopentadiene		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
Hexachloroethane		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
Indeno(1,2,3-Cd)Pyrene	148	G	41	80.6	ug/Kg	79.5	G	37	72.8	ug/Kg	286	G	46	91.7	ug/Kg
Isophorone		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
N-Nitrosodimethylamine		<MDL,G	170	242	ug/Kg		<MDL,G	150	219	ug/Kg		<MDL,G	190	275	ug/Kg
N-Nitrosodiphenylamine		<MDL	41	80.6	ug/Kg		<MDL	37	72.8	ug/Kg		<MDL	46	91.7	ug/Kg
Naphthalene		<MDL,G	65	121	ug/Kg		<MDL,G	59	109	ug/Kg		<MDL,G	74	138	ug/Kg
Nitrobenzene		<MDL,G	41	80.6	ug/Kg		<MDL,G	37	72.8	ug/Kg		<MDL,G	46	91.7	ug/Kg
Pentachlorophenol		<MDL,E,G	41	80.6	ug/Kg		<MDL,E,G	37	72.8	ug/Kg		<MDL,E,G	46	91.7	ug/Kg
Phenanthrene	216	G	24	40.4	ug/Kg	175	G	22	36.5	ug/Kg	449	G	28	46	ug/Kg
Phenol		<MDL,G	170	242	ug/Kg		<MDL,G	150	219	ug/Kg		<MDL,G	190	275	ug/Kg
Pyrene	396	G	24	40.4	ug/Kg	301	G	22	36.5	ug/Kg	1050	G	28	46	ug/Kg
M.Code=SW-846 8270 (SIM)															
1,2,4-Trichlorobenzene		<MDL,G	1	2.01	ug/Kg		<MDL,G	0.94	1.82	ug/Kg		<MDL,G	1.2	2.29	ug/Kg
1,2-Dichlorobenzene		<MDL,G	1	2.01	ug/Kg		<MDL,G	0.94	1.82	ug/Kg	1.5	<RDL,G	1.2	2.29	ug/Kg
1,3-Dichlorobenzene		<MDL,G	1	2.01	ug/Kg		<MDL,G	0.94	1.82	ug/Kg		<MDL,G	1.2	2.29	ug/Kg
1,4-Dichlorobenzene		<MDL,G	1	2.01	ug/Kg		<MDL,G	0.94	1.82	ug/Kg	6.25	G	1.2	2.29	ug/Kg
Hexachlorobenzene		<MDL,G	1	2.01	ug/Kg		<MDL,G	0.94	1.82	ug/Kg		<MDL,G	1.2	2.29	ug/Kg

* indicates wet weight used for this parameter

King County Environmental Lab Analytical Report

PROJECT: 421252	Locator: LTBC20 J	Locator: LTBD23 M	Locator: LTBC38 T
	Sampled: Aug 06, 96 0-2	Sampled: Aug 06, 96 0-2	Sampled: Aug 06, 96 0-10
	Lab ID: L9208-1	Lab ID: L9208-2	Lab ID: L9208-4
	Matrix: SALTWTRSED	Matrix: SALTWTRSED	Matrix: SALTWTRSED
	% Solids: 66.1	% Solids: 73.2	% Solids: 58.1

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis		
METALS															
M.Code=METRO 16-01-001															
Mercury, Total, CVAA	0.13	<RDL	0.03	0.3	mg/Kg	0.081	<RDL	0.025	0.25	mg/Kg	0.683		0.033	0.325	mg/Kg
M.Code=METRO 16-02-004															
Aluminum, Total, ICP	13100	L	7.9	39	mg/Kg	10900	L	6.6	32.9	mg/Kg	19300	L	8.8	44.2	mg/Kg
Antimony, Total, ICP		<MDL,G	2.3	11.7	mg/Kg		<MDL,G	1.9	9.86	mg/Kg	4.1	<RDL,G	2.6	13.3	mg/Kg
Arsenic, Total, ICP	4.8	<RDL	3.9	19.5	mg/Kg	6.4	<RDL	3.3	16.4	mg/Kg	7.9	<RDL	4.5	22.2	mg/Kg
Barium, Total, ICP	31.3		0.08	0.39	mg/Kg	39.2		0.066	0.329	mg/Kg	78		0.088	0.442	mg/Kg
Beryllium, Total, ICP	0.29	<RDL	0.08	0.39	mg/Kg	0.27	<RDL	0.066	0.329	mg/Kg	0.41	<RDL	0.088	0.442	mg/Kg
Cadmium, Total, ICP	0.47	<RDL	0.23	1.17	mg/Kg		<MDL	0.19	0.986	mg/Kg	1.3	<RDL	0.26	1.33	mg/Kg
Calcium, Total, ICP	4610		3.9	19.5	mg/Kg	3880		3.3	16.4	mg/Kg	5610		4.5	22.2	mg/Kg
Chromium, Total, ICP	18.2		0.39	1.95	mg/Kg	16.7		0.33	1.64	mg/Kg	48.2		0.45	2.22	mg/Kg
Copper, Total, ICP	24.5		0.32	1.56	mg/Kg	16.4		0.26	1.32	mg/Kg	65.7		0.36	1.77	mg/Kg
Iron, Total, ICP	20600		3.9	19.5	mg/Kg	20800		3.3	16.4	mg/Kg	22900		4.5	22.2	mg/Kg
Lead, Total, ICP	17.1		2.3	11.7	mg/Kg	11		1.9	9.86	mg/Kg	100		2.6	13.3	mg/Kg
Magnesium, Total, ICP	5040		2.3	11.7	mg/Kg	4630		1.9	9.86	mg/Kg	8730		2.6	13.3	mg/Kg
Manganese, Total, ICP	198		0.15	0.779	mg/Kg	202		0.13	0.657	mg/Kg	262		0.17	0.886	mg/Kg
Molybdenum, Total, ICP		<MDL	1.5	7.79	mg/Kg		<MDL	1.3	6.57	mg/Kg	4.6	<RDL	1.7	8.86	mg/Kg
Nickel, Total, ICP	16.8		1.5	7.79	mg/Kg	13.9		1.3	6.57	mg/Kg	45.1		1.7	8.86	mg/Kg
Potassium, Total, ICP	1490		150	779	mg/Kg	1260		130	657	mg/Kg	2320		170	886	mg/Kg
Selenium, Total, ICP		<MDL	3.9	19.5	mg/Kg		<MDL	3.3	16.4	mg/Kg		<MDL	4.5	22.2	mg/Kg
Silver, Total, ICP	1.5	<RDL	0.32	1.56	mg/Kg		<MDL	0.26	1.32	mg/Kg	4.78		0.36	1.77	mg/Kg
Sodium, Total, ICP															
Thallium, Total, ICP		<MDL	15	77.9	mg/Kg	16	<RDL	13	65.7	mg/Kg		<MDL	17	88.6	mg/Kg
Zinc, Total, ICP	63.8		0.39	1.95	mg/Kg	53		0.33	1.64	mg/Kg	124		0.45	2.22	mg/Kg
* indicates wet weight used for this parameter															
CONVENTIONALS															
M.Code=PSEP p9															
p+0.00 *	1.2		0.1		%	6.3		0.1		%	0.5		0.1		%
p+1.00 *	25.2		0.1		%	37.1		0.1		%	0.7		0.1		%
p+10.0 *		<MDL	0.1		%		<MDL	0.1		%	2.6		0.1		%
p+10.0(more than) *	3.1		0.1		%	0.7		0.1		%	7.5		0.1		%
p+2.00 *	44.5		0.1		%	39.9		0.1		%	1.9		0.1		%
p+3.00 *	13.2		0.1		%	5.2		0.1		%	9.4		0.1		%
p+4.00 *	3.1		0.1		%	0.8		0.1		%	21.5		0.1		%
p+5.00 *	1.2		0.1		%	3.4		0.1		%	12.5		0.1		%
p+6.00 *	1.6		0.1		%	0.4		0.1		%	15.3		0.1		%
p+7.00 *	2.2		0.1		%	1.5		0.1		%	11.5		0.1		%
p+8.00 *	2.9		0.1		%	2.3		0.1		%	10.4		0.1		%
p+9.00 *	0.5		0.1		%	0.3		0.1		%	5.3		0.1		%
p-1.00 *	0.5		0.1		%	1.2		0.1		%	0.5		0.1		%
p-2.00 *	0.3		0.1		%	0.3		0.1		%		<MDL	0.1		%
p-2.00(less than) *	0.8		0.1		%	0.7		0.1		%	0.5		0.1		%
M.Code=SM5310-B															
Total Organic Carbon	9030		7.6	15.1	mg/Kg	3310		6.8	13.7	mg/Kg	29600		8.6	17.2	mg/Kg
* indicates wet weight used for this parameter															

King County Environmental Lab Analytical Report

PROJECT: 421252

	Sample 1	Sample 2	Sample 3
Locator:	LTBC21 K	LTBC22 L	LTBC21 K
Sampled:	Aug 06, 96 0-2	Aug 06, 96 0-2	Aug 06, 96 2-10
Lab ID:	L9208-5	L9208-6	L9208-7
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	60.4	74.5	62.2

Parameters	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units
ORGANICS															
M.Code=SW-846 8080															
4,4'-DDD		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
4,4'-DDE		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
4,4'-DDT		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Aldrin		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Alpha-BHC		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Aroclor 1016		<MDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg		<MDL	21	42.9	ug/Kg
Aroclor 1221		<MDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg		<MDL	21	42.9	ug/Kg
Aroclor 1232		<MDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg		<MDL	21	42.9	ug/Kg
Aroclor 1242		<MDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg		<MDL	21	42.9	ug/Kg
Aroclor 1248		<MDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg		<MDL	21	42.9	ug/Kg
Aroclor 1254	26	<RDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg	40	<RDL	21	42.9	ug/Kg
Aroclor 1260	25	<RDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg	45.5		21	42.9	ug/Kg
Beta-BHC		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Chlordane		<MDL	11	22	ug/Kg		<MDL	9	17.9	ug/Kg		<MDL	11	21.4	ug/Kg
Delta-BHC		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Dieldrin		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Endosulfan I	4	<RDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Endosulfan II		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Endosulfan Sulfate		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Endrin		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Endrin Aldehyde		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Gamma-BHC (Lindane)		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Heptachlor		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Heptachlor Epoxide		<MDL	2.2	4.42	ug/Kg		<MDL	1.7	3.58	ug/Kg		<MDL	2.1	4.29	ug/Kg
Methoxychlor		<MDL	11	22	ug/Kg		<MDL	9	17.9	ug/Kg		<MDL	11	21.4	ug/Kg
Toxaphene		<MDL	22	44.2	ug/Kg		<MDL	17	35.8	ug/Kg		<MDL	21	42.9	ug/Kg
M.Code=SW-846 8260															
1,1,1-Trichloroethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
1,1,2,2-Tetrachloroethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
1,1,2-Trichloroethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
1,1,2-Trichloroethylene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
1,1-Dichloroethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
1,1-Dichloroethylene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
1,2-Dichloroethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
1,2-Dichloropropane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
2-Butanone (MEK)		<MDL	830	1660	ug/Kg		<MDL	670	1340	ug/Kg		<MDL	800	1610	ug/Kg
2-Chloroethylvinyl ether		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
2-Hexanone		<MDL	830	1660	ug/Kg		<MDL	670	1340	ug/Kg		<MDL	800	1610	ug/Kg
4-Methyl-2-Pentanone (MIBK)		<MDL	830	1660	ug/Kg		<MDL	670	1340	ug/Kg		<MDL	800	1610	ug/Kg
Acetone	980	<RDL,B	410	1660	ug/Kg	700	<RDL,B	340	1340	ug/Kg	760	<RDL,B	400	1610	ug/Kg
Acrolein		<MDL,X	830	1660	ug/Kg		<MDL,X	670	1340	ug/Kg		<MDL,X	800	1610	ug/Kg
Acrylonitrile		<MDL	830	1660	ug/Kg		<MDL	670	1340	ug/Kg		<MDL	800	1610	ug/Kg
Benzene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Bromodichloromethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Bromoform		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Bromomethane		<MDL,G	170	331	ug/Kg		<MDL,G	130	268	ug/Kg		<MDL,G	160	322	ug/Kg
Carbon Disulfide		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Carbon Tetrachloride		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Chlorobenzene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Chlorodibromomethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Chloroethane		<MDL,G	170	331	ug/Kg		<MDL,G	130	268	ug/Kg		<MDL,G	160	322	ug/Kg
Chloroform		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Chloromethane		<MDL,G	170	331	ug/Kg		<MDL,G	130	268	ug/Kg		<MDL,G	160	322	ug/Kg
Chloromethane		<MDL,G	170	331	ug/Kg		<MDL,G	130	268	ug/Kg		<MDL,G	160	322	ug/Kg
Cis-1,3-Dichloropropene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Ethylbenzene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Methylene Chloride		<MDL	170	1660	ug/Kg		<MDL	130	1340	ug/Kg		<MDL	160	1610	ug/Kg
Styrene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Tetrachloroethylene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Toluene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Total Xylenes		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Trans-1,2-Dichloroethylene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Trans-1,3-Dichloropropene		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Trichlorofluoromethane		<MDL	170	331	ug/Kg		<MDL	130	268	ug/Kg		<MDL	160	322	ug/Kg
Vinyl Acetate		<MDL,G	830	1660	ug/Kg		<MDL,G	670	1340	ug/Kg		<MDL,G	800	1610	ug/Kg
Vinyl Chloride		<MDL,X	170	331	ug/Kg		<MDL,X	130	268	ug/Kg		<MDL,X	160	322	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 421252

	Sample 1	Sample 2	Sample 3
Locator:	LTBC21 K	LTBC22 L	LTBC21 K
Sampled:	Aug 06, 96 0-2	Aug 06, 96 0-2	Aug 06, 96 2-10
Lab ID:	L9208-5	L9208-6	L9208-7
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	60.4	74.5	62.2

Parameters	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units
M.Code=SW-846 8270															
1,2-Diphenylhydrazine		<MDL	88	177	ug/Kg		<MDL	71	144	ug/Kg		<MDL	85	172	ug/Kg
2,4,5-Trichlorophenol		<MDL	180	353	ug/Kg		<MDL	150	286	ug/Kg		<MDL	180	342	ug/Kg
2,4,6-Trichlorophenol		<MDL	180	353	ug/Kg		<MDL	150	286	ug/Kg		<MDL	180	342	ug/Kg
2,4-Dichlorophenol		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
2,4-Dimethylphenol		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
2,4-Dinitrophenol		<MDL,G	88	177	ug/Kg		<MDL,G	71	144	ug/Kg		<MDL,G	85	172	ug/Kg
2,4-Dinitrotoluene		<MDL	18	35.3	ug/Kg		<MDL	15	28.6	ug/Kg		<MDL	18	34.2	ug/Kg
2,6-Dinitrotoluene		<MDL	18	35.3	ug/Kg		<MDL	15	28.6	ug/Kg		<MDL	18	34.2	ug/Kg
2-Chloronaphthalene		<MDL,G	26	44.2	ug/Kg		<MDL,G	21	35.8	ug/Kg		<MDL,G	26	42.9	ug/Kg
2-Chlorophenol		<MDL,G	88	177	ug/Kg		<MDL,G	71	144	ug/Kg		<MDL,G	85	172	ug/Kg
2-Methylnaphthalene		<MDL,G	71	132	ug/Kg		<MDL,G	58	107	ug/Kg		<MDL,G	69	129	ug/Kg
2-Methylphenol		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
2-Nitroaniline		<MDL	180	265	ug/Kg		<MDL	150	215	ug/Kg		<MDL	180	257	ug/Kg
2-Nitrophenol		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
3,3'-Dichlorobenzidine		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
3-Nitroaniline		<MDL,G	180	265	ug/Kg		<MDL,G	150	215	ug/Kg		<MDL,G	180	257	ug/Kg
4,6-Dinitro-O-Cresol		<MDL	88	177	ug/Kg		<MDL	71	144	ug/Kg		<MDL	85	172	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	18	26.5	ug/Kg		<MDL	15	21.5	ug/Kg		<MDL	18	25.7	ug/Kg
4-Chloro-3-Methylphenol		<MDL	88	177	ug/Kg		<MDL	71	144	ug/Kg		<MDL	85	172	ug/Kg
4-Chloroaniline		<MDL,G	88	177	ug/Kg		<MDL,G	71	144	ug/Kg		<MDL,G	85	172	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	26	44.2	ug/Kg		<MDL	21	35.8	ug/Kg		<MDL	26	42.9	ug/Kg
4-Methylphenol		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
4-Nitroaniline		<MDL	180	265	ug/Kg		<MDL	150	215	ug/Kg		<MDL	180	257	ug/Kg
4-Nitrophenol		<MDL	88	177	ug/Kg		<MDL	71	144	ug/Kg		<MDL	85	172	ug/Kg
Acenaphthene	25	<RDL	18	35.3	ug/Kg		<MDL	15	28.6	ug/Kg	99.5		18	34.2	ug/Kg
Acenaphthylene		<MDL	26	44.2	ug/Kg		<MDL	21	35.8	ug/Kg		<MDL	26	42.9	ug/Kg
Aniline		<MDL,G	88	177	ug/Kg		<MDL,G	71	144	ug/Kg		<MDL,G	85	172	ug/Kg
Anthracene	230	G	26	44.2	ug/Kg	54.5	G	21	35.8	ug/Kg	155	G	26	42.9	ug/Kg
Benzidine		<MDL,X	1100	2120	ug/Kg		<MDL,X	860	1720	ug/Kg		<MDL,X	1000	2060	ug/Kg
Benzo(a)anthracene	358	G	26	44.2	ug/Kg	94.9	G	21	35.8	ug/Kg	375	G	26	42.9	ug/Kg
Benzo(a)pyrene	422	G	45	88.2	ug/Kg	126	G	36	71.5	ug/Kg	453	G	43	85.7	ug/Kg
Benzo(b)fluoranthene	599		71	132	ug/Kg	164		58	107	ug/Kg	635		69	129	ug/Kg
Benzo(g,h,i)perylene	195	G	45	88.2	ug/Kg	76.6	G	36	71.5	ug/Kg	215	G	43	85.7	ug/Kg
Benzo(k)fluoranthene	283	G	71	132	ug/Kg	64	<RDL,G	58	107	ug/Kg	293	G	69	129	ug/Kg
Benzoic Acid		<MDL,L	180	265	ug/Kg		<MDL,L	150	215	ug/Kg		<MDL,L	180	257	ug/Kg
Benzyl Alcohol		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
Benzyl Butyl Phthalate	96.2		26	44.2	ug/Kg		<MDL	21	35.8	ug/Kg	94.9		26	42.9	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	26	44.2	ug/Kg		<MDL,G	21	35.8	ug/Kg		<MDL,G	26	42.9	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	88	177	ug/Kg		<MDL,G	71	144	ug/Kg		<MDL,G	85	172	ug/Kg
Bis(2-Ethylhexyl)Phthalate	2670		26	44.2	ug/Kg	117		21	35.8	ug/Kg	921		26	42.9	ug/Kg
Carbazole	88	<RDL	45	88.2	ug/Kg		<MDL	36	71.5	ug/Kg	74	<RDL	43	85.7	ug/Kg
Chrysene	546		26	44.2	ug/Kg	138		21	35.8	ug/Kg	540		26	42.9	ug/Kg
Coprostanol	808		180	265	ug/Kg	271		150	215	ug/Kg	815		180	257	ug/Kg
Di-N-Butyl Phthalate		<MDL	45	88.2	ug/Kg		<MDL	36	71.5	ug/Kg		<MDL	43	85.7	ug/Kg
Di-N-Octyl Phthalate	146		26	44.2	ug/Kg		<MDL	21	35.8	ug/Kg	40	<RDL	26	42.9	ug/Kg
Dibenzo(a,h)anthracene		<MDL	71	132	ug/Kg		<MDL	58	107	ug/Kg		<MDL	69	129	ug/Kg
Dibenzofuran		<MDL	45	88.2	ug/Kg		<MDL	36	71.5	ug/Kg		<MDL	43	85.7	ug/Kg
Diethyl Phthalate		<MDL	45	88.2	ug/Kg		<MDL	36	71.5	ug/Kg		<MDL	43	85.7	ug/Kg
Dimethyl Phthalate		<MDL	18	26.5	ug/Kg		<MDL	15	21.5	ug/Kg		<MDL	18	25.7	ug/Kg
Fluoranthene	773	G	26	53	ug/Kg	199	G	21	43	ug/Kg	770	G	26	51.4	ug/Kg
Fluorene	57.3	G	26	44.2	ug/Kg		<MDL,G	21	35.8	ug/Kg	111	G	26	42.9	ug/Kg
Hexachlorobutadiene		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
Hexachlorocyclopentadiene		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
Hexachloroethane		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
Indeno(1,2,3-Cd)Pyrene	217	G	45	88.2	ug/Kg	73.4	G	36	71.5	ug/Kg	220	G	43	85.7	ug/Kg
Isophorone		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
N-Nitrosodimethylamine		<MDL,G	180	265	ug/Kg		<MDL,G	150	215	ug/Kg		<MDL,G	180	257	ug/Kg
N-Nitrosodiphenylamine		<MDL	45	88.2	ug/Kg		<MDL	36	71.5	ug/Kg		<MDL	43	85.7	ug/Kg
Naphthalene		<MDL,G	71	132	ug/Kg		<MDL,G	58	107	ug/Kg		<MDL,G	69	129	ug/Kg
Nitrobenzene		<MDL,G	45	88.2	ug/Kg		<MDL,G	36	71.5	ug/Kg		<MDL,G	43	85.7	ug/Kg
Pentachlorophenol		<MDL,E,G	45	88.2	ug/Kg		<MDL,E,G	36	71.5	ug/Kg		<MDL,E,G	43	85.7	ug/Kg
Phenanthrene	411	G	26	44.2	ug/Kg	98.3	G	21	35.8	ug/Kg	601	G	26	42.9	ug/Kg
Phenol		<MDL,G	180	265	ug/Kg		<MDL,G	150	215	ug/Kg		<MDL,G	180	257	ug/Kg
Pyrene	714	G	26	44.2	ug/Kg	180	G	21	35.8	ug/Kg	749	G	26	42.9	ug/Kg
M.Code=SW-846 8270 (SIM)															
1,2,4-Trichlorobenzene		<MDL,G	1.1	2.2	ug/Kg		<MDL,G	0.93	1.79	ug/Kg		<MDL,G	1.1	2.14	ug/Kg
1,2-Dichlorobenzene		<MDL,G	1.1	2.2	ug/Kg		<MDL,G	0.93	1.79	ug/Kg		<MDL,G	1.1	2.14	ug/Kg
1,3-Dichlorobenzene		<MDL,G	1.1	2.2	ug/Kg		<MDL,G	0.93	1.79	ug/Kg		<MDL,G	1.1	2.14	ug/Kg
1,4-Dichlorobenzene		<MDL,G	1.1	2.2	ug/Kg		<MDL,G	0.93	1.79	ug/Kg		<MDL,G	1.1	2.14	ug/Kg
Hexachlorobenzene		<MDL,G	1.1	2.2	ug/Kg		<MDL,G	0.93	1.79	ug/Kg		<MDL,G	1.1	2.14	ug/Kg

* indicates wet weight used for this parameter

King County Environmental Lab Analytical Report

PROJECT: 421252	Locator: LTBC21 K	Locator: LTBC22 L	Locator: LTBC21 K
	Sampled: Aug 06, 96 0-2	Sampled: Aug 06, 96 0-2	Sampled: Aug 06, 96 2-10
	Lab ID: L9208-5	Lab ID: L9208-6	Lab ID: L9208-7
	Matrix: SALTWTRSED	Matrix: SALTWTRSED	Matrix: SALTWTRSED
	% Solids: 60.4	% Solids: 74.5	% Solids: 62.2

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis		
METALS															
M.Code=METRO 16-01-001															
Mercury, Total, CVAA	0.18	<RDL	0.03	0.303	mg/Kg	0.064	<RDL	0.027	0.263	mg/Kg	0.23	H	0.061	0.613	mg/Kg
M.Code=METRO 16-02-004															
Aluminum, Total, ICP	15600	L	7.9	40.1	mg/Kg	11400	L	6.7	33.7	mg/Kg	15000	L	8	40.2	mg/Kg
Antimony, Total, ICP	2.8	<RDL,G	2.5	12	mg/Kg		<MDL,G	2	10.1	mg/Kg		<MDL,G	2.4	12	mg/Kg
Arsenic, Total, ICP	5	<RDL	4	20	mg/Kg	3.8	<RDL	3.4	16.8	mg/Kg	5.1	<RDL	4	20.1	mg/Kg
Barium, Total, ICP	46.5		0.079	0.401	mg/Kg	26		0.067	0.337	mg/Kg	48.1		0.08	0.402	mg/Kg
Beryllium, Total, ICP	0.36	<RDL	0.079	0.401	mg/Kg	0.26	<RDL	0.067	0.337	mg/Kg	0.34	<RDL	0.08	0.402	mg/Kg
Cadmium, Total, ICP	0.3	<RDL	0.25	1.2	mg/Kg		<MDL	0.2	1.01	mg/Kg	0.43	<RDL	0.24	1.2	mg/Kg
Calcium, Total, ICP	5170		4	20	mg/Kg	3990		3.4	16.8	mg/Kg	4790		4	20.1	mg/Kg
Chromium, Total, ICP	22.8		0.4	2	mg/Kg	15.6		0.34	1.68	mg/Kg	24.1		0.4	2.01	mg/Kg
Copper, Total, ICP	32.6		0.31	1.6	mg/Kg	16.2		0.27	1.34	mg/Kg	38.1		0.32	1.61	mg/Kg
Iron, Total, ICP	23500		4	20	mg/Kg	19200		3.4	16.8	mg/Kg	21400		4	20.1	mg/Kg
Lead, Total, ICP	26.7		2.5	12	mg/Kg	10.2		2	10.1	mg/Kg	31.5		2.4	12	mg/Kg
Magnesium, Total, ICP	5990		2.5	12	mg/Kg	4580		2	10.1	mg/Kg	5760		2.4	12	mg/Kg
Manganese, Total, ICP	235		0.16	0.801	mg/Kg	207		0.13	0.672	mg/Kg	214		0.16	0.804	mg/Kg
Molybdenum, Total, ICP	1.6	<RDL	1.6	8.01	mg/Kg		<MDL	1.3	6.72	mg/Kg	2.4	<RDL	1.6	8.04	mg/Kg
Nickel, Total, ICP	19.4		1.6	8.01	mg/Kg	14.5		1.3	6.72	mg/Kg	19.9		1.6	8.04	mg/Kg
Potassium, Total, ICP	1890		160	801	mg/Kg	1130		130	672	mg/Kg	1860		160	804	mg/Kg
Selenium, Total, ICP		<MDL	4	20	mg/Kg		<MDL	3.4	16.8	mg/Kg		<MDL	4	20.1	mg/Kg
Silver, Total, ICP	1.5	<RDL	0.31	1.6	mg/Kg		<MDL	0.27	1.34	mg/Kg	1.4	<RDL	0.32	1.61	mg/Kg
Sodium, Total, ICP															
Thallium, Total, ICP		<MDL	16	80.1	mg/Kg		<MDL	13	67.2	mg/Kg		<MDL	16	80.4	mg/Kg
Zinc, Total, ICP	79.8		0.4	2	mg/Kg	53.6		0.34	1.68	mg/Kg	85.9		0.4	2.01	mg/Kg
* indicates wet weight used for this parameter															
CONVENTIONALS															
M.Code=PSEP p9															
p+0.00 *	2.1		0.1		%	4.4		0.1		%	2.5		0.1		%
p+1.00 *	20.6		0.1		%	38		0.1		%	20		0.1		%
p+10.0 *	0.9		0.1		%	0.3		0.1		%	0.8		0.1		%
p+10.0(more than) *	5		0.1		%	1.2		0.1		%	3.9		0.1		%
p+2.00 *	39.2		0.1		%	38.9		0.1		%	39.4		0.1		%
p+3.00 *	13.5		0.1		%	6.3		0.1		%	13.1		0.1		%
p+4.00 *	3		0.1		%	1		0.1		%	3.7		0.1		%
p+5.00 *	2.6		0.1		%	0.4		0.1		%	0.9		0.1		%
p+6.00 *	1.9		0.1		%	1.4		0.1		%	4.8		0.1		%
p+7.00 *	4.1		0.1		%	1.4		0.1		%	3.8		0.1		%
p+8.00 *	3.7		0.1		%	2		0.1		%	3.9		0.1		%
p+9.00 *	1.9		0.1		%	0.7		0.1		%	1.8		0.1		%
p-1.00 *	0.5		0.1		%	1.2		0.1		%	0.8		0.1		%
p-2.00 *	0.2		0.1		%	0.3		0.1		%		<MDL	0.1		%
p-2.00(less than) *	0.9		0.1		%	2.6		0.1		%	0.5		0.1		%
M.Code=SM5310-B															
Total Organic Carbon	14000		8.3	16.6	mg/Kg	3740		6.7	13.4	mg/Kg	13700		8	16.1	mg/Kg
* indicates wet weight used for this parameter															

King County Environmental Lab Analytical Report

PROJECT: 421252	Locator: LTBC22 L	Locator: LTBC38 T	Locator: LTBD25 S
	Sampled: Aug 06, 96 2-10	Sampled: Aug 12, 9(0-2	Sampled: Aug 27, 9(0-2
	Lab ID: L9208-8	Lab ID: L9281-1	Lab ID: L9317-1
	Matrix: SALTWTRSED	Matrix: SALTWTRSED	Matrix: SALTWTRSED
	% Solids: 73.8	% Solids: 55	% Solids: 79.7

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
ORGANICS															
M.Code=SW-846 8080															
4,4'-DDD		<MDL	1.8	3.62	ug/Kg	645		2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
4,4'-DDE		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
4,4'-DDT		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Aldrin		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Alpha-BHC		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Aroclor 1016		<MDL	18	36.2	ug/Kg		<MDL	24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
Aroclor 1221		<MDL	18	36.2	ug/Kg		<MDL	24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
Aroclor 1232		<MDL	18	36.2	ug/Kg		<MDL	24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
Aroclor 1242		<MDL	18	36.2	ug/Kg		<MDL	24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
Aroclor 1248		<MDL	18	36.2	ug/Kg	216		24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
Aroclor 1254		<MDL	18	36.2	ug/Kg	360		24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
Aroclor 1260		<MDL	18	36.2	ug/Kg	211		24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
Beta-BHC		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Chlordane		<MDL	9.1	18	ug/Kg		<MDL	12	24.2	ug/Kg		<MDL	8.4	16.7	ug/Kg
Delta-BHC		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Dieldrin		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Endosulfan I		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Endosulfan II		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Endosulfan Sulfate		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Endrin		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Endrin Aldehyde		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL,X	1.6	3.35	ug/Kg
Gamma-BHC (Lindane)		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Heptachlor		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Heptachlor Epoxide		<MDL	1.8	3.62	ug/Kg		<MDL	2.4	4.85	ug/Kg		<MDL	1.6	3.35	ug/Kg
Methoxychlor		<MDL	9.1	18	ug/Kg		<MDL	12	24.2	ug/Kg		<MDL	8.4	16.7	ug/Kg
Toxaphene		<MDL	18	36.2	ug/Kg		<MDL	24	48.5	ug/Kg		<MDL	16	33.5	ug/Kg
M.Code=SW-846 8260															
1,1,1-Trichloroethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
1,1,2,2-Tetrachloroethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
1,1,2-Trichloroethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
1,1,2-Trichloroethylene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
1,1-Dichloroethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
1,1-Dichloroethylene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
1,2-Dichloroethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
1,2-Dichloropropane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
2-Butanone (MEK)		<MDL	680	1360	ug/Kg		<MDL	910	1820	ug/Kg		<MDL	630	1250	ug/Kg
2-Chloroethylvinyl ether		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
2-Hexanone		<MDL	680	1360	ug/Kg		<MDL	910	1820	ug/Kg		<MDL	630	1250	ug/Kg
4-Methyl-2-Pentanone (MIBK)		<MDL	680	1360	ug/Kg		<MDL	910	1820	ug/Kg		<MDL	630	1250	ug/Kg
Acetone	500	<RDL,B	340	1360	ug/Kg	1000	<RDL,B	450	1820	ug/Kg	460	<RDL,B	310	1250	ug/Kg
Acrolein		<MDL,X	680	1360	ug/Kg		<MDL,X	910	1820	ug/Kg		<MDL,G	630	1250	ug/Kg
Acrylonitrile		<MDL	680	1360	ug/Kg		<MDL	910	1820	ug/Kg		<MDL	630	1250	ug/Kg
Benzene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Bromodichloromethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Bromoform		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Bromomethane		<MDL,G	140	271	ug/Kg		<MDL,G	180	364	ug/Kg		<MDL,G	130	251	ug/Kg
Carbon Disulfide		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Carbon Tetrachloride		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Chlorobenzene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Chlorodibromomethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Chloroethane		<MDL,G	140	271	ug/Kg		<MDL,G	180	364	ug/Kg		<MDL,G	130	251	ug/Kg
Chloroform		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Chloromethane		<MDL,G	140	271	ug/Kg		<MDL,G	180	364	ug/Kg		<MDL	130	251	ug/Kg
Chloromethane		<MDL,G	140	271	ug/Kg		<MDL,G	180	364	ug/Kg		<MDL	130	251	ug/Kg
Cis-1,3-Dichloropropene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Ethylbenzene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Methylene Chloride		<MDL	140	1360	ug/Kg		<MDL	180	1820	ug/Kg	940	<RDL,B	130	1250	ug/Kg
Styrene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Tetrachloroethylene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Toluene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Total Xylenes		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Trans-1,2-Dichloroethylene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Trans-1,3-Dichloropropene		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Trichlorofluoromethane		<MDL	140	271	ug/Kg		<MDL	180	364	ug/Kg		<MDL	130	251	ug/Kg
Vinyl Acetate		<MDL,G	680	1360	ug/Kg		<MDL,G	910	1820	ug/Kg		<MDL,X	630	1250	ug/Kg
Vinyl Chloride		<MDL,X	140	271	ug/Kg		<MDL,X	180	364	ug/Kg		<MDL,G	130	251	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 421252	Locator:	LTBC22 L	Locator:	LTBC38 T	Locator:	LTBD25 S
	Sampled:	Aug 06, 96 2-10	Sampled:	Aug 12, 9(0-2	Sampled:	Aug 27, 9(0-2
	Lab ID:	L9208-8	Lab ID:	L9281-1	Lab ID:	L9317-1
	Matrix:	SALTWTRSED	Matrix:	SALTWTRSED	Matrix:	SALTWTRSED
	% Solids:	73.8	% Solids:	55	% Solids:	79.7

Parameters	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units
M.Code=SW-846 8270															
1,2-Diphenylhydrazine		<MDL	72	145	ug/Kg		<MDL	96	195	ug/Kg		<MDL	66	134	ug/Kg
2,4,5-Trichlorophenol		<MDL	150	289	ug/Kg		<MDL	200	387	ug/Kg		<MDL	140	267	ug/Kg
2,4,6-Trichlorophenol		<MDL	150	289	ug/Kg		<MDL	200	387	ug/Kg		<MDL	140	267	ug/Kg
2,4-Dichlorophenol		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
2,4-Dimethylphenol		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
2,4-Dinitrophenol		<MDL,G	72	145	ug/Kg		<MDL	96	195	ug/Kg		<MDL	66	134	ug/Kg
2,4-Dinitrotoluene		<MDL	15	28.9	ug/Kg		<MDL	20	38.7	ug/Kg		<MDL	14	26.7	ug/Kg
2,6-Dinitrotoluene		<MDL	15	28.9	ug/Kg		<MDL	20	38.7	ug/Kg		<MDL	14	26.7	ug/Kg
2-Chloronaphthalene		<MDL,G	22	36.2	ug/Kg		<MDL	29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
2-Chlorophenol		<MDL,G	72	145	ug/Kg		<MDL	96	195	ug/Kg		<MDL	66	134	ug/Kg
2-Methylnaphthalene		<MDL,G	58	108	ug/Kg		<MDL	78	145	ug/Kg		<MDL	54	100	ug/Kg
2-Methylphenol		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
2-Nitroaniline		<MDL	150	217	ug/Kg		<MDL	200	291	ug/Kg		<MDL	140	201	ug/Kg
2-Nitrophenol		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
3,3'-Dichlorobenzidine		<MDL,G	37	72.2	ug/Kg		<MDL,G	49	96.9	ug/Kg		<MDL,G	34	66.9	ug/Kg
3-Nitroaniline		<MDL,G	150	217	ug/Kg		<MDL,G	200	291	ug/Kg		<MDL	140	201	ug/Kg
4,6-Dinitro-O-Cresol		<MDL	72	145	ug/Kg		<MDL	96	195	ug/Kg		<MDL	66	134	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	15	21.7	ug/Kg		<MDL	20	29.1	ug/Kg		<MDL	14	20.1	ug/Kg
4-Chloro-3-Methylphenol		<MDL	72	145	ug/Kg		<MDL	96	195	ug/Kg		<MDL	66	134	ug/Kg
4-Chloroaniline		<MDL,G	72	145	ug/Kg		<MDL,G	96	195	ug/Kg		<MDL,G	66	134	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	22	36.2	ug/Kg		<MDL	29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
4-Methylphenol		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
4-Nitroaniline		<MDL	150	217	ug/Kg		<MDL	200	291	ug/Kg		<MDL	140	201	ug/Kg
4-Nitrophenol		<MDL	72	145	ug/Kg		<MDL	96	195	ug/Kg		<MDL	66	134	ug/Kg
Acenaphthene		<MDL	15	28.9	ug/Kg	73.3		20	38.7	ug/Kg		<MDL	14	26.7	ug/Kg
Acenaphthylene		<MDL	22	36.2	ug/Kg		<MDL	29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
Aniline		<MDL,G	72	145	ug/Kg		<MDL,G	96	195	ug/Kg		<MDL,G	66	134	ug/Kg
Anthracene		<MDL,G	22	36.2	ug/Kg	222	G	29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
Benzidine		<MDL,X	870	1730	ug/Kg		<MDL,X	1200	2330	ug/Kg		<MDL,X	800	1610	ug/Kg
Benzo(a)anthracene	58.8	G	22	36.2	ug/Kg	513	G	29	48.5	ug/Kg	37.9		20	33.5	ug/Kg
Benzo(a)pyrene	91.2	G	37	72.2	ug/Kg	651	G	49	96.9	ug/Kg	36	<RDL	34	66.9	ug/Kg
Benzo(b)fluoranthene	100	<RDL	58	108	ug/Kg	785		78	145	ug/Kg		<MDL	54	100	ug/Kg
Benzo(g,h,i)perylene	47	<RDL,G	37	72.2	ug/Kg	313	G	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Benzo(k)fluoranthene		<MDL,G	58	108	ug/Kg	411	G	78	145	ug/Kg		<MDL	54	100	ug/Kg
Benzoic Acid		<MDL,L	150	217	ug/Kg		<MDL	200	291	ug/Kg		<MDL	140	201	ug/Kg
Benzyl Alcohol		<MDL,G	37	72.2	ug/Kg	85	<RDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Benzyl Butyl Phthalate		<MDL	22	36.2	ug/Kg	161		29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	22	36.2	ug/Kg		<MDL,G	29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	72	145	ug/Kg		<MDL	96	195	ug/Kg		<MDL	66	134	ug/Kg
Bis(2-Ethylhexyl)Phthalate	109		22	36.2	ug/Kg	1720		29	48.5	ug/Kg	332		20	33.5	ug/Kg
Carbazole		<MDL	37	72.2	ug/Kg	73	<RDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Chrysene	103		22	36.2	ug/Kg	689		29	48.5	ug/Kg	50.2		20	33.5	ug/Kg
Coprostanol	294		150	217	ug/Kg	725		200	291	ug/Kg		<MDL,E	140	201	ug/Kg
Di-N-Butyl Phthalate		<MDL	37	72.2	ug/Kg	218		49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Di-N-Octyl Phthalate		<MDL	22	36.2	ug/Kg		<MDL	29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
Dibenzo(a,h)anthracene		<MDL	58	108	ug/Kg	93	<RDL	78	145	ug/Kg		<MDL	54	100	ug/Kg
Dibenzofuran		<MDL	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Diethyl Phthalate		<MDL	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Dimethyl Phthalate		<MDL	15	21.7	ug/Kg		<MDL	20	29.1	ug/Kg	19	<RDL	14	20.1	ug/Kg
Fluoranthene	100	G	22	43.4	ug/Kg	805	G	29	58.2	ug/Kg	115		20	40.2	ug/Kg
Fluorene		<MDL,G	22	36.2	ug/Kg	76	G	29	48.5	ug/Kg		<MDL	20	33.5	ug/Kg
Hexachlorobutadiene		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL,G	34	66.9	ug/Kg
Hexachlorocyclopentadiene		<MDL,G	37	72.2	ug/Kg		<MDL,G	49	96.9	ug/Kg		<MDL,G	34	66.9	ug/Kg
Hexachloroethane		<MDL,G	37	72.2	ug/Kg		<MDL,G	49	96.9	ug/Kg		<MDL,G	34	66.9	ug/Kg
Indeno(1,2,3-Cd)Pyrene	41	<RDL,G	37	72.2	ug/Kg	331	G	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Isophorone		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
N-Nitrosodimethylamine		<MDL,G	150	217	ug/Kg		<MDL,G	200	291	ug/Kg		<MDL,G	140	201	ug/Kg
N-Nitrosodiphenylamine		<MDL	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Naphthalene		<MDL,G	58	108	ug/Kg		<MDL,G	78	145	ug/Kg		<MDL	54	100	ug/Kg
Nitrobenzene		<MDL,G	37	72.2	ug/Kg		<MDL	49	96.9	ug/Kg		<MDL	34	66.9	ug/Kg
Pentachlorophenol		<MDL,E,G	37	72.2	ug/Kg		<MDL,G	49	96.9	ug/Kg		<MDL,G	34	66.9	ug/Kg
Phenanthrene	47.2	G	22	36.2	ug/Kg	589	G	29	48.5	ug/Kg	38.3		20	33.5	ug/Kg
Phenol		<MDL,G	150	217	ug/Kg		<MDL	200	291	ug/Kg		<MDL	140	201	ug/Kg
Pyrene	111	G	22	36.2	ug/Kg	1080	G	29	48.5	ug/Kg	95		20	33.5	ug/Kg
M.Code=SW-846 8270 (SIM)															
1,2,4-Trichlorobenzene		<MDL,G	0.93	1.8	ug/Kg		<MDL,G	1.3	2.42	ug/Kg		<MDL,G	0.87	1.67	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.93	1.8	ug/Kg	1.7	<RDL,G	1.3	2.42	ug/Kg		<MDL,G	0.87	1.67	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.93	1.8	ug/Kg		<MDL,G	1.3	2.42	ug/Kg		<MDL,G	0.87	1.67	ug/Kg
1,4-Dichlorobenzene		<MDL,G	0.93	1.8	ug/Kg	5.24	G	1.3	2.42	ug/Kg		<MDL,G	0.87	1.67	ug/Kg
Hexachlorobenzene		<MDL,G	0.93	1.8	ug/Kg	2.2	<RDL,G	1.3	2.42	ug/Kg		<MDL,G	0.87	1.67	ug/Kg

* indicates wet weight used for this parameter

King County Environmental Lab Analytical Report

PROJECT: 421252				
	Locator:	LTBC22 L	LTBC38 T	LTBD25 S
	Sampled:	Aug 06, 96 2-10	Aug 12, 9(0-2	Aug 27, 9(0-2
	Lab ID:	L9208-8	L9281-1	L9317-1
	Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED
	% Solids:	73.8	55	79.7

Parameters	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units	Value	Qual	MDL - Dry Weight Basis	RDL	Units
METALS															
M.Code=METRO 16-01-001															
Mercury, Total, CVAA	0.12	<RDL	0.024	0.244	mg/Kg	0.622		0.036	0.358	mg/Kg	0 066	<RDL	0.025	0.253	mg/Kg
M.Code=METRO 16-02-004															
Aluminum, Total, ICP	11700	L	6.5	32.8	mg/Kg	16400	L	9.5	46.9	mg/Kg	6270	L	6.5	32.9	mg/Kg
Antimony, Total, ICP		<MDL,G	2	9.85	mg/Kg		<MDL,G	2.7	14.1	mg/Kg		<MDL,G	2	9.85	mg/Kg
Arsenic, Total, ICP	3.7	<RDL	3.3	16.4	mg/Kg	6.5	<RDL	4.7	23.5	mg/Kg		<MDL	3.3	16.4	mg/Kg
Barium, Total, ICP	31.6		0.065	0.328	mg/Kg						15.6		0.065	0.329	mg/Kg
Beryllium, Total, ICP	0.26	<RDL	0.065	0.328	mg/Kg	0.24	<RDL	0.095	0.469	mg/Kg	0.14	<RDL	0.065	0.329	mg/Kg
Cadmium, Total, ICP		<MDL	0.2	0.985	mg/Kg	0.87	<RDL	0.27	1.41	mg/Kg	0.23	<RDL	0.2	0.985	mg/Kg
Calcium, Total, ICP	4320		3.3	16.4	mg/Kg	4980		4.7	23.5	mg/Kg					
Chromium, Total, ICP	15.2		0.33	1.64	mg/Kg	43.1		0.47	2.35	mg/Kg	14.7		0.33	1.64	mg/Kg
Copper, Total, ICP	14.9		0.26	1.31	mg/Kg	59.5		0.38	1.87	mg/Kg	18.7		0.26	1.32	mg/Kg
Iron, Total, ICP	19200		3.3	16.4	mg/Kg	22500	G	4.7	23.5	mg/Kg	10800		3.3	16.4	mg/Kg
Lead, Total, ICP	9.6	<RDL	2	9.85	mg/Kg	86.5		2.7	14.1	mg/Kg	13		2	9.85	mg/Kg
Magnesium, Total, ICP	4620		2	9.85	mg/Kg	8690		2.7	14.1	mg/Kg	3760		2	9.85	mg/Kg
Manganese, Total, ICP	206		0.13	0.657	mg/Kg										
Molybdenum, Total, ICP		<MDL	1.3	6.57	mg/Kg	3.3	<RDL	1.8	9.36	mg/Kg	1.5	<RDL	1.3	6.56	mg/Kg
Nickel, Total, ICP	14.4		1.3	6.57	mg/Kg	42		1.8	9.36	mg/Kg	17.1		1.3	6.56	mg/Kg
Potassium, Total, ICP	1260		130	657	mg/Kg	2380		180	936	mg/Kg	390	<RDL	130	656	mg/Kg
Selenium, Total, ICP		<MDL	3.3	16.4	mg/Kg		<MDL	4.7	23.5	mg/Kg		<MDL	3.3	16.4	mg/Kg
Silver, Total, ICP		<MDL	0.26	1.31	mg/Kg	4.38		0.38	1.87	mg/Kg	1.3	<RDL	0.26	1.32	mg/Kg
Sodium, Total, ICP											3740		33	164	mg/Kg
Thallium, Total, ICP	14	<RDL	13	65.7	mg/Kg		<MDL	18	93.6	mg/Kg		<MDL	13	65.6	mg/Kg
Zinc, Total, ICP	55		0.33	1.64	mg/Kg	107		0.47	2.35	mg/Kg	45.4		0.33	1.64	mg/Kg
* indicates wet weight used for this parameter															
CONVENTIONALS															
M.Code=PSEP p9															
p+0.00 *	4.6		0.1		%	0.7		0.1		%	8.9		0.1		%
p+1.00 *	42		0.1		%	1.1		0.1		%	6.1		0.1		%
p+10.0 *		<MDL	0.1		%	1.8		0.1		%		<MDL	0.1		%
p+10.0(more than) *	0.7		0.1		%	10		0.1		%		<MDL	0.1		%
p+2.00 *	36.5		0.1		%	2.5		0.1		%	4.4		0.1		%
p+3.00 *	6.7		0.1		%	14.7		0.1		%	1.6		0.1		%
p+4.00 *	0.8		0.1		%	22.2		0.1		%	0.2		0.1		%
p+5.00 *	4.3		0.1		%	9.6		0.1		%	2.8		0.1		%
p+6.00 *	0.7		0.1		%	13.5		0.1		%		<MDL	0.1		%
p+7.00 *	0.5		0.1		%	10.8		0.1		%		<MDL	0.1		%
p+8.00 *	1.7		0.1		%	8		0.1		%		<MDL	0.1		%
p+9.00 *	0.3		0.1		%	3.7		0.1		%		<MDL	0.1		%
p-1.00 *	0.7		0.1		%	1.1		0.1		%	18.8		0.1		%
p-2.00 *	0.1		0.1		%		<MDL	0.1		%	5.3		0.1		%
p-2.00(less than) *	0.4		0.1		%	0.5		0.1		%	51.9		0.1		%
M.Code=SM5310-B															
Total Organic Carbon	4120		6.8	13.6	mg/Kg	30000		9.1	18.2	mg/Kg	4570		6.3	12.5	mg/Kg
* indicates wet weight used for this parameter															

King County Environmental Lab Analytical Report

PROJECT: 421252	Locator: LTBC21 K	Locator: LTBC22 L
	Sampled: Sep 10, 9 0-10	Sampled: Sep 10, 9 0-10
	Lab ID: L9445-1	Lab ID: L9445-2
	Matrix: SALTWTRSED	Matrix: SALTWTRSED
	% Solids: 63.3	% Solids: 75.3

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis			
ORGANICS										
M.Code=SW-846 8080										
4,4'-DDD		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
4,4'-DDE		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
4,4'-DDT		<MDL,L	2.1	4.22	ug/Kg		<MDL,L	1.7	3.55	ug/Kg
Aldrin		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Alpha-BHC		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Aroclor 1016		<MDL	21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
Aroclor 1221		<MDL	21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
Aroclor 1232		<MDL	21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
Aroclor 1242		<MDL	21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
Aroclor 1248		<MDL	21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
Aroclor 1254	44.4		21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
Aroclor 1260		<MDL	21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
Beta-BHC		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Chlordane		<MDL	11	21	ug/Kg		<MDL	8.9	17.7	ug/Kg
Delta-BHC		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Dieldrin		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Endosulfan I		<MDL,L	2.1	4.22	ug/Kg		<MDL,L	1.7	3.55	ug/Kg
Endosulfan II		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Endosulfan Sulfate		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Endrin		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Endrin Aldehyde		<MDL,G	2.1	4.22	ug/Kg		<MDL,G	1.7	3.55	ug/Kg
Gamma-BHC (Lindane)		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Heptachlor		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Heptachlor Epoxide		<MDL	2.1	4.22	ug/Kg		<MDL	1.7	3.55	ug/Kg
Methoxychlor		<MDL	11	21	ug/Kg		<MDL	8.9	17.7	ug/Kg
Toxaphene		<MDL	21	42.2	ug/Kg		<MDL	17	35.5	ug/Kg
M.Code=SW-846 8260										
1,1,1-Trichloroethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
1,1,2,2-Tetrachloroethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
1,1,2-Trichloroethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
1,1,2-Trichloroethylene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
1,1-Dichloroethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
1,1-Dichloroethylene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
1,2-Dichloroethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
1,2-Dichloropropane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
2-Butanone (MEK)		<MDL	790	1580	ug/Kg		<MDL	660	1330	ug/Kg
2-Chloroethylvinyl ether		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
2-Hexanone		<MDL	790	1580	ug/Kg		<MDL	660	1330	ug/Kg
4-Methyl-2-Pentanone (MIBK)		<MDL	790	1580	ug/Kg		<MDL	660	1330	ug/Kg
Acetone	430	<RDL,B	390	1580	ug/Kg		<MDL,B	330	1330	ug/Kg
Acrolein		<MDL,G	790	1580	ug/Kg		<MDL,G	660	1330	ug/Kg
Acrylonitrile		<MDL	790	1580	ug/Kg		<MDL	660	1330	ug/Kg
Benzene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Bromodichloromethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Bromoform		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Bromomethane		<MDL,G	160	316	ug/Kg		<MDL,G	130	266	ug/Kg
Carbon Disulfide		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Carbon Tetrachloride		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Chlorobenzene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Chlorodibromomethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Chloroethane		<MDL,G	160	316	ug/Kg		<MDL,G	130	266	ug/Kg
Chloroform		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Chloromethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Chloromethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Cis-1,3-Dichloropropene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Ethylbenzene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Methylene Chloride	1400	<RDL,B	160	1580	ug/Kg	1300	B	130	1330	ug/Kg
Styrene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Tetrachloroethylene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Toluene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Total Xylenes		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Trans-1,2-Dichloroethylene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Trans-1,3-Dichloropropene		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Trichlorofluoromethane		<MDL	160	316	ug/Kg		<MDL	130	266	ug/Kg
Vinyl Acetate		<MDL,X	790	1580	ug/Kg		<MDL,X	660	1330	ug/Kg
Vinyl Chloride		<MDL,G	160	316	ug/Kg		<MDL,G	130	266	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 421252	Locator: LTBC21 K	Locator: LTBC22 L
	Sampled: Sep 10, 9(0-10	Sampled: Sep 10, 9(0-10
	Lab ID: L9445-1	Lab ID: L9445-2
	Matrix: SALTWTRSED	Matrix: SALTWTRSED
	% Solids: 63.3	% Solids: 75.3

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis			
M.Code=SW-846 8270										
1,2-Diphenylhydrazine		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
2,4,5-Trichlorophenol		<MDL	170	336	ug/Kg		<MDL	150	283	ug/Kg
2,4,6-Trichlorophenol		<MDL	170	336	ug/Kg		<MDL	150	283	ug/Kg
2,4-Dichlorophenol		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
2,4-Dimethylphenol		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
2,4-Dinitrophenol		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
2,4-Dinitrotoluene		<MDL	17	33.6	ug/Kg		<MDL	15	28.3	ug/Kg
2,6-Dinitrotoluene		<MDL	17	33.6	ug/Kg		<MDL	15	28.3	ug/Kg
2-Chloronaphthalene		<MDL	25	42.2	ug/Kg		<MDL	21	35.5	ug/Kg
2-Chlorophenol		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
2-Methylnaphthalene		<MDL	68	126	ug/Kg		<MDL	57	106	ug/Kg
2-Methylphenol		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
2-Nitroaniline		<MDL	170	253	ug/Kg		<MDL	150	212	ug/Kg
2-Nitrophenol		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
3,3'-Dichlorobenzidine		<MDL,G	43	84.2	ug/Kg		<MDL,G	36	70.8	ug/Kg
3-Nitroaniline		<MDL,G	170	253	ug/Kg		<MDL,G	150	212	ug/Kg
4,6-Dinitro-O-Cresol		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	17	25.3	ug/Kg		<MDL	15	21.2	ug/Kg
4-Chloro-3-Methylphenol		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
4-Chloroaniline		<MDL,G	84	169	ug/Kg		<MDL,G	70	142	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	25	42.2	ug/Kg		<MDL	21	35.5	ug/Kg
4-Methylphenol		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
4-Nitroaniline		<MDL	170	253	ug/Kg		<MDL	150	212	ug/Kg
4-Nitrophenol		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
Acenaphthene	21	<RDL	17	33.6	ug/Kg		<MDL	15	28.3	ug/Kg
Acenaphthylene		<MDL	25	42.2	ug/Kg		<MDL	21	35.5	ug/Kg
Aniline		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
Anthracene	118	G	25	42.2	ug/Kg	47.3	G	21	35.5	ug/Kg
Benzidine		<MDL,X	1000	2020	ug/Kg		<MDL,X	850	1700	ug/Kg
Benzo(a)anthracene	310	G	25	42.2	ug/Kg	96.5	G	21	35.5	ug/Kg
Benzo(a)pyrene	379	G	43	84.2	ug/Kg	120	G	36	70.8	ug/Kg
Benzo(b)fluoranthene	562		68	126	ug/Kg	187		57	106	ug/Kg
Benzo(g,h,i)perylene	223	G	43	84.2	ug/Kg	62	<RDL,G	36	70.8	ug/Kg
Benzo(k)fluoranthene	216	G	68	126	ug/Kg	61	<RDL,G	57	106	ug/Kg
Benzoic Acid		<MDL	170	253	ug/Kg		<MDL	150	212	ug/Kg
Benzyl Alcohol		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Benzyl Butyl Phthalate	42.7		25	42.2	ug/Kg		<MDL	21	35.5	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL	25	42.2	ug/Kg		<MDL	21	35.5	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL	84	169	ug/Kg		<MDL	70	142	ug/Kg
Bis(2-Ethylhexyl)Phthalate	626		25	42.2	ug/Kg	81.1		21	35.5	ug/Kg
Carbazole	44	<RDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Chrysene	449		25	42.2	ug/Kg	154		21	35.5	ug/Kg
Coprostanol	852		170	253	ug/Kg	239		150	212	ug/Kg
Di-N-Butyl Phthalate		<MDL,G	43	84.2	ug/Kg		<MDL,G	36	70.8	ug/Kg
Di-N-Octyl Phthalate		<MDL	25	42.2	ug/Kg		<MDL	21	35.5	ug/Kg
Dibenzo(a,h)anthracene		<MDL,G	68	126	ug/Kg		<MDL,G	57	106	ug/Kg
Dibenzofuran		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Diethyl Phthalate		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Dimethyl Phthalate		<MDL	17	25.3	ug/Kg		<MDL	15	21.2	ug/Kg
Fluoranthene	504	G	25	50.6	ug/Kg	171	G	21	42.5	ug/Kg
Fluorene	30	<RDL,G	25	42.2	ug/Kg		<MDL,G	21	35.5	ug/Kg
Hexachlorobutadiene		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Hexachlorocyclopentadiene		<MDL,G	43	84.2	ug/Kg		<MDL,G	36	70.8	ug/Kg
Hexachloroethane		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Indeno(1,2,3-Cd)Pyrene	243	G	43	84.2	ug/Kg	64	<RDL,G	36	70.8	ug/Kg
Isophorone		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
N-Nitrosodimethylamine		<MDL	170	253	ug/Kg		<MDL	150	212	ug/Kg
N-Nitrosodiphenylamine		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Naphthalene		<MDL,G	68	126	ug/Kg		<MDL,G	57	106	ug/Kg
Nitrobenzene		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Pentachlorophenol		<MDL	43	84.2	ug/Kg		<MDL	36	70.8	ug/Kg
Phenanthrene	265	G	25	42.2	ug/Kg	64	G	21	35.5	ug/Kg
Phenol		<MDL	170	253	ug/Kg		<MDL	150	212	ug/Kg
Pyrene	528	G	25	42.2	ug/Kg	113	G	21	35.5	ug/Kg
M.Code=SW-846 8270 (SIM)										
1,2,4-Trichlorobenzene		<MDL,G	1.1	2.1	ug/Kg		<MDL,G	0.92	1.77	ug/Kg
1,2-Dichlorobenzene		<MDL,G	1.1	2.1	ug/Kg		<MDL,G	0.92	1.77	ug/Kg
1,3-Dichlorobenzene		<MDL,G	1.1	2.1	ug/Kg		<MDL,G	0.92	1.77	ug/Kg
1,4-Dichlorobenzene	5.06	G	1.1	2.1	ug/Kg		<MDL,G	0.92	1.77	ug/Kg
Hexachlorobenzene		<MDL,G	1.1	2.1	ug/Kg		<MDL,G	0.92	1.77	ug/Kg

* indicates wet weight used for this parameter

King County Environmental Lab Analytical Report

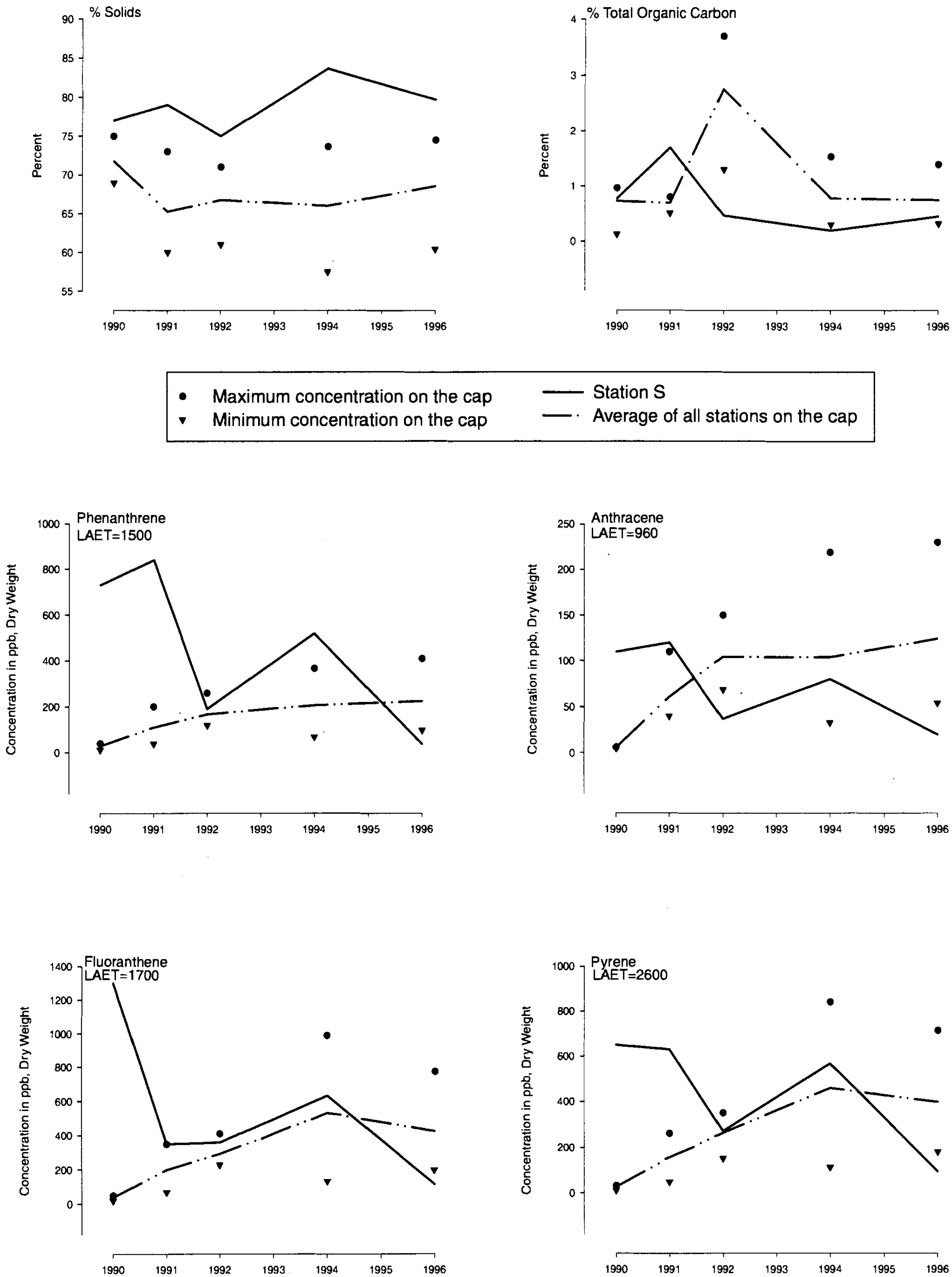
PROJECT: 421252

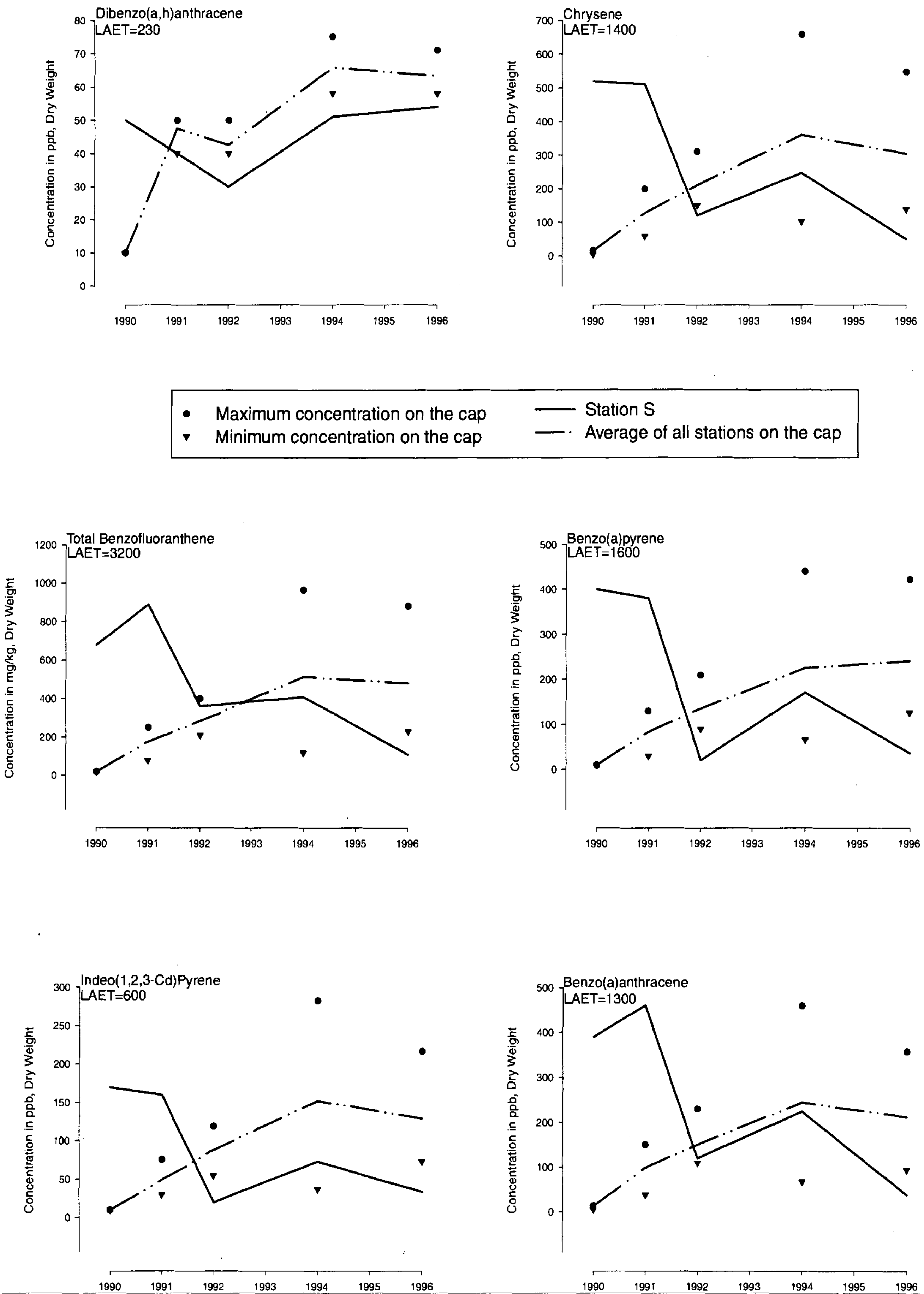
	Sample 1	Sample 2
Locator:	LTBC21 K	LTBC22 L
Sampled:	Sep 10, 9(0-10	Sep 10, 9(0-10
Lab ID:	L9445-1	L9445-2
Matrix:	SALTWTRSED	SALTWTRSED
% Solids:	63.3	75.3

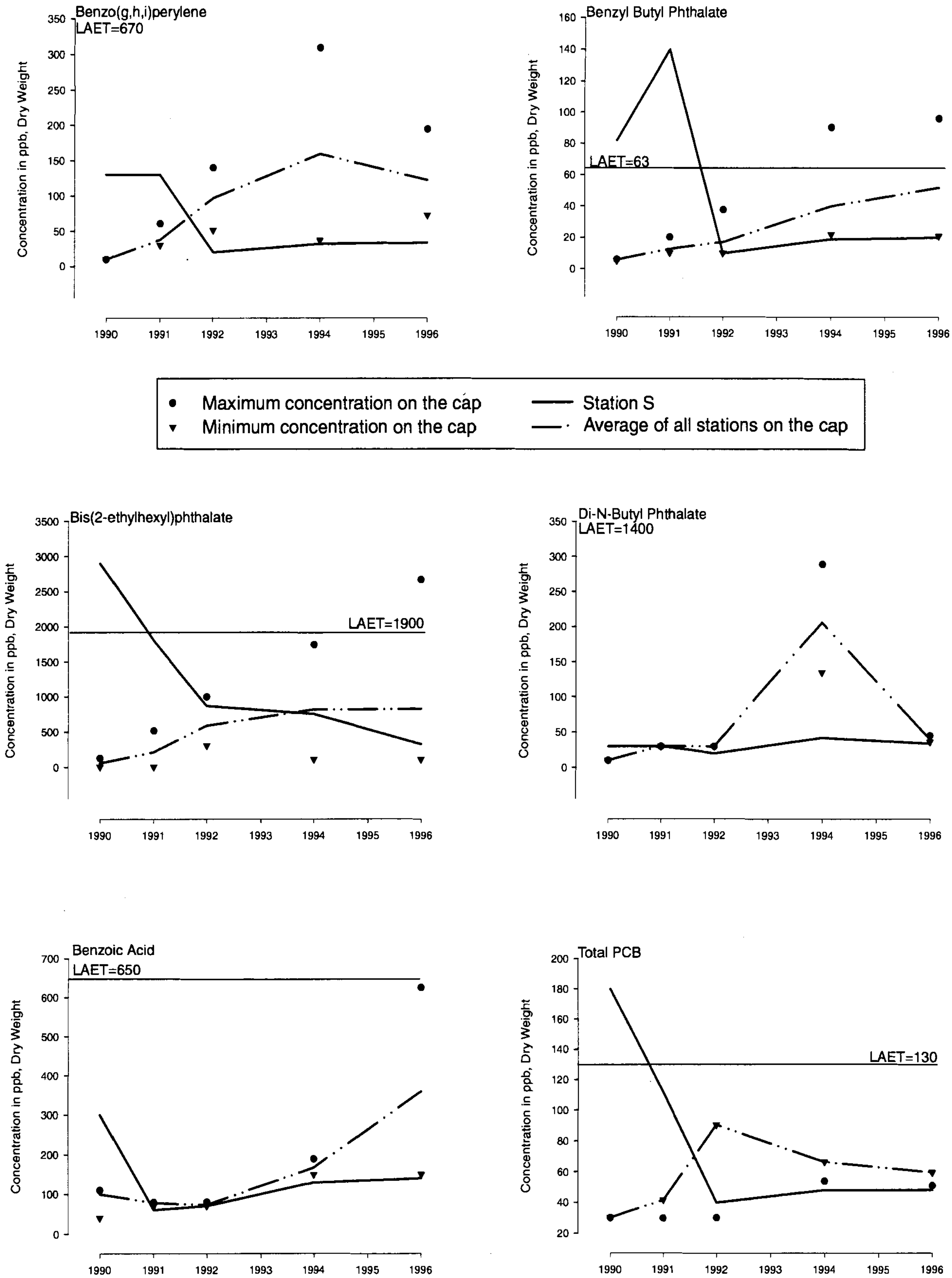
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis		
METALS										
M.Code=METRO 16-01-001										
Mercury, Total, CVAA	0.19	<RDL,H	0.03	0.303	mg/Kg	0.036	<RDL,H	0.021	0.211	mg/Kg
M.Code=METRO 16-02-004										
Aluminum, Total, ICP	14000	G	7.7	39	mg/Kg	10000	G	6.6	33.3	mg/Kg
Antimony, Total, ICP		<MDL,G	2.4	11.7	mg/Kg		<MDL,G	2	9.99	mg/Kg
Arsenic, Total, ICP	5.8	<RDL	3.9	19.4	mg/Kg	4	<RDL	3.3	16.6	mg/Kg
Barium, Total, ICP	40.9		0.077	0.39	mg/Kg	28.7		0.066	0.333	mg/Kg
Beryllium, Total, ICP	0.35	<RDL	0.077	0.39	mg/Kg	0.24	<RDL	0.066	0.333	mg/Kg
Cadmium, Total, ICP	0.3	<RDL	0.24	1.17	mg/Kg		<MDL	0.2	0.999	mg/Kg
Calcium, Total, ICP										
Chromium, Total, ICP	24.2		0.39	1.94	mg/Kg	15.9		0.33	1.66	mg/Kg
Copper, Total, ICP	34.6		0.32	1.56	mg/Kg	13.4		0.27	1.33	mg/Kg
Iron, Total, ICP	20200	G	3.9	19.4	mg/Kg	19000	G	3.3	16.6	mg/Kg
Lead, Total, ICP	26.7		2.4	11.7	mg/Kg	7.4	<RDL	2	9.99	mg/Kg
Magnesium, Total, ICP	5860		2.4	11.7	mg/Kg	4500		2	9.99	mg/Kg
Manganese, Total, ICP	209		0.16	0.779	mg/Kg	189		0.13	0.665	mg/Kg
Molybdenum, Total, ICP	2.1	<RDL	1.6	7.79	mg/Kg		<MDL	1.3	6.65	mg/Kg
Nickel, Total, ICP	19.6		1.6	7.79	mg/Kg	14.3		1.3	6.65	mg/Kg
Potassium, Total, ICP										
Selenium, Total, ICP		<MDL	3.9	19.4	mg/Kg		<MDL	3.3	16.6	mg/Kg
Silver, Total, ICP	0.81	<RDL	0.32	1.56	mg/Kg		<MDL	0.27	1.33	mg/Kg
Sodium, Total, ICP	6750		39	194	mg/Kg	3780		33	166	mg/Kg
Thallium, Total, ICP		<MDL	16	77.9	mg/Kg		<MDL	13	66.5	mg/Kg
Zinc, Total, ICP	80.4		0.39	1.94	mg/Kg	50.6		0.33	1.66	mg/Kg
* indicates wet weight used for this parameter										
CONVENTIONALS										
M.Code=PSEP p9										
p+0.00 *	2.1		0.1		%	7.1		0.1		%
p+1.00 *	19.1		0.1		%	50.9		0.1		%
p+10.0 *		<MDL	0.1		%		<MDL	0.1		%
p+10.0(more than) *	4.5		0.1		%		<MDL	0.1		%
p+2.00 *	43.3		0.1		%	32.9		0.1		%
p+3.00 *	13.4		0.1		%	3.7		0.1		%
p+4.00 *	3.1		0.1		%	0.5		0.1		%
p+5.00 *	5.3		0.1		%	2.7		0.1		%
p+6.00 *	3.2		0.1		%		<MDL	0.1		%
p+7.00 *	3.9		0.1		%	0.6		0.1		%
p+8.00 *	1.1		0.1		%	0.6		0.1		%
p+9.00 *	0.1		0.1		%	0.1		0.1		%
p-1.00 *	0.6		0.1		%	0.9		0.1		%
p-2.00 *		<MDL	0.1		%		<MDL	0.1		%
p-2.00(less than) *	0.3		0.1		%		<MDL	0.1		%
M.Code=SM5310-B										
Total Organic Carbon	10600		7.9	15.8	mg/Kg	2540		6.6	13.3	mg/Kg
* indicates wet weight used for this parameter										

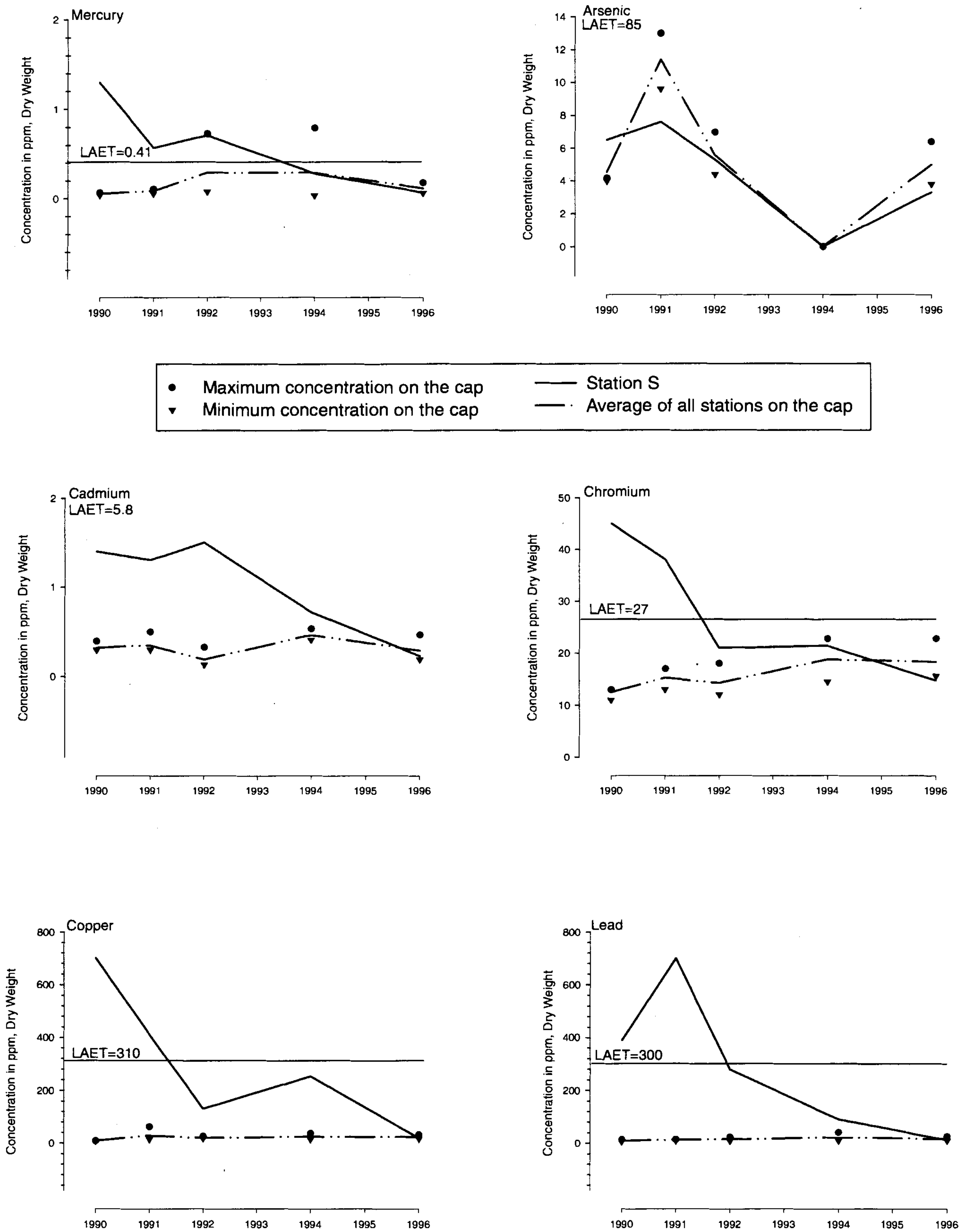
APPENDIX D:

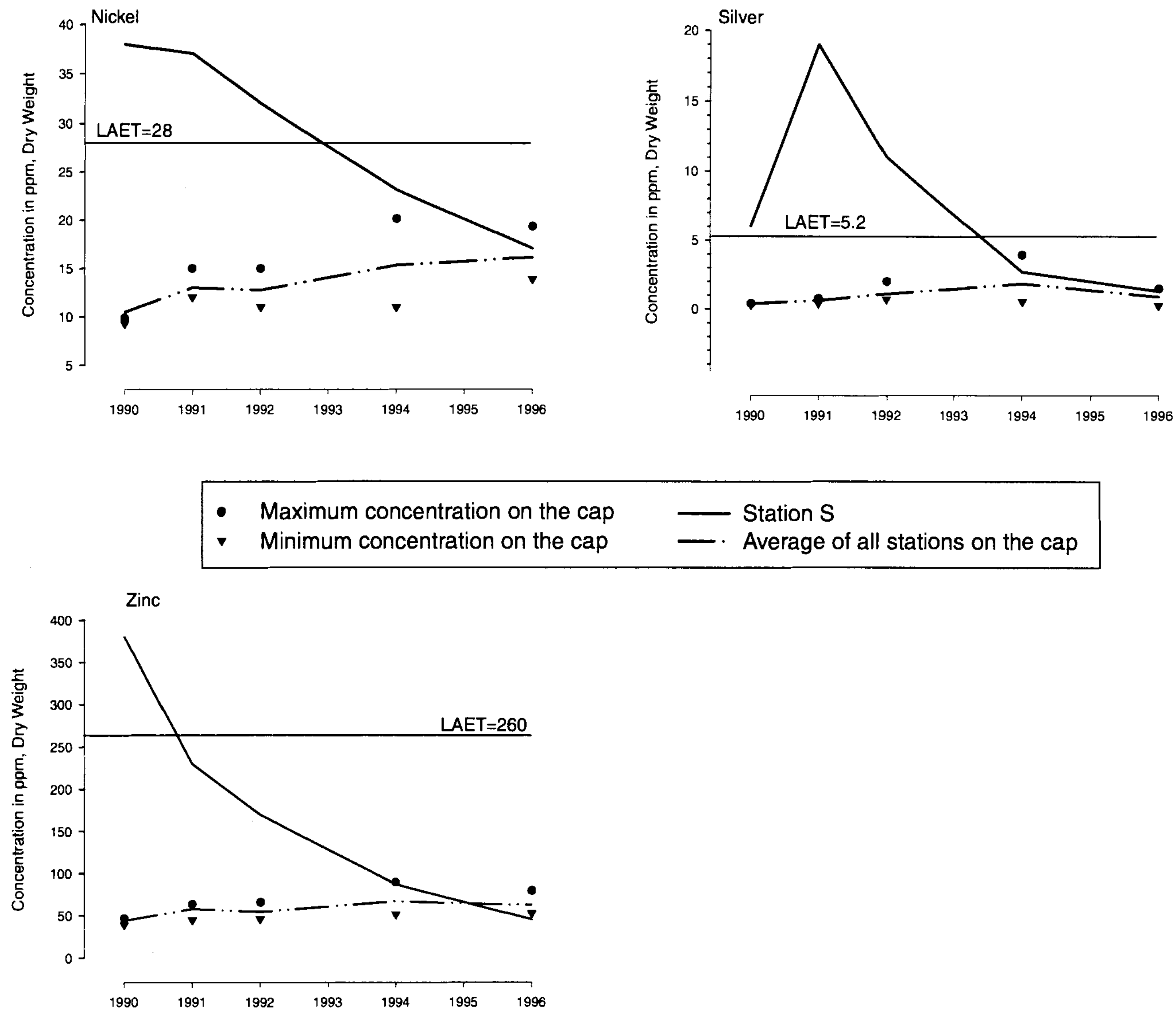
CHEMISTRY TREND CHARTS


% Solids
Percent
% Total Organic Carbon
Percent
Maximum concentration on the cap
Minimum concentration on the cap
Station S
Average of all stations on the cap
Phenanthrene
LAET=1500
Concentration in ppb, Dry Weight
Anthracene
LAET=960
Concentration in ppb, Dry Weight
Fluoranthene
LAET=1700
Concentration in ppb, Dry Weight
Pyrene
LAET=2600
Concentration in ppb, Dry Weight


Dibenzo(a,h)anthracene
LAET=230
Chrysene
LAET=1400
Maximum concentration on the cap
Minimum concentration on the cap
Station S
Average of all stations on the cap
Total Benzofluoranthene
LAET=3200
Benzo(a)pyrene
LAET=1600
Indeo(1,2,3-Cd)Pyrene
LAET=600
Benzo(a)anthracene
LAET=1300
Concentration in ppb, Dry Weight
Concentration in mg/kg, Dry Weight
1990
1991
1992
1993
1994
1995
1996


Benzo(g,h,i)perylene
LAET=670
Benzyl Butyl Phthalate
LAET=63
Maximum concentration on the cap
Minimum concentration on the cap
Station S
Average of all stations on the cap
Bis(2-ethylhexyl)phthalate
LAET=1900
Di-N-Butyl Phthalate
LAET=1400
Benzoic Acid
LAET=650
Total PCB
LAET=130
Concentration in ppb, Dry Weight
1990
1991
1992
1993
1994
1995
1996


Mercury
LAET=0.41
Arsenic
LAET=85
Cadmium
LAET=5.8
Chromium
LAET=27
Copper
LAET=310
Lead
LAET=300
Concentration in ppm, Dry Weight
1990
1991
1992
1993
1994
1995
1996
Maximum concentration on the cap
Minimum concentration on the cap
Station S
Average of all stations on the cap


Nickel
LAET=28
Concentration in ppm, Dry Weight
40
35
30
25
20
15
10
5
1990
1991
1992
1993
1994
1995
1996
Silver
LAET=5.2
Concentration in ppm, Dry Weight
20
15
10
5
0
1990
1991
1992
1993
1994
1995
1996
Maximum concentration on the cap
Minimum concentration on the cap
Station S
Average of all stations on the cap
Zinc
LAET=260
Concentration in ppm, Dry Weight
400
350
300
250
200
150
100
50
0
1990
1991
1992
1993
1994
1995
1996

APPENDIX E:

BIOASSAY QUALITY ASSURANCE REVIEW

AMPHIPOD – RHEPOXYNIUS ABRONIUS

- Sediment Bioassay Results
- Statistical Analyses
- Statistical Transformations
- Quality Assurance Review

AMPHIPOD SEDIMENT BIOASSAY RESULTS AND STATISTICAL ANALYSES

Field ID	Lab ID	Rep.	Absolute Surv. Day 10	Proport. Surv. Day 10	Absolute Survivorship Statistics				Proportional Survivorship Statistics				Absolute Mortality Day 10	Absolute Mortality Statistics				Prop. Mortality Day 10	Proportional Mortality Statistics				Arcsin-Sqrt Prop. Mortality Day 10	Arcsin-Sqrt (Prop) Mortality Statistics			
					AVG	STD	VAR	COV	AVG	STD	VAR	COV		AVG	STD	VAR	COV		AVG	STD	VAR	COV		AVG	STD	VAR	COV
P9445-1		A	20	1.00	18.80	1.64	2.70	9%	0.94	0.08	0.01	9%	0	1.20	1.64	2.70	137%	0.00	0.06	0.08	0.01	137%	0.00	0.18	0.19	0.04	106%
P9445-1		B	20	1.00									0					0.00					0.00				
P9445-1		C	19	0.95									1					0.05					0.23				
P9445-1		D	19	0.95									1					0.05					0.23				
P9445-1		E	16	0.80									4					0.20					0.46				
P9445-2		A	19	0.95	18.00	1.41	2.00	8%	0.90	0.07	0.01	8%	1	2.00	1.41	2.00	71%	0.05	0.10	0.07	0.01	71%	0.23	0.28	0.18	0.03	62%
P9445-2		B	17	0.85									3					0.15					0.40				
P9445-2		C	17	0.85									3					0.15					0.40				
P9445-2		D	20	1.00									0					0.00					0.00				
P9445-2		E	17	0.85									3					0.15					0.40				
West Beach A		A	20	1.00	19.40	0.89	0.80	5%	0.97	0.04	0.00	5%	0	0.60	0.89	0.80	149%	0.00	0.03	0.04	0.00	149%	0.00	0.11	0.15	0.02	140%
West Beach A		B	20	1.00									0					0.00					0.00				
West Beach A		C	20	1.00									0					0.00					0.00				
West Beach A		D	19	0.95									1					0.05					0.23				
West Beach A		E	18	0.90									2					0.10					0.32				
West Beach B		A	20	1.00	19.80	0.45	0.20	2%	0.99	0.02	0.00	2%	0	0.20	0.45	0.20	224%	0.00	0.01	0.02	0.00	224%	0.00	0.05	0.10	0.01	224%
West Beach B		B	19	0.95									1					0.05					0.23				
West Beach B		C	20	1.00									0					0.00					0.00				
West Beach B		D	20	1.00									0					0.00					0.00				
West Beach B		E	20	1.00									0					0.00					0.00				
P9446-1		A	20	1.00	18.80	1.79	3.20	10%	0.94	0.09	0.01	10%	0	1.20	1.79	3.20	149%	0.00	0.06	0.09	0.01	149%	0.00	0.16	0.22	0.05	141%
P9446-1		B	16	0.80									4					0.20					0.46				
P9446-1		C	20	1.00									0					0.00					0.00				
P9446-1		D	18	0.90									2					0.10					0.32				
P9446-1		E	20	1.00									0					0.00					0.00				

Field ID	T-Test Value against West Beach B	Is West Beach B t-Test sig?*	Is Mortality >25% Absolute?	Is Sed >30% of West Beach B mortality?	T-Test Value against West Beach A?	Is West Beach A t-Test Sig?*	Is Mortality >25% Absolute?	Is Sed >30% of West Beach A mortality?	T-Test Value against P9446-1?	Is P9446-1 t-Test Sig?*	Is Mortality >25% Absolute?	Is sed >30% of P9446-1 mortality?
P9445-1	1.41	no	no	no	0.67	no	no	no	.20	no	no	no
P9445-2	2.64	yes	no	no	1.67	no	no	no	1.00	no	no	no
West Beach A	0.78	no	no	no	0.00	no	no	no	-0.40	no	no	no
West Beach B	0.00	no	no	no	-0.78	no	no	no	-1.03	no	no	no
P-9446-1	1.03	no	no	no	0.00	no	no	no	0.00	no	no	no

** Value=1.86 (degrees of freedom 8, alpha level of 0.05, one tailed t-test*

Amphipod Statistical Transformations

Statistical transformation performed by MEC were incomplete and difficult to interpret. The following statistical transformations were performed by KCEL bioassay personnel.

Transform: ARC SINE (SQUARE ROOT (Y))

Shapiro Wilk's test for normality

D =	0.303
W =	0.939

Critical W (P = 0.05)	(n = 25)	=	0.918
Critical W (P = 0.01)	(n = 25)	=	0.888

Data PASS normality test at P=0.01 level. Continue analysis.

Transform: ARC SINE (SQUARE ROOT (Y))

Cochran's test for homogeneity of variance

Calculated G statistic =	0.3456		
Table value =	0.63	(alpha =	0.01, df =5, 5)
Table value =	0.54	(alpha =	0.05, df =5, 5)

Data PASS homogeneity test at 0.01 level. Continue analysis.

Transform: ARC SINE (SQUARE ROOT (Y))

Levene's test for homogeneity of variance

ANOVA TABLE

Source	DF	SS	MS	F
Between	4	0.024	0.006	0.464
Within (error)	20	0.259	0.013	
Total	24	0.283		

Critical F value =	2.87 (0.05, 4, 20)		
Since F < Critical F	FAIL TO REJECT	Ho:	All equal

Amphipod Quality Assurance Review

The following *Seattle Metro QA Audit* is a narrative prepared by MEC documenting problems encountered and deviations from the protocol. The two Denny Way samples were analyzed along with 17 other test samples from other King County projects, 2 reference samples and 2 control samples. MEC reported all these samples in the same report. Therefore, the MEC narrative contains information about samples not related to the Denny Way project.

MEC assigned their own sample identification numbers to maintain blind testing. Use the following cross reference table to identify the King County sample ID number, project and station. The top six samples refered specifically to the bioassays presented here. The other samples are shown for completeness, but are greyed out to indicate they are not part of this study.

MEC Sample ID	KC Sample ID	Project	Station
C960913.1233	9446-1	All Reference	
C960913.1333	9446-2	All Reference	
C960913.1433	9445-1	Denny Way K	LTBC21
C960913.1533	9445-2	Denny Way L	LTBC22
C960913.1733A	Control A	All Control A	
C960913.1733B	Control B	All Control B	
C960911.0533	9443-1	Duwamish Diagonal	DUD200
C960911.0633	9443-2	Duwamish Diagonal	DUD201
C960911.0733	9443-3	Duwamish Diagonal	DUD202
C960911.0833	9443-4	Duwamish Diagonal	DUD203
C960911.0933	9443-5	Duwamish Diagonal	DUD204
C960911.1033	9443-6	Duwamish Diagonal	DUD205
C960911.1133	9443-7	Duwamish Diagonal	DUD206
C960913.0233	9444-1	Seattle Waterfront	WF-01
C960913.0333	9444-2	Seattle Waterfront	WF-05
C960913.0433	9444-3	Seattle Waterfront	WF-06
C960913.0533	9444-4	Seattle Waterfront	WF-07
C960913.0633	9444-5	Seattle Waterfront	WF-10
C960913.0733	9444-6	Seattle Waterfront	WF-12
C960913.0833	9444-7	Seattle Waterfront	WF-13
C960913.0933	9444-8	Seattle Waterfront	WF-14
C960913.1033	9444-9	Seattle Waterfront	WF-15
C960913.1133	9444-10	Seattle Waterfront	WF-18

QA Summary

A minor deviation (16.9 °C) from the protocol for temperature occurred during testing for the sample from station L. Large (up to 2.3 °C over protocol limit) deviations for the two controls occurred at the end of testing. The pH in the sample from station K approached the protocol limit on the last day of testing. These excursions should not limit the usefulness of the data.

Seattle Metro QA Audit: *Rhepoxynius abronius* Set I

MEC Sop No.: P024.1
Laboratory: MEC Analytical Systems, Inc., Carlsbad
Date: December 3, 1996
By: Lin Craft

SAMPLE CUSTODY

Twenty-one sediment samples were collected September 9-11, 1996. Samples were received in two Federal Express shipments and logged into the Carlsbad laboratory system on September 11 and 13, 1996. Chains of Custody with Shipment Numbers EL-96-099 and EL-96-102 show transfer of custody from the client to MEC Carlsbad laboratory. The control sediment was received with Organism Batch No. KB091396 and logged in on September 13, 1996.

COMPLETENESS OF DATA

Data for 21 samples, including two reference controls are presented in the report. All water quality measurements were taken. There were no missing data.

SAMPLE HOLDING CONDITIONS AND TIMES

Sediment samples were stored at 4 ± 2° C, in darkness, in a lockable and distinct storage area. Samples were held for 6 days prior to testing.

METHODS

TEST ANIMALS

<u>Animal Receipt</u>

The Organism Receipt Log shows *Rhepoxynius abronius* were received in good condition from Aquatic Environmental Science (Ken Brooks) on September 13, 1996 and assigned Organism Batch No. KB 091396. Animals arrived in moist sediment with a salinity of 32 ppt.

<u>Animal acclimation</u>

The Culture Log indicates that, prior to test initiation, *Rhepoxynius* (Batch KB 091396) were held four days in tubs of the sediment in which they were shipped with fresh aerated seawater at a temperature of 14-17°C and a salinity of 29-32 ppt. 50% water changes were performed daily. There were no feeding requirements.

TEST PROCEDURES

A 10-day *Rhepoxynius abronius* test was initiated on September 17 and ended on September 27, 1996. All test specifications were as per the SOP.

Number of samples (including 2 reference sediment controls) = 21
Number of replicates per sample = 5
Number of negative controls = 2
Number of replicates per control = 5
Number of test organisms per chamber = 20
Test sediment depth = 2 cm

WATER QUALITY

Water quality measurements were performed on all replicates on the day of test initiation (Day 0) and Day 10. One replicate from each sample was measured on days 1 through 9.

Temperature

The protocol calls for temperature to be 15 ± 1° C in the chambers. Measured temperatures exceeded the protocol limit in the following cases:

Sample C960913.0433, Rep 5, Day 5; Reps 1-5 on Day 10.
Sample C960911.1133, Rep 5, Day 5; Reps 1 and 4 on Day 10.
Sample C960913.1533, Rep 5, Day 5.
Control C960913.1733A, Reps 1-5, Day 10.
Control C960913.1733B, Reps 1-5, Day 10.
Sample C960911.0533, Reps 1,4, and 5, Day 10.
Sample C960911.0733, Reps 1-5, Day 10.
Sample C960911.0833, Reps, 1-5, Day 10.
Sample C960911.0933, Rep 4, Day 10.
Sample C960913.0333, Reps 3 and 5, Day 10.
Sample C960913.0633, Reps 1-4, Day 10.

Dissolved Oxygen

The SOP specifies that dissolved oxygen be ≥ 60% saturation. Dissolved oxygen measurements were ≥ 60% saturation in all samples.

Salinity

It is specified that salinity be 28 ± 1 ppt and >25 ppt interstitial. All salinity measurements were within this range with the following exceptions:

Salinity in sample C960913.1133, Rep 1, was 26.4 ppt on Day 1.
Initial interstitial sediment salinity for sample C960911.0933 was 20.2 ppt.
Initial interstitial sediment salinity for sample C960911.1133 was 5.0 ppt.

Sediment salinities were adjusted to test specifications for these latter two samples before the test was started.

pH

The SOP specifies ambient ± 0.5 units. pH in chambers were within this range with the following exceptions:

- -pH on Day 0 in Sample C960913.0833, Reps 2-5, was 8.6 and for Day 10, Reps 1 and 5, was 8.8.
- -pH on Day 9, in Sample C960911.1033, Rep 4 and all Reps on Day 10, were 8.6 to 8.7.
- -pH on Day 10 in Sample C960913.0433, Rep 4, was 8.6.
- -pH on Day 10 in sample C960913.0933, Reps 1-5, were 8.6 to 8.9.
- -pH on Day 10 in sample C960913.1433, Rep 2, was 8.6.

Feeding

There are no feeding requirements for this test.

Renewals

No renewals of the overlying seawater were required.

TEST RESULTS

Mean percent mortality ranged from 4 to 53% for the samples compared to 6 and 8% for the reference sediment and 1 and 3 % for the negative control. Nine of the sample sediment mortality responses were significant relative to the reference sediment.

Mean percent failure to rebury ranged from 0 to 7% for the samples compared to 0% for the reference sediment and 1 and 9% for the negative control.

CONTROL CRITERIA

A table showing the criteria and test results for negative control, reference sediment and positive control for *Rhepoxynius abronius* follows.

Negative Control

The criteron of < 10% mortality was met for the negative control.

Reference Sediment

The criterion of < 25% mortality for the reference sediment was achieved.

Positive Control

The criterion was met for the positive control.

Metro - Set I Control Results

Bioassay	Organism	Negative Control		Reference Sediment		Positive Control	
		Criterion	Test Results	Criterion	Test Results	Criterion	Test Results
Amphipod	*Rhepoxynius abronius*	<10% mortality	3% mortality (Control A) 1% mortality (Control B)	<25% mortality	6% mortality (P9446-1); 8% mortality (P9446-2)	LC_{50} = 0.79 ± 0.48 mg/L cadmium	0.68 mg/L cadmium
Larval	*Dendraster excentricus* (Sand dollar)	<30% combined abnormality and mortality	11.82% combined abnormality and mortality	Not specified	--	EC_{50} = 10.1 ± 6.5 mg/L cadmium	6.20 mg/L cadmium
Juvenile Polychaete	*Neanthes arenaceodentata*	<10% mortality; mean individual growth rate of at least 0.72 mg/day	0% mortality; mean individual growth rate of 0.81 mg/day (Control A) and 0.77 mg/day (Control B)	Mean individual growth rate of at least 80% of control	Mean individual growth rate of 0.48 mg/day (P9446-1) and 0.6 mg/day (P9446-2)	LC_{50} = 12.5 ± 5.4 mg/L cadmium	8.44 mg/L cadmium

LARVAL ECHINODERM - DENDRASTER EXCENTRICUS

- Sediment Bioassay Results
- Statistical Analyses
- Statistical Transformations
- Unionized Ammonia Calculation
- Quality Assurance Review

Larval Echinoderm Sediment Bioassay Results

	Initial Loading Density (Embryos/ mL)	Target Loading Densities (Embryos/ mL)	Is Initial Loading Density Acceptable
Seawater Control t-Zero	37.4	20-30	No

	Final Density (Embryos/ mL)	Percent Survival	Minimum Acceptable Surv.	Is Seawater Control Surv. Acceptable?
Seawater Control t-Final	36.3	90.0%	70.0%	Yes

		Replicate A			Replicate B			Replicate C			Replicate D			Replicate E		
Lab ID	METRO Field ID	Total Larvae	Normal Larvae	Abnormal Larvae	Total Larvae	Normal Larvae	Abnormal Larvae	Total Larvae	Normal Larvae	Abnormal Larvae	Total Larvae	Normal Larvae	Abnormal Larvae	Total Larvae	Normal Larvae	Abnormal Larvae
Seawater t-Zero	-	374	-	-		-	-	392	-	-	425	-	-	306	-	-
Seawater t-Final	-	339	315	24	343	319	24	345	309	36	441	410	31	349	332	17
	P9445-1	334	311	23	304	289	15	336	316	20	288	262	26	322	313	9
	P9445-2	211	203	8	234	230	4	237	222	15	194	190	4	232	226	6
Reference Sed.	P9446-1	124	120	4	334	329	5	350	340	10	341	326	15	259	249	10
Reference Sed. A	W. Beach A	227	217	10	307	296	11	324	317	7	225	213	12	271	248	23
Reference Sed. B	W. Beach B	360	352	8	316	301	15	327	313	14	354	336	18	301	283	18

		Total Larvae					Normal Larvae					Abnormal Larvae				
Lab ID	METRO Field ID	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Seawater t-Zero	-	374		392	425	306	-	-	-	-	-	-	-	-	-	-
Seawater t-Final	-	339	343	345	441	349	315	319	309	410	332	24	24	36	31	17
	P9445-1	334	304	336	288	322	311	289	316	262	313	23	15	20	26	9
	P9445-2	211	234	237	194	232	203	230	222	190	226	8	4	15	4	6
Reference Sed.	P9446-1	124	334	350	341	259	120	329	340	326	249	4	5	10	15	10
Reference Sed. A	W. Beach A	227	307	324	225	271	217	296	317	213	248	10	11	7	12	23
Reference Sed. B	W. Beach B	360	316	327	354	301	352	301	313	336	283	8	15	14	18	18

		Total Larvae				Normal Larvae				Abnormal Larvae			
Lab ID	METRO Field ID	Avg	STD	VAR	COV	Avg	STD	VAR	COV	Avg	STD	VAR	COV
Seawater t-Zero	-	374.3	50.2	2516.3	13.4%	-	-	-	-	-	-	-	-
Seawater t-Final	-	363.4	43.5	1894.8	12.0%	337.0	41.7	1736.5	12.4%	26.4	7.3	53.3	27.7%
	P9445-1	316.8	20.5	421.2	6.5%	298.2	22.9	523.7	7.7%	18.6	6.7	45.3	36.2%
	P9445-2	221.6	18.5	343.3	8.4%	214.2	17.0	290.2	8.0%	7.4	4.6	20.8	61.6%
Reference Sed.	P9446-1	281.6	95.3	9075.3	33.8%	272.8	92.8	8604.7	34.0%	8.8	4.4	19.7	50.4%
Reference Sed. A	W. Beach A	270.8	45.2	2039.2	16.7%	258.2	46.7	2182.7	18.1%	12.6	6.1	37.3	48.5%
Reference Sed. B	W. Beach B	331.6	25.0	627.3	7.6%	317.0	27.4	753.5	8.7%	14.6	4.1	16.8	28.1%

Larval Echinoderm Statistical Analyses

Lab ID	METRO Field ID	Percent Normal Survivorship					Percent Abnormality & Mortality				
		A	B	C	D	E	A	B	C	D	E
Seawater t-Final	-	84.2	85.2	82.6	109.6	88.7	15.8	14.8	17.4	-9.6	11.3
	P9445-1	92.3	85.8	93.8	77.7	92.9	7.7	14.2	6.2	22.3	7.1
	P9445-2	60.2	68.2	65.9	56.4	67.1	39.8	31.8	34.1	43.6	32.9
Reference Sed.	P9446-1	35.6	97.6	100.9	96.7	73.9	64.4	2.4	-0.9	3.3	26.1
Reference Sed. A	W. Beach A	64.4	87.8	94.1	63.2	73.6	35.6	12.2	5.9	36.8	26.4
Reference Sed. B	W. Beach B	104.5	89.3	92.9	99.7	84.0	-4.5	10.7	7.1	0.3	16.0

Lab ID	METRO Field ID	Percent Normal Survivorship				Percent Abnormality & Mortality			
		Avg	STD	VAR	COV	Avg	STD	VAR	COV
Seawater t-Final	-	90.0	11.1	124.0	12.4%	10.0	11.1	124.0	111.9%
	P9445-1	88.5	6.8	46.1	7.7%	11.5	6.8	46.1	59.0%
	P9445-2	63.6	5.1	25.6	8.0%	36.4	5.1	25.6	13.9%
Reference Sed.	P9446-1	80.9	27.5	757.7	34.0%	19.1	27.5	757.7	144.5%
Reference Sed. A	W. Beach A	76.6	13.9	192.2	18.1%	23.4	13.9	192.2	59.3%
Reference Sed. B	W. Beach B	94.1	8.1	66.3	8.7%	5.9	8.1	66.3	137.2%

Lab ID	METRO Field ID	Compared to W. Beach B			Compared to W. Beach A			Compared to P9446-1		
		t-Value	df	Sig?*	t-Value	df	Sig?*	t-Value	df	Sig?*
	P9445-1	1.18	8	No	-1.72	8	No	-0.59	8	No
	P9445-2	7.12	8	Yes	1.98	8	Yes	1.39	8	No
Reference Sed.	P9446-1	1.02	8	No	-0.31	8	No	0.00	8	No
Reference Sed. A	W. Beach A	2.43	8	Yes	0.00	8	No	0.31	8	No
Reference Sed. B	W. Beach B	0.00	8	No	-2.43	8	No	-1.02	8	No

Lab ID	METRO Field ID	Percent Mortality	Mort. 15% Over W.Bch B	Mort 15% Over W. Bch A	Mort. 15% Over P9446-1	Mort 30% Over W.Bch B	Mort. 30% Over W. Bch A	Mort. 30% Over P9446-1
	P9445-1	11.5	No	No	No	No	No	No
	P9445-2	36.4	Yes	No	Yes	Yes	No	No
Reference Sed.	P9446-1	19.1	No	No	No	No	No	No
Reference Sed. A	W. Beach A	23.4	Yes	No	No	No	No	No
Reference Sed. B	W. Beach B	5.9	No	No	No	No	No	No

** Value = 1.397 (8 degrees of freedom, alpha level of 0.1, one tailed t-test)* difficult to interpret. The following statistical transformations were performed by KCEL bioassay personnel using SPSS version 8.0.

Transform: NO TRANSFORMATION

Shapiro Wilk's test for normality

D = 4352.620
W = 0.892

Critical W (P = 0.05)	(n = 25)	=	0.918
Critical W (P = 0.01)	(n = 25)	=	0.888

Data PASS normality test at P=0.01 level. Continue analysis.

Transform: NO TRANSFORMATION

Cochran's test for homogeneity of variance

Calculated G statistic = 0.6960
Table value = 0.63 (alpha =0.01, df =5, 5)
Table value = 0.54 (alpha =0.05, df =5, 5)

Data FAIL homogeneity test at 0.01 level. Try another transformation.
NOTE: Cochran's test is most powerful for detecting one large deviant variance.

Transform: NO TRANSFORMATION

Levene's test for homogeneity of variance

ANOVA TABLE

Source	DF	SS	MS	F
Between	4	674.478	168.619	1.052
Within (error)	20	3204.204	160.210	
Total	24	3878.682		

Critical F value = 2.87 (0.05, 4, 20)
Since F < Critical F FAIL TO REJECT Ho: All equal

Unionized Ammonia Calculation

Convert mean temperature from centigrade (C) to Kelvin (K)
T = C + 273 = K

	C	K
Control	16.5	289.5
P9445-1	16.1	289.1
P9445-2	16.5	289.5

Calculate the molal ionic strength of sea water from salinity
I = (19.9273 * S)/(1000 - (1.00519 * S)

	S	I
Control	28.8	0.5910144
P9445-1	28.8	0.5910144
P9445-2	28.8	0.5910144

Select the appropriate equation and determine $pKa^{S,298}$ (salinity dependent at 298K)
$pKa^{S,298} = 9.20 + 0.20(I)$

	I	$pKa^{S,298}$
Control	0.59101442	9.3182029
P9445-1	0.59101442	9.3182029
P9445-2	0.59101442	9.3182029

Calculate the $pKa^{S,T}$ at desired temperature using above $pKa^{S,298}$
$pKa^{S,T} = (2729.69/T) + (pKa^{S,298} - 9.1345) - (7.1x10^{-5} * T)$

	T	$pKa^{S,298}$	$pKa^{S,T}$
Control	289.5	9.3182029	9.5921294
P9445-1	289.1	9.3182029	9.6052038
P9445-2	289.5	9.3182029	9.5921294

Calculate unionized ammonia concentration
NH_3-N, mg/L = (Total ammonia, mg/L)/(1 + $10^{(pKaS,T-pH)}$)

	Total ammonia	$pKa^{S,T}$	pH	$10^{(pKaS,T-pH)}$	NH_3-N, mg/L	Exceed 0.04 mg/L?
Initial						
Control	0.06	9.5921294	8.0	39.095735	0.0014964	NO
P9445-1	0.13	9.6052038	8.1	32.003963	0.0039389	NO
P9445-2	0.12	9.5921294	8.0	39.095735	0.0029928	NO
Final						
Control	0	9.5921294	8.0	39.095735	0	NO
P9445-1	0.38	9.6052038	8.1	32.003963	0.0115138	NO
P9445-2	0.02	9.5921294	8.0	39.095735	0.0004988	NO

Larval Echinoderm Quality Assurance Review

The following *Seattle Metro QA Audit* is a narrative prepared by MEC documenting problems encountered and deviations from the protocol. The two Denny Way samples were analyzed along with 17 other test samples from other King County projects, 2 reference samples and 2 control samples. MEC reported all these samples in the same report. Therefore, the MEC narrative contains information about samples not related to the Denny Way project.

MEC assigned their own sample identification numbers to maintain blind testing. Use the following cross reference table to identify the King County sample ID number, project and station. The top 7 stations refer directly to this review, the others , which are greyed out, are given to provide continuity with the MEC report.

MEC Sample ID	KC Sample ID	Project	Station
C960913.1746A	Control A	All Control A	
C960913.1746B	Control B	All Control B	
Water Control	Water Control	All	
C960913.1246	9446-1	All Reference	
C960913.1346	9446-2	All Reference	
C960913.1446	9445-1	Denny Way K	LTBC21
C960913.1546	9445-2	Denny Way L	LTBC22
C960911.0546	9443-1	Duwamish Diagonal	DUD200
C960911.0646	9443-2	Duwamish Diagonal	DUD201
C960911.0746	9443-3	Duwamish Diagonal	DUD202
C960911.0846	9443-4	Duwamish Diagonal	DUD203
C960911.0946	9443-5	Duwamish Diagonal	DUD204
C960911.1046	9443-6	Duwamish Diagonal	DUD205
C960911.1146	9443-7	Duwamish Diagonal	DUD206
C960913.0246	9444-1	Seattle Waterfront	WF-01
C960913.0346	9444-2	Seattle Waterfront	WF-05
C960913.0446	9444-3	Seattle Waterfront	WF-06
C960913.0546	9444-4	Seattle Waterfront	WF-07
C960913.0646	9444-5	Seattle Waterfront	WF-10
C960913.0746	9444-6	Seattle Waterfront	WF-12
C960913.0846	9444-7	Seattle Waterfront	WF-13
C960913.0946	9444-8	Seattle Waterfront	WF-14
C960913.1046	9444-9	Seattle Waterfront	WF-15
C960913.1146	9444-10	Seattle Waterfront	WF-18

QA Summary

Testing was initiated on 20 September and completed on 23 September. Control development did not meet protocol specifications. New animals were received. Testing started over on 27 September and was completed 30 September. Sediment samples were two days past the fourteen day holding time at the start of the second test. The temperature protocol was exceeded for all samples on initiation and termination days by up to 1.7°C. MEC states that these excursions do not limit the usefulness of the data. Initial densities were higher than recommended by the protocol for many samples. MEC did not comment about how this may affect the usefulness of the data. MEC did not report the data in a seawater normalized format. The KCEL bioassay laboratory performed the necessary calculations for the tables in this report. These values will differ from the values reported by MEC in the comprehensive report and supporting documentation.

Seattle Metro QA Audit: *Dendraster excentricus* Set I

MEC Sop No.: P042.0
Laboratory: MEC Analytical Systems, Inc., Carlsbad
Date: November 27, 1996
By: Lin Craft

SAMPLE CUSTODY

Twenty-one sediment samples were collected September 9-11, 1996. Samples were received in two Federal Express shipments and logged into the Carlsbad laboratory system on September 11 and 13, 1996. Chains of Custody with Shipment Numbers EL-96-099 and EL-96-102 show transfer of custody from the client to MEC Carlsbad laboratory. The control sediment was received with Organism Batch No. KB091396 and logged in on September 13, 1996.

COMPLETENESS OF DATA

Data for 21 samples, including two reference controls are presented in the report. The following water quality measurements were missing:

No water quality readings were taken for C960913.0946 on Day 3 (9/30)

SAMPLE HOLDING CONDITIONS AND TIMES

Sediment samples were stored at 4 ± 2° C, in darkness, in a lockable and distinct storage area. Samples were 16 days old at the time of the repeat testing, exceeding the holding time by 2 days.

METHODS

TEST ANIMALS

Animal Receipt

The Organism Receipt Log shows *Dendraster excentricus* were received in good conditionon from Kim Siewers, Santa Cruz, CA (for first shipment) on September 17 and from Aquatic Enviromental Science (Ken Brooks) on September 27, 1996. The shipments were assigned MEC Organism Batch Nos. KS 091796 and KB 092796 respectively. Animals were shipped dry via Federal Express.

Animal acclimation

Batch KS 091796 *Dendraster* was held 3 days in fresh, aerated seawater (salinity 30-32 ppt) with water changes at 15-17 °C. Batch KB 092795 *Dendraster* was held in the ice chests in which the animals were received until they were spawned, which occurred within 4-5 hours of receipt.

TEST PROCEDURES

The first 20-day *Dendraster excentricus* test was initiated on September 20 and was ended on September 23, 1996 . Control development was only 79-83% normal in the negative controls and thus did not meet protocol specifications of 90%. The test was started over on September 27, 1966 with new animals (Batch KB 092796) and ended on September 30, 1966. All test specifications were as per the SOP.

Number of samples (including 2 reference sediment controls) = 21
Number of replicates per sample = 5
Number of negative controls = 2
Number of seawater controls = 1
Number of replicates per control = 5
Number of test organisms per chamber = 29,600

WATER QUALITY

Daily measurements were taken from a surrogate jar in the test room on Day 0 through test termination.

Temperature

The protocol calls for temperature to be 15 ± 1°C in the chambers.Temperature measurements on Day 0 (27 September) for all samples ranged from 16.0 to 17.5°, exceeding the temperature criterion. On Day 3 (30 September) temperatures for all samples ranged from 16.3 to 17.7°C, also exceeding the temperature criterion.

Dissolved Oxygen

The SOP specifies that dissolved oxygen be not less than 60% saturation. Dissolved oxygen measurements were > 60% saturation in all samples.

Salinity

The SOP specifies that salinity be 28 ± 1 ppt. All salinity measurements were within this range.

pH

The SOP specifies no range for pH. pH in test chambers ranged from 7.7 to 8.3.

TEST RESULTS

Mean percent combined larval mortality/abnormality was 15.24 to 30.96% for the two negative control, 15.24% for the seawater control, 15.88 to 51.82% for the 19 test samples, and 27.09 to 29.04% for the two reference sediment controls.

Mean percent for larval combined mortalities plus abnormalities was 11.29 to 28.18% for the negative controls, 18.18% for the seawater control, and 12.70 to 53.73% for the 19 test sediments, and 22.40 to 28.89% for the reference controls.

Separate mortality and abnormality data are also reported.

CONTROL CRITERIA

A table showing the criteria and test results for negative control, reference sediment and positive control for *Dendraster excentricus* follows.

Negative Control
The criterion was met for the negative controls.

Reference Sediment
Criteria were not specifically defined.

Positive Control
The criterion was met for the positive control.

Metro - Set I Control Results

Bioassay	Organism	Negative Control		Reference Sediment		Positive Control	
		Criterion	Test Results	Criterion	Test Results	Criterion	Test Results
Amphipod	*Rhepoxynius abronius*	<10% mortality	3% mortality (Control A) 1% mortality (Control B)	<25% mortality	6% mortality (P9446-1); 8% mortality (P9446-2)	LC_{50} = 0.79 ± 0.48 mg/L cadmium	0.68 mg/L cadmium
Larval	*Dendraster excentricus* (Sand dollar)	<30% combined abnormality and mortality	11.82% combined abnormality and mortality	Not specified	--	EC_{50} = 10.1 ± 6.5 mg/L cadmium	6.20 mg/L cadmium
Juvenile Polychaete	*Neanthes arenaceodentata*	<10% mortality; mean individual growth rate of at least 0.72 mg/day	0% mortality; mean individual growth rate of 0.81 mg/day (Control A) and 0.77 mg/day (Control B)	Mean individual growth rate of at least 80% of control	Mean individual growth rate of 0.48 mg/day (P9446-1) and 0.6 mg/day (P9446-2)	LC_{50} = 12.5 ± 5.4 mg/L cadmium	8.44 mg/L cadmium

JUVENILE POLYCHAETE – NEANTHES ARENACEODENTATA

- Sediment Bioassay Results
- Statistical Analyses
- Statistical Transformations
- Quality Assurance Review

Juvenile Polychaete Sediment Bioassay Results

METRO Field ID No.	t-Test Value West Beach A	Is the value Significant?*	Is Sediment Growth Rate <70% of West Beach A	Is Sediment Growth Rate <50% of West Beach A	t-Test Value P9446-1	Is the value Significant?*	Is Sediment Growth Rate <70% of P9446-1 ?	Is Sediment Growth Rate <50% of P9446-1 ?
P9445-1	1.49	No	No	No	-2.24	No	No	No
P9445-2	2.69	Yes	No	No	-1.44	No	No	No
West Beach A	0.00	No	No	No	-3.83	No	No	No
West Beach B	0.41	No	No	No	-2.90	No	No	No
P9446-1, Ref.	3.83	Yes	Yes	No	0.00	No	No	No

METRO Field ID Number	Laboratory ID Number	AVG of the Mean Individual Growth Rate	STD of the Mean Individual Growth Rate	VAR of the Mean Individual Growth Rate	COV of the Mean Individual Growth Rate	t-Test Value West Beach B	Is the Value Significant?	Is the Sediment Growth Rate <70% of West Beach B	Is the Sediment Growth Rate <50% of West Beach B
P9445-1		0.66	0.15	0.02	23.4%	0.93	No	No	No
P9445-2		0.57	0.11	0.01	18.8%	1.92	Yes	No	No
West Beach A		0.81	0.17	0.03	21.1%	-0.41	No	No	No
West Beach B		0.77	0.20	0.04	26.2%	0.00	No	No	No
P9446-1, Ref.		0.48	0.09	0.01	19.1%	2.90	Yes	Yes	No

** Value = 1.86 (8 degrees of freedom, alpha level of 0.05, one tailed t-test)*

Juvenile Polychaete Statistical Analyses

Lab ID Number	METRO Field ID No.	Replicate	No. T-0 Individuals	No. T-final Individuals	% Survivorship	AVG larval Survivorsh-ip	STD larval Survivors-hip	VAR larval Survivorship	COV larval Survivors-hip	Initial Weigh Boat (g)	Final Boat + larvae (g)	Total Larval Weight (g)
	Day 0	A		5						0.04052	0.04376	0.00324
	Day 0	B		5						0.03464	0.03871	0.00407
	Day 0	C		5						0.02854	0.03236	0.00382
	P9445-1	A	5	5	100%	1.00	0.00	0.00	0.0%	0.05832	0.11047	0.05215
	P9445-1	B	5	5	100%					0.04683	0.13105	0.08422
	P9445-1	C	5	5	100%					0.05653	0.11580	0.05927
	P9445-1	D	5	5	100%					0.05621	0.12214	0.06593
	P9445-1	E	5	5	100%					0.05899	0.14634	0.08735
	P9445-2	A	5	5	100%	1.00	0.00	0.00	0.0%	0.05039	0.10985	0.05946
	P9445-2	B	5	5	100%					0.06463	0.12883	0.06420
	P9445-2	C	5	5	100%					0.06493	0.11613	0.05120
	P9445-2	D	5	5	100%					0.05304	0.10490	0.05186
	P9445-2	E	5	5	100%					0.06374	0.14110	0.07736
	West Beach A	A	5	5	100%	1.00	0.00	0.00	0.0%	0.04389	0.14864	0.10475
	West Beach A	B	5	5	100%					0.04742	0.11373	0.06631
	West Beach A	C	5	5	100%					0.04853	0.11647	0.06794
	West Beach A	D	5	5	100%					0.04924	0.14532	0.09608
	West Beach A	E	5	5	100%					0.03812	0.12902	0.09090
	West Beach B	A	5	5	100%	1.00	0.00	0.00	0.0%	0.04278	0.13769	0.09491
	West Beach B	B	5	5	100%					0.05091	0.15350	0.10259
	West Beach B	C	5	5	100%					0.05146	0.13530	0.08384
	West Beach B	D	5	5	100%					0.05223	0.11850	0.06627
	West Beach B	E	5	5	100%					0.05233	0.10635	0.05402
	P9446-1, Ref.	A	5	5	100%	1.00	0.00	0.00	0.0%	0.04127	0.09141	0.05014
	P9446-1, Ref.	B	5	5	100%					0.04622	0.10498	0.05876
	P9446-1, Ref.	C	5	5	100%					0.06111	0.10207	0.04096
	P9446-1, Ref.	D	5	5	100%					0.04276	0.08840	0.04564
	P9446-1, Ref.	E	5	5	100%					0.05843	0.12169	0.06326

METRO Field ID No.	Mean Individual Larval Weight (mg)	AVG of Mean Individu-al Larval Weight (mg)	STD of Mean Individual Larval Weight (mg)	VAR of Mean Individual Larval Weight (mg)	COV of Mean Individual Larval Weight (mg)	Individual Growth Rate (mg/Day)	AVG of Individual Growth Rate (mg/Day)	STD of Individual Growth Rate (mg/Day)	VAR of Individual Growth Rate (mg/Day)	COV of Individual Growth Rate (mg/Day)
Day 0	0.65	0.74	0.09	0.01	11.5%					
Day 0	0.81									
Day 0	0.76									
P9445-1	10.43	13.96	3.09	9.53	22.1%	0.48	0.66	0.15	0.02	23.4%
P9445-1	16.84					0.81				
P9445-1	11.85					0.56				
P9445-1	13.19					0.62				
P9445-1	17.47					0.84				
P9445-2	11.89	12.16	2.14	4.60	17.6%	0.56	0.57	0.11	0.01	18.8%
P9445-2	12.84					0.60				
P9445-2	10.24					0.47				
P9445-2	10.37					0.48				
P9445-2	15.47					0.74				
West Beach A	20.95	17.04	3.45	11.88	20.2%	1.01	0.81	0.17	0.03	21.1%
West Beach A	13.26					0.63				
West Beach A	13.59					0.64				
West Beach A	19.22					0.92				
West Beach A	18.18					0.87				
West Beach B	18.98	16.07	4.01	16.10	25.0%	0.91	0.77	0.20	0.04	26.2%
West Beach B	20.52					0.99				
West Beach B	16.77					0.80				
West Beach B	13.25					0.63				
West Beach B	10.80					0.50				
P9446-1, Ref.	10.03	10.35	1.84	3.38	17.8%	0.46	0.48	0.09	0.01	19.1%
P9446-1, Ref.	11.75					0.55				
P9446-1, Ref.	8.19					0.37				
P9446-1, Ref.	9.13					0.42				
P9446-1, Ref.	12.65					0.60				

Juvenile Polychaete Statistical Tranformations

Statistical transformation performed by MEC were incomplete and difficult to interpret. The following statistical transformations were performed by KCEL bioassay personnel.

Transform: NO TRANSFORMATION

Shapiro Wilk's test for normality

D =	0.461
W =	0.961

Critical W (P = 0.05)	(n = 25)	=	0.918
Critical W (P = 0.01)	(n = 25)	=	0.888

Data PASS normality test at P=0.01 level. Continue analysis.

Transform: NO TRANSFORMATION

Cochran's test for homogeneity of variance

Calculated G statistic = 0.3503

Table value =	0.63	(alpha =0.01,	df =	5,	5)
Table value =	0.54	(alpha =0.05,	df =	5,	5)

Data FAIL homogeneity test at 0.01 level. Try another transformation.
NOTE: Cochran's test is most powerful for detecting one large deviant variance.

Transform: NO TRANSFORMATION

Levene's test for homogeneity of variance

ANOVA TABLE

Source	DF	SS	MS	F
Between	4	0.025	0.006	0.800
Within (error)	20	0.157	0.008	
Total	24	0.182		

Critical F value =	2.87	(0.05, 4, 20)		
Since F < Critical F	FAIL TO REJECT		Ho:	All equal

Juvenile Polychaete Quality Assurance Review

The following *Seattle Metro QA Audit* is a narrative prepared by MEC documenting problems encountered and deviations from the protocol. The two Denny Way samples were analyzed along with 17 other test samples from other King County projects, 2 reference samples and 2 control samples. MEC reported all these samples in the same report. Therefore, the MEC narrative contains information about samples not related to the Denny Way project.

MEC assigned their own sample identification numbers to maintain blind testing. Use the following cross reference table to identify the King County sample ID number, project and station. The non-shaded cells are samples pertinent to Denny Way.

MEC Sample ID	KC Sample ID	Project	Station
C960913.1737A	Control A	All Control A	
C960913.1737B	Control B	All Control B	
C960911.0537	9443-1	Duwamish Diagonal	DUD200
C960911.0637	9443-2	Duwamish Diagonal	DUD201
C960911.0737	9443-3	Duwamish Diagonal	DUD202
C960911.0837	9443-4	Duwamish Diagonal	DUD203
C960911.0937	9443-5	Duwamish Diagonal	DUD204
C960911.1037	9443-6	Duwamish Diagonal	DUD205
C960911.1137	9443-7	Duwamish Diagonal	DUD206
C960913.0237	9444-1	Seattle Waterfront	WF-01
C960913.0337	9444-2	Seattle Waterfront	WF-05
C960913.0437	9444-3	Seattle Waterfront	WF-06
C960913.0537	9444-4	Seattle Waterfront	WF-07
C960913.0637	9444-5	Seattle Waterfront	WF-10
C960913.0737	9444-6	Seattle Waterfront	WF-12
C960913.0837	9444-7	Seattle Waterfront	WF-13
C960913.0937	9444-8	Seattle Waterfront	WF-14
C960913.1037	9444-9	Seattle Waterfront	WF-15
C960913.1137	9444-10	Seattle Waterfront	WF-18
C960913.1237	9446-1	All Reference	
C960913.1337	9446-2	All Reference	
C960913.1437	9445-1	Denny Way	K LTBC21
C960913.1537	9445-2	Denny Way	L LTBC22

QA Summary

MEC monitored water quality every third day. While acceptable by PSEP guidance, the project required daily monitoring of water quality, as stated in the sampling and analysis plan.

Salinity was not measured for one of the reference samples on the final day. This would not affect the results, especially since this reference sample was rejected.

Seattle Metro QA Audit: *Neanthes arenaceodentata* Set I

MEC Sop No.: P014.1
Laboratory: MEC Analytical Systems, Inc., Carlsbad
Date: November 25, 1996
By: Lin Craft

SAMPLE CUSTODY

Twenty-one sediment samples were collected September 9-11, 1996. Samples were received in two Federal Express shipments and logged into the Carlsbad laboratory system on September 11 and 13, 1996. Chains of Custody with Shipment Numbers EL-96-099 and EL-96-102 show transfer of custody from the client to MEC Carlsbad laboratory. The control sediment was received with Organism Batch No. KB091396 and logged in on September 13, 1996.

COMPLETENESS OF DATA

Data for 21 samples, including two reference controls are presented in the report. The following water quality measurements were missing:

pH was not recorded for C960913.0937, Rep 1 on Day 3 (9/22)
Salinity was not recorded for C960913.1137, Rep 2 on Day 20 (10/9)
Salinity was not recorded for C960913.1237, Rep 2 on Day 20 (10/9)

SAMPLE HOLDING CONDITIONS AND TIMES

Sediment samples were stored at 4 ± 2° C, in darkness, in a lockable and distinct storage area. Samples were held for one week prior to testing.

METHODS

TEST ANIMALS

Animal Receipt

The Organism Receipt Log shows *Neanthes arenaceodentata* were received in good condition from Dr. Don Reish on September 17, 1996 and assigned Organism Batch No. DR 91796. Animals arrived in seawater with a salinity of 35.8 ppt.

Animal acclimation

Neanthes were held in fresh aerated seawater at 20° and adjusted gradually via water changes to a salinity of 28 ppt over the 48 hours prior to test initiation. Animals were fed TetraMarin daily during acclimation.

TEST PROCEDURES

The first 20-day *Neanthes arenaceodentata* test was initiated on September 19 and ended on October 9, 1996. All test specifications were as per the SOP.

Number of samples (including 2 reference sediment controls) = 21
Number of replicates per sample = 5
Number of negative controls = 2
Number of replicates per control = 5
Number of test organisms per chamber = 5

WATER QUALITY

Measurements were taken on all replicates prior to addition of organisms. One replicate for each sample was measured on days 3, 6, 9, 12, 15, 18, and 20 prior to seawater renewal.

Temperature
The protocol calls for temperature to be 19 to 21° C in the chambers. All temperatures fell within this range.

Dissolved Oxygen
The SOP specifies that dissolved oxygen be > 60% saturation. Dissolved oxygen measurements were > 60% saturation in all samples.

Salinity
The SOP specifies that salinity be 28 ± 2 ppt. All salinity measurements were within this range.

> Initial interstitial sediment salinity for sample C960911.0933 was 20.2 ppt.
> Initial interstitial sediment salinity for sample C960911.1133 was 5.0 ppt.

Sediment salinities were adjusted to test specifications for these latter two samples before the test was started.

pH
The SOP specifies no range for pH. pH in chambers ranged from 7.1 to 8.5.

Feeding
The polychaetes were fed TetraMarin every other day on September 20, 22, 24,

26, 28, 30 and October 2, 4, 6, and 8 as per the SOP.

Renewals
Seawater renewals, with exchange of one third of the the chamber volume on every third day, were done on September 22, 25, 28, and October 1,4, and 7 as per the SOP.

TEST RESULTS

Mean percent survival was 100 percent for all 21 samples and controls.

CONTROL CRITERIA

A table showing the criteria and test results for negative control, reference sediment and positive control for *Neanthes arenaceodentata* follows.

Negative Control
All criteria were met for the negative controls.

Reference Sediment
The criterion for the reference sediment of the mean individual growth rate being at least 80% of the negative control was not achieved.

Positive Control
All criteria were met for the positive controls.

Metro - Set I Control Results

Bioassay	Organism	Negative Control		Reference Sediment		Positive Control	
		Criterion	Test Results	Criterion	Test Results	Criterion	Test Results
Amphipod	*Rhepoxynius abronius*	<10% mortality	3% mortality (Control A) 1% mortality (Control B)	<25% mortality	6% mortality (P9446-1); 8% mortality (P9446-2)	LC_{50} = 0.79 ± 0.48 mg/L cadmium	0.68 mg/L cadmium
Larval	*Dendraster excentricus* (Sand dollar)	<30% combined abnormality and mortality	11.82% combined abnormality and mortality	Not specified	--	EC_{50} = 10.1 ± 6.5 mg/L cadmium	6.20 mg/L cadmium
Juvenile Polychaete	*Neanthes arenaceodentata*	<10% mortality; mean individual growth rate of at least 0.72 mg/day	0% mortality; mean individual growth rate of 0.81 mg/day (Control A) and 0.77 mg/day (Control B)	Mean individual growth rate of at least 80% of control	Mean individual growth rate of 0.48 mg/day (P9446-1) and 0.6 mg/day (P9446-2)	LC_{50} = 12.5 ± 5.4 mg/L cadmium	8.44 mg/L cadmium

APPENDIX F:

BIOASSAY RESULTS

Final Report
Seattle Metro Sampling Event One

Marine Sediment Bioassays

Submitted To

King County Department of Natural Resources
Water Resources Division
Environmental Lab
322 West Ewing Street
Seattle, WA 98119

Submitted By

MEC Analytical Systems, Inc.
6060 Corte del Cedro
Carlsbad, CA 92009

December 6, 1996

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

CASE SUMMARY

1. Project/Sample Identification

Bioassay testing on marine sediments was conducted in support of the Elliott Bay/Duwamish River Sediment Remediation Project, Seattle Waterfront Project, the Connecticut Hanford and Chelan Street, and other Combined Sewer Overflow (CSO) Projects. Toxicity tests were conducted on a total of 21 samples. Seven sediment samples were received by the laboratory on 11 September 1996, and 12 sediment samples plus 2 reference sediment samples were received on 13 September 1996 (see Table below). The control sediment was received and logged in on 13 September, 1996.

Sample ID	Collection Date	Date Received	Sample ID	Collection Date	Date Received
L9443-1	9/9/96	9/11/96	L9444-5	9/10/96	9/13/96
L9443-2	9/9/96	9/11/96	L9444-6	9/11/96	9/13/96
L9443-3	9/9/96	9/11/96	L9444-7	9/11/96	9/13/96
L9443-4	9/9/96	9/11/96	L9444-8	9/11/96	9/13/96
L9443-5	9/9/96	9/11/96	L9444-9	9/10/96	9/13/96
L9443-6	9/9/96	9/11/96	L9444-10	9/11/96	9/13/96
L9443-7	9/10/96	9/11/96	L9446-1 (Ref)	9/11/96	9/13/96
L9444-1	9/10/96	9/13/96	L9446-2 (Ref)	9/11/96	9/13/96
L9444-2	9/10/96	9/13/96	L9445-1	9/10/96	9/13/96
L9444-3	9/11/96	9/13/96	L9445-2	9/10/96	9/13/96
L9444-4	9/11/96	9/13/96			

[signature]	6 Dec 96	[signature]	6 DEC 96
QA Officer	Date	Laboratory Manager	Date

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

2. Test Method

Toxicity tests were conducted on juvenile polychaetes (*Neanthes arenaceodentata*) using MEC Protocol #P014.1. All methods and protocols employed in this program followed general procedures established by the EPA and the State of Washington in Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP, July 1995). Testing was performed at the MEC Analytical Systems, Inc. Bioassay Laboratory located in Carlsbad, California.

3. Case Narrative

Testing was initiated on 19 September 1996, and completed on 9 October 1996. Testing was performed concurrently on sample, reference, and control sediments.

Negative control and reference sediments were collected and tested in compliance with SMS performance standards for test validation.

Dissolved oxygen and pH meters used in the conduct of these bioassays were calibrated each day prior to use. The conductivity/salinity meter calibration is verified monthly. No irregularities were encountered in the calibration or operation of the instruments.

Water quality measurements were taken for all replicates of all samples on day 0 and then from one replicate test container for each sample every third day. Data on mean, minimum and maximum values are presented in the report following the case narrative.

Data were recorded on pre-printed data sheets in ink. All corrections were initialed by the person making the correction and the mistake was coded. A table of correction codes for the laboratory and a table with the names and initials of the laboratory staff are presented in the appendix of this report.

Data for water quality and mortality were double entered and cross compared for accuracy. In the event of a discrepancy, the correct information was confirmed from the original data sheets. The test acceptance criterion for the polychaete test is ≥90% survival and 0.72 mg/individual/day growth rate. The negative control had a mean survival of 100% and a weight gain range of 0.77 to 0.83 mg/individual/day. Reference site daily growth data was 0.48 mg/individual/day (9446-1) and 0.60 mg/individual/day (9446-2). These values are less than the SMS growth criterion of 80% of control growth. All data generated from this were accepted without qualification.

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Communications between the laboratory (MEC) and King County Environmental Laboratory (KCEL) were logged and kept as part of the permanent project file.

1. Sediment interstitial salinity for sample C960911.0937 was 20.2 ppt. Sediment interstitial salinity adjustment to test specifications (28 $\pm$ 2 ppt) was necessary before the test was started.

2. Sediment interstitial salinity for sample C960911.1137 was 5.0 ppt. Sediment interstitials salinity adjustment to test specifications was necessary before the test was started.

3. Salinity reading for sample C960913.1137, Rep 2, day 20 was not recorded. All previous salinity measurements were within protocol specifications (28 $\pm$ 2 ppt). This oversight does not limit the usefulness of the data.

4. Salinity reading for sample C960913.1237, Rep 2, day 20 was not recorded. All previous salinity measurements were within protocol specifications (28 $\pm$ 2 ppt). This oversight does not limit the usefulness of the data.

5. pH reading for sample C960913.0937, Rep 1, day 3 was not recorded. pH data for this sample and all other samples were within protocols specifications throughout the test. This oversight does not limit the usefulness of the data.

4. Summary of Test Response

The following tables show test response by replicate, mean, and standard deviation for negative control, reference, and test sediments. Analyses include survival, total biomass, individual biomass, and individual growth rate. Results marked with an asterisk (*) are statistically significant relative to reference sediment response (Student's t-test, p = 0.05).

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Survival (%) By Replicate	Survival (%) Mean	Survival (%) Standard Deviation	Total Biomass (Dry weight, mg) By Replicate	Total Biomass (Dry weight, mg) Mean	Total Biomass (Dry weight, mg) Standard Deviation
Control A	C960913.1737A	1	100%	100%	0.00	104.75	85.20	17.23
		2	100%			66.31		
		3	100%			67.94		
		4	100%			96.08		
		5	100%			90.90		
Control B	C960913.1737B	1	100%	100%	0.00	94.91	80.33	20.06
		2	100%			102.59		
		3	100%			83.84		
		4	100%			66.27		
		5	100%			54.02		
P9443-1	C960911.0537	1	100%	100%	0.00	39.76	63.28	15.35
		2	100%			66.25		
		3	100%			58.26		
		4	100%			72.32		
		5	100%			79.83		
P9443-2	C960911.0637	1	100%	100%	0.00	44.12	58.50	8.97
		2	100%			62.20		
		3	100%			68.28		
		4	100%			57.29		
		5	100%			60.62		
P9443-3	C960911.0737	1	100%	100%	0.00	50.41	65.34	14.63
		2	100%			57.66		
		3	100%			73.24		
		4	100%			58.49		
		5	100%			86.90		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11&13Sep96
Date Test Started: 19Sep96
Date Test Ended: 9Oct96

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Survival (%) By Replicate	Survival (%) Mean	Survival (%) Standard Deviation	Total Biomass (Dry weight, mg) By Replicate	Total Biomass (Dry weight, mg) Mean	Total Biomass (Dry weight, mg) Standard Deviation
P9443-4	C960911.0837	1	100%	100%	0.00	59.81	63.17	9.35
		2	100%			70.06		
		3	100%			74.54		
		4	100%			60.75		
		5	100%			50.68		
P9443-5	C960911.0937	1	100%	100%	0.00	61.29	54.74	10.45
		2	100%			48.80		
		3	100%			40.03		
		4	100%			66.42		
		5	100%			57.14		
P9443-6	C960911.1037	1	100%	100%	0.00	53.89	58.00	15.50
		2	100%			58.54		
		3	100%			38.74		
		4	100%			56.91		
		5	100%			81.91		
P9443-7	C960911.1137	1	100%	100%	0.00	53.85	55.59	5.48
		2	100%			50.68		
		3	100%			62.60		
		4	100%			50.72		
		5	100%			60.08		
P9444-1	C960913.0237	1	100%	100%	0.00	51.33	61.14	9.30
		2	100%			54.74		
		3	100%			75.28		
		4	100%			63.95		
		5	100%			60.39		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11&13Sep96
Date Test Started: 19Sep96
Date Test Ended: 9Oct96

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Survival (%)			Total Biomass (Dry weight, mg)		
			By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9444-2	C960913.0337	1	100%	100%	0.00	49.93	55.73	11.28
		2	100%			49.27		
		3	100%			44.29		
		4	100%			70.87		
		5	100%			64.31		
P9444-3	C960913.0437	1	100%	100%	0.00	61.21	64.04	10.35
		2	100%			62.87		
		3	100%			68.94		
		4	100%			77.64		
		5	100%			49.55		
P9444-4	C960913.0537	1	100%	100%	0.00	77.68	68.31	6.90
		2	100%			62.81		
		3	100%			73.41		
		4	100%			62.05		
		5	100%			65.58		
P9444-5	C960913.0637	1	100%	100%	0.00	45.50	67.99	15.74
		2	100%			89.66		
		3	100%			66.76		
		4	100%			71.43		
		5	100%			66.61		
P9444-6	C960913.0737	1	100%	100%	0.00	51.57	62.63	11.56
		2	100%			63.62		
		3	100%			58.17		
		4	100%			57.94		
		5	100%			81.86		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Survival (%)			Total Biomass (Dry weight, mg)		
			By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9444-7	C960913.0837	1	100%	100%	0.00	53.90	46.92	12.08
		2	100%			39.99		
		3	100%			48.81		
		4	100%			30.43		
		5	100%			61.46		
P9444-8	C960913.0937	1	100%	100%	0.00	45.47	58.19	22.44
		2	100%			90.23		
		3	100%			55.51		
		4	100%			31.44		
		5	100%			68.32		
P9444-9	C960913.1037	1	100%	100%	0.00	67.95	69.27	5.77
		2	100%			63.77		
		3	100%			64.01		
		4	100%			75.82		
		5	100%			74.79		
P9444-10	C960913.1137	1	100%	100%	0.00	58.39	59.35	10.77
		2	100%			73.19		
		3	100%			47.54		
		4	100%			50.69		
		5	100%			66.92		
P9446-1 Reference	C960913.1237	1	100%	100%	0.00	50.14	51.75	9.19
		2	100%			58.76		
		3	100%			40.96		
		4	100%			45.64		
		5	100%			63.26		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Survival (%)			Total Biomass (Dry weight, mg)		
			By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9446-2 Reference	C960913.1337	1	100%	100%	0.00	63.37	63.80	18.28
		2	100%			82.01		
		3	100%			54.32		
		4	100%			38.68		
		5	100%			80.63		
P9445-1	C960913.1437	1	100%	100%	0.00	52.15	69.78	15.44
		2	100%			84.22		
		3	100%			59.27		
		4	100%			65.93		
		5	100%			87.35		
P9445-2	C960913.1537	1	100%	100%	0.00	59.46	60.82	10.72
		2	100%			64.20		
		3	100%			51.20		
		4	100%			51.86		
		5	100%			77.36		

Initial Biomass

Number of Worms	Total Biomass (mg)	Average	Individual Biomass (mg)	Average
5	3.24	3.71	0.65	0.74
5	4.07		0.81	
5	3.82		0.76	

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Individual Biomass (Dry weight, mg) By Replicate	Mean	Standard Deviation	Individual Growth Rate (mg/Day) By Replicate	Mean	Standard Deviation
Control A	C960913.1737A	1	20.95	17.04	3.45	1.01	0.81	0.17
		2	13.26			0.63		
		3	13.59			0.64		
		4	19.22			0.92		
		5	18.18			0.87		
Control B	C960913.1737B	1	18.98	16.07	4.01	0.91	0.77	0.20
		2	20.52			0.99		
		3	16.77			0.80		
		4	13.25			0.63		
		5	10.80			0.50		
P9443-1	C960911.0537	1	7.95	12.66	3.07	0.36	0.60	0.15
		2	13.25			0.63		
		3	11.65			0.55		
		4	14.46			0.69		
		5	15.97			0.76		
P9443-2	C960911.0637	1	8.82	11.70	1.79	0.40	0.55	0.09
		2	12.44			0.58		
		3	13.66			0.65		
		4	11.46			0.54		
		5	12.12			0.57		
P9443-3	C960911.0737	1	10.08	13.07	2.93	0.47	0.62	0.15
		2	11.53			0.54		
		3	14.65			0.70		
		4	11.70			0.55		
		5	17.38			0.83		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11&13Sep96
Date Test Started: 19Sep96
Date Test Ended: 9Oct96

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Individual Biomass (Dry weight, mg)			Individual Growth Rate (mg/Day)		
			By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9443-4	C960911.0837	1	11.96	12.63	1.87	0.56	0.59	0.09
		2	14.01			0.66		
		3	14.91			0.71		
		4	12.15			0.57		
		5	10.14			0.47		
P9443-5	C960911.0937	1	12.26	10.95	2.09	0.58	0.51	0.10
		2	9.76			0.45		
		3	8.01			0.36		
		4	13.28			0.63		
		5	11.43			0.53		
P9443-6	C960911.1037	1	10.78	11.60	3.10	0.50	0.54	0.16
		2	11.71			0.55		
		3	7.75			0.35		
		4	11.38			0.53		
		5	16.38			0.78		
P9443-7	C960911.1137	1	10.77	11.12	1.10	0.50	0.52	0.05
		2	10.14			0.47		
		3	12.52			0.59		
		4	10.14			0.47		
		5	12.02			0.56		
P9444-1	C960913.0237	1	10.27	12.23	1.86	0.48	0.57	0.09
		2	10.95			0.51		
		3	15.06			0.72		
		4	12.79			0.60		
		5	12.08			0.57		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Individual Biomass (Dry weight, mg)			Individual Growth Rate (mg/Day)		
			By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
		1	9.99			0.46		
		2	9.85			0.46		
P9444-2	C960913.0337	3	8.86	11.15	2.26	0.41	0.52	0.11
		4	14.17			0.67		
		5	12.86			0.61		
		1	12.24			0.58		
		2	12.57			0.59		
P9444-3	C960913.0437	3	13.79	12.81	2.07	0.65	0.60	0.10
		4	15.53			0.74		
		5	9.91			0.46		
		1	15.54			0.74		
		2	12.56			0.59		
P9444-4	C960913.0537	3	14.68	13.66	1.38	0.70	0.65	0.07
		4	12.41			0.58		
		5	13.12			0.62		
		1	9.10			0.42		
		2	17.93			0.86		
P9444-5	C960913.0637	3	13.35	13.60	3.15	0.63	0.64	0.16
		4	14.29			0.68		
		5	13.32			0.63		
		1	10.31			0.48		
		2	12.72			0.60		
P9444-6	C960913.0737	3	11.63	12.53	2.31	0.54	0.59	0.12
		4	11.59			0.54		
		5	16.37			0.78		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11&13Sep96
Date Test Started: 19Sep96
Date Test Ended: 9Oct96

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Individual Biomass (Dry weight, mg)			Individual Growth Rate (mg/Day)		
			By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9444-7	C960913.0837	1	10.78	9.38	2.42	0.50	0.43	0.12
		2	8.00			0.36		
		3	9.76			0.45		
		4	6.09			0.27		
		5	12.29			0.58		
P9444-8	C960913.0937	1	9.09	11.64	4.49	0.42	0.54	0.22
		2	18.05			0.87		
		3	11.10			0.52		
		4	6.29			0.28		
		5	13.66			0.65		
P9444-9	C960913.1037	1	13.59	13.85	1.15	0.64	0.66	0.06
		2	12.75			0.60		
		3	12.80			0.60		
		4	15.16			0.72		
		5	14.96			0.71		
P9444-10	C960913.1137	1	11.68	11.87	2.15	0.55	0.56	0.11
		2	14.64			0.69		
		3	9.51			0.44		
		4	10.14			0.47		
		5	13.38			0.63		
P9446-1 Reference	C960913.1237	1	10.03	10.35	1.84	0.46	0.48	0.09
		2	11.75			0.55		
		3	8.19			0.37		
		4	9.13			0.42		
		5	12.65			0.60		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11&13Sep96
Date Test Started: 19Sep96
Date Test Ended: 9Oct96

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Client Sample ID	MEC Sample ID	Rep	Individual Biomass (Dry weight, mg)			Individual Growth Rate (mg/Day)		
			By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9446-2 Reference	C960913.1337	1	12.67	12.76	3.66	0.60	0.60	0.18
		2	16.40			0.78		
		3	10.86			0.51		
		4	7.74			0.35		
		5	16.13			0.77		
P9445-1	C960913.1437	1	10.43	13.96	3.09	0.48	0.66	0.15
		2	16.84			0.81		
		3	11.85			0.56		
		4	13.19			0.62		
		5	17.47			0.84		
P9445-2	C960913.1537	1	11.89	12.16	2.14	0.56	0.57	0.11
		2	12.84			0.60		
		3	10.24			0.47		
		4	10.37			0.48		
		5	15.47			0.74		

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Test Water Quality Data

Analyte:	**Salinity**	**Dissolved Oxygen**	**pH**
Method (ISP: Ion Specific Probe)	ISP	ISP	ISP
Method Reporting Limit:	0.1 ‰	1% sat	0.1 unit

Sample ID ***Client*** ***(MEC)***	**Statistic**	**pH**	**D.O. (% Sat.)**	**Temp (°C)**	**Salinity (ppt)**
Control A (C960913.1737A)	Mean Minimum Maximum	8.0 7.9 8.1	93.5 81.0 100.0	20.4 19.8 21.0	28.1 27.8 28.5
Control B (C960913.1737B)	Mean Minimum Maximum	8.0 7.1 8.3	94.3 77.0 99.0	20.3 19.8 21.0	28.1 27.7 28.8
P9443-1 (C960911.0537)	Mean Minimum Maximum	8.1 8.0 8.5	93.3 86.0 97.0	20.3 19.8 21.2	28.3 28.0 28.8
P9443-2 (C960911.0637)	Mean Minimum Maximum	8.0 7.1 8.3	92.3 81.0 97.0	20.2 19.9 20.9	28.2 27.9 28.6
P9443-3 (C960911.0737)	Mean Minimum Maximum	8.2 7.9 8.5	92.4 79.0 97.0	20.2 19.9 20.7	28.2 27.9 28.7

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Sample ID *Client* *(MEC)*	**Statistic**	**pH**	**D.O. (% Sat.)**	**Temp (°C)**	**Salinity (ppt)**
P9443-4 (C960911.0837)	Mean	8.0	92.0	20.2	28.2
	Minimum	7.9	80.0	19.8	28.0
	Maximum	8.1	97.0	21.8	28.5
P9443-5 (C960911.0937)	Mean	8.1	92.3	20.3	28.3
	Minimum	7.8	80.0	19.3	28.0
	Maximum	8.4	96.0	21.2	28.7
P9443-6 (C960911.1037)	Mean	8.1	92.6	20.2	28.2
	Minimum	7.9	80.0	19.6	28.0
	Maximum	8.3	101.0	21.0	28.6
P9443-7 (C960911.1137)	Mean	8.0	94.4	20.1	27.4
	Minimum	7.9	83.0	19.5	26.5
	Maximum	8.1	99.0	20.8	28.3
P9444-1 (C960913.0237)	Mean	8.1	92.3	20.2	28.3
	Minimum	8.0	80.0	19.8	28.1
	Maximum	8.3	97.0	20.8	28.8
P9444-2 (C960913.0337)	Mean	8.1	93.7	20.1	28.2
	Minimum	8.0	87.0	19.7	28.0
	Maximum	8.2	97.0	20.9	28.9
P9444-3 (C960913.0437)	Mean	8.2	91.1	20.2	28.3
	Minimum	8.0	77.0	19.8	28.0
	Maximum	8.5	96.0	21.2	28.9
P9444-4 (C960913.0537)	Mean	8.1	90.9	20.2	28.3
	Minimum	8.1	79.0	19.8	28.0
	Maximum	8.4	96.0	21.2	28.6
P9444-5 (C960913.0637)	Mean	8.0	90.5	20.3	28.2
	Minimum	7.8	77.0	19.9	28.0
	Maximum	8.2	97.0	20.9	28.6
P9444-6 (C960913.0737)	Mean	8.2	91.8	20.1	28.3
	Minimum	8.0	85.0	19.7	28.1
	Maximum	8.3	96.0	20.5	28.7

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Sample ID ***Client*** ***(MEC)***	**Statistic**	**pH**	**D.O. (% Sat.)**	**Temp (°C)**	**Salinity (ppt)**
P9444-7 (C960913.0837)	Mean Minimum Maximum	8.2 8.1 8.3	91.9 87.0 97.0	20.3 19.8 20.9	28.4 27.9 29.0
P9444-8 (C960913.0937)	Mean Minimum Maximum	8.2 8.0 8.5	91.3 81.0 97.0	20.3 19.6 21.6	28.4 28.1 28.8
P9444-9 (C960913.1037)	Mean Minimum Maximum	8.1 7.9 8.2	91.9 85.0 97.0	20.3 19.5 20.9	28.3 27.9 28.8
P9444-10 (C960913.1137)	Mean Minimum Maximum	8.1 8.0 8.3	91.7 82.0 95.0	20.3 20.0 20.7	28.3 28.0 28.9
P9446-1 Reference (C960913.1237)	Mean Minimum Maximum	8.0 7.1 8.2	92.7 80.0 99.0	20.3 19.9 20.8	28.1 27.9 28.7
P9446-2 Reference (C960913.1337)	Mean Minimum Maximum	8.1 7.9 8.4	91.2 85.0 97.0	20.2 19.9 20.8	28.2 28.0 28.5
P9445-1 (C960913.1437)	Mean Minimum Maximum	8.1 7.9 8.4	91.3 80.0 98.0	20.3 19.9 21.0	28.1 27.9 28.6
P9445-2 (C960913.1537)	Mean Minimum Maximum	8.0 7.1 8.2	94.1 83.0 98.0	20.2 19.4 21.2	28.2 27.8 29.4

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Interstitial Salinity

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1737A)	32.0	28.0	P9444-4 (C960913.0537)	26.4	28.0
Control B (C960913.1737B)	32.0	28.0	P9444-5 (C960913.0637)	27.6	28.0
P9443-1 (C960911.0537)	27.6	28.0	P9444-6 (C960913.0737)	26.4	28.0
P9443-2 (C960911.0637)	27.0	28.0	P9444-7 (C960913.0837)	28.3	28.0
P9443-3 (C960911.0737)	27.7	28.0	P9444-8 (C960913.0937)	25.5	28.0
P9443-4 (C960911.0837)	27.7	28.0	P9444-9 (C960913.1037)	28.5	28.0
P9443-5 (C960911.0937)	28.0**	28.0	P9444-10 (C960913.1137)	27.9	29.0
P9443-6 (C960911.1037)	25.4	28.0	P9446-1 Reference (C960913.1237)	30.6	28.0
P9443-7 (C960911.1137)	28.0**	28.0	P9446-2 Reference (C960913.1337)	30.0	29.0
P9444-1 (C960913.0237)	25.2	28.0	P9445-1 (C960913.1437)	29.1	28.0
P9444-2 (C960913.0337)	27.5	28.0	P9445-2 (C960913.1537)	30.9	28.0
P9444-3 (C960913.0437)	25.6	30.0			

**Initial interstitial salinity below 25 ppt. Salinity adjustment of sediment done prior to testing.

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Ammonia

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1737A)	0.49	6.75	P9444-4 (C960913.0537)	1.05	0.95
Control B (C960913.1737B)	0.56	7.64	P9444-5 (C960913.0637)	0.57	0.08
P9443-1 (C960911.0537)	1.27	0.14	P9444-6 (C960913.0737)	0.84	1.44
P9443-2 (C960911.0637)	1.75	0.14	P9444-7 (C960913.0837)	0.78	4.08
P9443-3 (C960911.0737)	1.47	6.37	P9444-8 (C960913.0937)	0.74	3.14
P9443-4 (C960911.0837)	1.02	0.14	P9444-9 (C960913.1037)	0.71	0.17
P9443-5 (C960911.0937)	2.05	3.39	P9444-10 (C960913.1137)	0.84	3.33
P9443-6 (C960911.1037)	1.55	0.09	P9446-1 Reference (C960913.1237)	0.34	0.16
P9443-7 (C960911.1137)	0.00	0.54	P9446-2 Reference (C960913.1337)	2.71	0.38
P9444-1 (C960913.0237)	0.37	2.42	P9445-1 (C960913.1437)	0.27	0.22
P9444-2 (C960913.0337)	0.00	0.33	P9445-2 (C960913.1537)	0.37	0.11
P9444-3 (C960913.0437)	1.81	0.08			

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

Sulfides (ppm)

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1737A)	<0.1	0.00	P9444-4 (C960913.0537)	<0.1	0.00
Control B (C960913.1737B)	<0.1	0.00	P9444-5 (C960913.0637)	<0.1	0.00
P9443-1 (C960911.0537)	<0.1	0.00	P9444-6 (C960913.0737)	<0.1	0.00
P9443-2 (C960911.0637)	<0.1	0.00	P9444-7 (C960913.0837)	<0.1	0.00
P9443-3 (C960911.0737)	0.00	0.00	P9444-8 (C960913.0937)	<0.1	0.00
P9443-4 (C960911.0837)	<0.1	0.00	P9444-9 (C960913.1037)	<0.1	0.00
P9443-5 (C960911.0937)	<0.1	0.00	P9444-10 (C960913.1137)	<0.1	0.00
P9443-6 (C960911.1037)	<0.1	0.00	P9446-1 Reference (C960913.1237)	<0.1	0.00
P9443-7 (C960911.1137)	<0.1	0.00	P9446-2 Reference (C960913.1337)	<0.1	0.00
P9444-1 (C960913.0237)	<0.1	0.00	P9445-1 (C960913.1437)	<0.1	0.00
P9444-2 (C960913.0337)	<0.1	0.00	P9445-2 (C960913.1537)	0.00	0.00
P9444-3 (C960913.0437)	<0.1	0.00			

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

5. Statistical Analyses

Tests of normal distribution were done using SAS® Proc Univariate. T-tests were done to compare each sample endpoint to the corresponding reference sample endpoint. Proc TTEST was used for these tests, are based on a one-tail test.

6. Positive Control Response

A reference toxicity test with cadmium chloride was performed on 18 September 1996. Concentrations tested were 3.8, 7.5, 15, 30 and 60 ppm cadmium. The estimate of the 96-hour EC_{50} was within PSEP guidelines (8.44 ppm). A laboratory control chart (attached) shows a laboratory mean of 9.55, with upper and lower 95% confidence limits of 14.45 and 4.64 ppm, respectively.

Verification of laboratory cadmium (10,000 ppm) stock solution gave a value of 10,400 ppm. Analysis of the highest reference concentration (60 ppm) gave a value of 57.8 ppm. The laboratory analysis results are included in the supporting documentation to this report

7. Dilution Water

Dilution water was collected by MEC personnel from Scripps Institute of Oceanography (SIO), La Jolla, CA on September 16 and 25 and October 7, 1996. The 3 batches of seawater were given the identification numbers SIO 091696, SIO 092596, and SIO 100796, respectively.

Priority pollutant analysis results SIO 091696, SIO 092596, and SIO 100796 indicated that all analytes were below detection limits except for cadmium. Cadmium at 8 ppb and 6 ppb appeared in SIO 092596 and SIO 100796, respectively. The laboratory analysis results are included in the supporting documentation to this report

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11&13Sep96
Project:	Metro Set I	**Date Test Started:**	19Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	9Oct96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
20-Day Solid Phase Polychaete

Test Organism: *Neanthes arenaceodentata*
MEC Protocol: P014.1

APPENDIX
Pertinent Test Data

DILUTION WATER: Scripps Institute of Oceanography filtered seawater

Target Values:		
	Salinity	28 ± 2 ppt
	pH	ambient, ± 0.5 units
	D.O.	> 60% saturation
	Temperature	20.0° C, ± 1° C

TEST ORGANISM: 2-3 week-old *Neanthes arenaceodentata*, 0.5 - 1.0 mg each, from California State University, Long Beach, cultured by Dr. Don Reish.

TEST CHAMBER: 1 L glass beakers, 5 replicates, brought to a 950 mL final volume.

EXPERIMENTAL DESIGN:

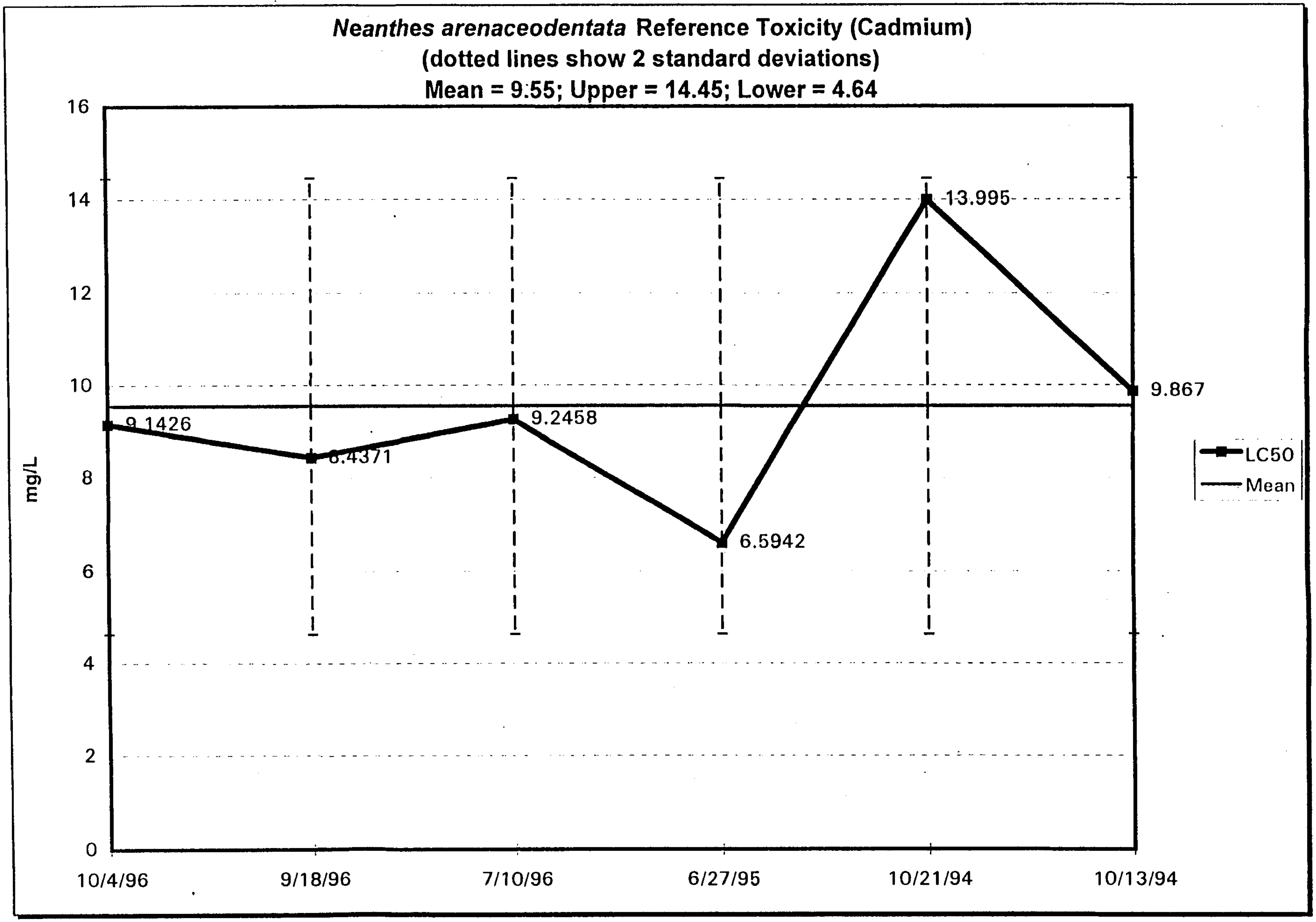
1. Two cm of sediment were placed into each beaker, seawater was added, the temperature of the seawater was adjusted to 20±1°C.
2. 5 test organisms were placed into each chamber.
3. Samples were aerated.
4. Test chambers were held at 20°C ±1° for 20 days with a photo period of 16 hours light, 8 hours darkness.
5. One-third of seawater from each chamber was renewed every third day.
6. Test organisms were fed every other day.
7. Test room temperature was monitored with a thermistor and continuously recorded with a data logger.

MORTALITY DEFINITION: Lack of respiratory movement and lack of reaction to gentle prodding.

CONTROL CRITERION: ≥90% Survival in controls, 0.72 mg/individual/day weight gain

STUDY DIRECTOR: A. Monji

INVESTIGATORS: A. Monji, E. McCoy, K. Bothner, T. Fitzsimmons, M. Woo


Neanthes arenaceodentata Reference Toxicity (Cadmium)
(dotted lines show 2 standard deviations)
Mean = 9.55; Upper = 14.45; Lower = 4.64
mg/L
16
14
12
10
8
6
4
2
0
9.1426
8.4371
9.2458
6.5942
13.995
9.867
10/4/96
9/18/96
7/10/96
6/27/95
10/21/94
10/13/94
LC50
Mean

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

CASE SUMMARY

1. Project/Sample Identification

Bioassay testing on marine sediments was conducted in support of the Elliott Bay/Duwamish River Sediment Remediation Project, Seattle Waterfront Project, the Connecticut Hanford and Chelan Street, and other Combined Sewer Overflow (CSO) Projects. Toxicity tests were conducted on a total of 21 samples. Seven sediment samples were received by the laboratory on 11 September 1996, and 12 sediment samples plus 2 reference samples were received on 13 September 1996 (see Table below). The control sediment was received and logged in on 13 September, 1996.

Sample ID	Collection Date	Date Received	Sample ID	Collection Date	Date Received
L9443-1	9/9/96	9/11/96	L9444-5	9/10/96	9/13/96
L9443-2	9/9/96	9/11/96	L9444-6	9/11/96	9/13/96
L9443-3	9/9/96	9/11/96	L9444-7	9/11/96	9/13/96
L9443-4	9/9/96	9/11/96	L9444-8	9/11/96	9/13/96
L9443-5	9/9/96	9/11/96	L9444-9	9/10/96	9/13/96
L9443-6	9/9/96	9/11/96	L9444-10	9/11/96	9/13/96
L9443-7	9/10/96	9/11/96	L9446-1 (Ref)	9/11/96	9/13/96
L9444-1	9/10/96	9/13/96	L9446-2 (Ref)	9/11/96	9/13/96
L9444-2	9/10/96	9/13/96	L9445-1	9/10/96	9/13/96
L9444-3	9/11/96	9/13/96	L9445-2	9/10/96	9/13/96
L9444-4	9/11/96	9/13/96			

Alan T [signature] — QA Officer — 6 Dec 96 — Date

[signature] — Laboratory Manager — 6 DEC 96 — Date

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

2. Test Method

Toxicity tests were conducted on amphipods (*Rhepoxynius abronius*) using MEC Protocol #P024.1. All methods and protocols employed in this program followed general procedures established by the EPA and the State of Washington in Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP, July 1995). Testing was performed at the MEC Analytical Systems, Inc. Bioassay Laboratory located in Carlsbad, California.

3. Case Narrative

Testing was initiated on 17 September 1996, and completed on 27 September 1996. Bioassays were performed concurrently on control, reference and test sediments.

Negative control and reference sediments were collected and tested in compliance with SMS performance standards for test validation.

Dissolved oxygen and pH meters used in the conduct of these bioassays were calibrated each day prior to use. The conductivity/salinity meter calibration is verified monthly. No irregularities were encountered in the calibration or operation of the instruments.

Water quality measurements were performed on all replicates on the day of test initiation (day 0) and day 10. Water quality from one replicate from each sample was measured on days 1 through 9. Data on mean, minimum and maximum values are presented in the report following the case narrative.

Data were recorded on pre-printed data sheets in ink. All corrections were initialed by the person making the correction and the mistake was coded. A table of correction codes for the laboratory and a table with the names and initials of the laboratory staff are presented in the appendix of this report.

Data for water quality and mortality were double entered and cross compared for accuracy. In the event of a discrepancy, the correct information was confirmed from the original data sheets. The test acceptance criterion for the Rhepox test is ≥90% survival in the controls. All controls exceeded this criterion, the percent survival ranged from 97 to 99% in the two controls. All data generated from this were accepted without qualification.

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Communications between the laboratory (MEC) and King County Environmental Laboratory (KCEL) were logged and kept as part of the permanent project file.

3.1 Protocol Deviations

1. pH measurements on day 0 in sample C960913.0833, replicates 2-5 were recorded as 8.6. This is very close to the protocol limit of ambient, $\pm$ 0.5 units, and was only a temporary occurence. Slightly different sediment settling rates are the likely cause of the pH differences. This increase in pH over the protocol specification does not limit the usefulness of the data.

2. pH measurements on day 10 in sample C960913.0833, replicates 1 and 5, were recorded as 8.8. This is very close to the protocol limit. A gradual increase in pH readings were noted over the 10 day duration of the test. This increase over time does not limit the usefulness of the data.

3. pH measurements on day 9, replicate 4 and all replicates on day 10 in sample C960911.1033 were recorded as 8.6-8.7. This is very close to the protocol limit. A gradual increase in pH readings were noted over the 10 day duration of the test. This increase over time does not limit the usefulness of the data.

4. pH measurements on day 10 in sample C960913.0433, replicate 4, was recorded as 8.6. This is very close to the protocol limit. A gradual increase in pH reading were noted over the 10 day duration of the test. This increase over time does not limit the usefulness of the data.

5. pH measurements on day 10 in sample C960913.0933 replicates 1-5, were recorded as 8.6-8.9. This is close to the protocol limit. A gradual increase in reading were noted over the 10 day duration of the test. This increase over time does not limit the usefulness of the data.

6. pH measurements on day 10 in sample C960913.1433, replicate 2, was recorded as 8.6. This is very close to the protocol limit. A gradual increase in reading was noted over the 10 day duration of the test. This increase over time does not limit the usefulness of the data.

7. Temperature measurement on day 5, replicate 5, for sample C960911.1133 exceeded the protocol limit of 15 °C $\pm$ 1 by 0.9 °C. Subsequent readings and the continuous temperature monitoring device show test withing test specifications. This temporary excursion above the test protocol limit does not limit the usefulness of the data.

8. Temperature measurement on day 5, replicate 5, for sample C960913.1533 exceeded theprotocol limit of 15 °C $\pm$ 1 by 0.9 °C. Subsequent readings and the continuous temperature monitoring

device show test within test specifications. This temporary excursion above the test protocol limit does not limit the usefulness of the data.

9. Temperature measurements on one or more replicates from samples C960913.1733A and B, C960911.0533, C960911.0733, C960911.0833, C960911.0933, C960911.1133, C960913.0333, C960913.0433, and C960913.0633 on day 10 exceeded the protocol limit of 15 °C ± 1 by 0.1 °C to 2.3 °C. Test containers were removed from their temperature controlled environment as they were processed for final water quality and animal counts. This short excursion above the test protocol limit does not limit the usefulness of the data.

10. Temperature measurement on day 5, replicate 5, for sample C960913.0433 exceeded the protocol limit. Subsequent readings and the continuous temperature monitoring device show temperatures withing test specifications. This temporary excursion above the test protocol limit does not limit the usefulness of the data.

11. Salinity in sample C960913.1133 replicate 1 was recorded as 26.4 ppt on day 1. This reading was probably due to an unknown error, such as sediment particles on the probe. Day 0 and all other subsequent readings are within protocol limits (28 ppt ± 1). This short excursion below the test protocol limit does not limit the usefulness of the data.

12. Sediment interstitial salinity for sample C960911.0933 was 20.2 ppt. Sediment interstitial salinity was adjusted to test specifications before the test was started.

13. Sediment interstitial salinity for sample C960911.1133 was 5.0 ppt. Sediment interstitial salinity was adjusted to test specifications before the test was started.

4. Summary of Test Response

The following tables show test response replicate mean and standard deviation for negative control, reference, and test sediments. Results marked with an asterisk (*) are statistically significant relative to reference sediment response (Student's t-test, p = 0.05).

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Client Sample ID	MEC Sample ID	Mortality (%)			Failure to Rebury (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
Control A	C960913.1733A	0%	3%	4%	45%	9%	2%
		0%			0%		
		0%			0%		
		5%			0%		
		10%			0%		
Control B	C960913.1733B	0%	1%	2%	0%	1%	2%
		5%			0%		
		0%			0%		
		0%			5%		
		0%			0%		
P9443-1	C960911.0533	0%	13%	8%	0%	2%	5%
		10%			0%		
		15%			12%		
		20%			0%		
		20%			0%		
P9443-2	C960911.0633	35%	21%*	9%	0%	0%	0%
		20%			0%		
		20%			0%		
		20%			0%		
		10%			0%		
P9443-3	C960911.0733	20%	18%*	3%	0%	0%	0%
		20%			0%		
		15%			0%		
		20%			0%		
		15%			0%		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 17Sep96
Date Test Ended: 27Sep96

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Client Sample ID	MEC Sample ID	Mortality (%)			Failure to Rebury (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9443-4	C960911.0833	50%	22%*	17%	0%	1%	3%
		10%			0%		
		10%			0%		
		25%			7%		
		15%			0%		
P9443-5	C960911.0933	20%	26%*	12%	0%	2%	4%
		45%			9%		
		30%			0%		
		15%			0%		
		20%			0%		
P9443-6	C960911.1033	30%	19%	11%	0%	4%	6%
		20%			0%		
		0%			5%		
		25%			13%		
		20%			0%		
P9443-7	C960911.1133	0%	4%	4%	0%	1%	2%
		5%			0%		
		5%			0%		
		10%			6%		
		0%			0%		
P9444-1	C960913.0233	10%	22%*	13%	11%	2%	5%
		30%			0%		
		15%			0%		
		15%			0%		
		40%			0%		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 17Sep96
Date Test Ended: 27Sep96

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Client Sample ID	MEC Sample ID	Mortality (%)			Failure to Rebury (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9444-2	C960913.0333	0%	15%	19%	0%	2%	4%
		0%			0%		
		20%			0%		
		45%			9%		
		10%			0%		
P9444-3	C960913.0433	40%	20%	17%	0%	2%	3%
		0%			0%		
		5%			5%		
		25%			0%		
		30%			7%		
P9444-4	C960913.0533	45%	28%*	20%	0%	3%	5%
		15%			6%		
		55%			11%		
		15%			0%		
		10%			0%		
P9444-5	C960913.0633	5%	11%	11%	0%	2%	4%
		10%			0%		
		10%			0%		
		30%			0%		
		0%			10%		
P9444-6	C960913.0733	45%	50%*	30%	0%	0%	0%
		40%			0%		
		20%			0%		
		45%			0%		
		100%			–		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Client Sample ID	MEC Sample ID	Mortality (%)			Failure to Rebury (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9444-7	C960913.0833	45%	53%*	13%	0%	7%	10%
		65%			0%		
		60%			0%		
		60%			12%		
		35%			23%		
P9444-8	C960913.0933	45%	45%*	38%	0%	0%	0%
		60%			0%		
		0%			0%		
		20%			0%		
		100%			—		
P9444-9	C960913.1033	30%	19%	13%	0%	3%	4%
		15%			6%		
		35%			8%		
		5%			0%		
		10%			0%		
P9444-10	C960913.1133	15%	15%	14%	0%	3%	4%
		20%			6%		
		35%			8%		
		0%			0%		
		5%			0%		
P9446-1 Reference	C960913.1233	0%	6%	9%	0%	0%	0%
		20%			0%		
		0%			0%		
		10%			0%		
		0%			0%		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Client Sample ID	MEC Sample ID	Mortality (%)			Failure to Rebury (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9446-2 Reference	C960913.1333	5%	8%	4%	0%	0%	0%
		10%			0%		
		5%			0%		
		5%			0%		
		15%			0%		
P9445-1	C960913.1433	0%	6%	8%	0%	0%	0%
		0%			0%		
		5%			0%		
		5%			0%		
		20%			0%		
P9445-2	C960913.1533	5%	10%	7%	0%	0%	0%
		15%			0%		
		15%			0%		
		0%			0%		
		15%			0%		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Test Water Quality Data

Analyte:	**Salinity**	**Dissolved Oxygen**	**pH**
Method (ISP: Ion Specific Probe)	ISP	ISP	ISP
Method Reporting Limit:	0.1 ‰	1% sat	0.1 unit

Sample ID *Client* *(MEC)*	**Statistic**	**pH**	**D.O. (% Sat.)**	**Temp (°C)**	**Salinity (ppt)**
Control A (C960913.1733A)	Mean	8.1	95.9	15.8	27.6
	Minimum	7.8	75.0	15.1	27.4
	Maximum	8.3	104.0	17.2	27.9
Control B (C960913.1733B)	Mean	8.1	96.4	15.6	27.6
	Minimum	7.8	87.0	14.6	27.4
	Maximum	8.3	101.0	17.2	27.8
P9443-1 (C960911.0533)	Mean	8.2	95.3	15.6	27.9
	Minimum	7.9	90.0	15.0	27.8
	Maximum	8.6	102.0	17.0	28.1
P9443-2 (C960911.0633)	Mean	8.2	94.1	15.7	27.8
	Minimum	7.7	84.0	14.8	27.6
	Maximum	8.6	103.0	16.4	28.3
P9443-3 (C960911.0733)	Mean	8.3	94.5	16.1	27.9
	Minimum	7.8	88.0	14.9	27.6
	Maximum	8.7	101.0	18.8	28.2
P9443-4 (C960911.0833)	Mean	8.1	93.4	16.0	27.9
	Minimum	7.8	82.0	15.0	27.8
	Maximum	8.3	101.0	18.7	28.1

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 17Sep96
Date Test Ended: 27Sep96

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Sample ID *Client* *(MEC)*	**Statistic**	**pH**	**D.O. (% Sat.)**	**Temp (°C)**	**Salinity (ppt)**
P9443-5	Mean	8.2	93.5	15.7	28.4
(C960911.0933)	Minimum	7.9	73.0	14.9	28.1
	Maximum	8.8	101.0	17.1	28.5
P9443-6	Mean	8.2	93.9	15.3	27.9
(C960911.1033)	Minimum	7.7	83.0	14.6	27.5
	Maximum	8.7	99.0	16.5	28.1
P9443-7	Mean	8.1	98.8	15.7	27.6
(C960911.1133)	Minimum	8.0	92.0	14.9	27.0
	Maximum	8.2	104.0	17.0	27.9
P9444-1	Mean	8.1	95.5	15.4	28.0
(C960913.0233)	Minimum	7.9	88.0	14.5	26.6
	Maximum	8.3	101.0	16.5	28.3
P9444-2	Mean	8.1	96.5	15.4	28.3
(C960913.0333)	Minimum	8.0	91.0	14.9	28.2
	Maximum	8.3	102.0	16.7	28.5
P9444-3	Mean	8.3	94.7	16.1	28.0
(C960913.0433)	Minimum	8.0	83.0	15.0	27.9
	Maximum	8.6	100.0	18.3	28.3
P9444-4	Mean	8.2	94.7	15.4	28.0
(C960913.0533)	Minimum	8.0	86.0	14.8	27.8
	Maximum	8.5	99.0	16.2	28.4
P9444-5	Mean	8.1	96.4	15.5	27.9
(C960913.0633)	Minimum	7.9	88.0	14.5	27.6
	Maximum	8.3	103.0	16.9	28.1
P9444-6	Mean	8.3	95.8	15.4	28.6
(C960913.0733)	Minimum	8.0	89.0	15.0	28.4
	Maximum	8.9	102.0	16.4	29.1
P9444-7	Mean	8.3	94.4	15.3	28.5
(C960913.0833)	Minimum	7.8	83.0	14.4	27.2
	Maximum	8.6	101.0	16.1	28.8

MEC AI·IALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Sample ID ***Client*** ***(MEC)***	**Statistic**	**pH**	**D.O. (% Sat.)**	**Temp (°C)**	**Salinity (ppt)**
P9444-8	Mean	8.3	95.7	15.4	28.6
(C960913.0933)	Minimum	7.9	88.0	14.3	28.3
	Maximum	8.9	105.0	16.2	28.8
P9444-9	Mean	8.2	95.5	15.3	28.4
(C960913.1033)	Minimum	8.0	88.0	14.7	28.2
	Maximum	8.3	101.0	16.3	28.6
P9444-10	Mean	8.2	95.1	15.3	28.3
(C960913.1133)	Minimum	8.0	89.0	14.7	26.4
	Maximum	8.5	101.0	16.5	28.8
P9446-1	Mean	8.2	96.5	15.4	28.2
Reference	Minimum	7.8	92.0	14.5	28.0
(C960913.1233)	Maximum	8.5	101.0	16.2	28.4
P9446-2	Mean	8.2	96.5	15.2	28.3
Reference	Minimum	8.0	92.0	14.9	28.1
(C960913.1333)	Maximum	8.5	100.0	15.8	28.4
P9445-1	Mean	8.2	92.9	15.4	28.3
(C960913.1433)	Minimum	7.9	66.0	14.1	28.1
	Maximum	8.6	104.0	16.4	28.6
P9445-2	Mean	8.1	97.2	15.4	28.2
(C960913.1533)	Minimum	7.9	93.0	14.5	27.8
	Maximum	8.3	104.0	16.9	28.4

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Interstitial Salinity

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1733A)	32.0	30.0	P9444-4 (C960913.0533)	26.4	27.0
Control B (C960913.1733B)	32.0	32.0	P9444-5 (C960913.0633)	27.6	28.0
P9443-1 (C960911.0533)	27.6	28.0	P9444-6 (C960913.0733)	26.4	30.0
P9443-2 (C960911.0633)	27.0	28.0	P9444-7 (C960913.0833)	28.3	30.0
P9443-3 (C960911.0733)	27.7	30.0	P9444-8 (C960913.0933)	25.5	30.0
P9443-4 (C960911.0833)	27.7	28.0	P9444-9 (C960913.1033)	28.5	30.0
P9443-5 (C960911.0933)	28.0**	29.0	P9444-10 (C960913.1133)	27.9	30.0
P9443-6 (C960911.1033)	25.4	30.0	P9446-1 Reference (C960913.1233)	30.6	29.0
P9443-7 (C960911.1133)	28.0**	27.0	P9446-2 Reference (C960913.1333)	30.0	29.0
P9444-1 (C960913.0233)	25.2	29.0	P9445-1 (C960913.1433)	29.1	30.0
P9444-2 (C960913.0333)	27.5	29.0	P9445-2 (C960913.1533)	30.90	28.0
P9444-3 (C960913.0433)	25.6	29.0			

** Initial interstitial salinity below 25 ppt. Salinity adjustment of sediment done prior to testing.

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 17Sep96
Date Test Ended: 27Sep96

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Total Ammonia (mg/L)

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1733A)	0.12	0.63	P9444-4 (C960913.0533)	0.89	0.76
Control B (C960913.1733B)	0.11	0.69	P9444-5 (C960913.0633)	0.30	1.18
P9443-1 (C960911.0533)	0.43	0.43	P9444-6 (C960913.0733)	0.71	1.67
P9443-2 (C960911.0633)	1.99	13.20	P9444-7 (C960913.0833)	0.92	4.17
P9443-3 (C960911.0733)	0.43	0.12	P9444-8 (C960913.0933)	0.41	2.03
P9443-4 (C960911.0833)	0.57	0.12	P9444-9 (C960913.1033)	0.62	0.29
P9443-5 (C960911.0933)	1.23	0.69	P9444-10 (C960913.1133)	0.59	0.89
P9443-6 (C960911.1033)	1.00	1.59	P9446-1 Reference (C960913.1233)	0.12	0.20
P9443-7 (C960911.1133)	0.00	0.04	P9446-2 Reference (C960913.1333)	1.44	3.22
P9444-1 (C960913.0233)	0.14	0.52	P9445-1 (C960913.1433)	0.55	0.03
P9444-2 (C960913.0333)	0.00	0.06	P9445-2 (C960913.1533)	0.83	0.03
P9444-3 (C960913.0433)	1.37	0.67			

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

Sulfides (ppm)

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1733A)	0.0043	0.0000	P9444-4 (C960913.0533)	0.0034	0.0000
Control B (C960913.1733B)	0.0031	0.0000	P9444-5 (C960913.0633)	0.0034	0.0000
P9443-1 (C960911.0533)	0.0012	0.0000	P9444-6 (C960913.0733)	0.0041	0.0000
P9443-2 (C960911.0633)	0.0026	0.0000	P9444-7 (C960913.0833)	0.0029	0.0000
P9443-3 (C960911.0733)	0.0041	0.0000	P9444-8 (C960913.0933)	0.0024	0.0000
P9443-4 (C960911.0833)	0.0029	0.0000	P9444-9 (C960913.1033)	0.0024	0.0000
P9443-5 (C960911.0933)	0.0019	0.0000	P9444-10 (C960913.1133)	0.0016	0.0000
P9443-6 (C960911.1033)	0.0034	0.0000	P9446-1 Reference (C960913.1233)	0.0010	0.0000
P9443-7 (C960911.1133)	0.0019	0.0000	P9446-2 Reference (C960913.1333)	0.0022	0.0000
P9444-1 (C960913.0233)	0.0050	0.0000	P9445-1 (C960913.1433)	0.0023	0.0000
P9444-2 (C960913.0333)	0.0021	0.0000	P9445-2 (C960913.1533)	0.0012	0.0000
P9444-3 (C960913.0433)	0.0025	0.0000			

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

5. Statistical Analyses

Tests of normal distribution were done using SAS® Proc Univariate. T-tests were done to compare each sample endpoint to the corresponding reference sample endpoint. Proc TTEST was used for these tests, and results adjusted for a one-tail test.

6. Positive Control Response

A reference toxicity test with cadmium chloride was performed on 25 September 1996. Concentrations tested were 0.12, 0.25, 0.5, 1 and 2 ppm cadmium. The estimate of the 96-hour EC_{50} was 0.68 ppm. A laboratory control chart (attached) shows a laboratory mean of 0.72, with upper and lower 95% confidence limits of 1.21 and 0.23 ppm, respectively.

Verification analysis of the laboratory cadmium stock solution (10,000 ppm) was recorded at 10,400 ppm cadmium. Analysis of the highest test concentration (2.0 ppm) was measured at 30.8 ppm by the chemistry laboratory. Improper sample storage, identification, and/or handling is suspected for the differences in expected and analyzed values in this test. The laboratory analysis results are included in the supporting documentation.

7. Dilution Water

Dilution water was collected by MEC personnel from Scrippps Institute of Oceanography (SIO) in La Jolla, CA on September 16, 1996. The seawater was assigned the identifcation number SIO 091696.

Priority pollutant analysis of SIO 091696 showed all analytes below laboratory detection limits. The results of this analysis are included in the supporting documentation.

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	17Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	27Sep96
MEC Project ID	0906		

Acute/Chronic Toxicity Bioassay
10-Day Solid Phase Amphipod

Test Organism: *Rhepoxynius abronius*
MEC Protocol: P024.1

APPENDIX
Pertinent Test Data

DILUTION WATER: Scripps Institute of Oceanography filtered seawater

Target Values:		
	Salinity	28 ‰, ± 1‰
	pH	ambient, ± 0.5 units
	D.O.	> 60% saturation
	Temperature	15.0° C, ± 1° C

TEST ORGANISM: 3 to 5 mm *Rhepoxynius abronius*, from Puget Sound, collected by Dr. Ken Brooks. Held for 4 days and acclimated to 28 ppt with daily water changes.

TEST CHAMBER: 1 L glass beakers, 5 replicates, brought to a 950 mL final volume.

EXPERIMENTAL DESIGN:

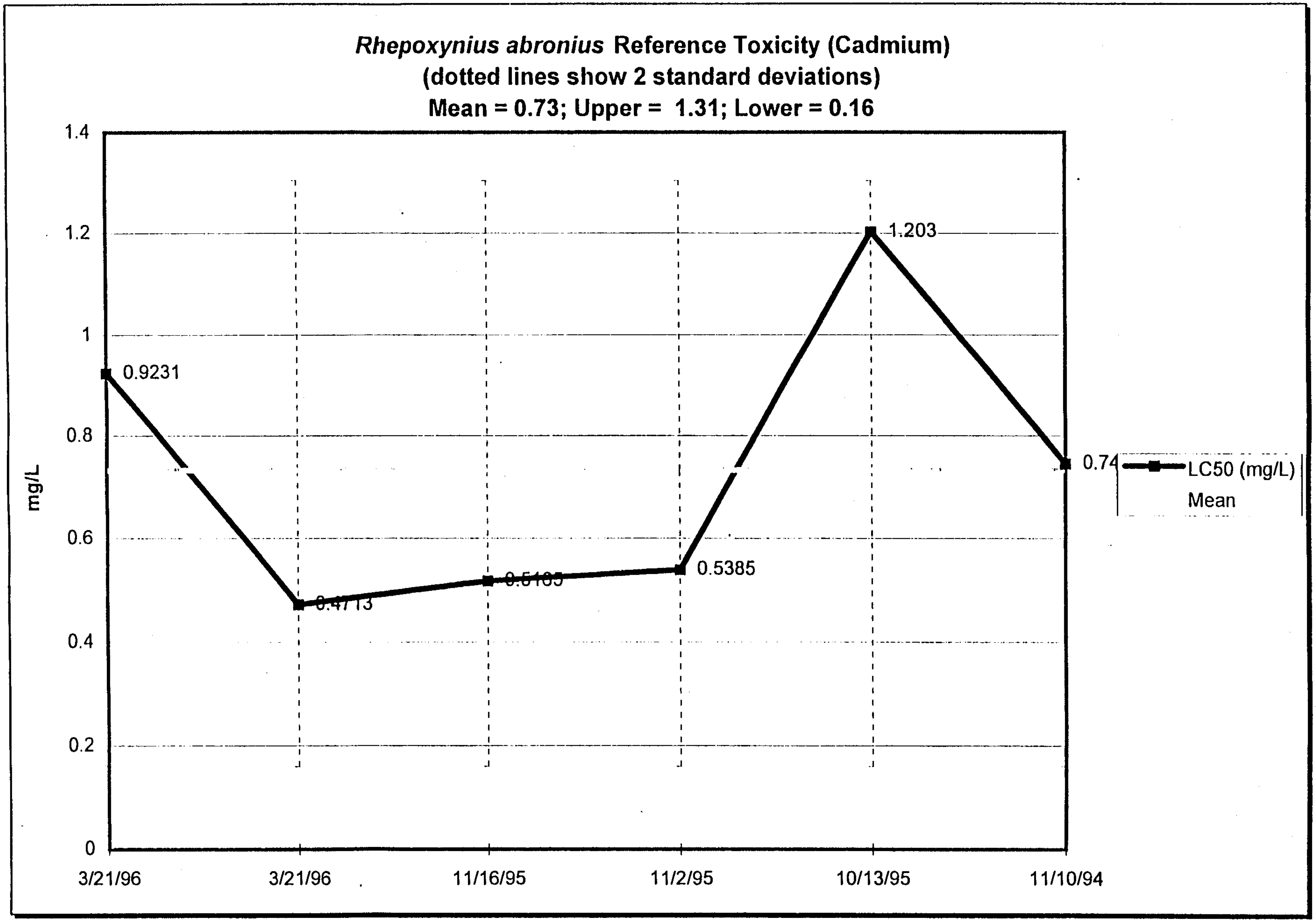
1. Two cm of sediment were placed into each beaker, seawater was added, the temperature of the seawater was adjusted to 15 ± 1°C.
2. 20 test organisms were placed into each chamber.
3. Samples were aerated.
4. Test chambers were held at 15°C ±1° for 10 days with continuous light.
5. Test room temperature was monitored with a thermistor and continuously recorded with a data logger.

MORTALITY DEFINITION: Lack of respiratory movement and lack of reaction to gentle prodding.

CONTROL CRITERION: ≥90% Survival in controls

STUDY DIRECTOR: A. Monji

INVESTIGATORS: A. Monji, M. Woo, E. McCoy, K. Bothner, T. Fitzsimmons, E. Basmadjian


Rhepoxynius abronius Reference Toxicity (Cadmium)
(dotted lines show 2 standard deviations)
Mean = 0.73; Upper = 1.31; Lower = 0.16
mg/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.9231
0.5385
1.203
0.74
LC50 (mg/L)
Mean
3/21/96
3/21/96
11/16/95
11/2/95
10/13/95
11/10/94

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

CASE SUMMARY

1. Project/Sample Identification

Bioassay testing on marine sediments was conducted in support of the Elliott Bay/Duwamish River Sediment Remediation Project, Seattle Waterfront Project, and the Connecticut Hanford and Chelan Street, and other Combined Sewer Overflow (CSO) Projects. Toxicity tests were conducted on a total of 21 samples. Seven sediment samples were received by the laboratory on 11 September 1996, and 12 sediment samples plus 2 reference samples were received on 13 September 1996 (see Table below). The control sediment was received and logged in on 13 September, 1996.

Sample ID	Collection Date	Date Received	Sample ID	Collection Date	Date Received
L9443-1	9/9/96	9/11/96	L9444-5	9/10/96	9/13/96
L9443-2	9/9/96	9/11/96	L9444-6	9/11/96	9/13/96
L9443-3	9/9/96	9/11/96	L9444-7	9/11/96	9/13/96
L9443-4	9/9/96	9/11/96	L9444-8	9/11/96	9/13/96
L9443-5	9/9/96	9/11/96	L9444-9	9/10/96	9/13/96
L9443-6	9/9/96	9/11/96	L9444-10	9/11/96	9/13/96
L9443-7	9/10/96	9/11/96	L9446-1 (Ref)	9/11/96	9/13/96
L9444-1	9/10/96	9/13/96	L9446-2 (Ref)	9/11/96	9/13/96
L9444-2	9/10/96	9/13/96	L9445-1	9/10/96	9/13/96
L9444-3	9/11/96	9/13/96	L9445-2	9/10/96	9/13/96
L9444-4	9/11/96	9/13/96			

Alan T Ng	6 Dec 96	[signature]	6 Dec 96
QA Unit	Date	Approved	Date

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

2. Test Method

Toxicity tests were conducted with the echinoderm (*Dendraster excentricus*), using MEC Protocol #P042.0. All methods and procedures employed in this program followed Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP, July 1995). Testing was performed at the MEC Analytical Systems, Inc. Bioassay Laboratory located in Carlsbad, California.

3. Case Narrative

Testing was initiated on 27 September 1996, and completed on 30 September 1996. Bioassays were performed concurrently on control, reference and test sediments.

Testing with echinoderms was initially started on 20 September, 1996 and completed on 23 September 1996. Control development of 79-83% normal did not meet the protocol specification of greater than 90%. New animals were received and testing started over on 27 September 1996 and completed on 30 September 1996. Sediment samples were past the 14 day holding time at the start of the second test.

Negative control and reference sediments were collected and tested in compliance with SMS performance standards for test validation.

Control sediment was also tested concurrently with the test and reference sediments but was not required for this program. Results were not used in statistical comparisons.

Dissolved oxygen and pH meters used in the monitoring of these bioassays were calibrated each day prior to use. The conductivity and salinity meter calibration is verified monthly. No irregularities were encountered in the calibration or operation of the instruments.

Data were recorded on pre-printed data sheets in ink. All corrections were initialed by the person making the correction and the mistake was coded. A table of correction codes for the laboratory and a table with the names and initials of the laboratory staff are presented in the supporting documentation section of this report.

Data for water quality and mortality was double entered and cross compared for accuracy. In the event of a discrepancy, the correct information was confirmed from the original data sheets. Test acceptance criteria for the echinoderm test is ≥90% normal development and ≥70% survival in the seawater controls. The seawater control had a mean of 93.6% normal development and a mean of 93.3% survival. All data generated from this was accepted without qualification.

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Communications between the laboratory (MEC) and King County Environmental Laboratory (KCEL) were logged and kept as part of the permanent project file.

Water quality measurements were taken daily from a surrogate test container for each sample on day 0 through test termination. Data on mean, minimum and maximum values are presented in the report following the case narrative.

3.1 Protocol Deviations

1. Temperature measurements on day 0 (27 September) for all samples ranged from 16.0 to 17.5°C. This exceeded the temperature criterion (15 ± 1° C) by up to 1.5° C. It is thought that this was a short-term excursion during the time that the test chambers completely equilibrated to the water bath. Examination of the continuous temperature recording devices show the test chambers within acceptable limits. This brief exceedence of protocol temperature does not limit the usefulness of the data.

2. Test termination temperatures measurements on day 3 (30 September) for all samples ranged from 16.3 to 17.7°C. At the time of test termination, all test aeration (including the surrogate test containers) was discontinued. As test containers were removed from the water bath, the water level of the bath dropped, and the thermal capacity of the bath was reduced. These two factors are the probable cause of the slight temperature increase in surrogate test containers. Examination of the continuous temperature recording devices show the test chambers within acceptable limits. This brief exceedence of protocol temperature does not limit the usefulness of the data.

3. No water quality readings performed on sample C960913.0946, day 3. Water quality readings from the first 3 sets of measurements from this sample, and for the other samples, were within protocol specifications, with the exception of the temperature issues described in paragraphs 1 and 2 of this case narrative. The consistency of water quality throughout the tests supports the assumptions that this oversight does not limit the usefulness of the data

4. Summary of Test Response

The following tables show test response replicate mean and standard deviation for negative control, seawater control, reference, and test sediments. The first table shows combined larval mortality/abnormality and larval percent mortality plus abnormalities. The second table presents mortality

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

and abnormality endpoints. Results marked with an asterisk (*) are statistically significant relative to reference sediment response (Student's t-test, $p = 0.05$).

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 27Sep96
Date Test Ended: 30Sep96

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Combined Larval Mortality/Abnormality (%)		
		By Replicate	Mean	Standard Deviation
Control A	C960913.1746A	41.98	30.96	12.49
		20.86		
		15.24		
		43.05		
		33.69		
Control B	C960913.1746B	5.88	15.24	7.34
		19.52		
		16.31		
		10.16		
		24.33		
Water Control	Water Control	15.78	11.82	6.98
		14.71		
		17.38		
		0.00		
		11.23		
P9443-1	C960911.0546	40.37	32.46	11.21
		44.92		
		30.75		
		15.78		
		30.48		
P9443-2	C960911.0646	35.83	34.55	4.50
		40.64		
		32.09		
		35.56		
		28.61		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 27Sep96
Date Test Ended: 30Sep96

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Combined Larval Mortality/Abnormality (%)		
		By Replicate	Mean	Standard Deviation
P9443-3	C960911.0746	53.74	34.97	13.58
		34.76		
		41.98		
		24.33		
		20.05		
P9443-4	C960911.0846	20.05	32.83	13.86
		29.41		
		22.19		
		54.01		
		38.50		
P9443-5	C960911.0946	30.48	16.63	10.40
		13.90		
		1.60		
		18.18		
		18.98		
P9443-6	C960911.1046	27.27	15.88	11.46
		7.22		
		18.18		
		1.07		
		25.67		
P9443-7	C960911.1146	33.96	34.17	5.78
		29.68		
		38.24		
		41.44		
		27.54		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Combined Larval Mortality/Abnormality (%) By Replicate	Mean	Standard Deviation
P9444-1	C960913.0246	37.17	34.49	4.57
		36.90		
		26.47		
		36.90		
		35.03		
P9444-2	C960913.0346	8.56	21.18	10.30
		13.10		
		31.55		
		21.93		
		30.75		
P9444-3	C960913.0446	32.89	28.93	6.71
		35.03		
		33.42		
		22.46		
		20.86		
P9444-4	C960913.0546	44.39	*51.82	10.42
		51.87		
		46.52		
		69.79		
		46.52		
P9444-5	C960913.0646	1.07	26.63	19.67
		55.88		
		20.86		
		28.88		
		26.47		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL		**Date Received:**	11 & 13Sep96
Project:	Metro Set I		**Date Test Started:**	27Sep96
Sample Matrix:	Sediment		**Date Test Ended:**	30Sep96
MEC Project ID	0906			

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Combined Larval Mortality/Abnormality (%)		
		By Replicate	Mean	Standard Deviation
P9444-6	C960913.0746	35.56	*40.11	7.94
		44.92		
		36.10		
		32.35		
		51.60		
P9444-7	C960913.0846	14.97	32.14	11.82
		30.48		
		29.14		
		45.72		
		40.37		
P9444-8	C960913.0946	44.39	*39.41	3.20
		40.64		
		36.36		
		37.43		
		38.24		
P9444-9	C960913.1046	29.14	29.14	6.45
		38.24		
		29.95		
		28.34		
		20.05		
P9444-10	C960913.1146	54.01	40.32	18.23
		43.58		
		58.02		
		12.57		
		33.42		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Combined Larval Mortality/Abnormality (%)		
		By Replicate	Mean	Standard Deviation
P9446-1 Reference	C960913.1246	67.91	27.06	24.80
		12.03		
		9.09		
		12.83		
		33.42		
P9446-2 Reference	C960913.1346	36.90	29.04	8.56
		26.74		
		38.77		
		18.72		
		24.06		
P9445-1	C960913.1446	16.84	20.27	6.12
		22.73		
		15.51		
		29.95		
		16.31		
P9445-2	C960913.1546	45.72	42.73	4.55
		38.50		
		40.64		
		49.20		
		39.57		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 27Sep96
Date Test Ended: 30Sep96

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Mortality (%)			Abnormality (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
Control A	C960913.1746A	32.64	19.64	13.40	4.41	4.79	2.37
		8.90			3.58		
		3.86			2.16		
		33.23			5.33		
		19.58			8.49		
Control B	C960913.1746B	0.00	3.98	4.55	2.22	4.46	1.40
		6.23			4.75		
		2.97			4.28		
		0.00			5.08		
		10.68			5.98		
Water Control	Water Control	9.36	6.68	4.20	7.08	6.36	3.60
		5.08			10.14		
		9.09			9.12		
		0.00			3.98		
		9.89			1.48		
P9443-1	C960911.0546	32.34	23.09	12.37	2.19	2.61	1.05
		36.50			3.74		
		20.18			3.72		
		4.75			1.87		
		21.66			1.52		
P9443-2	C960911.0646	24.63	24.51	5.25	5.51	3.76	1.07
		31.75			3.48		
		22.26			3.05		
		26.41			2.82		
		17.51			3.96		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 27Sep96
Date Test Ended: 30Sep96

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Mortality (%)			Abnormality (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9443-3	C960911.0746	46.88	25.58	15.26	3.35	3.09	0.61
		24.63			3.94		
		33.53			3.13		
		13.95			2.41		
		8.90			2.61		
P9443-4	C960911.0846	9.20	23.26	14.90	2.29	3.07	1.57
		20.18			1.86		
		12.17			1.69		
		46.29			4.97		
		28.49			4.56		
P9443-5	C960911.0946	19.88	6.77	7.78	3.70	3.38	1.02
		2.08			2.42		
		0.00			2.90		
		6.53			2.86		
		5.34			5.02		
P9443-6	C960911.1046	14.24	6.71	7.00	5.88	3.81	1.57
		0.00			3.34		
		5.64			3.77		
		0.00			1.60		
		13.65			4.47		
P9443-7	C960911.1146	24.93	24.33	6.59	2.37	3.45	1.33
		19.88			2.59		
		29.67			2.53		
		31.45			5.19		
		15.73			4.58		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 27Sep96
Date Test Ended: 30Sep96

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Mortality (%) By Replicate	Mortality (%) Mean	Mortality (%) Standard Deviation	Abnormality (%) By Replicate	Abnormality (%) Mean	Abnormality (%) Standard Deviation
P9444-1	C960913.0246	24.04	22.49	4.15	8.20	6.26	1.76
		25.22			6.35		
		15.43			3.51		
		25.52			5.98		
		22.26			7.25		
P9444-2	C960913.0346	0.00	10.33	9.54	3.39	3.61	1.74
		1.78			1.81		
		21.66			3.03		
		10.39			3.31		
		17.80			6.50		
P9444-3	C960913.0446	23.15	17.69	8.00	3.09	4.15	1.70
		25.22			3.57		
		21.96			5.32		
		8.01			6.45		
		10.09			2.31		
P9444-4	C960913.0546	34.72	42.61*	11.33	5.45	*7.20	2.91
		43.03			6.25		
		37.98			4.31		
		62.02			11.72		
		35.31			8.26		
P9444-5	C960913.0646	0.00	18.04	17.40	2.63	4.08	2.55
		46.59			8.33		
		10.39			1.99		
		18.69			2.92		
		14.54			4.51		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Mortality (%)			Abnormality (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9444-6	C960913.0746	27.60	30.74*	8.13	1.23	4.06	4.80
		30.27			12.34		
		26.41			3.63		
		24.63			0.39		
		44.81			2.69		
P9444-7	C960913.0846	2.08	21.66	13.70	3.64	3.85	0.50
		19.88			3.70		
		17.51			4.68		
		37.69			3.33		
		31.16			3.88		
P9444-8	C960913.0946	35.61	30.33*	3.48	4.15	3.50	0.53
		32.05			3.06		
		27.30			2.86		
		27.89			3.70		
		28.78			3.75		
P9444-9	C960913.1046	19.29	18.81	7.29	2.57	3.15	0.63
		29.38			2.94		
		19.29			3.68		
		17.21			3.94		
		8.90			2.61		
P9444-10	C960913.1146	47.48	31.81	20.65	2.82	2.90	0.68
		35.31			3.21		
		52.23			2.48		
		0.89			2.10		
		23.15			3.86		

* = statistically significant relative to reference sediment response (Student's t-test, p = 0.05)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 27Sep96
Date Test Ended: 30Sep96

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Client Sample ID	MEC Sample ID	Mortality (%)			Abnormality (%)		
		By Replicate	Mean	Standard Deviation	By Replicate	Mean	Standard Deviation
P9446-1 Reference	C960913.1246	63.20	17.45	27.43	3.23	3.17	1.11
		0.89			1.50		
		0.00			2.86		
		0.00			4.40		
		23.15			3.86		
P9446-2 Reference	C960913.1346	18.99	14.78	9.10	13.55	7.64	3.48
		11.57			8.05		
		28.19			5.37		
		4.45			5.59		
		10.68			5.65		
P9445-1	C960913.1446	0.89	5.99	6.09	6.89	*5.92	2.31
		9.79			4.93		
		0.30			5.95		
		14.54			9.03		
		4.45			2.80		
P9445-2	C960913.1546	37.39	34.24	5.50	3.79	3.30	1.87
		30.56			1.71		
		29.67			6.33		
		42.43			2.06		
		31.16			2.59		

* = statistically significant relative to reference sediment response (Student's t-test, $p = 0.05$)

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Test Water Quality Data

Analyte:	**Salinity**	**Dissolved Oxygen**	**pH**
EPA Method:	120.1	360.1	150.1
Method Reporting Limit:	0.1 ‰	1% sat	0.1 unit

Sample ID *Client* *(MEC)*	**Statistic**	**Temp (°C)**	**D.O. (% Sat.)**	**Salinity (ppt)**	**pH**
Control A (C960913.1746A)	Mean	16.3	96	28.8	8.0
	Minimum	15.4	94	28.6	7.7
	Maximum	17.7	98	28.8	8.2
Control B (C960913.1746B)	Mean	16.5	93	28.8	8.0
	Minimum	16.0	87	28.7	7.8
	Maximum	17.0	96	29.0	8.3
Water Control (Water Control)	Mean	16.1	97	28.8	8.1
	Minimum	15.6	96	28.8	7.9
	Maximum	16.8	99	28.9	8.2
P9443-1 (C960911.0546)	Mean	16.4	93	29.0	8.1
	Minimum	15.8	86	28.9	7.9
	Maximum	17.2	98	29.1	8.2
P9443-2 (C960911.0646)	Mean	16.5	92	28.9	8.0
	Minimum	15.8	88	28.7	7.8
	Maximum	17.4	95	29.0	8.2
P9443-3 (C960911.0746)	Mean	16.4	93	29.0	8.0
	Minimum	15.7	88	28.9	7.8
	Maximum	17.3	96	29.0	8.2
P9443-4 (C960911.0846)	Mean	16.4	96	28.9	8.0
	Minimum	15.6	93	28.6	7.8
	Maximum	17.3	99	29.1	8.1

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client: KCEL
Project: Metro Set I
Sample Matrix: Sediment
MEC Project ID 0906

Date Received: 11 & 13Sep96
Date Test Started: 27Sep96
Date Test Ended: 30Sep96

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Sample ID *Client* *(MEC)*	Statistic	Temp (°C)	D.O. (% Sat.)	Salinity (ppt)	pH
P9443-5 (C960911.0946)	Mean	16.3	95	29.0	8.0
	Minimum	15.6	88	29.0	7.8
	Maximum	17.1	100	29.1	8.2
P9443-6 (C960911.1046)	Mean	16.4	97	28.8	8.0
	Minimum	16.1	94	28.7	7.9
	Maximum	16.9	99	28.9	8.2
P9443-7 (C960911.1146)	Mean	16.6	96	28.9	8.1
	Minimum	15.8	94	28.8	7.9
	Maximum	17.3	101	28.9	8.2
P9444-1 (C960913.0246)	Mean	16.3	93	29.0	8.0
	Minimum	15.6	86	29.0	7.9
	Maximum	17.3	99	29.0	8.1
P9444-2 (C960913.0346)	Mean	16.5	97	28.8	8.1
	Minimum	16.2	95	28.6	8.0
	Maximum	17.0	99	28.9	8.2
P9444-3 (C960913.0446)	Mean	16.3	93	29.0	8.0
	Minimum	15.6	90	28.7	7.9
	Maximum	17.5	95	29.1	8.1
P9444-4 (C960913.0546)	Mean	16.2	94	29.0	8.0
	Minimum	15.7	88	28.9	7.9
	Maximum	17.3	99	29.1	8.2
P9444-5 (C960913.0646)	Mean	16.3	95	28.9	8.0
	Minimum	15.6	88	28.8	7.8
	Maximum	17.0	100	28.9	8.1
P9444-6 (C960913.0746)	Mean	16.3	96	28.8	8.1
	Minimum	15.8	91	28.5	7.9
	Maximum	16.8	98	28.9	8.2
P9444-7 (C960913.0846)	Mean	16.3	93	29.0	8.2
	Minimum	15.6	85	28.8	7.9
	Maximum	17.0	98	29.0	8.3

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Sample ID ***Client*** ***(MEC)***	**Statistic**	**Temp (°C)**	**D.O. (% Sat.)**	**Salinity (ppt)**	**pH**
P9444-8	Mean	15.8	93	29.1	8.0
(C960913.0946)	Minimum	15.1	89	29.0	7.9
	Maximum	16.9	98	29.1	8.1
P9444-9	Mean	16.5	94	28.8	8.0
(C960913.1046)	Minimum	15.8	87	28.7	7.9
	Maximum	17.3	100	28.9	8.1
P9444-10	Mean	16.4	94	29.0	8.0
(C960913.1146)	Minimum	15.7	90	28.9	7.9
	Maximum	17.3	96	29.1	8.1
P9446-1	Mean	16.6	95	28.9	8.1
Reference	Minimum	15.7	88	28.8	8.0
(C960913.1246)	Maximum	17.6	99	29.0	8.1
P9446-2	Mean	16.5	93	29.0	8.0
Reference	Minimum	15.7	89	28.8	7.9
(C960913.1346)	Maximum	17.3	98	29.0	8.1
P9445-1	Mean	16.1	93	28.8	8.1
(C960913.1446)	Minimum	15.4	89	28.7	8.0
	Maximum	17.0	98	28.9	8.2
P9445-2	Mean	16.5	96	28.8	8.0
(C960913.1546)	Minimum	15.6	93	28.6	7.8
	Maximum	17.5	102	28.9	8.1

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Total Ammonia (mg/L)

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1746A)	0.11	0.00	P9444-4 (C960913.0546)	0.26	0.02
Control B (C960913.1746B)	0.06	0.00	P9444-5 (C960913.0646)	0.07	0.03
P9443-1 (C960911.0546)	0.14	0.00	P9444-6 (C960913.0746)	0.14	0.00
P9443-2 (C960911.0646)	0.09	0.00	P9444-7 (C960913.0846)	0.18	0.08
P9443-3 (C960911.0746)	0.06	0.00	P9444-8 (C960913.0946)	0.20	0.00
P9443-4 (C960911.0846)	0.12	0.00	P9444-9 (C960913.1046)	0.20	0.07
P9443-5 (C960911.0946)	0.34	0.00	P9444-10 (C960913.1146)	0.20	0.71
P9443-6 (C960911.1046)	0.27	0.00	P9446-1 Reference (C960913.1246)	0.13	0.68
P9443-7 (C960911.1146)	0.01	0.00	P9446-2 Reference (C960913.1346)	0.36	0.69
P9444-1 (C960913.0246)	0.16	0.12	P9445-1 (C960913.1446)	0.13	0.38
P9444-2 (C960913.0346)	0.12	0.00	P9445-2 (C960913.1546)	0.12	0.02
P9444-3 (C960913.0446)	0.30	0.08	Seawater Control	0.00	0.00

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

Sulfides (ppm)

Sample ID	Initial	Final	Sample ID	Initial	Final
Control A (C960913.1746A)	<0.1	0.00	P9444-4 (C960913.0546)	<0.1	0.00
Control B (C960913.1746B)	<0.1	0.00	P9444-5 (C960913.0646)	<0.1	0.00
P9443-1 (C960911.0546)	<0.1	0.00	P9444-6 (C960913.0746)	<0.1	0.00
P9443-2 (C960911.0646)	<0.1	0.00	P9444-7 (C960913.0846)	<0.1	0.00
P9443-3 (C960911.0746)	<0.1	0.00	P9444-8 (C960913.0946)	0.005	0.00
P9443-4 (C960911.0846)	<0.1	0.00	P9444-9 (C960913.1046)	0.226	0.00
P9443-5 (C960911.0946)	<0.1	0.00	P9444-10 (C960913.1146)	<0.1	0.00
P9443-6 (C960911.1046)	<0.1	0.00	P9446-1 Reference (C960913.1246)	<0.1	0.00
P9443-7 (C960911.1146)	0.00	0.00	P9446-2 Reference (C960913.1346)	<0.1	0.00
P9444-1 (C960913.0246)	<0.1	0.00	P9445-1 (C960913.1446)	<0.1	0.00
P9444-2 (C960913.0346)	<0.1	0.00	P9445-2 (C960913.1546)	<0.1	0.00
P9444-3 (C960913.0446)	<0.1	0.00			

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

5. Statistical Analyses

Tests of normal distribution were done using SAS® Proc Univariate. T-tests were done to compare each sample endpoint to the corresponding reference sample endpoint. Proc TTEST was used for these tests, and results adjusted for a one-tail test.

6. Positive Control Response

A reference toxicity test with cadmium chloride was performed on 27 September 1996. Concentrations tested were 1.6, 3.2, 7.5, 15 and 30 cadmium ppm. The estimate of the 48-96 hour EC_{50} was 6.20 ppm. A laboratory control chart could not be generated due to lack of data points.

Verification analysis of the laboratory cadmium stock solution (10,000 ppm) was recorded at 10,400 ppm cadmium. Analysis of the highest test concentration (30 ppm) was at 10.4 ppm. Improper sample storage and handling is suspected for the differences in expected and analyzed values in this test. The laboratory analysis results are included in the supporting documentation section.

7. Dilution Water

Dilution water was collected by MEC personnel from Scripps Institute of Oceanography (SIO) in La Jolla, CA on September 16, 1996. The seawater was assigned the identifcation number SIO 091696.

Priority pollutant analysis of SIO 091696 showed all analytes below laboratory detection limits. The laboratory analysis results are included in the supporting documentation section.

MEC ANALYTICAL SYSTEMS, INC.

Analytical Report

Client:	KCEL	**Date Received:**	11 & 13Sep96
Project:	Metro Set I	**Date Test Started:**	27Sep96
Sample Matrix:	Sediment	**Date Test Ended:**	30Sep96
MEC Project ID	0906		

Echinoderm Embryo Sediment Bioassay

Test Organism: *Dendraster excentricus*
MEC Protocol: P042.0

APPENDIX
Pertinent Test Data

TEST: Echinoderm Embryo Sediment Bioassay (PSEP)
MEC Protocol P042.0

DILUTION WATER: Scripps Institute of Oceanography filtered seawater

Target Values:	Salinity	28 ± 1 ppt
	D.O.	> 60% saturation
	Temperature	15.0° C, ± 1° C

TEST ORGANISM: Sand Dollar (*Dendraster excentricus*), from Aquatic Environmental Science, Port Townsend, Washington. Collected by Ken Brooks, received 27 September 1996, holding time <1 day.
Stocking Density: 32.9 eggs/mL
Stocking Aliquot Size: 2.8 mL
Initial Count Data: 374 eggs/10 mL

TEST CHAMBER: 1L glass jars, sediment volume 18 grams

EXPERIMENTAL DESIGN:

1. 18 grams of sediment were placed into each jar, 900 mL of seawater was added, the temperature of the seawater was adjusted to 15 ± 1°C.
2. ~20,000 to 30,000 embryos were placed into each chamber.
3. Samples were aerated.
4. Test chambers were held at 15°C ±1° for 48 to 96 hours with a photoperiod of 14 hours light, 10 hours dark.
5. Test bath temperature was monitored with a thermistor, continuously recorded with a data logger.

CONTROL CRITERIA: ≥90% Normal Development; ≥70% survival in seawater controls

STUDY DIRECTOR: A. Monji

INVESTIGATORS: A. Monji, M. Woo, K. Bothner, T. Fitzsimmons, J. Lubenkov, E. Basmadjian

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