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BIOREMEDIATION MONITORING PROGRAM

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December, 1990

December 28, 1990

Captain D.E. Bodron, Co-Chairman RRT
Chief, Marine Safety Division
17th Coast Guard District
P.O. Box 3-5000
Juneau, AK 99802-1217

Dear Captain Bodron:

Enclosed are five copies of the final report on the Joint Bioremediation Monitoring Program conducted during the 1990 summer clean-up activities of the Exxon Valdez oil spill. We promised this report to Rear Admiral Ciancaglini, the FOSC, by 1 January, 1991, as a final analysis of the efficacy and ecological effects of bioremediation treatments used on shorelines in Prince William Sound in 1990. We ask that you forward the material, as necessary and appropriate, to Admiral Ciancaglini and other members of the RRT.

This document serves as a follow-up to our September 10, 1990, interim report and as final assessment of the treatment technology as applied during the summer of 1990. It should replace all interim reports as a reference document. The document contains all of the previously reported information as well as additional data on changes in oil chemistry as part of the degradation process.

We are available to answer any questions that may arise concerning this document.

Sincerely,

Roger Prince JRC
James Clark
James C. Gibeaut

Roger C. Prince
Exxon

James R. Clark
USEPA

James C. Gibeaut
ADEC

Enclosures

1

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<u>December, 1990</u>

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EXECUTIVE SUMMARY

The joint ADEC/USEPA/Exxon biodegradation monitoring team successfully organized and implemented a comprehensive program for assessing the utility of fertilizer amendments for enhancing the biodegradation of surface and subsurface oil, and for characterizing the associated ecological risks. Interim reports, with analyses of the data then available, were presented in July and September. This Final Report presents all the monitoring data, and reinforces the earlier conclusion that biodegradation is an important mechanism in the removal of oil from shorelines in Prince William Sound, and that the application of fertilizers is a safe and effective means to enhance this natural process.

- Chemical analyses of the remaining oil on the beaches indicates that biodegradation has already removed 10-70% of the oil in individual samples.

- By employing ratios of degradable and undegradable fractions of the oil components, we have derived an estimate of the baseline oil degradation rate. This is approximately
  2.2 g oil/Kg sediment/year on the surface
  1.1 g oil/Kg sediment/year in the subsurface.

- The activity of oil-degrading bacteria in surface sediments and subsurface sediments sampled at a depth of 30 cm was enhanced three to four fold relative to the unfertilized sediments. This enhancement was sustained for 32 days after the initial fertilizer application. A second application replenished nutrients and stimulated relative microbial activities five to ten fold.

- The microbial populations on the fertilized areas have consistently higher numbers of hydrocarbon degrading bacteria than the corresponding unfertilized areas. Adding fertilizer resulted in a five to ten-fold increase in hydrocarbon degraders.

- Fertilizer application resulted in no adverse ecological effects.

This report provides evidence that fertilizer application is an effective means to enhance the activity of oil-degrading bacteria in surface and subsurface sediments with minimal environmental impact. The elevated activity of hydrocarbon-degrading bacteria and the measured increase in their populations together provide convincing evidence that fertilizer application indeed enhances oil degradation. Reapplication of fertilizers is warranted every 3-5 weeks.

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INTRODUCTION

The State of Alaska's approval for the widespread use of bioremediation as one of the cleanup tools for 1990 was contingent on a detailed monitoring program to show that the technique did indeed speed the biodegradation of oil, and without imposing a significant toxicological impact on the shoreline and nearshore biota. A team of scientists from the Alaska Department of Environmental Conservation, the United States Environmental Protection Agency and Exxon therefore designed and executed such a program. Preliminary reports, which provided evidence that bioremediation is a safe and effective tool in removing oil from the shorelines of Prince William Sound and the Gulf of Alaska, were provided to the Federal On Scene Coordinator on July 10 and September 11. This final report, which provides an analysis of all the data collected during the program, confirms that biodegradation is an important process in the natural cleansing of oiled beaches, and reinforces the earlier conclusions that the addition of fertilizers is a safe and effective way to stimulate the biodegradation and removal of oil from the shorelines of Prince William Sound and the Gulf of Alaska.

Bioremediation in Prince William Sound in 1990 involved the addition of oleophilic and slow release fertilizers to speed the biodegradation of oil by the indigenous microbial flora. The initial design of the monitoring program was to quantify seven effects of these fertilizer applications;

- the presence of fertilizer nutrients in the beach interstitial water.
- the stimulation of biodegradation, achieved by the addition of fertilizers, at the surface and in subsurface sediments.
- the changes in the amount and composition of oil in the sediments.
- the toxicity to aquatic biota following application of fertilizers.
- the nutrient loading in the water off the treated areas in order to address the potential for stimulating algal growth.
- the amount of dissolved petroleum hydrocarbon in the water off the treated beaches in order to address the potential that enhanced microbial activity on the shorelines might cause the release of petroleum into the water column.
- the rate of disappearance of 2-butoxy-ethanol from Inipol EAP22 treated shorelines.

The results presented in the July 10 Interim Report provided strong evidence that bioremediation was indeed a safe and effective treatment for removing oil from shorelines in Prince William Sound. The program was thus continued with the goal of measuring the following additional effect:

- the potential that additional applications of fertilizer would further stimulate biodegradation of oil.

The program used a variety of field and laboratory techniques. The presence of fertilizer nutrients in the interstitial water was measured in samples collected from perforated stainless steel wells driven into the beach material. These wells were perforated throughout their length, and sampled water from just below the surface to approximately 50 cm into the substrate. Additional wells were sealed so that they only sampled subsurface water collected from a depth of approximately 40-50 cm. Interstitial water samples were analyzed for dissolved oxygen, salinity and temperature on the beach. Additional samples were returned to the ship; some were analyzed for pH, while others were filtered to remove bacteria, preserved, and shipped to analytical laboratories for analysis of ammonia/ammonium, nitrate, nitrite, total Kjeldahl nitrogen and phosphate.

The stimulation of biodegradation achieved by the addition of fertilizers was assessed on both microbiological and chemical criteria. The numbers of heterotrophic and oil-degrading organisms were determined by "most probable number" techniques, and the ability of the oil-degrading organisms to mineralize (convert to carbon dioxide) hydrocarbons was assessed using laboratory assays with radiolabelled hexadecane and phenanthrene. The amount of oil in shoreline sediments was also determined, and the chemical composition of this oil was quantified with gas chromatographic techniques.

The potential toxicity associated with fertilizer application was assessed by collecting samples of water as the tide receded from the treated area and sending the samples to a laboratory for toxicity tests. The toxicity tests followed standard methods employed for testing industrial effluents, and included standard dilution series. Samples were tested with Mysids, a shrimp-like crustacean that is the most sensitive of seven species tested when Inipol was screened in laboratory toxicity tests during the initial review in 1989. Toxicity was further assessed by quantifying ammonia and nitrate plus nitrite in nearshore waters for four days after application.

The potential for stimulation of algal growth was assessed by monitoring the concentrations of chlorophyll in nearshore waters over the several weeks following treatment. Nearshore waters also were monitored for total hydrocarbon concentrations to characterize the amount of oil leaving the treated shoreline.

Concerns had been raised about the potential hazard to wildlife exposed to the butoxy-ethanol present in Inipol EAP22. The rate of butoxy-ethanol disappearance from Inipol-treated shorelines was measured by collecting oil from the surface of cobbles with gauze swipes and quantifying butoxy-ethanol through GC/MS analyses.

ORGANIZATION

This program was a joint undertaking by USEPA, ADEC and Exxon, and as such was planned and directed by personnel from all three organizations. The responsibilities for the individual parts of the program were as follows.

The field teams were primarily personnel from America North Inc. under contract to Exxon; they made measurements on the beaches, collected samples, and shipped them to the analytical laboratories. Water samples for toxicological analysis were sent to Marine Environmental Consultants, Inc., Tiburon, CA. Water samples for organic nitrogen and total petroleum hydrocarbon analyses were sent to Chemical and Geological Laboratories, Anchorage, AK; those for inorganic nutrients were sent to Dr E. Loder, Institute for the Study of Earth, Oceans and Space, University of New Hampshire, Durham, NH. Sediment samples for microbiological analyses in the initial program were shipped to the laboratory of Dr. E. Brown, Water Research Center, University of Alaska, Fairbanks, AK. Subsequent microbiological analyses were performed in the Alaska Department of Environmental Conservation laboratory in Valdez, AK. Sediment samples for oil content and composition were sent to Battelle Ocean Sciences, Duxbury, MA. Time lapse photography was organized by Polar Alpine Inc., Berkeley, CA. These responsibilities are summarized in tabular form in Table 1.

Exxon chartered three vessels to support personnel at field sites. The 110 ft *Jolly Roger* served as the base vessel for housing field crews, their sampling gear and scientific equipment, and necessary laboratory space. A smaller vessel, *The Three Bears*, was used to house and transport field crews during the early part of the program when they were searching for appropriate sites, and when it was necessary to sample at more than one site on a single day. The Joint Operations Transport Command transported personnel to and from the sites, and transported samples to Anchorage for shipping to the analytical laboratories. A 36 ft fast-planing boat, the *Inga Kristine*, was used to transport samples from the field sites to Cordova for air shipment when air travel within the Sound was restricted. These arrangements ensured that the monitoring team continued operation despite adverse weather, and that all samples were collected and delivered on schedule.

MONITORING SITES

The first part of the program was to select representative shoreline segments that were suitable for monitoring. Key criteria in this selection process were the size of the segment, and the presence of two areas that appeared to be similar so that one could be treated with fertilizer while the other could be left as a reference. After extensive discussions with participants in the Interagency Technical Assessment Group, and examining more than thirty potential sites, three were selected as sites for monitoring; all are at the northern end of Knight Island, as shown in Figure 1.

KN-132B, Herring Bay. A low energy site near an anadromous stream with surface oil. It had not received bioremediation treatment in 1989.

KN-135B, Bay of Isles. A low energy site with surface and subsurface oil. It had not received bioremediation treatment in 1989.

KN-211E, Northeast coast of Knight Island. A high energy site with subsurface oil only. This site had received approximately 68 Kg of Inipol EAP22 and 8.3 Kg of Customblen on an area of 271 m^2 on September 15, 1989. This corresponds to an application of 251 g/m^2 of Inipol EAP22, and 31 g/m^2 of Customblen, but to only a portion of the beach.

Although more heavily oiled than the majority of shorelines receiving bioremediation treatment in 1990, they provided the opportunity to assess bioremediation of surface and subsurface oil, alone and in combination. They were chosen because each had appropriate sediment (small gravel) beneath the surface armor, the appearance of reasonably uniform oiling throughout the oiled zone, an area large enough to be subdivided, and no substantial input of surface water from the supratidal zone. The experimental design focussed on assessing the benefits and risks associated with the addition of Inipol EAP22 and Customblen, so both portions of each site received similar manual treatment before fertilizer application.

TABLE 1
SAMPLING SCHEDULE FOR BIOREMEDIATION MONITORING PROGRAM

SAMPLE TYPE	ANALYSIS	SAMPLING DAY First application	SAMPLING DAY Second application	LABORATORY
Photography	time lapse video	0-42	-	PAI
Visual observation	Depth of oil	0,2,4,8,16,32	3,17,55	Field
	Surface oil	0,2,4,8,16,32	3,17,55	Field
	Fertilizer	0,2,4,8,16,32	3,17,55	Field
Sediment	Microbial counts	0,2,4,8,16,32	3,17,55	UAF & ADEC
	Respirometry	0,2,4,8,16,32	3,17,55	UAF & ADEC
Sediment	petroleum	0,32	3,17,55	BOS
	GC/MS	0,32	3,17,55	BOS
Interstitial water	dissolved oxygen	0,2,4,8,16,32	3,17,55	Field
	temperature	0,2,4,8,16,32	3,17,55	Field
	salinity	0,2,4,8,16,32	3,17,55	Field
	ammonia, nitrate	0,2,4,8,16,32	3,17,55	UNH
	nitrite, phosphate	0,2,4,8,16,32	3,17,55	UNH
	Kjeldahl nitrogen	0,2,4,8,16,32	3,17,55	CGL
Water above beach	toxicology	0,1,7,19,32,57,82 hr	-	MEC
	ammonia, nitrate	0,1,7,19,32,57,82 hr	-	UNH
Water above beach	chlorophyll	0,2,4,8,16,32	3,17	Field
	petroleum	0,2,4,8,16,32	-	CGL
	ammonia, nitrate,	-	3,17	UNH
	nitrite, phosphate	-	3,17	UNH
Cobble surface	butoxy-ethanol	1,8,21,46 hr	-	ERE

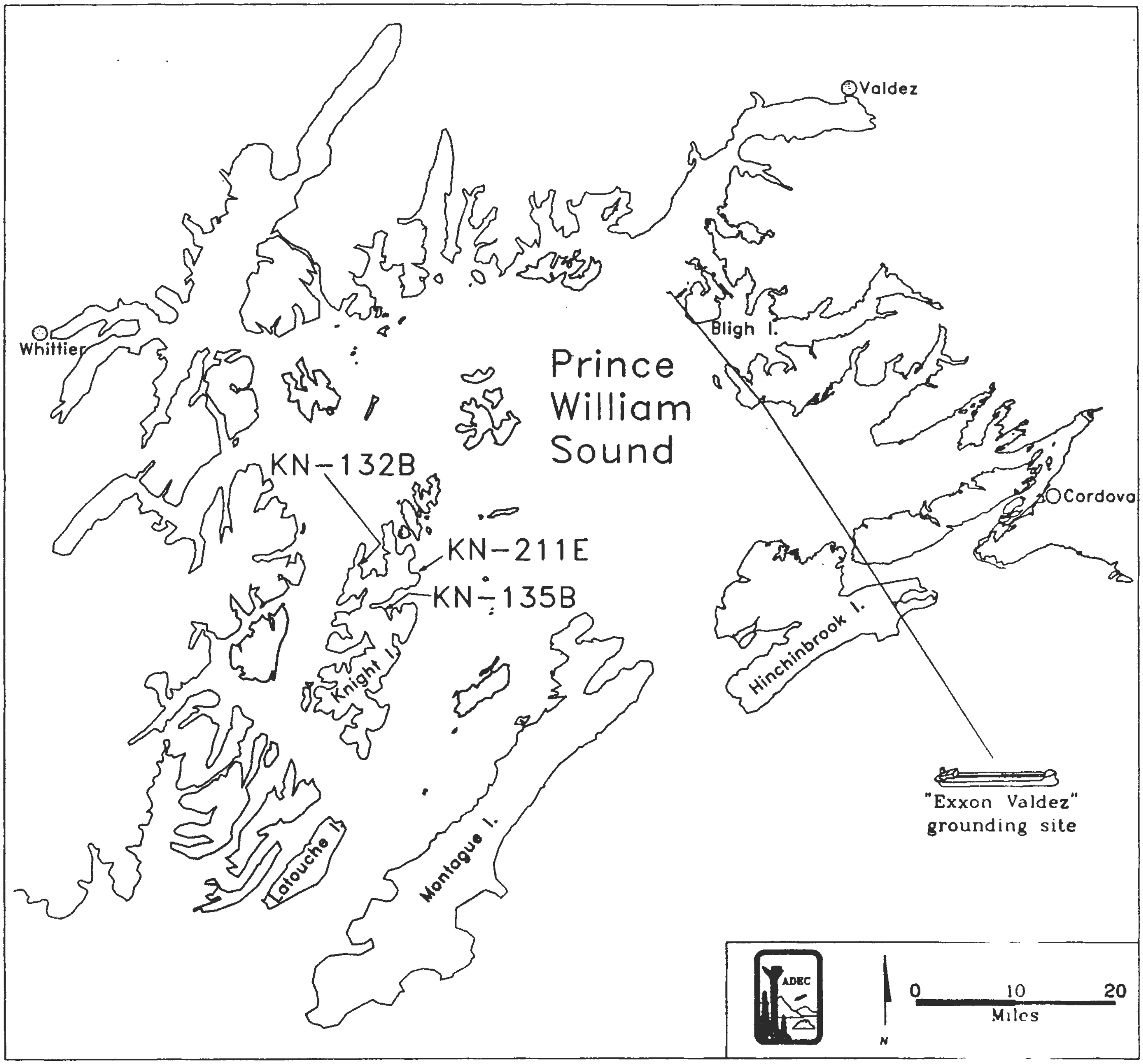
This chart indicates the planned sampling schedule; samples were collected as indicated, with some minor variations at the different locations due to tidal or weather constraints. The exact timing of the samplings is included in Appendices D1,2,3 and 4. The second fertilizer application was made on days 40 for KN-132B, 53 for KN-135B and 44 for KN-211E.

- indicates samples not taken.

KEY

Field	Field measurements by America North personnel
PAI	Polar Alpine Inc., Berkeley, CA
UAF	University of Alaska, Fairbanks, AK
ADEC	Alaska Department of Environmental Conservation, Valdez, AK
BOS	Battelle Ocean Sciences, Duxbury, MA
CGL	Chemical and Geological Laboratories, Anchorage, AK
UNH	University of New Hampshire, Durham, NH
MEC	Marine Environmental Consultants, Inc., Tiburon, CA
ERE	Exxon Research and Engineering, Annandale, NJ

FIGURE 1
BIOREMEDIATION MONITORING SITES



As part of the selection procedure for the sites, a large number of exploratory pits were dug on shorelines to assess the degree of oiling, and to delineate areas that seemed sufficiently similar and homogeneous to allow the comparison of fertilized to unfertilized areas. For sediment sampling, the surface was defined as the beginning of fine-grained sediment, and any overlying larger material, whether pebbles or cobbles, was removed prior to sampling.

On KN-132B the fine-grained sediment was overlain with scattered angular cobbles, as shown in Figure 2, and there was substantial surface oil penetrating to 2-5 cm throughout the sampling area in May, 1990. Surface samples were taken after mixing the top 5 cm of sediment, and no subsurface sediment samples were taken.

On KN-135B the fine sediment was typically overlain by 10 cm of mixed pebble and cobble, as shown in Figure 3. There was substantial surface and subsurface oiling, and while the extent of oiling and depth of penetration was very variable within the segment, the areas chosen for sampling had heavy oiling to a depth of about 40 cm. Surface samples were taken after clearing away the pebble and cobble, and mixing the top 2-5 cm of fine sediment. Subsurface samples, again of fine sediment, were taken 30cm deeper.

KN-211E had no oil within the 15-25 cm of the well rounded surface armor (Figure 4), but substantial subsurface oil extended from immediately below this cobble for 20-50 cm. Surface samples were taken after clearing away the pebble and cobble, and mixing the top 2-5 cm of fine sediment. Subsurface samples were taken 30cm deeper unless this was below the oil horizon, in which case the samples were taken from a few centimeters above the bottom of the oil layer.

SAMPLING STRATEGY

Three undisturbed but apparently similar sampling areas were selected on the fertilized and unfertilized portion of each shoreline, and a perforated pipe (5 cm diameter, 70 cm long, see Figure 5) was driven into the beach material at each sampling location; this allowed the gathering of interstitial water, and served as the center of the sediment sampling area. The wells on the area to receive fertilizer were designated A, B and C, while those on the area to remain unfertilized were designated D, E and F. The experimental design focussed on assessing the benefits and risks associated with the addition of fertilizers, so both portions of each site received similar manual treatment before fertilizer application. Samples of interstitial water were planned to be taken before and at 2, 4, 8, 16 and 32 days after the first fertilizer application, and at 3, 17 and 55 days after the second application. These were analyzed for the presence of nitrogen and phosphorus nutrients, dissolved oxygen, salinity and temperature.

With the same frequency, surface and subsurface samples of sediment (approximately 200g) were taken near each well, in triplicate, for analysis of microbial populations and activity. Additional samples (500g) taken before and at 32 days after the first application, and at 17 and 55 days after the second application, were analyzed for oil loading and oil chemistry. Each sample came from previously undisturbed sediment.

FIGURE 2

THE MONITORING SITE ON KN-132B

This photograph, taken on June 6, 1990, shows the time lapse camera in the background. The nearer "pom-pom" boom divides the fertilized (near) from the unfertilized portion of the beach. A balloon wild-life deterrent is also visible in the photograph.

FIGURE 3

THE MONITORING SITE ON KN-135B

This photograph, taken on July 17, 1990, is a view over the unfertilized portion of the site toward the fertilized portion. The boundary between the two areas lies approximately half-way down the measuring tape being used by the monitoring personnel.

FIGURE 4
THE MONITORING SITE ON KN-211E

This photograph, taken on June 30, 1990, is a view of the unfertilized portion of the site, showing the three sampling wells.

FIGURE 5
SAMPLING WELL BEING READIED FOR INSTALLATION

As the sampling holes were dug, the beach material was placed in a large bucket so that it did not contaminate the surrounding area. After samples had been collected, the bucket was emptied into the hole, and the sampling location marked with a piece of surveyor's tape to exclude this area from subsequent sampling.

Additional wells were added to the fertilized side of each site to sample only subsurface interstitial water, one (Z) at KN-135B and two (Y and Z) at KN-132B and KN-211E. These wells were coated with silicone sealant so that only the bottom 10-15 cm remained permeable. Water samples were collected from these with the same frequency as from the fully perforated wells.

Toxicity issues were addressed during the first application of fertilizer only, using an accelerated sampling schedule. Samples were collected in the fertilized area of the site and at a reference site (control) uninfluenced by the fertilizer applications. The strategy (detailed in Appendix SOP, Section 1) was designed to obtain worst-case representations of fertilizer entering the nearshore environment by sampling at a place along the shoreline where there was minimal dilution, and at a time during the tide that allowed the maximum opportunity for fertilizer release into overlying water. Water samples were collected at 0.5 m depth in an area of the shoreline covered by overlying water to a depth of 1 m. Samples were collected 1 hour after fertilizer application and then at the mid-point of an outgoing tide, after the area had been flooded during high tide. The schedule of sampling at the fertilized site consisted of:

Pre-application sampling (1 to 2 hr before treatment)
(Fertilizer was applied at low tide)
1 hr post application
1st mid-tide outgoing (7-hr post application)
2nd mid-tide outgoing (19-hr post application)
3rd mid-tide outgoing (32-hr post application)
5th mid-tide outgoing (57-hr post application)
7th mid-tide outgoing (82-hr post application)

Water samples were collected at an untreated reference site nearby to minimize logistical problems. The reference site was out of the influence of the fertilizer applications and not immediately influenced by nearshore water flowing from the treated site. Samples from the reference site were collected on the following schedule:

Pre-application
2nd mid-tide outgoing (19-hr post application)
5th mid-tide outgoing (57-hr post application)

All samples were collected as scheduled, kept on ice, and shipped via air express to a testing laboratory in California. Testing began the day samples were received by the laboratory; this was one, two, or three days after collection in the field, depending on the collection schedule, weather conditions for transporting, and weekend shipping schedules. As will be discussed below, no toxicity was detected after the first application of fertilizer, despite over-application of fertilizer at KN-132B and KN-135B. Therefore toxicity testing was not continued when the monitoring program was extended to study a second fertilizer application at each site.

Nearshore water samples for ammonia and nitrate analyses were collected concurrently with the toxicity samples, using the same collection protocol and schedule, but with replicate samples. As with the toxicology assessment, this strategy was designed to characterize the exposures of nearshore biota to toxic components of the fertilizer nutrients under worst-case conditions.

Water samples for the analysis of chlorophyll and total petroleum hydrocarbons were collected concurrently following the first application of fertilizer. Water samples were collected in the nearshore zone of fertilized and unfertilized areas of the monitoring sites as well as in the nearshore zone of the reference site, which was remote from the fertilizer applications. Sampling occurred on the same schedule as the on-shore monitoring parameters. Water was collected at 0.5 m depth at a point over the shoreline where the total depth at the time of sampling was 1 m, following the generalized shoreline sampling scheme for locating sampling sites described in Appendix SOP, section 1. Three samples were taken offshore of the fertilized area, three offshore of the unfertilized area, and three at the reference site. Since no significant levels of petroleum hydrocarbons were detected in the nearshore water, this analysis was not continued after the second application of fertilizer. Analyses of chlorophyll were continued to monitor for the potential stimulation of algal growth.

Sampling for butoxy-ethanol residues on Inipol EAP22 treated surfaces was implemented after the initial monitoring program began, due to delays in method development. Samples were collected by Exxon's operational monitoring team at KN-134A, just south of KN-135B, following treatment on 6/23/90. Two areas were sampled, one in the mid-intertidal zone and one in the upper-intertidal zone. The mid-intertidal area was covered with seawater at each high tide, the upper-intertidal area was not. Several Inipol-treated cobble surfaces were wiped with gauze sponges to collect a minimum of 100 mg of oil, which was used as the basis of the analytical technique. This required wiping approximately 0.25 m^2 of surface. Samples were collected in each area approximately 1 hr after Inipol application and then after the first, second, and fourth high tides.

Schematic maps of the three monitoring beaches, showing the approximate locations of the sampling stations, are presented as Figures 6-8.

FERTILIZER APPLICATION

Two fertilizers were used in the 1990 bioremediation program in Prince William Sound. Customblen (TM) 28-8-0 (Sierra Chemicals, Milpitas, CA 95035) is a slow release formulation of soluble nutrients encased in a polymerized vegetable oil; it contains ammonium nitrate, calcium phosphate and ammonium phosphates with a nitrogen to phosphorus ratio of 28:8. Customblen was applied to all bioremediation sites, with the application rate reduced when it was applied in conjunction with Inipol EAP22. Inipol EAP22 (TM) (CECA S.A., 92062 Paris La Defense, France) is an oleophilic fertilizer designed to adhere to oil. It is a microemulsion of a saturated solution of urea in oleic acid, containing tri(laureth-4)-phosphate and butoxy-ethanol. It was applied only where there was surface oil.

Exxon Operations Bioremediation teams applied fertilizers as follows:

KN-132B was treated on June 2, 1990. After manual cleaning and rock-turning, it received 34 g/m^2 Customblen and 302 g/m^2 of Inipol EAP22. A second application, of 17 g/m^2 of Customblen and 302 g/m^2 of Inipol EAP22, was made on July 12. At the request of the Alaska Department of Fish and Game, there was no final application at the end of the monitoring program.

KN-135B was treated on May 21, 1990. After manual cleaning and rock-turning, it received 103 g/m^2 of Customblen and 361 g/m^2 of Inipol EAP22. A second application, of 17 g/m^2 of Customblen and 303 g/m^2 of Inipol EAP22, was made on July 13. The entire segment was treated with Customblen at an application rate of 91 g/m^2 on August 1, 1990. A final application of Inipol at 361 g/m^2 and Customblen at 17 g/m^2 was applied to the entire segment on September 5, 1990.

KN-211E was treated on May 30, 1990. It had no surface oil, and received no manual treatment before fertilizer application; it received only Customblen, at a rate of 95 g/m^2. A second application, at a similar rate, was made on July 13. Finally, the entire segment was treated, on an experimental basis, with Inipol EAP22 at 361 g/m^2 on September 8, 1990

The applications were intended to follow the application guidelines being used for the 1990 cleanup program, but in fact the initial application of Customblen on KN-132B was double the recommended amount, while that on KN-135B was six-fold higher. In terms of available nitrogenous nutrients, KN-132B thus received approximately 115% of the recommended amount, and KN-135B received 200%. All other applications conformed to the application guidelines.

FIGURE 6
SITE MAP OF KN-132B

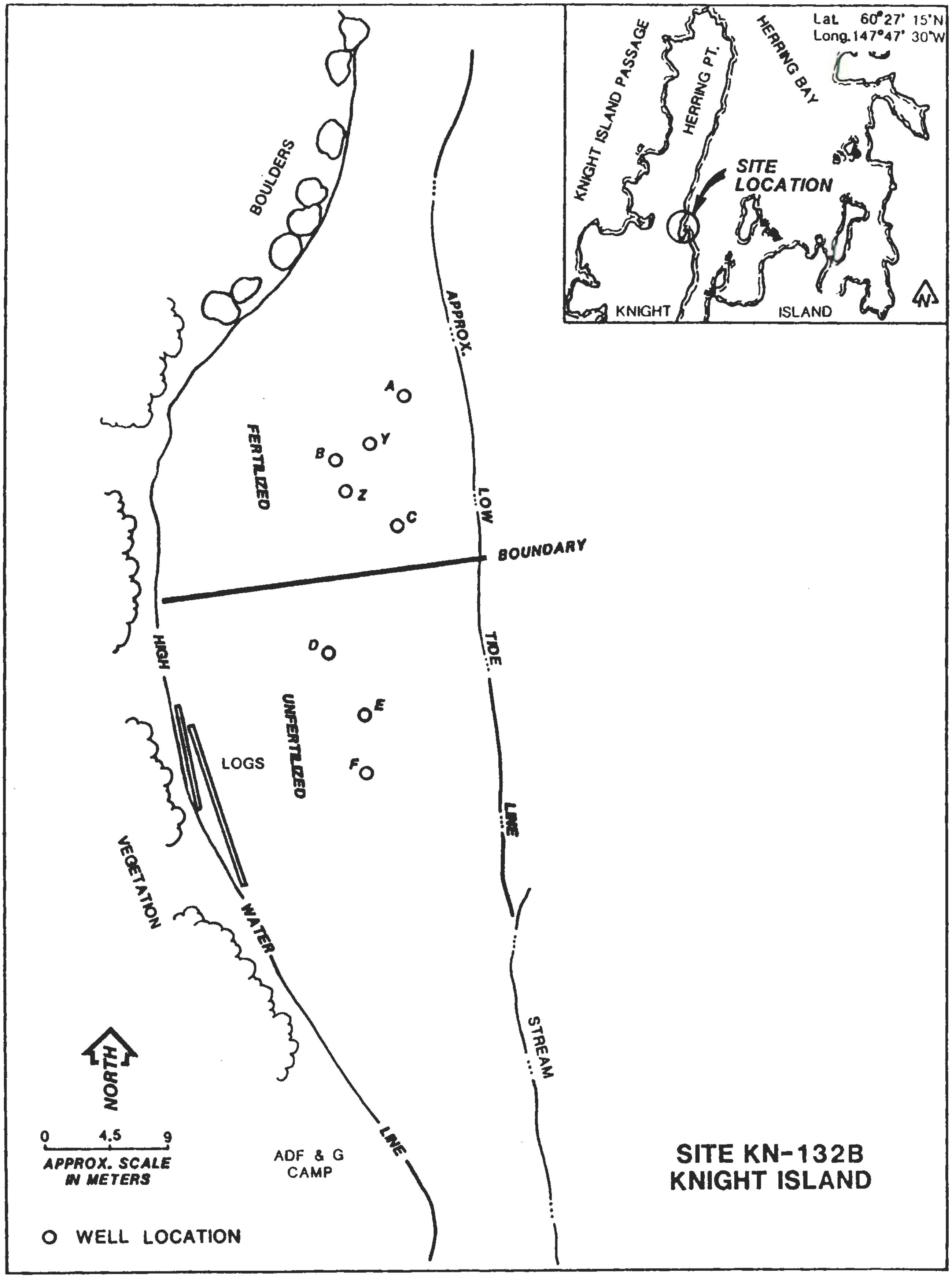


FIGURE 7
SITE MAP OF KN-135B

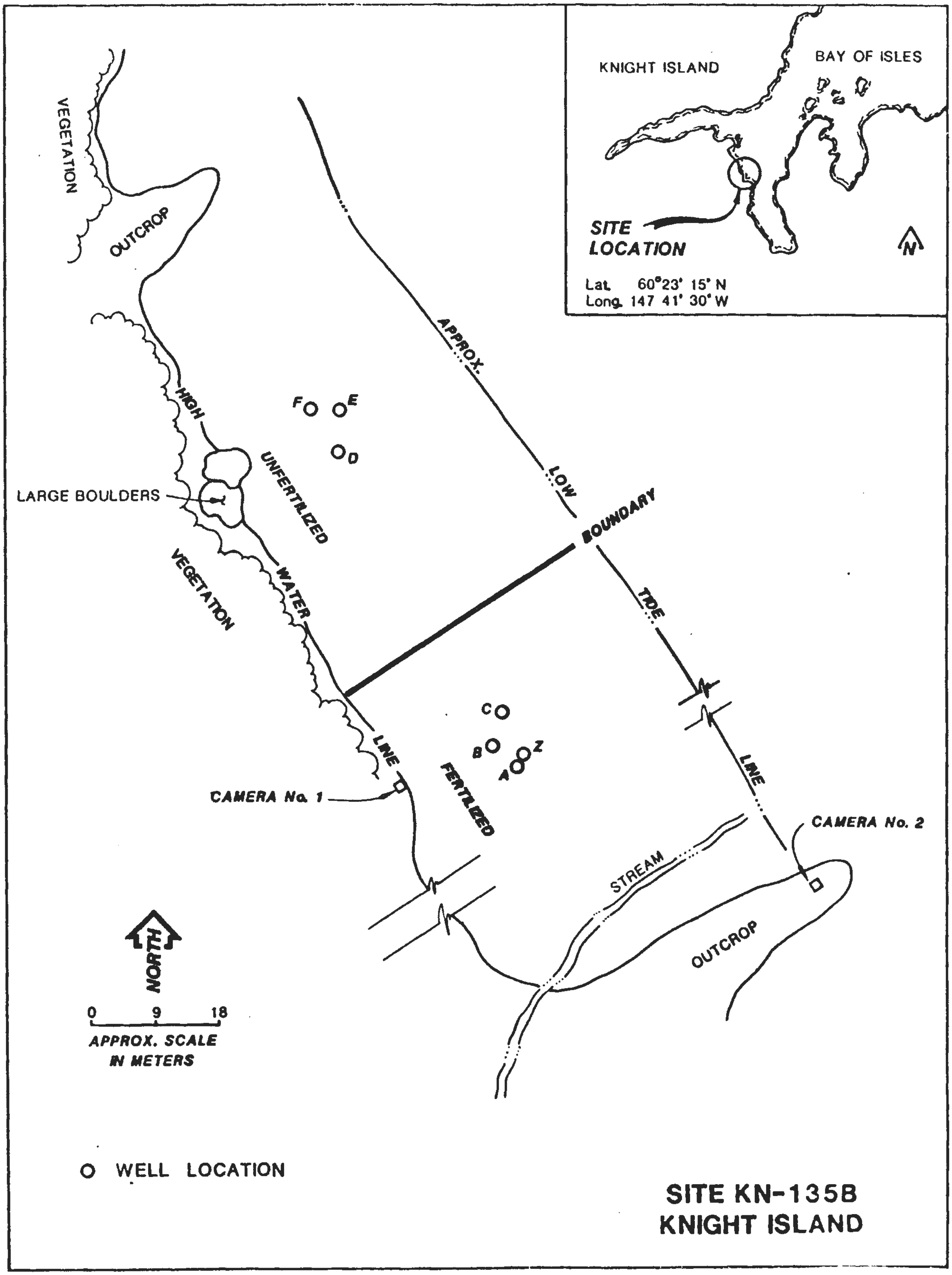
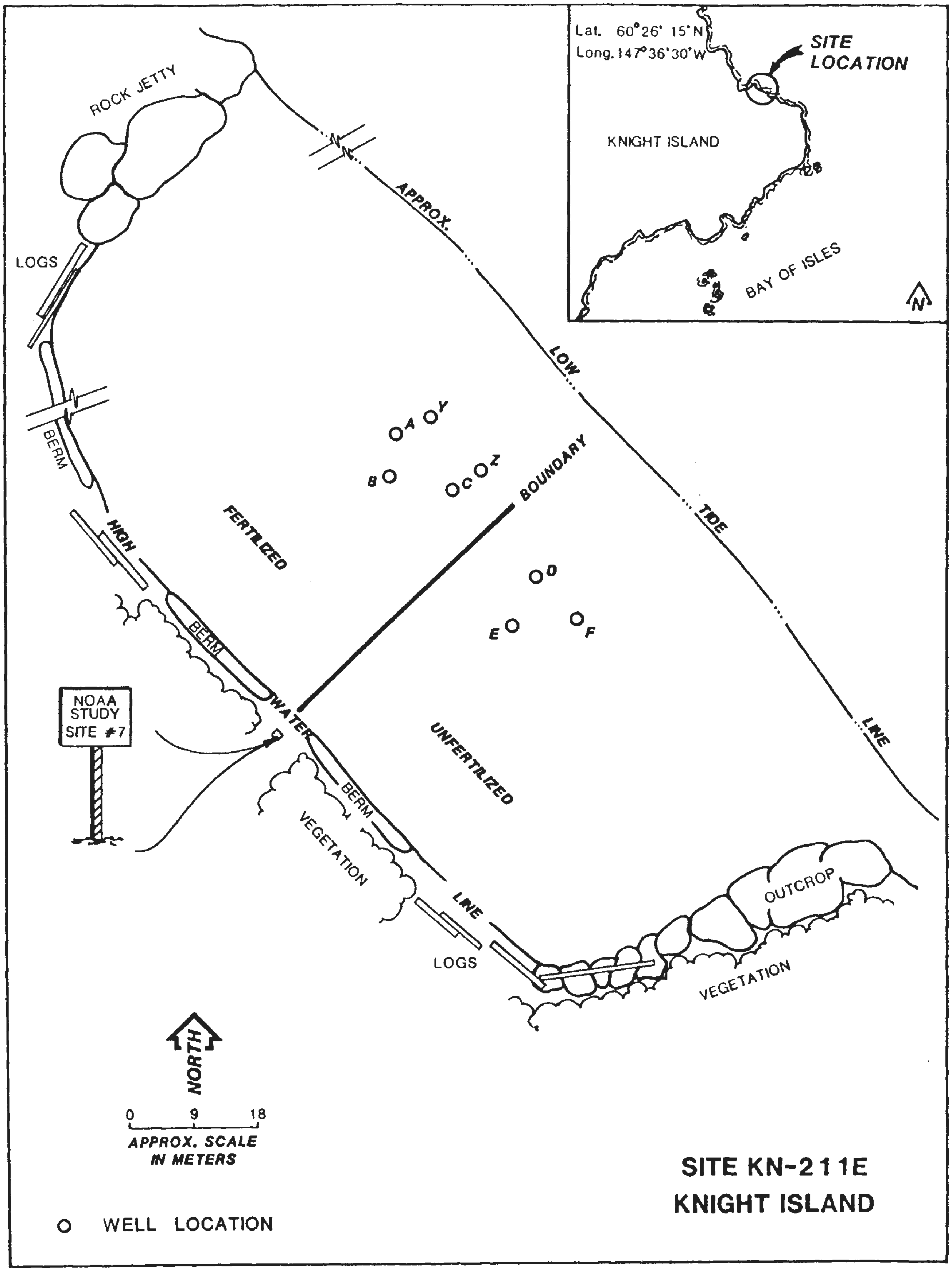


FIGURE 8
SITE MAP OF KN-211E



METHODS

INTERSTITIAL WATER: Interstitial water samples were collected from the surface and the bottom of the wells with a peristaltic pump. Temperature and salinity were determined with a YSI 33 portable meter on the beach, as soon as the samples were collected. Dissolved oxygen was measured with CHEMetrics K-7512 ampules. pH was measured with a portable Hach pH meter on board the support ship. Samples for nutrient analysis were returned to the ship, filtered to remove bacteria, and preserved prior to shipment. They were analyzed using the established protocol attached [Appendix SOP, Section 2]. Detection limits for ammonia and nitrate+nitrite were 0.02 micromolar (μM) nitrogen. Kjeldahl Nitrogen was measured using the established protocol [Appendix SOP, Section 3]. Kjeldahl Nitrogen includes organic nitrogen plus ammonia; the concentration of ammonia determined in the inorganic analyses was thus subtracted from the Kjeldahl Nitrogen to yield the concentration of organic nitrogen. The data following the first application of fertilizer indicated no differences in water samples collected from the surface and the bottom of the wells, so sampling of the surface water was discontinued following the second application of fertilizer.

SEDIMENT SAMPLES: Sediment samples of relatively homogeneous small gravel, with dimensions in the 2-5 mm range, were collected with a clean stainless steel spoon and placed into I-CHEM jars for oil analysis, and into sterile whirlpacks for microbial analyses. Samples for oil analysis were frozen prior to shipment. The microbial samples were shipped in coolers with chilled ice to the University of Alaska at Fairbanks, or the Alaska Department of Environmental Conservation laboratory in Valdez, so that they arrived within 12 hours of collection.

MICROBIAL ANALYSES: A weighed portion of each sediment sample was mixed with sterile seawater to extract the microorganisms into the aqueous phase. The number of heterotrophic and oil-degrading microorganisms was determined with most-probable-number techniques as outlined in the attached protocol [Appendix SOP, Section 4]. Hydrocarbon oxidation potentials were determined with radiolabelled hexadecane and phenanthrene by trapping and quantifying the amount of radiolabelled CO_2 evolved [Appendix SOP, Section 4].

OIL ANALYSES: The gravimetric estimation of oil in the sediment samples was planned to be determined after extraction with methylene chloride and acetone, using the protocol of Appendix SOP, Section 5. As discussed in this report, this procedure neglected to filter the extracts adequately to remove silts and fine particles. An additional filtration step, using a Gelman A/E glass fiber filter, was added to section 5.1.6 of the protocol. Gas chromatographic analyses for alkanes, polyaromatic hydrocarbons and hopanes followed the established protocols attached [Sections 6 and 7 in Appendix SOP]. The concentrations of individual chemical species were corrected for surrogate recovery before the calculations reported in the Tables in this report.

NEARSHORE WATER: Samples were collected into I-CHEM bottles and returned to the boat. Chlorophyll was assayed fluorometrically (excitation at 430 nm, emission at 670 nm) with a Turner 10-05 fluorometer. Reference samples were filtered and the filter extracted for quantitative standards. Total petroleum hydrocarbons were estimated after freon extraction by infra-red spectroscopy using the established protocol included as Section 8 of Appendix SOP. Results are reported as mg total petroleum hydrocarbon/liter of water with a detection limit of 0.20 mg/l. Samples for the assessment of ammonia and nitrate plus nitrite were filtered aboard ship, frozen and shipped to the University of New Hampshire for analysis as above. For toxicity assessments, the ammonia reported by the laboratory as μM concentrations of nitrogen have been converted to ppm concentrations of ammonia. For the combined nitrate plus nitrite results, μM concentrations were converted as if all nitrogen was in the nitrate form. The conversion to mg/l allows for direct comparison with published data on the toxicity of ammonia and nitrate to marine biota.

TOXICITY TESTS: The protocol for toxicity testing is attached as Section 1 of Appendix D4. All samples were tested with juvenile (5 to 12 day old) mysids (*Mysidopsis bahia*), a shrimp-like crustacean that is a standard organism for marine toxicity tests. Mysids are the most sensitive of 7 marine invertebrate and fish species previously tested with Inipol EAP22, and thus were selected as a sensitive surrogate for indigenous biota. The testing protocol followed ASTM guidelines for conducting static, acute toxicity tests (96-hr) with crustaceans and fishes. Three groups of 10 animals (3 replicates) were tested for each of the test concentrations, which were 100% field sample, 50% field sample, 25% field sample, 12.5% field sample, 6.25% field sample, and a control using only the dilution water from the testing laboratory. This dilution schedule was selected to allow calculations of the degree of dilution necessary to determine non-toxic concentrations, based on tests conducted during the 1989 bioremediation research/demonstration program.

BUTOXY-ETHANOL ANALYSES: Gauze samples were placed in I-CHEM jars, sealed with tape, stored in a cooler, and shipped to Exxon Research and Engineering laboratories for quantification. Samples were extracted with a solvent and quantified by GC/MS techniques, as outlined in Section 9 of Appendix SOP. Results are expressed per gram of oil in the sample.

RESULTS AND DISCUSSION

VISUAL OBSERVATIONS

General Observations

KN-132B had substantial oiling on upper intertidal boulders (20 to 50 cm), and fairly continuous surface oiling on the middle intertidal zone. By day 30 following the first application of fertilizer, the surface of the middle intertidal zone appeared substantially cleaner. This was true for both the fertilized and unfertilized portions of the beach, with subtly more improvement on the fertilized side. By the end of August the surfaces of the intertidal zone of both fertilized and unfertilized portions of the site were substantially cleaner than they had been in May, but the large angular cobbles and boulders near the high tide mark on the fertilized area still retained an obvious coating of oil. A time-lapse camera taking pictures once every six minutes detected no wildlife on the beach during the time when the wildlife deterrents were in place following the first application. The camera was not installed for the second application of fertilizer.

KN-135B had substantial oiling on upper intertidal boulders (20 to 50 cm), and continuous surface and subsurface oiling on the middle intertidal zone. The surface of the fertilized portion of the beach was substantially cleaner 32 days after application, as shown in Figure 9. The field of view of this figure precludes a comparison of the fertilized and unfertilized portions of the beach, but there was widespread agreement amongst site visitors that this improvement was more extensive than that seen on the unfertilized portion. This difference was still apparent by the end of August, although the surface of both portions of the shoreline was substantially improved from their appearance in May. Two time-lapse cameras taking pictures once every six minutes detected no wildlife on the beach during the period when the wildlife deterrents were in place following the first application of fertilizer. The cameras were not in place for the second fertilizer application.

KN-211E had clean surface cobble armor, but was heavily oiled below this. No visual change occurred during the monitoring period.

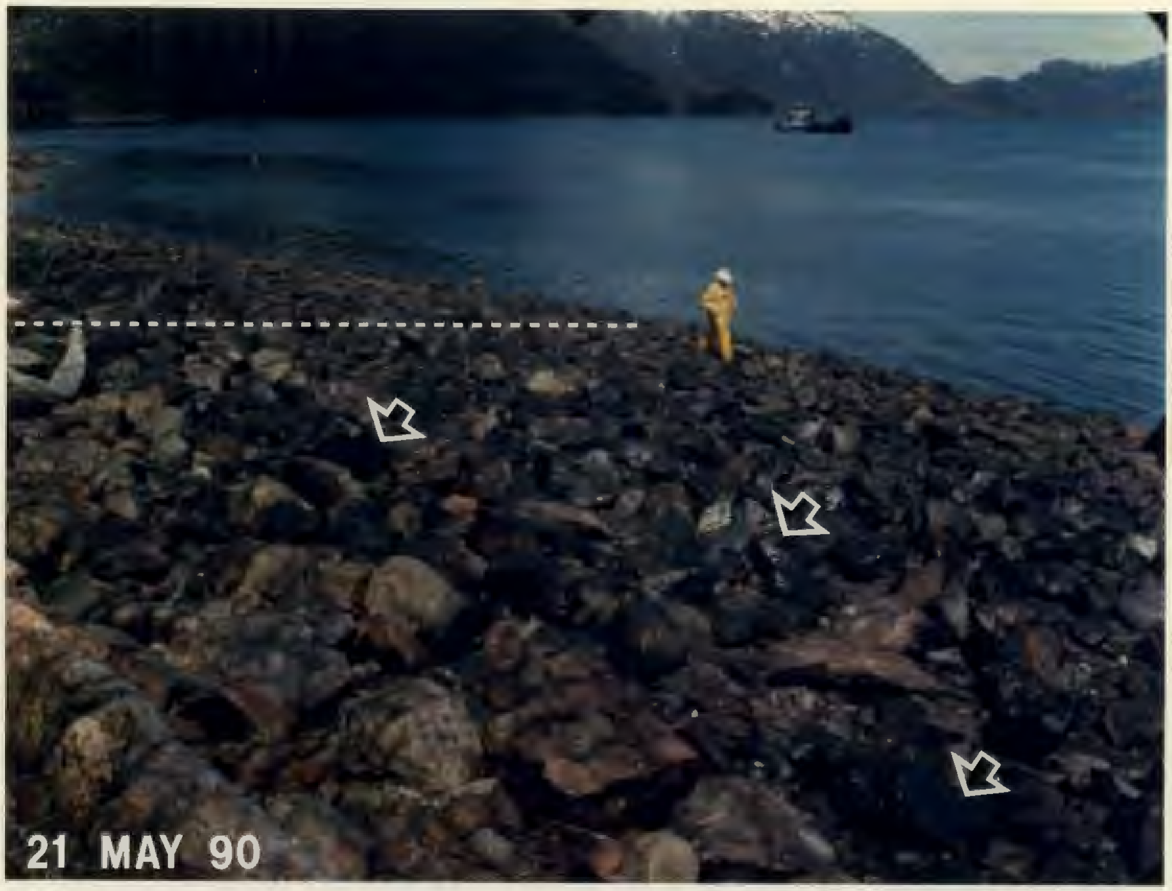
Fertilizer Pellets

Customblen pellets were consistently visible through the last day of sampling on the fertilized portions of all three beaches, although there was an apparent decrease in their abundance through time. Thirty days after the first application, none were observed on the unfertilized sections. Forty days after the second application of fertilizer, a few Customblen granules were found on the unfertilized portion of KN-132B, but none were found on the unfertilized portion of KN-211E at this time. No pellets were noted on the unfertilized portion of KN-135B following either the first or second application.

As the time since application increased, the fertilizer pellets became less obvious. Nevertheless, careful inspection invariably found them. At KN-211E, for example, pellets appeared sparse in the vicinity of the well heads as early as Day 8 (6/7/90), but pellets were noted during the sediment sampling on this and all other dates. It is likely that some pellets washed away from the more open areas surrounding the well heads, particularly on high energy sites such as KN-211E. Nevertheless, pellets often were found

FIGURE 9
(Following Page)
PHOTOGRAPH DEMONSTRATING LOSS OF SURFACE OIL AT KN-135B

The top photograph was taken at 1424 on 21 May, 1990, 54 minutes before the application of fertilizer. The bottom photograph was taken at 1136 on 22 June, 1990, 764 hours and 18 minutes after the application of fertilizer.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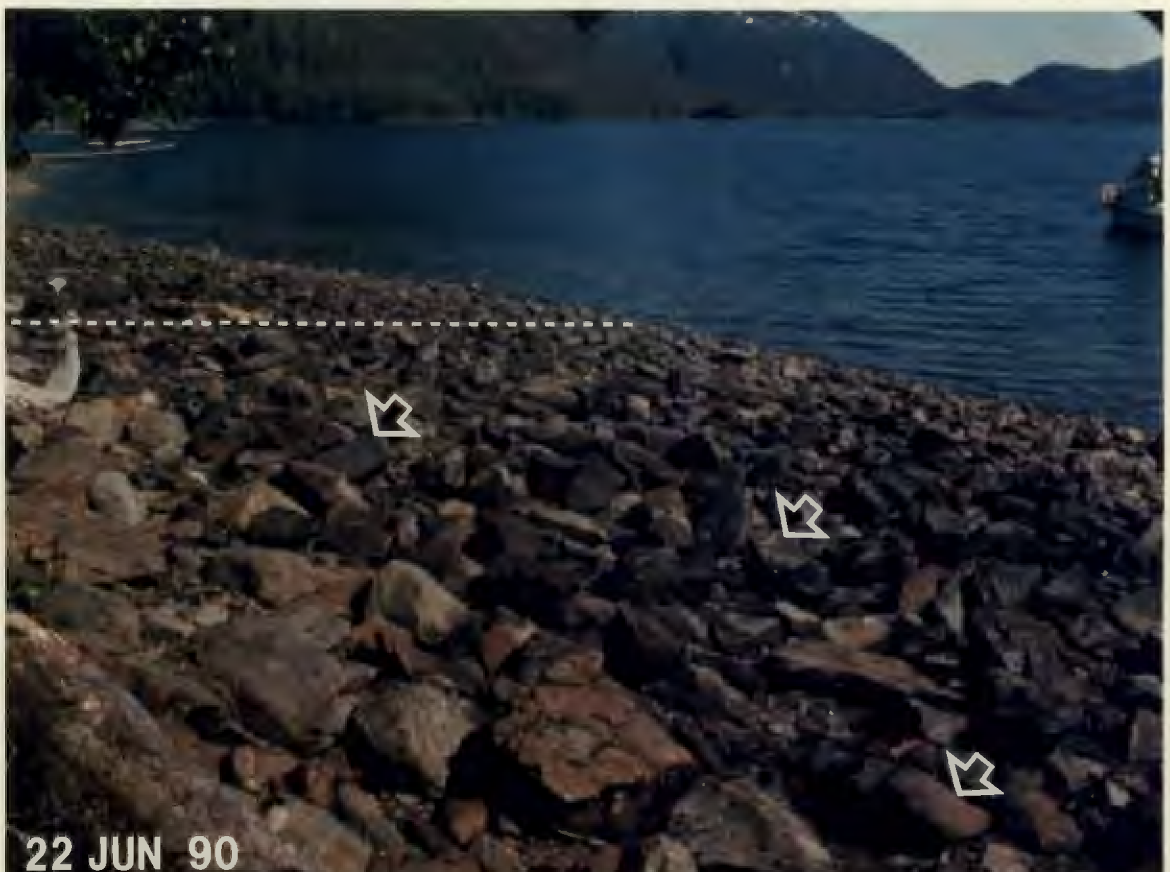
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under the large cobble armor when it was removed for sediment sampling. Pellets were noted in high concentrations in the upper intertidal areas of KN-132B and KN-135B, particularly at KN-135B on Day 32.

Fertilizer pellets appeared to remain on the surface of the beach; at no time was it noted that they were found at depth. As discussed above, pellets were frequently found beneath the larger cobbles on the beach. However, they did not appear to mix into the surface sediments subject to wave action on the beach. They were also noted adhering to the surfaces of large oiled cobble, particularly the sides of rocks with surface oiling. They apparently stuck to the overturned rocks which initially had soft oil on their lower surfaces. The Inipol EAP22 coating may have softened the oil, and further cemented the Customblen granules to the large cobble.

Oil Penetration

KN-132B was selected as a surface-oil only site since reconnaissance indicated oil penetration of 2 to 5 cm. For this reason, only surface samples of the top 0 to 5 cm were collected here. In fact, sample collection over the monitoring period showed occasional oil penetration of up to 10 cm. The degree of oiling varied a great deal at this site. In addition, it was noted that although the oiling appeared to be limited to the surface (0 to 5 cm), the actual surface of the fine-grained sediment was not always oiled. In a few cases, oiling began just below (2 cm) this surface. In other instances the overlying armor (larger pebbles and cobble) exhibited oiling, but there was little evidence of oiling in the sediment just below.

KN-135B had both surface and subsurface oiling. Oil penetration appeared to be greater than 50 cm during the initial site reconnaissance. Excavations at the end of the monitoring program indicated penetration into the fine grained sediment to a depth of 43 to 47 cm, although the transition from oiled to clean sediments was not very distinct. Subsurface samples were collected from this site at depths ranging from 26 to 36 cm, with most collected in the 28 to 30 cm range. All of these samples were collected within the depth of oil penetration on the beach.

KN-211E was selected as a high energy site with only subsurface oiling. The site has a large cobble armor that is uniform over the entire site. Reconnaissance showed oil penetration of approximately 40 cm from just below the armor. Sample collection at this site during the monitoring program revealed oil penetration to a maximum of 47 cm. Documented oil penetration actually varied from 20 to 47 cm, with sample collection occurring at depths of 17 to 35 cm. Oiling was usually apparent in the fine grained sediment immediately beneath the armor. The degree of oiling varied with depth, with some subsurface samples noted as having minimal, and others very heavy oiling.

FERTILIZER NUTRIENTS IN THE INTERSTITIAL WATER

Customblen contains ammonium nitrate and ammonium phosphate, while Inipol EAP22 contains urea and tri(laureth-4)phosphate, so the nutrients of interest were phosphate, ammonium, nitrate and urea. Ammonium was assayed as ammonia, and the amount of urea was calculated as Kjeldahl Nitrogen minus the ammonia measured in the inorganic assays. Nitrate was measured with nitrite, and the latter was then estimated individually, and the nitrate level determined by subtraction. Since the nitrite levels were very low in the initial samples (always <2 μM), this additional assay was eliminated; the nitrate plus nitrite measurements presented here are essentially nitrate alone.

The addition of fertilizer substantially increased the concentrations of available nitrogen in the interstitial water at all three sites. The data are presented in Tables 1 and 2 of Appendix D1, and are summarized in Tables 3-5 of Appendix D1. Microorganisms can utilize ammonium, nitrate, nitrite and urea as nitrogen sources; the total of these nutrients, and the contributions from the individual species, are plotted in Figures 10 to 12. Measurements after the first application indicated similar nutrient levels in samples from the surface and from the bottom of the wells, and in wells sealed except for the lowest 10 cm. Subsequent measurements were therefore made only on samples from the bottoms of the wells.

On KN-132B the total nitrogenous nutrients peaked at 340 μM on the second day after application of fertilizer in June (Figure 10). Approximately half of this was organic nitrogen, presumed to be urea from the Inipol EAP22; ammonia peaked at 103 μM and nitrate at 79 μM. Organic nitrogen dropped to zero for days 4 and 8, and then increased to 30-40 μM on the entire site until late July. This may have been due to the substantial tilling that occurred on approximately Day 15 upstream of the monitoring area, which may have liberated significant amounts of organic material into the nearshore water. These may then have become incorporated into the sediment throughout the segment. The second application used the same amount of Inipol EAP22 as the first, but only half as much Customblen. Because of the difference in compositions and application rates of Inipol EAP22 and Customblen, total nitrogenous nutrients applied to the site were thus only 86% of those applied in the first application. Nevertheless, total nitrogenous nutrient levels on the fourth day after the second application were similar to those measured four days after the first application, particularly after subtracting the 41 μM background organic nitrogen found after the second application. Levels of nitrogenous nutrient on the fertilized portion of the beach remained substantially above those on the unfertilized portion of the beach throughout the monitoring period, indicating that the fertilizer application had an effect for at least 30 days.

Figure 11 presents the nitrogenous nutrient data obtained from KN-135B. The total peaked at 383 μM on the second day after the first application, and declined to 50 μM by approximately Day 20. The application of Inipol EAP22 was at the same rate as that used on KN-132B, but the application of Customblen was three fold greater. This is reflected in the relative contributions of the different nutrients to the total; on KN-135B the inorganic nutrients are the predominant species on Day 2, together accounting for 76% of the nitrogenous nutrients. The second application used one-sixth the initial rate of Customblen, and the same amount of Inipol EAP22. This was the same as that used for the second application on KN-132B, and the measured nutrients were very similar at the two sites. Customblen was applied to the entire site on August 1 at a rate equivalent to that used on the fertilized portion of the beach in the first application, and inorganic nutrient levels on the fertilized portion of the beach 8 days after this third application were very similar to those measured 8 days after the first. Nutrient levels did not increase to this extent on what previously had been the unfertilized portion of the beach, suggesting that the application was not as effective in the area of these sampling wells, but the application still raised the total available nitrogen to this portion of the site at least ten-fold.

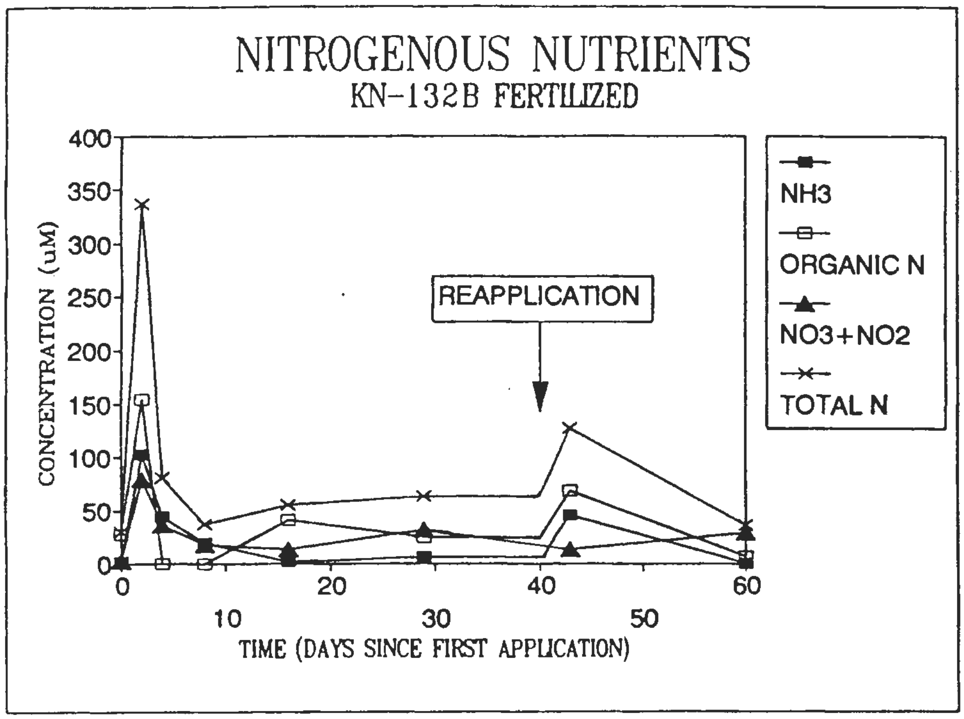
Figure 12 shows that nutrient levels in the interstitial water of KN-211E following the first application of fertilizer were only 12% of those measured on KN-135B, despite the application of similar rates of Customblen. This was most probably due to the rather densely packed beach matrix beneath the cobble armor at KN-211E, which was not disturbed during the pre-application preparation as had been done at KN-132B and KN-135B. Some evidence in favor of this notion is provided by the rather low dissolved oxygen levels in this beach (Figure 16). The much more effective second application of fertilizer, at the same application rate as the first, may perhaps be attributable to the increased permeability of the 18 disturbed areas in the vicinity of the sampling wells where sediment samples had been taken. Nevertheless, the first application of fertilizer did increase the levels of inorganic nutrients some 15-fold to at least Day 8, and following the second application this increase was some 44-fold on Day 3. A substantially increased level of nitrogenous nutrient on the fertilized portion of the beach was maintained for 45 days after this second application.

The entire segment of KN-211E received an application of Inipol EAP22 on September 8, 1990, but due to weather and tidal constraints, water samples could not be drawn from the sampling wells until 3 days later. The results of the analyses of this interstitial water are reported in Appendix D1, Table 5. In line with the findings on KN-132B and KN-135B, no organic nitrogen attributable to urea was present at this time.

Figures 10-12 indicate that the fertilizers behaved very much as predicted. Inipol EAP 22 provided a pulse of urea into the interstitial water for a few days after application, while Customblen provided a pulse of inorganic nutrients, followed by a continued slow release. Inipol EAP22 is formulated to provide nutrients at the oil:water interface by associating with the oil; as such it should release only a small portion of its nutrients into the interstitial water. While we did not measure nutrients immediately after application, the data suggest that this was indeed the case. Those nutrients that were released were distributed to at least 50 cm into the sediment. Customblen is formulated to provide a slow and continued release of nutrients; the data suggest that this was indeed achieved. The additional pulse of nutrient soon after application perhaps was due to damaged fertilizer beads, or beads with very thin coatings or pinholes. Analysis of Customblen beads collected 52 days after application indicated that they had lost approximately 80% of their nutrients by that time. Clearly the fertilizer applications were successful in providing substantial nitrogenous nutrients to at least 50 cm into the shoreline sediment at significantly elevated concentrations for at least 30 days.

It is perhaps noteworthy that there was a substantial increase in soluble organic nitrogen in mid June to early July on both fertilized and unfertilized portions of both KN-132B and KN-211E. As will be discussed below, this organic nitrogen did not stimulate microbial activity, and its source and nature is obscure. As we discussed above, the effect on KN-132B may have been correlated with upstream tilling, but no activity of this nature occurred on KN-211E.

FIGURE 10
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER
KN-132B



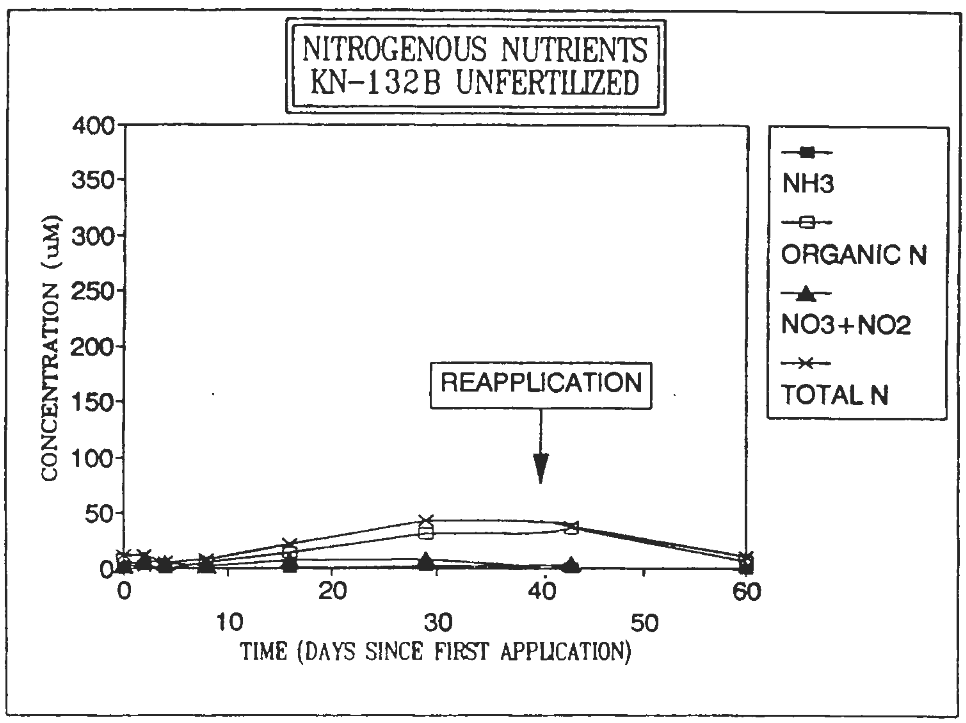
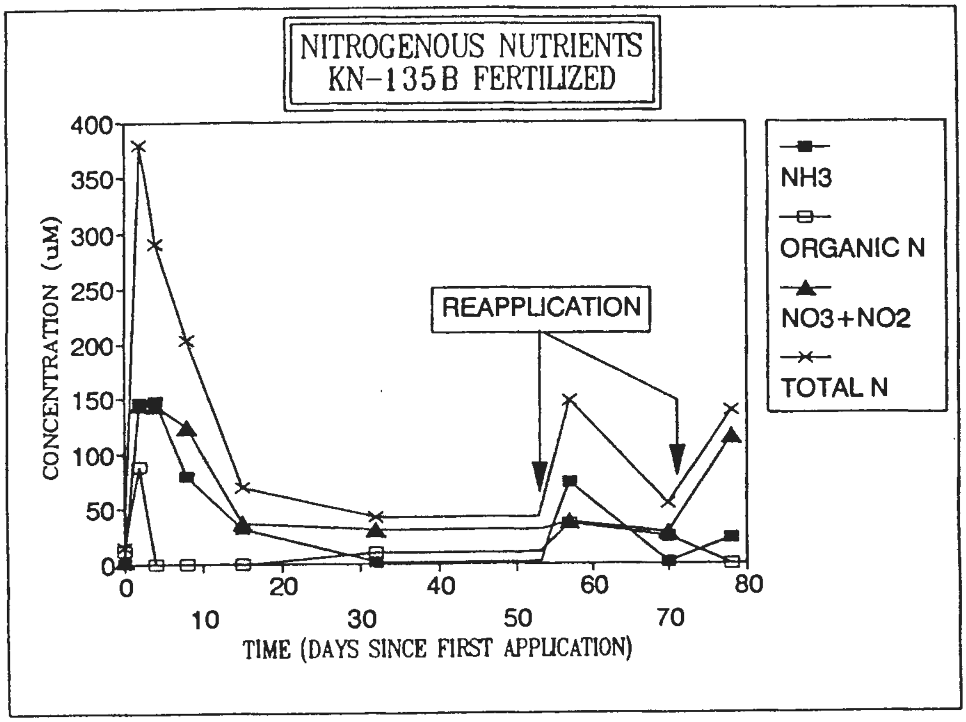


FIGURE 11
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER
KN-135B



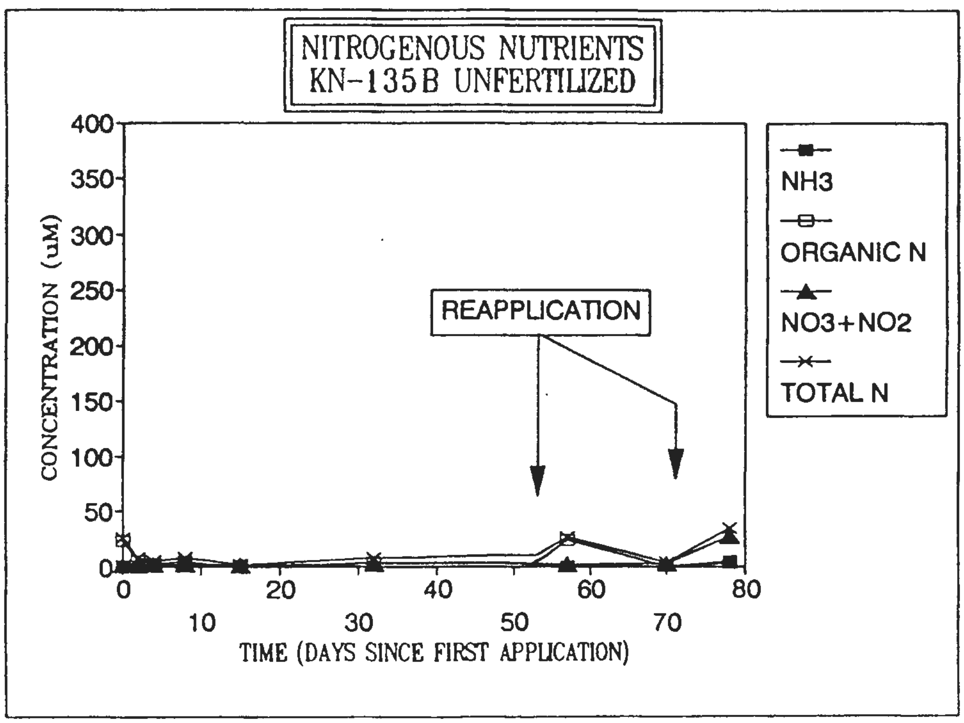
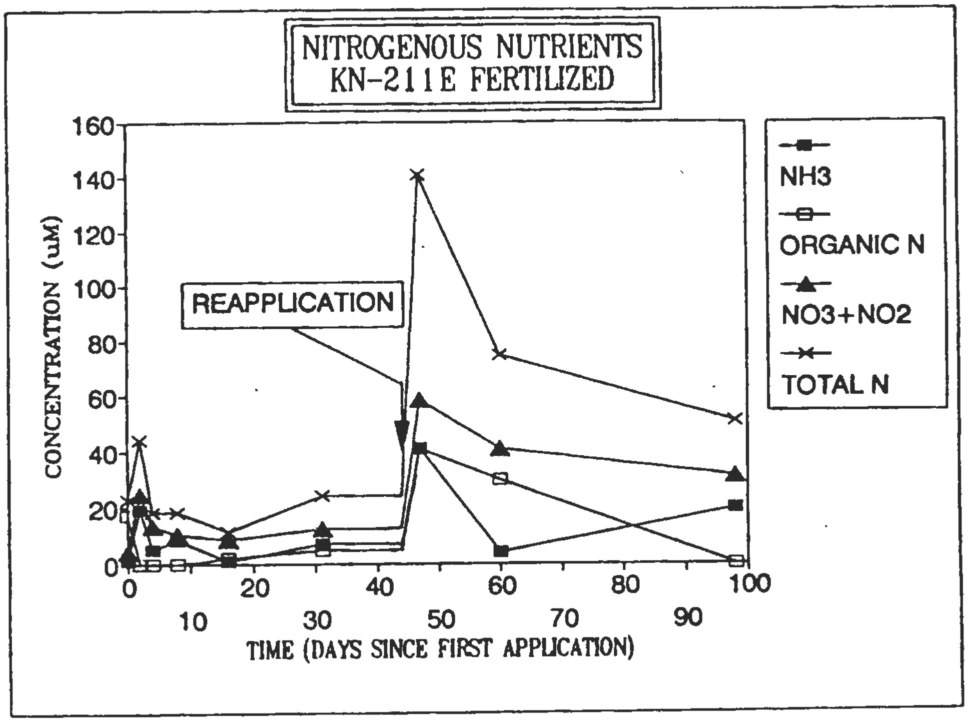


FIGURE 12
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER
KN-211E



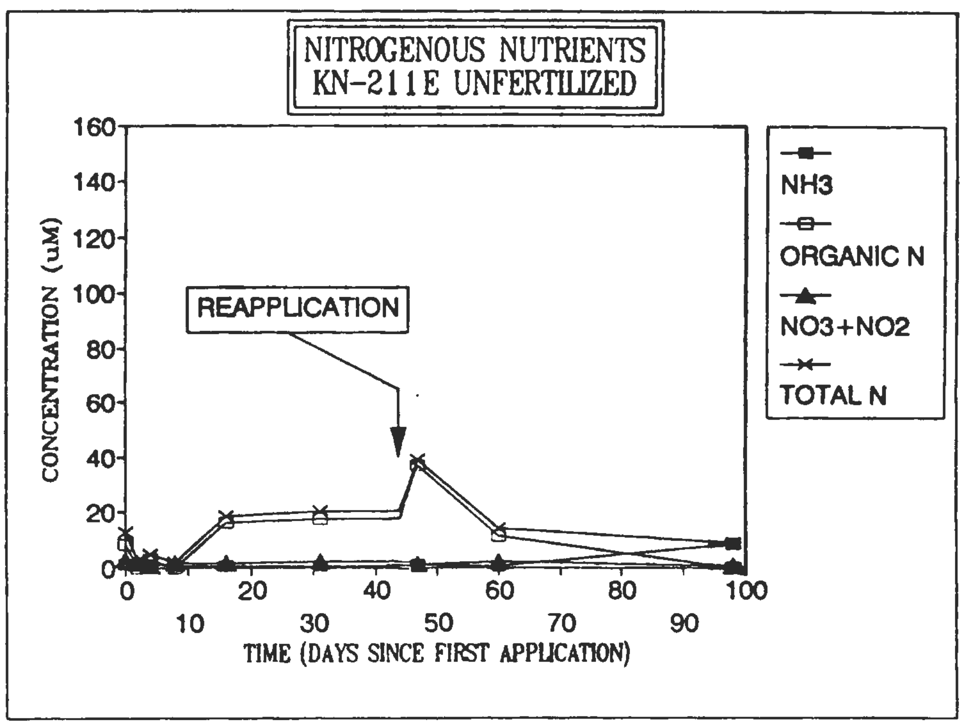
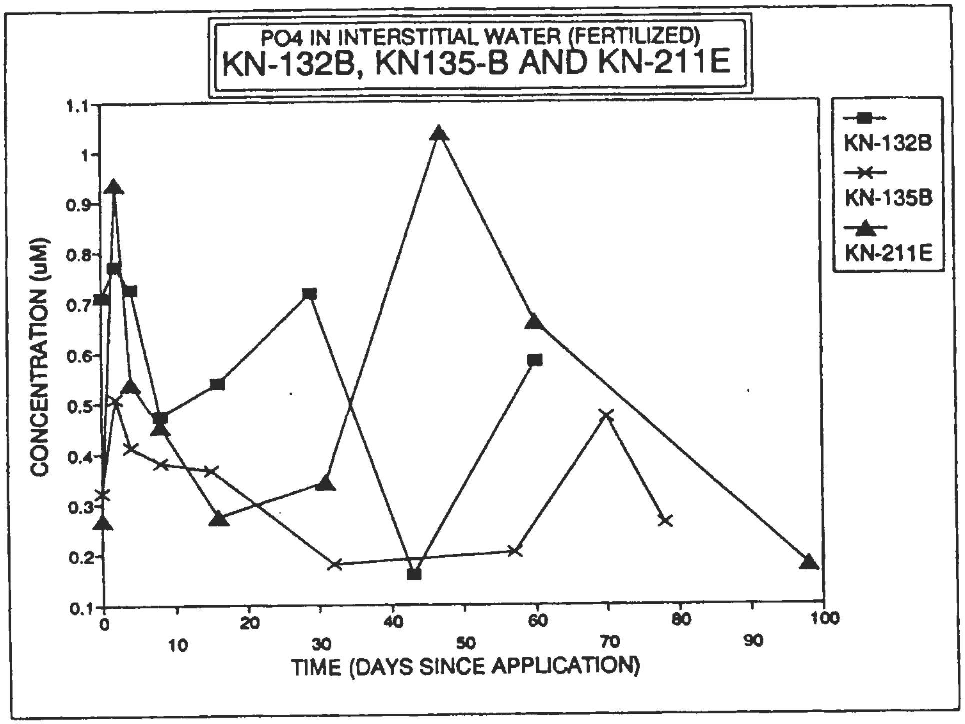
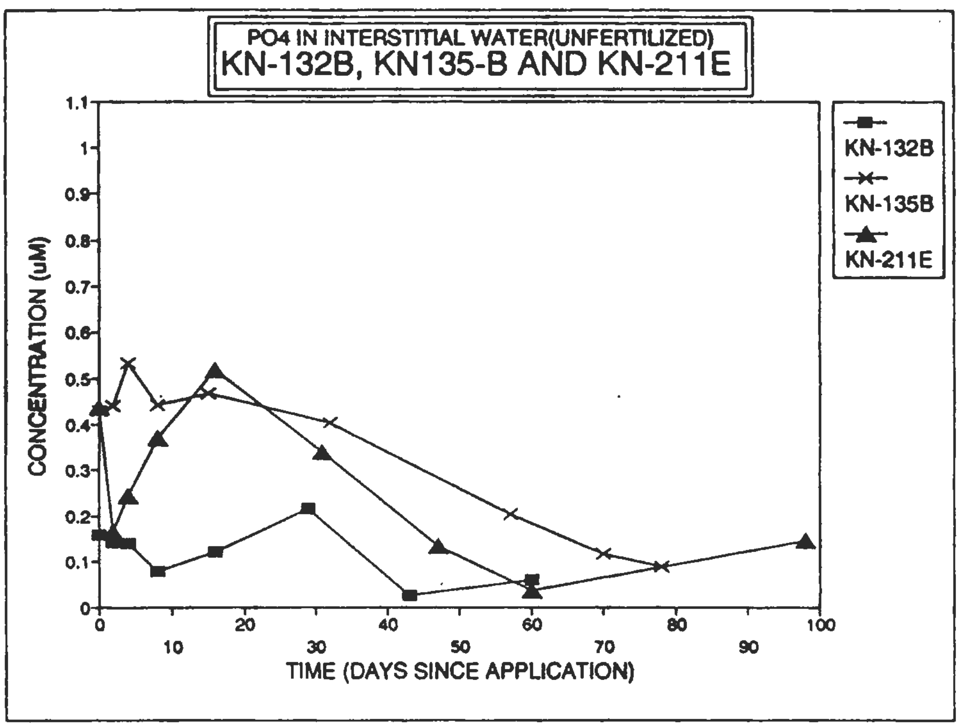


FIGURE 13
PHOSPHATE IN INTERSTITIAL WATER
KN-132B, KN-135B AND KN-211E





In contrast to the behavior of the nitrogenous components of the fertilizer, the levels of phosphate in the interstitial water only marginally increased after fertilizer application (Figure 13). This is not surprising, given the relative insolubility of phosphates in seawater due to the presence of divalent cations such as Ca^{2+}. Inorganic phosphate in Customblen probably precipitates once it leaves the Customblen vesicle, since the analysis of pellets collected 52 days after application revealed a very similar N:P ratio to that of fresh material. Nevertheless, the phosphate would be available if microorganisms depleted the soluble phosphate in the interstitial water. The phosphate in Inipol EAP22 is present as tri(laureth-4) phosphate, an organic form that may be taken up by microorganisms before release of the phosphate moiety.

DISSOLVED OXYGEN, SALINITY, TEMPERATURE AND pH IN INTERSTITIAL WATER

Tables 6-8 of Appendix D1 list the measured values of dissolved oxygen, salinity and temperature for the three sites monitored in this program, and Tables 9-11 of Appendix D1 provide average values for each site. The data are presented graphically in Figures 14-16.

The complexity of the physical and biological processes occurring in the beach suggest that conclusions based on measurements of dissolved oxygen, salinity and temperature should be tempered with caution. For example, dissolved oxygen concentrations are affected by temperature and salinity, which affect saturation capabilities. Furthermore, interstitial oxygen concentrations depend not only on the consumption of oxygen by biological processes, but also on the rate of replenishment of the interstitial water by aerated water from the Sound, from surface streams, and from other groundwater. An indication of the relative importance of freshwater sources can be seen in the dynamic range of the salinity measurements. KN-132B in particular, but all three sites to some extent, received substantial inputs of fresh water which diluted the salinity of the shoreline interstitial water. KN-132B has an obvious source, since the study site is at the mouth of a salmon stream, but all three sites receive groundwater input, especially after rain.

None of the sites showed evidence of being anaerobic before or after fertilizer application, and the measured levels were always adequate for substantial microbial respiration. Indeed, compared to water in the unfertilized portion of the beach, the dissolved oxygen on the fertilized parts of KN-132B and KN-135B were lower for several days after both the first and second application of fertilizer, suggestive of increased microbial activity following fertilizer application. This trend was not seen on KN-211E, although the dissolved oxygen measured in the fertilized portion of the beach did drop proportionally more than the drop on the unfertilized portion following each application. Taken together, the dissolved oxygen measurements provide strong, albeit indirect, evidence that microbial respiration is stimulated at depth by fertilizer application at the surface.

FIGURE 14

DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER

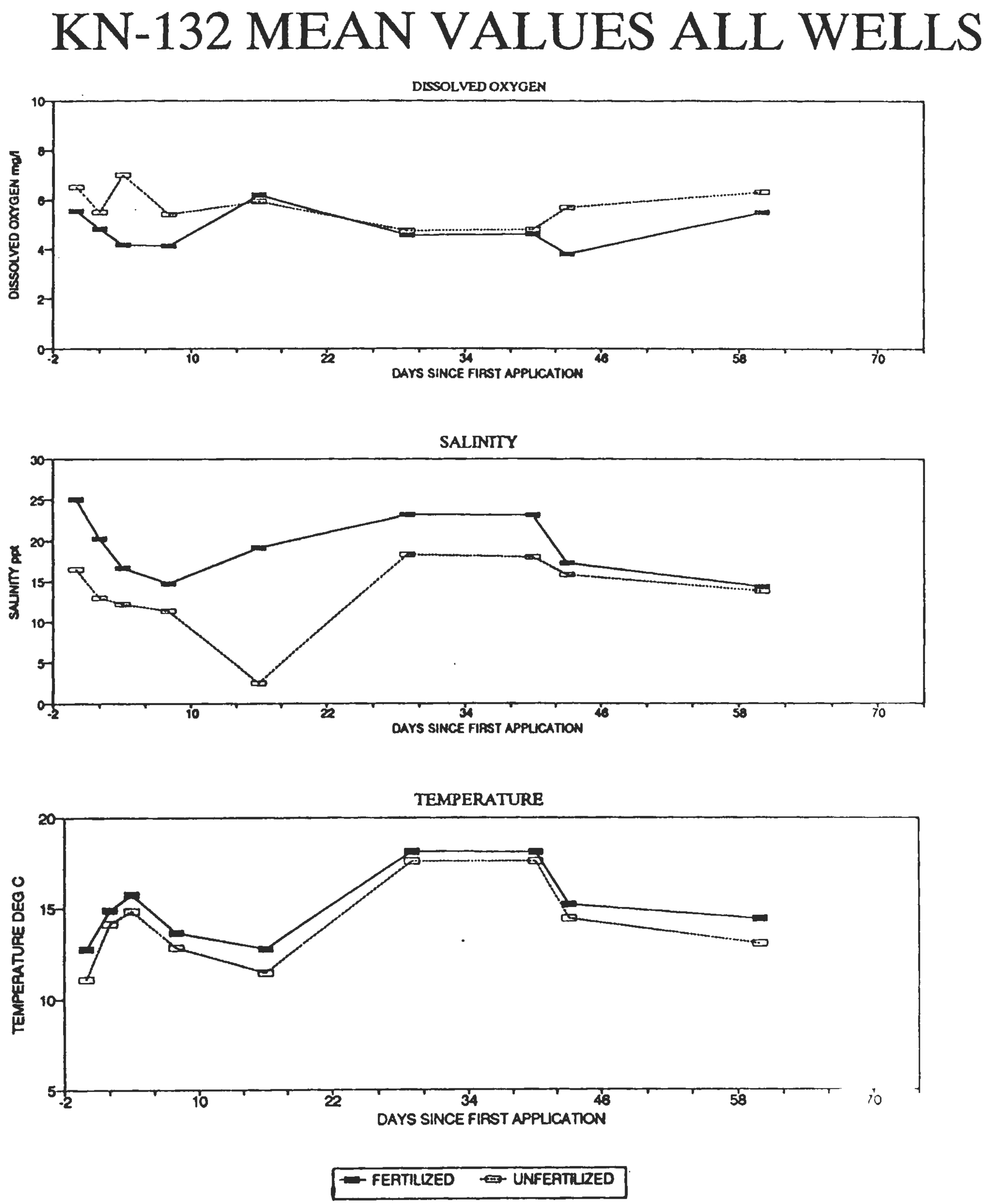


FIGURE 15
DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER

KN-135 MEAN VALUES ALL WELLS

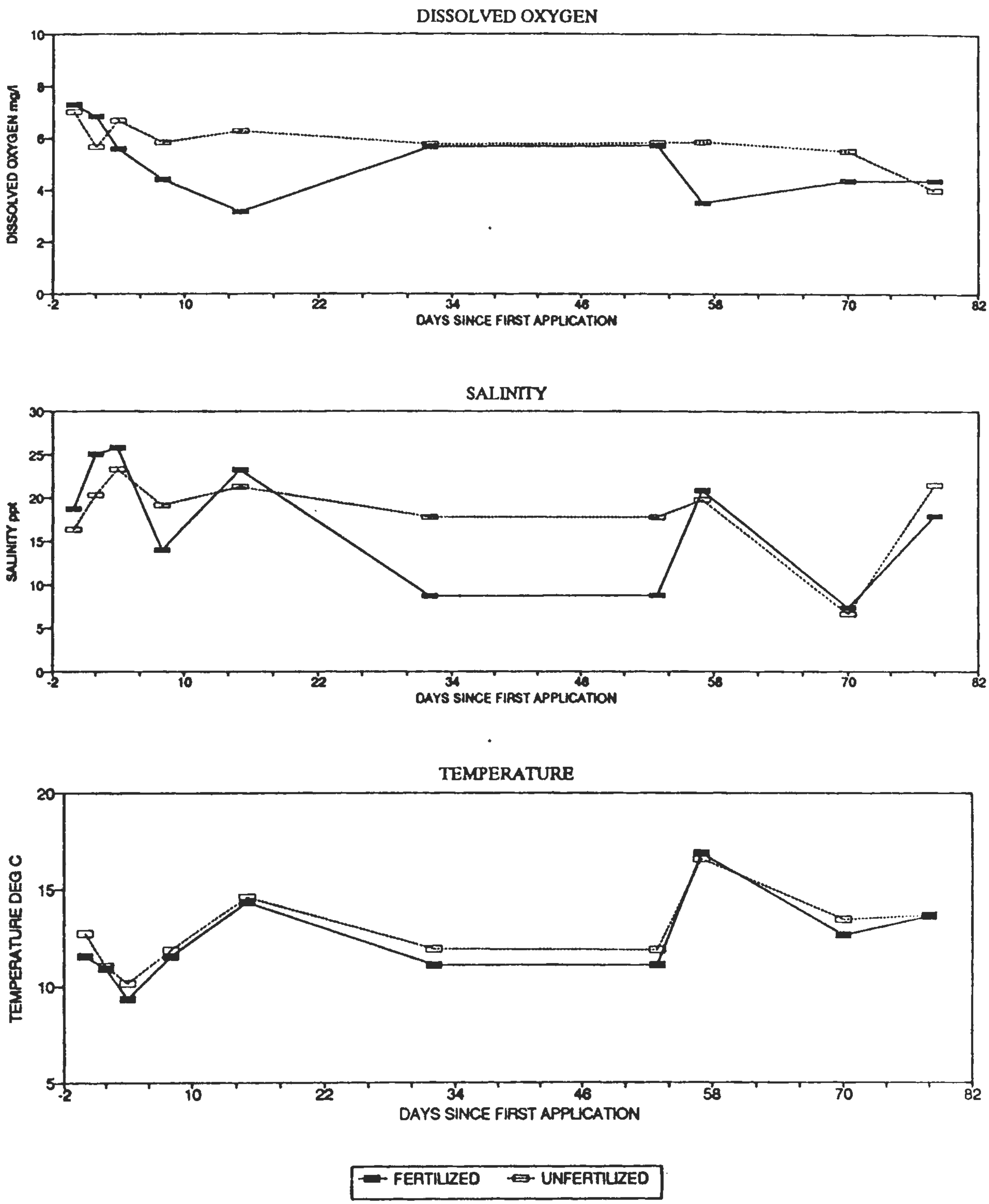
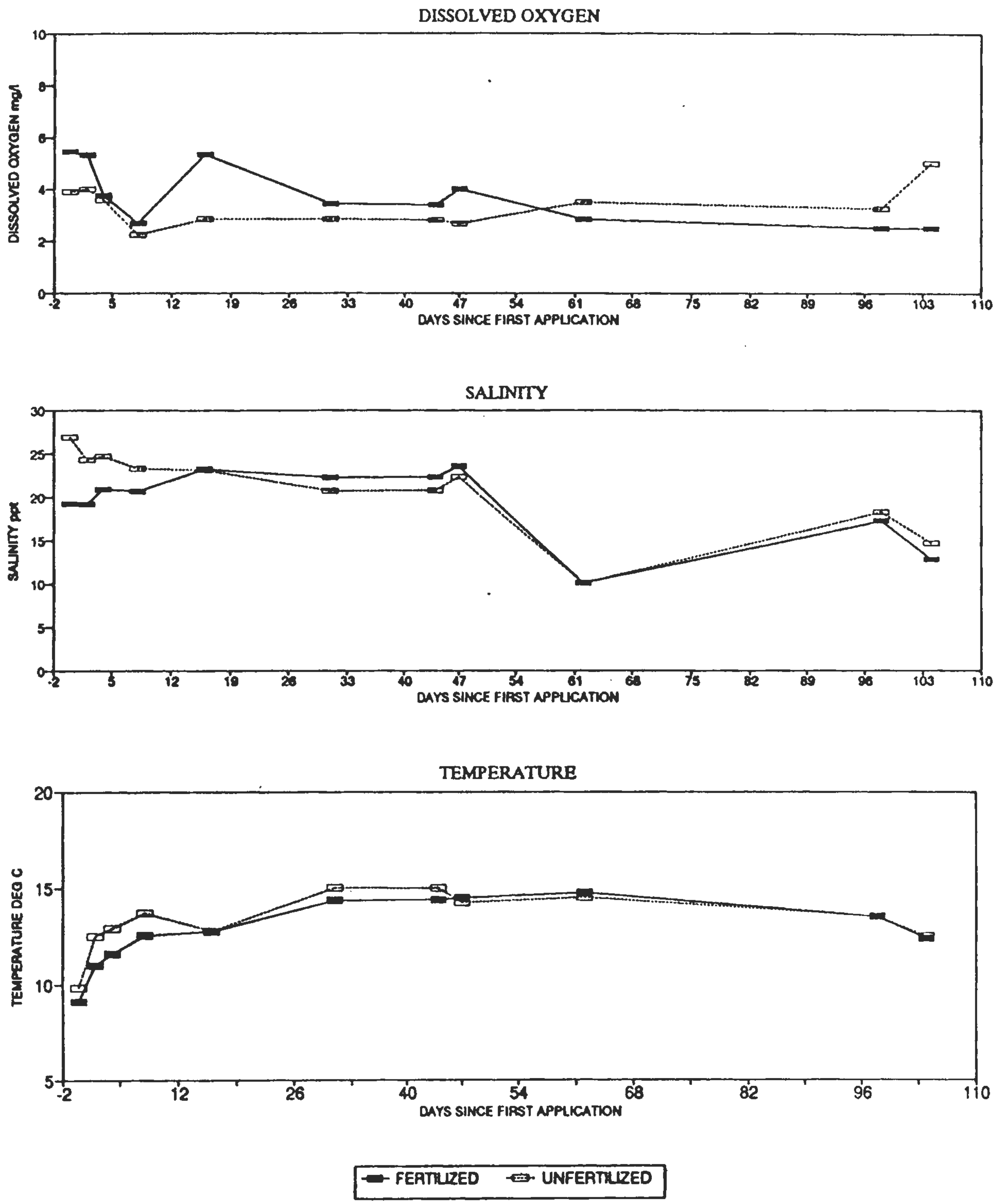


FIGURE 16

DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER

KN-211 MEAN VALUES ALL WELLS



The temperature of the interstitial water ranged from 8 to 18°C, with most values close to 15°C. As these measurements were taken during a falling tide, the range does not include potentially higher temperatures during low tides on warm, sunny days. The warmest site was KN-132B, followed by KN-211E and then KN-135B. Interpretation of the temperature changes is just as complex an issue as the salinity dynamics, and the two are interrelated. The temperatures observed in the field provide a justification for the use of 15°C as an appropriate laboratory temperature for mimicking field conditions.

Measurement of the pH of the interstitial water was begun on the last scheduled day of sampling at each site before the second application of fertilizer, and continued as a monitoring parameter through the end of the program whenever interstitial water was analyzed. The data are presented in Table 12 of Appendix D1. There were no consistent differences between samples collected on fertilized and unfertilized portions of the sites. The values range from 6.9 to 7.9, in the range expected for marine systems with some freshwater input. Measurements of offshore water varied from pH 8.0 to 8.4, as expected for seawater, while the pH of a small stream discharging onto KN-211E was 7.3. There is no evidence that fertilizer additions or enhanced microbial activity changed the pH of interstitial water.

MICROBIOLOGY

The rationale of the fertilizer applications in Prince William Sound and the Gulf of Alaska was that they would stimulate the metabolism of the indigenous oil-degrading microorganisms. This would be reflected by changes in the rate of hydrocarbon degradation, and perhaps by an increase in the number of microbes.

Microbial oil degradation activity was measured by radiorespirometry. The microbes were provided with a ^{14}C-radiolabelled hydrocarbon, and microbial metabolic activity was assessed by measuring the amount of ^{14}C-radiolabelled carbon dioxide that was produced. This is thus an assay of the mineralization of the substrate. Since the various components of crude oil are biodegraded at different rates by the microbial population, hexadecane was used as a representative paraffin, and phenanthrene was used as a representative polynuclear aromatic compound.

Microbial populations were enumerated by standard Most Probable Number (MPN) techniques; these are repetitive serial dilutions of a sample until no organisms can be detected. The total aerobic heterotrophic microbial population was estimated using a marine broth as the growth substrate. To assess that portion of this population that could degrade hydrocarbons, the assay was repeated using weathered crude oil as the growth substrate.

Mineralization of Hexadecane and Phenanthrene.

The results of the biomineralization assays are presented in Appendix D2 Tables 1,2 and 3. As discussed in the Introduction, this program was designed to assess the efficacy of bioremediation by comparing treated areas that differed only in that one received fertilizer while the other did not. The mineralization data are presented in Figures 17-21 as mean percentage CO_2 produced by the fertilized and unfertilized samples in the assay (i.e. mineralization activities). To allow comparison of the relative activities of hydrocarbon mineralization between fertilized and unfertilized areas, the data are also expressed as the ratio of activities on the fertilized versus unfertilized plots.

Within two weeks of the initial application, at every site, both at the surface and at the subsurface, and with hexadecane and with phenanthrene, the mineralization activity in samples from the fertilized portion was substantially increased over that in samples from the unfertilized area. The figures show elevated activity ratios generally increasing with time, with high values sustained over several weeks. The following table (Table 2) provides an estimate of the approximate relative enhancement of mineralization activity achieved and sustained from two weeks following the initial fertilizer application until the last sample taken before the second application.

TABLE 2
RELATIVE ENHANCEMENT OF HYDROCARBON BIOMINERALIZATION ACTIVITY FOLLOWING FIRST FERTILIZER APPLICATION

	Hexadecane		Phenanthrene	
	Surface	Subsurface	Surface	Subsurface
KN-132B	3-fold	-	3-fold	-
KN-135B	4-fold	5-fold	4.5-fold	4-fold
KN-211E	1.3-fold	3-fold	1.5-fold	1.3-fold

Reapplication of fertilizer to the test plots caused a further increase in the mineralization activities measured in sediments from the fertilized area on KN-135B, and sustained the activity in sediments from the fertilized areas of KN-132B and KN-211E. While the mineralization activities (as measured by %CO_2 evolved) in sediments from the fertilized areas increased slightly, or remained at a steady level after reapplication of fertilizer, the activity ratios (F/U in Figures 17-21) at some sites showed a more marked change. This is illustrated in the following table (Table 3).

TABLE 3
RELATIVE ENHANCEMENT OF HYDROCARBON BIOMINERALIZATION ACTIVITY FOLLOWING SECOND FERTILIZER APPLICATION

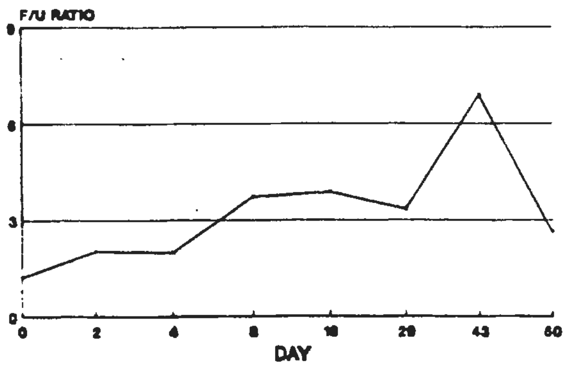
	Hexadecane		Phenanthrene	
	Surface	Subsurface	Surface	Subsurface
KN-132B	4.5-fold	-	2-fold	-
KN-135B	10-fold	15-fold	4-fold	4.5-fold
KN-211E	4-fold	5-fold	10-fold	3-fold

Figures 18 and 19 include data from six days after the third application at KN-135B, which was of Customblen to the entire site, both the previously fertilized and previously unfertilized portions. While the sediments from the original fertilized plot showed little change in activity (i.e. %CO_2 evolved), the previously unfertilized area exhibited increased mineralization activity. Thus, with the activities becoming more similar, the activity ratio (F/U) decreased.

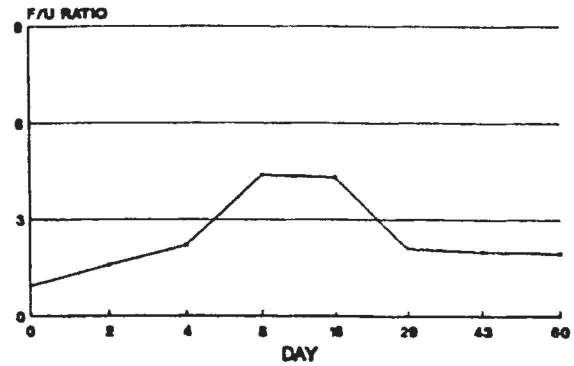
FIGURE 17

HEXADECANE AND PHENANTHRENE BIOMINERALIZATION ACTIVITY: KN-132B

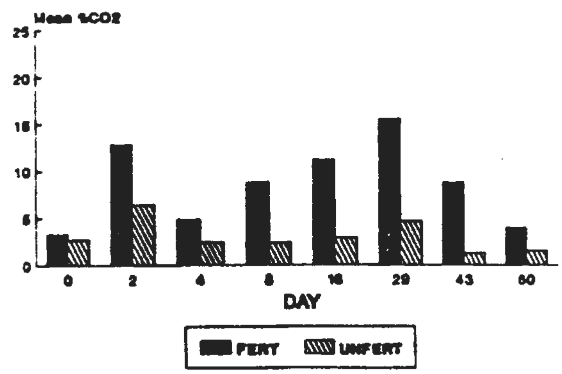
KN132B HEXADECANE MINERALIZATION RATIO
FERTILIZED/UNFERTILIZED SURFACE



KN132B PHENANTHRENE MINERALIZATION RATIO
FERTILIZED/UNFERTILIZED SURFACE



KN132B HEXADECANE MINERALIZATION
SURFACE SEDIMENTS



KN132B PHENANTHRENE MINERALIZATION
SURFACE SEDIMENTS

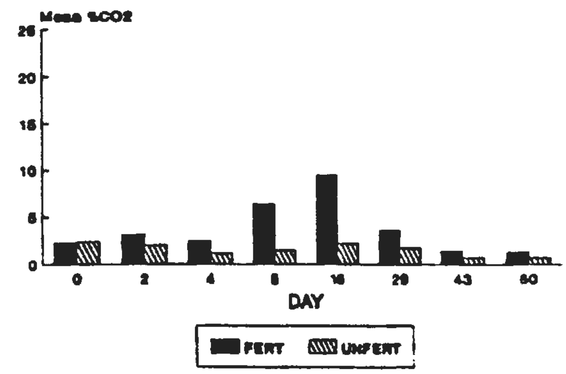
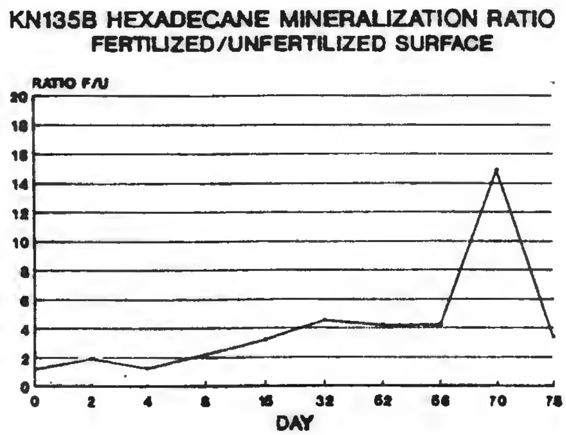
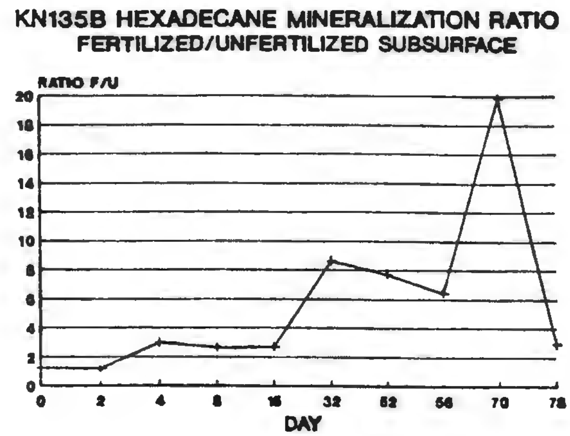
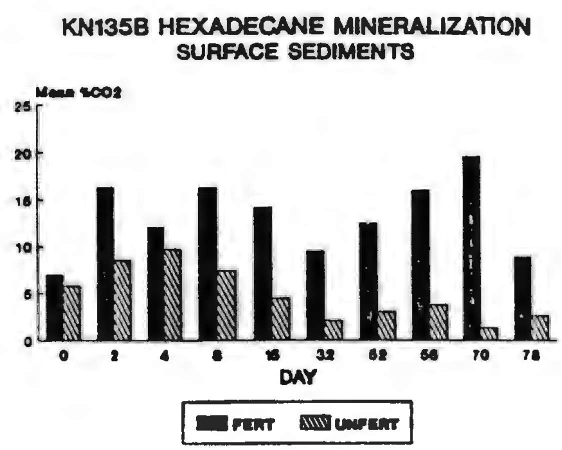


FIGURE 18

HEXADECANE BIOMINERALIZATION ACTIVITY: KN-135B







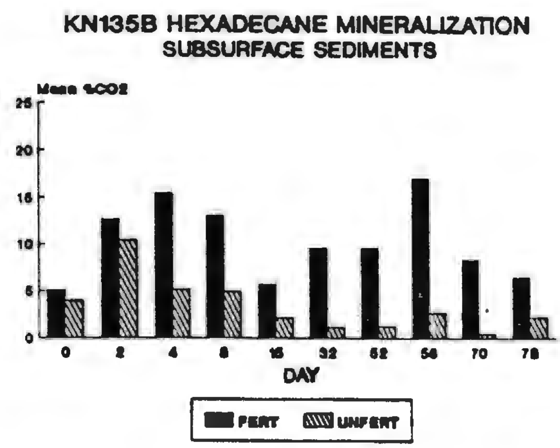
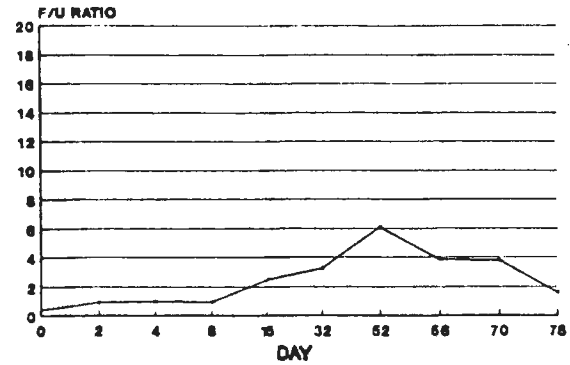
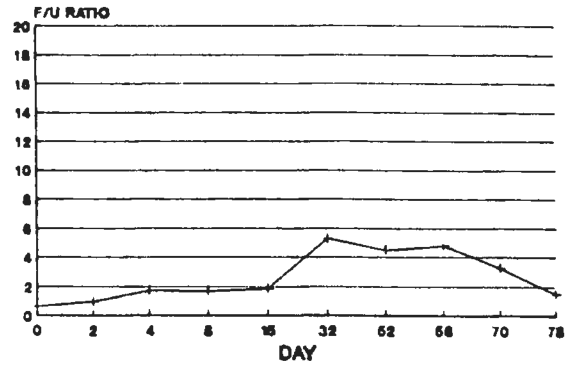


FIGURE 19
PHENANTHRENE BIOMINERALIZATION ACTIVITY; KN-135B

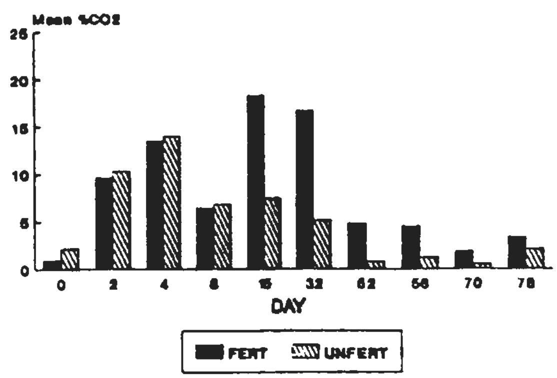
KN135B PHENANTHRENE MINERALIZATION RATIO
FERTILIZED/UNFERTILIZED SURFACE



KN135B PHENANTHRENE MINERALIZATION RATIO
FERTILIZED/UNFERTILIZED SUBSURFACE



KN135B PHENANTHRENE MINERALIZATION
SURFACE SEDIMENTS



KN135B PHENANTHRENE MINERALIZATION
SUBSURFACE SEDIMENTS

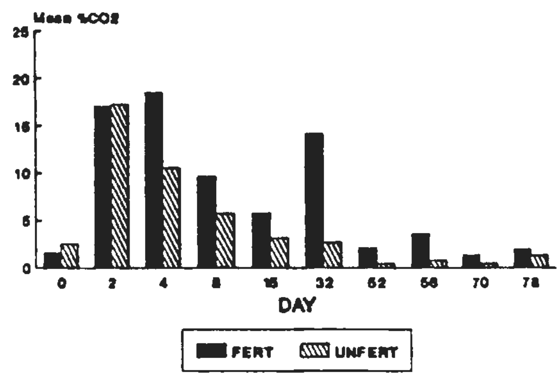
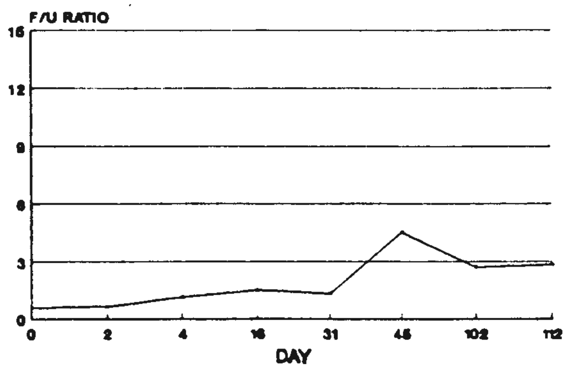
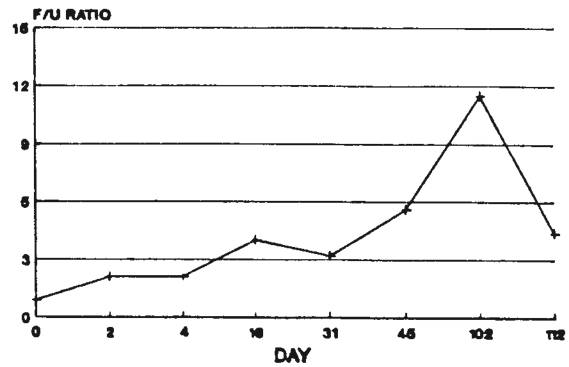


FIGURE 20
HEXADECANE BIOMINERALIZATION ACTIVITY: KN-211E

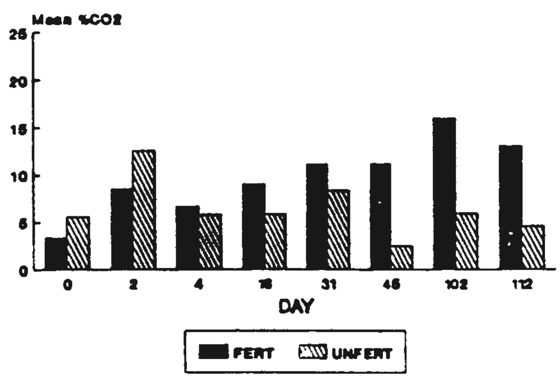
KN211E HEXADECANE MINERALIZATION RATIO
FERTILIZED/UNFERTILIZED SURFACE



KN211E HEXADECANE MINERALIZATION RATIO
FERTILIZED/UNFERTILIZED SUBSURFACE



KN211E HEXADECANE MINERALIZATION
SURFACE SEDIMENTS



KN211E HEXADECANE MINERALIZATION
SUBSURFACE SEDIMENTS

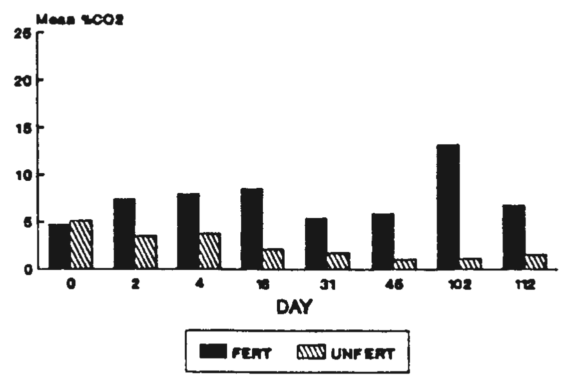
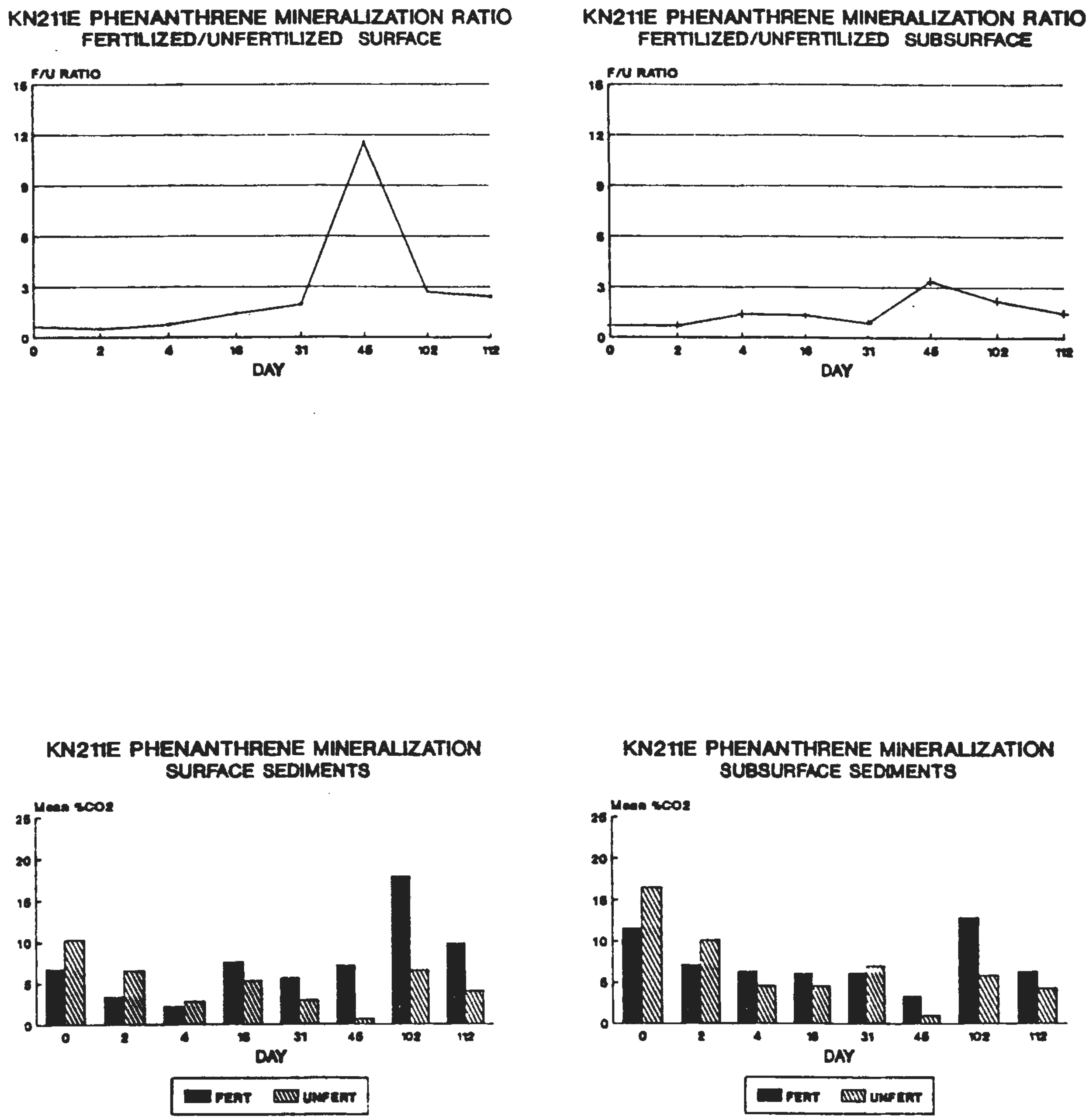


FIGURE 21

PHENANTHRENE BIOMINERALIZATION ACTIVITY: KN-211E



A similar response was seen on KN-211E; reapplication of fertilizer to the fertilized area on Day 44 caused a marked increase in nitrogenous nutrients (Figure 12) and a marked increase in the microbial activity ratio (Figures 20 and 21). Application of fertilizer to the entire beach several weeks later decreased the difference in measured activities, resulting in a decrease in the activity ratios.

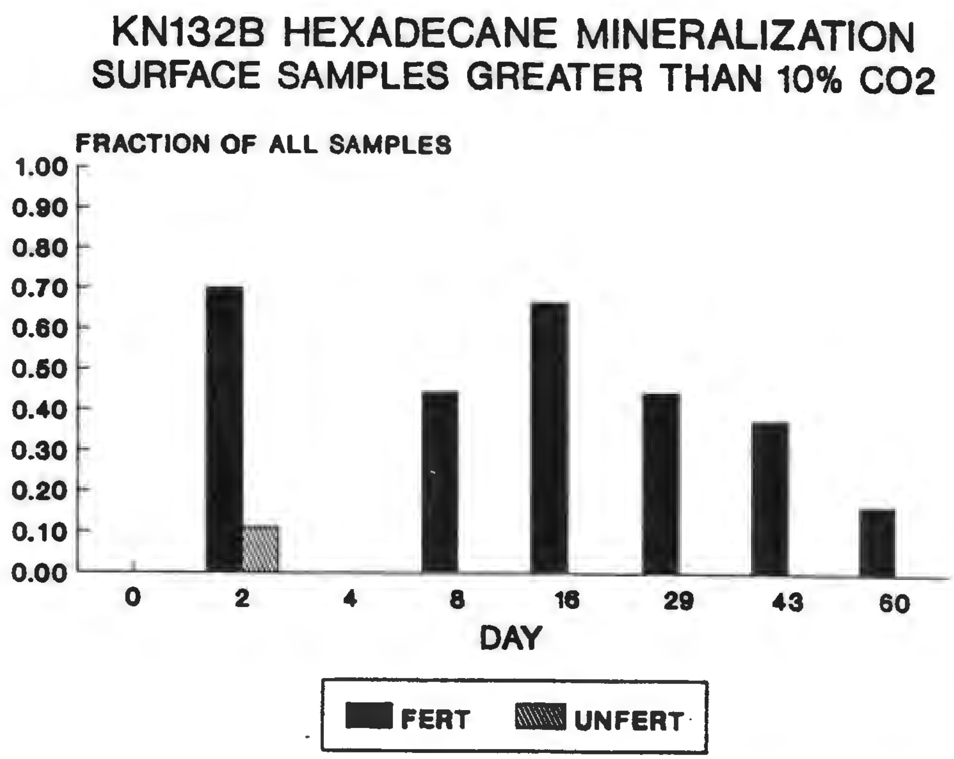
The marked change in ratios of mineralization activity illustrates both the benefits and drawbacks of relying exclusively on the ratio of activities as the primary metric of success of bioremediation. The dramatic increases of 10-15 fold at some of the sites is as much due to decreased activity in sediments from the unfertilized areas as it is to increases in sediments from the fertilized areas. The decrease in mineralization activity on unfertilized areas might be due to increased predation on the microbial population, or perhaps to increased competition for the low levels of indigenous nitrogenous nutrients, as the summer proceeds. In any case it highlights the complexity of the microbial ecosystem dynamics in the intertidal zone, and cautions of the danger of reading too much into the mineralization ratio. Nevertheless, it is clear that the application of fertilizer stimulates mineralization activity compared to that seen in the unfertilized area. The variability inherent in the data precludes the generation of a precise figure for the level of enhanced microbial mineralization over background levels. The elements of the ratio each have substantial associated variances, giving the ratio a high standard error.

Averaging all samples from a given time and treatment, as presented in Figures 17-21, yields the high standard deviations expected from the heterogeneous environment samples. An alternative approach is presented in Figures 22-24, which show the fraction of all samples collected from the fertilized and unfertilized portions of each site which exhibit a certain amount of mineralization activity. Thus, even though the range of activities for a given site and treatment may be large, the data are still comparable among sediments from fertilized and unfertilized areas without the attendant uncertainties generated by high standard deviations. Hexadecane mineralization activities were generally higher than those for phenanthrene, and this fact determined the threshold values for mineralization used in the figures. Table 4 in Appendix D2 contains the data on the fractions of all samples showing greater than 2%, 5%, 10% and 15% mineralization, the percentages used varying with the hydrocarbon substrate.

Figure 22 shows that very few of the samples collected from the unfertilized portion of KN-132B showed the degree of mineralization activity exhibited on the fertilized portion of the site. Overall, 40% of all samples collected following the first fertilizer application showed >10% hexadecane mineralization, compared with only 2% from the unfertilized area. For phenanthrene mineralization activity, 29% of samples from the fertilized area showed substantial activity compared to 1% from the unfertilized area. Figures 23 and 24 show similar data for KN-135B and KN-211E; by two weeks into the study, the fertilized area samples showed much more hydrocarbon biodegradation activity than those from the unfertilized areas. Overall, 65% of surface and 52% of subsurface samples from the fertilized portion of KN-135B showed high hexadecane mineralization activities, compared to 11% and 8% for corresponding

FIGURE 22

FRACTION OF SAMPLES EXHIBITING HIGH RATES OF BIOMINERALIZATION: KN-132B



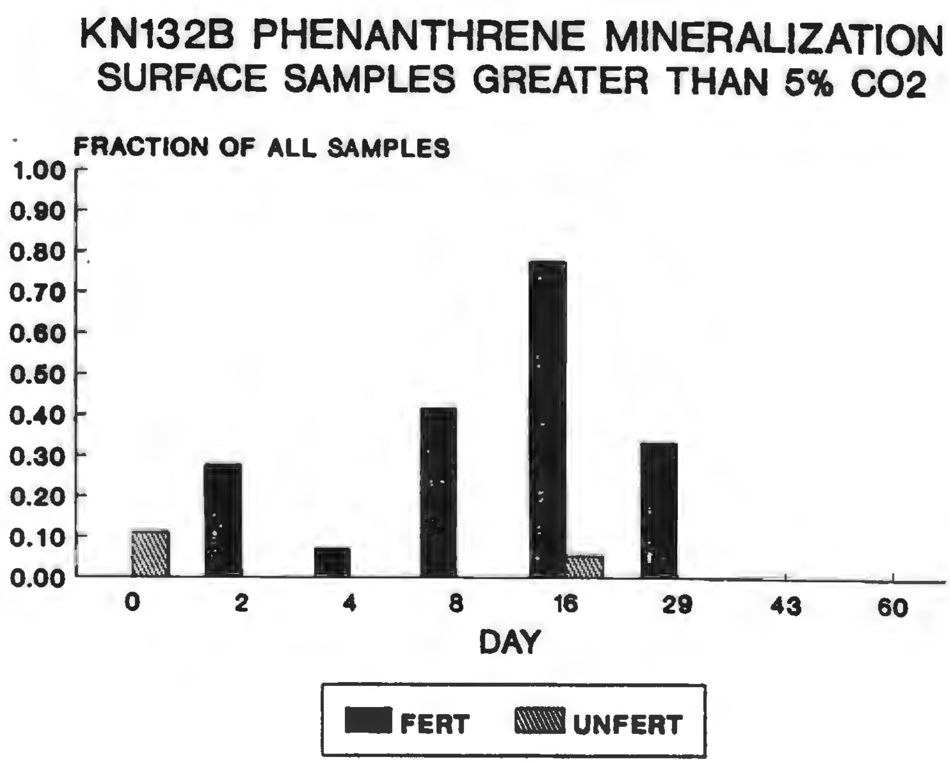
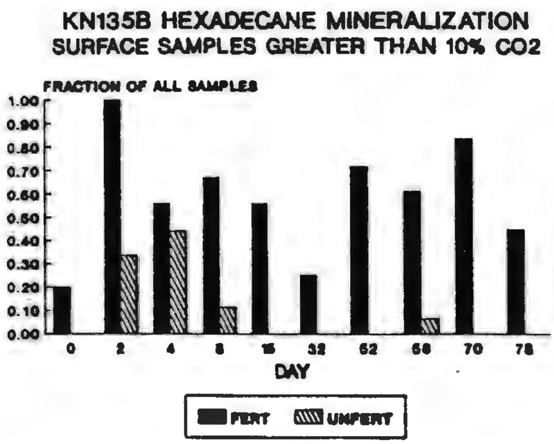
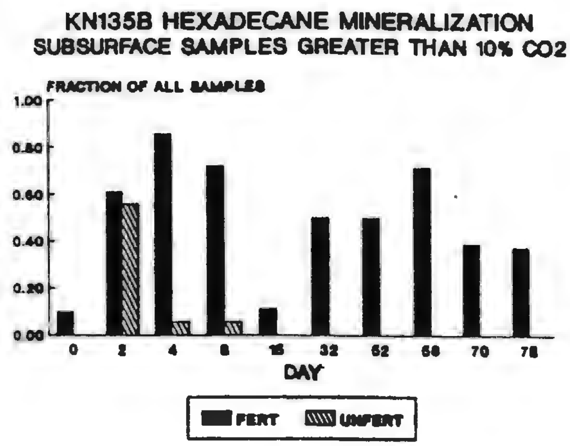
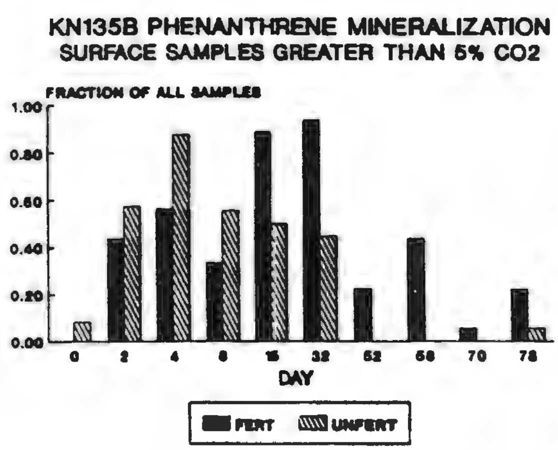


FIGURE 23

FRACTION OF SAMPLES EXHIBITING HIGH RATES OF BIOMINERALIZATION: KN-135B







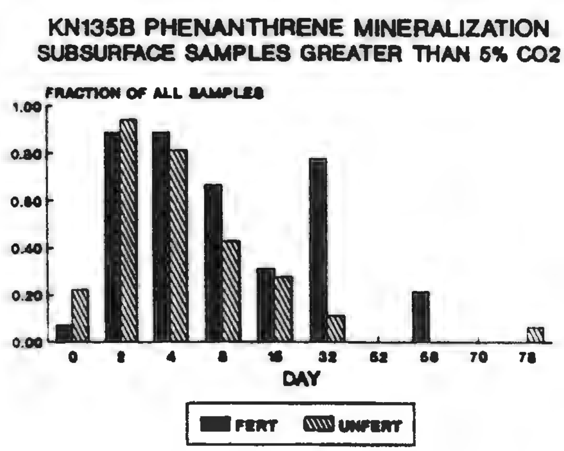
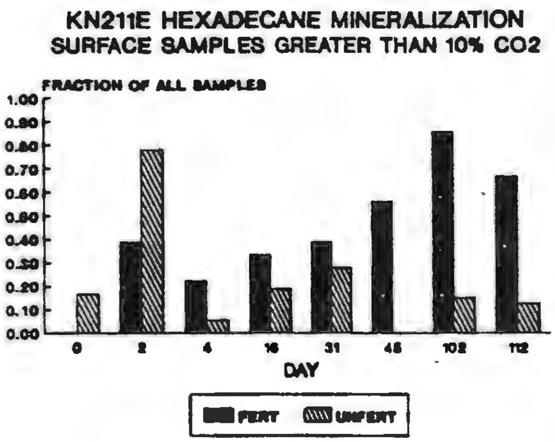
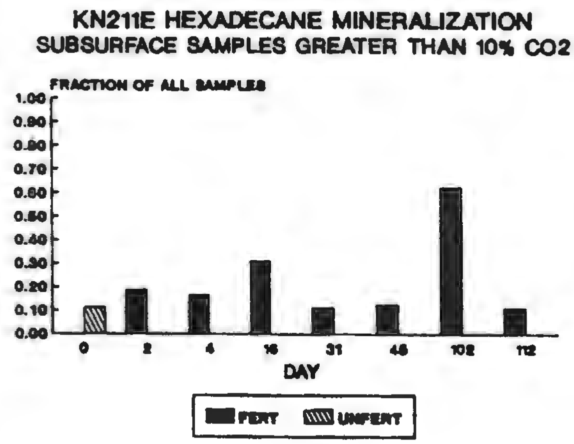
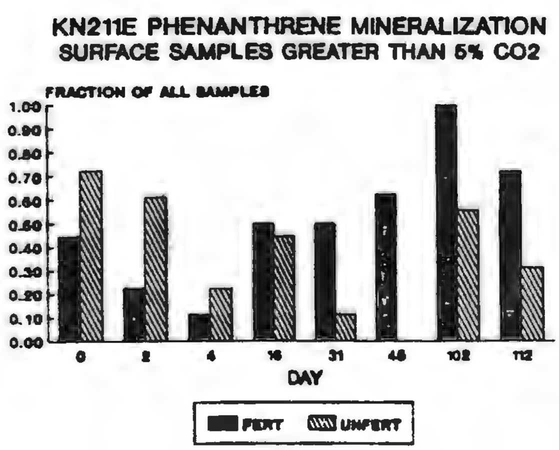


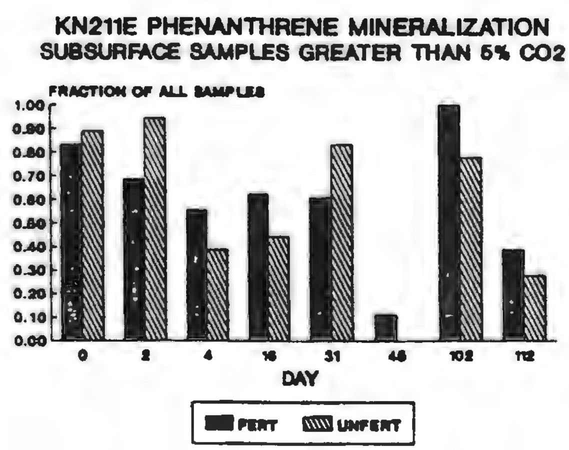
FIGURE 24

FRACTION OF SAMPLES EXHIBITING HIGH RATES OF BIOMINERALIZATION: KN-211E









samples from the unfertilized portion. While 29% of the subsurface samples from the fertilized portion of KN-211E showed >10% hexadecane mineralization in our assays, none of those collected from the subsurface of the unfertilized area showed such high activity.

Enumeration of Microbes

The most probable numbers (MPN) of heterotrophic and oil-degrading microbes are presented in Appendix D2, Table 5. As with the mineralization assay, the numbers generated from the enumeration assay reflect the variability of the environment sampled. Since the range of numbers from a given site and treatment is so large, the median of all MPN values generated for each set of samples is presented in Figures 25-27.

The initial populations of heterotrophic and oil-degrading microorganisms within the two areas of each site were similar, and both populations changed by approximately an order of magnitude during the study, which is close to the resolution of the technique. Of course the size of the microbial populations depends on more than nutrient levels, and comparisons between sites are complicated by the lack of knowledge of the abundance of predatory organisms that consume the bacteria, and are themselves consumed by ever higher trophic levels. Nevertheless, there is a general trend that the fertilized portions of the sites had more oil-degrading and heterotrophic bacteria than the unfertilized portions, especially on the surface at KN-132B and in the subsurface of KN-135B. Little change was seen on KN-211E.

OIL ANALYSES

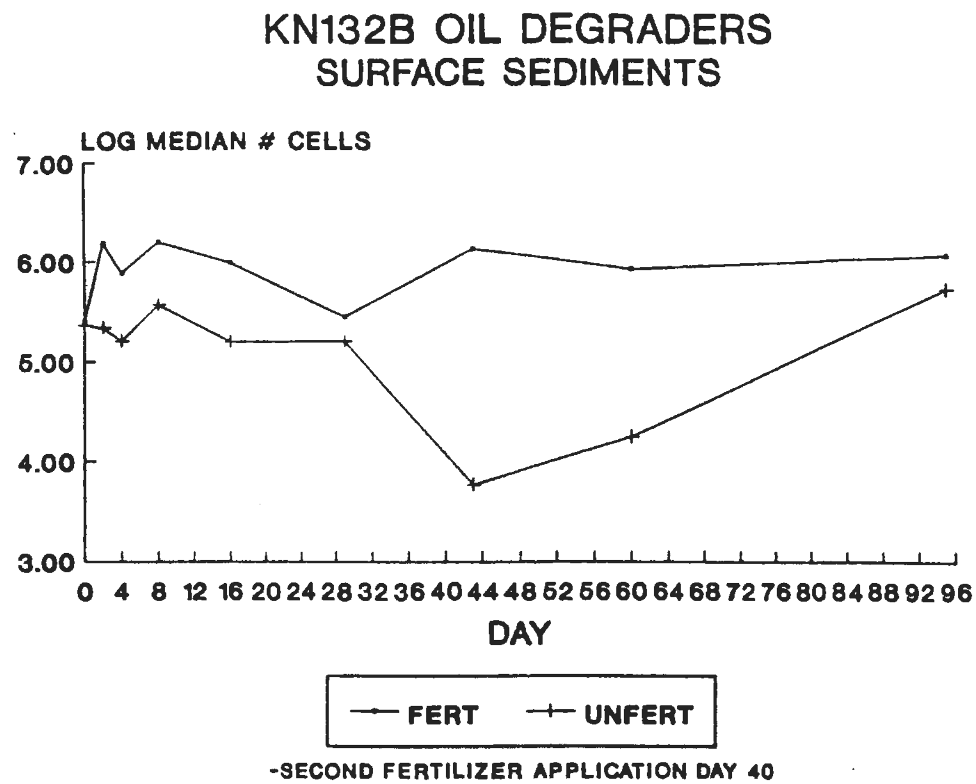
Gravimetric Analyses

Oil was extracted from the sediments using a methylene chloride : acetone mix as outlined in Section 5 of Appendix SOP. An unexpected problem arose in subsequent analyses, however, when it was discovered that silt, probably glacial flour in the micron range, was being entrained in the solvents, and was contributing to gravimetrically determined oil weights. An additional filtration step, using a glass fiber filter with a 99.98% efficiency of filtering 0.3 μm particles, was therefore introduced. Table 4 demonstrates the effect of this additional filtration for the Day 0 samples from KN-132B. Control experiments with standard oils indicated that the filtration did not remove any oil components.

The different samples had different amounts of filterable material; in this case an average of 45% of the unfiltered weight being sediment. Results of similar analyses on sediments from KN-135B and KN-211E are presented in Section 1 of Appendix D3. Filtration was included in the processing of all the samples discussed below.

Tables 5, 6 and 7 list the Total Extractable Hydrocarbon concentrations in individual sediment samples from KN-132B, KN-135B and KN-211E for initial sampling dates (Day 0) and for dates before (Day 29-32) and after (Day 60 and beyond) the second fertilizer application. Neither the means nor the medians demonstrate a clear trend with time, and indeed the standard deviations are so large that they indicate that the data do not follow a normal distribution, and must be analyzed using different statistical approaches.

FIGURE 25
BACTERIAL POPULATIONS ON KN-132B



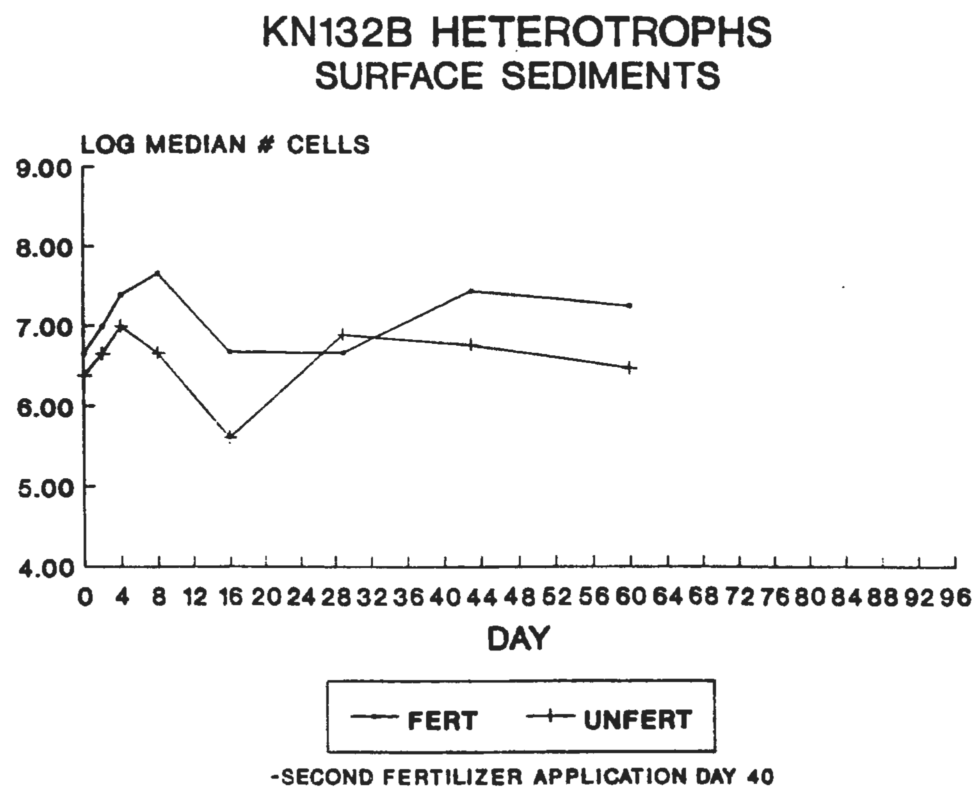


FIGURE 26
BACTERIAL POPULATIONS ON KN-135B

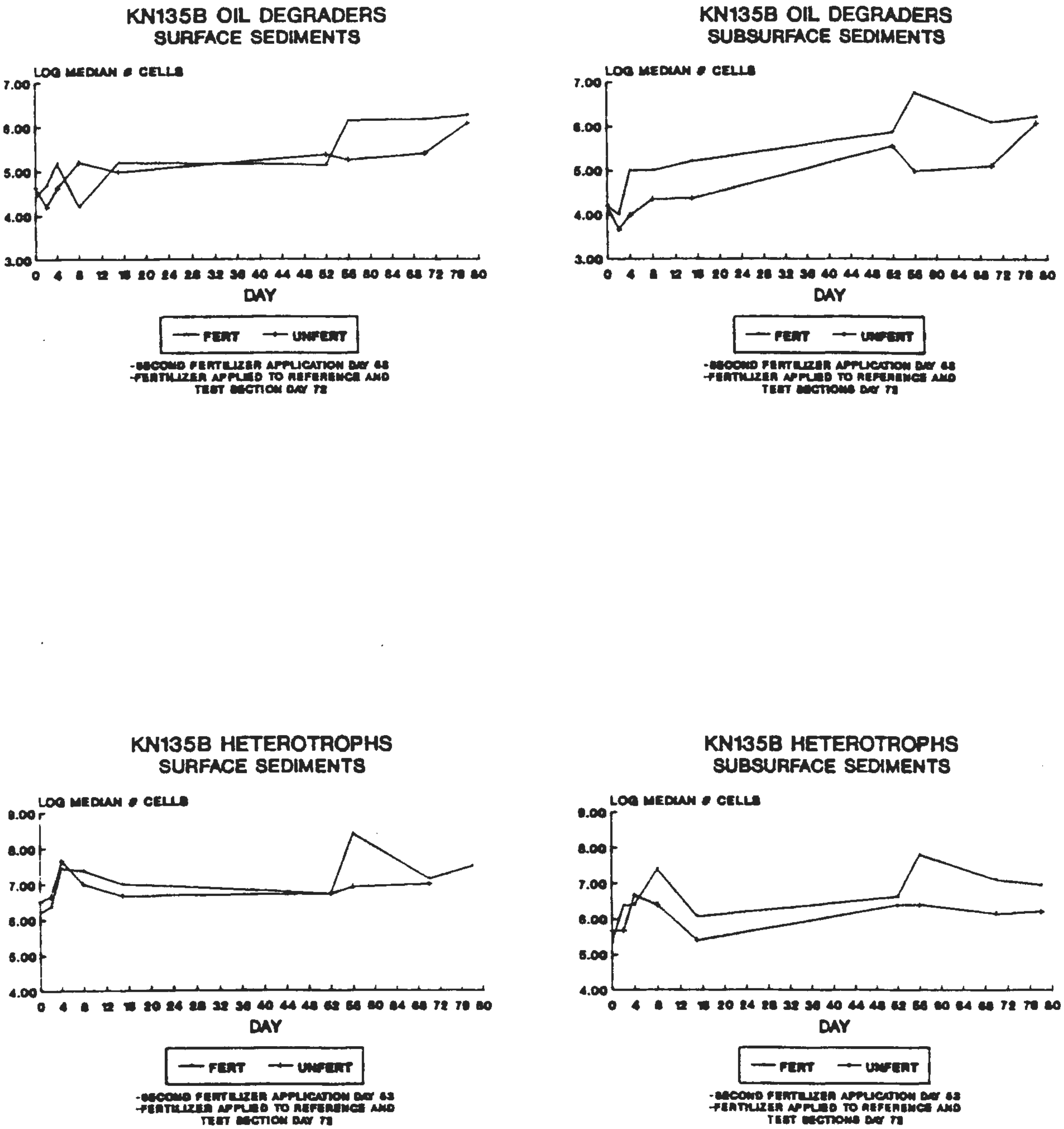
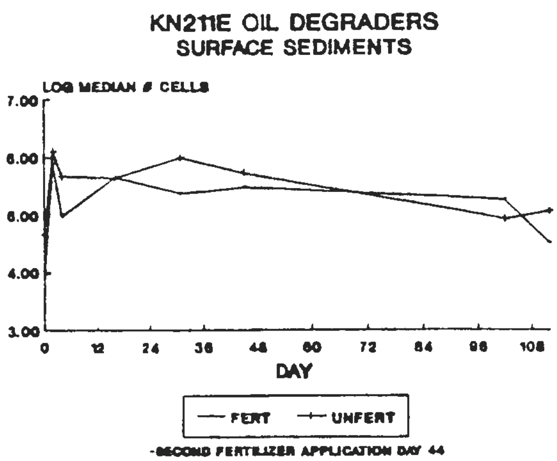
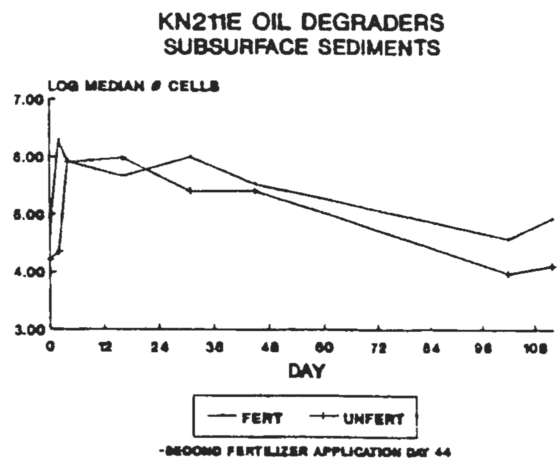
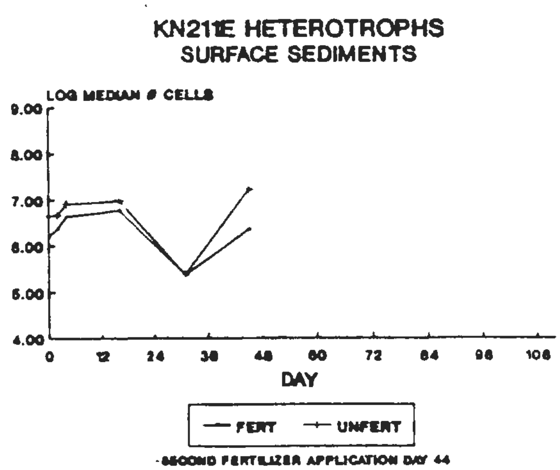


FIGURE 27
BACTERIAL POPULATIONS ON KN-211E







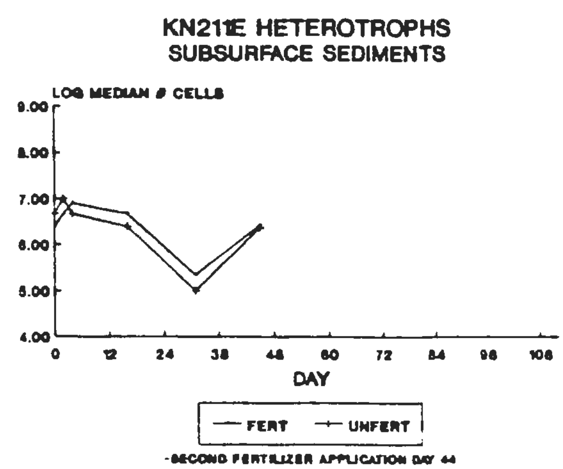


TABLE 4
TOTAL EXTRACTABLE HYDROCARBON IN OILED SEDIMENTS
KN-132B, DAY 0

Sample	Unfiltered	Filtered	Ratio
As	14380	8762	1.6
As	11320	3383	3.4
As	720	399	1.8
Bs	6910	3747	1.8
Bs	3710	1917	1.9
Bs	7650	2322	3.3
Cs	2180	1492	1.5
Cs	13140	1685	7.8
Cs	1880	1345	1.4
Ds	19480	16554	1.2
Ds	23910	15982	1.5
Ds	24550	14086	1.7
Es	12080	2742	4.4
Es	5250	3838	1.4
Es	7550	4747	1.6
Fs	1210	1280	0.9
Fs	2650	2073	1.3
Fs	1660	1436	1.2
mean	8900	4880	1.8
standard deviation	7690	5260	
standard error	1810	1240	

An analysis of the data using D'Agostino's D parameter suggests that in fact the weights of Total Extractable Hydrocarbon in the sediment sample more closely follow a lognormal distribution. In other words, when the data are transformed by taking their logarithms, the distribution of these logarithms more closely follows a normal distribution. This is shown graphically in Section 2 of Appendix D3. Assuming that the data do indeed follow a lognormal distribution allows the calculation of the confidence intervals around the mean values of Tables 5-7, and these are shown in Table 8.

The range of oil loadings measured on each beach is so great that it is almost meaningless to talk of an "average" loading in quantitative terms. For example, on Day 0 at KN-132B the mean loading on the unfertilized portion of the beach is 2.1 g oil / Kg sediment dry weight, but the 95% confidence limit ranges from 0.3 to 12.9 g. Similarly broad ranges are seen on the other sites. An alternative view of such wide ranges within the 95% confidence limits is that there is less than 50% confidence that the true mean value lies within a factor of two, in either direction, of the measured mean.

Taken together, Tables 5-8 reveal that it is essentially impossible to estimate the amount of oil in a section of shoreline with the necessary sensitivity that biodegradation could be quantitatively assessed in three months. As discussed in the Introduction, much effort went into finding the sites for this monitoring program, and seasoned observers from Exxon, ADEC, EPA, NOAA and Battelle Ocean Sciences all thought that the amount of oil in the sediments appeared homogeneous and similar in the two areas per site. Nevertheless, it is apparent that at least an order of magnitude more samples would have been needed in our data set to have reasonable confidence that the average of all the samples from a site was close to the true value, and at least an order of magnitude more if the oil residues at individual sampling times were to be compared with confidence. Fortunately, the chemical analysis of oil from sediment samples provides an alternative approach for quantifying the extent of biodegradation.

Analysis of the Oil Composition

Before chromatographic analysis of the extracted oil, the three samples taken around each well were pooled, and passed through an alumina column to remove polar components. The samples were then analyzed by flame ionization detection gas chromatography (GCFID), which resolves the paraffinic components [Section 6 of Appendix SOP], and gas chromatography/mass spectrometry (GC/MS) with selected ion monitoring (SIM) to resolve aromatic and multi-ring compounds [Section 7 of Appendix SOP]. The latter analysis was extended to include the detection of hopanes (*m/e* 191), since these are proving helpful in providing a quantitative assessment of biodegradation. The data are collected in Appendix D3, Section 4.

Many processes contribute to the disappearance of oil from a shoreline, including evaporation, dissolution, physical removal while adsorbed to particles, and biodegradation. The focus of this monitoring program was to assess the contribution from biodegradation, and this can be quantified from the chemistry of the oil. Crude oil contains innumerable molecular species, which vary in their ease of biodegradation. For example, it is well known that

TABLE 5

TOTAL EXTRACTABLE HYDROCARBON IN SEDIMENTS FROM KN-132B

The data are in mg/Kg sediment dry weight

SD is the standard deviation of the mean, SE the standard error

FERTILIZED-SURFACE	DAY 0 mg/Kg	DAY 29 mg/Kg	DAY 60 mg/Kg	DAY 95 mg/Kg
	399	1378	973	831
	1345	1444	1204	1330
	1492	2269	1370	1511
	1685	6783	1438	1579
	1917	7451	1837	1650
	2322	7946	2738	2483
	3383	11203	5948	12051
	3747	16620	9271	14519
	8762	20026	22844	21269
MEAN	2784	8347	5291	6358
SD	2324	6232	6736	7155
SE	775	2077	2245	2385
MEDIAN	1917	7946	1837	1650

UNFERTILIZED-SURFACE	DAY 0 mg/Kg	DAY 29 mg/Kg	DAY 60 mg/Kg	DAY 95 mg/Kg
	1280	903	1011	388
	1436	1297	1062	442
	2073	1511	1325	959
	2742	3919	2061	1048
	3838	5198	3239	2128
	4747	5230	4669	2375
	14086	5757	11758	5205
	15982	12384	12506	10779
	16554	18794	13056	14909
MEAN	6971	6110	5632	4248
SD	6176	5560	4945	4895
SE	2059	1853	1648	1632
MEDIAN	3838	5198	3239	2128

TABLE 6

TOTAL EXTRACTABLE HYDROCARBON IN SEDIMENTS FROM KN-135B

The data are in mg/Kg sediment dry weight

SD is the standard deviation of the mean, SE the standard error

	DAY 0 mg/Kg	DAY 32 mg/Kg	DAY 70 mg/Kg	DAY 109 mg/Kg
FERTILIZED-SURFACE				
	1373	1173	1137	873
	1661	1567	1885	1191
	1814	2680	2428	1819
	2242	2688	2455	5678
	2471	3097	2510	6451
	5501	4090	5999	7545
	8454	9542	9105	9657
	8958	20917	10820	15372
	20386	60799	12223	18484
MEAN	5873	11839	5396	7452
SD	5833	18282	4033	5847
SE	1944	6094	1344	1949
MEDIAN	2471	3097	2510	6451
FERTILIZED-SUBSURFACE				
	555	940	375	113
	950	1069	750	495
	2755	1477	767	503
	3877	1561	1310	571
	4840	1798	1737	904
	5766	3523	2759	966
	7135	5538	5378	1038
	10410	10863	5599	2065
	10440	14611	8375	2566
MEAN	5192	4598	3006	1025
SD	3435	4645	2640	750
SE	1145	1548	880	250
MEDIAN	4840	1798	1737	904

	DAY 0 mg/Kg	DAY 32 mg/Kg	DAY 70 mg/Kg	DAY 109 mg/Kg
UNFERTILIZED-SURFACE				
	1394	2944	2188	1807
	3274	3566	2501	3502
	3389	5426	8545	5135
	4126	10158	9371	5330
	4516	10583	9623	6928
	6018	11850	15012	9524
	7678	14570	16168	12159
	21219	19233	16864	21297
	27812	23753	24531	24697
MEAN	8825	11343	11645	10042
SD	8689	6624	6807	7548
SE	2896	2208	2269	2516
MEDIAN	4516	10583	9623	6928
UNFERTILIZED-SUBSURFACE				
	1418	340	133	652
	2654	1012	714	2169
	3051	1775	896	2333
	6404	1938	1383	2454
	8793	2157	1502	4082
	8838	3154	1740	4118
	9448	3306	7661	4158
	10601	11708	15521	9188
	29162	26456	24490	17274
MEAN	8930	5761	6004	5159
SD	7812	7972	8051	4840
SE	2604	2657	2684	1613
MEDIAN	8793	2157	1502	4082

TABLE 7
TOTAL EXTRACTABLE HYDROCARBON IN SEDIMENTS FROM KN-211E

The data are in mg/Kg sediment dry weight
SD is the standard deviation of the mean, SE the standard error

	DAY 0 mg/Kg	DAY 31 mg/Kg	DAY 61 mg/Kg	DAY 97 mg/Kg
FERTILIZED-SURFACE				
	114	210	13	179
	115	243	169	205
	148	282	367	288
	156	368	469	498
	169	591	733	788
	297	1154	1052	1198
	317	9351	2049	2386
	380	11183	2985	4331
	413	19234	10057	8022
MEAN	234	4735	1988	1988
SD	111	6521	2995	2487
SE	37	2174	998	829
MEDIAN	169	591	733	788
FERTILIZED-SUBSURFACE				
	141	228	165	47
	1204	303	1359	401
	4436	2378	3477	3374
	10753	6442	7916	11982
	17614	12353	10792	15439
	19233	15879	10811	19878
	19443	18808	17486	20735
	19861	20546	18738	21055
	21262	26854	23997	22099
MEAN	12661	11532	10527	12779
SD	8157	9141	7784	8696
SE	2719	3047	2595	2899
MEDIAN	17614	12353	10792	15439

	DAY 0 mg/Kg	DAY 31 mg/Kg	DAY 61 mg/Kg	DAY 97 mg/Kg
UNFERTILIZED-SURFACE				
	249	220	204	322
	858	2030	228	401
	871	3407	528	1033
	2136	3418	793	2162
	2528	4216	1013	2688
	4727	5706	1363	4268
	5049	6224	2064	7954
	9893	9619	3708	11736
	12953	19813	5835	12301
MEAN	4363	6073	1748	4763
SD	4146	5474	1777	4467
SE	1382	1825	592	1489
MEDIAN	2528	4216	1013	2688
UNFERTILIZED-SUBSURFACE				
	4101	6335	9218	6693
	4436	7097	9611	12042
	8304	14249	14553	13158
	16879	16196	14992	15193
	17476	18013	16017	15309
	17614	19177	16385	16821
	19443	21015	16578	17968
	20000	21028	17256	21220
	21555	23685	18525	23895
MEAN	14423	16311	14326	14801
SD	6467	5760	2949	4059
SE	2156	1920	983	1353
MEDIAN	17476	18013	16017	15309

TABLE 8

MEANS AND CONFIDENCE INTERVALS FOR THE TOTAL EXTRACTABLE HYDROCARBON DATA

The data are in mg/Kg sediment dry weight

		Mean	95% Confidence limits	
KN-132B Wells A-C, surface	Day 0	2060	328	12927
	Day 29	5740	2217	14858
	Day 60	2902	1047	8047
	Day 95	3248	1034	10199
KN-132B Wells D-F, surface	Day 0	4467	1704	11716
	Day 29	3984	1518	10453
	Day 60	3530	1291	9649
	Day 95	2080	605	7154
KN-135B Wells A-C, surface	Day 0	3870	1596	9384
	Day 32	5023	1496	16861
	Day 70	3945	1752	8884
	Day 109	4831	1704	13695
KN-135B Wells D-F, surface	Day 0	5836	2409	14139
	Day 32	9223	4649	18298
	Day 70	9089	4115	20077
	Day 109	7478	3381	16540
KN-135B Wells A-C, subsurface	Day 0	3674	1399	9644
	Day 32	2862	1105	7412
	Day 70	1912	701	5214
	Day 109	752	317	1786
KN-135B Wells D-F, subsurface	Day 0	6346	2712	14850
	Day 32	2724	406	4502
	Day 70	2128	453	9995
	Day 109	3551	1429	8525
KN-211E Wells A-C, surface	Day 0	209	129	338
	Day 31	1246	224	6926
	Day 61	642	108	3825
	Day 97	906	252	3260
KN-211E Wells D-F, surface	Day 0	2441	731	8153
	Day 31	3755	1153	12226
	Day 61	1021	344	3024
	Day 97	2499	690	9053
KN-211E Wells A-C, subsurface	Day 0	6561	1284	33518
	Day 31	5055	902	28334
	Day 61	5629	1245	25456
	Day 97	5081	642	40237
KN-211E Wells D-F, subsurface	Day 0	12328	6600	23029
	Day 31	14959	9516	23517
	Day 61	13971	11058	17651
	Day 97	14122	10186	19580

the straight chain alkanes are more readily metabolized by microbes than their branched chain analogs, and this is the basis of the well known *n*-octadecane (C18) : phytane ratio. The C18 : phytane ratios of samples collected from the three monitoring sites are presented in Tables 9-11. All of the values are substantially lower than the values determined for Prudhoe Bay crude oil that has been artificially weathered by evaporating 30% by weight. Evaporation of crude oil following an oil spill is generally assumed to remove 30% of the initial weight, so 30% evaporated oil is used as an approximate indicator of the composition of the oil when it arrived at the shoreline. This evaporation is done at reduced pressure at 521 F; the oil is thus called 521 oil.

As the indigenous microbes consume the more readily degradable straight chain paraffins, the C18 : phytane ratio declines. We can thus conclude that all the oil samples listed in Tables 9-11 show evidence of substantial biodegradation, with surface samples being more degraded than those collected from the subsurface. Furthermore, in general the samples collected later in the program were more biodegraded than those collected earlier.

The Rate of Biodegradation

Unfortunately the ratios discussed above do not provide information that can lead to a quantitative assessment of how much oil has been degraded. Changes in the C18 : phytane ratio are dependent on the amount of oil present in a sample, for biodegradation mainly occurs at the oil-water interface. Thick layers of oil in the sediment tend to mask biodegradation in the surface layer most available to the microbes. Nevertheless, if phytane was essentially non-biodegradable, the amount of oil consumed could be determined by reference to the amount of phytane in the sample and in a reference oil. Phytane is, however, biodegraded quite readily.

What is needed is a less degradable internal marker than phytane, and there is reason to believe that hopanes fulfill this role. Hopanes are pentacyclic molecules initially in the bacteria that were the original source of the crude oil. Diagenesis of the kerogen (conversion of the oil precursor to oil) removes some of the substituents on the bacterial molecules, and the major hopane found in oil is 17α,21β-hopane; this is shown in Figure 23.

FIGURE 28
HOPANE

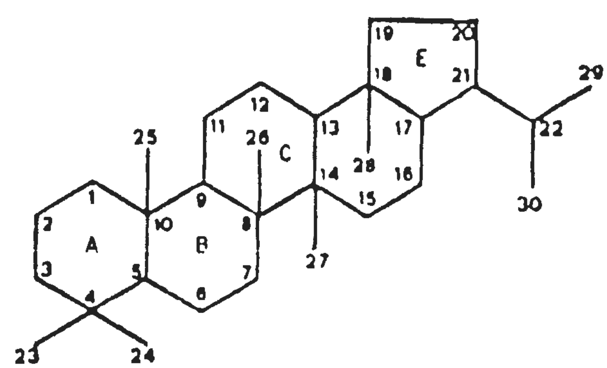


TABLE 9
C18:PHYTANE RATIOS OF OIL FROM KN-132B

	DAY			
WELL	0	29	60	95
As	0.54	0.57	0.74	0.59
Bs	0.35	0.43	NA	0.17
Cs	0.53	0.49	0.71	0.71
Ds	0.60	0.41	NA	0.57
Es	0.30	0.39	NA	0.26
Fs	0.33	0.33	0.33	NA

Prudhoe Bay Crude	2.16
30% weathered Prudhoe Bay Crude	1.83

Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion. Only surface (s) samples were collected at this site. NA indicates Not Appropriate, in that one or both of the analytes was non-detectable.

TABLE 10
C18:PHYTANE RATIOS OF OIL FROM KN-135B

		DAY		
WELL	**0**	**32**	**70**	**109**
As	1.05	0.32	0.29	NA
Ass	0.93	0.48	0.34	0.31
Bs	0.34	0.54	0.42	0.22
Bss	1.23	1.09	0.49	0.27
Cs	0.55	1.34	0.42	0.28
Css	0.75	1.10	0.52	NA
Ds	1.09	0.88	0.89	NA
Dss	1.10	1.39	0.94	1.10
Es	1.00	0.76	0.79	0.34
Ess	1.50	1.40	1.37	0.85
Fs	0.45	0.81	0.65	NA
Fss	1.30	1.14	1.20	1.09

Prudhoe Bay Crude	2.16
30% weathered Prudhoe Bay Crude	1.83

Well designations include s for surface and ss for subsurface. Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion, although the entire beach was fertilized just after Day 70. NA indicates Not Appropriate, in that one or both of the analytes was non-detectable.

TABLE 11
C18:PHYTANE RATIOS OF OIL FROM KN-211E

	DAY			
WELL	**0**	**31**	**61**	**98**
As	0.23	0.33	NA	NA
Ass	1.35	0.93	0.28	0.82
Bs	0.91	0.76	0.26	0.45
Bss	1.42	1.34	1.26	1.33
Cs	0.60	0.35	0.95	0.28
Css	1.23	1.11	1.32	0.92
Ds	0.60	0.57	0.23	0.80
Dss	1.28	1.45	1.22	1.41
Es	0.39	0.09	NA	0.29
Ess	1.59	1.36	1.14	1.36
Fs	1.18	0.70	NA	NA
Fss	1.47	1.44	1.31	1.37

Prudhoe Bay Crude	2.16
30% weathered Prudhoe Bay Crude	1.83

Well designations include s for surface and ss for subsurface. Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion. NA indicates Not Appropriate, in that one or both of the analytes was non-detectable.

Hopane analyses were not a routine part of oil analyses, and the analytical laboratories at Battelle Ocean Sciences and at Exxon Research and Engineering undertook a substantial research project to develop a quantitative assay for this compound. As illustrated in Appendix D3, Section 5, the quantitative method is now reliable. If indeed hopane is an almost completely non-degradable component in crude oil, knowing the amount of hopane in a sample allows a calculation of how much oil was originally in that sample, and thus how much has been biodegraded. As discussed above, it is generally assumed that approximately 30% of the volume of oil spilled from the tanker evaporated before the oil arrived at the shoreline. Oil that has been evaporated to lose 30% of its initial weight (521 oil) is therefore used as a standard in these calculations.

ILLUSTRATIVE CALCULATION BASED ON HOPANE
Gravimetric weight

521 oil has A mg hopane / Kg oil
Sample has a mg hopane and B Kg of oil / Kg sediment dry weight

Assuming that hopane is indeed a truly conserved species, the sample originally had a/A Kg oil / Kg sediment dry weight

Therefore the amount biodegraded = (a/A) - B Kg oil / Kg sediment

----

Tables 12-14 present the results of such calculations for the samples collected from the three monitoring sites. The estimate for any one batch of samples has a large uncertainty, but almost all the samples show evidence of substantial biodegradation. Note that the standard deviations of the estimates in Tables 12-14 are substantially smaller than the standard deviations reported in Tables 5-7 for the amount of oil in the sediment. This provides evidence that the biodegradation of oil is nutrient, not carbon limited, and so the amount of oil biodegraded is independent of the oil load above a threshold of several g oil / Kg sediment.

Although the range of values in Tables 12-14 precludes a comparison of fertilized with unfertilized areas on the timescale of this program, they can provide an overall estimate of the rate of biodegradation at each site. To arrive at this estimate, we have first eliminated all those samples with <2g oil/ Kg sediment, since initial inspection indicates that the rate of biodegradation is probably more than 2 g oil / Kg sediment per year, so that averaging samples with less oil than this will result in an underestimate of the actual rate.

Averaging all of the data from all the batches (53 surface and 40 subsurface) provides an estimate (Table 15) of

Approximately 2.2 g oil biodegraded / Kg sediment / year at the surface
Approximately 1.1 g oil biodegraded / Kg sediment / year in the subsurface

Note that the amount of oil lost in any process which removes hopane, such as physical removal, will not be included in this estimate, and that if the oil was initially less weathered than 521 oil, these values will be an underestimate. They will also be an underestimate if hopane is being biodegraded at an appreciable rate, or if the physical properties of well weathered oil allow easier removal by tidal action.

An alternative approach to estimating the amount of oil that has been biodegraded is to determine the amount of each individual chemical species that has been degraded. Again this relies on the assumption that hopane acts as an internal marker that is not biodegraded, but it is independent of the gravimetric estimate used above since all the quantitative estimates are obtained by Gas Chromatography.

ILLUSTRATIVE CALCULATION BASED ON HOPANE
Individual chemical components

521 oil has A mg hopane / Kg oil, B mg C18, C mg phytane, etc.
Sample has a mg hopane / Kg sediment, b mg C18, c mg phytane, etc.

Assuming that hopane is indeed a truly conserved species, the sample originally had a/A Kg oil / Kg sediment dry weight

and (a/A)B mg C18 / Kg sediment dry weight, (a/A)C mg phytane, etc.

Therefore the amount consumed: of C18 = [(a/A)B] - b mg / Kg sediment
phytane = [(a/A)C] - c mg / Kg sediment
etc.

The Percent Depleted of C18 = {[(a/A)B] - b} / (a/A)B} * 100%
phytane = {[(a/A)C] - c} / (a/A)B} * 100%
etc.

Tables 15-17 illustrate the results of such calculations for *n*-octadecane (C18), phytane, phenanthrene, chrysenes with two carbon substituents (C-2 chrysenes), total alkanes (C10 to C34 plus pristane and phytane) and total resolvable hydrocarbon (Total HC). These components were chosen as representatives of a readily degradable alkane (*n*-octadecane), a less readily degradable alkane (phytane), a soluble and biodegradable aromatic species (phenanthrene), insoluble and relatively slowly degradable aromatic compounds (the C-2 chrysenes), the bulk of the most degradable fraction of the oil (the total alkanes, which make up approximately 4.3% of 521 oil), and the maximal amount detectable with GC chromatography (Total HC, which is approximately 56% of 521 oil). The tables also include the percent depleted based on the gravimetric analyses of Tables 12-14.

Tables 16-18 demonstrate how effective biodegradation has been at reducing oil contamination on the beaches of Prince William Sound. These tables are of the percent depletion with respect to 521 oil, so a value of 90% indicates that 90% of the component that landed on the beach has disappeared.

For *n*-octadecane, phytane and the C-2 chrysenes, this disappearance is most likely to be exclusively by biodegradation, since they are very insoluble in seawater. The majority of the surface samples are already more than 50% depleted in *n*-octadecane and total alkanes, and the depletion of the branched, and hence less readily degraded, phytane is not far behind. Typically subsurface samples show only a third to a half as much depletion of these components, in line with the difference in rates shown in Table 15, but still substantial biodegradation. An obvious corollary is that the C18 : phytane ratios of Tables 9-11 are a substantial under-reflection of the amount of biodegradation that has taken place.

The polyaromatic compounds have also undergone substantial biodegradation. Phenanthrene is both biodegradable and soluble, and almost all the samples are >90% depleted in this compound. The C-2 chrysenes are insoluble, so their disappearance may be attributed to biodegradation. The C-2 chrysenes were chosen for this analysis because they are present in high enough concentrations that their analysis is reliable, and they are widely reputed to be amongst the most non-degradable polyaromatic hydrocarbons. Tables 16-18 indicate that there has already been a substantial biodegradation of the C-2 chrysenes, and as with the alkanes this has progressed further in the surface samples, but is still significant in the subsurface samples.

None of the analyzed components is consistently enriched with respect to hopane, which corroborates the assumption that hopane is amongst the least biodegradable components of crude oil. If hopane is being degraded at an appreciable rate, all the percent depletion values in Tables 16-18 will be underestimates. They will also be underestimates if the oil that arrived at the shoreline had lost less that 30% of its initial weight by evaporation.

WATER QUALITY OF NEARSHORE WATER

Ammonia and Nitrate Concentrations

The trends in ammonia and nitrate concentrations following the initial fertilizer applications for each site are plotted in Figures 29 and 31 and summarized in Table 19. Baseline ammonia concentrations at KN-132B varied slightly between the fertilized and reference sites before and after fertilizer application, but there was no indication of any significant ammonia release into the nearshore waters. Baseline concentrations of nitrate ranged from 0.01 to 0.03 mg/l at this site. The maximum nitrate concentration was 0.09 mg/l at 19 hr post-application, and this returned to baseline concentrations by 57 hr.

At KN-135B, both ammonia and nitrate showed the same trend, peaking at 57 hr post-application, with a trend toward baseline concentrations by 82 hr. Pre-application and reference site values for ammonia ranged from 0.01 to 0.05 mg/l. The maximum ammonia value recorded post-application was 0.29 mg/l at 57 hr; by 82 hr this had decreased to 0.08 mg/l. Background concentrations of nitrate ranged from 0.01 to 0.05 mg/l. Following fertilizer application, nitrate concentrations peaked at 0.65 mg/l with the 57-hr sample; by 82 hr this had decreased to 0.24 mg/l.

TABLE 12
ESTIMATED AMOUNTS OF OIL BIODEGRADED SINCE BEACHING, KN-132B
The data are in mg/Kg sediment dry weight
SD is the standard deviation of the mean, SE the standard error

	DAY			
WELL	**0**	**29**	**60**	**95**
As	5162	6218	107	1258
Bs	2117	1077	365	2315
Cs	5608	5281	2409	4559
Ds	10078	6704	2248	1645
Es	2363	4206	1950	585
Fs	1595	912	873	406

Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion. Only surface (s) samples were collected at this site.

Discounting samples with less than 2 g oil/Kg sediment dry weight:

Average Surface Fertilized*	2717
SD	2133
SE	711
Average Surface Unfertilized	4354
SD	2882
SE	1019

* An average of 61 days since the single fertilizer application.

TABLE 13

ESTIMATED AMOUNTS OF OIL BIODEGRADED SINCE BEACHING, KN-135B

The data are in mg/Kg sediment dry weight

SD is the standard deviation of the mean, SE the standard error

	DAY			
WELL	**0**	**32**	**70**	**109**
As	3908	2396	2690	3695
Ass	314	904	1325	273
Bs	2089	1989	2308	4086
Bss	-85	1417	1597	174
Cs	1140	767	2270	2225
Css	271	668	1414	219
Ds	3855	1391	3836	1927
Dss	1153	341	-30	595
Es	-603	2730	2567	3448
Ess	2302	1073	1859	486
Fs	397	2240	3274	5237
Fss	273	1109	938	1762

Well designations include s for surface and ss for subsurface. Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion, although the entire beach was fertilized just after Day 70.

Discounting samples with less than 2 g oil/Kg sediment dry weight:

Average Surface Fertilized*	2753
SD	1132
SE	327
Average Surface Unfertilized	2335
SD	1397
SE	421
Average Subsurface Fertilized*	1158
SD	465
SE	164
Average Subsurface Unfertilized	921
SD	716
SE	227

* An average of 60 days since the first fertilizer application.

TABLE 14
ESTIMATED AMOUNTS OF OIL BIODEGRADED SINCE BEACHING, KN-211E
The data are in mg/Kg sediment dry weight
SD is the standard deviation of the mean, SE the standard error

	DAY			
WELL	**0**	**31**	**60**	**98**
As	32	2242	1200	304
Ass	1340	58	1033	1500
Bs	142	2144	2841	583
Bss	2682	2372	1114	4223
Cs	147	91	-66	840
Css	3840	2537	1421	1914
Ds	3964	2441	1148	1646
Dss	3932	509	1219	3519
Es	3131	1130	1110	3008
Ess	-907	775	-158	1737
Fs	3661	1544	854	2486
Fss	-1939	-133	117	3928

Well designations include s for surface and ss for subsurface. Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion.

Discounting samples with less than 2 g oil/Kg sediment dry weight:

Average Surface Fertilized*	2136
SD	760
SE	287
Average Surface Unfertilized	2308
SD	1265
SE	516
Average Subsurface Fertilized*	2427
SD	1107
SE	350
Average Subsurface Unfertilized	940
SD	1799
SE	519

* An average of 61 days since the first fertilizer application.

TABLE 15
ESTIMATED RATE OF OIL BIODEGRADATION
SUMMARY OF ALL SAMPLES FROM ALL BEACHES

These calculations are based on the gravimetric weight of oil in a sediment sample, and assume that hopane is a conserved internal marker. They use 521 oil as the reference oil, and do not include samples with less than 2 g oil/Kg sediment dry weight.

The data are in mg/Kg sediment dry weight

AMOUNT BIODEGRADED SINCE BEACHING

SURFACE		
	KN-132B	3487
	KN-135B	2553
	KN-211E	2215
SUBSURFACE		
	KN-135B	1026
	KN-211E	1616

CONVERTING TO AN ANNUAL RATE

SURFACE		
	KN-132B	2790
	KN-135B	2042
	KN-211E	1772
SUBSURFACE		
	KN-135B	821
	KN-211E	1293

OVERALL ANNUAL RATE

SURFACE	2201
SUBSURFACE	1057

TABLE 16
REPRESENTATIVE CHEMICAL COMPONENTS, KN-132B
Percent depleted -v- 521 oil

	C18	phytane	phenan-threne	C-2 chrysene	total alkane	total HC	grav weight
DAY 0							
As	87	57	100	25	82	46	58
Bs	98	89	100	37	95	67	45
Cs	90	62	100	31	87	51	80
Ds	83	48	100	35	78	41	40
Es	99	93	100	53	96	70	39
Fs	99	93	100	51	97	70	50
DAY 95							
As	97	90	100	62	96	61	42
Bs	98	79	100	28	96	49	39
Cs	84	59	97	18	81	33	32
Ds	82	43	100	16	75	25	16
Es	98	91	100	56	98	63	18
Fs	100	91	100	69	98	63	39

Total alkanes includes C10 to C32, plus pristane and phytane; for 521 oil it is 4.3% of the total oil. Total HC is the total hydrocarbon resolvable by Gas chromatography; for 521 oil it is 56% of the total oil. Grav weight is based on the gravimetric data of Table 12.

Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion. Only surface (s) samples were collected at this site.

TABLE 17
REPRESENTATIVE CHEMICAL COMPONENTS, KN-135B
Percent depleted -v- 521 oil

	C18	phytane	phenan-threne	C-2 chrysene	total alkane	total HC	grav weight
DAY 0							
As	55	23	93	14	49	21	26
Ass	57	17	100	22	48	14	8
Bs	94	69	100	30	88	45	34
Bss	31	-2	100	13	23	3	-1
Cs	97	90	98	45	93	63	39
Css	59	1	97	-3	49	6	6
Ds	55	25	100	10	48	17	23
Dss	49	15	100	14	42	18	16
Es	61	29	74	19	57	30	-8
Ess	10	-10	95	5	0	-2	14
Fs	87	47	100	35	76	24	8
Fss	18	-14	100	18	9	-5	5
DAY 109							
As	100	84	100	21	98	42	32
Ass	95	70	98	17	93	36	18
Bs	98	85	99	23	98	46	34
Bss	95	66	99	23	92	22	17
Cs	94	61	100	14	91	28	29
Css	100	62	100	8	96	20	17
Ds	100	63	100	25	97	39	15
Dss	55	25	100	11	46	9	20
Es	95	76	92	48	93	49	39
Ess	66	26	100	7	57	8	14
Fs	100	58	94	29	96	32	30
Fss	50	16	100	2	38	1	16

Total alkane includes C10 to C32, plus pristane and phytane, for 521 oil it is 4.3% of the total oil. Total HC is the total hydrocarbon resolvable by Gas chromatography; for 521 oil it is 56% of the total oil. Grav weight is based on the gravimetric data of Table 13.

Well designations include s for surface and ss for subsurface. Wells A, B and C are in the portion of the beach that was fertilized on Day 0, wells D, E and F in the portion fertilized for the first time on Day 72.

TABLE 18
REPRESENTATIVE CHEMICAL COMPONENTS, KN-211E
Percent depleted -v- 521 oil

	C18	phytane	phenan-threne	C-2 chrysene	total alkane	total HC	grav weight
DAY 0							
As	99	91	100	46	95	61	14
Ass	30	6	100	-3	19	2	23
Bs	95	89	99	51	92	62	42
Bss	26	6	95	2	16	9	12
Cs	97	90	100	61	94	67	32
Css	34	2	100	22	22	-1	23
Ds	91	71	100	45	87	51	43
Dss	43	20	96	12	35	15	30
Es	94	71	100	14	90	51	66
Ess	5	-9	95	12	-12	-12	-5
Fs	46	17	100	14	38	14	45
Fss	16	-3	95	-10	4	-2	-13
DAY 98							
As	100	92	100	61	99	61	37
Ass	66	27	100	5	55	2	24
Bs	90	60	100	25	87	32	19
Bss	39	18	100	-2	26	-7	18
Cs	95	68	100	21	91	39	30
Css	56	14	100	4	48	8	17
Ds	82	59	100	35	76	40	35
Dss	28	8	100	10	13	-12	17
Es	94	64	100	32	89	38	35
Ess	6	-25	100	3	-9	-23	9
Fs	100	68	100	40	97	37	32
Fss	36	16	100	-2	19	-11	18

Total alkane includes C10 to C32, plus pristane and phytane, for 521 oil it is 4.3% of the total oil. Total HC is the total hydrocarbon resolvable by Gas chromatography; for 521 oil it is 56% of the total oil. Grav weight is based on the gravimetric data of Table 14.

Well designations include s for surface and ss for subsurface. Wells A, B and C were in the fertilized portion of the beach, D, E and F in the unfertilized portion.

At KN-211E, baseline concentrations of ammonia and nitrate ranged from 0.01 to 0.02 mg/l and 0.01 to 0.06 mg/l, respectively. Concentrations of both nitrogen forms peaked at 7 hr post-application and returned to baseline concentrations by 57 hr post-application. The maximum ammonia concentration measured was 0.59 mg/l, whereas that for nitrate was 1.64 mg/l.

Monitoring nutrient dynamics immediately after fertilizer application was not continued for subsequent applications since there was no evidence that ammonia or nitrate concentrations were leading to adverse ecological effects, despite over-application of fertilizer at KN-132B and KN-135B. Instead, samples were collected offshore on the same schedule as other monitoring parameters after the second fertilizer application. The levels of nutrients in these samples are reported in Table 21. They show nutrient concentrations of less than 3 μM available nitrogen (<0.05 mg/l ammonia or nitrate), which are within the normal range for nearshore waters.

Toxicity Tests

A comprehensive presentation of the results of static, acute toxicity tests with each field sample is presented in Section 1 of Appendix D4; it is the final report from MEC, Inc, the contract laboratory that conducted the tests. When reviewing the results, the reader should keep in mind that there is a background mortality rate within every test population. Because juvenile test animals may die in the course of a test as the result of handling stress or natural causes, a 90% survival is the appropriate criterion for determining when toxic effects have been exhibited. For our tests, survival in all laboratory control and field reference samples was $\geq$90%, indicating that the test animals were in excellent condition and that the tests were conducted with appropriate care.

We have reviewed the MEC report and have summarized the pertinent test results in Table 21. Survival in all undiluted field samples collected after fertilizer application ranged from 90% to 100%, indicating no toxicity due to fertilizer application. Mysid survival in the pre-application sample collected at site KN-132B was 83%, perhaps indicating some effects of site activities and manual clean-up as field crews prepared the site for bioremediation. Nevertheless, survival in all other dilutions of this sample were $\geq$90%, so we characterize this mortality as not environmentally significant.

Toxicity tests conducted during the 1989 bioremediation demonstration-research program using the same worst-case sampling plan showed toxicity to oyster larvae a water sample collected 18 hr after application of Inipol EAP22 and Customblen at the Passage Cove test site. Five samples were collected and tested between 1 hr and 18 hr post-application, no subsequent samples were collected. Ammonia in nearshore waters was not monitored in conjunction with these tests so there is no point of reference for comparing this test with the 1990 test. Oyster larvae, used in 1989, and Mysids, used in 1990, have the same sensitivity when tested with Inipol and Inipol plus oil. Thus we expected similar sensitivity in the field. Differences between 1989 and 1990 toxicity test results must be attributed to site specific differences, either in the nature of fertilizer release into overlying waters or the rate of local mixing and tidal flushing along the nearshore zone. The 1989 data show that a

FIGURE 29
AMMONIA IN NEARSHORE WATER OFF FERTILIZED SHORELINES

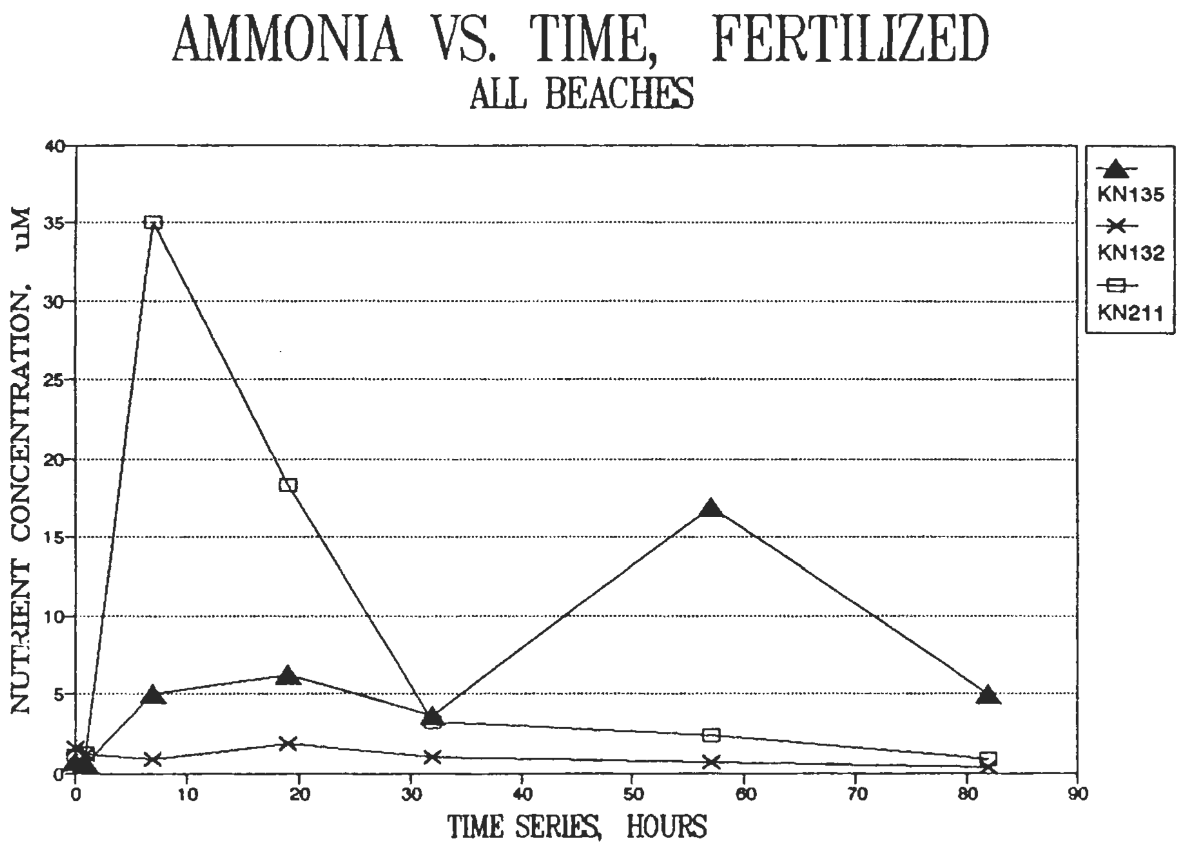


FIGURE 30

NITRATE + NITRITE IN NEARSHORE WATER OFF FERTILIZED SHORELINES

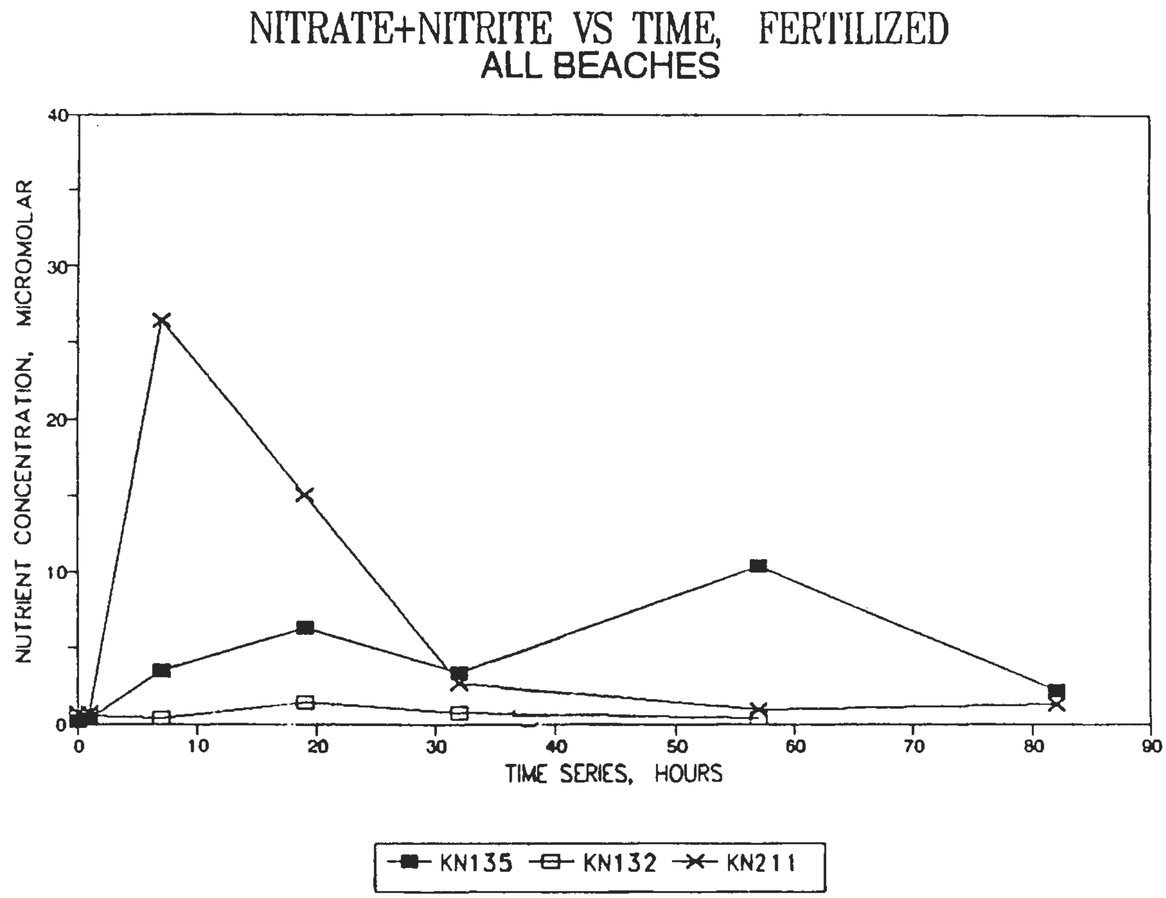


TABLE 19

SUMMARY OF AMMONIA AND NITRATE CONCENTRATIONS IN NEARSHORE WATER
AFTER FIRST APPLICATION OF FERTILIZER

Times are in hours after fertilizer application.

Test Site	Maximum Concentrations (mg/l)		Time of Peak	Returned to Baseline
	Ammonia	Nitrate		
KN-135	0.29	0.65	57 hours	82 hours
KN-211	0.59	1.64	7 hours	57 hours
KN-132	0.03	0.09	19 hours	57 hours

TABLE 20
NUTRIENT CONCENTRATIONS IN NEARSHORE WATER AFTER SECOND FERTILIZER APPLICATION

KN-132B - NUTRIENT DATA, FERTILIZED (uM)

DAY	NO3+NO2	NH3	PO4
43	0.40	2.75	0.10
60	0.39	0.63	0.06

KN-132B - NUTRIENT DATA, UNFERTILIZED (uM)

DAY	NO3+NO2	NH3	PO4
43	0.32	1.86	0.09
60	0.40	0.78	0.07

KN-132B - NUTRIENT DATA, REFERENCE REMOTE (uM)

DAY	NO3+NO2	NH3	PO4
43	0.21	0.82	0.04
60	0.95	0.73	0.03

KN-135B - NUTRIENT DATA, FERTILIZED (uM)

DAY	NO3+NO2	NH3	PO4
57	0.85	2.23	0.13
70	0.34	0.53	0.05

KN-135B - NUTRIENT DATA, UNFERTILIZED (uM)

DAY	NO3+NO2	NH3	PO4
57	0.05	0.30	0.01
70	0.46	0.75	0.02

KN-135B - NUTRIENT DATA, REFERENCE REMOTE (uM)

DAY	NO3+NO2	NH3	PO4
57	0.32	0.85	0.06
70	0.36	0.79	0.02

KN-211E - NUTRIENT DATA, FERTILIZED (uM)

DAY	NO3+NO2	NH3	PO4
47	1.21	2.19	0.25
61	1.19	1.15	0.15

KN-211E - NUTRIENT DATA, UNFERTILIZED (uM)

DAY	NO3+NO2	NH3	PO4
47	0.27	0.42	0.09
61	0.52	1.40	0.13

KN-211E - NUTRIENT DATA, REFERENCE REMOTE (uM)

DAY	NO3+NO2	NH3	PO4
47	0.56	2.79	0.23
61	0.26	1.04	0.16

TABLE 21

RESULTS OF ACUTE TOXICITY TESTS WITH MYSIDS

Water samples were collected before and after fertilizer application. Times given for sample collection are approximate; actual times were scheduled around tidal change.

	MYSID SURVIVAL IN 96-HOUR STATIC TOXICITY TEST					
	KN-135 TEST SITE		KN-211 TEST SITE		KN-132 TEST SITE	
Collection Time	Treated	Control	Treated	Control	Treated	Control
Pre-application	100%	100%	97%	90%	83%	100%
1 hr after application	90%	--	100%	--	90%	--
7 hr after application	90%	--	97%	--	93%	--
19 hr after application	100%	97%	97%	97%	93%	100%
32 hr after application	93%	--	97%	--	97%	--
57 hr after application	100%	93%	93%	97%	97%	97%
82 hr after application	100%	--	93%	--	97%	--

3-fold dilution was necessary to eliminate toxicity in the field samples. Because the samples were collected immediately above the fertilized shoreline, the results do not conflict with our assessment that any ecological effects that might occur would be localized, transient and short-term.

Toxicity tests were not continued for subsequent applications since there was no evidence of adverse ecological effects after the initial application, despite over-application of fertilizer at KN-132B and KN-135B.

Chlorophyll Monitoring

The potential that fertilizer application might stimulate an algal bloom was assessed by monitoring chlorophyll in the nearshore water. All readings were less than 0.67 μg chlorophyll/liter. This is consistent with values reported from previous bioremediation studies in Snug Harbor and Passage Cove, where chlorophyll values ranged from 0.2 to 1 μg/l. In contrast, chlorophyll levels in the lagoons behind KN-211D and DI-67 were in the range 10-30 μg/l in late July. There were no indications of fertilizer applications stimulating algal blooms in the nearshore zone at the monitoring sites (Figure 31). Chlorophyll concentrations show no consistent differences in treated versus reference comparisons and no increasing trends with time. The degree of nutrient release into nearshore waters does not stimulate an algal bloom faster than the rate of dilution and flushing driven by tidal exchange at any of the monitoring sites. These results agree with data generated during the 1989 bioremediation research/demonstration project.

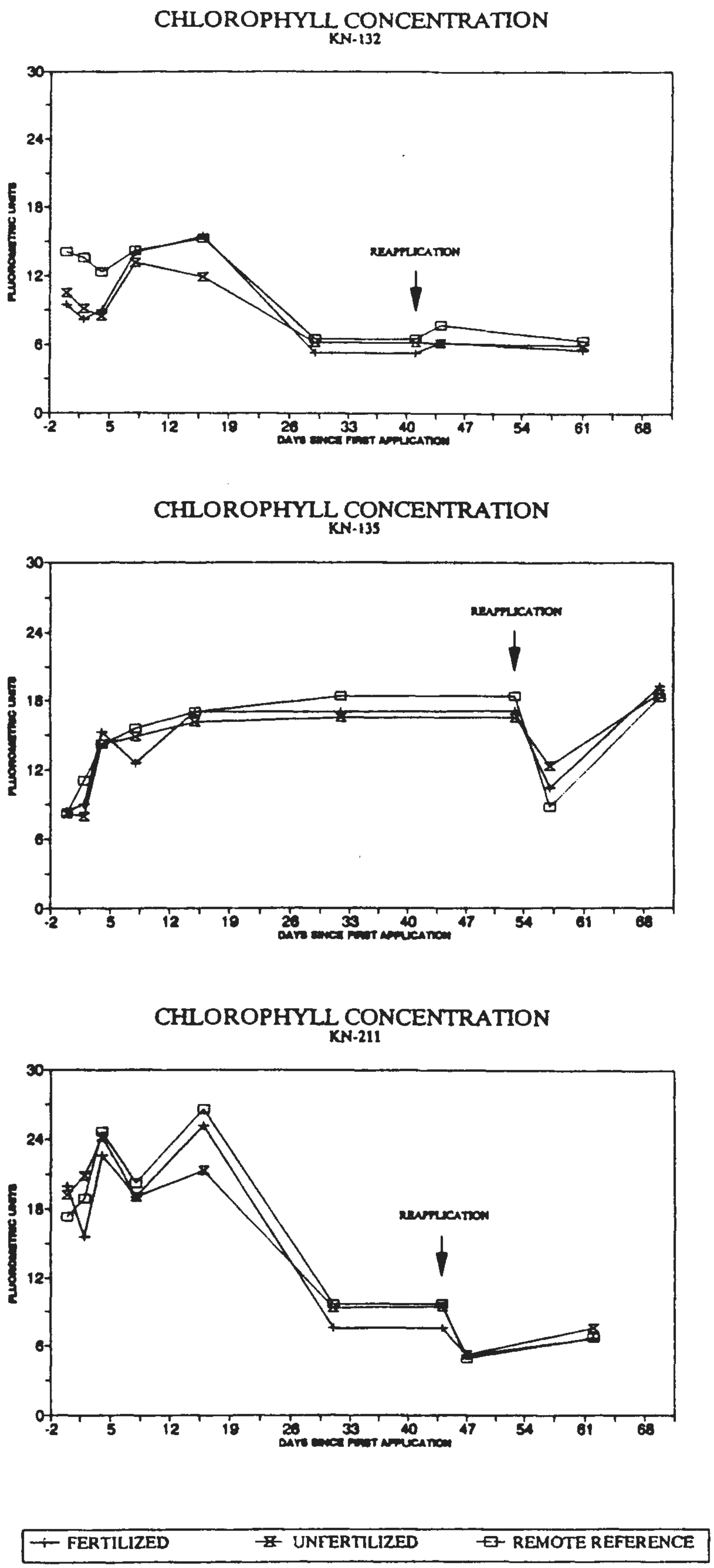
Total Petroleum Hydrocarbons

Measurements of the amounts of petroleum hydrocarbon in nearshore water are presented in Appendix D4, Table 1. Only 16 of the 174 samples of nearshore water collected in this program had detectable levels (0.2 mg/l) of Total Petroleum Hydrocarbon; none were greater than 0.41 mg/l, which was found in a sample from an untreated remote reference site.

Only a single sample from KN-132B had detectable hydrocarbon; 0.24 mg/l on day 29 from near the treated area. Nine samples had detectable hydrocarbon in the first two days of monitoring at KN-135B, three of them before fertilizer application. Levels near the fertilized and unfertilized shorelines were 0.2-0.3 mg/l, while at the remote reference site the level was 0.4 mg/l. Only two subsequent samples had detectable levels of hydrocarbon, these were from the treated area on Day 15, and both were 0.23 mg/l. Only three samples had detectable levels at KN-211E, all less than 0.25 mg/l, occurring within four days of fertilizer application.

There is no trend in the total petroleum hydrocarbon data to suggest any correlation between fertilizer applications and release of oil from the shoreline to nearshore waters. Rather, hydrocarbon releases are most likely related to clean-up crew efforts of manual removal and site preparation for bioremediation. Hydrocarbon release will continue to be a concern as part of any clean-up activity until all the oil has been removed or degraded in place, but concentrations are likely to be at or below detection limits, and should not cause environmental problems.

FIGURE 31
RELATIVE CHLOROPHYLL CONCENTRATIONS IN OFFSHORE WATER



BUTOXY-ETHANOL MONITORING

Butoxy-ethanol residues on the surfaces of oily cobbles are presented in Table 22. There was a five-fold difference between the initial concentrations in the two sampling areas. This could be the result of either incidental variations in the application rate within a test site or of variations in the amount of oil in the two areas of the beach, as the surface area sampled varied at the most by a factor of two. In either case, the trends through time were very similar for the upper-intertidal and mid-intertidal samples. After the first tidal flushing, the lower samples lost approximately 98% of the butoxy-ethanol, whereas the upper samples that were not covered by the high tide lost approximately 92%. Following the second tidal flushing, residues decreased to non-detectable concentrations in the lower-intertidal area and decreased another 92% in the upper-intertidal area, to approximately 0.6% of the original concentrations. During the next 24 hr, butoxy-ethanol decreased another 94%. These data agree with previous laboratory findings where 99% of the butoxy-ethanol was removed from microcosms within 24 hours.

TABLE 22
BUTOXY-ETHANOL IN SAMPLE WIPES OF COBBLE SURFACES

Sampling Interval	μg Butoxy-ethanol/g oil taken from cobble: Upper-Intertidal	Mid-Intertidal
1 hr post-application	52,000	10,000
after first tidal flooding	4,000	177
after second tidal flooding	300	ND
after fourth tidal flooding	19	ND

ND represents samples below the detection limit of 10 μg butoxy-ethanol/g oil.

Butoxy-ethanol poses a potential threat to wildlife if the chemical is inhaled, absorbed across the skin upon direct contact, or ingested from licking, chewing, ingesting treated substrates (i.e., rocks, sticks, gravel, etc) or as a result of cleaning or preening activities after animals have had direct contact with an Inipol-treated area. The rapid loss of butoxy-ethanol from Inipol-treated substrates supports the assertion that wildlife exposures are limited to periods immediately after application. Using the measured loss rates for butoxy-ethanol in the field, the expected 30 g of butoxy-ethanol/m^2 following Inipol application would be reduced to < 2.5 g/m^2 after one tidal exchange and to < 0.2 g/m^2 after 24 hours. At 0.2 g/m^2, butoxy-ethanol would be acutely toxic to a 1 Kg bird or mammal only if the animal absorbed all the chemical in one square meter (acute LC50 is 200 to 500 mg/Kg). As the amount of butoxy-ethanol continues to decrease with time, we feel that a 24-hr period after Inipol EAP22 application is a reasonable time to employ wildlife deterrent devices.

SUMMARY AND CONCLUSIONS

The Importance of Biodegradation in the Natural Cleansing Process

The data presented here demonstrate that biodegradation is an important process contributing to the removal of oil from the shorelines of Prince William Sound. By using hopane as an internal non-biodegradable marker, we estimate that all samples collected during this program show substantial evidence of biodegradation. This includes not only the alkane fraction of the oil, but also components often considered more resistant to biodegradation, such as the chrysenes with two carbon substituents. By the end of the 1990 clean-up season, the majority of surface samples were already more than 50% depleted in alkanes and more than 20% depleted in C-2 chrysenes, while subsurface samples provide evidence that the subsurface rate is typically one half to one third of that at the surface.

The Rate of Biodegradation

By using hopane as an internal non-biodegradable marker, we estimate that the rate of biodegradation of oil on beaches in Prince William Sound is approximately 2.2 g oil biodegraded/Kg sediment/year at the surface, and 1.1 g oil/Kg sediment/year in the subsurface (30 cm). These numbers would be underestimates if the oil landing on the beach had lost less than 30% of its bulk by evaporation, if hopane was biodegraded at a significant rate, or if heavily weathered oil was less adhesive, and thus more readily removed from sediments by tidal flushing.

Fertilizer Enhancements

There are several parameters that support our conclusion that the application of nitrogenous fertilizers is an effective technique for removing oil from surface and subsurface sediments. First, nitrogen nutrients increased in interstitial waters to a depth of 50 cm at all sites following all fertilizer additions. The magnitude and duration of the enhancement varied from site to site; 10 to 100-fold increases in initial nutrient concentrations declined over an 8 to 15 day period to a 2-10 fold enhancement, which was then sustained for at least thirty days. The inorganic nutrients seem to come principally from the Customblen, whereas urea release from Inipol EAP22 could not be detected beyond four days after application. This is consistent with our understanding of the mechanism of Inipol EAP22, which was designed to keep nutrients associated with the oil, but this has not been measured. When detected, the urea from the Inipol EAP22 was found in interstitial water from a depth of 50 cm, indicating that this component, at least, penetrated into the shoreline sediments. In conclusion, the fertilizer applications were successful in providing substantial nitrogenous nutrients to at least 50 cm into the shoreline sediment at significantly elevated concentrations for at least 30 days.

Second, dissolved oxygen in the interstitial waters never approached limiting concentrations. A decrease of 2 to 3 mg/l dissolved oxygen in interstitial water on the fertilized sides of KN-135B and KN-132B occurred after both applications, suggesting an increased biological activity stimulated by nitrogenous nutrients. The effect diminished as nutrient concentrations decreased with time.

Third, the fertilizer treatments produced a sustained increase in microbial numbers and microbial activity in surface and subsurface sediments.

As discussed in the Results section, the mineralization activity ratio represents a convenient, if imperfect, way to monitor the effect of fertilizer addition on hydrocarbon biodegradation. The increase in biodegradation activity measured in our assays does not necessarily directly equate to *in situ* biodegradation rates, since the laboratory assay involves removing the bacteria from their natural milieu, and providing them with conditions that only partially mimic their natural environment. Nevertheless, the activities do reflect the robustness of the microbial communities at the study sites, and the activities are reasonable indicators of the relative activities of the hydrocarbon oxidizers *in situ*. As such, they suggest that fertilizer addition effects a two to three fold increase in biomineralization activity after the first addition of fertilizer, and that subsequent applications sustain and further increase the effect to a five to ten fold enhancement.

Ecological Effects

Nearshore waters collected at the test sites during the 4 days following fertilizer application showed no toxicity when tested with Mysids, a shrimp-like crustacean selected as a surrogate for indigenous species. Ammonia and nitrate concentrations in nearshore waters peaked between 7 and 57 hours post-application at concentrations <0.6 mg/l ammonia and <1.6 mg/l nitrate. Samples collected three or four days after the second fertilizer applications at each site followed the same trend. Short-term, transient concentrations of ammonia or nitrate of this magnitude are less than published data on acute toxicity of ammonia to most marine biota.

Samples from cobble surfaces treated with Inipol showed that more than 99% of the butoxy-ethanol had dissipated from treated shorelines within 24 hr. The time-lapse camera, taking one frame every six minutes, recorded no wildlife on Inipol EAP22 treated areas while the wildlife deterrents were present. These findings demonstrate that potential wildlife exposures are at most transient and short-term.

Our monitoring efforts demonstrated no evidence of algal blooms stimulated by nutrient release from the fertilized shorelines. Only 9% of the samples of nearshore water contained total hydrocarbon concentrations above detection limits; none exceeded 0.41 mg/l. There was no correlation with fertilizer additions.

Frequency of Application

Although enhanced microbial activity is sustained for more than 30 days from a single fertilizer application, this program has provided evidence that subsequent applications of fertilizer have a further beneficial effect. By waiting approximately three weeks before reapplication, interstitial nutrient levels have returned to near background levels, as has dissolved oxygen depletion, and the potential for nutrient release to offshore water has returned to pre-treatment levels. Repeated fertilizer applications over the course of the summer at approximately monthly intervals would probably maximize the degradation benefits of bioremediation.

2

APPENDIX SOP.
Standard Operating Procedures

Section 1.	Protocol for collecting and processing samples for toxicity tests
Section 2.	Analyses of inorganic nutrients in seawater
Section 3.	Determination of Kjeldahl Nitrogen in seawater
Section 4.	Microbial Protocols
Section 5.	Extraction of sediment samples for low level petroleum analysis
Section 6.	Determination of low level total petroleum hydrocarbon and individual saturated hydrocarbon concentrations in environmental samples
Section 7.	Determination of low-level Polynuclear aromatic hydrocarbons (PAH) and selected heterocycles
Section 8.	Determination of Total Petroleum Hydrocarbon in seawater
Section 9.	Determination of 2-butoxy-ethanol in surface wipes

SECTION 1, APPENDIX SOP

PROTOCOL FOR COLLECTING AND PROCESSING SAMPLES FOR TOXICITY TESTS

Objective: A series of water samples will be collected over time to quantify any occurrence and subsequent dissipation of toxic concentrations of constituents of Inipol and Customblen following fertilizer applications to oiled shorelines. The water samples are intended to be representative of worst-case conditions in the intertidal zone to characterize exposures that might be encountered by marine biota moving onto a treated shoreline. Further, the samples will allow an assessment of when intertidal shoreline conditions have returned to conditions appropriate for recolonization by epibenthic invertebrates.

Approach:
Collection Site -- Sample collection will be along an upper-berm-to-lower-tidal transect established in the center of the treated area of the shoreline. A single float can be deployed to mark the middle of the transect and used as a visual reference for orienting during sample collection. Because the depth of water overlying the shoreline varies with the height of a given tide and the tidal stage when the sample is collected, samples are to be collected along the transect of the beach where water depth is approximately 1 m. The sample will be collected at mid-depth, that is half-way between the surface and bottom. This is to ensure that the water sample has minimum dilution by overlying water but collected far enough above the substrate so that particulate matter and sediment are not included in the water sample to be tested.

Sample Collection -- Two gallons of water will be collected at the designated sampling station during each sampling period for a toxicity test. A glass water sampling bottle or similar water collection device should be used to collect the water sample from a boat. Because wind, waves, and currents affect the collection process from a boat, samples can be collected within an 5-m radius of the target sampling point. Walking on the treated shoreline to collect the water sample should be avoided. Water can be stored for shipping in plastic water containers (such as cubitainers) as long as the container is clean and given an initial rinse with the site water before filling. Samples are to be labeled by station, date, and actual time of collection using labels that will not come off during storage and shipping and maintaining legibility.

Sample Processing -- Water is to be stored on ice or in a 4o C refrigerator after collection and during shipment. Samples taken during a day's collecting effort should be shipped out of Prince William Sound together. Storage time between collection and shipping to the testing laboratory should be minimized, but coordinated within practical sample processing schedules as part of the overall monitoring effort. Every effort should be made to ship samples out of Prince William Sound within 12 hours of collection. Delays due to mechanical problems or weather will make interpretation of test results difficult, but samples should be shipped for testing if holding time is less than 48 hours.

Sample Shipping -- Samples will be sent to Anchorage for shipping to the testing laboratory. Express or overnight service will be used to get the samples to the laboratory as soon as possible. Shipping delays will add to the uncertainty of how representative the samples are of Prince William Sound conditions. Unreasonable delays could develop a loss of credibility to the extent that the application and monitoring would have to be repeated. Samples are to be sent to the following address:

MEC Analytical Systems, Inc.
Bioassay Division
98 Main Street - Suite 428
Tiburon, CA 94920
Phone 415-435-1847

Collection Schedule -- Samples from treated shorelines will be collected at time 0, after the site has been prepared for bioremediation treatment but before fertilizer application. Fertilizer applications are scheduled for a 4-hour window that includes the period of 2 hours before low tide and 2 hours after low tide. The first post-treatment sample is to be collected 1 hour after fertilizer application has been completed, time +1. This should be approximately midway of the incoming tide, but the exact purpose is to demonstrate water quality at 1 hour post-application. The second post-treatment sample is to be collected midway of the subsequent outgoing tide, irrespective of the time by which application was completed. This should be approximately 7 hours after the ideal application window, time +7. The next sample is to be collected midway of the next outgoing tide, approximately 12 hours later or time +19. Subsequent samples will be collected at the midpoint of the outgoing tide that occurs during the morning or early afternoon. This allows for collection and transportation out of the sound during the day. Collection times, assuming a 25-hour periodicity for two tides over a day, are then scheduled for the next three days at +32 hours, +57 hours, and +82 hours. Actual time of collection for these samples can be + 2 hours to accommodate travel times between sites. Any samples that can not be collected for weather or mechanical problems should be noted in the sampling log, and the fixed schedule be followed without change.

Reference Samples from the Field -- A reference shoreline for bioassay testing will be located near test sites. Control areas used for microbiological sampling that represent a split of oiled shoreline on a single beach cannot be used for collection of controls for toxicity tests. Bioassay control shorelines should represent the degree of oiling seen on the test sites, however physical removal activities need not be present for these reference sites. The water samples will show the degree of water quality on oiled shorelines where no treatment has occurred. Also, they will show trends in water quality through time at untreated sites. Water samples will be collected using the same collection and processing techniques employed at the treated shorelines. The collection schedule will be different. Samples are to be collected on reference shorelines at the time 0, time +19, and time +57 periods, using the tide schedule to collect at the midpoint of outgoing tides as the exact schedule. Labeling and shipping will follow the same procedures specified for treated sites.

Collection Schedule for Toxicity Tests

Actual sampling time	Approximate Time (hrs)	Tidal Stage	Collection Site Treated	Collection Site Ref.
Pre-application	0	Near low tide	X	X
1-hr post application	+ 1	Near mid incoming	X	
1st outgoing post-appl.	+ 7	mid outgoing tide	X	
2nd outgoing post-appl.	+19	mid outgoing tide	X	X
3rd outgoing post-appl.	+32	mid outgoing tide	X	
5th outgoing post-appl.	+57	mid outgoing tide	X	X
7th outgoing post-appl.	+82	mid outgoing tide	X	

APPENDIX SOP.
Standard Operating Procedures

Section 2. Analyses of inorganic nutrients in seawater

of review and approval

Name	Initials	Date
Originator		
Concurrence		
Approved	WDS	5-23-90

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QUALITY ASSURANCE PROJECT PLAN

for

THE ANALYSES OF INORGANIC NUTRIENTS IN SEAWATER SAMPLES FROM PRINCE WILLIAM SOUND, ALASKA

prepared by

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Original: 21 May 1990

APPROVALS:

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Dr. Theodore C. Loder III, Principal Investigator   Date

Will Steinhauer   5/23/90

Dr. William Steinhauer, Manager, Marine Chem. Dept., Battelle   Date

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QUALITY ASSURANCE PROJECT PLAN

for

THE ANALYSES OF INORGANIC NUTRIENTS IN SEAWATER SAMPLES FROM PRINCE WILLIAM SOUND, ALASKA

1. PROJECT NAME: The Analyses of Inorganic Nutrients in Seawater Samples From Prince William Sound, Alaska

2. PROJECT REQUESTED BY: Battelle Ocean Sciences

3. DATE OF REQUEST: May 14, 1990

4. DATE OF PROJECT INITIATION: May 14, 1990

5. PROJECT DIRECTOR: DR. T. C. LODER III

6. QUALITY ASSURANCE OFFICER: Ms. Joanne Knight

7. PROJECT DESCRIPTION

   A. Objectives

The objective of this project is to analyze seawater samples collected in Prince William Sound for the following inorganic nutrients: nitrate, nitrite, ammonium, and phosphate~~, and silicate~~. The samples will be collected by * ~~Battelle Ocean Sciences~~ America North, Inc. personnel in coastal areas affected by the Exxon Valdez oil spill that are being experimentally being treated with fertilizers to enhance bacterial degradation of the residual oil.

silicate, not required
WWS
5-23-90

   B. Data Usage

The nutrient data will being provided to Battelle in a timely fashion to aid in interpreting the impact of the fertilizer additions while the experiment is still in progress.

* Battelle personnel will be involved in sample collection. However, ANI has management responsibility for field collection under direct contract to Exxon
WWS 5-23-90

su p3 WJ 5-23-90

C. Technical Approach

America North Inc.
~~Battelle Ocean Sciences~~ will determine the timing of sample collection and the number of samples to be collected. Samples will be filtered in the field, frozen, and delivered frozen to the University of New Hampshire. Laboratory analyses of the samples will be carried out in the Estuarine/Coastal Chemistry Lab at the University of New Hampshire using a 3-channel AutoAnalyser nutrient analyses system. The analyses to be conducted and the methods used are given in Table 1.

Table 1. List of nutrient parameters to be analysed.

Parameter	Matrix	Units	Methodology	Reference	Max holding Time	Preservation
Nitrate	water	µM	AutoAnalyzer	TIS(a)	2 mon	freezing
Nitrite	water	µM	AutoAnalyzer	TIS(b)	2 mon	freezing
Ammonium	water	µM	AutoAnalyzer	Adam.	2 mon	freezing
Phosphate	water	µM	AutoAnalyzer	TIS(c)	2 mon	freezing
Silicate	water	µM	AutoAnalyzer	TIS(d)	2 mon	freezing

References:
TIS (a): (Technicon Industrial Systems, 1972)
TIS(b): (Technicon Industrial Systems, 1973a)
TIS(c): (Technicon Industrial Systems, 1979)
TIS(d): (Technicon Industrial Systems, 1973b)
Adam.: (Adamski, 1976)

8. PROJECT FISCAL INFORMATION

A budget for this project is included in the contract between the University of New Hampshire and Battelle Ocean Sciences.

9. SCHEDULE OF TASKS AND PRODUCTS

Samples are to arrive at the University of New Hampshire, Durham, NH starting during the week of May 21, 1990. They are to be shipped frozen in sets of approximately 100-112 samples. The samples are to be analyzed within several days of receipt and draft data will be sent to Battelle within 2 weeks of receipt or sooner if possible. It is expected that samples will be shipped every 1-2 weeks to UNH during the end of May and the month of June, 1990.

Once all samples have been analyzed, a copy of the final data set and report will be prepared and delivered to Battelle within one month after the final receipt of samples.

10. PROJECT ORGANIZATION AND RESPONSIBILITY

Dr. T. Loder (EOS, University of New Hampshire, Durham, NH 03824, Tel. (603) 862-3151) will be the Principal Investigator and Program Manager for this project and will be the main contact for the project with Battelle Ocean Sciences. He will be directly responsible to Battelle Ocean Sciences for the quality and timely completion of the project. He will be responsible for data interpretation and preparation of reports to Battelle Ocean Sciences.

Dr. Loder will be assisted by several students (Lab. Tel. 603-862-1542) at the University of New Hampshire who will carry out the analyses on the samples. Ms. Joanne Knight will be responsible for sample tracking and the nutrient analyses. She will be assisted by Mr. Mark Holton, Mr. Paul Waldner, and Ms. Susan Becker. Ms. Knight will be in charge of the data management and quality control under the direction of Dr. Loder.

11. DATA QUALITY REQUIREMENTS AND ASSESSMENTS

A. Precision

The analytical precision for the nutrient analyses will be checked once or twice per sample set by triplicate analyses of several sets of duplicate nutrient samples, so that on the average 5% of the samples will be run in replicate. The standard deviations of these analyses will be compared to the standard deviation of the triplicate standards analyzed during each analytical sample run. The results of these replicate analyses will be reported with the data for each sample set. Although the analytical precision for these analyses varies as a function of the range of sample concentrations, they are expected to be close to those listed in Table 2.

Table 2. Average standard deviations for 3-4 standards analyzed at the same time (Gagosian et al., 1983). The detection limits are about 2x the standard deviation. The accuracy of these analyses for samples is 3-5x the Std. Dev. representing ±1-4% of the concentration range.

Nutrient	Conc. Range (µM)	Std. Dev. (± µM)	Est. Accuracy (4x S.D.) (± µM)
Phosphate	0-3.5	0.04	0.16
Silicate	0-45	0.06	0.24
Nitrate	0-12	0.04	0.16
Nitrite	0-8	0.02	0.08
Ammonium	0-4	0.02	0.08*

*The value of 0.08 µM for ammonium accuracy is probably too low in spite of the findings in the report and a value of twice that or about 0.15 µM is more realistic based on findings in our lab.

B. Accuracy

All inorganic nutrient samples will be analyzed utilizing a computerized 3-channel Technicon AutoAnalyzer system using methods for seawater nutrient chemistry described by Technicon and summarized by Glibert and Loder (1977) and Loder and Glibert (1977). All samples will be quantified against working standards made up in low nutrient seawater prepared from diluted stock standards made with dried and carefully weighed reagent-grade primary standard reagents. New standards are always compared to old standards to ensure that there is continuity between analyses made over long periods of time. The salinity of the low nutrient seawater is adjusted to approximate the salinity of the samples by dilution with small amounts of nutrient-free deionized water. Working standards are made daily or more often as needed by diluting the stock standards with calibrated Eppendorf microliter pipets and class A volumetrics, except for silicate standards which are made up in plastic volumetrics.

A working calibration curve based on a single standard addition technique with the low nutrient seawater is used for determining the concentration of the nutrients in the samples. All standards and blanks are run in triplicate. This works well because the chemistries are linear in the range of concentrations normally found in the coastal waters. In addition, linearity tests will be run several times during the analysis period using multiple standards covering the range of concentrations observed in the samples. These data will be compared against the calibration curve determined with the single standard addition technique.

Contamination by sample cups is eliminated because samples for the analyses are sucked directly from the original sample bottles into the analyzer. Sample peak heights are recorded on chart paper as well as by a computer linked into the system, so that hard copy of all analyses is available for cross checking. Peak height data, recorded by the computer, are then corrected for baseline drift and carryover and compared to standard peaks obtained during the calibration part of the analysis run. Then adjustments are made for refractive index corrections and chemical corrections and the final data are calculated as described by Loder and Glibert (1977).

C. Comparability

Because the methods for the nutrient analyses are standard oceanographic techniques, the data will be comparable with other data that may be collected later from the same area.

D. Completeness

It is expected that greater than 98% of the data will be obtained since duplicate samples will be collected by Battelle and one set of samples will be stored as back up samples in case any samples are lost or spilled.

12. SAMPLING AND LABORATORY PROCEDURES

America North Inc. see p3 WRS 5-23-90

Samples will be collected by ~~Battelle Ocean Sciences~~, following their own protocols. It is expected that the samples will be filtered using 0.45 µm pore size filters (Millipore HA or equivalent) and stored in acid-washed and sample rinsed 22-ml polyethylene scintillation vials. Samples will be frozen as soon as possible after filtration, preferably on dry ice. More details of sample collection recommendations are described in Appendix A.

13. SAMPLE CUSTODY PROCEDURES

Nutrient sample bottles will be individually labeled by the Battelle field sampling team. The samples will be frozen and shipped by by Federal Express or equivalent service to Loder's lab in New Hampshire where they will be examined for thawing, recorded on sample custody forms (Appendix B) and stored frozen in a chest freezer in the lab at UNH prior to analyses.

14. CALIBRATION PROCEDURES AND PREVENTATIVE MAINTENANCE

The AutoAnalyzer is calibrated with each individual analysis set of samples (30-34) run using standards analyzed in an identical manner as the samples. Calibration data will be kept with each set of sample data.

15. DOCUMENTATION, DATA REDUCTION AND REPORTING

A. Documentation

The analytical methods used in this study are standard methods cited in several of the above sections as are the initial data reduction methods. All finalized data for the project will be transferred to a spreadsheet (Excel-Macintosh) for initial analysis, formatting and printing in data reports. The data will be organized by sample set and experiment as defined by Battelle Ocean Sciences. All raw data and calculation data sheets for the nutrient analyses will be kept on file in Room 346 in the Science and Engineering Building at UNH.

B. Data Reduction and Reporting

Once the samples are analyzed, the appropriate corrections and calculations are made, including corrections for baseline drift, carryover, and sample refractive index (includes turbidity). These data are then validated as described in section 16 and finally listed and reported in the biweekly data reports. The data will be submitted to Battelle Ocean Sciences as computer print out hard copy and on computer disks if requested.

16. DATA VALIDATION

All data will be proofed for error at the time they are entered in the computer by either Holton, Knight, Becker, or Waldner. Then the data will be plotted using parameter/parameter plots such as nitrate vs phosphate. Any outliers will be checked for "oceanographic consistency" to ensure that the data reported are what were actually measured. Data that do not meet the criteria for proper handling and analyses as well as oceanographic consistency will either not be reported or reported with an explanation of the associated problems. This final proofing will be carried out by Loder and Knight during preparation of the final report.

17. PERFORMANCE AND SYSTEMS AUDITS

All the data files and records of this project will be available for inspection by Battelle officials and/or authorized representatives.

18. CORRECTIVE ACTION

Data quality objectives and validation procedures for this program have been designed to ensure that personnel will be able to identify and correct any analytical problems for each sample set. If there are questions concerning the nutrient analyses, samples can be rerun, since the samples will be refrozen after analyses and stored until all final data analyses are completed. In addition, a back-up set of samples will be available for analyses in case of uncertainity in any of the analyses. Any rerun analyses will be noted with the reasons for the rerun.

19. REPORTS

There will be two types of reports resulting from this project. The first will be available within two weeks after each sample set is received and will consist of draft data of all the analyses. Second, there will be the more formal final report which will consist of the final data (both hard copy and computer disk files on Excel -Macintosh), and copies of the requested lab records concerning all of the analyses.

LITERATURE CITED

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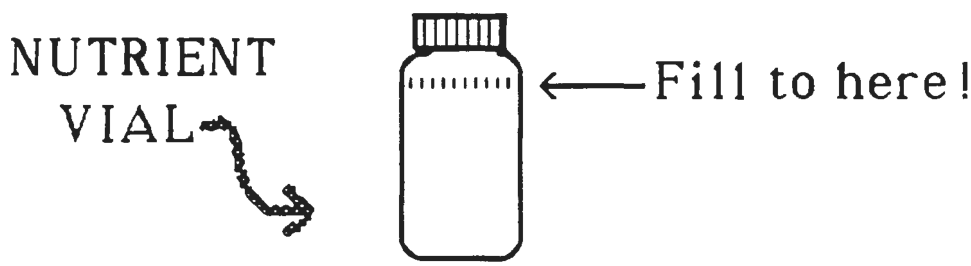
Appendix A

INSTRUCTIONS FOR NUTRIENT SAMPLE COLLECTION

Samples for nutrient analyses may be stored in polyethylene scintillation vials which hold approximately 22 ml. The vials supplied to you by UNH have been treated as follows:

The vials are washed prior to use with hot soapy water, rinsed with distilled water, soaked with approx. 10% HCl acid, and rinsed with low-nutrient, deionized distilled water (DDW). Only DDW has low enough ammonium and silicate. Note that any substitute bottles must be treated in a similar manner to ensure that they are clean.

Freshly collected samples should be filtered in the field through 0.45μm filters (Millipore HA or equiv.), using cleaned and acid–washed plastic syringes (50-60 ml) and 25–mm inline filter holders from Millipore or Gelman. We like the Gelman ones the best. After rinsing the syringe with the sample several times, the syringe is filled and approx. 20 ml of sample filtered and discarded to rinse the filter and holder. Then the vials and caps should be rinsed with the filtered sample three(3) times prior to filling to below the shoulder as shown here:



Do not fill the bottles any fuller than the shoulder because when the samples are frozen the caps are pushed out and some sample is lost, rendering the data suspect(useless?). Once the bottle is filled as above and the cap tightened, the samples should be frozen in an <u>upright position</u> as soon as possible, we recommend dry ice. If freezing is not possible immediately, then samples should be kept on ice until they can be frozen. Keep the samples frozen until delivered for analysis.

MEMO FROM: T.C. Loder, UNH, 4/14/90

Appendix B. Sample custody form.

ESTUARINE/COASTAL CHEMISTRY LABORATORY **Sample Custody Transfer Form**
EOS, UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NH 03824

Project: Battelle Ocean Sciences 1990 Sampling Date: ________
Project #: Exxon Study No. 71
Number of Samples: ________
Type of Samples: Nutrients

Sample I.D. No.	Description	Sample I.D. No.	Description
71NUT000		71NUT000	
71NUT000		71NUT000	
71NUT000		71NUT000	
71NUT000		71NUT000	
71NUT000		71NUT000	
71NUT000		71NUT000	
71NUT000		71NUT000	
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71NUT000		71NUT000	
71NUT000		71NUT000	
71NUT000		71NUT000	

TRANSFER RECORD:

Released by:		Date	Received By:	Date	Time & Comments:

Comments: ________

____

Form SCT (5/90)

APPENDIX SOP.
Standard Operating Procedures

Section 3. Determination of Kjeldahl Nitrogen in seawater

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
5633 B STREET • ANCHORAGE, ALASKA 99518 • TELEPHONE (907) 562-2343

STANDARD OPERATING PROCEDURE
For The Determination of
Total Kjeldahl Nitrogen in Water

A. Standard Methods for the Examination of Water and Wastewater. 17th ed., 1989, Method 4500-N_{org} C, 4500-NH_3 C.

B. Annual Book of ASTM Standards. 1981. Method D3590.

1. Scope and Application

1.1 This method is for the determination of Total Kjeldahl Nitrogen in drinking water, surface and saline waters and domestic and industrial wastes.

1.2 Total Kjeldahl nitrogen as low as 10 ug/L can be reliably detected using this method.

2. Summary of Method

2.1 In the presence of H_2SO_4, potassium sulfate (K_2SO_4), and mercuric sulfate ($HgSO_4$) catalyst, amino nitrogen of many organic materials is converted to ammonium sulfate $(NH_4)_2SO_4$. Free ammonia and ammonium-nitrogen are also converted to $(NH_4)_2SO_4$. The sample containing this nitrogen is digested until SO_3 fumes are obtained and the solution becomes colorless or pale yellow. The residue, a mercury ammonium complex, is cooled , diluted and then made alkaline and thus decomposed with a hydroxide-thiosulfate solution. The ammonia is distilled into a boric acid solution. Addition of nessler reagent results in a color change proportional to the ammonia concentration which can be quantified by spectroscopy and direct comparison to standards.

3. Sampling and Storage

3.1 Collect sample in a 1 liter chemically cleaned bottle (ASTM method D 3370) and immediately preserve the sample by adding 1 ml of concentrated H_2SO_4 The pH should be 2.0 or less. Store at 4C. If possible, analyze the sample within 24 hours of sampling.

4. Interferences

4.1 Nitrate: during digestion, nitrate in excess of 10 mg/L can oxidize a portion of the ammonia released resulting in a negative interference. Also, nitrate can be reduced to ammonia, resulting in a positive interference.

4.2 Inorganic salts and solids: the acid and salt content of the digestion reagent is intended to produce a digestion temperature of 365-370C. If the sample contains a very large quantity of inorganic salts and solids that dissolve during digestion, the temperature may rise above 400C and a pyrolytic loss of N may occur. To prevent this, add 1ml H_2SO_4 per gram of salt in the sample. Add the same amount of acid to both the sample and reagent blank. Too much acid will lower the digestion temperature below 360C and result in incomplete digestion and recovery.

5. Apparatus

5.1 Micro Kjeldahl Distillation Apparatus: use an all glass Micro-Kjeldahl still equipped with a steam generating vessel containing an immersion heater, a water cooled condenser with an outlet tip that may be submerged below the surface of the receiving acid, and an outer glass-stoppered funnel to facilitate sample addition.

5.2 pH Meter.

5.3 Spectrophotometer: suitable for absorbance measurements at 425nm.

5.4 Digestion apparatus: use Kjeldahl flasks with a capacity of 100 ml in a semi-micro-kjeldahl digestion apparatus equipped with heating elements to accomodate Kjeldahl flasks and a suction outlet to vent fumes. The heating elements should provide a temperature range of 365-370C for effective digestion.

6. **Reagents**

6.1 Ammonia-free water: prepared by passing distilled water through an ion-exchange column containing a strongly acid cation-exchange resin mixed with a strongly basic anion-exchange resin. Select resins that will remove organic compounds that interefere with ammonia determination. It is very difficult to store ammonia-free water in the laboratory without contamination from gaseous ammonia, therefore, freshly deionized water should be used for all reagents, rinses, blanks, standards and sample dilutions.

6.2 Stock Ammonium Nitrogen Solution: dissolve 3.819g anhydrous NH_4Cl that has been dried at 100c 1 hour, in water and dilute to 1 L.
1.00ml= 1.00 mg N= 1.22 mg NH_3

6.3 Standard Ammonium Solution: dilute 10 ml stock solution to 1000 ml with deionized water.
1.00 ml= 10.0 ug N= 12.2 ug NH_3.

6.4 Sodium Hydroxide, 6N: 240g NaOH in 1 liter.

6.5 Boric Acid Solution (20 g/L) : Dissolve 20g boric acid (H_3BO_3) in water, dilute to 1 L.

6.6 Dechlorinating agent: Dissolve 1.0g of sodium arsenite ($NaAsO_2$) in ammonia-free water and dilute to 1 L. 1 ml will remove 1 mg/L of residual chlorine from a 500 ml sample. (0.1 ml for 50 ml sample)
Caution: toxic, avoid ingestion. Make fresh weekly.

6.7 Nessler Reagent: dissolve 50g of anhydrous Mercuric Iodide (HgI_2) and 35g of anhydrous Potassium Iodide (KI) in a small volume of water and add this mixture slowly, with stirring, to a cooled solution of 80g NaOH in 250ml water. Dilute solution to 500 ml. Store solution in a brown bottle in the dark for 5 days. Filter twice through a fritted glass crucible or a glass fiber filter before use. If reagent is stored in a chemically resistant bottle out of direct sunlight, it remains stable up to 1 year. (reagent may be used without 5 day storage if filtered through a rinsed 0.45 um membrane)
Caution: toxic.

6.8 Nitrogen QC Standard: 1ml= 150 mg/L by HACH chemical.

6.9 Digestion reagent: dissolve 134g K_2SO_4 in 650 ml water and 200 ml conc. H_2SO_4. Add with stirring, 25 ml mercuric sulfate solution (2g red HgO in 25 ml 6N H_2SO_4). Dilute to 1 L.

6.10 Sodium Hydroxide-Sodium Thiosulfate Solution: dissolve 500g NaOH and 25g $Na_2S_2O_3$-$5H_2O$ in water and dilute to 1 L.

7. **Procedure**

7.1 Digestion

a. Connect up evacuation tube to sink vacuum.

b. Place 50.0 ml of sample or an aliquot (for high samples) in a 100-ml Kjeldahl flask and add 3-4 boiling chips and 10 ml of digestion solution. At the same time start a duplicate and spike per 10 samples, a blank, and a standard curve check sample (QC).

A typical spike is 3-5 ml of standard NH_3-N (1 ml= 10 ug)
A typical QC is 1 ml of 150 ug/ml solution.

c. Evaporate the samples at setting 4 (may have to turn down if bumping occurs) until SO_3 fumes are given off, then digest for 30 min at setting 7.

d. Cool the residue and add 25ml water to dissolve.

7.2 Distillation

A. Close evacuation outlet and place appropriately labeled 50 ml flask containing boric acid beneath condenser tip.

B. Quantitatively transfer sample into distillation apparatus by rinsing the beaker twice and then rinsing the sample inlet cup once. All rinses should not be more than 10 ml total.

C. Close inlet stopper and fill cup with deionized water.

D. Push receiving flask up so that condenser tip is below the level of acid.

E. Distill at a rate of 6 to 10 ml/min and at a rate at which steam does not escape from condenser tip nor bubbling of contents in receiving flask occurs.

F. Distill and collect 30 to 40 mls distillate below the surface of 10 ml boric acid.

G. Lower collected distillate free of contact with delivery tube and continue distillation during last 1 or 2 min to cleanse condenser and delivery tube.

H. Tightly seal flask with rubber stopper.

I. Evacuate sample and rinse apparatus 3 times, including one rinse that is allowed to steam approximately 5 min .

7.3. Nesslerization

A. Neutralize the pH of the distillate with 6N NaOH, before adding 1 ml Nesslers.

B. Prescreen samples for approximate concentration of NH_3-N by adding 10 ml sample to a glass test tube and 1 ml Nessler reagent to this sample. Mix. Estimate the concentration and make cuts if needed in 10 ml so that the concentration will fall on the curve. (An orange to brown color indicates high concentration)

C. Add 10 mls of the samples, blanks, dups, spikes, and standards to appropriately labeled test tubes. Write up work sheet in same order as tubes to ease the writing of absorbances every 30 seconds.

D. While watching a timer, add 1 ml Nessler reagent at time 0 to tube 1 (blank) and mix on vortex mixer. At 30 seconds, add 1 ml Nessler to 2nd tube and mix. At 1 min, 3rd tube, etc..

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E. Reaction time must be the same for all samples, standards and blanks. So after at least 20 minutes from time 0, read the absorbances at 425 nm every 30 seconds starting with tube 1 (blank). If NH_3-N concentration is very low in samples, reaction time can be extended to 30 min for all samples, standards and blanks.

8. **Calculations**

$$\text{TKN ug/ml} = \frac{\text{ug TKN (curve) X Vol Distilled (ml) + Boric acid}}{\text{vol sample digested (ml) X vol tested in nesslerization (ml)}}$$

Prepared by: Chris Brown	Date: 8/22/90
Stephen C. Ede	8-22-90
Effective Date: January 1, 1990	

APPENDIX SOP.
Standard Operating Procedures

Section 4. Microbial Protocols

APPENDIX SOP, SECTION 4
MICROBIAL PROTOCOLS

Assessment of microbial populations was an important component of this study since the ultimate fate of spilled petroleum depends on the ability of microorganisms to use hydrocarbons as a source of carbon and energy (Leahy and Colwell, 1990). However, the absolute amount and rate of biodegradation of any petroleum will depend on its composition and specific abiotic environmental parameters. Petroleum is not a single defined organic compound, thus monitoring its biodegradation or transformation is complex, demanding and often relatively inaccurate. Thus, in addition to enumeration of hydrocarbon-oxidizing microorganisms, metabolic equivalents (CO_2 evolution, O_2 consumption, enzyme assays, etc.) are often used to characterize the microbial response in soils or sediments exposed to hydrocarbons (Bartha and Atlas, 1987). The microbiology portion of the study was designed to document the numbers of hydrocarbon-oxidizing and heterotrophic microorganisms and the hydrocarbon oxidation potential of microorganisms on fertilized and unfertilized plots in the study areas.

MOST PROBABLE NUMBER OF MICROORGANISMS

Sediment samples were analyzed using the Most Probable Number (MPN) technique for determining the number of heterotrophic and hydrocarbon-degrading microorganisms. While no technique to enumerate specific metabolic types of microorganisms in marine systems is absolute, the MPN technique can give consistent results that are appropriate for relative comparisons among sites and treatments. The "sheen screen" method for enumerating hydrocarbon-degrading microorganisms (Brown and Braddock, 1990) was employed throughout the study.

Hydrocarbon-degrading microorganisms are defined as those microorganisms capable of emulsifying a Prudhoe Bay oil sheen layered on Bushnell-Haas marine mineral salts (Difco Laboratories, Detroit, Michigan) broth. Total heterotrophs are defined as those microorganisms capable of growth (turbidity) in marine broth (Difco Laboratories). The procedure calls for inoculation of five 100-ul aliquots of each serially diluted sample into sterile 24-well microtiter plates containing approximately 1.75 ml of sterile broth. Following inoculations, a sheen of sterile Prudhoe Bay crude oil is applied to each well of the Bushnell-Haas plates using a syringe fitted with a 26-gauge needle. Each microtiter plate is incubated at 16 $\pm$ 2 C for three weeks following inoculation. Wells are scored as positive when oil emulsification is clearly indicated by disruption of the sheen.

HYDROCARBON OXIDATION POTENTIAL

Radiorespirometry was used to assay the hydrocarbon-oxidation potential of microorganisms in sediment slurries. [1-^{14}C]-

hexadecane and [9-^{14}C]-phenanthrene were used as paradigms of aliphatic and medium weight polycyclic aromatic hydrocarbons. The assay was designed to be independent of all of the complex factors regulating microbial hydrocarbon metabolism (including hydrocarbon availability) except the microbial biomass and its potential to degrade hydrocarbons in each sample. The rate of $^{14}CO_2$ production (r^*; dpm/day) from radiolabelled hydrocarbon is a function of the overall rate of CO_2 production (R; ug/day) and the specific activity of the added radiotracer ($A^*/(Sn + A)$; dpm/ug; where A^* is the total radioactivity added, Sn is the 'in situ' hydrocarbon concentration and A is the concentration of hydrocarbon added with the radiolabelled hydrocarbon). Therefore,

$$r^* = \frac{RA^*}{(Sn + A)} . \qquad (1)$$

The overall rate of CO_2 production (R) is in turn a function of hydrocarbon availability and the biomass, metabolic activity and growth rate of the microorganisms in the sample.

r* was assayed in sediment slurries (one part sediment and nine parts sterile seawater) amended with 10 ppm radiolabelled hydrocarbon. After vigorous shaking for 30 minutes, 10-ml aliquots of each sediment slurry were pipetted into sterile 40-ml glass incubation vials fitted with Teflon-lined septa (I-Chem Research, Hayward, CA). Each vial was then injected with 50 ul of a 2 g/l solution of the radiolabelled hydrocarbon (in acetone). Vials were incubated without shaking for various time periods at 16 $\pm$ 2 C, in the dark and killed by adding one ml of 4 M HCl at the appropriate time. After incubation, r* was measured by recovering $^{14}CO_2$ by purging the acidified samples with N_2 gas through a toluene-containing Harvey trap (Harvey Biological Supplies, Hillsdale, NJ) into CO_2 sorbing liquid scintillation cocktail and counting the radiolabel in a liquid scintillation counter. r* was standardized to sediment dry weight. By adding 100 ug of hydrocarbon substrate to each vial (10 ppm in each slurry), A in equation (1) is large enough to make Sn negligible for all samples regardless of the degree of oil contamination. By incubating the microorganisms in the samples in identical conditions, the effect of most other external factors is minimized. Therefore, r* is an indicator of the potential for the microbial community assayed to metabolize a particular hydrocarbon. Those microbial communities in sediment samples with high r* imply higher biomass and/or metabolic activity with respect to hydrocarbon degradation. r* measured in this way is not a measure of 'in situ' hydrocarbon mineralization rates.

SEDIMENT DRY WEIGHT

Dry weight determinations were obtained for each sediment sample by removing approximately 50g of sediment and weighing in a tared container. The samples were dried at 90 C for 24 hours, cooled, and re-weighed. Sediment dry weights are used to standardize all of the data.

QUALITY ASSURANCE

MOST PROBABLE NUMBER OF MICROORGANISMS

The most probable number (MPN) microbial enumeration procedure is a statistical method that helps ensure the attainment of quality data through its design. Based on the results of a number of replicate inoculations (typically either three or five), the statistically significant MPN of microbes (selected for by the medium) per unit volume is calculated.

Positive results in the MPN procedure were scored when the sheen of pre-sterilized oil applied to the surface of the media became emulsified, or in the case of heterotrophs, turbidity resulted. Negative controls were run by preparing sterile media plates not inoculated with sample.

HYDROCARBON OXIDATION POTENTIAL

A number of controls were run to assure the quality of the data for biodegradation potentials. Each incubation had an associated killed control. The latter was used to check for abiotic evolution of radiolabelled-CO_2 for the duration of the incubation period and to correct for duplicates. The controls were killed by addition of 1 ml of 4M HCl.

$^{14}CO_2$ capture efficiency was assessed by running samples spiked with known quantities of radiolabelled bicarbonate. The purging system recovers >99% of $^{14}CO_2$ from these radiolabelled bicarbonate samples. Carryover in the purging system was assessed by periodically running acidified water samples through the line. The dpm values from these samples must fall within the range of the blank sediment samples. In addition, the ^{14}C-labelled products collected in the Harvey traps were monitored on a daily basis. This toluene was replaced daily with a fresh aliquot.

Leakage of CO_2 from the sample vials was monitored by looking for bubble production after applying a soap solution.

The radiorespirometry measurements were run in duplicate to allow the elimination of unreliable data:

1. First exclude all data pairs where one or both of the duplicates was identified visually as leaking during incubation. The remaining replicates were then compared using a Comparison Index calculated as follows:

$$\text{Comparison Index} = \frac{(\text{Replicate 1} - \text{Replicate 2})}{[(\text{Replicate 1} + \text{Replicate 2})/2]}$$

2. Next compute the mean of all Comparison Index values for a given substrate, and exclude from further consideration those data pairs where the Comparison Index for that data pair falls outside the mean $\pm$ 2 standard deviations.

3. Use a similar procedure to exclude background control samples that had not in fact been killed.

4. Calculate the activity attributable to biodegradation of the substrate as the difference between reliable experimental data and the mean of reliable killed controls.

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APPENDIX SOP.
Standard Operating Procedures

Section 5. Extraction of sediment samples for low level petroleum analysis

Title: Extraction of Sediment Samples for Low Level Petroleum Analysis

SOP No:	Revision No.:	Effective Date:
EVC89-4	3.0	November 27, 1989

1.0 SCOPE AND APPLICATION

Assessment of the environmental impact of spilled oil requires that certain chemical parameters be measured in sediment samples collected from the impacted area. These parameters include selected saturated hydrocarbons, substituted and unsubstituted polynuclear aromatic hydrocarbon compounds (PAH) and heterocyclic compounds, and total petroleum hydrocarbon compounds (PHC).

This document describes the application of EPA SW846 Method 3550 and modified Method 3611 for extraction of the petroleum hydrocarbon compounds from sediments and extract cleanup by alumina column chromatography. The method will be used together with SOP EVC89-2 for analysis of unsubstituted and substituted PAH and certain heterocyclic compounds by gas chromatography using mass spectrometry detection (GC/MS), and with SOP EVC89-3 for analysis of saturated hydrocarbon compounds and total oil (PHC) by gas chromatography using flame ionization detection (GC/FID). The method is applicable for the analysis of sediment samples containing PAH at 10 to 800 µg/kg, and PHC at 10 to 800 µg/g (wet weight), although it can be applied to samples of higher concentration if spiking levels are adjusted and extracts split for processing based on extract weight.

Thirty (30) grams of sediment is spiked with the appropriate surrogates and serially extracted with 1:1 methylene chloride/acetone using sonication techniques. The extract is dried with sodium sulfate, concentrated, and cleaned up using the EPA Method 3611 alumina column cleanup procedure to remove matrix interferences. The alumina cleanup procedure is required prior to PHC or PAH analyses. The aliphatic and aromatic fractions collected from the cleanup column are combined and optionally split into aliquots for analysis.

PHC and PAH must be determined on the same 30g sediment sample aliquot.

Note: In the EVC89-Series of SOPs, the methods are designed to produce data at certain environmental concentrations in order to satisfy programmatic needs. To achieve these reporting limits (RL), instruments need to be operated at maximum sensitivity for the sample sizes specified. Therefore the RL and the method detection limit (MDL) are conceptually the same value. In these SOPs the method detection limit goal (MDLG) will be used to indicate both the MDL and the RL.

Approved By:

________________________________, Exxon Date:

2.0 SAMPLE COLLECTION, PRESERVATION, STORAGE AND HOLDING TIMES

2.1 **Sample Collection**--Sediment should be sampled in precleaned glass jars, or core liners, frozen in the field, and shipped frozen to the laboratory.

2.2 **Sample preservation**--Sediment samples should be stored at -20°C. Samples should be frozen after careful inspection, and removal of overlying water. After subsampling excess sample should be archived at -20°C in the dark.

2.3 **Holding Times**--Frozen samples should be extracted within 30 days of verified sample delivery acceptance. The extract should be analyzed as soon as possible within 90 days after extract preparation. The extract should be stored with sufficient solvent so that extract will not evaporate to dryness during storage either prior to or after analysis. Extract analysis or reanalysis after 90 days is acceptable if surrogate spiking recoveries are acceptable.

3.0 INTERFERENCES

Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines observed by GC/MS or GC/FID detection. All of these materials must be routinely demonstrated to be free from interferences under the conditions of analysis presented in SOPs EVC89-2 and EVC89-3 by running laboratory reagent blanks.

Matrix interferences may be caused by contaminants that are coextracted from the sample. Since biogenic and other naturally occurring materials (i.e elemental sulfur) will cause interferences in the analysis of sediment extracts, alumina cleanup with activated copper will be used to eliminate matrix interference prior to GC/MS or GC/FID analysis for PAH and PHC respectively.

4.0 APPARATUS AND MATERIALS

4.1 Labware and Apparatus

Labware must be scrupulously cleaned. Clean all labware as soon as possible after use by rinsing with the last solvent used in it. This should be followed by detergent washing with hot water, and rinses with tap water, reagent water and acetone.

Glassware should then be oven dried at 150 to 200°C for a minimum of 30 minutes, and heated in a muffle furnace at 400°C for 15 to 30 minutes. Solvent rinses of benzene or methylene chloride may be substituted for the muffle furnace heating. Volumetric glassware should not be heated in a muffle furnace. After drying and cooling, glassware should be sealed and stored in a clean environment to prevent any accumulation of dust or other contaminants. Store glassware inverted or capped with solvent-washed aluminum foil. The following labware and equipment is needed to perform the sediment extraction and cleanup procedure:

250 mL or 500-mL Teflon jars, or other suitable containers

Vials: 1-mL glass vials with Teflon-lined caps, 7-mL vials

Glass Funnels

500-mL roundbottom flasks

500-mL Erlenmeyer flasks

Ultrasonic cell disrupters: Heat Systems-Ultrasonic, Inc. Model W-385 or equivalent

Drying column: 20-mm ID Pyrex chromatographic column with glass wool at bottom and Teflon Stopcock, or Pyrex glass funnel.

Concentrator tube: Kuderna-Danish - 10 mL, graduated. Ground glass stoppers are used to prevent evaporation of extracts.

Snyder column: Kuderna-Danish - Three ball macro column.
Evaporative flask: Kuderna-Danish - 500 mL. Attach to concentrator tube with springs or clips.

Micro reaction vessels: 2.0 mL or 1.0 mL autosampler vials with crimp cap septa.

Chromatographic column: 300-mm x 10-mm ID, with Pyrex glass wool at bottom and Teflon stopcock.

Analytical balance capable of weighing to 0.001 mg

Analytical balance capable of weighing to 0.1 g

Nitrogen blowdown apparatus

Note: Balances and volumetric glassware used for sample measurement or introduction of internal standards must be calibrated.

4.2 Reagents

Reagent Water: Reagent water is defined as water in which an interferant is not observed at the method detection limit of the compounds of interest.

Sodium sulfate: (ACS) Granular, anhydrous (purified by heating at 400 degrees C for 4 h in a shallow tray or other suitable method).

Solvents: Acetone, methylene chloride (pesticide quality or equivalent).

Alumina: Neutral 80-325 MCB chromatographic grade or equivalent. Dry alumina overnight at 130 degrees C prior to use.

Activated copper powder

6 N HCl

Surrogate spiking solutions: The compounds in the surrogate solutions are naphthalene-d_8, fluorene-d_{10}, and chrysene-d_{12} for PAH analysis and o-terphenyl for PHC analysis. As general guidance, the surrogate solution is made up at a concentration so that spiking of approximately 100 µl of this solution gives a final concentration each sample is ca. 3 to 10x MDLG for low level PAH and PHC samples. However, spiking levels depend on the expected levels of PAH and PHC in the samples. Refer to SOPs EVC89-2 and EVC89-3 for additional guidance on the preparation of appropriate surrogate spiking solutions for PAH and PHC.

Matrix Spike Standard: Refer to SOPs EVC89-2 and EVC89-3 for preparation of appropriate matrix spiking solution.

Internal Standard Solution: Refer to SOPs EVC89-2 and EVC89-3 for preparation of appropriate internal standard spiking solution.

Boiling chips, solvent extracted, approximately 10/40 mesh, silicon carbide or equivalent.

5.0 PROCEDURE

5.1 Sample Preparation

5.1.1 Thaw sediment sample at room temperature. Decant off overlying liquid from sediment sample. Homogenize the soil sample with a solvent-rinsed stainless steel spatula. Removal of material not representative of the sample (e.g. large

rocks) should be performed with the guidance of the Program Manager. Remove 5 g of sediment and place in a pre-weighed aluminum pan. Dry at 105°C for 12 hours and calculate the percent moisture content.

For the analysis of core samples or sections, the sample should be obtained by extrusion of the frozen core after slight warming the outside liner so that extrusion of the frozen sediment can take place. Core sectioning, or subsampling must be conducted under the direction of the Program Manager.

5.1.2 Add 30 g (wet weight) of the sample to a 250 or 500 mL Teflon or disposable glass jar. Mix in 60 g sodium sulfate. If the sample has excess moisture, add additional sodium sulfate.

5.1.3 Add surrogates. Spike with PAH and/or PHC surrogates such that the final extract concentration is 240 ng/mL and/or 20 µg/mL, respectively.

Note: Higher spiking levels are required for samples in which moderate to high oil levels are expected. As guidance, spiking levels should be increased by a factor of 10 if oil is visually observed, and by a factor of 100 if heavy oil (i.e. total coverage of substrate) is observed.

5.1.4. Add 100 mL of 1:1 methylene chloride/acetone to the sample. Sonicate for 3 min with the output knob set at 10, the mode switch on pulse and the percent duty knob set at 50 percent. After extraction, decant solvent into an Erlenmeyer flask.

5.1.5. Repeat step 5.1.4 two more times combining all extracts. Mix the sample thoroughly between extraction steps.

5.1.6. Filter and dry the extract with glass wool and sodium sulfate.

5.1.7. Concentrate the extract by Kuderna-Danish techniques to 4-5 mL. Add 50 mL hexane and reconcentrate sample by Kuderna-Danish and/or nitrogen evaporation to exactly 1.0 mL.

5.1.8. Remove 50 µL of the extract for aliquot weight determination. Transfer the aliquot to a tared pan, dry, and weigh to +/-0.001 mg.

5.2 Alumina Column Cleanup

5.2.1. Fill the glass chromatographic column to about 20 cm with hexane. Add 2 g of activated copper to the column, then 10.0 g alumina. Gently tap the column to distribute the alumina evenly. Alternatively, a slurry of alumina in hexane may be used to pack the column.

5.2.2. Allow the alumina to settle and then add 1.0 g of anhydrous sodium sulfate on top of the alumina and 10.0 g of activated copper.

5.2.3. Drain the hexane and elute the column with 50 mL hexane. Drain the column until the head of the liquid in the column is just above the sodium sulfate layer. Close the stopcock to stop solvent flow.

5.2.4. **If the extract weight determined in step 5.1.8 indicates an extract weight in excees of this amount, the extract must be split and only a fraction added to the column. In this case the spilt ratio must be recorded and the ratio taken into account in final calculations.** Transfer the 1.0 mL of sample extract or extract split onto the column. Rinse out the extract vial with 1 mL methylene chloride and add it to the column immediately. To avoid overloading the column, it is suggested that no more than 300 mg of extractable organics be placed on the column.

5.2.5. Just prior to exposure of the sodium sulfate plug on the column to the air, add 100 mL methylene chloride, and elute at a flow rate of 2 mL/min. Collect the effluent in a 250 mL Erlenmeyer flask or a Kuderna-Danish evaporative concentrator. The collected fraction contains aliphatic and aromatic hydrocarbons as defined in EPA Method 3611.

5.2.6. Concentrate the extract as above in 5.1.7 to 5 mL.

5.3 Preparation for Instrumental Analysis

5.3.1. The extract from the alumina column should be concentrated to 5 mL for PAH and PHC analysis. Refer to instrumental analysis SOPs for guidance on addition of PAH internal standards (defined in SOP EVC89-2) and PHC internal standard (SOP EVC89-3). It is recommended that the sediment extract be split; 20% for PAH analysis and 80% for PHC analysis.

6.0 INSTRUMENTAL ANALYSIS

Instrumental analysis of sediment extracts for PAH will be carried out following SOP EVC89-2 or EVC89-7, and for PHC following SOP EVC89-3. In both cases, sample extracts may need to be diluted or the concentrations of the instrumental calibration curves extended to cover the range of potential analyte concentration found in contaminated sediment samples. This method is applicable to the analysis of heavily oiled sediment samples if appropriate increases in surrogate spikes and internal standards are made and extract volumes adjusted.

7.0 QUALITY CONTROL

Quality control samples must be processed in an identical manner as actual samples.

7.1 One method blank must be run with every 20 samples, or with every sample set, whichever is more frequent. Blank levels should be no more than 5x MDL. If blank levels for any component are above 5x MDL, samples analyzed in that sample set should be reextracted and reanalyzed. If sample cannot be reextracted and reanalyzed, flag data to indicate to the data user to take appropriate action.

7.2 Matrix spike/matrix spike duplicate (MS/MSD) samples should be run with every 20 samples, or with every sample set, whichever is more frequent. MS/MSD compounds are presented in SOPs EVC89-2 and EVC89-3. Appropriate spiking level is 3 to 10x the method detection limit.

7.3 Surrogate materials must be spiked into every sample and QC sample. Surrogate materials are presented in SOPs EVC89-2 and EVC89-3. Appropriate spiking level is 3 to 10x the method detection limit.

7.4 Surrogate and matrix spike recovery acceptance criteria: Refer to SOP No. EVC89-2 or EVC89-3 for appropriate recovery acceptance criteria.

7.4 A Reference standard solution containing crude oil, when available, should be analyzed with each batch of samples. Refer to analytical SOPs for further guidance.

8.0 CALCULATIONS

Refer to EPA Method 3550 for calculation of percent moisture. Other calculations are presented in SOPs EVC89-2 and EVC89-3.

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9.0 REPORTING

9.1 Reporting units are µg/kg for PAH, µg/kg for PHC, and µg/g for gravimetric weight (dry weight). Percent moisture must be reported.

9.2 MDLG or Reporting limits are 10 µg/g for total crude oil, and 0.1 µg/g for individual alkanes, and 10 µg/kg for individual PAH compounds.

9.3 Results of Matrix Spikes, Surrogate Recoveries, and Reference Material Analyses should be reported.

9.4 Data will be reported to two (2) significant figures.

APPENDIX SOP.
Standard Operating Procedures

Section 6. Determination of low level total extractable hydrocarbon and individual saturated hydrocarbon concentrations in environmental samples

Title: Determination of Low Level Total Petroleum Hydrocarbon and Individual Saturated Hydrocarbon Concentrations in Environmental Samples

SOP No:	Revision No.	Effective Date:
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1.0 INTRODUCTION

This document describes modification and utilization of EPA Method 8100 for the instrumental analysis of environmental samples for the analysis of petroleum hydrocarbons (PHC); C_{10} through C_{32} normal alkanes, pristane and phytane, and total petroleum hydrocarbon concentrations (resolved plus unresolved aliphatic (i.e. saturated) and aromatic hydrocarbons (C_{10} to C_{36}) as defined by EPA Method 3611). The method relies on high resolution capillary gas chromatography using flame ionization detection (GC) for identification and quantification of the above analytes. Combined with SOPs EVC89-1, EVC89-4, or EVC89-5, this method allows for quantitative determination of compounds in the n-C_{10} to approximately n-C_{36} range. Compounds eluting before n-C_{10} will not be quantitatively recovered.

Prior to use of this method, appropriate sample extraction techniques must be followed. Sediment, biological tissue, and oil residue extracts must be processed through alumina before GC analysis. The alumina column is optional for water analyses.

PAH and PHC must be determined on the same field sample.

Note: This method can be used for quantification of PHC at any levels in environmental samples. However, the amounts of spiking materials, and final sample extract volumes will have to be adjusted upward to allow for use of this method in the analysis of samples with high levels of oil and PHC.

Note: In the EVC89-Series of SOPs, the methods are designed to produce data at certain environmental concentrations in order to satisfy programmatic needs. To achieve these reporting limits (RL), instruments need to be operated at maximum sensitivity for the sample sizes specified. Therefore the RL and the method detection limit (MDL) are conceptually the same value. In these SOPs the method detection limit goal (MDLG) will be used to indicate both the MDL and the RL.

2.0 SAMPLE COLLECTION, PRESERVATION, STORAGE, AND HOLDING TIMES

Refer to SOPs EVC89-1, EVC89-4, and EVC89-5 for sample collection, preservation, storage and holding times for water, sediment, and tissue samples, respectively. The extract should be analyzed as soon as possible within 90 days after extract preparation. The extract should be stored with sufficient solvent so that extract will not evaporate to dryness during storage either prior to or after analysis. Extract analysis or reanalysis after 90 days is acceptable if surrogate spiking recoveries are acceptable.

3.0 APPARATUS AND MATERIALS

Title: Determination of Low Level Total Petroleum Hydrocarbon and Individual Saturated Hydrocarbon Concentrations in Environmental Samples

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A GC with split/splitless injector (splitless mode) equipped with a capillary column and flame ionization detector (FID). The output must be connected to a data acquisition system analyzer for the chromatograms.

3.1 **GC Column**--30-m long x 0.32-mm I.D. capillary DB5 column (J&W Scientific Catalog No. 123-5032, or equivalent). This column will allow for the baseline resolution of alkanes from n-C_{10} to n-C_{36} and phytane/n-C_{18} and pristane/n-C_{17} pairs.

3.2 **Autosampler**--An autosampler capable of making 1-4 µL injections.

4.0 REAGENTS

4.1 Calibration Solution

The stock solution should contain all available normal alkanes from C_{10} to C_{36}. However, at a minimum, a stock solution containing the following n-alkanes should be prepared: C_{10}, C_{12}, C_{14}, C_{16}, C_{18}, C_{20}, C_{22}, C_{24}, C_{28}, and C_{32} and matrix spike compounds (Section 4.4). In addition, the isoprenoid hydrocarbons, pristane, and phytane should be included. The use of the odd carbon number normal alkanes is strongly recommended. The concentration will be 1 µg/µL in isooctane or hexane.

Calibration standards should be prepared to cover, at a minimum, the concentration range of 1.25 to 240 µg/mL. Internal standard and surrogate compound should be added at the 20 µg/mL level to all calibration standards.

4.2 Surrogate Spiking Solution

The surrogate compound for this analysis for all sample types is ortho-terphenyl. A surrogate solution is made by weighing an appropriate aliquot of purified material to a volumetric flask and diluting to volume with methylene chloride. Surrogate should be added to each sample at a concentration 3 to 10x MDLG for low level analyses and higher concentrations if oil is suspected to be in the sample.

4.3 Internal Standard Solution

The internal standard for this analysis is 5-alpha-androstane. An internal standard solution is made by weighing an appropriate aliquot of purified material to a volumetric flask and diluting to volume with methylene chloride. Internal standard should be added to each sample extract to obtain a final extract concentration of approximately 20 µg/mL for low level analysis and higher concentrations if oil is suspected to be present in the sample.

4.4 Matrix Recovery Spiking Solution

The matrix recovery spiking solution should, at a minimum, consist of the following: n-C_{15}, n-C_{20}, and n-C_{30}.

The matrix spike compounds should be added to samples at a concentration 3 to 10x MDLG for low level analysis and at much higher concentrations if oil is suspected to be in the samples.

4.5 Retention Index Solution

A retention index solution comprised of individual n-alkanes, n-C_{10} through n-C_{36}, and pristane and phytane will be prepared to document relative retention times for all compounds eluting in the range of petroleum crude oil. The solution should be prepared from authentic materials of known purity.

Note: The calibration solution and the retention index solution may be one in the same. If so, calibration compounds will be a subset of retention index compounds.

5.0 PROCEDURE

5.1 Sample Extraction and Cleanup

Water samples are extracted and processed following SOP EVC89-1. Sediment samples are extracted and cleaned up following SOP EVC89-4. Tissue samples are extracted and cleaned up following SOP EVC89-5. Oil samples are prepared for analysis according to SOP EVC89-6. For water analyses and for tissue analyses the same extract is to be used for PAH and PHC (SOP EVC89-3) analyses. For sediment extracts 20% of the total sample extract is recommended for use in the GC/MS (SIM) analysis, with the remaining used in the PHC analysis (SOP EVC89-3) although the entire extract may be used for both analyses with the appropriate changes in internal standard spiking amounts. **If any split of the initial extract is made, the split ratio must be taken into account during final calculations.**

5.2 Addition of Internal Standard

The 5mL sample extracts prepared as per these SOPs are reduced in volume to 1mL. Sufficient PHC internal standard (5-alpha-androstane) is added so that the final extract concentration is approximately 20µg/mL for PHC. **Higher amounts of internal standards will be needed for samples in which high levels of oil are suspected.**

5.3 High Resolution GC-FID Analysis

5.3.1 GC Conditions

The recommended analytical system for the analysis of PHC is as follows.

Instrument:	Hewlett Packard 5880A (or equivalent)
Features:	Split/splitless capillary inlet system; VG, Beckman Cals data acquisition system (or equivalent)
Inlet:	Splitless
Detector:	Flame ionization
Column:	0.32-mm I.D. x 30-m DB5 fused silica (J&W Scientific)
Gases:	
Carrier:	Helium 2 mL/min
Make-Up:	Helium 25 mL/min
Detector:	Air 240 mL/min Hydrogen 50 mL/min

Temperatures:

Injection port:	275°C
Detector:	325°C
Oven Program:	60°C for 1 min then 6°C/min to 300°C, hold 5 min

(GC oven temperature program may be modified to improve resolution)

Daily calibration:	Mid-level calibration solution; Retention index solution
Quantification:	Internal standard/calibration standard.

Note: The GC must be capable of the baseline resolution of all target compounds (n-alkanes, pristane,phytane) surrogates (ortho-terphenyl), and internal standard (androstane) from each other and from interfering compounds. Potential problems of resolution of n-C_{19} and ortho-terphenyl at varying relative concentrations should be noted. Alteration of the GC program to 4 C/min may be required to achieve this goal.

5.3.2 Calibrations

5.3.2.1 Procedure

Two types of calibrations are required - initial and daily or routine calibrations. GC calibration will be carried out following procedures described in EPA SW-846 Method 8000 Section 7.4. Quantification of individual components will be made using response factors determined in the initial calibration.

Prior to use of the method for individual component or total PHC analysis, a five-point response factor calibration curve must be established showing the linear range of the analysis. A minimum of five concentration levels should be analyzed. One of the concentration levels should be at a concentration near, but above the method detection limit. The remaining concentrations should correspond to the expected working range of the GC, or the range expected in samples. A range of 1.25 to 240 µg/mL is recommended. The calibration factor must be linear within this range linearity is established, an average calibration factor

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(response factor, RF) may be used for the analysis of samples. The initial calibration must be verified each working day by the measurement of one or more calibration standards.

Quantification of individual components in the samples is to be performed using RF for that component determined from the initial calibration. **The RF for each individual hydrocarbon component is calculated from authentic material, and is used to calculate analyte concentrations in samples. If an individual saturated hydrocarbon is missing from the calibration solution, an RF is estimated for that hydrocarbon from the average RF of hydrocarbons eluting immediately before and after in the chromatogram.**

For total petroleum hydrocarbon (PHC) determination only, an **average RF** is calculated from only those even numbered n-alkanes listed in Section 4.1 and used for the calculation of total petroleum hydrocarbon (resolved plus unresolved) concentrations (i.e. PHC). Use of a selected subset of universally available hydrocarbons will ensure that the average RF used to calculate total resolved plus unresolved will be the same for all laboratories performing these analyses.

For routine or daily calibration, a mid-level standard is analyzed immediately prior to conducting any analyses, and after each group of 10 samples. The response factors (RF) criteria for each analyte must be met as presented below in Section 5.2.2.2.

5.3.2.2 Calibration Criteria

Daily response factors for each compound must be compared to the initial calibration curve. Comparison of daily with initial calibrations must yield the following results in order for analysis to proceed.

- o The RRF of 90% of the analytes must be within ±25% of the average RRF computed from the initial calibration.
- o The remaining 10% of the analytes must be within ±35% of the average RRF.

If these criteria are not met an initial calibration must be performed.

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5.3.3 Retention Time Windows

Retention time windows must be established and maintained according to procedures outlined in EPA Method 8000, Section 7.5. Three times the standard deviation of the retention time for a compound will be used to calculate a suggested window size. However, the experience of the analysts should weigh heavily in the interpretation of chromatograms.

The retention index solution should be analyzed once per day or with every set of 20 samples, whichever is more frequent. The retention index solution may be used to calculate retention time windows.

5.3.4 Sample Analysis

Analyses will follow an analysis sequence initiated with a routine or daily calibration, followed by ten samples, and ending with a routine calibration. Every 20 samples, or once a day when samples are being analyzed, whichever is more frequent, a retention index solution should be analyzed. If the RF for any analyte in the routine calibration fails to meet the criteria established in Section 5.2.2.2, the routine calibration should be reinjected and if it fails the second time, instrument maintenance should be performed and an initial calibration performed. All samples that were injected after the standard exceeding criteria must be reinjected.

Sample injections should be made with an autosampler device and should consist of 1 to 4 µL of the sample extract.

If the response for any peak exceeds the working range of the system, the extract should be diluted and reanalyzed.

5.3.5 Calculations

Calculations are based on the methods of internal standards. The general formula for calculating PHC is found in Section 7.8.2 of EPA SW-846 Method 8000. See Section 7.1 of this method for details of the calculation.

6.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) REQUIREMENTS

6.1 Initial Calibration and Routine or Daily Calibration Check

Prior to the use of the method for low level analysis of individual components or total PHC, a five-point response factor calibration curve must be established showing the linear range of the analysis.

Each calibration standard is analyzed and the area of the response factor (RF) for each compound at each concentration level is calculated using the equation the presented in Section 7.0.

For every 10 sample analyses or once each day samples are analyzed, the response factor for each compound of interest relative to the internal standard is determined.

These daily response factors for each compound must be compared to the initial calibration curve. The percent difference is calculated using the following equation:

$$\text{Percent Difference} = \frac{\overline{RFI} - RFC}{\overline{RFI}} \times 100$$

where:

$\overline{RFI}$ =Average response factor from initial calibration.

RFC =Response factor from current verification check standard.

If the daily response factors meet the criteria presented in Section 5.2.2.2 the analysis may proceed. If, for any analyte, the daily response factor does not meet these criteria, a five-point calibration curve must be repeated for that compound prior to the analysis of the samples.

6.2 Method Blank Analysis

An acceptable method blank analysis must not contain any target compound at concentrations 5 times greater than the MDLG. If the method blank does not meet these criteria, the analytical system is out of control and the source of the contamination must be investigated and corrective measures taken and documented before further sample analysis proceeds.

6.3 Surrogate Compound Analysis

The laboratory will spike all samples and quality control samples with ortho-terphenyl (OTP). OTP will be spiked into the sample prior to extraction and this will measure individual sample matrix effects associated with sample preparation and analysis.

The laboratory will take corrective action whenever the recovery OTP is outside of 40 to 120 percent for water, sediment and tissue matrices.

The following corrective action will be taken when required as stated above:

a. Check calculations to assure there are no errors;

b. Check internal standard and surrogate solutions for degradation, contamination, etc., and check instrument performance;

c. If the surrogate could not be measured because the sample required a dilution, no corrective action is required. The recovery of the surrogate is recorded as "D" with the note surrogate diluted out.

d. Reanalyze the sample or extract if the steps above fail to reveal a problem. If reanalysis of the extract yields surrogate recoveries within the stated limits, then the reanalysis data will be used. Both the original and reanalysis data will be reported.

6.4 Matrix Spike Analysis

The laboratory will spike and analyze one set of MS/MSD samples for every 20 samples or with every sample set, whichever is more frequent. The compounds and the spiking levels are presented in Section 4.4. The initial matrix spike criteria for water, sediment and tissue analysis are as follows:

- The average of the percent recoveries for all compounds must fall between 40 and 120 percent.

- Only one compound can be below its required minimum percent recovery.

If the matrix spike criteria are not met, the matrix spike analysis will be repeated. If the subsequent matrix spike analysis meets the criteria, then the reanalysis data will be used. If not, the data for the sample will be reported, but qualified as being outside the acceptance criteria of the method. Both the original and reanalysis data will be reported.

6.5 Method Detection Limit

The actual method detection limit will be determined following procedures outlined in Federal register (1984), Vol. 49 No. 209: 198-199. The MDL should be determined for each sample extraction and analysis SOP pair [e.g. Water Extraction (EVC89-1) and PHC Analysis (EVC89-3)]. This determination will be repeated at least once per year.

6.6 GC Resolution

The target compounds, surrogate, and internal standard must be resolved from one another and from interfering compounds. Complete baseline resolution of the n-C_{17}/Pristane and n-C_{18}/Phytane pairs is required. Baseline resolution of OTP and n-C_{19} much be achieved as well. Potential problems may arise from the lack of baseline resolution of these compounds. Corrective action, i.e. reruns with a different temperature program, should be taken.

6.7 Reference Sample Analysis

A reference crude oil standard solution, when available, will be analyzed for PHC by methods presented in this SOP. One sample will be analyzed per batch of 20 samples, and the results will be used to establish laboratory QC charts. The results should agree within 30% of the mean of the previously reported PHC data used to construct the control charts.

7.0 CALCULATIONS

7.1 Calculation of Total Area Attributable to Petroleum (PHC)

To calculate the concentration of total petroleum hydrocarbons (PHC) in the sample, the area response attributed to the petroleum must first be determined. This area includes the all of the resolved peaks and the unresolved "envelope". This total area must be adjusted to remove the area response of the internal standards and surrogates and the GC column bleed.

Column bleed is defined as the reproducible baseline shift that occurs during temperature programming of the GC column oven. To determine this area, a methylene chloride blank injection should be analyzed at the beginning of the day and after every 10 samples to determine the baseline response. The baseline is then set at a stable reproducible point just before the solvent peak (T_o, Figure 1). This baseline should be extended horizontally to the end of the run (T_f). The area for the blank run that must be subtracted from the actual sample run, includes all of the area between C_{10} (T_o) and C_{36} (T_f) or "Area A" in Figure 1.

The baseline for the sample should be set in the same manner. The area in the sample will contain the area attributable to petroleum (Area B) and that attributable to the baseline (Area A). Area B (peaks plus unresolved attributable to petroleum) must be calculated by subtracting Area A and those for the standards from the total area,

or, $$A_{PHC} = A_T - (A_A + A_S)$$

where,

A_{PHC} = Corrected area of the chromatogram attributable to PHC
A_T = Total area of the chromatogram
A_A = Area due to column bleed
A_S = Area of the internal and surrogate standards.

The PHC is then calculated according to the equation in Section 7.2.

Note: If the GC data system is capable of automatically compensating for the column bleed, as defined above, by chromatogram subtraction of the methylene chloride blank, the above manual steps need not be taken. However, the overall principles are identical whether the correction is manual or automatic.

As the concentration of PHC in the sample approaches the detection limit, the baseline correction becomes more critical. Therefore the following suggestions may help to improve the accuracy of the method.

1. Mass discrimination must be kept to a minimum by placing a small plug of silanized glass wool one cm from the base of the glass injection liner. The capillary column should be placed just below the glass wool. A full range alkane standard should be run to test the degree of mass discrimination before performing any actual sample

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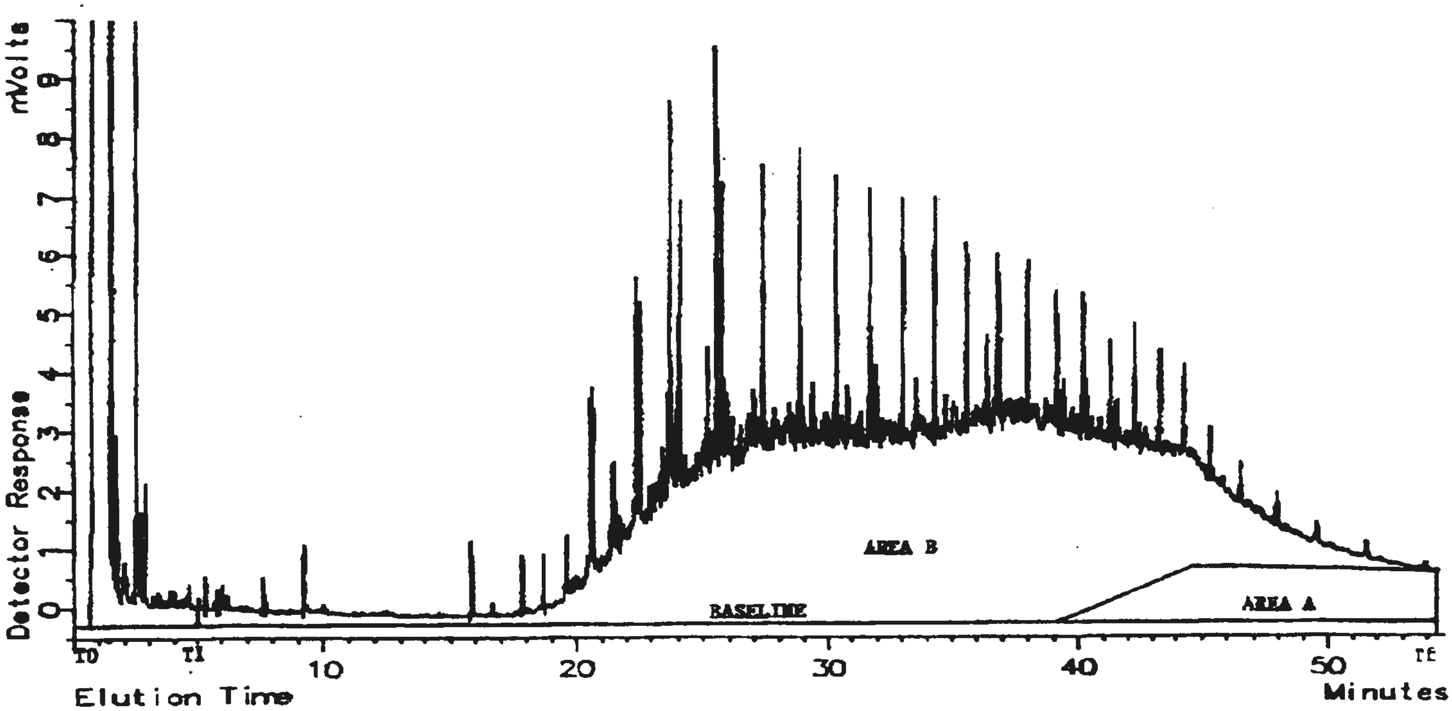
FIGURE 1. PHC QUANTITATION METHOD



analyses. The response factor ratio of C_{32}/C_{21} should be greater than 0.8. If less than 0.8, reposition the column in the glass liner until the mass discrimination is minimized.

2. The instrument sensitivity must be maximized. Injection of 2µL of a 1ng/µL hydrocarbon standard should yield a detector signal-to-noise ratio of between 10:1 and 20:1 for the individual alkanes.

3. Samples should be prescreened based on color. Low level clear samples should be analyzed separately from high level, colored, samples in order to minimize baseline drift and potential carryover.

4. Holding the column temperature at 310 degrees for 5 minutes after the GC run is useful to minimize carryover. Methylene chloride runs should be compared to monitor and baseline shift.

7.2 PHC calculations are based on the methods of internal standards from Section 7.8.2 of EPA SW-846 Method 8000:

- **PHC µg/(L or g): = $(A_c \times C_{is} \times D)/(A_{is} \times RF \times S)$**

where:

A_c = The corrected area of the sample chromatogram. (A_c = total resolved + unresolved area) minus the area of internal standards).
C_{is} = µg of internal standard (I.S). androstane added to the extract
D = Dilution factor
A_{is} = Area response of the I.S. 5-α androstane
RF = Average response factor of the continuing calibration standard
S = Amount of sample extracted--in L for water, in g for sediments or tissue samples.

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- **RF = average of $(A_s \times C_{is})/(A_{is} \times C_s)$**

where:

A_s = Response of analyte to be measured
A_{is} = Response of internal standard (5-α androstane)
C_{is} = Concentration of the internal standard 5-α androstane, μg
C_s = Concentration of the analyte to be measured, μg.

7.3 Calculation Notes

7.3.1 To each sample, a specific amount of ortho-terphenyl surrogate is added. The recovery of this surrogate is monitored in each sample using the response of the androstane I.S. added to the final extract.

Percent OTP recovery = $(A_{otp} \times C_{and})/(C_{otp} \times A_{and})$

where:

A_{and} = Area of 5-α androstane
A_{otp} = Area of OTP
C_{otp} = μg of OTP added to the sample
C_{and} = μg of 5-α androstane added to the sample extract.

7.3.2 The saturated hydrocarbons n-C_{10} through n-C_{14} may not be quantitatively recovered by the method due to volatility. Concentrations of individual n-alkanes, n-C_{10} through n-C_{14} are considered estimates. Total resolved plus unresolved hydrocarbon (e.g. total PHC) should be determined from n-C_{10} to n-C_{36}. The PHC, or total hydrocarbon concentration is therefore an estimate.

8.0 REPORTING

8.1 Reporting Units--Units are reported in µg/L for water, µg/g (dry weight) for sediments, and µg/g (wet weight) for biological tissue.

8.2 Reporting Limits or MDLG -- Reporting limit/Method Detection Limit goals for water are approximately 50 µg/L for PHC and 0.2 µg/L for individual normal alkanes and isoprenoids. Goals for sediments are 10 µg/g for PHC 0.1 µg/g for individual alkane and isoprenoid hydrocarbons. MDLG or Reporting limit goals for biological tissue are 10 µg/g PHC and 0.1 µg/g individual alkane and isoprenoid hydrocarbons. Actual detection limits must be determined before the initiation of sample analyses.

8.3 Significant Figures--Significant figures are 2.

8.4 Surrogate Recovery--Surrogate recovery is reported for each sample analyzed.

8.5 Matrix Spike-- Matrix spike recoveries should be reported for each batch of samples analyzed

8.6 Reference Materials--The results of the analysis of the crude oil standard reference solution, when available, will be reported for each batch of samples analyzed.

APPENDIX SOP.
Standard Operating Procedures

Section 7. Determination of low-level Polynuclear aromatic hydrocarbons (PAH) and selected heterocycles

Title: Determination of Low-level Polynuclear Aromatic Hydrocarbons (PAH) and Selected Heterocycles

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1.0 SUMMARY OF METHOD

This method has been designed for the analysis of polynuclear aromatic hydrocarbons (PAH) and selected heterocyclic compounds and their alkylated homologues at the parts-per-trillion level (ppt, ng/L) in water, and at part-per-billion levels in sediment and biological tissue samples. Quantitation of the isolated target analytes is performed by gas chromatography mass spectrometry (GC/MS) in the selected ion monitoring mode (SIM). Samples of any PAH concentration can be analyzed by this method if the appropriate dilutions and/or splits are made on the extracts in order to bring the extract concentrations into the useable range of the method. Alternatively, EVC89-7 (PAH by Full Scan GC/MS) can be used for high level samples. The compounds listed in Table 1 can be quantitatively determined using this analytical method.

This method describes the final preparation of sample extracts for analysis and their analysis by GC/MS (SIM).

In the EVC89-Series of SOPs, the methods are designed to produce data at certain environmental concentrations in order to satisfy programmatic needs. To achieve these reporting limits (RL), instruments need to be operated at maximum sensitivity for the sample sizes specified. Therefore the RL and the method detection limit (MDL) are conceptually the same value. In these SOPs the method detection limit goal (MDLG) will be used to indicate both the MDL and the RL.

2.0 INTERFERENCES

Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the ion current profiles. All of these materials must be routinely demonstrated to be free from interferences under the conditions of the analysis by running laboratory reagent blanks.

Matrix interferences may be caused by contaminants that are coextracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the environment being sampled.

Approved By:

____________________________, Exxon Date:

TABLE 1. PAH AND ALKYL PAH TARGET COMPOUNDS[a]

Compounds	IS Reference	Compounds	IS Reference
Naphthalene	1	Fluoranthene	2
C_1-Naphthalenes[a]	1	C_1-Fluoranthenes[a]	2
C_2-Naphthalenes[a]	1		
C_3-Naphthalenes[a]	1	Pyrene	2
C_4-Naphthalenes[a]	1	C_1-Pyrene[a]	2
Acenaphthylene	1	Benzo[a]anthracene	3
Acenaphthene	1	Chrysene	3
		C_1-Chrysene[a]	3
Fluorene	1	C_2-Chrysene	3
C_1-Fluorenes[a]	1	C3-Chrysene[a]	3
C_2-Fluorenes[a]	1	C_4-Chrysene[a]	3
C_3-Fluorenes[a]	1		
		Benzo[b]fluoranthene	3
Dibenzothiophene	2		
C_1-Dibenzothiophenes[a]	2	Benzo[k]fluoranthene	3
C_2-Dibenzothiophenes[a]	2		
C_3-Dibenzothiophenes[a]	2	Benzo[a]pyrene	3
Phenanthrene	2	Indeno]1,2,3-c,d]pyrene	3
C_1-Phenanthrenes[a]	2		
C_2-Phenanthrenes[a]	2	Dibenzo[a,h]anthracene	3
C_3-Phenanthrenes[a]	2		
C_4-Phenanthrenes[a]	2	Benzo[g,h,i]perylene	3
Anthracene	2		
C_1-Anthracenes[a]	2		
C_2-Anthracenes[a]	2		
C_3-Anthracenes[a]	2		
C_4-Anthracenes[a]	2		
<u>Internal Standards</u>			
Acenaphthene-d_{10}	1		
Phenanthrene-d_{10}	2		
Benzo(a)pyrene-d_{12}	3		
<u>Surrogates</u>			
Naphthalene-d_8	1		
Fluorene-d_{10}	1		
Chrysene-d_{12}	3		

[a]Alkylated homologues not included in calibration solution.
Note: Alkylated phenanthrenes and anthracenes, and alklylated fluoranthenes and pyrenes are quantified together as total alkylated (Cx) phenanthrene/anthracenes and total alkylated (Cx) fluoranthenes/pyrenes.

An interference which is unique to selecting ion monitoring techniques can arise from the presence of an interfering compound which contains the quantitation mass ion. This event results in a positive interference to the reported value for the compound of interest. This interference is controlled to some degree by acquiring data for a confirmation ion. If the ion ratios between the quantitation ion and the confirmation ion are not the specified limits, then interferences may be present.

3.0 APPARATUS AND MATERIALS

3.1 Gas Chromatograph

The analytical system includes a temperature programmable gas chromatograph and all required accessories including syringes, analytical columns, and gases. The injection port is designed for on-column injection when using packed columns and for splitless injection when using capillary columns.

3.2 Column

A 25- or 30-m fused silica capillary column with DB-5 bonded phase, or equivalent. Capillary columns of 0.25 mm or 0.32 mm i.d. may be used.

3.3 Mass Spectrometer

A mass spectrometer operating at 70 ev (nominal) electron energy in the electron impact ionization mode and tuned to maximize the sensitivity of the instrument to the compounds being analyzed. The GC capillary column is fed directly into the ion source of the mass spectrometer.

A computer system interfaced to the mass spectrometer allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer has software that allows searching any GC/MS data file for ions of a specific mass and plotting such ion abundances versus time or scan number. The computer allows acquisition at pre-selected mass windows for selected ion monitoring.

4.0 REAGENTS

4.1 Surrogate Spiking Solution

A surrogate solution is made by weighing an appropriate aliquot of each purified compound into a volumetric flask and diluting to volume with methylene chloride or other suitable solvent and added to the sample prior to extraction. The compounds in the surrogate solutions are naphthalene-d_8, fluorene-d_{10}, and chrysene-d_{12}. As general guidance, for low level of expected PAH concentrations in the samples the surrogate solution is made up at a concentration so that spiking of approximately 100 µl of this solution gives a final concentration each sample is ca. 3 to 10x MDLG. For sediments and tissues (See SOPs EVC89-4 and EVC89-5 for guidance) the amount of surrogates spiked will depend on the anticipated level of oil in the sample.

4.2 Internal Standard Solutions

A solution containing ca. 400 ng/mL of each internal standard is prepared by weighing an appropriate aliquot of each purified compound into a volumetric flask and diluting to volume with methylene chloride or other suitable solvent. The compound(s) chosen as the internal standard should be clearly resolved from the analytes of interest and elute within a reasonable range of the analytes of interest. Possible internal standards include acenaphthene-d_{10}, phenanthrene-d_{10}, benzo(a)pyrene-d_{12}. Other suitable internal standards may be used if acceptable calibration response factors can be obtained. Add sufficient internal standard solution to the extract prior to analysis to give a concentration of the internal standards in the extract of 20 to 100 ng/mL.

4.3 Matrix Recovery Standard Spiking Solution

A solution containing 2- and 5-ring PAH compounds is used to fortify matrix spike samples. A solution for use in water analyses, containing the compounds at the listed concentrations is found in Table 2. The solution is prepared by weighing an appropriate aliquot of each purified compound into a volumetric flask and diluting to volume with methylene chloride or other suitable solvent. Alternately, a stock solution may be purchased from a commercial vendor and diluted to the appropriate working concentration. The spiking solution is added to give a concentration of ca. 3 to 10x MDLG.

TABLE 2. PAH MATRIX SPIKE COMPOUNDS

Compound	Spiking Solution Concentration (ng/mL)
Naphthalene	40
Acenaphthylene	40
Acenaphthene	40
Fluorene	40
Phenanthrene	40
Anthracene	40
Fluoranthene	40
Chrysene	40
Pyrene	40
Benzo[a]anthracene	40
Benzo[b]fluoranthene	40
Benzo[k]fluoranthene	40
Benzo[a]pyrene	40
Indeno[1,2,3-c,d]pyrene	40
Dibenzo[a,h]anthracene	40
Benzo[g,h,i]Perylene	40

[a]Spiking solution in methylene chloride or other suitable solvent. The low-level spiking solution is added at 0.5 mL/1-L sample.

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5.0 SAMPLE PRESERVATION, STORAGE, AND HOLDING TIMES

5.1 Sample Preservation and Storage

Addressed in appropriate extraction SOP.

5.2 Extract Holding Times

The extracts should be analyzed as soon as possible within 90 days after extraction. Analysis beyond this date and any reanalysis are acceptable if results produce acceptable surrogate recoveries (i.e. quality control checks).

6.0 SAMPLE EXTRACTION

Water samples are extracted following SOP EVC89-1. Sediment samples are extracted following SOP EVC89-4. Biological tissue samples are extracted following SOP EVC89-5. The extracts are reduced to 5mL, per these SOPs, and are further prepared for analyses according to Section 9.0 of this SOP (EVC89-2).

7.0 GC/MS CALIBRATIONS

Two types of calibrations are required - initial and daily or routine calibrations. Sample **quantification are to be performed using response factors from the initial calibrations.**

7.1 Initial Calibration

Prior to use of the method for the low-level analysis of PAH, a five-point response factor calibration curve must be established showing the linear range of the analysis. The target concentrations of the standards used to construct the curve are 20, 40, 240, 1200, and 4800 ng/mL. For water samples, these concentrations correspond to 10, 20, 120, 450, and 2400 ng/L. The calibration solutions may be adjusted to meet instrumental sensitivity requirements (ie. the low standard should yield approximately a 5 to 1 signal to noise ratio). From this initial calibration the average relative response factors (RRF) for all analytes are computed relative to the internal standard. The percent relative standard deviation for the RRF all calibrated analytes must not exceed 40 percent of the average value computed in the initial calibration.

7.2 Daily or Routine Calibrations

Approximately every 12 h of GC/MS analysis, the mass spectrometer response for each PAH relative to the internal standard is determined, as described in Section 10, using daily check standards at concentrations of 40 ng/mL. Daily response factors for each compound must be compared to the initial calibration curve. Comparison of daily with initial calibrations must yield the following results in order for analysis to proceed.

- The RRF of 90% of the analytes must be within ±25% of the average RRF computed from the initial calibration.
- The remaining 10% of the analytes must be within ±35% of the average RRF.

If these criteria are not met an initial calibration must be performed.

7.3 Compound Identification

Qualitative identification of target compounds will follow the relative retention time (RRT) criteria. Table 3 contains example RRT data for parent (unsubstituted) compounds. RRT windows for alkyl homologues will be based on analysis National Institute of Standards and Technology (formerly National Bureau of Standards) SRM 1582 or other suitable reference oil.

8.0 DAILY GC/MS PERFORMANCE TESTS

The laboratory will tune the mass spectrometer using PFTBA to maximize the sensitivity of the instrument in the mass range of interest, 100-300 amu. The GC/MS will not be tuned to meet decafluorotriphenylphosphine (DFTPP) ion abundance criteria. EPA has dropped this requirement for selected ion monitoring (SIM) methods. This allows the laboratory to tune the instrument to maximize the sensitivity for the compounds being analyzed.

9.0 GAS CHROMATOGRAPHY/MASS SPECTROMETRY ANALYSIS

For water analyses and for tissue analyses the same extract is to be used for PAH and PHC (SOP EVC89-3) analyses. For sediment extracts 20% of the total sample extract is recommended for use in the GC/MS (SIM) analysis, with the remaining used in the PHC analysis (SOP EVC89-3) although the entire extract may be used for both analyses with the appropriate changes in internal standard spiking amounts. **If any split of the initial extract is made, the split ratio must be taken into account during final calculations.**

TABLE 3. RELATIVE RETENTION TIMES AND CONFIDENCE FOR THE COMPOUNDS ASSOCIATED WITH THE LOW-LEVEL PAH AND HETEROCYCLIC METHODOLOGY (a)

	Absolute Retention Time (minutes)	Average RRT	SD	Percent RSD	95 Percent Confidence Limits
Naphthalene-d_8(Surr.)	11:14	0.733	0.017	2.289	0.699-0.767
Naphthalene	11:16	0.735	0.017	2.289	0.701-0.769
2-Methylnaphthalene	12:59	0.832	0.017	2.084	0.798-0.866
1-Methylnaphthalene	13:15	0.848	0.017	2.055	0.814-0.882
Acenaphthylene	15:15	0.962	0.018	1.822	0.927-0.988
Acenaphthene	15:44	0.988	0.018	1.849	0.952-1.024
Fluorene-d_{10}(Surr.)	16:57	0.872	0.015	1.735	0.842-0.902
Fluorene	17:01	0.875	0.015	1.745	0.845-0.905
Dibenzothiophene	19:08	0.974	0.016	1.617	0.942-1.006
Phenanthrene	19:28	0.988	0.016	1.589	0.956-1.020
Anthracene	19:34	0.994	0.016	1.597	0.962-1.026
Fluoranthene	22:32	1.130	0.017	1.461	1.096-1.164
Pyrene	23:07	1.157	0.017	1.443	1.123-1.191
Benz[a]anthracene	26:16	0.873	0.012	1.325	0.849-0.897
Chrysene-d_{12}(Surr.)	26:18	0.8974	0.012	1.320	0.850-0.898
Chrysene	26:22	0.876	0.012	1.320	0.852-0.900
Benzofluoranthenes	29:00	0.960	0.014	1.501	0.932-0.988
Benzo[e]pyrene	29:34	0.984	0.016	1.590	0.952-1.016
Benzo[a]pyrene	29:44	0.988	0.016	1.615	0.956-1.020
Perylene	29:55	0.996	0.016	1.644	0.964-1.028
Indeno[1,2,3-cd]pyrene	32:31	1.114	0.025	2.276	1.064-1.164
Dibenz[a,h]anthracene	32:36	1.113	0.031	2.743	1.051-1.175
Benzo[g,h,i]perylene	33:17	1.149	0.028	2.422	1.093-1.205

(a) This table is to serve as an example. Absolute retention times will vary depending on the length and condition of the GC column.

9.1 Sample Extract Concentration

Prior to analysis, the extract volume is concentrated to ca. 1 mL under nitrogen at room temperature and transferred to a GC autosampler vial. The evaporative concentrator tube is successively rinsed with methylene chloride, the rinsings added to the autosampler vial, and the methylene chloride again evaporated. This process is continued until at least five rinsings of the tube have occurred. The pre-injection volume (PIV) for PAH analysis is 0.25 to 0.5 mL for low level analysis. The PIV for PHC analysis (SOP EVC89-3) is 0.25 mL.

Note: All solvent evaporations under nitrogen must occur at room temperature with no heating. Heating may result in the unacceptable loss of volatile components of the sample.

9.2 Addition of Internal Standards

At this point, and just prior to the analysis, the entire extract or extract split must be spiked with the appropriate amount of PHC and/or PAH internal standard (contained in ca. 10 µL), or the PAH extract split spiked with the PAH internal standards, if the extract is to be split for separate PHC and PAH instrumental analyses. The PHC internal standard is 5-alpha-androstane. The PAH internal standards are acenaphthene-d_{10}, phenanthrene-d_{10}, and benzo(a)pyrene-d_{12}. An aliquot of internal standard solution is transferred to the PAH extract of extract split to give a final internal standard concentration of approximately 40 ng/mL. Note: The amount of internal standard added will be higher if oil is present in the sample

9.3 Instrumental Analysis

Representative aliquots are injected into the capillary column of the gas chromatograph using the following, or similar conditions:

Injector Temp--250°C
Transfer Line Temp--290°C
Initial Oven Temp--30°C
Initial Hold Time--1 min
Ramp Rate--10°C/min
Final Temperature--325°C

The effluent from the GC capillary column is fed directly into the ion source of the mass spectrometer. The MS is operated in the selected ion monitoring (SIM) mode using appropriate windows to include the quantitation and confirmation masses for each PAH as shown in Table 4. For all compounds detected at a concentration above the MDLG, a check is made to ensure the confirmation ion is present.

9.4 Qualitative Identification

Obtain extracted ion current profiles (EICP) for the primary m/z and the confirmatory ion. The following criteria must be met to make a qualitative identification:
The characteristic masses of each parameter of interest must maximize in the same or within one scan of each other. The retention time must fall within $\pm$10 s of the retention time of the authentic compound or alkyl homologue grouping determined by analysis of reference material.

Note: The alkylated PAH homologue groupings (e.g. C3 naphthalenes) appear in the EICPs as clusters of isomers. The pattern of each cluster and the retention time window for the cluster should be established by analysis of reference crude oil. Peaks within the cluster should be integrated by straight line integration to the baseline, taking into account background noise in the EICPs. Representative EICPs for all of the PAH homologous series of naphthalenes, fluorenes, phenanthrenes, and dibenzothiphenes are presented in Figure 1.

The relative peak heights of the primary ion compared to the confirmation or secondary ion masses in the EICPs must fall within $\pm$ 20 percent of the relative intensities of these masses in a reference mass spectrum (Table 4). Note, that the relative intensities of the primary and secondary ions may vary widely within a given group of PAH isomers (e.g. C_3-naphthalenes). The reference mass spectrum must be obtained from reference material analyzed in the GC/MS system. In some instances, a compound that does not meet secondary ion confirmation criteria may still be determined to be present in a sample after

close inspection of the data by the mass spectroscopist. Supportive data includes the presence of the secondary ion, but the ratio is greater than $\pm$ 20 percent of the primary ion which may be caused by an interference of the secondary ion. When the primary ion is not affected by interferences and the decision is agreed to by the reviewer, the compound is flagged with an asterisk (*) on the sample summary sheet.

TABLE 4. PARAMETERS FOR TARGET ANALYTES

Analyte	Quant. Ion	Conf. Ions	% Rel. Abund. of Conf. Ions[B]
d_8-Naphthalene[A]	136	134	15
Naphthalene	128	127	15
C_1-Naphthalenes	142	141	80
C_2-Naphthalenes	156	141	
C_3-Naphthalenes	170	155	
C_4-Naphthalenes	184	169,141	
d_{10}-Acenaphthene[A]	164	162	95
Acenaphthylene	152	153	15
Acenaphthene	154	153	98
d10-Fluorene	176	174	85
Fluorene	166	165	95
C_1-Fluorenes	180	165	100
C_2-Fluorenes	194	179	25
C_3-Fluorenes	208	193	
d_{10}-Phenanthrene[A]	188	184	
Phenanthrene	178	176	20
Anthracene	178	176	20
C_1-Phenanthrenes/anthracenes	192	191	60
C_2-Phenanthrenes/anthracenes	206	191	
C_3-Phenanthrenes/anthracenes	220	205	
C_4-Phenanthrenes/anthracenes	234	219,191	
Dibenzothiophene	184	152,139	15
C_1-Dibenzothiophenes	198	184,197	25
C_2-Dibenzothiophenes	212	197	
C_3-Dibenzothiophenes	226	211	
Fluoranthene	202	101	15
d_{12}-Chrysene[A]	240	236	
Pyrene	202	101	15
C_1-Fluoranthenes/pyrenes	216	215	60
Benzo[a]anthracene	228	226	20
Chrysene	228	226	30
C_1-Chrysenes	242	241	
C_2-Chrysenes	256	241	
C_3-Chrysenes	270	255	
C_4-Chrysenes	284	269,241	
d_{12}-Benz(a)pyrene[A]	264	260	20
Benzo[b]fluoranthene	252	253,125	30,10
Benzo[k]fluoranthene	252	253,125	30,10
Benzo[a]pyrene	252	253,125	30,10
Indeno[1,2,3-c,d]pyrene	276	277,138	25,30
Dibenzo[a,h]anthracene	278	279,139	25,20
Benzo[g,h,i]perylene	276	277,138	25,20

[A] Denotes spiking compound
[B] Note: Relative abundance of ions within any given isomer group will vary considerably, depending on isomer of interest. Relative abundances should be determined in analysis of crude oil solution

10.0 CALCULATIONS

10.1 Quantitation

The initial calibration will be used to determine response factors for use in quantification of all compounds. The following formula is used to calculate the response factors of the internal standard to each of the calibration standards.

$$RF = (A_s C_{is})/(A_{is} C_s)$$

where:

A_s =Area of the characteristic ion for the parameter to be measured.
A_{is} =Area of the characteristic ion for the internal standard.
C_{is} =Concentration of the internal standard (ng/mL).
C_s =Concentration of the parameter to be measured (ng/mL).

Note: Response factor of alkyl homologues is assumed equal to that of respective unsubstituted compounds. Based on these response factors, sample extract concentrations for each PAH and alkyl homologue grouping is calculated using the following formula:

$$Ce = \frac{(A_s)(I_s)}{(A_{is})(RF)}$$

where:

Ce =Sample extract concentration (ng/mL).
A_s =Area of the characteristic ion for the parameter to be measured.
A_{is} =Area of the characteristic ion for the internal standard.
I_s =Amount of internal standard added to each extract (ng/mL).

The actual sample concentration (C) for each compound is calculated by the following formula:

$$C = (Ce) \times \frac{V_e}{V_s}$$

where:

C =Concentration in sample (ng/L).
V_E =The final extract volume (mL).
V_s =The original volume of sample extracted (L).

Alkyl homologues will be reported as total C-1, total C-2, etc.

Compounds identified and quantified below the MDLG should be clearly identified in the data report with letter "J". If the concentration of any target compound in a sample exceeds the linear range defined by the standards above, the extract must be diluted so that the concentrations of all target compounds fall within the range of the calibration curve.

Note: The final determined concentration in the sample must be calculated taking into account any extract splits prior to alumuna column chromatography or prior to internal standard spiking step.

11.0 QUALITY CONTROL/QUALITY ASSURANCE

11.1 GC/MS Tuning

The GC/MS is tuned as described in Section 8.0.

11.2 GC/MS Initial Calibration and Continuing Calibration Check

Prior to the use of the method for low level analysis of PAH, a five-point response factor calibration curve must be established showing the linear range of the analysis.

Each calibration standard is analyzed and the area of the primary characteristic ion is tabulated against concentration for each compound. The response factor (RF) for each compound at each concentration level is calculated using the following equation:

$$RF = \frac{A_s \times C_{is}}{A_{is} \quad C_s}$$

where:

A_s = Area of the characteristic ion for the compound to be measured.
A_{is} = Area of the characteristic ion for the specific internal standard.
C_{is} = Concentration of the internal standard.
C_s = Concentration of the compound to be measured.

The percent relative standard deviation for all calibrated analytes must not exceed 40 percent.

For every 12 h of GC/MS analysis, the mass spectrometer response factor (RF) for each PAH of interest (Table 1) relative to the internal standard is determined.

These daily response factors for each compound must be compared to the initial calibration curve. The percent difference is calculated using the following equation:

$$\text{Percent Difference} = \frac{\overline{RFI} - RFC}{\overline{RFI}} \times 100$$

where:

$\overline{RFI}$ = Average response factor from initial calibration.

RFC = Response factor from current verification check standard.

The criteria for acceptability of the daily calibration are presented in Section 7.2 of this SOP. If, for any analyte, the daily response factor does not meet these criteria, a five-point calibration curve must be repeated for that compound prior to the analysis of the samples.

11.3 Method Blank Analysis

An acceptable method blank analysis must not contain any target compound in Table 1 at concentrations 5 times greater than MDLG. If the method blank does not meet these criteria, the analytical procedure is out of control and the source of the contamination must be investigated and corrective measures taken and documented before further sample analysis proceeds.

11.4 Surrogate Compound Analysis

The laboratory will spike all samples and quality control samples with deuterated PAH surrogate compounds. The surrogate compounds will be spiked into the sample prior to extraction and this will measure individual sample matrix effects associated with sample preparation and analysis. They will include naphthalene-d_8, fluorene-d_{10}, and chrysene-d_{12}.

The laboratory will take corrective action whenever the surrogate recovery for any one or more surrogates is outside the following acceptance criteria for water, sediment and tissue matrices:

Surrogate	Acceptance Criteria %
Naphthalene-d_8	**40-120**
Fluorene-d_{10}	**40-120**
Chrysene-d_{12}	**40-120**

The following corrective action will be taken when required as stated above:

a. Check calculations to assure there are no errors;

b. Check internal standard and surrogate solutions for degradation, contamination, etc., and check instrument performance;

c. If the surrogate recovery is outside the control limits, the secondary ion may be used to check the quantitation of the surrogate. If the secondary ion meets within the control limits, this recovery is reported with flag of "#" next to the percent recovery.

d. If the upper control limit is exceeded for only one surrogate, and the instrument calibration, surrogate standard concentration, etc. are in control, it can be concluded that an interference specific to the surrogate was present that resulted in high recovery and this interference would not affect the quantitation of other target compounds. The presence of this type of interference can be confirmed by evaluating the chromatographic peak shapes in ion intensities of the surrogate.

e. If the surrogate could not be measured because the sample required a dilution, no corrective action is required. The recovery of the surrogate is recorded as "D" with the note surrogate diluted out.

f. Reextract and reanalyze the sample or reanalyze the extract if the steps above fail to reveal a problem. If reanalysis of the extract yields surrogate recoveries within the stated limits, then the reanalysis data will be used. Both the original and reanalysis data will be reported.

11.5 Matrix Spike Analysis

The laboratory will spike and analyze one set of MS/MSD sample for every 20 samples or with every sample set, whichever is more frequent. The compounds are listed in Table 2. The initial matrix spike criteria for water, sediment and tissue analysis are as follows:

- The average of the percent recoveries for all 16 compounds must fall between 40 and 120 percent.
- Only one compound can be below its required minimum percent recovery. These minimum percent recoveries are as follows:
  1. Ten percent for chrysene and benz(a)pyrene
  2. Twenty percent for all other compounds.

Criteria for data validity for each individual matrix spike compound will be developed as data are collected and will be updated on a quarterly basis.

If the matrix spike criteria are not met, the matrix spike analysis will be repeated. If the subsequent matrix spike analysis meets the criteria, then the reanalysis data will be used. If not, the data for the sample will be reported, but qualified as being outside the acceptance criteria of the method. Both the original and reanalysis data will be reported.

11.6 Reference Material

When available, one ampoule of the crude oil standard solution will be analyzed per batch of samples. Laboratory control charts will be established for the PAH levels in the sample. The average percent difference for the target compounds should not exceed 20% of the mean of all previous values, and no single compound/isomer grouping should deviate by more than 30% of its mean value of all previous determinations.

11.7 Method Detection Limit

The actual analytical method detection limit (MDL) will be determined following procedures outlined in Federal Register (1984), Vol. 49 No. 209: 198-199 for each sample extraction and analysis SOP pair [e.g. Water Extraction (EVC89-1) and PAH Analysis (EVC89-2)]. This determination will be repeated at least once per year.

12.0 REPORTING

12.1 Reporting Units

Units are reported in ng/L for water, and µg/kg (dry weight) for sediment and µg/kg (wet weight) for tissue samples.

12.2 Reporting Limits/Method Detection Limit Goals (MDLG)

Concentrations of approximately 10 ng/L per PAH component for 2-L water samples, 10 µg/kg in sediments, and 10 µg/kg for biological tissues are the targeted PAH goals of the program.

12.3 Significant Figures

Results should be reported to two (2) significant figures.

12.4 Surrogate Recoveries

Surrogate recoveries must be reported for each sample.

12.5 Matrix Spike

Matrix spike results should be reported for each batch of samples

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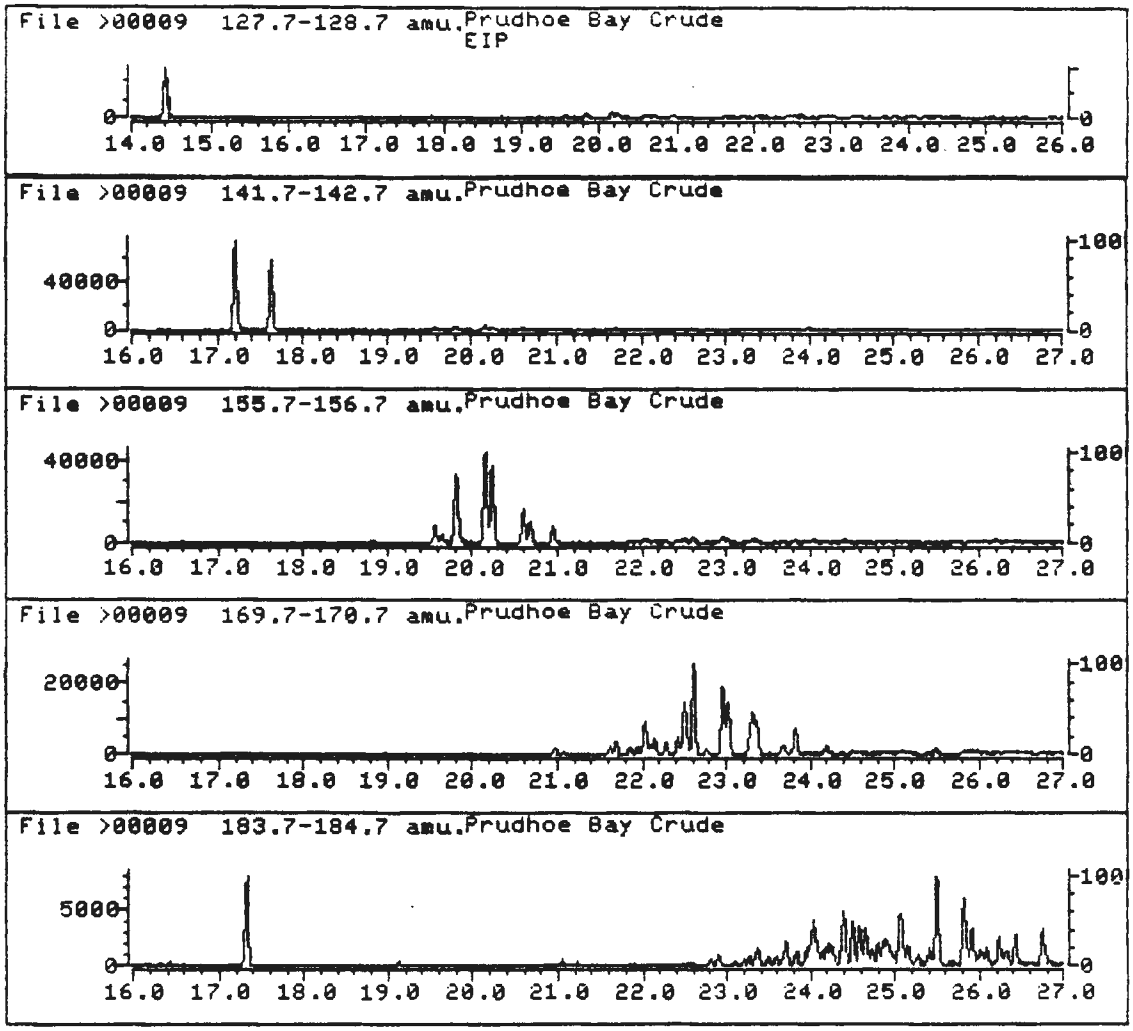

Figure 1. PAH Akyl Homologue Patterns for Naphthalenes

Title: Determination of Low-level Polynuclear Aromatic Hydrocarbons (PAH) and Selected Heterocycles

SOP No.:	Revision No.	Effective Date:
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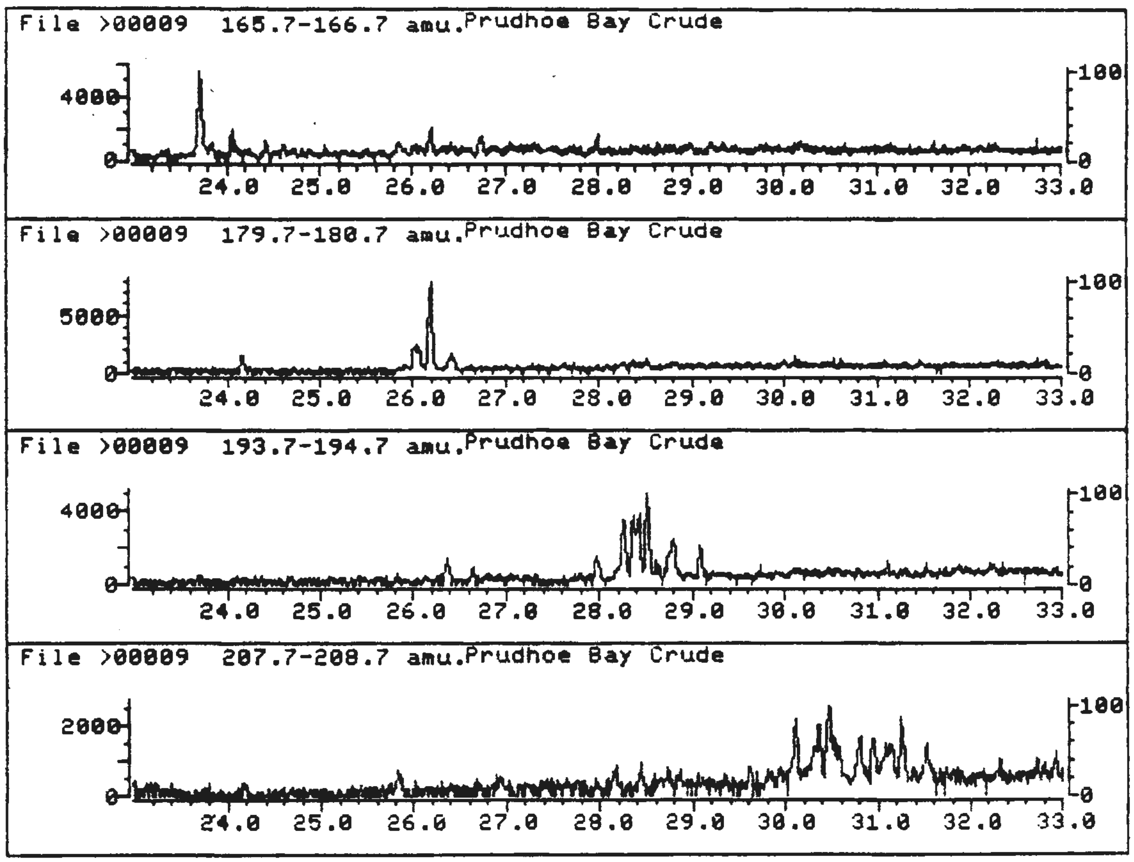

Figure 1. (Continued) PAH Akyl Homologue Patterns for Fluorenes

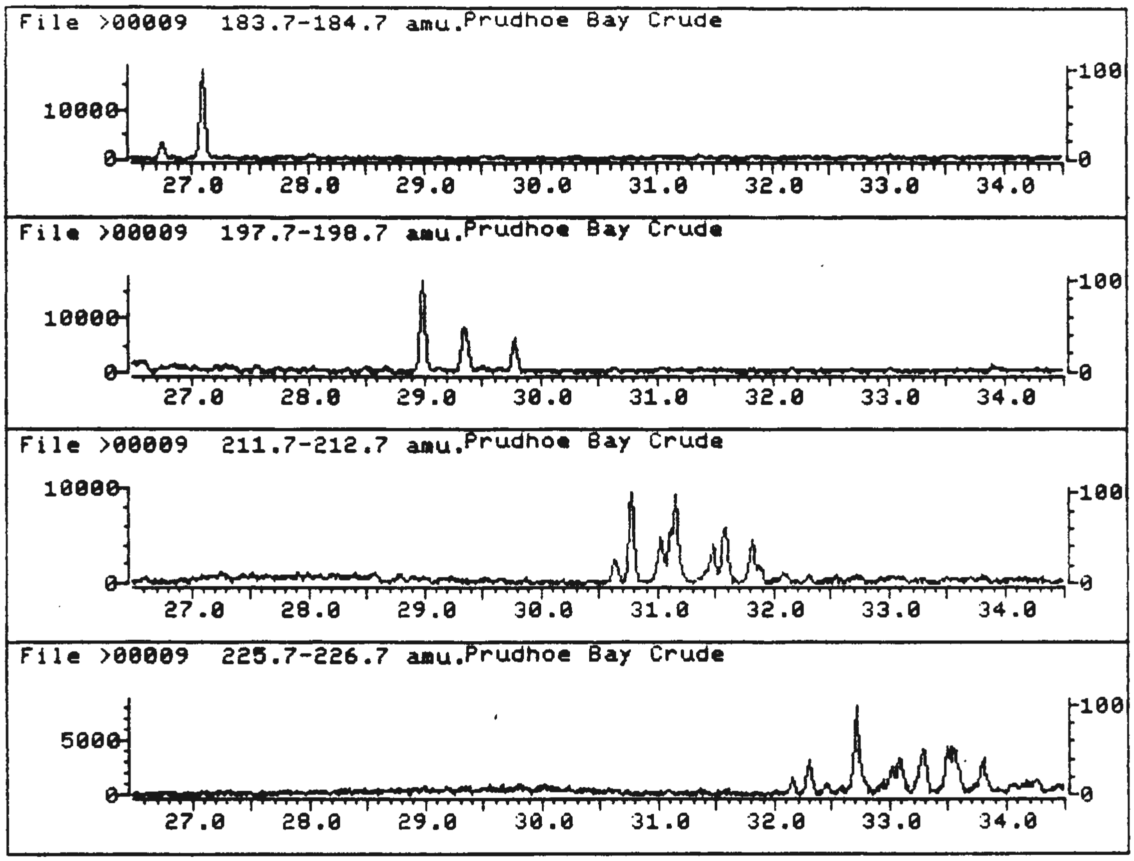

Figure 1. (Continued) PAH Akyl Homologue Patterns for Dibenzothiophenes

Title: Determination of Low-level Polynuclear Aromatic Hydrocarbons (PAH) and Selected Heterocycles

SOP No.:	Revision No.	Effective Date:
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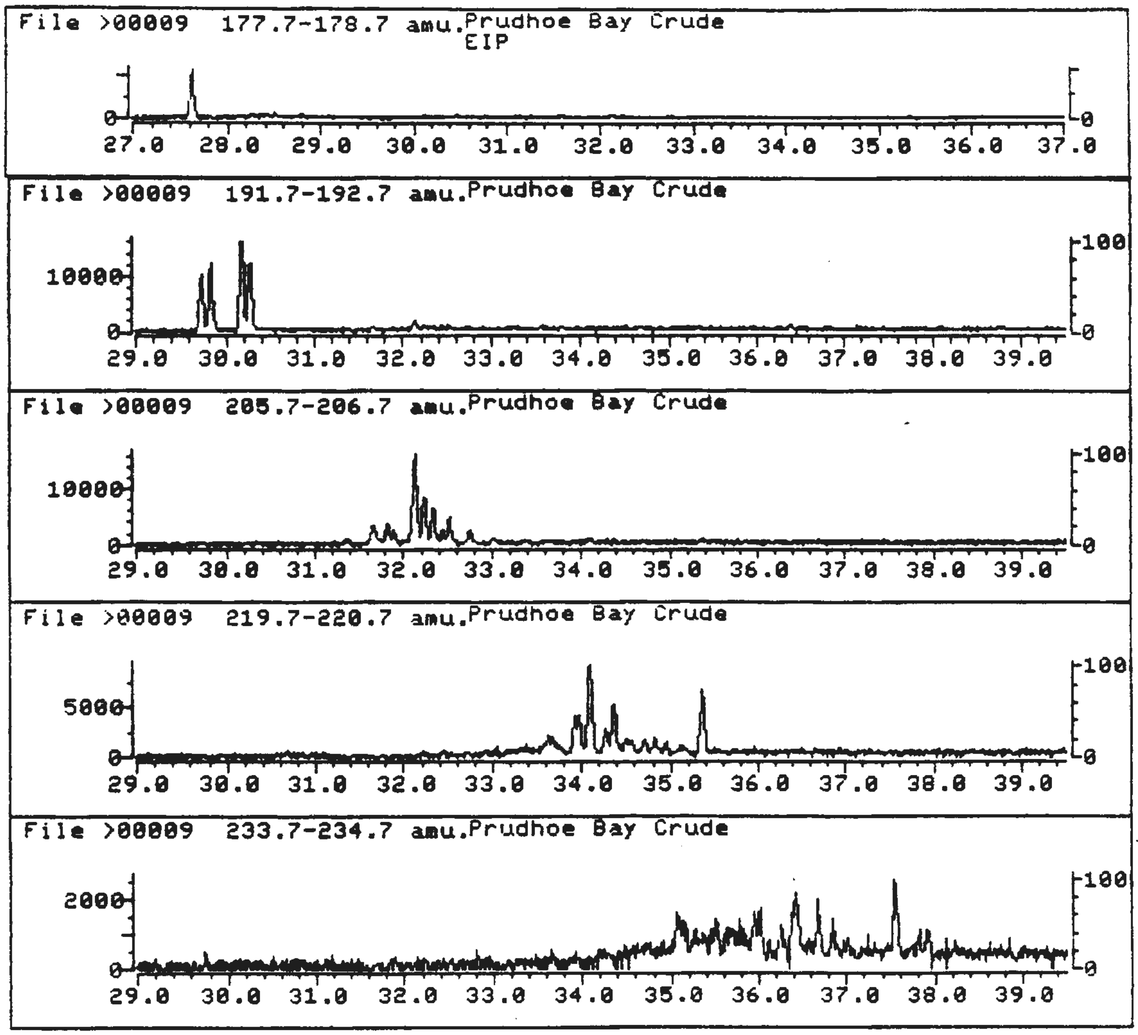

Figure 1. (Continued) PAH Akyl Homologue Patterns for Phenanthrenes

APPENDIX SOP.
Standard Operating Procedures

Section 8. Determination of Total Petroleum Hydrocarbon in seawater

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
5633 B STREET • ANCHORAGE, ALASKA 99518 • TELEPHONE (907) 562-2343

Subject: Extraction of Water samples for Total Petroleum Hydrocarbon Analysis

SOP No:	Revision No:	Effective Date:
EVC89-9	1.0	November 8, 1989

1.0 SCOPE AND APPLICATION

This document describes the application of EPA600 method 418.1 for the measurement of fluorocarbon-113 extractable petroleum hydrocarbons, as defined by the method, from surface water, industrial and domestic wastes.

The method is applicable to the measurement of light fuels, although loss of about half of any gasoline present during the extraction manipulations can be expected. Heavy constituents of crude oil, such as asphaltenes, are only slightly soluble in the solvent used and do not extract from the matrix.

2.0 SUMMARY OF METHOD

A 1 liter sample is acidified to a low pH (<2) and serially extracted with fluorocarbon-113 in a separatory funnel. Interferences are removed with silica gel adsorbent. Infrared analysis of the extract is performed by direct comparison with standards.

Prepared by:

Chris Brown — Date: November 8, 1989

Stephen C. Ede — Date: November 8, 1989

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3.0 SAMPLING AND STORAGE

3.1 A representative sample of 1 liter volume should be collected in an amber glass bottle with a Teflon lined lid. Because a loss of grease will occur on sampling equipment, the collection of a composite sample is impractical. The entire sample is consumed by this test; no other analyses may be performed using aliquots of the sample.

3.2 If not preserved in the field, samples are acidified (with 1:1 HCl to a pH less than 2) upon receipt and refrigerated at or below 4 degrees centigrade (C) until analysis.

3.3 Maximum holding time is 14 days from receipt of sample.

4.0 INTERFERENCES

Method interferences may be caused by contaminants in solvents, glassware and body oil from the analyst and other sources that lead to elevated baselines. Glassware must be demonstrated to be free of contaminants before each extraction by recording the volume and absorbance of the last solvent rinse.

Matrix interferences may be caused by non-petroleum compounds which simultaneously extract from the sample. These interferences can be removed with silica gel adsorbent.

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5.0 APPARATUS AND MATERIALS

5.1 Glassware and Apparatus

Separatory funnel. 2000ml Pyrex or equivalent. with Teflon stopcock.

Phase separation filter paper, Whatman No. 1PS, 15.0cm (catalogue number 2200-150), or equivalent.

Infrared spectrophotometer, Foxboro Miran 1FF. Fixed filter with nichrome source (maximum at 3.5 micrometers. slit width 2mm and resolution of ± 0.05um), filter at 3.48um or Perkin-Elmer 710B Scanning Double Beam.

Cells. 10.0 mm, 50.0 mm pathlength, infrared grade quartz.

Magnetic stirrer, with Teflon coated stirring bars.

Graduated cylinder, class A 50.0 ml or 100.0 ml. Pyrex or equivalent.

Beaker. 50ml pyrex or equivalent.

Disposable centrifuge tubes, Polyethylene/polypropylene, inert with solvent. 50 ml VWR or equivalent.

Centrifuge, Beckman GP counter top.

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5.2 Reagents

Fluorocarbon-113 (1,1,2trichloro-1,2,2 trifluoroethane), bp 48C, Freon reagent grade or equivalent. Freon should contain less than 1.0mg/l total oil and grease as determined by evaporative concentration and comparison to known blank Freon. Dispose of solvent in chlorinated waste container only.

Sodium sulfate, anhydrous granular. Fisher reagent grade (catalogue number 3421-3), or equivalent.

Silica gel, J.T. Baker reagent grade or equivalent 60-200 mesh (cat.# 3405-01) or equivalent. Heated to 100C for 8 hours to activate.

Hydrochloric Acid, concentrated. J.T. Baker reagent grade (cat.# 9535-03) or equivalent.

6.0 PROCEDURE

6.1 Blank all glassware with freon before analysis. Verify blank by reading solvent on IR spectrophotometer after rinsing glassware. Record blank absorbance value and volume (use 30ml per rinse) of last solvent rinse.[1]

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[1]Blank limit is 0.1mg in rinse solvent.

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6.2 Mark the sample bottle at the meniscus for later determination of sample volume. If the sample was not acidified at the time of collection, add 5 ml HCl to the sample bottle and mix.

6.3 Pour the sample into the separatory funnel.

6.4 Add 15ml fluorocarbon-113 to sample bottle and rotate the bottle to rinse the sides. Transfer the solvent into the separatory funnel. Extract by shaking vigorously for 2 minutes. Allow layers to separate, and filter the solvent layer into the graduated cylinder through a funnel containing solvent moistened filter paper. Vent separatory funnel through stopcock to prevent pressure buildup.

6.5 Filter solvent layer through prerinsed, blanked phase separation paper into graduated cylinder. Note: An emulsion that fails to dissipate can be broken by pouring about 1 gram of sodium sulfate into the filter paper cone and slowly draining the emulsion through the salt. Additional 1 gram portions can be added to the cone as required. Alternately, the emulsion may be drawn into centrifuge tubes and spun for 20 minutes at 3000 RPM.

6.6 Repeat 6.4 and 6.5 twice more with 15 ml portions (heavily oiled samples may require larger extraction volumes) of fresh solvent, Combining the solvent extracts into the graduated cylinder.[1]

[1]For justification of reduced total Freon extraction volume, see attached "418.1 Spike Survey."

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6.7 Measure sample volume by refilling sample bottle with tap water to the previously marked sample meniscus level and measuring the volume in a graduated cylinder. Record sample volume, total freon extraction volume and total oil and grease absorbance value from the IR spec. Archive 25 ml of total oil and grease extract indefinitely.

6.8 For total petroleum hydrocarbon determination, pour extract into a blanked 50ml beaker. Add silica gel according to the following procedure (1 gram silica gel adsorbs 33mg grease):[1]

6.9 Calculate mg/l total oil and grease using standard curve and absorbance value. Multiply by the liters of freon extract to be analyzed (if sample has been diluted. use dilution volume). This yields mg of oil and grease being analyzed in the extract. Divide mg by 33 and double the resulting number for the gram weight of silica gel to be used. Add a freon rinsed stir bar, cover beaker and stir solution for a minimum of 5 minutes. Allow silica gel to settle, measure absorbance and record value.

[1]Standard Methods, method 503E, pg 502, "less than 100mg fatty material, add 3.0g silica gel."

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7.0 QUALITY CONTROL

7.1 Matrix spikes. duplicates and method Blanks are run as submitted by clients or 10 percent of samples, which ever is greater. In addition, periodic, blind check samples are submitted by section supervisor.

7.2 Continuing calibration verification standards are measured on IR spectrophotometer daily for each calibration curve. Acceptance criteria are 90 to 110% of true value. Instruments are recalibrated if standard recovery falls outside of accepted values.

7.3 Calibration mixtures:

7.3.1 Reference oil: 15.0ml n-hexadecane, 15.0ml isooctane, 10.0ml chlorobenzene.

7.3.2 Working standards: Low standard must be 5.0mg/L. Use 4 calibration points, not including the blank, which cover the instrument working range to be used.

8.0 CALCULATIONS

8.1 mg/l total oil and grease or total petroleum hydrocarbons:

R x D x (F/S)
where R= mg/l freon from standard curve.
D= dilution factor. if used.
F= total freon extract volume in ml.
S= sample volume in ml.

9.0 REPORTING

9.1 Reporting units for total petroleum hydrocarbons are mg/l.

9.2 Reporting limits are 0.20mg/l.

APPENDIX SOP.
Standard Operating Procedures

Section 9. Determination of 2-butoxy-ethanol in surface wipes

A. MS METHODOLOGY

Concentrations of butoxy-ethanol in the 10 minus to 50,000 ppm range are determined with a procedure developed in June 1990 in the Corporate Research Analytical Sciences Laboratory of Exxon Research and Engineering Company. A summary of the established methodology and of the development and evaluation steps are given below:

1. Methodology

The methodology is based on a GC/MS analysis using toluene as an internal standard. The steps used, in the order carried out, are the following:

- Approximately 40-60 mg of the oil is diluted with CH_2Cl_2, in a 1:9 ratio. Sample concentration is determined accurately on a 4 or 5 place analytical balance.

- An internal standard, toluene in CH_2Cl_2, is prepared in concentrations of 10, 100 or 1000 ppm to "match" the expected butoxy-ethanol concentration in the sample. Toluene was selected as internal standard because of the closeness of its retention time to that of butoxy-ethanol and because it is not contained in detectable amounts in weathered oil samples.

- Sample solution and internal standard solution are combined in exactly 1:1 ratio (25μl each), measured volumetrically.

- 0.5μl of the 1:1 blend is injected in a GC/MS instrument, a Finnigan Model 46B TSQ (triple stage quadrupole), and run under the following experimental conditions:

  + column:

    30M DB1 "boiling point" column, .32mm id, and .25μ film thickness

  + temperature programming: start 50 C; 8 C/min to 100; then 20 C/min to 310 C

- With the GC/MS instrument operating in MID (multiple ion detection) mode, areas of m/e 87 and m/e 92 are measured. M/e 87 is one of the largest peaks in the mass spectrum of ethoxy-butanol; m/e 92 is the molecular ion of toluene. There is very little or no interference to m/e 87 from components likely to be present in petroleum streams.

- Concentration of the butoxy-ethanol, expressed in ppm units, is calculated from the area measurements with the formula:

$$\text{ppm butoxy ethanol} = \frac{\text{Area "87"}}{\text{Area "92"}} \times \frac{St}{Sb} \times \frac{100}{C_1} \times C_2$$

where St is the relative sensitivity of m/e 92 of toluene vs. that of m/e 87 of butoxy-ethanol (6.7 in our case)

Sb is 1.0

C_1 is the concentration (wt. %) of the sample in CH_2Cl_2, i.e. the dilution factor

C_2 is the concentration of the toluene internal standard in CH_2Cl_2 expressed in ppm

- Notes:

  + The analysis can be carried out on any GC/MS system that possesses performance characteristics equivalent to those of the system used at CR-ASL.

  + Complete GC/MS scans also can be used, although this involves a decrease in sensitivity. We used this mode in method development, and to assess the interferences of the various components (weathered oil, butoxy-ethanol, internal standard, solvent). In this case, the relative sensitivity ratio between the total ionization of toluene and that of butoxy-ethanol was found to be 1.9.

  + Accuracy of the determination is improved by checking instrument performance with a known standard. In our case we used 1:99 and 1:999 parts INIPOL: weathered Alaska North Slope (ANS) standards containing, respectively, approximately 700 and 70 ppm butoxy-ethanol. The ANS standard was weathered 521F+ (ANS 521+). Oil: ethoxy-butanol standards could also be used.

2. Method Development

This phase of the work consisted of the following:

- Identification of butoxy-ethanol and determination of its elution time at standard conditions used. This step was carried out with pure butoxy-ethanol; retention time was approximately 680 scan numbers (136 seconds). These data were also used to select the characteristic m/e value (87) to use in the analysis.

- Selection of an appropriate internal standard (toluene, as mentioned in Section 1).

- Optimization of the GC/MS conditions to eliminate or at least minimize interferences between solvent, toluene, butoxy-ethanol, ANS 521+ (taken as typical of the samples to be analyzed later on). The conditions were arrived at using full scan GC/MS runs; the final conditions decided upon were those reported in 1. At those conditions, toluene elutes at approximately 400 scan numbers, butoxy-ethanol at approximately 680 scan numbers, and the first detectable components of ANS 521+ at 1000+ scan numbers.

- Establishing the relative sensitivities between the internal standard (toluene) and the butoxy-ethanol, using 50:50 blends in CH_2Cl_2 solution. Values found were 6.7:1 in the MID mode and 1.9:1 in the full scan mode, as mentioned above.

- Establishing "informal" repeatability, accuracy data and the detectability limit. This was done using 99:1 and 999:1 blends of ANS 521+ and INIPOL containing approximately 700 and 70 ppm butoxy-ethanol.

  + Replicate values for the 99:1 were standard were: 747, 757, 717; for the 999:1 blend, used to check detectability, the value found was 67 ppm. Detectability is estimated to be less than 10 ppm.

B. <u>LABORATORY EXPERIMENTS</u>

Laboratory experiments were carried out to predict the depletion of butoxy-ethanol in field conditions and also to test the GC/MS methodology to be used.

- A thin film of INIPOL, about 0.1 g, containing approximately 10 percent butoxy-ethanol was spread over 0.9g of ANS 521+/

- After approximately 5′ "rest", this mixture was contacted with either 1:1 or 10:1 concentrations of seawater and agitated in a separatory funnel for approximately 20′, simulating tidal action. Contact and agitation were carried out one, two, three, or four times on four separate samples to simulate the effect of one to four tidal periods. The oil phase was then separated (no emulsion was observed) and submitted to the GC/MS analysis.

- GC/MS data on these experiments are shown in Table I and clearly indicate the rapid disappearance of the butoxy-ethanol, with a coefficient of partition of approximately 1.0 between the water and oil phases.

- In another experiment, the butoxy-ethanol:ANS 521+ mixtures, in an hourglass were exposed to the sheltered atmosphere in our laboratories (~72F, no winds). After five hours, 50% of the butoxy-ethanol was missing; and there was no detectable butoxy-ethanol (loss of at least 99.999 percent) after 29 hours. These data indicate that we should expect rapid depletion in butoxy-ethanol even without tidal action.

C. Determination of the Butoxy-Ethanol Content of the Field Samples

This effort is summarized in the following paragraphs:

- Field samples were collected on plastic "wipes" and sent to us in refrigerated containers. They consisted of four samples from a lower tidal zone and four from an upper tidal zone. Both sets included materials after the initial treatment and after 1, 2, 4 tidal actions.
- The "wipes" were extracted in CH_2Cl_2.
- The solvent was evaporated and the extracts weighed. Control experiments with partial solvent evaporation indicated that this step did not involve loss of ethoxy-butanol.
- The extracted samples were analyzed by GC/MS with the methodology described in A.

Data obtained from these experiments are reported in Table II. They unequivocally confirmed that butoxy-ethanol disappears very rapidly under tidal action. The rate of disappearance is faster in the lower tidal region, where there is more contact with seawater. The high initial value in the upper tidal zone is due probably to surface migration or sampling. At any rate, even that much butoxy-ethanol disappears very rapidly. These data are illustrated visually in Figures 1-8. These field experiments corroborate extremely well the data obtained in the Laboratory, greatly increasing our confidence in laboratory predictions.

D. Conclusion

The GC/MS method developed in CR-ASL has been shown to determine the butoxy-ethanol content of INIPOL treated materials both accurately and rapidly.

Laboratory and field data definitively show that butoxy-ethanol disappears very rapidly from INIPOL treated oils.

E. <u>Acknowledgement</u>

Major contributors to the effort described in this note included:

M. Genowitz	Laboratory experiments, sample extractions
G. Dechert	GC/MS method development, analyses
S. C. Blum	Planning, consulting
Dave Moser and Barbara Essler	Extractions

TABLE I

DISAPPEARANCE OF BUTOXY-ETHANOL IN LABORATORY EXPERIMENTS

No. of "Washes" (tidal action)	Butoxy-Ethanol Concentration, ppm: 1:1 Water:ANS Plus INIPOL	Butoxy-Ethanol Concentration, ppm: 10:1 Water:ANS Plus INIPOL
0 (starting material)	(10,000)	(10,000)
1	5083	910;729
2	3068	107;150
3	1019	137
4	428	0

TABLE II

DISAPPEARANCE OF BUTOXY-ETHANOL IN FIELD SITUATIONS

Tidal Action	Butoxy-Ethanol Concentration, ppm: Upper Tidal Zone	Butoxy-Ethanol Concentration, ppm: Lower Tidal Zone
Initial Treatment	52,000	10,000
After 1st Tide	4,000	177
After 2nd Tide	300	Not detected(1)
After 4th Tide	19	Not detected(1)

(1) Below 10 ppm

3

APPENDIX D1.
Data tables from interstitial water samples

APPENDIX D1, TABLE 1
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000115	SAMP	KN132	T	A	0	SURF	31-MAY-90	10:02	2.86	2.01	0.58	
71NUT000116	SAMP	KN132	T	A	0	BOT	31-MAY-90	10:08	2.30	0.92	0.54	
71NUT000117	SAMP	KN132	T	B	0	SURF	31-MAY-90	08:58	0.79	1.21	0.53	
71NUT000118	SAMP	KN132	T	B	0	BOT	31-MAY-90	09:04	0.69	0.86	0.70	
71NUT000119	SAMP	KN132	T	C	0	SURF	31-MAY-90	09:38	2.23	1.86	0.88	
71NUT000131	DUP	KN132	T	C	0	SURF	31-MAY-90	09:43	2.08	0.65	0.84	
71NUT000120	SAMP	KN132	T	C	0	BOT	31-MAY-90	09:50	2.43	0.60	0.86	
71NUT000122	SAMP	KN132	T	Y	0	BOT	31-MAY-90	09:35	2.15	0.77	0.71	
71NUT000124	SAMP	KN132	T	Z	0	BOT	31-MAY-90	09:15	1.91	1.07	0.74	
71NUT000125	SAMP	KN132	R	D	0	SURF	31-MAY-90	08:15	1.37	1.09	0.14	
71NUT000132	DUP	KN132	R	D	0	BOT	31-MAY-90	08:19	1.65	0.36	0.08	
71NUT000126	SAMP	KN132	R	D	0	BOT	31-MAY-90	08:18	1.70	1.39	0.13	
71NUT000127	SAMP	KN132	R	E	0	SURF	31-MAY-90	08:59	3.33	1.35	0.26	
71NUT000128	SAMP	KN132	R	E	0	BOT	31-MAY-90	09:04	4.12	1.38	0.41	
71NUT000129	SAMP	KN132	R	F	0	SURF	31-MAY-90	09:15	3.07	0.58	0.06	
71NUT000130	SAMP	KN132	R	F	0	BOT	31-MAY-90	09:17	2.87	0.43	0.03	
71NUT000165	SAMP	KN132	T	A	2	SURF	04-JUN-90	02:14	65.50	83.80	0.72	
71NUT000166	SAMP	KN132	T	A	2	BOT	04-JUN-90	02:19	62.80	83.20	0.49	
71NUT000167	SAMP	KN132	T	B	2	SURF	04-JUN-90	01:36	57.20	96.30	1.10	
71NUT000168	SAMP	KN132	T	B	2	BOT	04-JUN-90	01:40	65.70	103.10	0.90	
71NUT000169	SAMP	KN132	T	C	2	SURF	04-JUN-90	01:59	87.30	122.60	0.91	
71NUT000170	SAMP	KN132	T	C	2	BOT	04-JUN-90	02:07	88.70	115.80	0.92	
71NUT000171	SAMP	KN132	T	Y	2	BOT	04-JUN-90	02:29	82.60	90.50	0.61	
71NUT000180	DUP	KN132	T	Y	2	BOT	04-JUN-90	02:30	83.30	91.30	0.54	
71NUT000172	SAMP	KN132	T	Z	2	BOT	04-JUN-90	01:51	119.20	143.40	0.75	
71NUT000173	SAMP	KN132	R	D	2	SURF	04-JUN-90	01:41	5.05	0.59	0.08	
71NUT000179	DUP	KN132	R	D	2	SURF	04-JUN-90	01:42	5.91	0.90	0.11	
71NUT000174	SAMP	KN132	R	D	2	BOT	04-JUN-90	01:45	7.25	0.76	0.12	
71NUT000175	SAMP	KN132	R	E	2	SURF	04-JUN-90	01:54	10.80	8.05	0.22	
71NUT000176	SAMP	KN132	R	E	2	BOT	04-JUN-90	02:00	12.00	9.04	0.28	
71NUT000177	SAMP	KN132	R	F	2	SURF	04-JUN-90	02:06	4.52	1.86	0.11	
71NUT000178	SAMP	KN132	R	F	2	BOT	04-JUN-90	02:12	3.34	1.12	0.08	
71NUT000197	SAMP	KN132	T	A	4	SURF	06-JUN-90	03:45	18.80	15.60	0.43	
71NUT000211	DUP	KN132	T	A	4	SURF	06-JUN-90	03:49	25.90	17.60	0.51	
71NUT000198	SAMP	KN132	T	A	4	BOT	06-JUN-90	03:51	25.90	18.20	0.48	
71NUT000199	SAMP	KN132	T	B	4	SURF	06-JUN-90	03:11	26.80	30.00	0.63	
71NUT000200	SAMP	KN132	T	B	4	BOT	06-JUN-90	03:14	29.70	34.20	1.37	
71NUT000212	DUP	KN132	T	B	4	BOT	06-JUN-90	03:16	29.90	36.10	0.72	
71NUT000201	SAMP	KN132	T	C	4	SURF	06-JUN-90	03:27	51.70	70.30	1.13	
71NUT000202	SAMP	KN132	T	C	4	BOT	06-JUN-90	03:34	63.20	83.30	0.91	
71NUT000203	SAMP	KN132	T	Y	4	BOT	06-JUN-90	04:11	41.70	46.60	0.56	
71NUT000204	SAMP	KN132	T	Z	4	BOT	06-JUN-90	04:00	52.70	93.10	0.53	
71NUT000205	SAMP	KN132	R	D	4	SURF	06-JUN-90	03:09	3.72	0.13	0.11	
71NUT000206	SAMP	KN132	R	D	4	BOT	06-JUN-90	03:16	4.53	1.12	0.19	
71NUT000207	SAMP	KN132	R	E	4	SURF	06-JUN-90	03:25	7.19	0.34	0.19	
71NUT000208	SAMP	KN132	R	E	4	BOT	06-JUN-90	03:28	8.68	1.05	0.24	
71NUT000209	SAMP	KN132	R	F	4	SURF	06-JUN-90	03:40	2.86	0.58	0.06	
71NUT000210	SAMP	KN132	R	F	4	BOT	06-JUN-90	03:47	2.74	0.37	0.05	
71NUT000181	EB	KN132		NA	4	NA	04-JUN-90	05:05	0.28	1.04	0.00	
71NUT000229	SAMP	KN132	T	A	8	SURF	10-JUN-90	05:37	10.90	8.76	0.41	
71NUT000230	SAMP	KN132	T	A	8	BOT	10-JUN-90	05:45	10.80	8.36	0.35	
71NUT000244	DUP	KN132	T	A	8	BOT	10-JUN-90	05:44	8.34	11.40	0.30	

APPENDIX D1, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000231	SAMP	KN132	T	B	8	SURF	10-JUN-90	05:17	24.50	16.40	0.69	
71NUT000243	DUP	KN132	T	B	8	SURF	10-JUN-90	05:18	22.90	17.50	0.66	
71NUT000232	SAMP	KN132	T	B	8	BOT	10-JUN-90	05:23	10.50	14.00	0.35	
71NUT000233	SAMP	KN132	T	C	8	SURF	10-JUN-90	05:50	18.40	27.70	0.47	
71NUT000234	SAMP	KN132	T	C	8	BOT	10-JUN-90	05:55	31.80	48.90	0.70	
71NUT000235	SAMP	KN132	T	Y	8	BOT	10-JUN-90	06:14	19.90	18.10	0.45	
71NUT000236	SAMP	KN132	T	Z	8	BOT	10-JUN-90	06:06	20.40	21.00	0.38	
71NUT000237	SAMP	KN132	R	D	8	SURF	10-JUN-90	04:06	1.28	0.63	0.06	
71NUT000238	SAMP	KN132	R	D	8	BOT	10-JUN-90	04:10	1.25	1.13	0.09	
71NUT000239	SAMP	KN132	R	E	8	SURF	10-JUN-90	05:20	2.51	0.60	0.16	
71NUT000240	SAMP	KN132	R	E	8	BOT	10-JUN-90	05:27	3.24	0.12	0.12	
71NUT000241	SAMP	KN132	R	F	8	SURF	10-JUN-90	05:37	2.54	0.55	0.04	
71NUT000242	SAMP	KN132	R	F	8	BOT	10-JUN-90	05:43	1.48	0.30	0.00	
71NUT000261	SAMP	KN132	T	A	16	SURF	18-JUN-90	12:04	10.90	1.34	0.65	
71NUT000262	SAMP	KN132	T	A	16	BOT	18-JUN-90	12:14	4.57	0.34	0.41	
71NUT000263	SAMP	KN132	T	B	16	SURF	18-JUN-90	10:38	29.60	2.18	0.67	
71NUT000276	SAMP	KN132	T	B	16	BOT	18-JUN-90	10:48	15.50	0.84	0.47	
71NUT000264	SAMP	KN132	T	B	16	BOT	18-JUN-90	10:46	19.20	0.94	0.53	
71NUT000265	SAMP	KN132	T	C	16	SURF	18-JUN-90	11:46	8.44	1.33	0.56	
71NUT000275	DUP	KN132	T	C	16	SURF	18-JUN-90	11:48	10.40	1.60	0.68	
71NUT000266	SAMP	KN132	T	C	16	BOT	18-JUN-90	11:56	9.31	1.99	0.59	
71NUT000267	SAMP	KN132	T	Y	16	BOT	18-JUN-90	11:31	4.04	0.68	0.40	
71NUT000268	SAMP	KN132	T	Z	16	BOT	18-JUN-90	11:19	22.60	0.95	0.44	
71NUT000269	SAMP	KN132	R	D	16	SURF	18-JUN-90	10:24	9.96	0.51	0.20	
71NUT000270	SAMP	KN132	R	D	16	BOT	18-JUN-90	10:30	12.80	0.87	0.17	
71NUT000271	SAMP	KN132	R	E	16	SURF	18-JUN-90	10:44	4.88	0.35	0.09	
71NUT000272	SAMP	KN132	R	E	16	BOT	18-JUN-90	10:46	4.93	0.35	0.16	
71NUT000273	SAMP	KN132	R	F	16	SURF	18-JUN-90	10:58	4.97	0.13	0.06	
71NUT000274	SAMP	KN132	R	F	16	BOT	18-JUN-90	11:04	5.11	0.21	0.05	
71NUT000277	EB	KN132		NA	16	NA	18-JUN-90	15:20	0.15	0.11	0.00	
71NUT000313	SAMP	KN132	T	A	29	SURF	30-JUN-90	23:39	21.50	5.74	0.60	
71NUT000314	SAMP	KN132	T	A	29	BOT	30-JUN-90	23:42	22.80	7.02	0.65	
71NUT000315	SAMP	KN132	T	B	29	SURF	30-JUN-90	23:04	26.70	5.28	1.08	
71NUT000316	SAMP	KN132	T	B	29	BOT	30-JUN-90	23:10	30.80	5.40	0.71	
71NUT000317	DUP	KN132	T	B	29	BOT	30-JUN-90	23:44	21.40	5.64	0.65	
71NUT000318	SAMP	KN132	T	C	29	SURF	30-JUN-90	23:51	39.10	5.51	0.85	
71NUT000319	DUP	KN132	T	C	29	SURF	30-JUN-90	23:52	36.90	5.67	0.88	
71NUT000320	SAMP	KN132	T	C	29	BOT	30-JUN-90	23:58	33.90	5.56	0.91	
71NUT000328	SAMP	KN132	T	Y	29	BOT	30-JUN-90	23:28	27.50	6.38	0.39	
71NUT000327	SAMP	KN132	T	Z	29	BOT	30-JUN-90	23:18	60.50	7.15	0.45	
71NUT000321	SAMP	KN132	R	D	29	SURF	30-JUN-90	22:28	5.51	0.27	0.23	
71NUT000322	SAMP	KN132	R	D	29	BOT	30-JUN-90	22:33	4.50	0.17	0.19	
71NUT000323	SAMP	KN132	R	E	29	SURF	30-JUN-90	23:01	14.70	4.87	0.36	
71NUT000324	SAMP	KN132	R	E	29	BOT	30-JUN-90	23:08	16.30	4.36	0.29	
71NUT000325	SAMP	KN132	R	F	29	SURF	30-JUN-90	23:16	4.61	0.31	0.11	
71NUT000326	SAMP	KN132	R	F	29	BOT	30-JUN-90	23:25	4.34	4.84	0.12	
71NUT000329	EB	KN132		NA	29	NA	01-JUL-90		0.00	0.07	0.00	
94NUT000001	SAMP	KN132	T	A	43	BOT	07-15-90	22:47	9.37	22.80	0.14	
94NUT000004	SUP	KN132	T	B	43	BOT	07-15-90	22:09	7.40	12.60	0.13	
94NUT000002	SAMP	KN132	T	B	43	BOT	07-15-90	22:09	9.86	13.30	0.14	
94NUT000003	SAMP	KN132	T	C	43	BOT	07-15-90	22:40	15.20	117.30	0.22	

APPENDIX D1, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
94NUT000008	SAMP	KN132	T	Y	43	BOT	07-15-90	22:32	13.70	62.70	0.17	
94NUT000009	SAMP	KN132	T	Z	43	BOT	07-15-90	22:20	24.60	44.40	0.16	
94NUT000005	SAMP	KN132	R	D	43	BOT	07-15-90	21:52	0.69	0.06	0.01	
94NUT000006	SAMP	KN132	R	E	43	BOT	07-15-90	22:12	1.58	0.58	0.07	
94NUT000007	SAMP	KN132	R	F	60	BOT	07-15-90	21:24	1.06	0.47	0.00	
94NUT000062	SAMP	KN132	T	A	60	BOT	08-01-90	00:30	33.20	0.25	0.65	
94NUT000063	SAMP	KN132	T	B	60	BOT	08-01-90	00:00	17.00	0.25	0.82	
94NUT000070	DUP	KN132	T	B	60	BOT	08-01-90	00:00	17.40	0.32	0.80	
94NUT000064	SAMP	KN132	T	C	60	BOT	08-01-90	00:45	34.70	0.25	0.58	
94NUT000065	SAMP	KN132	T	Y	60	BOT	08-01-90	00:15	21.80	0.28	0.20	
94NUT000066	SAMP	KN132	T	Z	60	BOT	08-01-90	00:05	53.00	0.30	0.45	
94NUT000067	SAMP	KN132	R	D	60	BOT	07-31-90	23:29	2.32	0.88	0.09	
94NUT000068	SAMP	KN132	R	E	60	BOT	07-31-90	23:50	8.36	0.53	0.08	
94NUT000069	SAMP	KN132	R	F	60	BOT	08-01-90	00:01	1.82	0.86	0.01	
94NUT000071	SAMP	KN132	R	STR	60	SURF	08-01-90	00:15	1.57	3.57	0.30	
71NUT000005	SAMP	KN135	T	A	0	SURF	19-MAY-90	14:11	2.71	1.18	0.75	0.02
71NUT000022	SAMP	KN135	T	A	0	SURF	20-MAY-90	13:54	2.25	1.41	0.62	0.07
71NUT000024	DUP	KN135	T	A	0	SURF	20-MAY-90	13:55	1.95	0.19	0.47	0
71NUT000023	SAMP	KN135	T	A	0	BOT	20-MAY-90	14:07	2.19	1.11	0.54	0.01
71NUT000025	DUP	KN135	T	A	0	BOT	20-MAY-90	14:08	1.58	0.27	0.34	0
71NUT000006	SAMP	KN135	T	A	0	BOT	19-MAY-90	14:13	2.78	1.00	0.58	0.03
71NUT000026	SAMP	KN135	T	B	0	SURF	20-MAY-90	13:19	2.26	0.15	0.05	0
71NUT000027	SAMP	KN135	T	B	0	BOT	20-MAY-90	13:28	2.95	1.22	0.11	0.04
71NUT000007	SAMP	KN135	T	B	0	BOT	19-MAY-90	14:49	3.95	0.81	0.29	0.02
71NUT000008	DUP	KN135	T	B	0	BOT	19-MAY-90	14:50	3.25	0.63	0.03	0.02
71NUT000028	SAMP	KN135	T	C	0	SURF	20-MAY-90	14:35	2.22	0.53	0.12	0
71NUT000010	SAMP	KN135	T	C	0	BOT	19-MAY-90	14:57	3.00	0.83	0.22	0
71NUT000029	SAMP	KN135	T	C	0	BOT	20-MAY-90	14:41	2.05	0.19	0.09	0
71NUT000036	SAMP	KN135	T	Z	0	SURF	20-MAY-90		3.57	1.22	0.23	0.81
71NUT000021	SAMP	KN135	T	Z	0	BOT	19-MAY-90	15:19	3.72	0.73	0.35	0.02
71NUT000037	SAMP	KN135	T	Z	0	BOT	20-MAY-90	14:25	3.21	1.50	0.38	0.28
71NUT000030	SAMP	KN135	R	D	0	SURF	20-MAY-90	13:47	0.97	0.89	0.33	0.03
71NUT000031	SAMP	KN135	R	D	0	BOT	20-MAY-90	13:53	1.30	1.08	0.41	0
71NUT000032	SAMP	KN135	R	E	0	SURF	20-MAY-90	14:26	1.31	0.20	0.40	0.01
71NUT000033	SAMP	KN135	R	E	0	BOT	20-MAY-90	14:35	1.47	0.72	0.44	0.04
71NUT000034	SAMP	KN135	R	F	0	SURF	20-MAY-90	14:06	2.11	0.41	0.44	0
71NUT000035	SAMP	KN135	R	F	0	BOT	20-MAY-90	14:11	2.54	2.28	0.56	0.12
71NUT000038	EB	KN135	R	NA	0	NA	22-MAY-90	10:06	0.00	0.44	0.00	0
71NUT000049	SAMP	KN135	T	A	2	SURF	23-MAY-90	16:24	133.30	153.40	1.03	0.04
71NUT000050	SAMP	KN135	T	A	2	BOT	23-MAY-90	16:28	153.90	168.40	1.14	0
71NUT000051	SAMP	KN135	T	B	2	SURF	23-MAY-90	16:00	136.20	139.80	0.38	0.12
71NUT000056	DUP	KN135	T	B	2	SURF	23-MAY-90	16:09	216.50	190.90	0.52	0.28
71NUT000052	SAMP	KN135	T	B	2	BOT	23-MAY-90	16:06	132.40	129.00	0.40	0.08
71NUT000057	DUP	KN135	T	B	2	BOT	23-MAY-90	16:11	184.30	162.90	0.37	0.08
71NUT000053	SAMP	KN135	T	C	2	SURF	23-MAY-90	16:56	93.90	118.70	0.21	0.03
71NUT000054	SAMP	KN135	T	C	2	BOT	23-MAY-90	16:58	144.90	162.50	0.27	0.07
71NUT000058	SAMP	KN135	T	Z	2	SURF	23-MAY-90	16:40	123.10	117.70	0.42	0.04
71NUT000059	SAMP	KN135	T	Z	2	BOT	23-MAY-90	16:46	133.10	121.30	0.35	0.04
71NUT000055	SAMP	KN135	R	D	2	SURF	23-MAY-90	16:44	0.47	0.98	0.46	0.01
71NUT000060	SAMP	KN135	R	D	2	BOT	23-MAY-90	16:50	0.91	1.15	0.38	0
71NUT000061	SAMP	KN135	R	E	2	SURF	23-MAY-90	16:59	1.40	2.17	0.44	0

APPENDIX D1, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000062	SAMP	KN135	R	E	2	BOT	23-MAY-90	17:00	1.14	0.95	0.46	0
71NUT000063	SAMP	KN135	R	F	2	SURF	23-MAY-90	16:28	1.07	0.70	0.45	0.02
71NUT000064	SAMP	KN135	R	F	2	BOT	23-MAY-90	16:35	1.52	1.14	0.45	0
71NUT000065	SAMP	KN135	T	A	4	SURF	25-MAY-90	05:33	63.40	93.70	0.89	0.01
71NUT000066	SAMP	KN135	T	A	4	BOT	25-MAY-90	05:38	74.40	79.50	0.92	0
71NUT000069	SAMP	KN135	T	B	4	SURF	25-MAY-90	05:47	188.20	185.10	0.22	0.07
71NUT000070	SAMP	KN135	T	B	4	BOT	25-MAY-90	05:49	182.80	180.50	0.26	0.14
71NUT000067	SAMP	KN135	T	C	4	SURF	25-MAY-90	06:11	179.80	168.00	0.31	0.01
71NUT000079	DUP	KN135	T	C	4	SURF	25-MAY-90	06:10	189.30	175.90	0.35	0
71NUT000068	SAMP	KN135	T	C	4	BOT	25-MAY-90	06:15	195.60	173.70	0.33	0.04
71NUT000080	DUP	KN135	T	C	4	BOT	25-MAY-90	06:14	163.20	153.10	0.22	0.01
71NUT000077	SAMP	KN135	T	Z	4	SURF	25-MAY-90	05:56	103.00	132.70	0.26	0.72
71NUT000078	SAMP	KN135	T	Z	4	BOT	25-MAY-90	06:00	103.00	132.70	0.37	0.38
71NUT000072	SAMP	KN135	R	D	4	BOT	25-MAY-90	06:05	1.47	0.44	0.46	0
71NUT000074	SAMP	KN135	R	E	4	BOT	25-MAY-90	06:13	1.67	0.95	0.41	0.05
71NUT000076	SAMP	KN135	R	F	4	BOT	25-MAY-90	05:50	2.46	1.29	0.73	0.09
71NUT000100	SAMP	KN135	T	A	8	SURF	29-MAY-90	21:57	75.00	96.40	0.63	
71NUT000113	DUP	KN135	T	A	8	SURF	29-MAY-90	21:57	76.60	34.40	0.62	
71NUT000101	SAMP	KN135	T	A	8	BOT	29-MAY-90	22:02	83.70	49.40	0.48	
71NUT000102	SAMP	KN135	T	B	8	SURF	29-MAY-90	21:43	163.90	93.20	0.35	
71NUT000103	SAMP	KN135	T	B	8	BOT	29-MAY-90	21:48	151.50	93.40	0.34	
71NUT000114	DUP	KN135	T	B	8	BOT	29-MAY-90	21:48	157.20	95.20	0.29	
71NUT000104	SAMP	KN135	T	C	8	SURF	29-MAY-90	22:17	147.60	93.50	0.20	
71NUT000105	SAMP	KN135	T	C	8	BOT	29-MAY-90	22:22	128.10	81.70	0.21	
71NUT000112	SAMP	KN135	T	Z	8	BOT	29-MAY-90	22:12	130.70	76.10	0.32	
71NUT000106	SAMP	KN135	R	D	8	SURF	29-MAY-90	22:05	1.93	1.57	0.26	
71NUT000107	SAMP	KN135	R	D	8	BOT	29-MAY-90	21:10	2.22	0.66	0.33	
71NUT000108	SAMP	KN135	R	E	8	SURF	29-MAY-90	22:25	2.80	1.03	0.53	
71NUT000109	SAMP	KN135	R	E	8	BOT	29-MAY-90	21:20	2.99	0.67	0.53	
71NUT000110	SAMP	KN135	R	F	8	SURF	29-MAY-90	21:49	2.10	0.89	0.47	
71NUT000111	SAMP	KN135	R	F	8	BOT	29-MAY-90	21:58	2.60	1.70	0.53	
71NUT000182	SAMP	KN135	T	A	15	SURF	05-JUN-90	03:02	23.90	7.80	0.60	
71NUT000183	SAMP	KN135	T	A	15	BOT	05-JUN-90	03:05	28.80	10.00	0.64	
71NUT000184	SAMP	KN135	T	B	15	SURF	05-JUN-90	02:46	58.20	47.60	0.32	
71NUT000185	SAMP	KN135	T	B	15	BOT	05-JUN-90	02:54	37.10	43.20	0.21	
71NUT000186	SAMP	KN135	T	C	15	SURF	05-JUN-90	03:25	40.00	51.30	0.30	
71NUT000187	SAMP	KN135	T	C	15	BOT	05-JUN-90	03:30	39.50	37.80	0.23	
71NUT000188	SAMP	KN135	T	Z	15	BOT	05-JUN-90	03:15	32.70	25.40	0.28	
71NUT000189	SAMP	KN135	R	D	15	SURF	05-JUN-90	02:59	1.16	0.61	0.45	
71NUT000190	SAMP	KN135	R	D	15	BOT	05-JUN-90	03:03	0.94	0.41	0.46	
71NUT000191	SAMP	KN135	R	E	15	SURF	05-JUN-90	03:27	1.92	0.70	0.45	
71NUT000195	DUP	KN135	R	E	15	SURF	05-JUN-90	03:31	1.39	0.56	0.41	
71NUT000192	SAMP	KN135	R	E	15	BOT	05-JUN-90	03:32	2.29	0.86	0.51	
71NUT000193	SAMP	KN135	R	F	15	SURF	05-JUN-90	03:14	1.95	1.65	0.47	
71NUT000194	SAMP	KN135	R	F	15	BOT	05-JUN-90	03:15	1.72	1.22	0.48	
71NUT000196	DUP	KN135	R	F	15	BOT	05-JUN-90	03:20	1.73	1.10	0.51	
71NUT000278	SAMP	KN135	T	A	32	SURF	22-JUN-90	04:42	42.50	0.27	0.40	
71NUT000280	DUP	KN135	T	A	32	SURF	22-JUN-90	04:42	41.10	0.22	0.35	
71NUT000279	SAMP	KN135	T	A	32	BOT	22-JUN-90	04:47	45.90	0.75	0.37	
71NUT000281	SAMP	KN135	T	B	32	SURF	22-JUN-90	04:28	22.40	1.13	0.01	
71NUT000282	SAMP	KN135	T	B	32	BOT	22-JUN-90	04:32	18.50	1.37	0.06	

APPENDIX D1, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000283	DUP	KN135	T	B	32	BOT	22-JUN-90	04:34	21.70	1.03	0.00	
71NUT000284	SAMP	KN135	T	C	32	SURF	22-JUN-90	04:59	20.90	1.58	0.12	
71NUT000285	SAMP	KN135	T	C	32	BOT	22-JUN-90	05:05	20.80	1.81	0.24	
71NUT000292	SAMP	KN135	T	Z	32	BOT	22-JUN-90	05:13	47.30	1.05	0.09	
71NUT000286	SAMP	KN135	R	D	32	SURF	22-JUN-90	04:39	2.72	0.60	0.37	
71NUT000287	SAMP	KN135	R	D	32	BOT	22-JUN-90	04:43	2.74	0.21	0.33	
71NUT000288	SAMP	KN135	R	E	32	SURF	22-JUN-90	04:54	4.13	0.53	0.43	
71NUT000289	SAMP	KN135	R	E	32	BOT	22-JUN-90	04:58	4.62	0.35	0.51	
71NUT000290	SAMP	KN135	R	F	32	SURF	22-JUN-90	04:24	2.36	0.53	0.44	
71NUT000291	SAMP	KN135	R	F	32	BOT	22-JUN-90	04:30	3.56	0.56	0.34	
94NUT000029	SAMP	KN135	T	A	57	BOT	07-17-90	11:42	15.10	30.90	0.22	
94NUT000030	SAMP	KN135	T	B	57	BOT	07-17-90	11:34	69.30	100.20	0.33	
94NUT000031	SAMP	KN135	T	C	57	BOT	07-17-90	12:58	28.40	71.30	0.18	
94NUT000032	DUP	KN135	T	C	57	BOT	07-17-90	13:00	28.80	67.30	0.10	
94NUT000037	SAMP	KN135	T	Z	57	BOT	07-17-90	10:29	45.80	98.80	0.19	
94NUT000034	SAMP	KN135	R	D	57	BOT	07-17-90	12:23	2.15	0.27	0.17	
94NUT000035	SAMP	KN135	R	E	57	BOT	07-17-90	13:00	3.04	0.76	0.21	
94NUT000036	SAMP	KN135	R	F	57	BOT	07-17-90	12:15	0.78	0.35	0.23	
94NUT000033	EB	KN135		NA	57	NA	07-17-90	00:00	0.92	6.33	0.19	
94NUT000042	SAMP	KN135	T	A	70	BOT	07-30-90	10:13	28.10	0.64	0.25	
94NUT000043	SAMP	KN135	T	B	70	BOT	07-30-90	09:56	58.00	3.14	1.81	
94NUT000044	SAMP	KN135	T	C	70	BOT	07-30-90	11:37	15.10	0.76	0.08	
94NUT000045	DUP	KN135	T	C	70	BOT	07-30-90	11:38	23.70	0.88	0.14	
94NUT000049	SAMP	KN135	T	Z	70	BOT	07-30-90	11:13	16.80	1.04	0.09	
94NUT000051	SAMP	KN135	T	STR	70	SURF	07-30-90	18:00	0.42	0.27	0.02	
94NUT000046	SAMP	KN135	R	D	70	BOT	07-30-90	10:26	1.48	0.54	0.10	
94NUT000047	SAMP	KN135	R	E	70	BOT	07-30-90	11:35	3.24	0.90	0.12	
94NUT000048	SAMP	KN135	R	F	70	BOT	07-30-90	10:14	4.53	0.54	0.13	
94NUT000050	EB	KN135		NA	70	NA	07-30-90		0.30	0.21	0.00	
94NUT000072	SAMP	KN135	T	A	78	BOT	08-07-90	18:16	100.90	14.30	0.31	
94NUT000079	DUP	KN135	T	A	78	BOT	08-07-90	18:18	113.90	15.70	0.35	
94NUT000082	SAMP	KN135	T	B	78	BOT	08-07-90	18:05	150.20	45.60	0.57	
94NUT000074	SAMP	KN135	T	C	78	BOT	08-07-90	18:40	39.10	9.47	0.07	
94NUT000075	SAMP	KN135	T	Z	78	BOT	08-07-90	18:30	173.80	32.30	0.01	
94NUT000076	SAMP	KN135	R	D	78	BOT	08-07-90	18:20	22.20	3.88	0.03	
94NUT000077	SAMP	KN135	R	E	78	BOT	08-07-90	18:30	36.00	2.54	0.13	
94NUT000078	SAMP	KN135	R	F	78	BOT	08-07-90	18:15	23.60	7.59	0.11	
94NUT000081	EB	KN135		NA	78	NA	08-07-90	22:34	0.43	4.28	0.00	
94NUT000080	EB	KN135		NA	78	NA	08-07-90	23:35	0.23	4.19	0.00	
71NUT000081	SAMP	KN211	T	A	0	SURF	26-MAY-90	06:20	2.71	1.42	0.32	
71NUT000082	SAMP	KN211	T	A	0	BOT	26-MAY-90	06:32	4.35	1.78	0.36	
71NUT000083	SAMP	KN211	T	B	0	SURF	26-MAY-90	06:01	4.78	0.51	0.12	
71NUT000093	DUP	KN211	T	B	0	SURF	26-MAY-90	06:02	4.88	1.14	0.13	
71NUT000084	SAMP	KN211	T	B	0	BOT	26-MAY-90	06:07	2.51	1.12	0.07	
71NUT000085	SAMP	KN211	T	C	0	SURF	26-MAY-90	06:15	4.04	0.56	0.12	
71NUT000086	SAMP	KN211	T	C	0	BOT	26-MAY-90	06:18	2.26	0.58	0.09	
71NUT000098	SAMP	KN211	T	Z	0	BOT	26-MAY-90	06:56	9.61	2.38	0.95	
71NUT000087	SAMP	KN211	R	D	0	SURF	26-MAY-90	06:17	4.73	2.59	0.75	
71NUT000088	SAMP	KN211	R	D	0	BOT	26-MAY-90	06:23	4.84	1.67	0.83	
71NUT000089	SAMP	KN211	R	E	0	SURF	26-MAY-90	05:47	2.52	0.92	0.29	
71NUT000090	SAMP	KN211	R	E	0	BOT	26-MAY-90	05:51	2.77	1.56	0.34	

APPENDIX D1, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000094	DUP	KN211	R	E	0	BOT	26-MAY-90	05:53	2.46	0.69	0.31	
71NUT000091	SAMP	KN211	R	F	0	SURF	26-MAY-90	06:01	2.29	0.54	0.23	
71NUT000092	SAMP	KN211	R	F	0	BOT	26-MAY-90	06:07	2.30	0.91	0.31	
71NUT000099	EB	KN211		NA	0	NA	26-MAY-90	11:27	0.00	0.21	0.10	
71NUT000133	SAMP	KN211	T	A	2	SURF	01-JUN-90	11:58	40.10	33.90	1.86	
71NUT000147	DUP	KN211	T	A	2	SURF	01-JUN-90	11:58	43.10	38.30	1.82	
71NUT000134	SAMP	KN211	T	A	2	BOT	01-JUN-90	12:01	43.20	41.20	1.83	
71NUT000135	SAMP	KN211	T	B	2	SURF	01-JUN-90	11:20	17.30	8.78	0.37	
71NUT000136	SAMP	KN211	T	B	2	BOT	01-JUN-90	11:25	12.50	7.60	0.27	
71NUT000137	SAMP	KN211	T	C	2	SURF	01-JUN-90	11:41	9.28	7.04	0.22	
71NUT000138	SAMP	KN211	T	C	2	BOT	01-JUN-90	11:45	13.80	8.14	0.20	
71NUT000139	SAMP	KN211	T	Y	2	BOT	01-JUN-90	12:18	23.70	13.10	1.08	
71NUT000140	SAMP	KN211	T	Z	2	BOT	01-JUN-90	12:10	21.40	15.40	0.77	
71NUT000141	SAMP	KN211	R	D	2	SURF	01-JUN-90	11:19	1.57	1.22	0.12	
71NUT000142	SAMP	KN211	R	D	2	BOT	01-JUN-90	11:22	2.40	1.52	0.20	
71NUT000143	SAMP	KN211	R	E	2	SURF	01-JUN-90	10:28	1.50	1.52	0.15	
71NUT000144	SAMP	KN211	R	E	2	BOT	01-JUN-90	10:34	0.49	0.93	0.10	
71NUT000145	SAMP	KN211	R	F	2	SURF	01-JUN-90	11:33	1.62	0.78	0.17	
71NUT000146	SAMP	KN211	R	F	2	BOT	01-JUN-90	11:42	1.21	0.55	0.16	
71NUT000148	DUP	KN211	R	F	2	BOT	01-JUN-90	11:41	1.80	2.36	0.26	
71NUT000149	SAMP	KN211	T	A	4	SURF	03-JUN-90	02:50	14.30	6.72	0.72	
71NUT000163	DUP	KN211	T	A	4	SURF	03-JUN-90	02:51	17.00	7.70	0.68	
71NUT000150	SAMP	KN211	T	A	4	BOT	03-JUN-90	02:57	17.50	7.47	0.94	
71NUT000151	SAMP	KN211	T	B	4	SURF	03-JUN-90	02:17	1.90	1.72	0.20	
71NUT000152	SAMP	KN211	T	B	4	BOT	03-JUN-90	02:18	2.47	1.95	0.24	
71NUT000153	SAMP	KN211	T	C	4	SURF	03-JUN-90	02:37	2.93	1.31	0.21	
71NUT000154	SAMP	KN211	T	C	4	BOT	03-JUN-90	02:40	1.56	1.24	0.16	
71NUT000155	SAMP	KN211	T	Y	4	BOT	03-JUN-90	03:04	28.50	7.08	0.84	
71NUT000156	SAMP	KN211	T	Z	4	BOT	03-JUN-90	03:13	32.90	11.00	0.87	
71NUT000157	SAMP	KN211	R	D	4	SURF	03-JUN-90	02:17	0.55	0.78	0.20	
71NUT000158	SAMP	KN211	R	D	4	BOT	03-JUN-90	02:21	0.69	1.56	0.22	
71NUT000159	SAMP	KN211	R	E	4	SURF	03-JUN-90	02:00	0.38	1.24	0.27	
71NUT000160	SAMP	KN211	R	E	4	BOT	03-JUN-90	02:04	0.07	0.41	0.12	
71NUT000164	DUP	KN211	R	E	4	BOT	03-JUN-90	02:03	0.15	0.78	0.17	
71NUT000161	SAMP	KN211	R	F	4	SURF	03-JUN-90	02:28	1.32	2.61	0.42	
71NUT000162	SAMP	KN211	R	F	4	BOT	03-JUN-90	02:33	1.42	0.68	0.30	
71NUT000213	SAMP	KN211	T	A	8	SURF	07-JUN-90	04:52	13.30	8.15	0.58	
71NUT000214	SAMP	KN211	T	A	8	BOT	07-JUN-90	04:57	13.70	8.14	0.53	
71NUT000215	SAMP	KN211	T	B	8	SURF	07-JUN-90	04:28	0.92	7.16	0.19	
71NUT000216	SAMP	KN211	T	B	8	BOT	07-JUN-90	04:31	0.39	7.34	0.26	
71NUT000217	SAMP	KN211	T	C	8	SURF	07-JUN-90	04:39	1.52	7.34	0.23	
71NUT000218	SAMP	KN211	T	C	8	BOT	07-JUN-90	04:42	9.43	11.20	0.39	
71NUT000219	SAMP	KN211	T	Y	8	BOT	07-JUN-90	05:05	16.80	7.38	0.61	
71NUT000227	DUP	KN211	T	Y	8	BOT	07-JUN-90	05:04	17.00	7.75	0.61	
71NUT000220	SAMP	KN211	T	Z	8	BOT	07-JUN-90	05:13	19.30	8.15	0.71	
71NUT000221	SAMP	KN211	R	D	8	SURF	07-JUN-90	04:25	3.03	0.67	0.62	
71NUT000222	SAMP	KN211	R	D	8	BOT	07-JUN-90	04:29	2.72	0.65	0.55	
71NUT000223	SAMP	KN211	R	E	8	SURF	07-JUN-90	04:12	1.02	0.87	0.40	
71NUT000228	DUP	KN211	R	E	8	SURF	07-JUN-90		0.67	0.26	0.20	
71NUT000224	SAMP	KN211	R	E	8	BOT	07-JUN-90	04:17	0.57	0.52	0.26	
71NUT000225	SAMP	KN211	R	F	8	SURF	07-JUN-90	04:36	1.20	0.25	0.29	

FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000226	SAMP	KN211	R	F	8	BOT	07-JUN-90	04:40	1.22	0.14	0.27	
71NUT000245	SAMP	KN211	T	A	16	SURF	15-JUN-90	09:37	14.00	0.86	0.40	
71NUT000259	DUP	KN211	T	A	16	SURF	15-JUN-90	09:39	11.80	2.00	0.52	
71NUT000246	SAMP	KN211	T	A	16	BOT	15-JUN-90	09:43	10.50	2.18	0.45	
71NUT000247	SAMP	KN211	T	B	16	SURF	15-JUN-90	09:05	4.15	0.67	0.20	
71NUT000248	SAMP	KN211	T	B	16	BOT	15-JUN-90	09:09	3.79	0.28	0.20	
71NUT000260	DUP	KN211	T	B	16	BOT	15-JUN-90	09:11	3.59	1.83	0.14	
71NUT000249	SAMP	KN211	T	C	16	SURF	15-JUN-90	09:22	2.07	0.53	0.08	
71NUT000250	SAMP	KN211	T	C	16	BOT	15-JUN-90	09:28	1.98	0.17	0.06	
71NUT000258	SAMP	KN211	T	Y	16	BOT	15-JUN-90	10:05	18.20	0.90	0.33	
71NUT000257	SAMP	KN211	T	Z	16	BOT	15-JUN-90	09:56	13.80	0.66	0.37	
71NUT000251	SAMP	KN211	R	D	16	SURF	15-JUN-90	09:15	2.66	0.42	0.32	
71NUT000252	SAMP	KN211	R	D	16	BOT	15-JUN-90	09:23	3.58	1.28	2.10	
71NUT000253	SAMP	KN211	R	E	16	SURF	15-JUN-90	08:53	0.35	0.09	0.07	
71NUT000254	SAMP	KN211	R	E	16	BOT	15-JUN-90	09:00	0.28	0.31	0.15	
71NUT000255	SAMP	KN211	R	F	16	SURF	15-JUN-90	09:35	1.55	0.40	0.22	
71NUT000256	SAMP	KN211	R	F	16	BOT	15-JUN-90	09:46	1.55	0.30	0.25	
71NUT000309	SAMP	KN211	T	A	31	SURF	30-JUN-90	11:14	15.30	6.78	0.44	
71NUT000310	SAMP	KN211	T	A	31	BOT	30-JUN-90	11:17	16.30	8.07	0.47	
71NUT000307	DUP	KN211	T	A	31	BOT	30-JUN-90	11:20	14.60	7.38	0.46	
71NUT000311	SAMP	KN211	T	B	31	SURF	30-JUN-90	10:37	5.84	8.96	0.30	
71NUT000312	SAMP	KN211	T	B	31	BOT	30-JUN-90	10:43	21.90	30.20	0.92	
71NUT000297	SAMP	KN211	T	C	31	SURF	30-JUN-90	10:52	1.27	0.86	0.13	
71NUT000308	DUP	KN211	T	C	31	SURF	30-JUN-90	10:55	1.72	0.55	0.09	
71NUT000298	SAMP	KN211	T	C	31	BOT	30-JUN-90	10:59	1.73	0.56	0.04	
71NUT000305	SAMP	KN211	T	Y	31	BOT	30-JUN-90	11:40	19.90	4.67	0.26	
71NUT000306	SAMP	KN211	T	Z	31	BOT	30-JUN-90	11:29	23.40	4.47	0.34	
71NUT000299	SAMP	KN211	R	D	31	SURF	30-JUN-90	10:26	2.72	0.77	0.15	
71NUT000300	SAMP	KN211	R	D	31	BOT	30-JUN-90	10:31	2.95	0.43	0.20	
71NUT000301	SAMP	KN211	R	E	31	SURF	30-JUN-90	10:12	0.10	0.00	1.00	
71NUT000302	SAMP	KN211	R	E	31	BOT	30-JUN-90	10:18	0.47	0.55	0.16	
71NUT000303	SAMP	KN211	R	F	31	SURF	30-JUN-90	10:39	3.96	0.42	0.28	
71NUT000304	SAMP	KN211	R	F	31	BOT	30-JUN-90	10:41	3.23	0.23	0.25	
94NUT000018	SAMP	KN211	T	A	47	BOT	07-16-90	11:33	111.93	74.40	1.44	
94NUT000019	SAMP	KN211	T	B	47	BOT	07-16-90	10:48	78.20	103.40	2.04	
94NUT000020	SAMP	KN211	T	C	47	BOT	07-16-90	11:01	18.20	20.10	1.27	
94NUT000021	DUP	KN211	T	C	47	BOT	07-16-90	11:02	9.81	12.60	0.63	
94NUT000027	SAMP	KN211	T	Y	47	BOT	07-16-90	11:52	58.00	10.60	0.43	
94NUT000028	SAMP	KN211	T	Z	47	BOT	07-16-90	11:43	75.00	26.70	0.42	
94NUT000024	SAMP	KN211	R	D	47	BOT	07-16-90	11:12	1.62	1.26	0.13	
94NUT000025	SAMP	KN211	R	E	47	BOT	07-16-90	11:06	0.24	0.76	0.13	
94NUT000026	SAMP	KN211	R	F	47	BOT	07-16-90	11:13	2.19	0.74	0.14	
94NUT000052	SAMP	KN211	T	A	62	BOT	07-31-90	13:49	45.90	5.47	1.29	
94NUT000057	DUP	KN211	T	B	62	BOT	07-31-90	13:56	37.90	3.68	0.45	
94NUT000053	SAMP	KN211	T	B	62	BOT	07-31-90	13:55	54.20	4.90	0.64	
94NUT000054	SAMP	KN211	T	C	62	BOT	07-31-90	14:10	25.20	2.26	0.26	
94NUT000058	SAMP	KN211	R	D	62	BOT	07-31-90	12:14	2.63	0.36	0.05	
94NUT000059	SAMP	KN211	R	E	62	BOT	07-31-90	10:24	0.97	0.27	0.00	
94NUT000060	SAMP	KN211	R	F	62	BOT	07-31-90	12:20	3.40	0.78	0.06	
94NUT000061	SAMP	KN211	R	STR	62	SURF	07-31-90	14:30	8.61	0.49	0.00	
94NUT000083	SAMP	KN211	T	A	98	BOT	09-05-90	18:10	84.30	29.30	0.66	

APPENDIX D1, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
94NUT000084	SAMP	KN211	T	B	98	BOT	09-05-90	17:45	33.80	18.90	0.02	
94NUT000085	DUP	KN211	T	B	98	BOT	09-05-90	17:45	18.40	17.20	0.00	
94NUT000086	SAMP	KN211	T	C	98	BOT	09-05-90	17:55	13.80	12.50	0.15	
94NUT000091	SAMP	KN211	T	Y	98	BOT	09-05-90	18:20	5.71	21.20	0.07	
94NUT000087	SAMP	KN211	R	D	98	BOT	09-05-90	17:55	0.68	7.03	0.00	
94NUT000088	SAMP	KN211	R	E	98	BOT	09-05-90	17:51	0.59	10.10	0.44	
94NUT000089	SAMP	KN211	R	F	98	BOT	09-05-90	18:04	0.61	7.95	0.00	
94NUT000090	SAMP	KN211	NA	AMB	98	NA	09-05-90	18:07	1.13	8.12	0.02	
94NUT000094	SAMP	KN211	T	A	104	BOT	09-11-90	10:54	57.50	19.10	0.18	
94NUT000095	SAMP	KN211	T	B	104	BOT	09-11-90	10:40	7.71	15.70	0.00	
94NUT000096	DUP	KN211	T	B	104	BOT	09-11-90	10:40	7.58	16.10	0.00	
94NUT000097	SAMP	KN211	T	C	104	BOT	09-11-90	10:50	5.65	25.90	1.59	
94NUT000100	SAMP	KN211	T	Y	104	BOT	09-11-90	10:55	8.15	49.50	1.29	
94NUT000098	SAMP	KN211	R	D	104	BOT	09-11-90	10:45	3.03	11.00	0.00	
94NUT000099	SAMP	KN211	R	F	104	BOT	09-11-90	10:55	2.50	10.70	1.10	
94NUT000102	SAMP	KN211	NA	AMB	104	NA	09-11-90	10:55	3.21	10.10	0.07	
94NUT000103	EB	KN211	NA	EB	104	NA	09-11-90		0.34	6.78	0.00	

SAMP = Sample
DUP = Duplicate Sample
EB = Equipment Blank
AMB = Ambient Sample
T = Treated
R = Reference

APPENDIX D1, TABLE 2
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE	NET TKN (uM)	BATCH#	GROSS TKN (MG/L)	GROSS TKN (uM)
71KDL000114	SAMP	KN132	T	A	0	SURF	31-MAY-90	0.00	901653	0.31	22.13
71KDL000129	DUP	KN132	T	A	0	SURF	31-MAY-90	0.00	901653	0.31	22.13
71KDL000115	SAMP	KN132	T	A	0	BOT	31-MAY-90	131.85	901653	2.23	159.22
71KDL000116	SAMP	KN132	T	B	0	SURF	31-MAY-90	0.00	901653	0.33	23.56
71KDL000117	SAMP	KN132	T	B	0	BOT	31-MAY-90	55.45	901653	1.16	82.82
71KDL000118	SAMP	KN132	T	C	0	SURF	31-MAY-90	35.46	901653	0.88	62.83
71KDL000119	SAMP	KN132	T	C	0	BOT	31-MAY-90	24.75	901653	0.73	52.12
71KDL000126	SAMP	KN132	T	Y	0	BOT	31-MAY-90	0.00	901653	0.37	26.42
71KDL000127	SAMP	KN132	T	Z	0	BOT	31-MAY-90	9.04	901653	0.51	36.41
71KDL000120	SAMP	KN132	R	D	0	SURF	31-MAY-90	0.00	901653	0.34	24.28
71KDL000121	SAMP	KN132	R	D	0	BOT	31-MAY-90	0.00	901653	0.23	16.42
71KDL000122	SAMP	KN132	R	E	0	SURF	31-MAY-90	0.00	901653	0.29	20.71
71KDL000123	SAMP	KN132	R	E	0	BOT	31-MAY-90	0.00	901653	0.27	19.28
71KDL000130	DUP	KN132	R	E	0	BOT	31-MAY-90	21.90	901653	0.69	49.27
71KDL000124	SAMP	KN132	R	F	0	SURF	31-MAY-90	30.46	901653	0.81	57.83
71KDL000125	SAMP	KN132	R	F	0	BOT	31-MAY-90	10.47	901653	0.53	37.84
71KDL000167	SAMP	KN132	T	B	2	SURF	04-JUN-90	151.13	901689	2.50	178.50
71KDL000168	SAMP	KN132	T	B	2	BOT	04-JUN-90	143.99	901689	2.40	171.36
71KDL000169	SAMP	KN132	T	C	2	SURF	04-JUN-90	279.65	901689	4.30	307.02
71KDL000170	SAMP	KN132	T	C	2	BOT	04-JUN-90	508.13	901689	7.50	535.50
71KDL000177	SAMP	KN132	T	Y	2	BOT	04-JUN-90	172.55	901689	2.80	199.92
71KDL000178	SAMP	KN132	T	Z	2	BOT	04-JUN-90	272.51	901689	4.20	299.88
71KDL000180	DUP	KN132	T	Z	2	BOT	04-JUN-90	272.51	901689	4.20	299.88
71KDL000171	SAMP	KN132	R	D	2	SURF	04-JUN-90	0.00	901689	0.17	12.14
71KDL000172	SAMP	KN132	R	D	2	BOT	04-JUN-90	0.00	901689	0.10	7.14
71KDL000173	SAMP	KN132	R	E	2	SURF	04-JUN-90	0.00	901689	0.11	7.85
71KDL000179	DUP	KN132	R	E	2	SURF	04-JUN-90	0.00	901689	0.31	22.13
71KDL000174	SAMP	KN132	R	E	2	BOT	04-JUN-90	0.00	901689	0.13	9.28
71KDL000175	SAMP	KN132	R	F	2	SURF	04-JUN-90	0.00	901689	0.16	11.42
71KDL000176	SAMP	KN132	R	F	2	BOT	04-JUN-90	32.61	901689	0.84	59.98
71KDL000181	EB	KN132		NA	2	NA	04-JUN-90	NA	901689	0.29	20.71
71KDL000198	SAMP	KN132	T	A	4	SURF	06-JUN-90	0.00	901765	0.29	20.71
71KDL000199	SAMP	KN132	T	A	4	BOT	06-JUN-90	3.33	901765	0.43	30.70
71KDL000200	SAMP	KN132	T	B	4	SURF	06-JUN-90	12.61	901765	0.56	39.98
71KDL000201	SAMP	KN132	T	B	4	BOT	06-JUN-90	25.47	901765	0.74	52.84
71KDL000202	SAMP	KN132	T	C	4	SURF	06-JUN-90	19.04	901765	0.65	46.41
71KDL000203	SAMP	KN132	T	C	4	BOT	06-JUN-90	24.75	901765	0.73	52.12
71KDL000204	SAMP	KN132	T	Y	4	BOT	06-JUN-90	13.33	901765	0.57	40.70
71KDL000211	SAMP	KN132	T	Z	4	BOT	06-JUN-90	34.75	901765	0.87	62.12
71KDL000205	SAMP	KN132	R	D	4	SURF	06-JUN-90	0.00	901765	0.00	0.00
71KDL000212	DUP	KN132	R	D	4	SURF	06-JUN-90	0.00	901765	0.00	0.00
71KDL000206	SAMP	KN132	R	D	4	BOT	06-JUN-90	0.00	901765	0.00	0.00
71KDL000207	SAMP	KN132	R	E	4	SURF	06-JUN-90	0.00	901765	0.00	0.00
71KDL000208	SAMP	KN132	R	E	4	BOT	06-JUN-90	0.00	901765	0.00	0.00
71KDL000213	SAMP	KN132	R	E	4	BOT	06-JUN-90	0.00	901765	0.00	0.00
71KDL000209	DUP	KN132	R	F	4	SURF	06-JUN-90	0.00	901765	0.00	0.00
71KDL000210	SAMP	KN132	R	F	4	BOT	06-JUN-90	0.00	901765	0.00	0.00
71KDL000230	SAMP	KN132	T	A	8	SURF	10-JUN-90	0.00	901796	0.28	19.99
71KDL000231	SAMP	KN132	T	A	8	BOT	10-JUN-90	0.00	901796	0.33	23.56
71KDL000232	SAMP	KN132	T	B	8	SURF	10-JUN-90	4.05	901796	0.44	31.42
71KDL000233	SAMP	KN132	T	B	8	BOT	10-JUN-90	4.05	901796	0.44	31.42
71KDL000234	SAMP	KN132	T	C	8	SURF	10-JUN-90	5.47	901796	0.46	32.84

APPENDIX D1, TABLE 2 (continued)
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE	NET TKN (uM)	BATCH#	GROSS TKN (MG/L)	GROSS TKN (uM)
71KDL000235	SAMP	KN132	T	C	8	BOT	10-JUN-90	31.89	901796	0.83	59.26
71KDL000236	SAMP	KN132	T	Y	8	BOT	10-JUN-90	0.00	901796	0.08	5.71
71KDL000237	SAMP	KN132	T	Z	8	BOT	10-JUN-90	8.33	901796	0.50	35.70
71KDL000238	SAMP	KN132	R	D	8	SURF	10-JUN-90	0.00	901796	0.33	23.56
71KDL000239	SAMP	KN132	R	D	8	BOT	10-JUN-90	21.18	901796	0.68	48.55
71KDL000244	DUP	KN132	R	D	8	BOT	10-JUN-90	14.76	901796	0.59	42.13
71KDL000240	SAMP	KN132	R	E	8	SURF	10-JUN-90	0.00	901796	0.31	22.13
71KDL000245	DUP	KN132	R	E	8	SURF	10-JUN-90	0.00	901796	0.25	17.85
71KDL000241	SAMP	KN132	R	E	8	BOT	10-JUN-90	6.90	901796	0.48	34.27
71KDL000242	SAMP	KN132	R	F	8	SURF	10-JUN-90	0.00	901796	0.26	18.56
71KDL000243	SAMP	KN132	R	F	8	BOT	10-JUN-90	5.47	901796	0.46	32.84
71KDL000165	SAMP	KN132	T	A	16	SURF	04-JUN-90	122.57	901689	2.10	149.94
71KDL000166	SAMP	KN132	T	A	16	BOT	04-JUN-90	136.85	901689	2.30	164.22
71KDL000265	SAMP	KN132	T	B	16	SURF	18-JUN-90	6.90	901957	0.48	34.27
71KDL000266	SAMP	KN132	T	B	16	BOT	18-JUN-90	10.47	901957	0.53	37.84
71KDL000267	SAMP	KN132	T	C	16	SURF	18-JUN-90	18.33	901957	0.64	45.70
71KDL000268	SAMP	KN132	T	C	16	BOT	18-JUN-90	4.76	901957	0.45	32.13
71KDL000277	SAMP	KN132	T	Y	16	BOT	18-JUN-90	18.33	901957	0.64	45.70
71KDL000278	SAMP	KN132	T	Z	16	BOT	18-JUN-90	16.18	901957	0.61	43.55
71KDL000270	SAMP	KN132	R	D	16	BOT	18-JUN-90	14.04	901957	0.58	41.41
71KDL000269	SAMP	KN132	R	D	16	SURF	18-JUN-90	7.62	901957	0.49	34.99
71KDL000275	DUP	KN132	R	D	16	SURF	18-JUN-90	22.61	901957	0.70	49.98
71KDL000271	SAMP	KN132	R	E	16	SURF	18-JUN-90	18.33	901957	0.64	45.70
71KDL000272	SAMP	KN132	R	E	16	BOT	18-JUN-90	19.04	901957	0.65	46.41
71KDL000276	DUP	KN132	R	E	16	BOT	18-JUN-90	11.19	901957	0.54	38.56
71KDL000273	SAMP	KN132	R	F	16	SURF	18-JUN-90	9.76	901957	0.52	37.13
71KDL000274	SAMP	KN132	R	F	16	BOT	18-JUN-90	17.61	901957	0.63	44.98
71KDL000279	EB	KN132		NA	16	NA	18-JUN-90	NA	901957	1.10	78.54
71KDL000313	SAMP	KN132	T	A	29	SURF	30-JUN-90	30.46	902212	0.81	57.83
71KDL000314	SAMP	KN132	T	A	29	BOT	30-JUN-90	26.18	902212	0.75	53.55
71KDL000315	SAMP	KN132	T	B	29	SURF	30-JUN-90	11.19	902212	0.54	38.56
71KDL000316	SAMP	KN132	T	B	29	BOT	30-JUN-90	10.47	902212	0.53	37.84
71KDL000317	SAMP	KN132	T	C	29	SURF	30-JUN-90	0.00	902212	0.36	25.70
71KDL000318	SAMP	KN132	T	C	29	BOT	30-JUN-90	0.00	902212	0.36	25.70
71KDL000327	SAMP	KN132	T	Y	29	BOT	30-JUN-90	89.01	902212	1.63	116.38
71KDL000328	SAMP	KN132	T	Z	29	BOT	30-JUN-90	79.73	902212	1.50	107.10
71KDL000319	SAMP	KN132	R	D	29	SURF	30-JUN-90	4.76	902212	0.45	32.13
71KDL000325	DUP	KN132	R	D	29	SURF	30-JUN-90	94.01	902212	1.70	121.38
71KDL000320	SAMP	KN132	R	D	29	BOT	30-JUN-90	8.33	902212	0.50	35.70
71KDL000321	SAMP	KN132	R	E	29	SURF	30-JUN-90	0.00	902212	0.33	23.56
71KDL000322	SAMP	KN132	R	E	29	BOT	30-JUN-90	1.90	902212	0.41	29.27
71KDL000326	DUP	KN132	R	E	29	BOT	30-JUN-90	94.01	902212	1.70	121.38
71KDL000323	SAMP	KN132	R	F	29	SURF	30-JUN-90	5.47	902212	0.46	32.84
71KDL000324	SAMP	KN132	R	F	29	BOT	30-JUN-90	68.31	902212	1.34	95.68
71KDL000329	EB	KN132	NA	NA	29	NA	01-JUL-90	NA	902212	1.10	78.54
71KDL000263	SAMP	KN132	T	A	32	SURF	18-JUN-90	0.00	901957	0.21	14.99
71KDL000264	SAMP	KN132	T	A	32	BOT	18-JUN-90	0.00	901957	0.22	15.71
94KDL000001	SAMP	KN132	T	A	43	BOT	07-15-90	79.73	902517	1.50	107.10
94KDL000002	SAMP	KN132	T	B	43	BOT	07-15-90	58.31	902517	1.20	85.68
94KDL000003	SAMP	KN132	T	C	43	BOT	07-15-90	165.41	902517	2.70	192.78
94KDL000006	DUP	KN132	T	C	43	BOT	07-15-90	158.27	902517	2.60	185.64

APPENDIX D1, TABLE 2 (continued)
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE	NET TKN (uM)	BATCH#	GROSS TKN (MG/L)	GROSS TKN (uM)
94KDL000005	SAMP	KN132	T	Z	43	BOT	07-15-90	94.01	902517	1.70	121.38
94KDL000007	SAMP	KN132	R	D	43	BOT	07-15-90	35.46	902517	0.88	62.83
94KDL000008	SAMP	KN132	R	E	43	BOT	07-15-90	37.60	902517	0.91	64.97
94KDL000009	SAMP	KN132	R	F	43	BOT	07-15-90	36.89	902517	0.90	64.26
94KDL000048	SAMP	KN132	T	A	60	BOT	08-01-90	4.76		0.45	32.13
94KDL000049	SAMP	KN132	T	B	60	BOT	08-01-90	9.76		0.52	37.13
94KDL000050	SAMP	KN132	T	C	60	BOT	08-01-90	11.19		0.54	38.56
94KDL000053	DUP	KN132	T	C	60	BOT	08-01-90	0.48		0.39	27.85
94KDL000051	SAMP	KN132	T	Y	60	BOT	08-01-90	6.90		0.48	34.27
94KDL000052	SAMP	KN132	T	Z	60	BOT	08-01-90	6.90		0.48	34.27
94KDL000054	SAMP	KN132	R	D	60	BOT	08-01-90	9.04		0.51	36.41
94KDL000055	SAMP	KN132	R	E	60	BOT	08-01-90	4.05		0.44	31.42
94KDL000056	SAMP	KN132	R	F	60	BOT	08-01-90	7.62		0.49	34.99
94KDL000057	SAMP	KN132	R	STR	60	BOT	08-01-90	37.60		0.91	64.97
71KDL000017	SAMP	KN135	T	A	0	SURF	20-MAY-90	0.00	901475	0.22	15.71
71KDL000001	SAMP	KN135	T	A	0	SURF	19-MAY-90	93.30	901454	1.69	120.67
71KDL000002	SAMP	KN135	T	A	0	BOT	19-MAY-90	0.00	901454	0.27	19.28
71KDL000018	SAMP	KN135	T	A	0	BOT	20-MAY-90	0.00	901475	0.35	24.99
71KDL000019	SAMP	KN135	T	B	0	SURF	20-MAY-90	71.16	901475	1.38	98.53
71KDL000004	SAMP	KN135	T	B	0	BOT	19-MAY-90	0.00	901454	0.34	24.28
71KDL000020	SAMP	KN135	T	B	0	BOT	20-MAY-90	0.00	901475	0.35	24.99
71KDL000021	SAMP	KN135	T	C	0	SURF	20-MAY-90	0.00	901475	0.37	26.42
71KDL000022	SAMP	KN135	T	C	0	BOT	20-MAY-90	0.00	901475	0.24	17.14
71KDL000006	SAMP	KN135	T	C	0	BOT	19-MAY-90	5.47	901454	0.46	32.84
71KDL000005	DUP	KN135	T	C	0	BOT	19-MAY-90	0.00	901454	0.22	15.71
71KDL000029	SAMP	KN135	T	Z	0	SURF	20-MAY-90	0.00	901475	0.28	19.99
71KDL000014	SAMP	KN135	T	Z	0	BOT	19-MAY-90	0.00	901454	0.21	14.99
71KDL000030	SAMP	KN135	T	Z	0	BOT	20-MAY-90	0.00	901475	0.36	25.70
71KDL000024	SAMP	KN135	R	D	0	SURF	20-MAY-90	13.33	901475	0.57	40.70
71KDL000031	DUP	KN135	R	D	0	SURF	20-MAY-90	158.98	901475	2.61	186.35
71KDL000023	SAMP	KN135	R	D	0	BOT	20-MAY-90	0.00	901475	0.28	19.99
71KDL000032	DUP	KN135	R	D	0	BOT	20-MAY-90	0.00	901475	0.27	19.28
71KDL000025	SAMP	KN135	R	E	0	SURF	20-MAY-90	0.00	901475	0.25	17.85
71KDL000026	SAMP	KN135	R	E	0	BOT	20-MAY-90	22.61	901475	0.70	49.98
71KDL000027	SAMP	KN135	R	F	0	SURF	20-MAY-90	0.00	901475	0.35	24.99
71KDL000028	SAMP	KN135	R	F	0	BOT	20-MAY-90	0.00	901475	0.29	20.71
71KDL000035	EB	KN135	R	NA	0	NA	22-MAY-90	NA	901527	0.34	24.28
71KDL000048	SAMP	KN135	T	A	2	SURF	23-MAY-90	175.41	901527	2.84	202.78
71KDL000049	SAMP	KN135	T	A	2	BOT	23-MAY-90	171.84	901527	2.79	199.21
71KDL000050	SAMP	KN135	T	B	2	SURF	23-MAY-90	262.51	901527	4.06	289.88
71KDL000051	SAMP	KN135	T	B	2	BOT	23-MAY-90	253.95	901527	3.94	281.32
71KDL000052	SAMP	KN135	T	C	2	SURF	23-MAY-90	260.37	901527	4.03	287.74
71KDL000060	DUP	KN135	T	C	2	SURF	23-MAY-90	201.11	901527	3.20	228.48
71KDL000053	SAMP	KN135	T	C	2	BOT	23-MAY-90	215.39	901527	3.40	242.76
71KDL000061	DUP	KN135	T	C	2	BOT	23-MAY-90	251.09	901527	3.90	278.46
71KDL000062	SAMP	KN135	T	Z	2	SURF	23-MAY-90	272.51	901527	4.20	299.88
71KDL000063	SAMP	KN135	T	Z	2	BOT	23-MAY-90	279.65	901527	4.30	307.02
71KDL000054	SAMP	KN135	R	D	2	SURF	23-MAY-90	0.00	901527	0.36	25.70
71KDL000055	SAMP	KN135	R	D	2	BOT	23-MAY-90	6.19	901527	0.47	33.56
71KDL000056	SAMP	KN135	R	E	2	SURF	23-MAY-90	21.90	901527	0.69	49.27
71KDL000057	SAMP	KN135	R	E	2	BOT	23-MAY-90	6.19	901527	0.47	33.56
71KDL000058	SAMP	KN135	R	F	2	SURF	23-MAY-90	5.47	901527	0.46	32.84

APPENDIX D1, TABLE 2 (continued)
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE	NET TKN (uM)	BATCH#	GROSS TKN (MG/L)	GROSS TKN (uM)
71KDL000059	SAMP	KN135	R	F	2	BOT	23-MAY-90	1.90	901527	0.41	29.27
71KDL000064	SAMP	KN135	T	A	4	SURF	25-MAY-90	61.17	901558	1.24	88.54
71KDL000078	DUP	KN135	T	A	4	SURF	25-MAY-90	69.02	901558	1.35	96.39
71KDL000065	SAMP	KN135	T	A	4	BOT	25-MAY-90	145.42	901558	2.42	172.79
71KDL000079	DUP	KN135	T	A	4	BOT	25-MAY-90	91.15	901558	1.66	118.52
71KDL000068	SAMP	KN135	T	B	4	SURF	25-MAY-90	191.83	901558	3.07	219.20
71KDL000069	SAMP	KN135	T	B	4	BOT	25-MAY-90	242.52	901558	3.78	269.89
71KDL000066	SAMP	KN135	T	C	4	SURF	25-MAY-90	183.26	901558	2.95	210.63
71KDL000067	SAMP	KN135	T	C	4	BOT	25-MAY-90	191.11	901558	3.06	218.48
71KDL000076	SAMP	KN135	T	Z	4	SURF	25-MAY-90	141.13	901558	2.36	168.50
71KDL000077	SAMP	KN135	T	Z	4	BOT	25-MAY-90	149.70	901558	2.48	177.07
71KDL000071	SAMP	KN135	R	D	4	BOT	25-MAY-90	4.76	901558	0.45	32.13
71KDL000073	SAMP	KN135	R	E	4	BOT	25-MAY-90	6.19	901558	0.47	33.56
71KDL000075	SAMP	KN135	R	F	4	BOT	25-MAY-90	1.19	901558	0.40	28.56
71KDL000099	SAMP	KN135	T	A	8	SURF	29-MAY-90	18.33	901615	0.64	45.70
71KDL000100	SAMP	KN135	T	A	8	BOT	29-MAY-90	31.18	901615	0.82	58.55
71KDL000101	SAMP	KN135	T	B	8	SURF	29-MAY-90	86.16	901615	1.59	113.53
71KDL000102	SAMP	KN135	T	B	8	BOT	29-MAY-90	91.87	901615	1.67	119.24
71KDL000103	SAMP	KN135	T	C	8	SURF	29-MAY-90	79.73	901615	1.5	107.10
71KDL000112	SAMP	KN135	T	C	8	SURF	29-MAY-90	85.44	901615	1.58	112.81
71KDL000104	SAMP	KN135	T	C	8	BOT	29-MAY-90	103.29	901615	1.83	130.66
71KDL000111	SAMP	KN135	T	Z	8	BOT	29-MAY-90	59.02	901615	1.21	86.39
71KDL000105	SAMP	KN135	R	D	8	SURF	29-MAY-90	0.00	901615	0.33	23.56
71KDL000106	SAMP	KN135	R	D	8	BOT	29-MAY-90	9.04	901615	0.51	36.41
71KDL000113	DUP	KN135	R	D	8	BOT	29-MAY-90	0.48	901615	0.39	27.85
71KDL000107	SAMP	KN135	R	E	8	SURF	29-MAY-90	21.18	901615	0.68	48.55
71KDL000108	SAMP	KN135	R	E	8	BOT	29-MAY-90	0.00	901615	0.28	19.99
71KDL000109	SAMP	KN135	R	F	8	SURF	29-MAY-90	11.19	901615	0.54	38.56
71KDL000110	SAMP	KN135	R	F	8	BOT	29-MAY-90	0.00	901615	0.29	20.71
71KDL000182	SAMP	KN135	T	A	15	SURF	05-JUN-90	0.00	901765	0.38	27.13
71KDL000183	SAMP	KN135	T	A	15	BOT	05-JUN-90	11.90	901765	0.55	39.27
71KDL000184	SAMP	KN135	T	B	15	SURF	05-JUN-90	34.75	901765	0.87	62.12
71KDL000195	DUP	KN135	T	B	15	SURF	05-JUN-90	26.18	901765	0.75	53.55
71KDL000185	SAMP	KN135	T	B	15	BOT	05-JUN-90	44.03	901765	1.00	71.40
71KDL000186	SAMP	KN135	T	C	15	SURF	05-JUN-90	40.46	901765	0.95	67.83
71KDL000187	SAMP	KN135	T	C	15	BOT	05-JUN-90	63.31	901765	1.27	90.68
71KDL000196	DUP	KN135	T	C	15	BOT	05-JUN-90	16.18	901765	0.61	43.55
71KDL000190	SAMP	KN135	T	F	15	SURF	05-JUN-90	7.62	901765	0.49	34.99
71KDL000189	SAMP	KN135	T	Z	15	BOT	05-JUN-90	20.47	901765	0.67	47.84
71KDL000194	SAMP	KN135	R	D	15	SURF	05-JUN-90	0.00	901765	0.32	22.85
71KDL000197	SAMP	KN135	R	D	15	BOT	05-JUN-90	0.00	901765	0.38	27.13
71KDL000192	SAMP	KN135	R	E	15	SURF	05-JUN-90	0.48	901765	0.39	27.85
71KDL000193	SAMP	KN135	R	E	15	BOT	05-JUN-90	1.19	901765	0.40	28.56
71KDL000191	SAMP	KN135	R	F	15	BOT	05-JUN-90	0.00	901765	0.36	25.70
71KDL000282	SAMP	KN135	T	A	32	SURF	22-JUN-90	0.00	902035	0.26	18.56
71KDL000283	SAMP	KN135	T	A	32	BOT	22-JUN-90	0.00	902035	0.33	23.56
71KDL000284	SAMP	KN135	T	B	32	SURF	22-JUN-90	0.00	902035	0.35	24.99
71KDL000285	SAMP	KN135	T	B	32	BOT	22-JUN-90	8.33	902035	0.50	35.70
71KDL000286	SAMP	KN135	T	C	32	SURF	22-JUN-90	12.61	902035	0.56	39.98
71KDL000287	SAMP	KN135	T	C	32	BOT	22-JUN-90	19.75	902035	0.66	47.12
71KDL000294	SAMP	KN135	T	Z	32	BOT	22-JUN-90	34.03	902035	0.86	61.40
71KDL000292	SAMP	KN135	R	D	32	SURF	22-JUN-90	11.90	902035	0.55	39.27

APPENDIX D1, TABLE 2 (continued)
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE	NET TKN (uM)	BATCH#	GROSS TKN (MG/L)	GROSS TKN (uM)
71KDL000295	DUP	KN135	R	D	32	SURF	22-JUN-90	7.62	902035	0.49	34.99
71KDL000293	SAMP	KN135	R	D	32	BOT	22-JUN-90	0.00	902035	0.29	20.71
71KDL000288	SAMP	KN135	R	E	32	SURF	22-JUN-90	0.00	902035	0.37	26.42
71KDL000289	SAMP	KN135	R	E	32	BOT	22-JUN-90	5.47	902035	0.46	32.84
71KDL000296	DUP	KN135	R	E	32	BOT	22-JUN-90	0.00	902035	0.35	24.99
71KDL000290	SAMP	KN135	R	F	32	SURF	22-JUN-90	4.76	902035	0.45	32.13
71KDL000291	SAMP	KN135	R	F	32	BOT	22-JUN-90	6.90	902035	0.48	34.27
94KDL000019	SAMP	KN135	T	A	57	BOT	07-17-90	72.59	902517	1.40	99.96
94KDL000020	SAMP	KN135	T	B	57	BOT	07-17-90	122.57	902517	2.10	149.94
94KDL000021	SAMP	KN135	T	C	57	BOT	07-17-90	108.29	902517	1.90	135.66
94KDL000026	SAMP	KN135	T	Z	57	BOT	07-17-90	136.85	902517	2.30	164.22
94KDL000022	SAMP	KN135	R	D	57	BOT	07-17-90	22.61	902517	0.70	49.98
94KDL000023	SAMP	KN135	R	E	57	BOT	07-17-90	24.04	902517	0.72	51.41
94KDL000024	SAMP	KN135	R	F	57	BOT	07-17-90	29.75	902517	0.80	57.12
94KDL000025	DUP	KN135	R	F	57	BOT	07-17-90	21.90	902517	0.69	49.27
94KDL000027	EB	KN135	NA	NA	57		07-17-90	NA	902517	0.66	47.12
94KDL000028	SAMP	KN135	T	A	70	BOT	07-30-90	21.18		0.68	48.55
94KDL000032	DUP	KN135	T	A	70	BOT	07-30-90	16.18		0.61	43.55
94KDL000029	SAMP	KN135	T	B	70	BOT	07-30-90	51.88		1.11	79.25
94KDL000030	SAMP	KN135	T	C	70	BOT	07-30-90	27.61		0.77	54.98
94KDL000031	SAMP	KN135	T	Z	70	BOT	07-30-90	11.90		0.55	39.27
94KDL000037	SAMP	KN135	T	STR	70	SURF	07-30-90	6.19		0.47	33.56
94KDL000034	SAMP	KN135	R	D	70	BOT	07-30-90	0.00		0.38	27.13
94KDL000035	SAMP	KN135	R	E	70	BOT	07-30-90	2.62		0.42	29.99
94KDL000036	SAMP	KN135	R	F	70	BOT	07-30-90	0.00		0.35	24.99
94KDL000033	EB	KN135		NA	70	NA	07-30-90	NA		0.28	19.99
94KDL000058	SAMP	KN135	T	A	78	BOT	08-07-90	8.33		0.50	35.70
94KDL000065	SAMP	KN135	T	A	78	BOT	08-07-90	8.33		0.50	35.70
94KDL000059	SAMP	KN135	T	B	78	BOT	08-07-90	28.32		0.78	55.69
94KDL000060	SAMP	KN135	T	C	78	BOT	08-07-90	8.33		0.50	35.70
94KDL000061	SAMP	KN135	T	Z	78	BOT	08-07-90	21.90		0.69	49.27
94KDL000062	SAMP	KN135	R	D	78	BOT	08-07-90	6.90		0.48	34.27
94KDL000063	SAMP	KN135	R	E	78	BOT	08-07-90	6.19		0.47	33.56
94KDL000064	SAMP	KN135	R	F	78	BOT	08-07-90	9.04		0.51	36.41
94KDL000067	SAMP	KN135		NA	78	NA	08-07-90	0.00		0.28	19.99
94KDL000066	SAMP	KN135		NA	78	NA	08-07-90	0.00		0.34	24.28
71KDL000080	SAMP	KN211	T	A	0	SURF	26-MAY-90	24.04	901573	0.72	51.41
71KDL000096	DUP	KN211	T	A	0	SURF	26-MAY-90	3.33	901573	0.43	30.70
71KDL000081	SAMP	KN211	T	A	0	BOT	26-MAY-90	27.61	901573	0.77	54.98
71KDL000082	SAMP	KN211	T	B	0	SURF	26-MAY-90	7.62	901573	0.49	34.99
71KDL000083	SAMP	KN211	T	B	0	BOT	26-MAY-90	7.62	901573	0.49	34.99
71KDL000084	SAMP	KN211	T	C	0	SURF	26-MAY-90	4.76	901573	0.45	32.13
71KDL000085	SAMP	KN211	T	C	0	BOT	26-MAY-90	21.90	901573	0.69	49.27
71KDL000095	SAMP	KN211	T	Z	0	BOT	26-MAY-90	49.03	901573	1.07	76.40
71KDL000086	SAMP	KN211	R	D	0	SURF	26-MAY-90	0.00	901573	0.32	22.85
71KDL000087	SAMP	KN211	R	D	0	BOT	26-MAY-90	39.03	901573	0.93	66.40
71KDL000097	DUP	KN211	R	D	0	BOT	26-MAY-90	7.62	901573	0.49	34.99
71KDL000088	SAMP	KN211	R	E	0	SURF	26-MAY-90	16.18	901573	0.61	43.55
71KDL000089	SAMP	KN211	R	E	0	BOT	26-MAY-90	0.00	901573	0.34	24.28
71KDL000090	SAMP	KN211	R	F	0	SURF	26-MAY-90	3.33	901573	0.43	30.70
71KDL000091	SAMP	KN211	R	F	0	BOT	26-MAY-90	0.00	901573	0.27	19.28
71KDL000098	EB	KN211		NA	0	NA	26-MAY-90	NA	901573	0.44	31.42

APPENDIX D1, TABLE 2 (continued)
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE	NET TKN (uM)	BATCH#	GROSS TKN (MG/L)	GROSS TKN (uM)
71KDL000131	SAMP	KN211	T	A	2	SURF	01-JUN-90	34.75	901679	0.87	62.12
71KDL000132	SAMP	KN211	T	A	2	BOT	01-JUN-90	50.46	901679	1.09	77.83
71KDL000133	SAMP	KN211	T	B	2	SURF	01-JUN-90	6.90	901679	0.48	34.27
71KDL000134	SAMP	KN211	T	B	2	BOT	01-JUN-90	0.00	901679	0.36	25.70
71KDL000136	SAMP	KN211	T	C	2	SURF	01-JUN-90	0.00	901679	0.28	19.99
71KDL000141	DUP	KN211	T	C	2	SURF	01-JUN-90	0.00	901679	0.23	16.42
71KDL000135	SAMP	KN211	T	C	2	BOT	01-JUN-90	1.19	901679	0.40	28.56
71KDL000138	SAMP	KN211	T	Y	2	BOT	01-JUN-90	2.62	901679	0.42	29.99
71KDL000140	SAMP	KN211	T	Z	2	BOT	01-JUN-90	0.00	901679	0.28	19.99
71KDL000143	SAMP	KN211	R	D	2	SURF	01-JUN-90	0.00	901679	0.19	13.57
71KDL000144	SAMP	KN211	R	D	2	BOT	01-JUN-90	0.00	901679	0.19	13.57
71KDL000145	SAMP	KN211	R	E	2	SURF	01-JUN-90	0.00	901679	0.16	11.42
71KDL000146	SAMP	KN211	R	E	2	BOT	01-JUN-90	0.00	901679	0.17	12.14
71KDL000142	DUP	KN211	R	E	2	BOT	01-JUN-90	0.00	901679	0.28	19.99
71KDL000147	SAMP	KN211	R	F	2	SURF	01-JUN-90	0.00	901679	0.21	14.99
71KDL000148	SAMP	KN211	R	F	2	BOT	01-JUN-90	0.00	901679	0.19	13.57
71KDL000149	SAMP	KN211	T	A	4	SURF	03-JUN-90	0.00	901690	0.10	7.14
71KDL000150	SAMP	KN211	T	A	4	BOT	03-JUN-90	0.00	901690	0.34	24.28
71KDL000151	SAMP	KN211	T	B	4	SURF	03-JUN-90	0.00	901690	0.26	18.56
71KDL000163	DUP	KN211	T	B	4	SURF	03-JUN-90	23.32	901690	0.71	50.69
71KDL000152	SAMP	KN211	T	B	4	BOT	03-JUN-90	0.00	901690	0.23	16.42
71KDL000153	SAMP	KN211	T	C	4	SURF	03-JUN-90	0.00	901690	0.21	14.99
71KDL000154	SAMP	KN211	T	C	4	BOT	03-JUN-90	0.00	901690	0.21	14.99
71KDL000155	SAMP	KN211	T	Y	4	BOT	03-JUN-90	0.00	901690	0.26	18.56
71KDL000156	SAMP	KN211	T	Z	4	BOT	03-JUN-90	0.00	901690	0.33	23.56
71KDL000157	SAMP	KN211	R	D	4	SURF	03-JUN-90	0.00	901690	0.31	22.13
71KDL000164	DUP	KN211	R	D	4	BOT	03-JUN-90	20.47	901690	0.67	47.84
71KDL000159	SAMP	KN211	R	E	4	SURF	03-JUN-90	0.00	901690	0.36	25.70
71KDL000160	SAMP	KN211	R	E	4	BOT	03-JUN-90	4.76	901690	0.45	32.13
71KDL000161	SAMP	KN211	R	F	4	SURF	03-JUN-90	0.00	901690	0.28	19.99
71KDL000162	SAMP	KN211	R	F	4	BOT	03-JUN-90	0.00	901690	0.20	14.28
71KDL000215	SAMP	KN211	T	A	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000216	SAMP	KN211	T	B	8	SURF	07-JUN-90	0.00	901765	0.00	0.00
71KDL000217	SAMP	KN211	T	B	8	BOT	07-JUN-90	0.00	901765	0.25	17.85
71KDL000218	SAMP	KN211	T	C	8	SURF	07-JUN-90	0.00	901765	0.00	0.00
71KDL000219	SAMP	KN211	T	C	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000226	SAMP	KN211	T	Y	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000227	SAMP	KN211	T	Z	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000229	DUP	KN211	T	Z	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000220	SAMP	KN211	R	D	8	SURF	07-JUN-90	0.00	901765	0.00	0.00
71KDL000228	DUP	KN211	R	D	8	SURF	07-JUN-90	0.00	901765	0.00	0.00
71KDL000221	SAMP	KN211	R	D	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000222	SAMP	KN211	R	E	8	SURF	07-JUN-90	0.00	901765	0.00	0.00
71KDL000223	SAMP	KN211	R	E	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000224	SAMP	KN211	R	F	8	SURF	07-JUN-90	0.00	901765	0.00	0.00
71KDL000225	SAMP	KN211	R	F	8	BOT	07-JUN-90	0.00	901765	0.00	0.00
71KDL000246	SAMP	KN211	T	A	16	SURF	15-JUN-90	0.00	901930	0.25	17.85
71KDL000247	SAMP	KN211	T	A	16	BOT	15-JUN-90	0.00	901930	0.34	24.28
71KDL000248	SAMP	KN211	T	B	16	SURF	15-JUN-90	19.75	901930	0.66	47.12
71KDL000249	SAMP	KN211	T	B	16	BOT	15-JUN-90	0.00	901930	0.30	21.42
71KDL000250	SAMP	KN211	T	C	16	SURF	15-JUN-90	4.76	901930	0.45	32.13
71KDL000251	SAMP	KN211	T	C	16	BOT	15-JUN-90	0.00	901930	0.32	22.85

APPENDIX D1, TABLE 2 (continued)
NITROGENOUS NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE	NET TKN (uM)	BATCH#	GROSS TKN (MG/L)	GROSS TKN (uM)
71KDL000261	SAMP	KN211	T	Y	16	BOT	15-JUN-90	0.00	901930	0.36	25.70
71KDL000262	SAMP	KN211	T	Z	16	BOT	15-JUN-90	0.00	901930	0.29	20.71
71KDL000252	SAMP	KN211	R	D	16	SURF	15-JUN-90	12.61	901930	0.56	39.98
71KDL000253	SAMP	KN211	R	D	16	BOT	15-JUN-90	48.31	901930	1.06	75.68
71KDL000257	SAMP	KN211	R	F	16	BOT	15-JUN-90	6.19	901930	0.47	33.56
71KDL000258	DUP	KN211	R	F	16	BOT	15-JUN-90	0.00	901930	0.38	27.13
71KDL000297	SAMP	KN211	T	A	31	SURF	30-JUN-90	4.05	902212	0.44	31.42
71KDL000298	SAMP	KN211	T	A	31	BOT	30-JUN-90	4.05	902212	0.44	31.42
71KDL000299	SAMP	KN211	T	B	31	SURF	30-JUN-90	0.00	902212	0.34	24.28
71KDL000303	DUP	KN211	T	B	31	SURF	30-JUN-90	1.19	902212	0.40	28.56
71KDL000300	SAMP	KN211	T	B	31	BOT	30-JUN-90	11.19	902212	0.54	38.56
71KDL000301	SAMP	KN211	T	C	31	SURF	30-JUN-90	1.19	902212	0.40	28.56
71KDL000302	SAMP	KN211	T	C	31	BOT	30-JUN-90	0.00	902212	0.35	24.99
71KDL000305	DUP	KN211	T	C	31	BOT	30-JUN-90	2.62	902212	0.42	29.99
71KDL000311	SAMP	KN211	T	Y	31	BOT	30-JUN-90	51.17	902212	1.10	78.54
71KDL000312	SAMP	KN211	T	Z	31	BOT	30-JUN-90	42.60	902212	0.98	69.97
71KDL000306	SAMP	KN211	R	D	31	BOT	30-JUN-90	3.33	902212	0.43	30.70
71KDL000304	SAMP	KN211	R	D	31	SURF	30-JUN-90	0.00	902212	0.32	22.85
71KDL000307	SAMP	KN211	R	E	31	SURF	30-JUN-90	18.33	902212	0.64	45.70
71KDL000308	SAMP	KN211	R	E	31	BOT	30-JUN-90	29.04	902212	0.79	56.41
71KDL000309	SAMP	KN211	R	F	31	SURF	30-JUN-90	27.61	902212	0.77	54.98
71KDL000310	SAMP	KN211	R	F	31	BOT	30-JUN-90	29.75	902212	0.80	57.12
94KDL000010	SAMP	KN211	T	A	47	BOT	07-16-90	94.01	902517	1.70	121.38
94KDL000013	DUP	KN211	T	A	47	BOT	07-16-90	86.87	902517	1.60	114.24
94KDL000011	SAMP	KN211	T	B	47	BOT	07-16-90	151.13	902517	2.50	178.50
94KDL000012	SAMP	KN211	T	C	47	BOT	07-16-90	51.17	902517	1.10	78.54
94KDL000014	SAMP	KN211	T	Y	47	BOT	07-16-90	58.31	902517	1.20	85.68
94KDL000015	SAMP	KN211	T	Z	47	BOT	07-16-90	51.17	902517	1.10	78.54
94KDL000016	SAMP	KN211	R	D	47	BOT	07-16-90	41.17	902517	0.96	68.54
94KDL000017	SAMP	KN211	R	E	47	BOT	07-16-90	44.03	902517	1.00	71.40
94KDL000018	SAMP	KN211	R	F	47	BOT	07-16-90	28.32	902517	0.78	55.69
94KDL000038	SAMP	KN211	T	A	60	BOT	07-31-90	66.16	902809	1.31	93.53
94KDL000044	DUP	KN211	T	A	60	BOT	07-31-90	66.16	902809	1.31	93.53
94KDL000039	SAMP	KN211	T	B	60	BOT	07-31-90	42.60	902809	0.98	69.97
94KDL000040	SAMP	KN211	T	C	60	BOT	07-31-90	27.61	902809	0.77	54.98
94KDL000041	SAMP	KN211	R	D	60	BOT	07-31-90	16.18	902809	0.61	43.55
94KDL000045	SAMP	KN211	R	E	60	BOT	07-31-90	12.61	902809	0.56	39.98
94KDL000046	SAMP	KN211	R	F	60	BOT	07-31-90	6.90	902809	0.48	34.27
94KDL000047	SAMP	KN211	R	STR	60	SURF	07-31-90	4.05	902809	0.44	31.42
94KDL000068	SAMP	KN211	T	A	98	BOT	09-05-90	27.61	903520	0.77	54.98
94KDL000069	SAMP	KN211	T	B	98	BOT	09-05-90	6.19	903520	0.47	33.56
94KDL000070	DUP	KN211	T	B	98	BOT	09-05-90	6.19	903520	0.47	33.56
94KDL000071	SAMP	KN211	R	C	98	BOT	09-05-90	11.19	903520	0.54	38.56
94KDL000072	SAMP	KN211	R	D	98	BOT	09-05-90	0.00	903520	0.36	25.70
94KDL000073	SAMP	KN211	R	F	98	BOT	09-05-90	4.05	903520	0.44	31.42
94KDL000074	SAMP	KN211	R	AMB	98	BOT	09-05-90	1.90	903520	0.41	29.27
94KDL000076	SAMP	KN211	T	A	104	BOT	09-11-90	14.76	903520	0.59	42.13
94KDL000077	SAMP	KN211	T	B	104	BOT	09-11-90	9.04	903520	0.51	36.41
94KDL000078	DUP	KN211	T	B	104	BOT	09-11-90	28.32	903520	0.78	55.69
94KDL000081	SAMP	KN211	T	Y	104	BOT	09-11-90	43.32	903520	0.99	70.69
94KDL000079	SAMP	KN211	R	D	104	BOT	09-11-90	11.19	903520	0.54	38.56
94KDL000080	SAMP	KN211	R	F	104	BOT	09-11-90	3.33	903520	0.43	30.70

APPENDIX D1, TABLE 3
SUMMARY OF FERTILIZER NUTRIENTS FROM KN-132B

KN132B - NUTRIENT DATA, FERTILIZED (uM)

DAY	NO3+NO2	NH3	ORGANIC N	TOTAL N	PO4
0	1.94	1.11	27.40	30.44	0.71
2	79.14	103.33	153.88	336.35	0.77
4	36.63	44.50	0.00	81.13	0.73
8	17.84	19.21	0.00	37.06	0.48
16	13.46	1.22	40.58	55.25	0.54
29	32.11	5.94	24.95	62.99	0.72
43	13.36	45.52	68.72	127.60	0.16
60	29.52	0.28	6.39	36.18	0.58

KN132B - NUTRIENT DATA, UNFERTILIZED (uM)

DAY	NO3+NO2	NH3	ORGANIC N	TOTAL N	PO4
0	2.59	0.94	8.04	11.56	0.16
2	6.98	3.19	1.47	11.64	0.14
4	4.95	0.60	0.00	5.55	0.14
8	2.05	0.56	5.48	8.09	0.08
16	7.11	0.40	14.76	22.27	0.12
29	8.33	2.47	32.13	42.93	0.22
43	1.11	0.37	36.28	37.76	0.03
60	4.17	0.76	6.15	11.07	0.06

KN132B - NUTRIENT DATA, F/U RATIOS

DAY	F/U NO3+NO2	F/U NH3	F/U ORGANIC N	F/U TOTAL N	F/U PO4
0	0.75	1.18	3.41	2.63	4.47
2	11.34	32.41	104.72	28.90	5.40
4	7.40	74.37		14.61	5.19
8	8.70	34.62	0.00	4.58	6.08
16	1.89	3.02	2.75	2.48	4.44
29	3.86	2.40	0.78	1.47	3.31
43	12.03	123.02	1.89	3.38	6.00
60	7.08	0.36	1.04	3.27	9.72

NOTE: The fertilized beach values are the averages of surface and subsurface samples from wells A,B,C,Y and Z. The unfertilized values are the averages of surface and subsurface samples from wells D,E and F.

NOTE: 1mg/L of Nitrogen * 71.4 = 1 uM Nitrogen

ORGANIC N = Kjeldahl Nitrogen - NH3. If this results in a negative value it is set to zero.
TOTAL N = ORGANIC N + NH3 + NO3+NO2

APPENDIX D1, TABLE 4
SUMMARY OF FERTILIZER NUTRIENTS FROM KN-135B

KN135B - NUTRIENT DATA, FERTILIZED (uM)

DAY	NO3+NO2	NH3	ORGANIC N	TOTAL N	PO4
0	2.73	0.81	11.33	14.87	0.32
2	145.16	146.46	87.92	379.54	0.51
4	144.27	147.49	-0.86	290.90	0.41
8	123.81	79.26	0.00	203.07	0.38
15	37.17	31.87	0.00	69.04	0.37
32	31.23	1.02	9.65	41.91	0.18
57	37.48	73.70	36.38	147.56	0.20
70	28.34	1.29	24.46	54.09	0.47
78	115.58	23.47	0.00	139.05	0.26

KN135B - NUTRIENT DATA, UNFERTILIZED (uM)

DAY	NO3+NO2	NH3	ORGANIC N	TOTAL N	PO4
0	1.62	0.93	23.44	25.98	0.43
2	1.09	1.18	5.76	8.03	0.44
4	1.87	0.89	3.15	5.91	0.53
8	2.44	1.09	4.90	8.42	0.44
15	1.64	0.89	-0.56	1.97	0.47
32	3.36	0.46	4.12	7.94	0.40
57	1.99	0.46	24.11	26.56	0.20
70	3.08	0.66	0.21	3.96	0.12
78	27.27	4.67	2.71	34.64	0.09

KN135B - NUTRIENT DATA, F/U RATIOS

DAY	F/U NO3+NO2	F/U NH3	F/U ORGANIC N	F/U TOTAL N	F/U PO4
0	1.69	0.87	0.48	0.57	0.75
2	133.79	123.94	15.26	47.29	1.16
4	77.29	165.10	-0.27	49.20	0.77
8	50.74	72.93	0.00	24.11	0.87
15	22.70	35.86	0.00	35.03	0.79
32	9.31	2.21	2.34	5.28	0.45
57	18.83	160.22	1.51	5.55	1.00
70	9.19	1.96	115.01	13.67	4.06
78	4.24	5.03	0.00	4.01	2.91

NOTE: The fertilized beach values are the averages of surface and subsurface samples from wells A,B,C and Z. The unfertilized values are the averages of surface and subsurface samples from wells D,E and F.

NOTE: 1mg/L of Nitrogen * 71.4 = 1 uM Nitrogen

ORGANIC N = Kjeldahl Nitrogen - NH3. If this results in a negative value it is set to z
TOTAL N = ORGANIC N + NH3 + NO3+NO2

APPENDIX D1, TABLE 5
SUMMARY OF FERTILIZER NUTRIENTS FROM KN-211E

KN211E - NUTRIENT DATA, FERTILIZED (uM)

DAY	NO3+NO2	NH3	ORGANIC N	TOTAL N	PO4
0	4.39	1.19	17.05	22.63	0.27
2	24.93	19.27	0.00	44.20	0.94
4	13.23	5.13	0.00	18.36	0.54
8	10.26	8.07	0.00	18.33	0.46
16	8.39	1.01	2.06	11.45	0.28
31	12.20	7.25	4.55	24.00	0.35
47	58.52	41.30	40.81	140.63	1.04
60	40.80	4.08	29.68	74.56	0.66
98	31.20	19.82	0.00	51.02	0.18
104	17.32	25.26	0.00	42.58	0.61

KN211E - NUTRIENT DATA, UNFERTILIZED (uM)

DAY	NO3+NO2	NH3	ORGANIC N	TOTAL N	PO4
0	3.13	1.27	8.18	12.58	0.44
2	1.51	1.27	0.00	2.78	0.17
4	0.65	1.15	3.05	4.86	0.24
8	1.49	0.48	0.00	1.97	0.37
16	1.66	0.47	16.31	18.44	0.52
31	2.24	0.40	17.61	20.25	0.34
47	1.35	0.92	36.92	39.19	0.13
60	2.33	0.47	11.43	14.23	0.04
98	0.63	8.36	0.00	8.99	0.15
104	2.77	10.85	0.00	13.62	0.55

KN211E - NUTRIENT DATA, F/U RATIOS

DAY	F/U NO3+NO2	F/U NH3	F/U ORGANIC N	F/U TOTAL N	F/U PO4
0	1.40	0.94	2.08	1.80	0.62
2	16.48	15.19		15.89	5.65
4	20.22	4.46	0.00	3.78	2.22
8	6.89	16.81		9.30	1.23
16	5.05	2.16	0.13	0.62	0.53
31	5.45	18.13	0.26	1.19	1.01
47	43.35	44.89	1.11	3.59	7.79
60	17.49	8.68	2.60	5.24	18.00
98	49.79	2.37	NA	5.68	
104	6.26	2.33	NA	3.13	

NOTE: The fertilized beach values are the averages of surface and subsurface samples from wells A,B,C,Y and Z. The unfertilized values are the averages of surface and subsurface samples from wells D,E and F.

NOTE: 1mg/L of Nitrogen * 71.4 = 1 uM Nitrogen

ORGANIC N = Kjeldahl Nitrogen - NH3. If this results in a negative value it is set to zero.
TOTAL N = ORGANIC N + NH3 + NO3+NO2

APPENDIX D1, TABLES 6-12

Tables 6-11 of Appendix D1 list the measured values of dissolved oxygen, salinity and temperature for the three shorelines monitored in this program. Tables 6-8 list the samples from the individual wells; A, B and C are on the fertilized portion of the beach, D, E and F are on the unfertilized portion. Wells A-F represent the centers of the sediment sampling areas. Wells Y (KN-132B and KN-211E) and Z (KN-132B, KN-135B and KN-211E) are sealed so that they collect interstitial water from only the bottom 10cm of their depth, and are on the fertilized portion of the beach. The Tables indicate samples collected from the top of the well as SFC (surface) and from the bottom of the well as BOT.; D.O. is dissolved oxygen, measured in mg/l (ppm); SAL. is salinity, measured in ppt; and TEMP is temperature, measured in degrees Celsius. Samples collected from nearshore, surface water are labeled AMB, for ambient conditions offshore of the fertilized (FERT) and unfertilized (UNFERT) portions of the beach. Tables 9-11 indicate the average values for the fertilized (FERT), unfertilized (UNFERT), and ambient samples, together with standard deviations of the means (STD) to give an idea of the differences between the wells. The ratio of the values on fertilized and unfertilized portions is included as F/U. The data are presented graphically in Figures 10-12 of the main report.

Table 12 lists pH measurements made on some interstitial water samples, beginning on Day 29 for KN-132B. The abbreviations are the same as those used in Tables 6-11.

APPENDIX D1, TABLE 6

DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER ON KN-132B

DATE	05/31	06/04	06/06	06/10	06/18	06/30	07/12	07/15	08/01
DAY	0	2	4	8	16	29	40	43	60
							REAPPLY		
D.O. SFC A	5.0	4.5	4.0	4.0	7.0	3.5		NO	NO
D.O. SFC B	5.5	3.5	4.0	5.0	6.0	4.0		SFC	SFC
D.O. SFC C	5.0	5.5	3.5	4.5	5.5	5.5		TAKEN	TAKEN
D.O. SFC D	7.0	5.0	7.0	8.0	5.5	5.5			
D.O. SFC E	8.0	6.0	7.0	5.5	6.0	4.0			
D.O. SFC F	5.0	5.5	7.0	5.0	6.0	5.0			
D.O. BOT A	5.0	4.5	5.0	4.0	7.0	5.5		4.0	7.0
D.O. BOT B	6.0	4.5	4.0	3.5	5.5	4.0		4.5	5.5
D.O. BOT C	5.5	5.5	4.0	4.0	6.0	6.0		1.5	6.0
D.O. BOT D	7.0	5.0	7.0	4.5	5.5	5.0		4.5	5.0
D.O. BOT E	6.0	5.5	7.0	4.5	6.0	4.0		5.5	7.0
D.O. BOT F	6.0	6.0	7.0	5.0	6.5	5.0		7.0	7.0
D.O. BOT Y	6.0	6.0	5.0	4.0	6.5	4.0		4.5	3.5
D.O. BOT Z	6.5	4.5	4.0	4.0	6.0	4.0		4.5	5.5
D.O. AMB FERT	6.0		6.0	5.5	8.0	7.0		9.0	8.0
D.O. AMB UNFERT	11.0	7.0	7.0		8.0	7.0		7.0	6.0
SAL. SFC A	23.5	20.5	17.0	15.2	20.0	23.0		NO	NO
SAL. SFC B	26.5	22.0	20.0	14.0	16.8	23.0		SFC	SFC
SAL. SFC C	23.0	19.0	15.0	13.5	19.8	23.0		TAKEN	TAKEN
SAL. SFC D	12.0	12.9	14.2	9.0	4.5	18.0			
SAL. SFC E	20.0	14.0	12.5	14.5	1.5	19.0			
SAL. SFC F	15.7	12.0	10.5	10.5	0.2	18.0			
SAL. BOT A	23.0	20.0	17.0	15.2	20.9	23.0		18.5	15.5
SAL. BOT B	26.5	22.0	20.0	14.9	18.4	23.0		18.2	16.0
SAL. BOT C	27.0	19.0	15.0	15.5	19.3	24.0		16.5	13.2
SAL. BOT D	15.1	13.5	14.0	10.0	6.0	18.5		15.5	16.8
SAL. BOT E	21.0	13.5	11.5	14.0	2.5	19.0		17.8	15.6
SAL. BOT F	15.2	12.0	10.3	10.0	0.1	17.5		14.2	9.0
SAL. BOT Y	25.1	19.0	14.0	15.5	21.2	23.0		17.0	13.6
SAL. BOT Z	25.2	20.5	15.5	13.8	17.1	23.0		16.0	13.5
SAL. AMB FERT	27.1		16.5	20.0	23.5	23.0		21.0	18.0
SAL. AMB UNFERT	8.0		25.0	8.5	15.5	20.0		22.0	19.8
TEMP SFC A	13.0	14.5	16.0	13.2	13.0	18.0		NO	NO
TEMP SFC B	13.0	16.0	16.0	13.0	12.8	18.0		SFC	SFC
TEMP SFC C	12.5	14.0	15.0	13.2	12.9	18.0		TAKEN	TAKEN
TEMP SFC D	11.6	16.0	16.0	13.0	12.5	19.0			
TEMP SFC E	11.0	14.0	15.0	13.0	12.0	18.0			
TEMP SFC F	10.5	13.5	14.0	12.5	10.0	16.5			
TEMP BOT A	13.0	15.0	16.0	13.5	12.5	18.0		14.9	14.1
TEMP BOT B	12.5	16.0	16.0	13.8	12.9	19.0		16.0	14.9
TEMP BOT C	12.5	14.0	15.0	13.8	12.8	18.0		15.0	14.5
TEMP BOT D	11.9	14.5	15.5	13.0	12.5	18.0		15.8	14.0
TEMP BOT E	11.5	14.0	14.5	13.0	11.8	17.0		14.5	13.2
TEMP BOT F	10.0	13.0	14.0	12.5	9.8	17.0		13.0	12.0
TEMP BOT Y	12.5	14.5	16.0	13.2	12.3	18.0		15.0	14.3
TEMP BOT Z	13.2	15.0	16.0	15.5	13.0	18.0		15.0	14.2
TEMP AMB FERT	12.0		14.0	13.0	12.1	16.0		14.0	14.1
TEMP AMB UNFERT	9.2		15.0	10.0	12.2	16.5		14.5	14.0

APPENDIX D1, TABLE 7
DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER ON KN-135B

DATE	05/20	05/23	05/25	05/29	06/05	06/22	07/13	07/17	07/30	08/07
DAY	0	2	4	8	15	32	53	57	70	78
							REAPPLY			
D.O. SFC A	7.0	7.0	6.0	3.5	2.5	6.0		NO	NO	NO
D.O. SFC B	7.0	7.5	5.5	5.0	3.5	6.0		SFC	SFC	SFC
D.O. SFC C	7.0	7.0	5.5	5.5	3.0	5.5		TAKEN	TAKEN	TAKEN
D.O. SFC D	8.0	6.0	7.0	5.5	7.0	5.5				
D.O. SFC E	7.0	5.5	7.0	6.0	5.0	5.0				
D.O. SFC F	6.0	4.5	6.0	5.0	6.0	5.5				
D.O. BOT A	8.0	7.0	5.5	3.5	3.5	5.5		4.5	5.5	4.5
D.O. BOT B	7.0	6.0	5.5	5.0	3.5	6.0		3.0	3.5	3.5
D.O. BOT C	7.0	6.5	5.5	4.0	3.0	5.0		3.0	3.5	4.5
D.O. BOT D	7.0	6.0	7.0	6.0	7.0	7.0		5.5	6.0	6.0
D.O. BOT E	7.0	6.0	7.0	6.5	7.0	6.0		6.0	5.0	4.0
D.O. BOT F	7.0	6.0	6.0	6.0	5.5	5.5		6.0	5.5	2.0
D.O. BOT Z	8.0	7.0	5.0	5.5	4.5	5.5		3.5	5.0	5.0
D.O. AMB FERT	9.0			5.5	5.5	7.0		7.0	7.0	7.0
D.O. AMB UNFERT		8.0		5.0	7.0	5.5		8.0	7.0	6.0
SAL. SFC A	20.8	25.9	27.8	14.7	24.0	14.0		NO	NO	NO
SAL. SFC B	16.8	24.9	24.5	12.0	23.5	4.0		SFC	SFC	SFC
SAL. SFC C	18.3	24.7	25.3	14.0	22.5	8.5		TAKEN	TAKEN	TAKEN
SAL. SFC D	16.4	20.7	23.5	17.2	20.0	18.0				
SAL. SFC E	15.3	19.5	23.0	18.3	22.0	18.3				
SAL. SFC F	16.8	20.6	23.5	18.8	20.5	18.0				
SAL. BOT A	19.6	25.3	27.2	16.1	24.0	14.0		23.0	11.0	19.7
SAL. BOT B	17.2	25.1	24.3	11.2	23.0	4.0		20.0	8.8	18.7
SAL. BOT C	18.4	24.3	25.8	16.0	22.5	8.0		21.5	4.5	17.2
SAL. BOT D	16.6	20.3	23.5	19.8	21.0	16.5		19.2	5.1	22.0
SAL. BOT E	15.8	19.5	23.0	20.9	22.0	18.0		19.5	6.8	21.0
SAL. BOT F	17.0	21.2	23.5	20.1	22.0	18.0		20.6	8.0	21.5
SAL. BOT Z	20.0	25.6	26.8	16.3	23.0	6.0		19.0	5.0	16.1
SAL. AMB FERT	20.2				21.0	24.0		22.5	8.5	21.9
SAL. AMB UNFERT		23.0		17.3	16.0	23.0		21.8	14.8	22.5
TEMP SFC A	12.8	11.6	9.9	12.9	15.5	11.0		NO	NO	NO
TEMP SFC B	12.7	11.5	9.0	11.4	15.0	11.0		SFC	SFC	SFC
TEMP SFC C	11.0	10.3	9.1	11.1	13.5	11.0		TAKEN	TAKEN	TAKEN
TEMP SFC D	12.1	11.2	10.0	11.8	15.0	11.8				
TEMP SFC E	12.8	11.2	10.5	11.8	14.0	12.0				
TEMP SFC F	12.9	11.0	10.0	12.3	15.0	11.8				
TEMP BOT A	12.1	11.5	9.9	12.1	15.0	11.0		17.0	12.5	13.8
TEMP BOT B	11.0	10.7	9.0	11.0	14.0	11.0		17.5	12.8	13.5
TEMP BOT C	10.8	9.9	9.1	10.8	13.0	11.5		16.0	12.8	13.7
TEMP BOT D	11.6	11.0	10.0	11.5	14.5	12.0		16.1	13.0	13.5
TEMP BOT E	12.5	10.8	10.5	11.9	14.0	12.0		16.8	13.6	13.5
TEMP BOT F	14.6	11.0	10.0	12.0	15.0	12.0		16.8	13.8	14.0
TEMP BOT Z	10.7	10.4	9.8	11.4	14.0	11.0		17.0	12.5	13.5
TEMP AMB FERT	13.9				14.0	12.0		17.5	13.0	14.2
TEMP AMB UNFERT		11.0		11.1	15.0	11.5		16.9	13.9	14.0

APPENDIX D1, TABLE 8
DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER ON KN-211E

DATE	05/26	06/01	06/03	06/07	06/15	06/30	07/13	07/16	07/31	09/05	09/11
DAY	0	2	4	8	16	31	44	47	62	98	104
							REAPPLY				
D.O. SFC A	5.4	7.0	5.5	3.0	6.0	6.0		NO	NO	NO	NO
D.O. SFC B	6.0	5.0	1.5	2.0	5.0	2.0		SFC	SFC	SFC	SFC
D.O. SFC C	5.2	3.5	1.0	2.0	4.0	2.0		TAKEN	TAKEN	TAKEN	TAKEN
D.O. SFC D	3.5	5.0	1.5	2.5	3.5	3.5					
D.O. SFC E	3.5	3.0	2.0	1.5	1.5	1.0					
D.O. SFC F	6.5	4.0	7.0	3.0	4.0	4.5					
D.O. BOT A	5.5	6.0	6.0	3.5	4.5	4.0		5.5	6.0	3.5	5.0
D.O. BOT B	4.5	4.5	1.5	1.0	5.0	1.0		1.0	1.5	2.0	1.0
D.O. BOT C	4.5	3.5	1.0	1.0	4.0	2.0		2.5	1.0	1.5	
D.O. BOT D	2.5	5.5	1.5	2.0	3.0	3.5		1.5	3.0	2.5	4.5
D.O. BOT E	2.5	3.0	2.0	1.0	1.0	1.0		1.5	3.5		
D.O. BOT F	5.0	3.5	7.5	3.5	4.0	3.5		5.0	4.0	4.0	5.5
D.O. BOT Y		7.0	6.5	4.5	7.0	5.0		5.5		3.0	
D.O. BOT Z	7.0	6.0	7.0	4.5	7.0	5.5		5.5			1.5
D.O. AMB FERT	7.0	6.0	4.5	5.5	7.0	5.5		7.0	7.0	6.0	8.0
D.O. AMB UNFERT	7.0	7.0	8.0	6.0	7.0	6.0		7.5	6.0	7.0	7.0
SAL. SFC A	19.3	17.0	20.0	20.0	21.5	20.5		NO	NO	NO	NO
SAL. SFC B	20.0	22.0	23.5	22.2	25.0	23.0		SFC	SFC	SFC	SFC
SAL. SFC C	20.0	19.5	22.0	21.0	24.0	23.0		TAKEN	TAKEN	TAKEN	TAKEN
SAL. SFC D	24.7	24.0	24.0	23.0	22.9	20.9					
SAL. SFC E	27.5	24.0	23.9	21.5	19.4	20.3					
SAL. SFC F	28.6	23.5	26.0	24.3	25.0	21.0					
SAL. BOT A	19.3	18.0	19.5	20.8	22.5	21.0		23.5	9.0	14.8	10.0
SAL. BOT B	20.0	21.5	24.0	23.7	24.8	23.5		24.4	9.5	17.2	12.5
SAL. BOT C	21.6	20.0	22.0	21.9	24.5	23.0		24.9	12.0	19.2	13.5
SAL. BOT D	25.2	23.5	24.8	22.8	24.0	21.0		22.5	10.6	19.1	16.0
SAL. BOT E	26.8	25.0	23.4	23.5	23.5	21.0		22.0	5.8		
SAL. BOT F	28.8	26.0	26.2	24.8	24.2	20.5		22.5	14.2	17.5	13.5
SAL. BOT Y	18.2	17.5	18.5	18.2	22.5	22.5		23.8		17.8	
SAL. BOT Z	15.9	18.0	18.0	18.0	21.2	21.5		21.0			15.5
SAL. AMB FERT					28.0	26.0		25.8	20.5	21.5	15.0
SAL. AMB UNFERT		26.5		25.3	26.0	21.5		23.0	22.2	21.5	22.8
TEMP SFC A	9.0	11.0	11.5	12.5	12.8	14.0		NO	NO	NO	NO
TEMP SFC B	9.8	12.5	13.0	13.9	12.8	16.0		SFC	SFC	SFC	SFC
TEMP SFC C	9.1	11.0	12.0	12.8	12.9	14.0		TAKEN	TAKEN	TAKEN	TAKEN
TEMP SFC D	10.8	12.5	13.0	13.4	12.8	15.0					
TEMP SFC E	9.1	12.9	13.2	14.0	12.5	15.0					
TEMP SFC F	9.0	12.7	13.0	14.0	12.5	15.0					
TEMP BOT A	9.1	11.0	11.0	12.0	12.5	14.0		15.0	15.0	[illegible]	12.0
TEMP BOT B	9.5	11.5	13.0	14.0	12.9	16.5		14.8	15.3	[illegible]	13.0
TEMP BOT C	9.0	11.0	12.0	12.8	12.8	14.0		14.0	14.0	[illegible]	12.5
TEMP BOT D	11.0	12.1	12.5	13.5	13.0	15.0		14.2	15.0	[illegible]	13.0
TEMP BOT E	9.8	12.2	13.0	13.8	12.5	15.0		14.5	14.8		
TEMP BOT F	9.4	12.7	13.0	13.8	13.5	15.2		14.0	13.8	[illegible]	12.0
TEMP BOT Y	8.8	10.0	10.5	11.0	12.5	13.5		14.1			
TEMP BOT Z	8.5	10.0	10.0	11.5	12.8	13.0		14.6			12.0
TEMP AMB FERT					13.0	14.0		14.5	15.0	[illegible]	12.5
TEMP AMB UNFERT		12.7		13.3	12.3	15.0		14.5	13.8	[illegible]	12.0

APPENDIX D1, TABLE 9
SUMMARY OF DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER ON KN-132B

DATE	05/31	06/04	06/06	06/10	06/18	06/30	07/12	07/15	08/01
DAY	0	2	4	8	16	29	40	43	60
D.O. FERT-AVG	5.6	4.8	4.2	4.1	6.2	4.6	4.6	3.8	5.5
D.O. UNFERT-AVG	6.5	5.5	7.0	5.4	5.9	4.8	4.8	5.7	6.3
AMB-AVG	8.5	7.0	6.5	5.5	8.0	7.0		8.0	7.0
F/U	0.9	0.9	0.6	0.8	1.0	1.0	1.0	0.7	0.9
FERT-STD	0.4	0.7	0.4	0.5	0.6	0.9	0.9	1.2	1.1
UNFERT-STD	1.0	0.4	0.0	1.2	0.3	0.6	0.6	1.0	0.9
AMBIENT-STD	2.5	0.0	0.5	0.0	0.0	0.0		1.0	1.0
SAL. FERT-AVG	25.0	20.3	16.7	14.7	19.2	23.1	23.1	17.2	14.4
SAL. UNFERT-AVG	16.5	13.0	12.2	11.3	2.5	18.3	18.0	15.8	13.8
AMBIENT-AVG	17.6		20.8	14.3	19.5	21.5		21.5	18.9
F/U	1.5	1.6	1.4	1.3	7.8	1.3	1.3	1.1	1.0
FERT-STD	1.8	1.2	2.1	0.7	1.3	0.4	0.4	1.0	1.2
UNFERT-STD	3.1	0.8	1.5	2.1	2.2	0.6	0.6	1.5	3.4
AMBIENT-STD	9.6		4.3	5.8	4.0	1.5		0.5	0.9
TEMP FERT-AVG	12.8	14.9	15.8	13.7	12.8	18.1	18.1	15.2	14.4
TEMP UNFERT-AVG	11.1	14.2	14.8	12.8	11.4	17.6	17.6	14.4	13.1
AMBIENT-AVG	10.6		14.5	11.5	12.2	16.3		14.3	14.1
F/U	1.2	1.1	1.1	1.1	1.1	1.0	1.0	1.1	1.1
FERT-STD	0.3	0.8	0.5	0.3	0.2	0.4	0.4	0.4	0.3
UNFERT-STD	0.7	0.9	0.7	0.2	1.1	0.8	0.8	1.1	0.8
AMBIENT-STD	1.4		0.5	1.5	0.0	0.3		0.3	0.0

APPENDIX D1, TABLE 10
SUMMARY OF DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER ON KN-135B

DATE	05/20	05/23	05/25	05/29	06/05	06/22	07/13	07/17	07/30	08/07
DAY	0	2	4	8	15	32	53	57	70	78
D.O. FERT-AVG	7.3	6.8	5.6	4.4	3.2	5.7	5.7	3.5	4.4	4.4
D.O. UNFERT-AVG	7.0	5.7	6.7	5.8	6.3	5.8	5.8	5.8	5.5	4.0
AMB-AVG	9.0	8.0		5.3	6.3	6.3		7.5	7.0	6.5
F/U	1.0	1.2	0.8	0.8	0.5	1.0	1.0	0.6	0.8	1.1
FERT-STD	0.4	0.5	0.2	0.8	0.4	0.4	0.4	0.6	0.9	0.5
UNFERT-STD	0.6	0.6	0.5	0.5	0.8	0.6	0.6	0.2	0.4	1.6
AMBIENT-STD	0.0	0.0		0.3	0.8	0.8		0.5	0.0	0.5
SAL. FERT-AVG	18.7	25.0	25.8	14.0	23.3	8.8	8.8	20.9	7.3	17.9
SAL. UNFERT-AVG	16.3	20.3	23.3	19.2	21.3	17.8	17.8	19.8	6.6	21.5
AMBIENT-AVG	20.2	23.0		17.3	18.5	23.5		22.2	11.7	22.2
F/U	1.1	1.2	1.1	0.7	1.1	0.5	0.5	1.1	1.1	0.8
FERT-STD	1.4	0.5	1.3	1.9	0.6	4.1	4.1	1.5	2.7	1.4
UNFERT-STD	0.6	0.6	0.2	1.2	0.8	0.6	0.6	0.6	1.2	0.4
AMBIENT-STD	0.0	0.0		0.0	2.5	0.5		0.3	3.2	0.3
TEMP FERT-AVG	11.6	10.9	9.3	11.6	14.3	11.1	11.1	16.9	12.7	13.6
TEMP UNFERT-AVG	12.8	11.0	10.2	11.9	14.6	11.9	11.9	16.6	13.5	13.7
AMBIENT-AVG	13.9	11.0		11.1	14.5	11.8		17.2	13.5	14.1
F/U	0.9	1.0	0.9	1.0	1.0	0.9	0.9	1.0	0.9	1.0
FERT-STD	0.8	0.7	0.4	0.7	0.9	0.2	0.2	0.5	0.2	0.1
UNFERT-STD	0.9	0.1	0.2	0.2	0.4	0.1	0.1	0.3	0.3	0.2
AMBIENT-STD	0.0	0.0		0.0	0.5	0.3		0.3	0.5	0.1

APPENDIX D1, TABLE 11
SUMMARY OF DISSOLVED OXYGEN, SALINITY AND TEMPERATURE OF INTERSTITIAL WATER ON KN-211E

DATE	05/26	06/01	06/03	06/07	06/15	06/30	7/13	07/16	07/31	09/05	09/11
DAY	0	2	4	8	16	31	44	47	62	98	104
D.O. FERT-AVG	5.4	5.3	3.8	2.7	5.3	3.4	3.4	4.0	2.8	2.5	2.5
D.O. UNFERT-AVG	3.9	4.0	3.6	2.3	2.8	2.8	2.8	2.7	3.5	3.3	5.0
AMB-AVG	7.0	6.0	5.8	5.0	7.0	5.5	0.0	6.3	7.0	6.0	4.8
F/U	1.4	1.3	1.0	1.2	1.9	1.2	1.2	1.5	0.8	0.8	0.5
FERT-STD	0.5	1.3	2.1	0.9	0.7	1.7	1.7	1.9	2.2	0.8	1.8
UNFERT-STD	1.4	1.0	2.6	0.9	1.2	1.3	1.3	1.6	0.4	0.8	0.5
AMBIENT-STD	0.0	0.0	1.3	0.5	0.0	0.0	0.0	0.8	0.0	0.0	3.3
SAL. FERT-AVG	19.3	19.2	20.9	20.7	23.3	22.3	22.3	23.5	10.2	17.3	12.9
SAL. UNFERT-AVG	26.9	24.3	24.7	23.3	23.2	20.8	20.8	22.3	10.2	18.3	14.8
AMBIENT-AVG		26.5		25.3	27.0	23.8		24.4	21.4	21.5	18.9
F/U	0.7	0.8	0.8	0.9	1.0	1.1	1.1	1.1	1.0	0.9	0.9
FERT-STD	0.8	1.8	1.6	1.2	1.3	1.1	1.1	1.3	1.3	1.6	2.0
UNFERT-STD	1.6	0.9	1.1	1.1	1.8	0.3	0.3	0.2	3.4	0.8	1.3
AMBIENT-STD		0.0		0.0	1.0	2.3		1.4	0.8	0.0	3.9
TEMP FERT-AVG	9.1	11.0	11.6	12.6	12.8	14.4	14.4	14.5	14.8	13.5	12.4
TEMP UNFERT-AVG	9.9	12.5	13.0	13.8	12.8	15.0	15.0	14.2	14.5	13.5	12.5
AMBIENT-AVG		12.7		13.3	12.6	14.5		14.5	14.4	13.9	12.3
F/U	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FERT-STD	0.3	0.6	0.7	0.7	0.1	1.1	1.1	0.4	0.6	0.8	0.4
UNFERT-STD	0.8	0.3	0.2	0.2	0.4	0.1	0.1	0.2	0.5	0.0	0.5
AMBIENT-STD		0.0		0.0	0.4	0.5		0.0	0.6	0.1	0.3

APPENDIX D1, TABLE 12
pH OF INTERSTITIAL WATER

pH VALUES ALL BEACHES

BEACH	KN-211	KN-132		KN-135	KN-211	KN-132	KN-135	KN-211	KN-132
DAY	31	29		57	47	44	70	62	61
pH SFC A	7.60	7.50	REAPPLY						
pH SFC B	7.20	7.90	ALL						
pH SFC C	7.20	7.50	BEACHES						
pH SFC D	7.10	7.30	MID	NO	SFC	TAKEN	NO	SFC	TAKEN
pH SFC E	6.90	7.50	JULY						
pH SFC F	7.40	7.30							
pH BOT A	7.50	7.60		7.11	7.68	7.70	7.11	7.42	7.44
pH BOT B	7.10	7.90		6.95	7.19	7.73	6.85	7.20	7.45
pH BOT C	7.10	7.50		6.97	7.22	7.44	6.97	7.09	7.10
H BOT D	7.20	7.30		7.41	7.17	7.65	7.00	6.99	7.31
H BOT E	6.90	7.40		7.44	6.97	7.90	7.32	7.13	7.47
pH BOT F	7.40	7.30		7.40	7.39	7.63	7.38	7.31	7.46
pH BOT Y	7.30	7.40			7.35	7.42			6.94
pH BOT Z	7.40	6.90		7.12	7.39	7.46	7.10		7.09
pH AMB FERT				8.37	8.24	8.25	8.16	8.31	8.17
pH AMB UNFERT	8.07	7.99		8.37	8.30	8.25	8.10	8.30	8.22

APPENDIX D1.
Data tables from interstitial water samples

APPENDIX D1, TABLE 1
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000115	SAMP	KN132	T	A	0	SURF	31-MAY-90	10:02	2.86	2.01	0.58	
71NUT000116	SAMP	KN132	T	A	0	BOT	31-MAY-90	10:08	2.30	0.92	0.54	
71NUT000117	SAMP	KN132	T	B	0	SURF	31-MAY-90	08:58	0.79	1.21	0.53	
71NUT000118	SAMP	KN132	T	B	0	BOT	31-MAY-90	09:04	0.69	0.86	0.70	
71NUT000119	SAMP	KN132	T	C	0	SURF	31-MAY-90	09:38	2.23	1.86	0.88	
71NUT000131	DUP	KN132	T	C	0	SURF	31-MAY-90	09:43	2.08	0.65	0.84	
71NUT000120	SAMP	KN132	T	C	0	BOT	31-MAY-90	09:50	2.43	0.60	0.86	
71NUT000122	SAMP	KN132	T	Y	0	BOT	31-MAY-90	09:35	2.15	0.77	0.71	
71NUT000124	SAMP	KN132	T	Z	0	BOT	31-MAY-90	09:15	1.91	1.07	0.74	
71NUT000125	SAMP	KN132	R	D	0	SURF	31-MAY-90	08:15	1.37	1.09	0.14	
71NUT000132	DUP	KN132	R	D	0	BOT	31-MAY-90	08:19	1.65	0.36	0.08	
71NUT000126	SAMP	KN132	R	D	0	BOT	31-MAY-90	08:18	1.70	1.39	0.13	
71NUT000127	SAMP	KN132	R	E	0	SURF	31-MAY-90	08:59	3.33	1.35	0.26	
71NUT000128	SAMP	KN132	R	E	0	BOT	31-MAY-90	09:04	4.12	1.38	0.41	
71NUT000129	SAMP	KN132	R	F	0	SURF	31-MAY-90	09:15	3.07	0.58	0.06	
71NUT000130	SAMP	KN132	R	F	0	BOT	31-MAY-90	09:17	2.87	0.43	0.03	
71NUT000165	SAMP	KN132	T	A	2	SURF	04-JUN-90	02:14	65.50	83.80	0.72	
71NUT000166	SAMP	KN132	T	A	2	BOT	04-JUN-90	02:19	62.80	83.20	0.49	
71NUT000167	SAMP	KN132	T	B	2	SURF	04-JUN-90	01:36	57.20	96.30	1.10	
71NUT000168	SAMP	KN132	T	B	2	BOT	04-JUN-90	01:40	65.70	103.10	0.90	
71NUT000169	SAMP	KN132	T	C	2	SURF	04-JUN-90	01:59	87.30	122.60	0.91	
71NUT000170	SAMP	KN132	T	C	2	BOT	04-JUN-90	02:07	88.70	115.80	0.92	
71NUT000171	SAMP	KN132	T	Y	2	BOT	04-JUN-90	02:29	82.60	90.50	0.61	
71NUT000180	DUP	KN132	T	Y	2	BOT	04-JUN-90	02:30	83.30	91.30	0.54	
71NUT000172	SAMP	KN132	T	Z	2	BOT	04-JUN-90	01:51	119.20	143.40	0.75	
71NUT000173	SAMP	KN132	R	D	2	SURF	04-JUN-90	01:41	5.05	0.59	0.08	
71NUT000179	DUP	KN132	R	D	2	SURF	04-JUN-90	01:42	5.91	0.90	0.11	
71NUT000174	SAMP	KN132	R	D	2	BOT	04-JUN-90	01:45	7.25	0.76	0.12	
71NUT000175	SAMP	KN132	R	E	2	SURF	04-JUN-90	01:54	10.80	8.05	0.22	
71NUT000176	SAMP	KN132	R	E	2	BOT	04-JUN-90	02:00	12.00	9.04	0.28	
71NUT000177	SAMP	KN132	R	F	2	SURF	04-JUN-90	02:06	4.52	1.86	0.11	
71NUT000178	SAMP	KN132	R	F	2	BOT	04-JUN-90	02:12	3.34	1.12	0.08	
71NUT000197	SAMP	KN132	T	A	4	SURF	06-JUN-90	03:45	18.80	15.60	0.43	
71NUT000211	DUP	KN132	T	A	4	SURF	06-JUN-90	03:49	25.90	17.60	0.51	
71NUT000198	SAMP	KN132	T	A	4	BOT	06-JUN-90	03:51	25.90	18.20	0.48	
71NUT000199	SAMP	KN132	T	B	4	SURF	06-JUN-90	03:11	26.80	30.00	0.63	
71NUT000200	SAMP	KN132	T	B	4	BOT	06-JUN-90	03:14	29.70	34.20	1.37	
71NUT000212	DUP	KN132	T	B	4	BOT	06-JUN-90	03:16	29.90	36.10	0.72	
71NUT000201	SAMP	KN132	T	C	4	SURF	06-JUN-90	03:27	51.70	70.30	1.13	
71NUT000202	SAMP	KN132	T	C	4	BOT	06-JUN-90	03:34	63.20	83.30	0.91	
71NUT000203	SAMP	KN132	T	Y	4	BOT	06-JUN-90	04:11	41.70	46.60	0.56	
71NUT000204	SAMP	KN132	T	Z	4	BOT	06-JUN-90	04:00	52.70	93.10	0.53	
71NUT000205	SAMP	KN132	R	D	4	SURF	06-JUN-90	03:09	3.72	0.13	0.11	
71NUT000206	SAMP	KN132	R	D	4	BOT	06-JUN-90	03:16	4.53	1.12	0.19	
71NUT000207	SAMP	KN132	R	E	4	SURF	06-JUN-90	03:25	7.19	0.34	0.19	
71NUT000208	SAMP	KN132	R	E	4	BOT	06-JUN-90	03:28	8.68	1.05	0.24	
71NUT000209	SAMP	KN132	R	F	4	SURF	06-JUN-90	03:40	2.86	0.58	0.06	
71NUT000210	SAMP	KN132	R	F	4	BOT	06-JUN-90	03:47	2.74	0.37	0.05	
71NUT000181	EB	KN132		NA	4	NA	04-JUN-90	05:05	0.28	1.04	0.00	
71NUT000229	SAMP	KN132	T	A	8	SURF	10-JUN-90	05:37	10.90	8.76	0.41	
71NUT000230	SAMP	KN132	T	A	8	BOT	10-JUN-90	05:45	10.80	8.36	0.35	
71NUT000244	DUP	KN132	T	A	8	BOT	10-JUN-90	05:44	8.34	11.40	0.30	

APPENDIX D1, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
71NUT000231	SAMP	KN132	T	B	8	SURF	10-JUN-90	05:17	24.50	16.40	0.69	
71NUT000243	DUP	KN132	T	B	8	SURF	10-JUN-90	05:18	22.90	17.50	0.66	
71NUT000232	SAMP	KN132	T	B	8	BOT	10-JUN-90	05:23	10.50	14.00	0.35	
71NUT000233	SAMP	KN132	T	C	8	SURF	10-JUN-90	05:50	18.40	27.70	0.47	
71NUT000234	SAMP	KN132	T	C	8	BOT	10-JUN-90	05:55	31.80	48.90	0.70	
71NUT000235	SAMP	KN132	T	Y	8	BOT	10-JUN-90	06:14	19.90	18.10	0.45	
71NUT000236	SAMP	KN132	T	Z	8	BOT	10-JUN-90	06:06	20.40	21.00	0.38	
71NUT000237	SAMP	KN132	R	D	8	SURF	10-JUN-90	04:06	1.28	0.63	0.06	
71NUT000238	SAMP	KN132	R	D	8	BOT	10-JUN-90	04:10	1.25	1.13	0.09	
71NUT000239	SAMP	KN132	R	E	8	SURF	10-JUN-90	05:20	2.51	0.60	0.16	
71NUT000240	SAMP	KN132	R	E	8	BOT	10-JUN-90	05:27	3.24	0.12	0.12	
71NUT000241	SAMP	KN132	R	F	8	SURF	10-JUN-90	05:37	2.54	0.55	0.04	
71NUT000242	SAMP	KN132	R	F	8	BOT	10-JUN-90	05:43	1.48	0.30	0.00	
71NUT000261	SAMP	KN132	T	A	16	SURF	18-JUN-90	12:04	10.90	1.34	0.65	
71NUT000262	SAMP	KN132	T	A	16	BOT	18-JUN-90	12:14	4.57	0.34	0.41	
71NUT000263	SAMP	KN132	T	B	16	SURF	18-JUN-90	10:38	29.60	2.18	0.67	
71NUT000276	SAMP	KN132	T	B	16	BOT	18-JUN-90	10:48	15.50	0.84	0.47	
71NUT000264	SAMP	KN132	T	B	16	BOT	18-JUN-90	10:46	19.20	0.94	0.53	
71NUT000265	SAMP	KN132	T	C	16	SURF	18-JUN-90	11:46	8.44	1.33	0.56	
71NUT000275	DUP	KN132	T	C	16	SURF	18-JUN-90	11:48	10.40	1.60	0.68	
71NUT000266	SAMP	KN132	T	C	16	BOT	18-JUN-90	11:56	9.31	1.99	0.59	
71NUT000267	SAMP	KN132	T	Y	16	BOT	18-JUN-90	11:31	4.04	0.68	0.40	
71NUT000268	SAMP	KN132	T	Z	16	BOT	18-JUN-90	11:19	22.60	0.95	0.44	
71NUT000269	SAMP	KN132	R	D	16	SURF	18-JUN-90	10:24	9.96	0.51	0.20	
71NUT000270	SAMP	KN132	R	D	16	BOT	18-JUN-90	10:30	12.80	0.87	0.17	
71NUT000271	SAMP	KN132	R	E	16	SURF	18-JUN-90	10:44	4.88	0.35	0.09	
71NUT000272	SAMP	KN132	R	E	16	BOT	18-JUN-90	10:46	4.93	0.35	0.16	
71NUT000273	SAMP	KN132	R	F	16	SURF	18-JUN-90	10:58	4.97	0.13	0.06	
71NUT000274	SAMP	KN132	R	F	16	BOT	18-JUN-90	11:04	5.11	0.21	0.05	
71NUT000277	EB	KN132		NA	16	NA	18-JUN-90	15:20	0.15	0.11	0.00	
71NUT000313	SAMP	KN132	T	A	29	SURF	30-JUN-90	23:39	21.50	5.74	0.60	
71NUT000314	SAMP	KN132	T	A	29	BOT	30-JUN-90	23:42	22.80	7.02	0.65	
71NUT000315	SAMP	KN132	T	B	29	SURF	30-JUN-90	23:04	26.70	5.28	1.08	
71NUT000316	SAMP	KN132	T	B	29	BOT	30-JUN-90	23:10	30.80	5.40	0.71	
71NUT000317	DUP	KN132	T	B	29	BOT	30-JUN-90	23:44	21.40	5.64	0.65	
71NUT000318	SAMP	KN132	T	C	29	SURF	30-JUN-90	23:51	39.10	5.51	0.85	
71NUT000319	DUP	KN132	T	C	29	SURF	30-JUN-90	23:52	36.90	5.67	0.88	
71NUT000320	SAMP	KN132	T	C	29	BOT	30-JUN-90	23:58	33.90	5.56	0.91	
71NUT000328	SAMP	KN132	T	Y	29	BOT	30-JUN-90	23:28	27.50	6.38	0.39	
71NUT000327	SAMP	KN132	T	Z	29	BOT	30-JUN-90	23:18	60.50	7.15	0.45	
71NUT000321	SAMP	KN132	R	D	29	SURF	30-JUN-90	22:28	5.51	0.27	0.23	
71NUT000322	SAMP	KN132	R	D	29	BOT	30-JUN-90	22:33	4.50	0.17	0.19	
71NUT000323	SAMP	KN132	R	E	29	SURF	30-JUN-90	23:01	14.70	4.87	0.36	
71NUT000324	SAMP	KN132	R	E	29	BOT	30-JUN-90	23:08	16.30	4.36	0.29	
71NUT000325	SAMP	KN132	R	F	29	SURF	30-JUN-90	23:16	4.61	0.31	0.11	
71NUT000326	SAMP	KN132	R	F	29	BOT	30-JUN-90	23:25	4.34	4.84	0.12	
71NUT000329	EB	KN132		NA	29	NA	01-JUL-90		0.00	0.07	0.00	
94NUT000001	SAMP	KN132	T	A	43	BOT	07-15-90	22:47	9.37	22.80	0.14	
94NUT000004	SUP	KN132	T	B	43	BOT	07-15-90	22:09	7.40	12.60	0.13	
94NUT000002	SAMP	KN132	T	B	43	BOT	07-15-90	22:09	9.86	13.30	0.14	
94NUT000003	SAMP	KN132	T	C	43	BOT	07-15-90	22:40	15.20	117.30	0.22	

APPENDIX DI, TABLE 1 (continued)
FERTILIZER NUTRIENTS IN INTERSTITIAL WATER

SAMPLE FIELD ID	SAMPLE TYPE	BEACH	TREATED OR REFERENCE	STATION	TIME SERIES (DAYS)	DEPTH	DATE COLLECTED	TIME	NO3+NO2 (uM)	NH4 (uM)	PO4 (uM)	NO2 (uM)
94NUT000008	SAMP	KN132	T	Y	43	BOT	07-15-90	22:32	13.70	62.70	0.17	
94NUT000009	SAMP	KN132	T	Z	43	BOT	07-15-90	22:20	24.60	44.40	0.16	
94NUT000005	SAMP	KN132	R	D	43	BOT	07-15-90	21:52	0.69	0.06	0.01	
94NUT000006	SAMP	KN132	R	E	43	BOT	07-15-90	22:12	1.58	0.58	0.07	
94NUT000007	SAMP	KN132	R	F	60	BOT	07-15-90	21:24	1.06	0.47	0.00	
94NUT000062	SAMP	KN132	T	A	60	BOT	08-01-90	00:30	33.20	0.25	0.65	
94NUT000063	SAMP	KN132	T	B	60	BOT	08-01-90	00:00	17.00	0.25	0.82	
94NUT000070	DUP	KN132	T	B	60	BOT	08-01-90	00:00	17.40	0.32	0.80	
94NUT000064	SAMP	KN132	T	C	60	BOT	08-01-90	00:45	34.70	0.25	0.58	
94NUT000065	SAMP	KN132	T	Y	60	BOT	08-01-90	00:15	21.80	0.28	0.20	
94NUT000066	SAMP	KN132	T	Z	60	BOT	08-01-90	00:05	53.00	0.30	0.45	
94NUT000067	SAMP	KN132	R	D	60	BOT	07-31-90	23:29	2.32	0.88	0.09	
94NUT000068	SAMP	KN132	R	E	60	BOT	07-31-90	23:50	8.36	0.53	0.08	
94NUT000069	SAMP	KN132	R	F	60	BOT	08-01-90	00:01	1.82	0.86	0.01	
94NUT000071	SAMP	KN132	R	STR	60	SURF	08-01-90	00:15	1.57	3.57	0.30	
71NUT000005	SAMP	KN135	T	A	0	SURF	19-MAY-90	14:11	2.71	1.18	0.75	0.02
71NUT000022	SAMP	KN135	T	A	0	SURF	20-MAY-90	13:54	2.25	1.41	0.62	0.07
71NUT000024	DUP	KN135	T	A	0	SURF	20-MAY-90	13:55	1.95	0.19	0.47	0
71NUT000023	SAMP	KN135	T	A	0	BOT	20-MAY-90	14:07	2.19	1.11	0.54	0.01
71NUT000025	DUP	KN135	T	A	0	BOT	20-MAY-90	14:08	1.58	0.27	0.34	0
71NUT000006	SAMP	KN135	T	A	0	BOT	19-MAY-90	14:13	2.78	1.00	0.58	0.03
71NUT000026	SAMP	KN135	T	B	0	SURF	20-MAY-90	13:19	2.26	0.15	0.05	0
71NUT000027	SAMP	KN135	T	B	0	BOT	20-MAY-90	13:28	2.95	1.22	0.11	0.04
71NUT000007	SAMP	KN135	T	B	0	BOT	19-MAY-90	14:49	3.95	0.81	0.29	0.02
71NUT000008	DUP	KN135	T	B	0	BOT	19-MAY-90	14:50	3.25	0.63	0.03	0.02
71NUT000028	SAMP	KN135	T	C	0	SURF	20-MAY-90	14:35	2.22	0.53	0.12	0
71NUT000010	SAMP	KN135	T	C	0	BOT	19-MAY-90	14:57	3.00	0.83	0.22	0
71NUT000029	SAMP	KN135	T	C	0	BOT	20-MAY-90	14:41	2.05	0.19	0.09	0
71NUT000036	SAMP	KN135	T	Z	0	SURF	20-MAY-90		3.57	1.22	0.23	0.81
71NUT000021	SAMP	KN135	T	Z	0	BOT	19-MAY-90	15:19	3.72	0.73	0.35	0.02
71NUT000037	SAMP	KN135	T	Z	0	BOT	20-MAY-90	14:25	3.21	1.50	0.38	0.28
71NUT000030	SAMP	KN135	R	D	0	SURF	20-MAY-90	13:47	0.97	0.89	0.33	0.03
71NUT000031	SAMP	KN135	R	D	0	BOT	20-MAY-90	13:53	1.30	1.08	0.41	0
71NUT000032	SAMP	KN135	R	E	0	SURF	20-MAY-90	14:26	1.31	0.20	0.40	0.01
71NUT000033	SAMP	KN135	R	E	0	BOT	20-MAY-90	14:35	1.47	0.72	0.44	0.04
71NUT000034	SAMP	KN135	R	F	0	SURF	20-MAY-90	14:06	2.11	0.41	0.44	0
71NUT000035	SAMP	KN135	R	F	0	BOT	20-MAY-90	14:11	2.54	2.28	0.56	0.12
71NUT000038	EB	KN135	R	NA	0	NA	22-MAY-90	10:06	0.00	0.44	0.00	0
71NUT000049	SAMP	KN135	T	A	2	SURF	23-MAY-90	16:24	133.30	153.40	1.03	0.04
71NUT000050	SAMP	KN135	T	A	2	BOT	23-MAY-90	16:28	153.90	168.40	1.14	0
71NUT000051	SAMP	KN135	T	B	2	SURF	23-MAY-90	16:00	136.20	139.80	0.38	0.12
71NUT000056	DUP	KN135	T	B	2	SURF	23-MAY-90	16:09	216.50	190.90	0.52	0.28
71NUT000052	SAMP	KN135	T	B	2	BOT	23-MAY-90	16:06	132.40	129.00	0.40	0.08
71NUT000057	DUP	KN135	T	B	2	BOT	23-MAY-90	16:11	184.30	162.90	0.37	0.08
71NUT000053	SAMP	KN135	T	C	2	SURF	23-MAY-90	16:56	93.90	118.70	0.21	0.03
71NUT000054	SAMP	KN135	T	C	2	BOT	23-MAY-90	16:58	144.90	162.50	0.27	0.07
71NUT000058	SAMP	KN135	T	Z	2	SURF	23-MAY-90	16:40	123.10	117.70	0.42	0.04
71NUT000059	SAMP	KN135	T	Z	2	BOT	23-MAY-90	16:46	133.10	121.30	0.35	0.04
71NUT000055	SAMP	KN135	R	D	2	SURF	23-MAY-90	16:44	0.47	0.98	0.46	0.01
71NUT000060	SAMP	KN135	R	D	2	BOT	23-MAY-90	16:50	0.91	1.15	0.38	0
71NUT000061	SAMP	KN135	R	E	2	SURF	23-MAY-90	16:59	1.40	2.17	0.44	0

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APPENDIX D2.

Data Tables from Microbial Analyses

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APPENDIX D2.

TABLE 1. Percentage mineralization of hexadecane

%HEXADECANE MINERALIZED FERTILIZED BEACHES
AVERAGE ALL SURFACE AND SUBSURFACE SEDIMENTS

	DAY	SURFACE Avg. %CO2	St.Dev.	SUBSURFACE Avg. %CO2	St.Dev.
KN-135B	0	7.0	3.8	5.0	3.2
	2	16.4	6.3	12.6	5.7
	4	12.1	6.5	15.4	5.2
	8	16.3	10.5	13.0	5.1
	15	14.2	7.3	5.7	2.8
	32	9.5	5.9	9.6	5.2
	52	12.5	4.7	9.6	5.8
	56	15.9	10.2	17.0	10.5
	70	19.5	8.8	8.4	6.2
	78	8.9	6.0	6.5	4.5
KN-211E	0	3.4	2.4	4.7	1.3
	2	8.5	5.1	7.4	4.1
	4	6.7	3.6	7.9	3.1
	16	9.0	5.7	8.5	5.8
	31	11.1	8.5	5.4	3.2
	45	11.2	5.8	5.9	4.1
	102	16.0	7.8	13.2	8.9
	112	13.1	6.3	6.8	9.6
KN-132B	0	3.3	1.1		
	2	12.9	8.0		
	4	4.8	2.3		
	8	8.7	6.8		
	16	11.2	8.8		
	29	15.5	7.7		
	43	8.8	8.2		
	60	4.0	3.4		

APPENDIX D2.

TABLE 1. Percentage mineralization of hexadecane

%HEXADECANE MINERALIZED UNFERTILIZED BEACHES
AVERAGE ALL SURFACE AND SUBSURFACE SEDIMENTS

	DAY	SURFACE Avg. %CO2	St.Dev.	SUBSURFACE Avg. %CO2	St.Dev.
KN-135B	0	5.8	2.3	4.0	2.0
	2	8.6	2.8	10.4	3.9
	4	9.7	4.7	5.1	3.0
	8	7.4	2.1	4.9	3.2
	15	4.4	0.8	2.1	2.3
	32	2.1	1.2	1.1	0.5
	52	3.0	2.2	1.2	0.7
	56	3.8	2.6	2.7	2.0
	70	1.3	0.8	0.4	0.3
	78	2.6	2.7	2.2	2.8
KN-211E	0	5.6	3.2	5.1	3.2
	2	12.6	4.2	3.5	1.4
	4	5.8	2.7	3.8	1.9
	16	5.9	4.6	2.1	2.0
	31	8.4	3.9	1.7	0.7
	45	2.5	1.8	1.1	1.3
	102	5.9	5.3	1.2	0.6
	112	4.6	3.7	1.5	1.1
KN-132B	0	2.7	1.6		
	2	6.4	2.5		
	4	2.4	2.1		
	8	2.4	1.1		
	16	2.9	1.4		
	29	4.7	2.4		
	43	1.3	1.2		
	60	1.5	0.9		

APPENDIX D2.

TABLE 2. Percentage mineralization of phenanthrene

%PHENANTHRENE MINERALIZED FERTILIZED BEACHES
AVERAGE ALL SURFACE AND SUBSURFACE SEDIMENTS

	DAY	SURFACE Avg. %CO2	SURFACE St.Dev.	SUBSURFACE Avg. %CO2	SUBSURFACE St.Dev.
KN-135B	0	0.9	0.6	1.6	1.5
	2	9.6	10.5	17.1	7.3
	4	13.5	13.0	18.5	13.2
	8	6.4	6.3	9.6	7.5
	15	18.3	11.0	5.8	7.1
	32	16.7	10.1	14.2	9.2
	52	4.8	4.4	2.1	1.1
	56	4.5	4.3	3.7	3.3
	70	1.8	1.6	1.4	1.1
	78	3.4	3.8	2.0	1.1
KN-211E	0	6.7	6.3	11.5	6.3
	2	3.4	4.7	7.1	4.2
	4	2.2	1.6	6.3	4.5
	16	7.5	7.6	6.2	4.3
	31	5.6	4.9	6.1	3.9
	45	7.2	5.0	3.4	2.1
	102	17.9	9.7	12.9	4.1
	112	9.8	5.3	6.3	4.7
KN-132B	0	2.3	0.9		
	2	3.2	2.8		
	4	2.5	1.5		
	8	6.4	5.7		
	16	9.5	5.8		
	29	3.6	2.9		
	43	1.4	1.2		
	60	1.3	1.5		

APPENDIX D2.

TABLE 2. Percentage mineralization of phenanthrene

%PHENANTHRENE MINERALIZED UNFERTILIZED BEACHES
AVERAGE ALL SURFACE AND SUBSURFACE SEDIMENTS

	DAY	SURFACE Avg. %CO2	St.Dev.	SUBSURFACE Avg. %CO2	St.Dev.
KN-135B	0	2.1	2.4	2.6	2.7
	2	10.4	8.0	17.3	9.5
	4	14.0	7.6	10.5	5.9
	8	6.8	4.8	5.7	4.7
	15	7.4	4.9	3.1	2.4
	32	5.1	1.9	2.7	1.9
	52	0.8	0.4	0.5	0.5
	56	1.2	0.8	0.8	1.0
	70	0.5	0.3	0.4	0.2
	78	2.1	1.9	1.3	1.4
KN-211E	0	10.3	7.1	16.5	5.7
	2	6.5	3.2	10.2	3.8
	4	2.7	2.3	4.6	2.6
	16	5.3	4.0	4.6	2.8
	31	2.9	1.3	7.0	2.1
	45	0.6	0.5	1.0	0.8
	102	6.6	5.3	5.9	1.7
	112	4.0	3.3	4.3	1.9
KN-132B	0	2.4	1.6		
	2	2.0	1.4		
	4	1.1	1.1		
	8	1.5	0.9		
	16	2.2	1.6		
	29	1.7	0.8		
	43	0.7	0.6		
	60	0.7	0.8		

APPENDIX D2.

TABLE 3. Mineralization Ratios

HEXADECANE MINERALIZATION RATIO

FERTILIZED/UNFERTILIZED
AVERAGE ALL SEDIMENTS

	DAY	SURFACE	SUBSURFACE
KN-135B	0	1.2	1.3
	2	1.9	1.2
	4	1.2	3.0
	8	2.2	2.6
	15	3.2	2.7
	32	4.5	8.6
	52	4.2	7.7
	56	4.2	6.4
	70	14.9	19.9
	78	3.4	3.0
KN-211E	0	0.6	0.9
	2	0.7	2.1
	4	1.2	2.1
	16	1.5	4.0
	31	1.3	3.2
	45	4.5	5.6
	102	2.7	11.5
	112	2.8	4.4
KN-132B	0	1.2	
	2	2.0	
	4	2.0	
	8	3.7	
	16	3.9	
	29	3.3	
	43	6.9	
	60	2.6	

APPENDIX D2.

TABLE 3. Mineralization Ratios

PHENANTHRENE MINERALIZATION RATIO

FERTILIZED/UNFERTILIZED
AVERAGE ALL SEDIMENTS

	DAY	SURFACE	SUBSURFACE
KN-135B	0	0.4	0.6
	2	0.9	1.0
	4	1.0	1.8
	8	0.9	1.7
	15	2.5	1.9
	32	3.3	5.3
	52	6.1	4.5
	56	3.9	4.8
	70	3.8	3.3
	78	1.6	1.5
KN-211E	0	0.7	0.7
	2	0.5	0.7
	4	0.8	1.4
	16	1.4	1.3
	31	2.0	0.9
	45	11.6	3.4
	102	2.7	2.2
	112	2.4	1.5
KN-132B	0	0.9	
	2	1.6	
	4	2.2	
	8	4.4	
	16	4.3	
	29	2.1	
	43	2.0	
	60	1.9	

APPENDIX D2.

TABLE 4. Mineralization Frequency Distribution

KN132 HEXADECANE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT FRACTION GT 5%	UNFERT FRACTION GT 5%	FERT FRACTION GT 10%	UNFERT FRACTION GT 10%
0	0.06	0.11	0	0
2	0.72	0.67	0.70	0.11
4	0.44	0.22	0.00	0.00
8	0.61	0.00	0.44	0.00
16	0.78	0.06	0.67	0.00
29	0.67	0.44	0.44	0.00
43	0.50	0.00	0.38	0.00
60	0.25	0.00	0.17	0.00
DAY 2-60	0.58	0.21	0.40	0.02

KN132 PHENANTHRENE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT GT2%	UNFERT GT2%	FERT GT5%	UNFERT GT5%
0	0.69	0.67	0.00	0.11
2	0.50	0.36	0.28	0.00
4	0.64	0.14	0.07	0.00
8	0.75	0.39	0.42	0.00
16	1.00	0.50	0.78	0.06
29	0.56	0.33	0.33	0.00
43	0.25	0.06	0.00	0.00
60	0.25	0.08	0.00	0.00
DAY 2-60	0.57	0.28	0.29	0.01

KN132 PHENANTHRENE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT GT10%	UNFERT GT10%
0	0.00	0.00
2	0.00	0.00
4	0.00	0.00
8	0.25	0.00
16	0.33	0.00
29	0.00	0.00
43	0.00	0.00
60	0.00	0.00
DAY 2-60	0.08	0.00

KN135 HEXADECANE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 5%	UNFERT/SURF FRACTION GT 5%	FERT/SUB FRACTION GT 5%	UNFERT/SUB FRACTION GT 5%
0	0.70	0.58	0.50	0.33
2	1.00	0.94	0.94	0.94
4	0.83	0.94	1.00	0.56
8	0.94	0.89	1.00	0.44
15	1.00	0.22	0.44	0.13
32	0.88	0.00	0.75	0.00
52	0.93	0.25	0.71	0.00
56	0.94	0.19	1.00	0.11
70	0.89	0.00	0.50	0.00
78	0.56	0.29	0.50	0.13
DAY 2-78	0.92	0.42	0.75	0.26

DAY	FERT/SURF FRACTION GT 10%	UNFERT/SURF FRACTION GT 10%	FERT/SUB FRACTION GT 10%	UNFERT/SUB FRACTION GT 10%
0	0.20	0.00	0.10	0.00
2	1.00	0.33	0.61	0.56
4	0.56	0.44	0.86	0.06
8	0.67	0.11	0.72	0.06
15	0.56	0.00	0.11	0.00
32	0.25	0.00	0.50	0.00
52	0.71	0.00	0.50	0.00
56	0.61	0.06	0.71	0.00
70	0.83	0.00	0.39	0.00
78	0.44	0.00	0.38	0.00
DAY 2-78	0.65	0.11	0.52	0.08

KN135 HEXADECANE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 15%	UNFERT/SURF FRACTION GT 15%	FERT/SUB FRACTION GT 15%	UNFERT/SUB FRACTION GT 15%
0	0.00	0.00	0.00	0.00
2	0.50	0.00	0.39	0.17
4	0.33	0.13	0.71	0.00
8	0.39	0.00	0.33	0.00
15	0.50	0.00	0.00	0.00
32	0.19	0.00	0.13	0.00
52	0.21	0.00	0.14	0.00
56	0.50	0.00	0.43	0.00
70	0.83	0.00	0.11	0.00
78	0.22	0.00	0.06	0.00
DAY 2-78	0.43	0.01	0.25	0.02

KN135 PHENANTHRENE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 2%	UNFERT/SURF FRACTION GT 2%	FERT/SUB FRACTION GT 2%	UNFERT/SUB FRACTION GT 2%
0	0.00	0.33	0.14	0.39
2	0.81	1.00	1.00	0.94
4	0.94	1.00	1.00	0.88
8	0.78	0.83	1.00	0.79
15	0.89	0.94	0.69	0.56
32	1.00	0.94	0.94	0.56
52	0.72	0.00	0.50	0.00
56	0.56	0.06	0.71	0.11
70	0.39	0.00	0.19	0.00
78	0.56	0.39	0.44	0.13
DAY 2-78	0.73	0.57	0.74	0.46

DAY	FERT/SURF FRACTION GT 5%	UNFERT/SURF FRACTION GT 5%	FERT/SUB FRACTION GT 5%	UNFERT/SUB FRACTION GT 5%
0	0.00	0.08	0.07	0.22
2	0.44	0.57	0.89	0.94
4	0.56	0.88	0.89	0.81
8	0.33	0.56	0.67	0.43
15	0.89	0.50	0.31	0.28
32	0.94	0.44	0.78	0.11
52	0.22	0.00	0.00	0.00
56	0.44	0.00	0.21	0.00
70	0.06	0.00	0.00	0.00
78	0.22	0.06	0.00	0.06
DAY 2-78	0.45	0.33	0.45	0.31

KN135 PHENANTHRENE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 10%	UNFERT/SURF FRACTION GT 10%	FERT/SUB FRACTION GT 10%	UNFERT/SUB FRACTION GT 10%
0	0.00	0.00	0.00	0.00
2	0.31	0.50	0.89	0.72
4	0.44	0.69	0.61	0.50
8	0.28	0.22	0.33	0.21
15	0.72	0.38	0.13	0.00
32	0.81	0.00	0.56	0.00
52	0.11	0.00	0.00	0.00
56	0.13	0.00	0.07	0.00
70	0.00	0.00	0.00	0.00
78	0.06	0.00	0.00	0.00
DAY 2-78	0.31	0.19	0.32	0.17

KN211 HEXADECANE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 5%	UNFERT/SURF FRACTION GT 5%	FERT/SUB FRACTION GT 5%	UNFERT/SUB FRACTION GT 5%
0	0.19	0.50	0.50	0.50
2	0.61	0.89	0.69	0.11
4	0.56	0.56	0.94	0.33
16	0.72	0.44	0.69	0.11
31	0.61	0.89	0.44	0.00
45	0.88	0.13	0.63	0.00
102	1.00	0.35	0.75	0.00
112	0.89	0.25	0.28	0.00
DAY 2-112	0.74	0.53	0.63	0.08

DAY	FERT/SURF FRACTION GT 10%	UNFERT/SURF FRACTION GT 10%	FERT/SUB FRACTION GT 10%	UNFERT/SUB FRACTION GT 10%
0	0.00	0.17	0.00	0.11
2	0.39	0.78	0.19	0.00
4	0.22	0.06	0.17	0.00
16	0.33	0.19	0.31	0.00
31	0.39	0.28	0.11	0.00
45	0.56	0.00	0.13	0.00
102	0.86	0.15	0.63	0.00
112	0.67	0.13	0.11	0.00
DAY 2-112	0.48	0.24	0.23	0.00

KN211 HEXADECANE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 15%	UNFERT/SURF FRACTION GT 15%	FERT/SUB FRACTION GT 15%	UNFERT/SUB FRACTION GT 15%
0	0.00	0.00	0.00	0.00
2	0.17	0.28	0.06	0.00
4	0.00	0.00	0.06	0.00
16	0.11	0.06	0.25	0.00
31	0.33	0.06	0.00	0.00
45	0.19	0.00	0.06	0.00
102	0.29	0.05	0.31	0.00
112	0.39	0.00	0.11	0.00
DAY 2-112	0.21	0.07	0.12	0.00

KN211 PHENANTHRENE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 2%	UNFERT/SURF FRACTION GT 2%	FERT/SUB FRACTION GT 2%	UNFERT/SUB FRACTION GT 2%
0	0.78	1.00	0.89	1.00
2	0.33	1.00	1.00	1.00
4	0.39	0.44	0.83	0.89
16	0.83	0.89	0.75	0.78
31	0.78	0.67	0.89	1.00
45	0.81	0.00	0.78	0.14
102	1.00	0.89	1.00	1.00
112	1.00	0.69	0.94	0.89
DAY 2-112	0.73	0.65	0.89	0.84

DAY	FERT/SURF FRACTION GT 5%	UNFERT/SURF FRACTION GT 5%	FERT/SUB FRACTION GT 5%	UNFERT/SUB FRACTION GT 5%
0	0.44	0.72	0.83	0.89
2	0.22	0.61	0.69	0.94
4	0.11	0.22	0.56	0.39
16	0.50	0.44	0.63	0.44
31	0.50	0.11	0.61	0.83
45	0.63	0.00	0.11	0.00
102	1.00	0.56	1.00	0.78
112	0.72	0.31	0.39	0.28
DAY 2-112	0.52	0.32	0.57	0.54

KN211 PHENANTHRENE MINERALIZATION FREQUENCY DISTRIBUTION

DAY	FERT/SURF FRACTION GT 10%	UNFERT/SURF FRACTION GT 10%	FERT/SUB FRACTION GT 10%	UNFERT/SUB FRACTION GT 10%
0	0.22	0.44	0.61	0.89
2	0.22	0.17	0.19	0.50
4	0.00	0.00	0.11	0.06
16	0.22	0.11	0.19	0.00
31	0.11	0.00	0.22	0.06
45	0.31	0.00	0.00	0.00
102	0.75	0.17	0.67	0.00
112	0.39	0.13	0.17	0.00
DAY 2-112	0.28	0.08	0.22	0.09

APPENDIX D2.

TABLE 5. Median MPN Values

MPN DATA SUMMARY
MEDIAN MPN VALUES

FERTILIZED/SURFACE

	DAY	OIL DEGRADERS	LOG OIL	HETEROTROPHS	LOG HET
KN135B	0	2.62E+04	4.42	1.58E+06	6.20
	2	4.79E+04	4.68	2.39E+06	6.38
	4	1.55E+05	5.19	2.75E+07	7.44
	8	1.56E+04	4.19	2.40E+07	7.38
	15	1.56E+05	5.19	9.86E+06	6.99
	52	1.37E+05	5.14	5.24E+06	6.72
	56	1.39E+06	6.14	2.51E+08	8.40
	70	1.49E+06	6.17	1.36E+07	7.13
	78	1.85E+06	6.27	3.11E+07	7.49
KN211E	0	9.58E+03	3.98	1.56E+06	6.19
	2	7.70E+05	5.89	2.41E+06	6.38
	4	9.55E+04	4.98	4.44E+06	6.65
	16	4.54E+05	5.66	5.97E+06	6.78
	31	2.39E+05	5.38	2.39E+05	5.38
	45	3.08E+05	5.49	2.29E+06	6.36
	102	1.81E+05	5.26		
	112	3.19E+04	4.50		
KN132B	0	2.49E+05	5.40	4.46E+06	6.65
	2	1.55E+06	6.19	9.64E+06	6.98
	4	7.77E+05	5.89	2.44E+07	7.39
	8	1.60E+06	6.20	4.59E+07	7.66
	16	9.73E+05	5.99	4.73E+06	6.67
	29	2.80E+05	5.45	4.61E+06	6.66
	43	1.35E+06	6.13	2.77E+07	7.44
	60	8.41E+05	5.92	1.77E+07	7.25
	95	1.17E+06	6.07		

MPN DATA SUMMARY
MEDIAN MPN VALUES

UNFERTILIZED/SURFACE

	DAY	OIL DEGRADERS	LOG OIL	HETEROTROPHS	LOG HET
KN135B	0	4.24E+04	4.63	3.30E+06	6.52
	2	1.58E+04	4.20	4.53E+06	6.66
	4	4.20E+04	4.62	4.59E+07	7.66
	8	1.56E+05	5.19	9.85E+06	6.99
	15	9.75E+04	4.99	4.61E+06	6.66
	52	2.34E+05	5.37	5.15E+06	6.71
	56	1.79E+05	5.25	8.43E+06	6.93
	70	2.52E+05	5.40	9.99E+06	7.00
	78	1.22E+06	6.09		
KN211E	0	4.63E+04	4.67	4.56E+06	6.66
	2	1.27E+06	6.10	4.61E+06	6.66
	4	4.80E+05	5.68	8.37E+06	6.92
	16	4.44E+05	5.65	9.61E+06	6.98
	31	9.88E+05	5.99	2.44E+05	5.39
	45	5.32E+05	5.73	1.72E+07	7.24
	102	8.51E+04	4.93		
	112	1.17E+05	5.07		
KN132B	0	2.30E+05	5.36	2.40E+06	6.38
	2	2.17E+05	5.34	4.47E+06	6.65
	4	1.60E+05	5.20	9.91E+06	7.00
	8	3.71E+05	5.57	4.56E+06	6.66
	16	1.57E+05	5.20	4.12E+05	5.61
	29	1.60E+05	5.20	7.75E+06	6.89
	43	5.94E+03	3.77	5.82E+06	6.76
	60	1.78E+04	4.25	2.97E+06	6.47
	95	5.32E+05	5.73		

MPN DATA SUMMARY
MEDIAN MPN VALUES

FERTILIZED/SUBSURFACE

	DAY	OIL DEGRADERS	LOG OIL	HETEROTROPHS	LOG HET
KN135B	0	1.66E+04	4.22	2.22E+05	5.35
	2	1.02E+04	4.01	2.47E+06	6.39
	4	1.03E+05	5.01	2.49E+06	6.40
	8	1.01E+05	5.00	2.51E+07	7.40
	15	1.62E+05	5.21	1.17E+06	6.07
	52	7.54E+05	5.88	4.40E+06	6.64
	56	5.82E+06	6.76	6.52E+07	7.81
	70	1.26E+06	6.10	1.28E+07	7.11
	78	1.70E+06	6.23	8.99E+06	6.95
KN211E	0	4.60E+04	4.66	2.46E+06	6.39
	2	1.93E+06	6.29	4.62E+06	6.66
	4	8.19E+05	5.91	7.89E+06	6.90
	16	4.62E+05	5.66	4.61E+06	6.66
	31	9.98E+05	6.00	2.23E+05	5.35
	45	3.32E+05	5.52	2.74E+06	6.44
	102	3.72E+04	4.57		
	112	8.51E+04	4.93		

MPN DATA SUMMARY
MEDIAN MPN VALUES

UNFERTILIZED/SUBSURFACE

	DAY	OIL DEGRADERS	LOG OIL	HETEROTROPHS	LOG HET
KN135B	0	1.63E+04	4.21	4.63E+05	5.67
	2	4.70E+03	3.67	4.74E+05	5.68
	4	9.97E+03	4.00	4.70E+06	6.67
	8	2.27E+04	4.36	2.51E+06	6.40
	15	2.34E+04	4.37	2.50E+05	5.40
	52	3.60E+05	5.56	2.54E+06	6.40
	56	9.78E+04	4.99	2.50E+06	6.40
	70	1.30E+05	5.11	1.43E+06	6.16
	78	1.17E+06	6.07	1.63E+06	6.21
KN211E	0	1.63E+04	4.21	4.64E+06	6.67
	2	2.23E+04	4.35	9.87E+06	6.99
	4	8.03E+05	5.90	4.60E+06	6.66
	16	9.75E+05	5.99	2.44E+06	6.39
	31	2.50E+05	5.40	9.99E+04	5.00
	45	2.53E+05	5.40	2.41E+06	6.38
	102	9.57E+03	3.98		
	112	1.28E+04	4.11		

APPENDIX D2.

TABLE 6. Biomineralization Data

BIOMINERALIZATION DATA

KN135
Site #1
Time 0
Day 0
05/19/90

Hex spike=64,000DPM
Phen spike=60,000DPM

BEACH SEGMENT	Hex. DPM Rep #1	Hex. DPM Rep #2	Hex. DPM Rep #3	Phen. DPM Rep #1	Phen. DPM Rep #2	Phen. DPM Rep #3
AU1	1824	3823				
AU2	5291	1853				
AU3	4110			2652		446
BU1	4128			343	107	
BU2	4543	3407		1196	411	
BU3	621		160	1236	469	116
CU1		2618		126	498	
CU2	3602	4886		830	689	
CU3	8813	8176	411	487	754	110
DU1				464	697	
DU2	1991	2497			1498	
DU3	3162	496	155	866	162	76
EU1	4173	340		588	364	
EU2	6203	5516		632	660	
EU3	1982	2509	267	149	669	310
FU1	4444	2940		2052	1068	
FU2	4770	4802		3018	4931	
FU3	4952	4093	199	1242	1429	433
AL1	2286			721	1189	
AL2	3463	6136		971	1257	
AL3	1046	3077	263	423	498	
BL1	1198	236		190	126	
BL2	5347	5001		624	514	
BL3	3954	3263	130	1002	1223	76
CL1	3872	506		330	717	
CL2	670	4474		2307	3285	
CL3	1623	420	108	149	198	248
DL1	3169	4073		314	349	
DL2	1747	2701		568	384	
DL3	3783	127	397	752	210	465
EL1	3630	4342		1530	912	
EL2		1371		3375	4994	
EL3	2599	2997	1676	1488	2313	88
FL1	1233	3484		1293	1242	
FL2	778	1199		616	650	
FL3	154	2824		3382	4519	131

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BEACH
SEGMENT

KN135
Site #1
Time 1
Day 2
05/23/90

Hex spike=64,000 DPM
Phen spike=60,000 DPM

AU1	7128	8635		3390	2842	
AU2	10458	10825		1917	2024	
AU3	13107	11682	104	18772	17718	468
BU1	16214	21556		2299	2742	
BU2	7238	7787		6928	4720	
BU3	6992	11363	121	11227	11983	195
CU1	7984	6828		1522	1216	
CU2	13426	11528		899	830	
CU3	7053	6819	121	103	845	456
DU1	5317	4890		1646	3104	
DU2	4686	4774		2738	7077	
DU3	7494	6642	677	14475	8452	751
EU1	4418	3614		2948	1816	
EU2	2292	3440		15819	2209	
EU3	5209	5401	131	8583	212	218
FU1	4779	7546		1999	2374	
FU2	9057	5792		6439	15284	
FU3	7519	6757	547	7377	9389	111
AL1	10101	8077		12097	15038	
AL2	1385	4637		2222	2525	
AL3	12245	10687	12338	6342	7503	1441
BL1	12961	11036		15430	14178	
BL2	11063	6074		14605	10828	
BL3	8593	8775	4852	9615	7906	100
CL1	3493	3452		6980	7722	
CL2	5301	5456		13233	11524	
CL3	8526	10117	400	9150	8158	8756
DL1	6549	5611		5039	3582	
DL2	6394	5818		1211	4358	
DL3	7319	6107	6665	5757	5666	750
EL1	6496	6964		14611	14751	
EL2	3354	3165		6639	5831	
EL3	7885	11609	9524	16581	15916	2312
FL1	9433	6791		11446	11555	
FL2	9817	3763		15899	17544	
FL3	4351	4777	6817	9083	9632	99

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BEACH
SEGMENT

KN135 Site #1 Time 2 Day 4 05/25/90	AU1	9854	11140		24703	22284	
	AU2	15503	15288		11935	11752	
	AU3	9001	10004	948	13346	12934	265
	BU1	8171	8965		8732	4056	
	BU2	5921	7964		2687	4295	
	BU3	9729	4592	522	1654	1810	158
Hex spike=64,000 DPM	CU1	2169	1773		189	190	
Phen spike=60,000 DPM	CU2	5513	4191		1335	1598	
	CU3	3160	5903	4581	2104	2127	86
	DU1	9221	9115		5414	5968	
	DU2	4908	4181		1842	2029	
	DU3	97	514	325	7683	231	79
	EU1	3975	5132		5497	6145	
	EU2	6576	8714		6413	5674	
	EU3	3524	3495	895	7157	6898	117
	FU1	2263	3826		9608	10202	
	FU2	10865	10327		13850	12311	
	FU3	4800	8674	161	15292	15919	108
	AL1	11227	10312		7818	8666	
	AL2	12254	11468		8521	8090	
	AL3	11443	10457	527	18446	19257	103
	BL1	7229	9043		16759	15462	
	BL2	9242	10050		3042	2648	
	BL3	12128	218	115	13020	5149	88
	CL1	4048	4631		3291	3739	
	CL2	10823	8731		20977	24216	
	CL3		7197	254	2212	4205	115
	DL1	539	1264		1099	378	
	DL2	1515	2169		7467	7721	
	DL3	6231	4915	828	22159	1525	81
	EL1	2977	4171		9904	10899	
	EL2	3705	3507		6547	6270	
	EL3	4260	2963	90	1573	4878	96
	FL1	4609	5498		4267	4498	
	FL2	1262	1078		5456	5090	
	FL3	3939	5703	134	9036	10394	256

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	BEACH SEGMENT						
KN135	AU1	5412	8162		821	1025	

Site #1	AU2	12771	20665		6009	6826	
Time 3	AU3	5801	6577	208	2730	2072	302
Day 8	BU1	18331	17505		13589	7067	
05/29/90	BU2	5275	5930		1943	2751	
	BU3	11285	14409	273	8254	8503	140
Hex spike=55,000 DPM	CU1	3478	3907		1631	1913	
Phen spike=60,000 DPM	CU2	2977	4068		1078	991	
	CU3	5696	8496	94	1390	1545	128
	DU1	3302	3457		1317	1736	
	DU2	2741	3926		994	1035	
	DU3	2938	3264	195	1535	1878	141
	EU1	4177	5163		4933	4813	
	EU2	3902	4177		4561	5102	
	EU3	3355	4062	654	1771	1949	91
	FU1	5196	4711		5050	6071	
	FU2	7016	5272		9291	9792	
	FU3	5579	3949	120	5673	6128	92
	AL1	7781	6608		1921	2913	
	AL2	7383	6000		4365	2269	
	AL3	8833	9613	182	15174	14478	105
	BL1	13128	10428		2093	2671	
	BL2	8459	8215		10531	5232	
	BL3	7593	5093	120	3813	2383	102
	CL1	4262	3347		3094	3235	
	CL2	3388	3693		3023	6283	
	CL3	5992	5653	172	8443	8171	204
	DL1	4918	2358		1932	1485	
	DL2	2086	1339		18080	2292	
	DL3	2561	2147	95	1336	701	73
	EL1	2644	3262		3689	1588	
	EL2	3833	6312		2933	16184	
	EL3	1829	1158	110	5333	1495	81
	FL1	2949	3252		5510	6032	
	FL2	4894	4676		7562	7718	
	FL3	555	419	93	1200	1299	103

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	BEACH SEGMENT						
KN135	AU1	5063	3248		11746	11723	
Site #1	AU2	12108	13456		24028	21861	

Time 4	AU3	10958	13677	277	11608	13088	852
Day 15	BU1	10570	9083		18259	11704	
06/05/90	BU2	3998	3247		1039	988	
	BU3	3868	4656	145	5795	7478	146
Hex spike=55,000 DPM	CU1	4683	4570		4933	3853	
Phen spike=60,000 DPM	CU2	13266	10015		14043	12703	
	CU3	6043	8671	492	9263	9872	199
	DU1	3019	3531		2946	3311	
	DU2	3084	3586		4088		
	DU3	1969	2022	265	1055	1397	178
	EU1	2054	2687		6851	8191	
	EU2	2477	2516		7541	6933	
	EU3	2720	2421	152	1898	2335	430
	FU1	2320	2647		7891	8593	
	FU2	2639	2468		2269	3577	
	FU3	2802	2850	146	2784	2410	145
	AL1	4516	4400			3153	
	AL2	5845	6101		12234	13663	
	AL3	3425	3938	750	3832	4392	197
	BL1	1779	2039		2579	3617	
	BL2	2118	2524		461	504	
	BL3	3269	2960	375	1120	1224	137
	CL1	2767	2338		1953	1641	
	CL2	2209	1981		1968	2405	
	CL3	2237	2344	241	1136	1301	136
	DL1	931	942		884	1221	
	DL2	1702	1821		672	994	
	DL3	678	1041	233	333	454	117
	EL1	812	1090		3712	2290	
	EL2	1119	802		743	669	
	EL3	850	790	235	2883	3080	109
	FL1	892	890		2320	2285	
	FL2	1917			1488	1578	
	FL3	4140	4212	151	4105	4291	236

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	BEACH SEGMENT						
KN135	AU1	4256	5513		8450	11506	
Site #1	AU2	9065	4444		14378	17970	
Time 5	AU3	3093	3494	771	7623	11486	279

Day 32	BU1	2884	3798		2357	3625	
06/22/90	BU2	8885	14142		25783	7107	
	BU3	4111	7360	232	6239	8339	134
Hex spike=55,000 DPM	CU1	4459	4350		7825	5604	
Phen spike=60,000 DPM	CU2	2472	2414		10135	2319	
	CU3		2642	129	9488	7080	317
	DU1	1797	1096		3232	2994	
	DU2	1350	1903		2478	2476	
	DU3	709	773	844	2710	1196	197
	EU1	718	953		3903	4173	
	EU2	1140	2234		3046	4690	
	EU3	1376	2476	105	3081	3992	93
	FU1	695	1337		2046	2926	
	FU2	1338	2890		2735	5408	
	FU3	1585	1481	237	1520	2347	214
	AL1	7018	7023		10402	8026	
	AL2	7174	5065		14511	8161	
	AL3	10725		568	11359	14256	99
	BL1	1256	3536		10396	11343	
	BL2	6543	3643		5024	3924	
	BL3	8220	8609	4674	2378	2693	903
	CL1	3052	2612		3290	2907	
	CL2	6673	7976		13731	16597	
	CL3	2221	1202	89	2015	1263	509
	DL1	744	736		1709	1898	
	DL2	992	241		1292	1984	
	DL3	1054	932	80	1374	1451	81
	EL1	762	675		905	1242	
	EL2	1332	1184		940	751	
	EL3	743	876	270	1684	1123	87
	FL1	537	1134		4390	4090	
	FL2	1179	720		1889	1099	
	FL3	1240	819	78	1392	936	138

KN135B refertilized 7/12/90

KN135	AU1	8975	9090	0	4765	4730	0
Site #1	AU2	1442	11199	0	2008	2492	0
Time 6	AU3	3125	6982	1281	1529	1099	104
Pre-reapplication	BU1	12727	86	0	2925	2850	0
07/12/90	BU2	13231	8652	0	9075	8433	0
(Day 52)	BU3	5267	3498	896	2369	2143	445
	CU1	7454	5602	0	1238	865	0

Hex spike=61,000 DPM	CU2	6552	7870	0	600	748	0
Phen spike=58,500 DPM	CU3	9917	10137	2221	2050	1940	145
	DU1	3517	5288	0	774	814	0
	DU2	3401	3775	0	571	730	0
	DU3	2443	1846	2686	655	694	152
	EU1	706	1676	0	670	670	0
	EU2	1037	1332	0	869	1042	0
	EU3	2037	1393	930	524	615	126
	FU1	1139	1490	0	577	326	0
	FU2	1202	127	0	446	270	0
	FU3	1251	842	255	654	506	205
	AL1	6387	8192	0	2083	2068	0
	AL2	8213	1198	0	1463	289	0
	AL3	1999	1493	286	139	489	118
	BL1	5836	11470	0	1512	1667	0
	BL2	2481	11557	0	1521	154	0
	BL3	6020	3285	1107	964	910	311
	CL1	1917	2274	0	120	540	0
	CL2	4783	8658	0	840	899	0
	CL3	10171	7940	1429	1917	1335	302
	DL1	1592	1567	0	196	267	0
	DL2	1326	1148	0	294	333	0
	DL3	1496	699	944	148	125	76
	EL1	798	951	0	1182	1035	0
	EL2	181	725	0	590	248	0
	EL3	655	1027	131	230	395	589
	FL1	1560	852	0	208	181	0
	FL2	593	667	0	558	411	0
	FL3	1157	1337	240	442	336	117
KN135	AU1	4588	3557	0	3521	4693	0
Site #1	AU2	7858	3693	0	931	1376	0
Time 7	AU3	16270	10738	1293	8811	3692	343
Day 4 Re-app.	BU1	13675	7438	0	3799	364	0
07/16/90	BU2	24550	11983	0	3777	2248	0
(Day 56)	BU3	2474	3465	2270	651	976	896
	CU1	6174	3308	0	1013	594	0
Hex spike=61,000 DPM	CU2	13483	14669	0	5988	3627	0
Phen spike=58,500 DPM	CU3	11511	10610	1417	456	221	776

	DU1	2921	5395	0	761	1074	0
	DU2	3064	2071	0	2542	618	0
	DU3	6411	2115	517	569	338	237
	EU1	1799	1801	0	795	687	0
	EU2	1779	1374	0	574	215	0
	EU3	858	1223	588	927	890	232
	FU1	2801	260	0	763	654	0
	FU2	2210	3383	0	942	1123	0
	FU3	2560	1546	1030	2236	1001	139
	AL1	19656	16064	0	2124	3080	0
	AL2	3210	4829	0	868	1763	0
	AL3	9208	5763	2385	1219	1306	3051
	BL1	3180	6818	0	1294	2317	0
	BL2	49	11450	0	6177	4877	0
	BL3	13699	19092	1261	3535	232	511
	CL1	8065	8387	0	1892	1388	0
	CL2	8708	6133	0	5212	181	0
	CL3	3005	395	525	395	513	89
	DL1	3413	2242	0	255	501	0
	DL2	2625	2225	0	413	327	0
	DL3	1212	1017	904	254	311	463
	EL1	1155	1481	0	406	450	0
	EL2	365	510	0	479	625	0
	EL3	2167	1500	337	546	593	150
	FL1	1124	1219	0	254	395	0
	FL2	3073	4871	0	2146	1925	0
	FL3	744	692	373	818	381	98
KN135	AU1	9843	9901	0	805	770	0
Site #1	AU2	14286	14550	0	787	489	0
Time 8	AU3	14092	14548	2710	2082	2987	204
Day 18 Re-app.	BU1	16410	12074	0	2383	1342	0
07/30/90	BU2	12517	15807	0	1125	2337	0
(Day 70)	BU3	11299	4536	946	750	227	199
	CU1	468	396	0	246	213	0
Hex spike=61,000 DPM	CU2	13531	11861	0	1999	1948	0
Phen spike=58,500 DPM	CU3	16610	16763	1636	639	681	154
	DU1	1426	1956	0	90	686	0
	DU2	1563	1058	0	537	488	0
	DU3	173	880	186	294	548	142
	EU1	1533	1298	0	661	905	0

EU2	1185	1123	0	546	456	0
EU3	1319	1317	273	479	525	162
FU1	879	995	0	404	449	0
FU2	660	501	0	330	250	0
FU3	380	525	236	251	365	148
AL1	2511	2807	0	546	588	0
AL2	8293	5540	0	1506	1705	0
AL3	5319	7231	1030	986	1183	215
BL1	11588	11150	0			
BL2	7015	7783	0	2215	1199	0
BL3	6636	2719	525	1076	1255	299
CL1	2344	2387	0	445	398	0
CL2	899	721	0	245	270	0
CL3	1901	1843	937	686	717	194
DL1	448	915	0	1850	130	0
DL2	482	413	0	167	143	0
DL3	582	357	127	137	146	301
EL1	714	554	0	554	513	0
EL2	564	555	0	402	424	0
EL3	1056	236	173	470	477	213
FL1	250	240	0	132	162	0
FL2	588	399	0	120	89	0
FL3	317	561	126	276	388	174

KN135
Site #1
Time 9
Day 27 Re-app.
08/07/90
(Day 78)

Hex spike=61,000 DPM
Phen spike=28,570 DPM

AU1	3860	2642	0	252	370	0
AU2	9715	6838	0	752	1060	0
AU3	9462	11923	917	2762	1732	430
BU1	6771	8654	0	842	719	0
BU2	7256	2605	0	857	918	0
BU3	9349	5690	2629	2745	3942	1677
CU1	2865	3105	0	308	518	0
CU2	1060	482	0	267	821	0
CU3	2315	3102	427	488	527	176
DU1	7065	1102	0	1512	935	0
DU2	924	4606	0	288	273	0
DU3	675	627	1590	1232	660	254
EU1	1285	731	0	406	682	0
EU2	471	802	0	377	142	0
EU3	644	673	230	210	267	301
FU1	3226	4882	0	2098	550	0
FU2	4237	3381	0	686	1017	0

	FU3	2511	1608	2363	1067	748	675
	AL1	2054	1168	0	436	1104	0
	AL2	6679	3144	0	695	965	0
	AL3	5225	5579	1432	3557	857	396
	BL1	3236	2354	0	568	994	0
	BL2	6124	4595	0	574	1208	0
	BL3	9080	6120	2013	844	713	1235
	CL1	1069	1404	0	327	407	0
	CL2	2493	1852	0	418	167	0
	CL3	4029	702	646	875	826	748
	DL1	789	1049	0	274	237	0
	DL2	1625	164	0	119	560	0
	DL3	494	407	207	282	443	267
	EL1	946	774	0	408	436	0
	EL2	457	544	0	423	468	0
	EL3	1908	2704	168	311	488	152
	FL1	4395	5790	0	1223	651	0
	FL2	1446	2386	0	230	726	0
	FL3	862	649	181	704	1524	238
KN135	AU1	181	1716		471	1003	
Site #1	AU2	1782	655		146	123	
Time 10	AU3	521	381	343	442	771	248
Day 57 Re-app.	BU1	163	809		562	84	
09/07/90	BU2	831	1030		251	431	
(Day 109)	BU3	1767	737	777	707	626	232
Processed 9/8/90	CU1	1447	4675		1148	203	
	CU2	500	603		86	235	
Hex spike=61,000 DPM	CU3	153	110	286	166	182	69
Phen spike=58,500 DPM							
	DU1	418	1248		156	251	
	DU2	902	1388		100	106	
	DU3	751	3590	113	3730	1239	186
	EU1	462	138		181	91	
	EU2	796	1046		397	397	
	EU3	233	246	112	60	195	155
	FU1	1606	345		87	190	
	FU2	795	472		255	213	
	FU3	2051	3962	204	427	95	74
	AL1	177	1038		914	442	
	AL2	295	252		93	155	

AL3	249	170	282	181	117	477
BL1	85	585		82	124	
BL2	411	160		214	90	
BL3	619	358	63	291	186	68
CL1	74	310		134	139	
CL2	347	343		213	152	
CL3	2932	1502	167	65	88	115
DL1	490	425		241	91	
DL2	143	441		52	325	
DL3	1237	232	57	829	104	204
EL1	52	287		62	198	
EL2	276	607		246	45	
EL3	243	1189	93	167	73	51
FL1	1186	781		83	694	
FL2	902	300		227	313	
FL3	518	2335	960	301	1126	213

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KN211
Site #2
Time 0
Day 0
05/26/90

Hex spike=64,000 DPM
Phen spike=60,000 DPM

BEACH SEGMENT						
AU1	1226	1107		2232	2170	
AU2	2417	2735		12315	13008	
AU3	1224	952	110	428	482	93
BU1	2129	2067		4506	4404	
BU2	1374	1230		778	986	
BU3	5832	5351	157	2903	2933	85
CU1		3159		5776	4283	
CU2	2039	2597		2044	1765	
CU3	3415	3485	93	6167	6368	97
DU1	5623	6828		8168	7785	
DU2	2187	1875		2841	2672	
DU3	6866	6606	1469	3176	3278	87
EU1	4879	4966		3353	2603	
EU2	917	946		1640	1531	
EU3	2762	2606	270	8412	9337	108
FU1	4359	3667		14845	14732	
FU2	3801	2722		7290	7334	
FU3	2689	2598	137	3520	5860	692
AL1	2810	2604		343	505	
AL2	2074	2162		7003	6266	
AL3	4189	3836	86	11449	12882	212
BL1	4040	3870		10364	10040	
BL2	3958	3749		8922	8278	

BL3	3378	4214	116	6838	5339	111
CL1	3449	2124		4690	2897	
CL2	2236	2627		7801	8266	
CL3	3069	2518	126	4211	3791	87
DL1	7819	7872		2386	2381	
DL2	4044	4140		12583	12871	
DL3	4660	3843	235	6229	8097	106
EL1	1535	2153		11014	12727	
EL2	1262	1521		9024	12684	
EL3	1468	1374	125	10664	9356	166
FL1	3359	2382		11761	11162	
FL2	3503	3266		9402	8940	
FL3	3764	3908	250	9808	8583	98

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KN211
Site #2
Time 1
Day 2
06/01/90

Hex spike=55,000 DPM
Phen spike=60,000 DPM

BEACH SEGMENT						
AU1	2119	2262		405	307	
AU2	3277	2976		1686	1892	
AU3	1950	1865	88	500	278	85
BU1	8378	8280		7829	7068	
BU2	4243	4878		6787	6067	
BU3	2372	2227	83	249	269	118
CU1	6722	4936		582	648	
CU2	6575	6935		1119	1217	
CU3	7959	10249	964	972	737	141
DU1	6541	8930		6242	4069	
DU2	7560	6319		2697	2140	
DU3	5838	5308	128	3127	3458	90
EU1	8067	9417		2597	2761	
EU2	9313	9312		5531	2668	
EU3	7825	9233	147	2112	1957	134
FU1	6845	7291		4135	4747	
FU2	2295	2727		3093	3105	
FU3	5570	4461	261	8300	6496	174
AL1	6280	5246		1967	1682	
AL2	3616	438		1574	1618	
AL3	2906	3980	581	4127	131	97
BL1	9381	7441		4933	8925	
BL2	4731	3053		4308	3049	
BL3	3854	4537	166	3293	3890	99
CL1	3768	3651		9144	5285	
CL2	1452	1473		5814	5032	
CL3	2323	2779	317	2564	3892	1555

DL1	3762	3276		8270	5119	
DL2	2051	2374		4658	4401	
DL3	2680	2150	398	3770	3086	103
EL1	811	1559		8646	8944	
EL2	2057	1425		8618	7126	
EL3	1841	1672	77	5266	3924	96
FL1	2658	2352		8094	7461	
FL2	1603	1352		2890	3456	
FL3	2944	2364	196	6158	6277	620

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KN211
Site #2
Time 2
Day 4
06/03/90

Hex spike=55,000 DPM
Phen spike=60,000 DPM

BEACH SEGMENT						
AU1	6254	6277		776	832	
AU2	5320	4983		543	473	
AU3	2547	2722	190	3529	3440	78
BU1	1817	2389		2280	2519	
BU2	3256	4953		1052	1184	
BU3	4019	2909	185	978	1125	219
CU1	6710	7139		1882	1675	
CU2	1551	3430		471	524	
CU3	1734	2240	203	1669	1262	135
DU1	3555	2563		1264	2885	
DU2	1223	1102		476	993	
DU3	2342	2673	128	3303	3608	889
EU1	2733	3144		1372	1088	
EU2	3725	5656		762	972	
EU3	5149	4691	421	636	898	90
FU1	4749	4244		2054	1856	
FU2	3203	5050		3732	4254	
FU3	2295	1910	166	545	677	131
AL1	2588	3070		5183	4206	
AL2	3754	3616		1389	1230	
AL3	3774	3446	262	7066	4393	210
BL1	3912	4573		4416	4246	
BL2	6434	3707		5104	4190	
BL3	5486	4678	70	1871	1703	333
CL1	9122	6824		1268	1337	
CL2	3751	4405		11224	4272	
CL3	3994	3224	526	2212	2395	151
DL1	3225	3375		2267	3993	
DL2	2185	2290		3061	2961	

DL3	2349	3481	290	1858	1372	362
EL1	2960	3686		4257	3910	
EL2	1707	3120		6141	4593	
EL3	2054	1366	74	2652	1962	285
FL1	1342	1965		3619	2963	
FL2	2650	2876		1698	1518	
FL3	389	517	90	532	456	159

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KN211
Site #2
Time 3
Day 8
06/07/90

Hex spike=55,000 DPM
Phen spike=60,000 DPM

BEACH SEGMENT						
AU1	119	106		78	241	
AU2	106	112		104	109	
AU3	337	302	67			
BU1	364	261		126	133	
BU2	132	146		138	85	
BU3	3386	4781	86	600	501	83
CU1	250	91		292	129	
CU2	331	337		189	164	
CU3	963	920	89	1960	1902	107
DU1	381	336		189	273	
DU2	874	893		440	476	
DU3	2386	2138	118	467	279	112
EU1	8251	7811		1108	1033	
EU2	2696	3228		874	643	
EU3	4763	4214	79	742	979	103
FU1	2535	2675		1519	1569	
FU2	9766	6922		4440	242	
FU3	1982	1654	93	1742	1555	272
AL1	126	291		85	97	
AL2	867	1368		413	446	
AL3	304	641	69	172	155	292
BL1	572	144		539	488	
BL2	457	463		684	889	
BL3	1007	283	104	605	555	150
CL1	268	327		381	215	
CL2	2272	2001		2517	2655	
CL3	450	239	100	646		215
DL1	237	110		532	356	
DL2	442	353		442	273	

DL3	2082	1291	78	3205	3025	94
EL1	1451	1311		4436	4271	
EL2	1843	1416		4741	5483	
EL3	2251	2742	259	3678	3254	103
FL1	1109	976		3345	3491	
FL2	872	894		2810	2818	
FL3	1275	1134	77	825	846	70

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BEACH

SEGMENT

KN211
Site #2
Time 4
Day 16
06/15/90

Hex spike=55,000 DPM
Phen spike=60,000 DPM

AU1	4495	4983		2990	3960	
AU2	12349	11935		15623	16003	
AU3	4728	4369	376	3132	2781	194
BU1	1622	2363		874	1401	
BU2	5870	5700		2721	2359	
BU3	2779	2546	359	3237	3346	101
CU1	3756	3914		1248	1260	
CU2	7478	7623		5766	2272	
CU3	3081	2664	83	6308	6908	176
DU1		3773		305	1127	
DU2	1539	3215		8819	8857	
DU3	3772	7833	189	4203	2230	99
EU1	1753	1497		2051	1614	
EU2	7036	8373		2012	2387	
EU3	2272	1809	163	1517	2592	469
FU1	3734	4354		2169	4561	
FU2	1824	2284		3243	3667	
FU3	1646	1596	72	3134	3121	243
AL1	3561	3367		939	888	
AL2	4242	5799		4536	4160	
AL3	2307	1965	239	715	658	310
BL1		3947		3512	3581	
BL2	9848	10414		4688		
BL3	1938	2128	264	4460	4971	94
CL1	2642	4199		1923	2106	
CL2	9076	8769		3603	7118	
CL3	3124	3098	218	7331	8009	97
DL1	1517	1551		1009	1373	
DL2	888	1026		2279	4011	

	DL3	4528	3804	68	4590	4282	219
	EL1	1385	1314		4699	5138	
	EL2	949	1051		4541	4213	
	EL3	869	743	109	3213	1197	100
	FL1	754	655		2252	2579	
	FL2	967	971		1663	2175	
	FL3	1258	1975	75	370	332	182

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	BEACH SEGMENT						
KN211	AU1	2520	2892		1765	1964	
Site #2	AU2	2576	4653		10280	9909	
Time 5	AU3	10875	14874	99	2481	2213	195
Day 31	BU1	8059	10759		3474	4119	
06/30/90	BU2	9404	12903		5081	4509	
	BU3	2388	3086	1005	3188	2694	184
Hex spike=55,000 DPM	CU1	2357	3077		503	526	
Phen spike=60,000 DPM	CU2	1713	2629		339	418	
	CU3	5633	9820	601	3920	3694	132
	DU1	6453	7302		2627	3143	
	DU2	3177	3649		3061	2827	
	DU3	4587	5198	205	824	953	165
	EU1	3393	4513		1319	1575	
	EU2	3881	6061		1127	918	
	EU3	8118	9942	513	1676	1716	151
	FU1	3020	3314		1203	1716	
	FU2	2674	3147		1760	2151	
	FU3	2780	3598	335	2165	1903	323
	AL1	6641	6615		598	759	
	AL2	5079	4117		2735	1579	
	AL3	2395	1630	116	3096	3005	189
	BL1	1105	1387		5753	5257	
	BL2	2302	1613		3821	3121	
	BL3	2859	2009	107	1907	1789	152
	CL1	2956	2457		3539	3006	
	CL2	3571	2915		6579	7919	
	CL3	4486	3010	242	4947	3266	150
	DL1	2056	1595		5023	6353	
	DL2	1567	1486		2381	2047	

	DL3	1081	983	203	5695	3963	204
	EL1	1100	1451		4587	4126	
	EL2	1295	1093		5038	5021	
	EL3	1216	990	146	4896	5056	152
	FL1	1351	974		4104	3873	
	FL2	1045	1370		3100	3683	
	FL3	1129	524	200	3051	2618	127

KN211E refertilized 7/12/90

KN211	AU1	8935	8098	0	807	94	0
Site #2	AU2	13315	12723	0	4198	3323	0
Time 6	AU3	10352	7332	512	5913	5856	173
Day 4 Re-app.	BU1	8601	8461	0	10727	5960	0
07/16/90	BU2	4435	461	0	1986	1757	0
(Day 45)	BU3	3451	4624	1495	6902	5073	1083
	CU1	5351	3481	0	692	729	0
Hex spike=61,000 DPM	CU2	2623	6479	0	6746	4860	0
Phen spike=58,500 DPM	CU3	2436	4418	1495	1293	1850	736
	DU1	3087	3002	0	254	252	0
	DU2	3442	3673	0	595	671	0
	DU3	1932	369	892	387	274	319
	EU1	1545	1325	0	400	768	0
	EU2	827	338	0	1140	925	0
	EU3	1231	925	649	818	613	354
	FU1	2385	1335	0	631	874	0
	FU2	720	982	0	332	340	0
	FU3	1467	939	490	256	380	85
	AL1	2064	3621	0	1846	1458	0
	AL2	9585	4327	0	1120	1818	0
	AL3	943	558	1100	3613	5004	355
	BL1	3632	1627	0	2065	1598	0
	BL2	1714	7944	0	1717	2813	0
	BL3	5440	3173	570	880	1170	1400
	CL1	1890	4312	0	1461	1319	0
	CL2	7446	4680	0	2371	2605	0
	CL3	2560	3921	151	1192	2488	190
	DL1	2280	1071	0	749	882	0
	DL2	2701	1757	0	998	399	0
	DL3	460	304	315	1832	1464	563
	EL1	767	742	0	658	531	0
	EL2	283	563	0	655	773	0
	EL3	712	415	224	295	483	413
	FL1	195	392	0	79	346	0

KN211
Site #2
Time 7
Day 19 Re-app.
07/31/90
(Day 60)

Hex spike=61,000 DPM
Phen spike=58,500 DPM

FL2	568	883	0	137	787	0
FL3	735	390	158	213	494	121
AU1	1506	1090	0	871	929	0
AU2	2414	3742	0	968	952	0
AU3	1131	130	236	208	273	289
BU1	929	1065	0	329	333	0
BU2	6211	1729	0	4324	976	0
BU3	1107	574	326	232	289	983
CU1	3052	454	0	948	851	0
CU2	1105	1007	0	285	232	0
CU3	829	727	373	1154	355	296
DU1	1437	1161	0	417	633	0
DU2	502	346	0	123	154	0
DU3	1326	1392	165	1281	1170	136
EU1	1656	2327	0	335	546	0
EU2	450	1967	0	1452	767	0
EU3	2233	2093	237	2207	406	161
FU1	932	256	0	268	399	0
FU2	1056	1290	0	377	514	0
FU3	705	708	179	421	485	173
AL1	323	240	0	148	105	0
AL2	92	796	0	590	688	0
AL3	1598	4814	989	195	219	86
BL1	473	340	0	605	683	0
BL2	280	1315	0	476	114	0
BL3	5138	104	857	1801	3696	154
CL1	233	331	0	425	406	0
CL2	213	771	0	431	599	0
CL3	1943	2426	381	506	6846	98
DL1	223	114	0	561	312	0
DL2	146	1270	0	123	138	0
DL3	926	667	202	208	1824	101
EL1	324	261	0	401	165	0
EL2	190	495	0	170	135	0
EL3	708	105	139	182	1456	89
FL1	180	135	0	214	138	0
FL2	152	583	0	185	238	0
FL3	649	718	167	139	588	102

KN211	AU1	1318	1032		314	428	
Site #2	AU2	110	104		363	98	
Time 8	AU3	778	382	544	163	642	289
Day 55 Re-app.	BU1	570	366		569	830	
09/05/90	BU2	323	601		200	444	
(Day 96)	BU3	4869	6823	219	190	235	150
Processed 9/7/90	CU1	118	771		393	210	
	CU2	104	829		283	116	
Hex spike=61,000 DPM	CU3	465	224	93	127	172	207
Phen spike=58,500 DPM							
	DU1	81	114		153	354	
	DU2	633	245		104	116	
	DU3	107	85	79	178	146	121
	EU1	191	80		153	369	
	EU2	427	647		219	323	
	EU3	1674	195	103	91	257	115
	FU1	99	80		113	138	
	FU2	94	72		115	267	
	FU3	87	94	79	399	71	122
	AL1	1310	855		784	1143	
	AL2	209	276		641	656	
	AL3	954	809	150	373	176	197
	BL1	1467	706		393	624	
	BL2	290	631		242	125	
	BL3	2693	2661	104	299	304	74
	CL1	1988	729		179	70	
	CL2	1226	126		163	87	
	CL3	414	396	100	149	384	130
	DL1	417	523		238	244	
	DL2	570	225		301	971	
	DL3	112	348	104	480	285	193
	EL1	248	171		96	612	
	EL2	291	360		322	129	
	EL3	194	654	82	137	78	87
	FL1	305	270		151	123	
	FL2	200	276		109	90	
	FL3	361	253	84	246	175	114
KN211	AU1	268	2697		2645	15565	
Site #2	AU2	7690	6766		3044	4759	
Time 9	AU3	5756	6149	97	10191	10381	165
Day 61 Re-app.	BU1	8801	5858		4430	8800	
09/11/90	BU2	20827	14063		9385	11534	

(Day 102)	BU3	6247	8338	776	8024	2972	2815
Processed 10/23/90	CU1	1283	6682		7191	4634	
	CU2	7574	7274		17664	13940	
Hex spike=61,000 DPM	CU3	14413	13817	149	7115	3010	900
Phen spike=46,000 DPM							
	DU1	2992	2245		1568	4495	
	DU2	5678	3822		4912	2949	
	DU3	63	2525	628	2422	1263	148
	EU1	1942	2043		1965	1016	
	EU2	2329	3891		2789	2750	
	EU3	12304	8038	476	10050	6155	982
	FU1	1475	2529		2775	2081	
	FU2	298	1864		2054	3948	
	FU3	1602	1698	1096	1122	400	1101
	AL1	8276	5539		6757	7436	
	AL2	2037	87		6675	6019	
	AL3	6707	5516	2030	5512	3745	999
	BL1	17453	16330		4942	5546	
	BL2	12017	6919		8262	7253	
	BL3	2645	2184	131	3955	2653	1512
	CL1	1012	782		4301	3783	
	CL2	13013	11026		7065	8220	
	CL3	8934	8768	576	7868	3819	991
	DL1	1225	385		2457	2963	
	DL2	1005	1114		2988	2912	
	DL3	1244	1159	697	2594	2711	562
	EL1	699	999		4279	2845	
	EL2	992	362		2725	2542	
	EL3	1559	630	92	2554	4308	690
	FL1	1150	891		3538	2651	
	FL2	1297	966		2131	2087	
	FL3	451	1694	252	1525	1502	395
KN211	AU1	14932	11494		7764	8290	
Site #2	AU2	10657	10877		2762	3874	
Time 10	AU3	3100	3576	1120	3241	2045	103
Day 71 Re-app.	BU1	8135	7542		1508	5604	
09/21/90	BU2	8362	5175		4847	7498	
(Day 112)	BU3	10686	9147	544	3749	4130	1148
Processed 10/25/90	CU1	6130	7548		6377	8034	
	CU2	4878	12790		2145	3640	
Hex spike=61,000 DPM	CU3	1268	5280	288	2233	1945	333
Phen spike=46,000 DPM							

	DU1	744	1694		845	984	
	DU2	3052	2648		65	94	
	DU3	7239	4174	210	2429	2965	373
	EU1	7040	1565		560	1566	
	EU2	4941	3217		985	2159	
	EU3	1217	1239	457	1256	508	256
	FU1	5377	848		5276	4981	
	FU2	1881	1320		1282	1373	
	FU3	400	1932	789	1568	2513	1188
	AL1	1881	1397		1621	1635	
	AL2	4316	4661		5402	5932	
	AL3	1202	1896	196	2508	3160	537
	BL1	2276	3115		2279	2655	
	BL2	1818	1584		1953	1933	
	BL3	2779	2757	291	2012	1325	161
	CL1	3576	2272		2364	2233	
	CL2	21070	16840		4001	9155	
	CL3	1812	1449	1143	974	1636	1206
	DL1	1523	1462		950	1309	
	DL2	1267	1157		2118	1412	
	DL3	692	532	364	2411	2153	1119
	EL1	1974	1802		2291	2042	
	EL2	1013	1099		726	2173	
	EL3	859	620	909	3086	1508	189
	FL1	501	1781		2126	3300	
	FL2	2419	2041		2543	1185	
	FL3	523	325	909	4010	1789	361

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	BEACH SEGMENT						
KN132	AU1	1574	1855		1336	1772	
Site #3	AU2	2114	2149		949	1158	
Time 0	AU3	2153	2918	78	137	172	123
Day 0	BU1	2219	2668		1635	1374	
05/31/90	BU2	1988	2779		2151	2577	
	BU3	2664	1929	80	2235	637	93
Hex spike=55,000 DPM	CU1	1363	1659		1029	1367	
Phen spike=60,000 DPM	CU2	2284	2658		1688	1685	

	CU3	1072	987	86	1593	941	87
	DU1	1749	2359		1614	1564	
	DU2	2705	1453		2066	2024	
	DU3	2193	1818	84	1874	2021	259
	EU1	1041	1061		416	860	
	EU2	1484	1202		1721	1690	
	EU3	1620	1440	168	2058	2457	117
	FU1	507	588		327	319	
	FU2	3530	3273		3248	3103	
	FU3	1682	1862	78	509	490	107

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	BEACH SEGMENT						
KN132	AU1	1969	1793		362	357	
Site #3	AU2	2923	3363		514	532	
Time 1	AU3	6801	7595	67	2328	870	81
Day 2	BU1	5716	6645		3006	3572	
06/04/90	BU2	1969	1351		749	668	
	BU3	10343	8084	110	2568	1763	272
Hex spike=55,000 DPM	CU1	10315	9476		5196	4627	
Phen spike=60,000 DPM	CU2	13174	12112		3609	3927	
	CU3	13496	12227	296	800	967	103
	DU1	5702	4588		2625	1842	
	DU2	3010	2731		1542	17432	
	DU3	2222	2028	145	1306	1276	80
	EU1	3869	3772		1151	1147	
	EU2	3212	3975		121	1647	
	EU3	5401	6107	141	2638	2617	129
	FU1	2444	1810		387	377	
	FU2	3256	3084		512	386	
	FU3	4906	5164	449	1490	1299	70

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	BEACH SEGMENT						
KN132	AU1	823	774		96	112	
Site #3	AU2	3072	3893		1614	1486	
Time 2	AU3	340	346	66	136	123	115
Day 4	BU1	2001	2092		1984	2016	
06/06/90	BU2	3493	3562		1269	1444	
	BU3	4054	4118	179	627	169	74
Hex spike=55,000 DPM	CU1	2116	2521		679	667	
Phen spike=60,000 DPM	CU2	2309	2558		1518	1756	
	CU3	4386	4759	85	2142	3796	131

	DU1	1816	1282		590	669	
	DU2	999	1127		733	962	
	DU3	3626	3369	83	2083	2309	84
	EU1	1857	1136		359	405	
	EU2	3332	3576		919	1023	
	EU3	1187	1314	195	654	541	235
	FU1	731	981		333	294	
	FU2	396	565		139	182	
	FU3	1133	1043	87	200	186	83

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	BEACH SEGMENT						
KN132	AU1	613	1260		531	516	
Site #3	AU2	327	384		135	125	
Time 3	AU3	4119	3606	191	2275	2359	114
Day 8	BU1	9179	6238		9526	9688	
06/10/90	BU2	5412	5902		5523	6187	
	BU3	9960	10390	324	4133	2681	117
Hex spike=55,000 DPM	CU1	2118	3323			7799	
Phen spike=60,000 DPM	CU2	10211	8483		688	3521	
	CU3	1540	1130	262	2169	630	190
	DU1	2746	2245		1080	1121	
	DU2	1584	1917		1521	1706	
	DU3	899	981	169	1349	1345	76
	EU1	2132	2771		1609	1758	
	EU2	1467	1720		788	934	
	EU3	1610	1499	77	1080	1429	76
	FU1	915	1104		279	490	
	FU2	1361	1512		750	700	
	FU3	978	961	157	305	391	86

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	BEACH SEGMENT						
KN132	AU1	440	1674		3002	3859	
Site #3	AU2	6003	8251		10142	9971	
Time 4	AU3	2849	1795	123	2167	1856	144
Day 16	BU1	10521	11467		11298	8204	
07/01/90	BU2	14250	12804		8842	4865	
	BU3	9111	9116	130	10213	5694	152
Hex spike=55,000 DPM	CU1	5037	3756		3613	4151	
Phen spike=60,000 DPM	CU2	3232	695		2349	4482	
	CU3	1345	1023	1027	2285	3094	216

	DU1	1019	1303		1425	1755	
	DU2	3560	2037		1713	1701	
	DU3	961	1864	88	1092	883	89
	EU1	2471	2487		1546	2204	
	EU2	1102	890		1171	1415	
	EU3	2772	2486	140	2803	4179	234
	FU1	1647	1212		796	657	
	FU2	2140	1778		669	617	
	FU3	1669	1366	112	732	505	68

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	BEACH SEGMENT						
KN132	AU1	11751	12739		1131	1188	
Site #3	AU2	8680	9426		668	742	
Time 5	AU3	6921	6765	179	4161	4005	170
Day 29	BU1	14432	14789		4904	4141	
07/01/90	BU2	14224	11313		3625	4651	
	BU3	5227	5466	930	507	562	150
Hex spike=55,000 DPM	CU1	2452	2293		311	288	
Phen spike=60,000 DPM	CU2	7903	8032		2122	2483	
	CU3	4816	4539	184	2755	2512	134
	DU1	1498	1714		1173	1277	
	DU2	1388	1528		1249	1256	
	DU3	3496	3487	191	1838	1519	140
	EU1	3747	3071		1107	1203	
	EU2	3968	3798		1892	1844	
	EU3	5369	5137	170	1415	1288	162
	FU1	2224	2031		324	368	
	FU2	1888	1758		543	582	
	FU3	2185	2328	153	1302	1347	140

KN132B refertilized 7/11/90

KN132	AU1	881	431	0	175	804	0
Site #3	AU2	1739	2870	0	277	239	0
Time 6	AU3	235	404	295	527	1127	336
Day 4 Re-app.	BU1	9712	10364	0	1827	1818	0
07/15/90	BU2	3788	4768	0	2027	1252	0
(Day 43)	BU3	246	256	164	388	730	113
	CU1	8290	12975	0	104	93	0
Hex spike=61,000 DPM	CU2	10713	12331	0	214	154	0
Phen spike=58,500 DPM	CU3	1155	1049	99	176	489	307

	DU1	2188	2376	0	744	638	0
	DU2	2399	1877	0	610	402	0
	DU3	1163	256	1267	1370	1224	169
	EU1	1039	869	0	399	652	0
	EU2	883	929	0	336	646	0
	EU3	800	949	827			854
	FU1	446	380	0	470	408	0
	FU2	533	467	0	157	394	0
	FU3	427	98	0	238	312	694
KN132	AU1	510	432	0	370	198	0
Site #3	AU2	4202	735	0	838	482	0
Time 7	AU3	601	285	313	179	193	448
Day 21 Re-app.	BU1	2445	3013	0	410	224	0
08/01/90	BU2	3099	4148	0	1812	2093	0
(Day 60)	BU3	1508	829	607	420	296	374
	CU1	7143	6321	0	2633	2179	0
Hex spike=61,000 DPM	CU2	3052	2083	0	625	500	0
Phen spike=58,500 DPM	CU3	2440	2533	308	511	760	273
	DU1	1587	1446	0	357	1427	0
	DU2	1510	1555	0	287	199	0
	DU3	1544	1835	270	739	431	208
	EU1	1676	667	0	177	29	0
	EU2	3855	490	0	500	404	0
	EU3	175	411	171	600	317	218
	FU1	729	730	0	217	170	0
	FU2	393	26	0	155	81	0
	FU3	0	0	0	1692	661	0
KN132	AU1	390	574		129	97	
Site #3	AU2	801	252		259	258	
Time 8	AU3	2956	1127	192	385	881	79
Day 56 Re-app.	BU1	758	216		272	167	
09/05/90	BU2	2333	5645		693	252	
(Day 95)	BU3	190	752	130	118	72	89
Processed 9/7/90	CU1	987	574		112	350	
	CU2	659	2868		386	332	
Hex spike=61,000 DPM	CU3	278	376	221	511	1353	286
Phen spike=58,500 DPM							
	DU1	866	940		277	193	
	DU2	393	409		983	364	
	DU3	503	315	270	436	261	112

EU1	132	98		248	341	
EU2	109	209		104	240	
EU3	230	293	109	236	245	190
FU1	537	471		213	226	
FU2	185	163		279	814	
FU3	113	258	172	144	335	116

APPENDIX D2.

TABLE 7. Microbial Enumeration Data

MICROBIAL ENUMERATION DATA

	BEACH SEGMENT	% Dry Wt.	HET MPN	Corr. MPN	Oil MPN	Corr. Oil
KN135	AU1	0.95		0.00E+00	2.40E+05	2.52E+05
Site #1	AU2	0.94	2.40E+06	2.55E+06	2.70E+05	2.87E+05
Time 0	AU3	0.95	1.50E+06	1.58E+06	9.30E+04	9.78E+04
Day 0	BU1	0.94	7.50E+05	8.01E+05	1.50E+04	1.60E+04
05/19/90	BU2	0.95	4.30E+05	4.50E+05	4.30E+03	4.50E+03
	BU3	0.95	1.50E+06	1.57E+06	2.40E+04	2.52E+04
	CU1	0.93		0.00E+00	7.50E+03	8.04E+03
	CU2	0.92		0.00E+00	2.40E+04	2.62E+04
	CU3	0.96	4.30E+06	4.49E+06	4.30E+04	4.49E+04
	DU1	0.94		0.00E+00	2.80E+03	2.97E+03
	DU2	0.92	4.60E+06	5.00E+06	3.90E+04	4.24E+04
	DU3	0.95	1.50E+06	1.58E+06	4.30E+03	4.52E+03
	EU1	0.94	9.30E+05	9.87E+05	1.50E+04	1.59E+04
	EU2	0.96	7.50E+06	7.79E+06	4.30E+04	4.47E+04
	EU3	0.96		0.00E+00	7.50E+04	7.81E+04
	FU1	0.95		0.00E+00	9.30E+04	9.82E+04
	FU2	0.94	1.50E+06	1.59E+06	4.60E+05	4.88E+05
	FU3	0.97	2.40E+08	2.46E+08	2.90E+04	2.98E+04
	AL1	0.93		0.00E+00	1.50E+05	1.61E+05
	AL2	0.90	2.00E+05	2.22E+05	2.10E+04	2.33E+04
	AL3	0.91		0.00E+00	4.30E+04	4.74E+04
	BL1	0.92	4.30E+04	4.67E+04	9.30E+02	1.01E+03
	BL2	0.94	9.30E+05	9.90E+05	2.00E+03	2.13E+03
	BL3	0.94	4.30E+06	4.59E+06	9.30E+03	9.93E+03
	CL1	0.99		0.00E+00	9.30E+04	9.42E+04
	CL2	0.91		0.00E+00	9.30E+03	1.02E+04
	CL3	0.90	7.50E+04	8.29E+04	1.50E+04	1.66E+04
	DL1	0.91		0.00E+00	7.50E+04	8.20E+04
	DL2	0.92	4.30E+04	4.66E+04	4.30E+03	4.66E+03
	DL3	0.93	4.30E+05	4.63E+05	9.30E+03	1.00E+04
	EL1	0.91	9.30E+05	1.02E+06	9.30E+03	1.02E+04
	EL2	0.92		0.00E+00	1.50E+04	1.63E+04
	EL3	0.87	4.60E+06	5.29E+06	2.30E+02	2.65E+02
	FL1	0.92		0.00E+00	1.50E+04	1.63E+04
	FL2	0.91	1.50E+05	1.65E+05	1.50E+04	1.65E+04
	FL3	0.92		0.00E+00	4.30E+04	4.68E+04

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BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil

KN135
Site #1
Time 1
Day 2
05/23/90

BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
AU1	0.95	3.90E+07	4.11E+07	1.50E+04	1.58E+04
AU2	0.96	2.30E+06	2.39E+06	1.50E+04	1.56E+04
AU3	0.96	9.30E+05	9.70E+05	9.30E+03	9.70E+03
BU1	0.97	4.30E+05	4.45E+05		0.00E+00
BU2	0.97	9.30E+06	9.60E+06	1.50E+05	1.55E+05
BU3	0.92	9.30E+06	1.01E+07	4.30E+03	4.69E+03
CU1	0.96	9.30E+05	9.72E+05	2.30E+05	2.40E+05
CU2	0.96	9.30E+05	9.72E+05	4.30E+05	4.49E+05
CU3	0.94	4.30E+06	4.58E+06	7.50E+04	7.99E+04
DU1	0.93	9.30E+06	1.00E+07	4.30E+03	4.64E+03
DU2	0.94	2.30E+06	2.46E+06	2.30E+03	2.46E+03
DU3	0.95	4.30E+06	4.53E+06	1.40E+03	1.48E+03
EU1	0.92	2.30E+07	2.51E+07	2.30E+04	2.51E+04
EU2	0.95	2.30E+07	2.42E+07	9.30E+04	9.80E+04
EU3	0.94	2.30E+06	2.44E+06	7.50E+04	7.96E+04
FU1	0.96	4.30E+06	4.48E+06	7.50E+03	7.81E+03
FU2	0.95	9.30E+06	9.82E+06	1.50E+04	1.58E+04
FU3	0.96	2.30E+06	2.41E+06	4.30E+04	4.50E+04
AL1	0.93	2.30E+06	2.47E+06	2.70E+04	2.91E+04
AL2	0.90	4.30E+05	4.79E+05	4.30E+03	4.79E+03
AL3	0.91	2.30E+06	2.51E+06	9.30E+03	1.02E+04
BL1	0.91	2.30E+07	2.52E+07	1.50E+05	1.64E+05
BL2	0.90	2.30E+06	2.55E+06	4.30E+03	4.76E+03
BL3	1.07	9.30E+04	8.67E+04	2.00E+03	1.86E+03
CL1	0.93	2.30E+07	2.48E+07	1.20E+05	1.30E+05
CL2	0.91	2.30E+05	2.51E+05	4.30E+04	4.70E+04
CL3	0.91	9.30E+05	1.02E+06	9.30E+03	1.02E+04
DL1	0.92	2.30E+06	2.50E+06	2.30E+04	2.50E+04
DL2	0.91	4.30E+05	4.74E+05	2.40E+03	2.65E+03
DL3	0.91	4.30E+05	4.70E+05	4.30E+03	4.70E+03
EL1	0.92	2.10E+05	2.29E+05	7.50E+03	8.17E+03
EL2	0.93	2.30E+05	2.48E+05	1.50E+03	1.62E+03
EL3	0.92	2.30E+05	2.51E+05	4.30E+03	4.69E+03
FL1	0.92	9.30E+05	1.01E+06	4.30E+03	4.69E+03
FL2	0.91	9.30E+06	1.02E+07	4.30E+04	4.71E+04
FL3	0.93	9.30E+05	1.00E+06	1.50E+04	1.62E+04

KN135 Site #1 Time 2 Day 4 05/25/90	AU1	0.97	9.30E+07	9.63E+07	1.50E+05	1.55E+05
	AU2	0.96		0.00E+00	9.30E+03	9.66E+03
	AU3	0.96	2.30E+06	2.40E+06	1.50E+04	1.56E+04
	BU1	0.90	9.30E+06	1.03E+07	1.50E+05	1.66E+05
	BU2	0.96	4.30E+07	4.46E+07	4.30E+04	4.46E+04
	BU3	0.94	9.30E+06	9.89E+06	9.30E+05	9.89E+05
	CU1	0.96	4.30E+07	4.48E+07	2.30E+04	2.40E+04
	CU2	0.94	9.30E+06	9.86E+06	2.30E+05	2.44E+05
	CU3	0.95	4.30E+07	4.51E+07	9.30E+05	9.75E+05
	DU1	0.94	4.30E+07	4.59E+07	7.50E+04	8.01E+04
	DU2	0.93	7.50E+07	8.08E+07	3.90E+04	4.20E+04
	DU3	0.96	2.30E+06	2.39E+06	7.50E+03	7.79E+03
	EU1	0.94	4.30E+07	4.59E+07	7.50E+04	8.01E+04
	EU2	0.93	2.30E+07	2.46E+07	9.30E+04	9.95E+04
	EU3	0.97	1.50E+06	1.54E+06	2.30E+03	2.36E+03
	FU1	0.95	2.30E+08	2.42E+08	9.30E+03	9.78E+03
	FU2	0.93	4.30E+08	4.61E+08	9.30E+06	9.96E+06
	FU3	0.96	1.50E+08	1.57E+08	1.50E+04	1.57E+04
	AL1	0.90	4.30E+04	4.78E+04	9.30E+04	1.03E+05
	AL2	0.91	9.30E+06	1.02E+07	4.30E+05	4.70E+05
	AL3	0.90	9.30E+05	1.03E+06	4.30E+04	4.76E+04
	BL1	0.90	9.30E+06	1.04E+07	9.30E+04	1.04E+05
	BL2	0.92	2.30E+06	2.49E+06	4.30E+05	4.66E+05
	BL3	0.92	9.30E+05	1.01E+06	2.30E+04	2.51E+04
	CL1	0.92	7.50E+07	8.17E+07	7.50E+04	8.17E+04
	CL2	0.92	4.30E+07	4.66E+07	4.30E+05	4.66E+05
	CL3	0.92	9.30E+05	1.01E+06	4.30E+04	4.66E+04
	DL1	0.93	9.30E+04	9.97E+04	1.50E+03	1.61E+03
	DL2	0.92	2.30E+05	2.50E+05	7.50E+03	8.15E+03
	DL3	0.92	4.30E+06	4.70E+06	4.30E+03	4.70E+03
	EL1	0.91	9.30E+05	1.03E+06	2.30E+04	2.54E+04
	EL2	0.90	7.50E+05	8.35E+05	1.50E+05	1.67E+05
	EL3	0.89	1.50E+08	1.68E+08	1.50E+04	1.68E+04
	FL1	0.93	2.30E+07	2.47E+07	9.30E+03	9.97E+03
	FL2	0.91	2.30E+07	2.52E+07	7.50E+04	8.22E+04
	FL3	0.91	2.10E+08	2.30E+08	4.30E+02	4.72E+02

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN135	AU1	0.96	4.30E+07	4.46E+07	1.50E+04	1.56E+04

Site #1	AU2	0.97	2.30E+07	2.36E+07	9.30E+05	9.55E+05
Time 3	AU3	0.94	4.30E+07	4.58E+07	9.30E+03	9.90E+03
Day 8	BU1	0.95	2.30E+07	2.42E+07	4.30E+04	4.52E+04
05/29/90	BU2	0.95	4.30E+07	4.53E+07	7.50E+03	7.90E+03
	BU3	0.96	2.30E+07	2.39E+07	9.30E+03	9.66E+03
	CU1	0.96	2.30E+07	2.40E+07	9.30E+03	9.71E+03
	CU2	0.97	2.30E+07	2.38E+07	4.30E+04	4.44E+04
	CU3	0.93	2.30E+06	2.47E+06	4.30E+05	4.62E+05
	DU1	0.96	2.30E+07	2.40E+07	2.10E+04	2.19E+04
	DU2	0.94	4.30E+07	4.57E+07	2.10E+05	2.23E+05
	DU3	0.96	2.30E+07	2.41E+07	4.30E+04	4.50E+04
	EU1	0.96	4.30E+06	4.46E+06	3.90E+04	4.05E+04
	EU2	0.94	9.30E+06	9.85E+06	2.30E+05	2.44E+05
	EU3	0.94	4.30E+06	4.58E+06	1.50E+05	1.60E+05
	FU1	0.94	2.30E+07	2.44E+07	1.50E+05	1.59E+05
	FU2	0.96	4.30E+06	4.48E+06	1.50E+05	1.56E+05
	FU3	0.94	4.30E+06	4.58E+06	4.30E+04	4.58E+04
	AL1	0.92	2.30E+07	2.51E+07	7.50E+04	8.18E+04
	AL2	0.92	4.30E+07	4.69E+07	2.30E+04	2.51E+04
	AL3	0.93	4.30E+07	4.60E+07	9.30E+05	9.95E+05
	BL1	0.92	2.30E+07	2.50E+07	9.30E+03	1.01E+04
	BL2	0.92	9.30E+07	1.01E+08	9.30E+04	1.01E+05
	BL3	0.93	2.30E+07	2.46E+07	7.50E+05	8.03E+05
	CL1	0.92	2.30E+07	2.49E+07	9.30E+04	1.01E+05
	CL2	0.92	2.30E+07	2.51E+07	2.10E+06	2.29E+06
	CL3	0.92	2.30E+07	2.49E+07	1.50E+04	1.63E+04
	DL1	0.91	4.30E+06	4.72E+06	9.30E+03	1.02E+04
	DL2	0.90	9.30E+06	1.03E+07	2.10E+05	2.33E+05
	DL3	0.93	2.30E+06	2.47E+06	9.30E+04	1.00E+05
	EL1	0.91	4.30E+06	4.71E+06	1.50E+05	1.64E+05
	EL2	0.93	2.30E+05	2.49E+05	2.10E+03	2.27E+03
	EL3	0.92	2.30E+06	2.51E+06	9.30E+03	1.01E+04
	FL1	0.92	9.30E+05	1.01E+06	1.50E+04	1.63E+04
	FL2	0.91	4.30E+06	4.73E+06	2.10E+07	2.31E+07
	FL3	0.93	2.30E+06	2.48E+06	2.10E+04	2.27E+04

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN135	AU1	0.97	9.30E+05	9.63E+05	9.30E+04	9.63E+04
Site #1	AU2	0.96	2.30E+07	2.39E+07	9.30E+05	9.65E+05

Time 4	AU3	0.96	2.30E+06	2.39E+06	1.50E+05	1.56E+05
Day 15	BU1	0.96	3.90E+07	4.07E+07	2.10E+04	2.19E+04
06/05/90	BU2	0.94	4.30E+07	4.57E+07	2.90E+08	3.08E+08
	BU3	0.96	4.30E+06	4.49E+06	9.30E+03	9.72E+03
	CU1	0.94	9.30E+06	9.86E+06	1.20E+06	1.27E+06
	CU2	0.96	9.30E+05	9.72E+05	7.50E+04	7.84E+04
	CU3	0.96	2.30E+07	2.40E+07	9.30E+05	9.69E+05
	DU1	0.95	2.30E+07	2.42E+07	2.30E+05	2.42E+05
	DU2	0.96	9.30E+05	9.71E+05	2.30E+02	2.40E+02
	DU3	0.93	2.30E+06	2.47E+06	4.30E+06	4.62E+06
	EU1	0.95	2.30E+05	2.42E+05	2.30E+04	2.42E+04
	EU2	0.90	2.30E+07	2.56E+07	1.50E+03	1.67E+03
	EU3	0.93	9.30E+04	9.96E+04	4.30E+04	4.60E+04
	FU1	0.96	2.30E+07	2.40E+07	1.50E+05	1.56E+05
	FU2	0.93	4.30E+06	4.61E+06	1.20E+06	1.29E+06
	FU3	0.95	2.30E+07	2.41E+07	9.30E+04	9.75E+04
	AL1	0.80	9.30E+05	1.17E+06	2.70E+04	3.39E+04
	AL2	0.92	7.10E+06	7.76E+06	3.90E+05	4.26E+05
	AL3	0.88	4.30E+05	4.90E+05	4.30E+03	4.90E+03
	BL1	0.93	2.30E+07	2.48E+07	1.20E+06	1.29E+06
	BL2	0.93	7.50E+04	8.09E+04	1.50E+05	1.62E+05
	BL3	0.93	2.30E+07	2.47E+07	4.30E+06	4.61E+06
	CL1	0.90	2.30E+05	2.56E+05	2.10E+05	2.34E+05
	CL2	0.89	2.30E+06	2.59E+06	9.30E+04	1.05E+05
	CL3	0.91	2.10E+05	2.31E+05	7.50E+04	8.24E+04
	DL1	0.95	2.30E+05	2.42E+05	2.30E+05	2.42E+05
	DL2	0.93	9.30E+04	1.00E+05	2.30E+03	2.48E+03
	DL3	0.93	2.30E+05	2.47E+05	4.30E+04	4.62E+04
	EL1	0.85	9.30E+06	1.09E+07	7.50E+06	8.78E+06
	EL2	0.91	9.30E+05	1.03E+06	7.50E+04	8.27E+04
	EL3	0.88	4.30E÷05	4.89E+05	4.30E+02	4.89E+02
	FL1	0.92	2.30E+05	2.50E+05	4.30E+03	4.67E+03
	FL2	0.92	4.30E+04	4.66E+04	7.50E+03	8.12E+03
	FL3	0.90	4.30E+06	4.78E+06	2.10E+04	2.34E+04

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN135	AU1	0.95	2.30E+06	2.42E+06	4.30E+06	4.52E+06
Site #1	AU2	0.95	4.30E+07	4.54E+07	4.30E+04	4.54E+04
Time 5	AU3	0.93	2.30E+07	2.47E+07	4.30E+06	4.62E+06

Day 32 06/22/90	BU1	0.91	2.30E+07	2.54E+07	2.10E+08	2.32E+08
	BU2	0.95	1.50E+08	1.58E+08	9.30E+04	9.80E+04
	BU3	0.95	4.30E+06	4.53E+06	7.50E+05	7.90E+05
	CU1	0.95	4.30E+07	4.53E+07	2.10E+06	2.21E+06
	CU2	0.89	4.30E+07	4.83E+07	7.50E+05	8.43E+05
	CU3	0.95	4.30E+07	4.54E+07	9.30E+06	9.83E+06
	DU1	0.95	4.30E+07	4.52E+07	2.30E+07	2.42E+07
	DU2	0.90	7.50E+06	8.35E+06	7.50E+05	8.35E+05
	DU3	0.91	9.30E+07	1.02E+08	2.30E+06	2.53E+06
	EU1	0.91	9.30E+06	1.02E+07	1.20E+04	1.32E+04
	EU2	0.89	2.30E+07	2.57E+07	2.10E+07	2.35E+07
	EU3	0.94	1.20E+07	1.28E+07		0.00E+00
	FU1	0.95	2.30E+07	2.43E+07	4.30E+07	4.54E+07
	FU2	0.94	1.50E+07	1.59E+07		0.00E+00
	FU3	0.95	2.30E+07	2.41E+07	7.50E+04	
	AL1	0.87	1.50E+05	1.72E+05	2.10E+05	2.40E+05
	AL2	0.91	4.30E+07	4.71E+07	4.30E+05	4.71E+05
	AL3	0.92	4.30E+07	4.68E+07	2.10E+05	2.29E+05
	BL1	0.89	2.30E+07	2.59E+07	7.20E+04	8.10E+04
	BL2	0.91			4.30E+04	4.70E+04
	BL3	0.90	7.50E+06	8.38E+06	1.20E+05	1.34E+05
	CL1	0.89	4.30E+07	4.81E+07	9.30E+04	1.04E+05
	CL2	0.92	2.30E+07	2.49E+07	2.10E+05	2.27E+05
	CL3	0.89	2.30E+05	2.59E+05	4.30E+03	4.84E+03
	DL1	0.90	9.30E+08	1.04E+09	1.60E+06	1.78E+06
	DL2	0.92	4.30E+05	4.66E+05	7.20E+04	7.80E+04
	DL3	0.92	9.30E+05	1.02E+06		0.00E+00
	EL1	0.92	9.30E+05	1.01E+06	2.10E+07	2.28E+07
	EL2	0.90	2.30E+06	2.56E+06		0.00E+00
	EL3	0.92	4.30E+07	4.67E+07		0.00E+00
	FL1	0.91	4.30E+07	4.74E+07	9.30E+03	1.03E+04
	FL2	0.92	2.30E+07	2.50E+07	9.30E+06	1.01E+07
	FL3	0.92	9.30E+05	1.02E+06	4.30E+05	4.69E+05

KN135B refertilized 7/12/90

KN135 Site #1 Time 6 Pre-reapplication 07/12/90 (Day 52)	AU1	0.95	5.00E+06	5.24E+06	1.10E+05	1.15E+05
	AU2	0.96		0.00E+00	7.00E+04	7.26E+04
	AU3	0.94	5.00E+07	5.33E+07	2.30E+05	2.45E+05
	BU1	0.97	5.00E+06	5.15E+06	2.60E+04	2.68E+04
	BU2	0.95	1.30E+07	1.37E+07	1.30E+05	1.37E+05
	BU3	0.95		0.00E+00	3.00E+05	3.16E+05
	CU1	0.96	5.00E+06	5.23E+06	2.80E+04	2.93E+04

	CU2	0.95		0.00E+00	8.00E+05	8.42E+05
	CU3	0.94	3.00E+06	3.19E+06	3.00E+05	3.19E+05
	DU1	0.98	8.00E+06	8.20E+06	7.00E+04	7.18E+04
	DU2	0.92	3.00E+06	3.25E+06	5.00E+06	5.41E+06
	DU3	0.92	5.00E+06	5.45E+06	2.20E+05	2.40E+05
	EU1	0.97	1.10E+07	1.14E+07	2.20E+05	2.27E+05
	EU2	0.79	5.00E+06	6.34E+06	2.20E+05	2.79E+05
	EU3	0.93	2.40E+06	2.58E+06	1.70E+05	1.83E+05
	FU1	0.97	5.00E+06	5.15E+06	3.00E+05	3.09E+05
	FU2	0.96	1.10E+06	1.15E+06	1.30E+05	1.35E+05
	FU3	0.97	1.30E+06	1.34E+06		
	AL1	0.90	8.00E+05	8.92E+05	2.20E+05	2.45E+05
	AL2	0.91		0.00E+00	1.70E+06	1.86E+06
	AL3	0.91	8.00E+05	8.83E+05	1.30E+06	1.43E+06
	BL1	0.91	3.00E+06	3.28E+06	1.30E+06	1.42E+06
	BL2	0.93	3.00E+07	3.22E+07	3.00E+05	3.22E+05
	BL3	0.91	5.00E+06	5.52E+06	1.70E+04	1.88E+04
	CL1	0.94	2.20E+06	2.33E+06	2.20E+06	2.33E+06
	CL2	0.95	8.00E+06	8.38E+06	8.00E+04	8.38E+04
	CL3	0.93	1.30E+07	1.40E+07	7.00E+05	7.54E+05
	DL1	0.92	5.00E+06	5.41E+06	7.00E+05	7.58E+05
	DL2	0.94	2.40E+06	2.56E+06	3.00E+05	3.21E+05
	DL3	0.95	1.70E+05	1.80E+05	3.40E+03	3.59E+03
	EL1	0.95	3.00E+06	3.14E+06	3.00E+05	3.14E+05
	EL2	0.95	2.40E+06	2.54E+06	1.30E+06	1.37E+06
	EL3	0.93	1.10E+06	1.18E+06	1.10E+06	1.18E+06
	FL1	0.86	1.10E+06	1.28E+06	2.40E+06	2.80E+06
	FL2	0.94	5.00E+06	5.30E+06	3.40E+05	3.60E+05
	FL3	0.94	5.00E+05	5.33E+05	2.80E+05	2.99E+05
KN135	AU1	0.94	1.60E+09	1.71E+09	1.30E+06	1.39E+06
Site #1	AU2	0.91	3.00E+08	3.30E+08	3.30E+06	3.63E+06
Time 7	AU3	0.96	2.40E+08	2.51E+08	2.20E+06	2.30E+06
Day 4 Re-app.	BU1	0.92	1.60E+09	1.73E+09	5.00E+06	5.42E+06
07/16/90	BU2	0.93	1.60E+09	1.72E+09	9.00E+05	9.69E+05
(Day 56)	BU3	0.90	9.00E+07	1.00E+08	2.20E+06	2.45E+06
	CU1	0.95	2.30E+07	2.41E+07	2.80E+05	2.94E+05
	CU2	0.93	3.00E+07	3.24E+07	2.20E+05	2.37E+05
	CU3	0.96	9.00E+07	9.42E+07	1.30E+06	1.36E+06

	DU1	0.94	8.00E+06	8.48E+06	1.30E+05	1.38E+05
	DU2	0.95	8.00E+06	8.45E+06	1.70E+05	1.80E+05
	DU3	0.93	3.00E+06	3.22E+06	5.00E+05	5.37E+05
	EU1	0.93	1.30E+06	1.40E+06	2.80E+05	3.02E+05
	EU2	0.94	1.30E+06	1.39E+06	1.40E+06	1.49E+06
	EU3	0.94	8.00E+06	8.50E+06	1.10E+05	1.17E+05
	FU1	0.95	3.00E+06	3.17E+06	1.30E+05	1.37E+05
	FU2	0.95	8.00E+06	8.43E+06	1.70E+05	1.79E+05
	FU3	0.95	3.00E+07	3.16E+07	3.30E+03	3.48E+03
	AL1	0.90	9.00E+07	1.00E+08	5.00E+05	5.57E+05
	AL2	0.88	5.00E+08	5.69E+08	2.20E+06	2.50E+06
	AL3	0.91	1.60E+09	1.76E+09	1.70E+06	1.87E+06
	BL1	0.90	2.10E+06	2.33E+06	2.20E+06	2.44E+06
	BL2	0.86	3.00E+07	3.49E+07	5.00E+06	5.82E+06
	BL3	0.84	2.20E+07	2.63E+07	2.20E+05	2.63E+05
	CL1	0.92	6.00E+07	6.52E+07	2.20E+06	2.39E+06
	CL2	0.85	2.20E+06	2.58E+06	1.10E+06	1.29E+06
	CL3	0.76	2.40E+08	3.15E+08	3.00E+06	3.94E+06
	DL1	0.92	2.20E+06	2.39E+06	9.00E+04	9.78E+04
	DL2	0.92	2.30E+06	2.51E+06	1.40E+05	1.53E+05
	DL3	0.92	4.00E+05	4.37E+05	2.20E+04	2.40E+04
	EL1	0.91	3.00E+06	3.29E+06	8.00E+04	8.79E+04
	EL2	0.92	2.30E+06	2.50E+06	7.00E+04	7.61E+04
	EL3	0.90		0.00E+00	1.30E+06	1.45E+06
	FL1	0.84		0.00E+00	1.70E+05	2.04E+05
	FL2	0.93	8.00E+05	8.62E+05	2.20E+04	2.37E+04
	FL3	0.94	8.00E+06	8.53E+06	5.00E+05	5.33E+05
KN135	AU1	0.96	1.30E+07	1.35E+07	5.00E+05	5.21E+05
Site #1	AU2	0.96	1.30E+07	1.36E+07	3.00E+06	3.14E+06
Time 8	AU3	0.93	2.40E+08	2.58E+08	1.70E+06	1.83E+06
Day 18 Re-app.	BU1	0.94	1.30E+07	1.38E+07	1.40E+06	1.49E+06
07/30/90	BU2	0.94			2.20E+05	2.34E+05
(Day 70)	BU3	0.96	8.00E+06	8.30E+06	2.40E+06	2.49E+06
	CU1	0.96	5.00E+07	5.22E+07	1.10E+06	1.15E+06
	CU2	0.93	8.00E+06	8.61E+06	3.00E+06	3.23E+06
	CU3	0.96	1.10E+07	1.15E+07	8.00E+05	8.37E+05
	DU1	0.94		0.00E+00	7.00E+05	7.48E+05
	DU2	0.95	1.30E+07	1.36E+07	1.70E+06	1.78E+06
	DU3	0.92	1.30E+07	1.42E+07	1.70E+05	1.86E+05
	EU1	0.89	3.00E+06	3.37E+06		0.00E+00

	EU2	0.91	7.00E+06	7.70E+06		0.00E+00
	EU3	0.95	1.10E+07	1.16E+07	3.00E+05	3.17E+05
	FU1	0.95	8.00E+06	8.38E+06	1.70E+04	1.78E+04
	FU2	0.92		0.00E+00		0.00E+00
	FU3	0.94		0.00E+00	3.00E+04	3.19E+04
	AL1	0.86	1.10E+07	1.28E+07	1.10E+06	1.28E+06
	AL2	0.87	2.20E+06	2.52E+06	3.00E+04	3.44E+04
	AL3	0.93				0.00E+00
	BL1	0.90	1.30E+07	1.44E+07	2.20E+05	2.43E+05
	BL2	0.89	2.20E+07	2.48E+07	1.10E+06	1.24E+06
	BL3	0.92	1.10E+07	1.20E+07	3.00E+06	3.28E+06
	CL1	0.87	2.40E+07	2.77E+07	1.70E+06	1.96E+06
	CL2	0.89	1.30E+06	1.46E+06	1.70E+05	1.91E+05
	CL3	0.89		0.00E+00	3.00E+06	3.36E+06
	DL1	0.92	7.00E+04	7.58E+04	1.10E+05	1.19E+05
	DL2	0.93		0.00E+00	3.30E+04	3.55E+04
	DL3	0.93	4.00E+04	4.31E+04	2.20E+05	2.37E+05
	EL1	0.91	1.30E+06	1.43E+06		0.00E+00
	EL2	0.92	1.70E+06	1.84E+06	1.30E+05	1.41E+05
	EL3	0.91	8.00E+05	8.78E+05	2.80E+04	3.07E+04
	FL1	0.93	9.00E+06	9.67E+06	1.30E+06	1.40E+06
	FL2	0.92		0.00E+00	5.00E+04	5.43E+04
	FL3	0.92	2.20E+06	2.39E+06	1.70E+05	1.84E+05
KN135	AU1	0.94	2.80E+07	2.98E+07	1.10E+07	1.17E+07
Site #1	AU2	0.92	5.00E+06	5.43E+06	1.70E+06	1.85E+06
Time 9	AU3	0.95		0.00E+00	3.50E+06	3.68E+06
Day 27 Re-app.	BU1	0.94		0.00E+00	1.10E+06	1.16E+06
08/07/90	BU2	0.90		0.00E+00	1.30E+06	1.45E+06
(Day 78)	BU3	0.93	5.00E+07	5.36E+07	1.30E+06	1.39E+06
	CU1	0.93	3.00E+07	3.24E+07	1.70E+06	1.83E+06
	CU2	0.93		0.00E+00	8.00E+06	8.62E+06
	CU3	0.91		0.00E+00	2.80E+06	3.06E+06
	DU1	0.96		0.00E+00	1.70E+06	1.78E+06
	DU2	0.93		0.00E+00	3.00E+07	3.21E+07
	DU3	0.90		0.00E+00	1.10E+06	1.22E+06
	EU1	0.94		0.00E+00	8.00E+05	8.48E+05
	EU2	0.92		0.00E+00	5.00E+05	5.41E+05
	EU3	0.95		0.00E+00	8.00E+05	8.45E+05
	FU1	0.93		0.00E+00	7.00E+05	7.55E+05
	FU2	0.92		0.00E+00	1.30E+07	1.41E+07

	FU3	0.90		0.00E+00	8.00E+06	8.86E+06
	AL1	0.91	5.00E+06	5.52E+06	1.30E+05	1.44E+05
	AL2	0.93		0.00E+00	2.20E+06	2.36E+06
	AL3	0.78		0.00E+00	1.70E+06	2.19E+06
	BL1	0.91		0.00E+00	1.70E+05	1.87E+05
	BL2	0.92		0.00E+00		0.00E+00
	BL3	0.90	2.20E+07	2.45E+07	1.70E+06	1.90E+06
	CL1	0.94		0.00E+00	1.40E+06	1.49E+06
	CL2	0.93		0.00E+00	2.80E+06	3.01E+06
	CL3	0.89		0.00E+00	1.10E+05	1.24E+05
	DL1	0.91	4.00E+05	4.40E+05	5.00E+05	5.51E+05
	DL2	0.93	1.70E+06	1.82E+06	1.30E+06	1.39E+06
	DL3	0.92		0.00E+00		0.00E+00
	EL1	0.91		0.00E+00	1.70E+06	1.86E+06
	EL2	0.91	7.00E+06	7.69E+06	2.20E+05	2.42E+05
	EL3	0.92		0.00E+00	3.00E+06	3.25E+06
	FL1	0.92		0.00E+00	7.00E+05	7.61E+05
	FL2	0.94		0.00E+00	1.10E+06	1.17E+06
	FL3	0.90	1.30E+06	1.44E+06		0.00E+00
KN135	AU1	0.93			5.00E+05	5.38E+05
Site #1	AU2	0.93			1.70E+05	1.83E+05
Time 10	AU3	0.93			2.20E+06	2.37E+06
Day 57 Re-app.	BU1	0.93			3.00E+05	3.23E+05
09/07/90	BU2	0.93			3.30E+05	3.55E+05
(Day 109)	BU3	0.93			3.00E+05	3.23E+05
Processed 9/8/90	CU1	0.93			3.00E+06	3.23E+06
	CU2	0.93			2.30E+06	2.47E+06
	CU3	0.93			1.40E+05	1.51E+05
	DU1	0.93			9.00E+04	9.68E+04
	DU2	0.93			1.70E+06	1.83E+06
	DU3	0.93			3.00E+06	3.23E+06
	EU1	0.93			1.10E+05	1.18E+05
	EU2	0.93			3.00E+05	3.23E+05
	EU3	0.93			1.70E+05	1.83E+05
	FU1	0.93			5.00E+05	5.38E+05
	FU2	0.93			8.00E+05	8.60E+05
	FU3	0.93			3.00E+06	3.23E+06
	AL1	0.93			2.80E+05	3.01E+05
	AL2	0.93			1.30E+06	1.40E+06

AL3	0.93			3.00E+05	3.23E+05
BL1	0.93			3.00E+05	3.23E+05
BL2	0.93			2.80E+05	3.01E+05
BL3	0.93			2.20E+06	2.37E+06
CL1	0.93			1.70E+06	1.83E+06
CL2	0.93			8.00E+04	8.60E+04
CL3	0.93			1.70E+06	1.83E+06
DL1	0.93			2.20E+04	2.37E+04
DL2	0.93			5.00E+05	5.38E+05
DL3	0.93			8.00E+05	8.60E+05
EL1	0.93			2.30E+05	2.47E+05
EL2	0.93			8.00E+05	8.60E+05
EL3	0.93			7.00E+05	7.53E+05
FL1	0.93			5.00E+05	5.38E+05
FL2	0.93			3.00E+05	3.23E+05
FL3	0.93			1.40E+06	1.51E+06

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	BEACH SEGMENT					
KN211	AU1	0.97	4.30E+05	4.43E+05	9.30E+03	9.58E+03
Site #2	AU2	0.96	1.50E+06	1.56E+06	1.50E+05	1.56E+05
Time 0	AU3	0.97	9.30E+05	9.55E+05	9.30E+03	9.55E+03
Day 0	BU1	0.97	9.30E+05	9.54E+05	9.30E+03	9.54E+03
05/26/90	BU2	0.97	4.30E+06	4.44E+06	1.50E+04	1.55E+04
	BU3	0.96	2.30E+06	2.40E+06	7.50E+04	7.81E+04
	CU1	0.95	2.30E+05	2.42E+05	4.30E+03	4.52E+03
	CU2	0.95	9.30E+06	9.80E+06	2.10E+04	2.21E+04
	CU3	0.96	4.30E+06	4.46E+06	3.90E+03	4.04E+03
	DU1	0.95	2.30E+06	2.43E+06	2.30E+05	2.43E+05
	DU2	0.93	4.30E+06	4.61E+06	7.50E+04	8.05E+04
	DU3	0.93	4.30E+06	4.63E+06	1.50E+05	1.61E+05
	EU1	0.95	3.90E+06	4.13E+06	9.30E+03	9.84E+03
	EU2	0.96	9.30E+06	9.67E+06	1.50E+04	1.56E+04
	EU3	0.93	2.30E+06	2.48E+06	4.30E+04	4.63E+04
	FU1	0.96	4.30E+06	4.46E+06	7.50E+04	7.78E+04
	FU2	0.94	7.50E+06	8.01E+06	4.30E+04	4.59E+04
	FU3	0.94	4.30E+06	4.56E+06	4.30E+03	4.56E+03
	AL1	0.94	1.50E+05	1.59E+05	2.30E+02	2.44E+02
	AL2	0.93	9.30E+06	9.98E+06	2.30E+04	2.47E+04
	AL3	0.93	2.10E+06	2.26E+06	9.30E+04	1.00E+05
	BL1	0.94	2.30E+06	2.46E+06	4.30E+04	4.60E+04
	BL2	0.94	2.30E+06	2.45E+06	9.30E+04	9.89E+04

	BL3	0.92	9.30E+06	1.01E+07	1.50E+04	1.62E+04
	CL1	0.93	2.30E+07	2.47E+07	1.50E+04	1.61E+04
	CL2	0.95	4.30E+05	4.54E+05	9.30E+04	9.81E+04
	CL3	0.93	4.30E+06	4.64E+06	2.40E+06	2.59E+06
	DL1	0.96	1.50E+07	1.56E+07	4.30E+03	4.48E+03
	DL2	0.92	9.30E+06	1.01E+07	1.50E+04	1.63E+04
	DL3	0.94	2.30E+06	2.45E+06	4.30E+04	4.58E+04
	EL1	0.94	9.30E+06	9.85E+06	9.30E+03	9.85E+03
	EL2	0.94	4.30E+06	4.59E+06	2.30E+04	2.46E+04
	EL3	0.93	4.30E+06	4.64E+06	3.90E+02	4.21E+02
	FL1	0.94	4.30E+06	4.60E+06	1.50E+06	1.60E+06
	FL2	0.93	9.30E+06	9.98E+06	1.50E+04	1.61E+04
	FL3	0.93	2.30E+06	2.47E+06	1.50E+06	1.61E+06

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN211	AU1	0.97	1.50E+05	1.55E+05	9.30E+05	9.60E+05
Site #2	AU2	0.97	7.50E+05	7.71E+05	1.20E+05	1.23E+05
Time 1	AU3	0.97	4.30E+06	4.45E+06	9.30E+04	9.63E+04
Day 2	BU1	0.96	4.30E+06	4.49E+06	9.30E+05	9.72E+05
06/01/90	BU2	0.96	4.30E+06	4.46E+06	1.20E+06	1.24E+06
	BU3	0.98	4.30E+06	4.41E+06	2.10E+05	2.15E+05
	CU1	0.97	3.90E+05	4.02E+05	3.90E+03	4.02E+03
	CU2	0.96	2.30E+06	2.41E+06	2.90E+06	3.03E+06
	CU3	0.97	2.30E+06	2.36E+06	7.50E+05	7.70E+05
	DU1	0.94	9.30E+06	9.93E+06	9.30E+05	9.93E+05
	DU2	0.94	4.30E+06	4.56E+06	1.20E+06	1.27E+06
	DU3	0.91	4.30E+06	4.71E+06	1.50E+06	1.64E+06
	EU1	0.94	2.30E+07	2.46E+07	4.30E+05	4.59E+05
	EU2	0.92	2.30E+07	2.49E+07	2.10E+05	2.28E+05
	EU3	0.94	4.30E+06	4.60E+06	9.30E+06	9.94E+06
	FU1	0.95	2.30E+05	2.43E+05	4.30E+05	4.54E+05
	FU2	0.93	4.30E+06	4.61E+06	1.50E+06	1.61E+06
	FU3	0.93	4.30E+06	4.61E+06	2.30E+06	2.47E+06
	AL1	0.95	9.30E+04	9.83E+04	3.50E+05	3.70E+05
	AL2	0.95	4.30E+05	4.54E+05	2.10E+07	2.22E+07
	AL3	0.95	2.30E+06	2.43E+06	9.30E+05	9.82E+05
	BL1	0.94	4.30E+06	4.59E+06	2.10E+06	2.24E+06
	BL2	0.93	4.30E+06	4.62E+06	9.30E+05	9.99E+05
	BL3	0.93	4.30E+06	4.63E+06	1.50E+06	1.62E+06
	CL1	0.92	9.30E+06	1.01E+07		0.00E+00
	CL2	0.93	4.30E+06	4.64E+06	4.30E+06	4.64E+06
	CL3	0.92	4.30E+06	4.65E+06	2.30E+07	2.49E+07

	DL1	0.94	4.30E+06	4.60E+06	1.50E+04	1.60E+04

	DL2	0.94	9.30E+06	9.92E+06	1.50E+05	1.60E+05
	DL3	0.94	9.30E+06	9.87E+06	2.10E+04	2.23E+04
	EL1	0.93	4.30E+06	4.63E+06	2.10E+05	2.26E+05
	EL2	0.92	9.30E+06	1.01E+07	9.30E+04	1.01E+05
	EL3	0.94	4.30E+06	4.58E+06	9.30E+03	9.92E+03
	FL1	0.94	9.60E+06	1.02E+07	1.50E+04	1.59E+04
	FL2	0.94	4.30E+07	4.59E+07	4.30E+04	4.59E+04
	FL3	0.94	4.30E+06	4.57E+06	9.30E+02	9.88E+02

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN211	AU1	0.97	4.30E+07	4.43E+07	7.50E+03	7.72E+03
Site #2	AU2	0.97	4.30E+06	4.44E+06	1.50E+04	1.55E+04
Time 2	AU3	0.97	4.30E+06	4.45E+06	1.20E+05	1.24E+05
Day 4	BU1	0.98	4.30E+06	4.39E+06	4.30E+04	4.39E+04
06/03/90	BU2	0.98	9.30E+05	9.51E+05	1.50E+04	1.53E+04
	BU3	0.97	2.30E+07	2.38E+07	1.50E+06	1.55E+06
	CU1	0.92	2.30E+06	2.49E+06	9.30E+05	1.01E+06
	CU2	0.97	1.50E+06	1.55E+06	9.30E+04	9.62E+04
	CU3	0.97	2.30E+07	2.36E+07	9.30E+04	9.55E+04
	DU1	0.94	4.30E+06	4.60E+06	2.30E+05	2.46E+05
	DU2	0.97	3.50E+05	3.60E+05	1.50E+04	1.54E+04
	DU3	0.90	7.50E+06	8.37E+06	4.30E+05	4.80E+05
	EU1	0.95	9.30E+07	9.82E+07	7.50E+04	7.92E+04
	EU2	0.89	4.30E+07	4.80E+07	4.30E+06	4.80E+06
	EU3	0.94	2.30E+06	2.44E+06	2.30E+07	2.44E+07
	FU1	0.96	1.50E+07	1.56E+07	1.50E+07	1.56E+07
	FU2	0.94	9.30E+06	9.84E+06	1.50E+04	1.59E+04
	FU3	0.94	4.30E+06	4.56E+06	1.50E+06	1.59E+06
	AL1	0.92	9.30E+06	1.02E+07	7.50E+05	8.19E+05
	AL2	0.94	7.50E+05	7.94E+05	3.90E+04	4.13E+04
	AL3	0.94	4.30E+06	4.57E+06	4.30E+06	4.57E+06
	BL1	0.93	9.30E+05	9.95E+05	3.50E+05	3.74E+05
	BL2	0.94	9.30E+06	9.89E+06	9.30E+05	9.89E+05
	BL3	0.93	1.50E+07	1.61E+07	9.30E+06	9.97E+06
	CL1	0.95	4.30E+07	4.54E+07	2.10E+06	2.22E+06
	CL2	0.95	7.50E+06	7.89E+06	9.30E+04	9.78E+04
	CL3	0.94	4.30E+06	4.59E+06	7.50E+05	8.01E+05
	DL1	0.94	4.30E+06	4.60E+06	1.50E+06	1.60E+06
	DL2	0.95	6.40E+05	6.77E+05	4.30E+03	4.55E+03

DL3	0.93	4.30E+07	4.62E+07	1.20E+07	1.29E+07
EL1	0.93	2.30E+07	2.46E+07	7.50E+05	8.03E+05
EL2	0.94	4.30E+06	4.57E+06	1.50E+04	1.59E+04
EL3	0.93	9.30E+06	9.97E+06	1.50E+07	1.61E+07
FL1	0.94	9.30E+06	9.94E+06	2.30E+07	2.46E+07
FL2	0.95	4.30E+05	4.51E+05	1.50E+04	1.57E+04
FL3	0.95	9.30E+05	9.82E+05	1.50E+03	1.58E+03

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN211 Site #2 Time 3 Day 8 06/07/90	AU1	0.97	2.30E+06	2.37E+06	2.30E+02	2.37E+02
	AU2	0.97	9.30E+05	9.58E+05	2.30E+03	2.37E+03
	AU3	0.94	2.30E+07	2.44E+07	4.30E+05	4.57E+05
	BU1	0.98	9.30E+05	9.52E+05	2.30E+04	2.35E+04
	BU2	0.97	2.10E+06	2.16E+06	4.30E+04	4.43E+04
	BU3	0.93	9.30E+06	1.00E+07	4.30E+06	4.63E+06
	CU1	0.95	1.50E+05	1.57E+05	1.50E+04	1.57E+04
	CU2	0.96	4.30E+05	4.47E+05	1.50E+05	1.56E+05
	CU3	0.94		0.00E+00	1.50E+06	1.60E+06
	DU1	0.93	9.30E+04	9.96E+04	2.30E+04	2.46E+04
	DU2	0.92	4.30E+05	4.66E+05	1.50E+05	1.62E+05
	DU3	0.93	4.30E+05	4.61E+05	1.50E+06	1.61E+06
	EU1	0.93	4.30E+05	4.60E+05	1.50E+05	1.61E+05
	EU2	0.95	2.30E+06	2.43E+06	4.30E+04	4.54E+04
	EU3	0.95	1.50E+06	1.59E+06	9.30E+05	9.84E+05
	FU1	0.94	9.30E+06	9.84E+06	4.30E+04	4.55E+04
	FU2	0.93	9.30E+05	9.95E+05	4.30E+05	4.60E+05
	FU3	0.95	7.50E+06	7.93E+06	4.30E+06	4.55E+06
	AL1	0.95	9.30E+04	9.77E+04	1.50E+05	1.58E+05
	AL2	0.95	9.30E+05	9.80E+05	4.30E+05	4.53E+05
	AL3	0.95	4.30E+06	4.54E+06	2.10E+05	2.22E+05
	BL1	0.94	9.30E+05	9.88E+05	2.30E+05	2.44E+05
	BL2	0.95	2.30E+05	2.43E+05	1.50E+06	1.58E+06
	BL3	0.95	2.30E+07	2.41E+07	2.30E+05	2.41E+05
	CL1	0.94	2.30E+05	2.44E+05	4.30E+04	4.57E+04
	CL2	0.93	2.30E+06	2.47E+06	4.30E+06	4.63E+06
	CL3	0.94	4.30E+05	4.60E+05	9.30E+06	9.94E+06
	DL1	0.94	4.30E+05	4.56E+05	1.50E+04	1.59E+04
	DL2	0.93	4.30E+05	4.61E+05	1.50E+06	1.61E+06

DL3	0.94	4.30E+05	4.55E+05	2.10E+05	2.22E+05
EL1	0.93	9.30E+05	9.99E+05	9.30E+03	9.99E+03
EL2	0.91	4.30E+05	4.72E+05	9.30E+03	1.02E+04
EL3	0.94	9.30E+05	9.92E+05	9.30E+05	9.92E+05
FL1	0.94	2.30E+06	2.45E+06	2.10E+05	2.24E+05
FL2	0.94	1.50E+05	1.60E+05	9.30E+04	9.92E+04
FL3	0.94	2.30E+05	2.44E+05	9.30E+04	9.85E+04

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	BEACH	% Dry Wt.	MPN	Corr.	Oil MPN	Corr.
	SEGMENT			MPN		Oil
KN211	AU1	0.95	4.30E+05	4.55E+05	2.30E+06	2.43E+06
Site #2	AU2	0.97	9.30E+06	9.57E+06	7.50E+05	7.72E+05
Time 4	AU3	0.95	1.20E+06	1.27E+06	4.30E+05	4.54E+05
Day 16	BU1	0.97	2.30E+06	2.37E+06	4.30E+05	4.43E+05
06/15/90	BU2	0.96	9.30E+06	9.65E+06	9.30E+06	9.65E+06
	BU3	0.97	2.30E+07	2.36E+07	1.10E+05	1.13E+05
	CU1	0.94		0.00E+00	4.30E+04	4.56E+04
	CU2	0.95	2.30E+07	2.42E+07	2.30E+06	2.42E+06
	CU3	0.96	4.30E+05	4.46E+05	7.50E+04	7.78E+04
	DU1	0.88	4.30E+05	4.86E+05	2.30E+04	2.60E+04
	DU2	0.97	9.30E+06	9.61E+06	4.30E+05	4.44E+05
	DU3	0.92	2.10E+06	2.27E+06	3.90E+05	4.22E+05
	EU1	0.95	4.30E+06	4.52E+06	2.10E+05	2.21E+05
	EU2	0.94	2.30E+08	2.46E+08	9.30E+04	9.93E+04
	EU3	0.95	2.30E+07	2.41E+07	4.30E+05	4.51E+05
	FU1	0.96	4.30E+05	4.50E+05	7.50E+05	7.85E+05
	FU2	0.95	9.30E+06	9.84E+06	9.30E+05	9.84E+05
	FU3	0.94	4.30E+07	4.56E+07	9.30E+05	9.87E+05
	AL1	0.94	2.30E+05	2.45E+05	4.30E+04	4.57E+04
	AL2	0.94	9.30E+05	9.85E+05	2.30E+05	2.44E+05
	AL3	0.95	3.90E+05	4.11E+05	1.50E+05	1.58E+05
	BL1	0.93	4.30E+06	4.61E+06	4.30E+06	4.61E+06
	BL2	0.94	7.50E+07	7.94E+07	9.30E+06	9.85E+06
	BL3	0.93	9.30E+07	1.00E+08	4.30E+05	4.62E+05
	CL1	0.93	4.30E+07	4.60E+07	2.30E+06	2.46E+06
	CL2	0.94	9.30E+06	9.88E+06	4.30E+05	4.57E+05
	CL3	0.93	9.30E+05	1.00E+06	3.90E+06	4.20E+06
	DL1	0.92	4.30E+05	4.67E+05	2.30E+06	2.50E+06
	DL2	0.92	4.30E+05	4.68E+05	1.50E+06	1.63E+06

	DL3	0.94	2.30E+06	2.44E+06	4.30E+05	4.56E+05
	EL1	0.94	9.30E+06	9.95E+06	2.30E+06	2.46E+06
	EL2	0.94	9.30E+05	9.88E+05	9.30E+05	9.88E+05
	EL3	0.94	2.30E+06	2.45E+06	7.50E+03	7.98E+03
	FL1	0.95	2.30E+07	2.41E+07	9.30E+05	9.75E+05
	FL2	0.94	9.30E+06	9.87E+06	1.50E+05	1.59E+05
	FL3	0.95	4.30E+04	4.51E+04	2.30E+04	2.41E+04

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	BEACH SEGMENT					
KN211	AU1	0.96	1.50E+05	1.56E+05	9.30E+04	9.65E+04
Site #2	AU2	0.97	2.30E+05	2.38E+05	4.30E+04	4.44E+04
Time 5	AU3	0.91	2.30E+05	2.52E+05	2.30E+06	2.52E+06
Day 31	BU1	0.95	2.30E+05	2.43E+05	2.30E+05	2.43E+05
06/30/90	BU2	0.93	1.50E+06	1.61E+06	9.30E+06	9.95E+06
	BU3	0.97	9.30E+04	9.56E+04	4.30E+04	4.42E+04
	CU1	0.96	9.30E+04	9.68E+04	2.30E+05	2.39E+05
	CU2	0.96	4.30E+05	4.47E+05	2.30E+04	2.39E+04
	CU3	0.96	2.30E+05	2.39E+05	7.50E+05	7.78E+05
	DU1	0.94	2.30E+05	2.44E+05	9.30E+05	9.88E+05
	DU2	0.92	4.30E+06	4.66E+06	2.10E+06	2.28E+06
	DU3	0.95	2.30E+06	2.41E+06	4.30E+06	4.50E+06
	EU1	0.93	9.50E+04	1.02E+05	4.30E+05	4.63E+05
	EU2	0.95	2.30E+07	2.42E+07	9.30E+05	9.80E+05
	EU3	0.95	4.30E+04	4.51E+04	4.30E+05	4.51E+05
	FU1	0.94	9.30E+04	9.89E+04	4.30E+06	4.57E+06
	FU2	0.95	9.30E+04	9.79E+04	9.30E+05	9.79E+05
	FU3	0.93	2.30E+07	2.46E+07	1.50E+06	1.61E+06
	AL1	0.94	2.30E+05	2.45E+05	4.30E+05	4.58E+05
	AL2	0.94	7.50E+04	7.99E+04	2.30E+05	2.45E+05
	AL3	0.93	2.30E+05	2.47E+05	9.30E+05	9.98E+05
	BL1	0.75	9.30E+04	1.25E+05	4.30E+05	5.77E+05
	BL2	1.13	7.50E+05	6.64E+05	2.30E+06	2.04E+06
	BL3	0.94	2.30E+07	2.44E+07	1.20E+06	1.27E+06
	CL1	0.94	2.10E+05	2.23E+05	1.50E+06	1.60E+06
	CL2	0.94	9.30E+04	9.90E+04	1.50E+06	1.60E+06
	CL3	0.93	1.50E+05	1.62E+05	1.50E+05	1.62E+05
	DL1	0.94	1.50E+05	1.60E+05	1.50E+06	1.60E+06
	DL2	0.92	2.30E+05	2.50E+05	2.30E+05	2.50E+05

	DL3	0.93	4.30E+04	4.61E+04	1.50E+06	1.61E+06
	EL1	0.93		0.00E+00	2.30E+04	2.47E+04
	EL2	0.95	9.30E+04	9.80E+04	2.30E+05	2.42E+05
	EL3	0.93	2.30E+05	2.47E+05	2.30E+05	2.47E+05
	FL1	0.93	9.30E+04	9.98E+04	2.10E+04	2.25E+04
	FL2	0.93	9.30E+04	1.00E+05	1.50E+07	1.62E+07
	FL3	0.94	9.30E+04	9.87E+04	1.50E+06	1.59E+06

KN211E refertilized 7/12/90

KN211	AU1	0.95	8.00E+06	8.43E+06	2.70E+06	2.84E+06
Site #2	AU2	0.95	3.00E+07	3.14E+07	2.70E+06	2.83E+06
Time 6	AU3	0.97		0.00E+00	1.30E+05	1.33E+05
Day 4 Re-app.	BU1	0.96	2.20E+06	2.29E+06	3.00E+05	3.12E+05
07/16/90	BU2	0.98	1.30E+05	1.33E+05	1.40E+04	1.43E+04
(Day 45)	BU3	0.97	1.30E+06	1.34E+06	3.00E+05	3.08E+05
	CU1	0.94	1.70E+06	1.80E+06	2.70E+04	2.87E+04
	CU2	0.94		0.00E+00	1.10E+06	1.17E+06
	CU3	0.95	5.00E+06	5.27E+06	7.00E+04	7.38E+04
	DU1	0.93	2.30E+06	2.47E+06	3.00E+04	3.22E+04
	DU2	0.94		0.00E+00	5.00E+05	5.32E+05
	DU3	0.95	2.40E+08	2.54E+08	8.00E+05	8.45E+05
	EU1	0.95		0.00E+00	3.00E+06	3.16E+06
	EU2	0.95		0.00E+00	1.70E+04	1.80E+04
	EU3	0.95	2.30E+06	2.43E+06	5.00E+05	5.29E+05
	FU1	0.95		0.00E+00	5.00E+06	5.26E+06
	FU2	0.96		0.00E+00	5.00E+05	5.20E+05
	FU3	0.94	3.00E+07	3.20E+07	1.30E+06	1.39E+06
	AL1	0.95	8.00E+05	8.46E+05	1.70E+05	1.80E+05
	AL2	0.94	2.10E+06	2.24E+06	1.40E+06	1.49E+06
	AL3	0.93	3.00E+05	3.23E+05	1.30E+04	1.40E+04
	BL1	0.90	5.00E+06	5.53E+06	3.00E+05	3.32E+05
	BL2	0.93	3.00E+06	3.23E+06	5.00E+06	5.38E+06
	BL3	0.92	5.00E+06	5.46E+06	8.00E+05	8.73E+05
	CL1	0.93		0.00E+00	1.10E+06	1.18E+06
	CL2	0.94	8.00E+06	8.54E+06	5.00E+04	5.34E+04
	CL3	0.92	1.10E+06	1.20E+06	1.10E+05	1.20E+05
	DL1	0.91		0.00E+00	3.30E+04	3.62E+04
	DL2	0.91	2.20E+06	2.41E+06	1.70E+05	1.86E+05
	DL3	0.93		0.00E+00	7.00E+05	7.54E+05
	EL1	0.92		0.00E+00	3.00E+06	3.26E+06
	EL2	0.93	1.70E+06	1.83E+06	1.70E+05	1.83E+05
	EL3	0.94		0.00E+00	2.40E+06	2.56E+06
	FL1	0.94		0.00E+00	8.00E+05	8.53E+05

	FL2	0.96	7.00E+06	7.32E+06	2.70E+04	2.82E+04
	FL3	0.95		0.00E+00	2.40E+05	2.53E+05
KN211	AU1	0.94	1.70E+06	1.82E+06	8.00E+04	8.55E+04
Site #2	AU2	0.91	2.40E+06	2.65E+06	1.10E+06	1.21E+06
Time 7	AU3	0.97	3.00E+05	3.09E+05	3.00E+04	3.09E+04
Day 19 Re-app.	BU1	0.93	5.00E+05	5.38E+05	8.00E+04	8.61E+04
07/31/90	BU2	0.95	2.40E+06	2.53E+06	5.00E+06	5.28E+06
(Day 60)	BU3	0.91	5.00E+05	5.49E+05	5.00E+04	5.49E+04
	CU1	0.96		0.00E+00	1.70E+05	1.77E+05
	CU2	0.91	1.10E+07	1.21E+07	1.10E+04	1.21E+04
	CU3	0.95	3.00E+06	3.15E+06	2.20E+04	2.31E+04
	DU1	0.93	3.40E+06	3.64E+06	1.40E+05	1.50E+05
	DU2	0.97	5.00E+06	5.13E+06	3.00E+04	3.08E+04
	DU3	0.96	8.00E+06	8.36E+06	5.00E+05	5.23E+05
	EU1	0.94	1.30E+07	1.38E+07	1.30E+06	1.38E+06
	EU2	0.95	1.10E+06	1.15E+06	3.00E+05	3.15E+05
	EU3	0.95	8.00E+05	8.44E+05	1.70E+05	1.79E+05
	FU1	0.97	1.10E+06	1.13E+06	5.00E+04	5.14E+04
	FU2	0.94	3.00E+05	3.19E+05	2.10E+04	2.24E+04
	FU3	0.97	2.40E+07	2.47E+07	2.20E+05	2.26E+05
	AL1	0.95	3.00E+06	3.15E+06	8.00E+05	8.40E+05
	AL2	0.95	8.00E+05	8.38E+05	7.00E+05	7.33E+05
	AL3	0.91	1.10E+06	1.21E+06	9.00E+03	9.92E+03
	BL1	0.98	3.00E+06	3.05E+06	1.10E+06	1.12E+06
	BL2	0.91	1.30E+06	1.43E+06	3.00E+05	3.30E+05
	BL3	0.95	8.00E+06	8.40E+06	2.20E+06	2.31E+06
	CL1	0.95	5.00E+06	5.26E+06	1.70E+06	1.79E+06
	CL2	0.96	9.00E+06	9.39E+06	2.20E+05	2.30E+05
	CL3	0.94	1.30E+06	1.39E+06	3.00E+06	3.20E+06
	DL1	0.93	1.30E+06	1.40E+06	3.00E+04	3.23E+04
	DL2	0.94	1.30E+07	1.38E+07	1.40E+05	1.48E+05
	DL3	0.94	5.00E+06	5.33E+06	7.00E+05	7.47E+05
	EL1	0.94	2.40E+06	2.56E+06		0.00E+00
	EL2	0.96	1.70E+06	1.78E+06	8.00E+05	8.37E+05
	EL3	0.94	3.00E+06	3.20E+06	1.10E+06	1.17E+06
	FL1	0.93	3.00E+06	3.22E+06	2.20E+04	2.36E+04
	FL2	0.94	5.00E+05	5.34E+05	1.70E+05	1.82E+05
	FL3	0.95	8.00E+06	8.44E+06	8.00E+05	8.44E+05

KN211 Site #2 Time 8 Day 55 Re-app. 09/05/90 (Day 96) Processed 9/7/90	AU1	0.94	4.00E+05	4.26E+05
	AU2	0.94	1.40E+04	1.49E+04
	AU3	0.94	3.50E+05	3.72E+05
	BU1	0.94	1.40E+05	1.49E+05
	BU2	0.94	1.30E+06	1.38E+06
	BU3	0.94	3.00E+06	3.19E+06
	CU1	0.94	3.50E+05	3.72E+05
	CU2	0.94	1.70E+05	1.81E+05
	CU3	0.94	2.30E+06	2.45E+06
	DU1	0.94	5.00E+05	5.32E+05
	DU2	0.94		0.00E+00
	DU3	0.94	8.00E+05	8.51E+05
	EU1	0.94	1.10E+05	1.17E+05
	EU2	0.94	2.20E+05	2.34E+05
	EU3	0.94	5.00E+05	5.32E+05
	FU1	0.94	1.40E+05	1.49E+05
	FU2	0.94	5.00E+05	5.32E+05
	FU3	0.94	7.00E+04	7.45E+04
	AL1	0.94	1.30E+05	1.38E+05
	AL2	0.94	9.00E+03	9.57E+03
	AL3	0.94	5.00E+05	5.32E+05
	BL1	0.94	3.50E+05	3.72E+05
	BL2	0.94	5.00E+05	5.32E+05
	BL3	0.94	2.30E+05	2.45E+05
	CL1	0.94	1.30E+06	1.38E+06
	CL2	0.94	8.00E+05	8.51E+05
	CL3	0.94	1.30E+06	1.38E+06
	DL1	0.94	9.00E+05	9.57E+05
	DL2	0.94	5.00E+05	5.32E+05
	DL3	0.94	2.30E+05	2.45E+05
	EL1	0.94	7.00E+05	7.45E+05
	EL2	0.94	3.00E+05	3.19E+05
	EL3	0.94	8.00E+04	8.51E+04
	FL1	0.94	1.40E+06	1.49E+06
	FL2	0.94	1.10E+06	1.17E+06
	FL3	0.94	3.00E+05	3.19E+05
KN211 Site #2 Time 9 Day 61 Re-app. 09/11/90	AU1	0.94	5.00E+05	5.32E+05
	AU2	0.94	3.00E+03	3.19E+03
	AU3	0.94	1.70E+05	1.81E+05
	BU1	0.94	1.30E+04	1.38E+04
	BU2	0.94	1.70E+06	1.81E+06

(Day 102) Processed 10/23/9	BU3	0.94	3.00E+05	3.19E+05
	CU1	0.94	1.40E+05	1.49E+05
	CU2	0.94	1.70E+06	1.81E+06
	CU3	0.94	5.00E+04	5.32E+04
	DU1	0.94	2.20E+05	2.34E+05
	DU2	0.94	2.20E+03	2.34E+03
	DU3	0.94	1.70E+04	1.81E+04
	EU1	0.94	5.00E+04	5.32E+04
	EU2	0.94	9.00E+04	9.57E+04
	EU3	0.94	3.50E+05	3.72E+05
	FU1	0.94	2.80E+04	2.98E+04
	FU2	0.94	8.00E+04	8.51E+04
	FU3	0.94	1.70E+05	1.81E+05
	AL1	0.94	1.70E+04	1.81E+04
	AL2	0.94	1.70E+04	1.81E+04
	AL3	0.94	1.70E+05	1.81E+05
	BL1	0.94	3.00E+06	3.19E+06
	BL2	0.94	5.00E+04	5.32E+04
	BL3	0.94	3.50E+04	3.72E+04
	CL1	0.94	9.00E+04	9.57E+04
	CL2	0.94	3.00E+02	3.19E+02
	CL3	0.94	3.00E+04	3.19E+04
	DL1	0.94	5.00E+04	5.32E+04
	DL2	0.94	1.70E+04	1.81E+04
	DL3	0.94	7.00E+03	7.45E+03
	EL1	0.94	3.00E+03	3.19E+03
	EL2	0.94	5.00E+03	5.32E+03
	EL3	0.94	1.70E+04	1.81E+04
	FL1	0.94	8.00E+02	8.51E+02
	FL2	0.94	9.00E+03	9.57E+03
	FL3	0.94	3.00E+04	3.19E+04
KN211 Site #2 Time 10	AU1	0.94	7.00E+04	7.45E+04
	AU2	0.94	7.00E+03	7.45E+03
	AU3	0.94	1.10E+05	1.17E+05
Day 71 Re-app. 09/21/90 (Day 112) Processed 10/25/9	BU1	0.94	3.00E+04	3.19E+04
	BU2	0.94	2.20E+04	2.34E+04
	BU3	0.94	3.00E+04	3.19E+04
	CU1	0.94		0.00E+00
	CU2	0.94	5.00E+03	5.32E+03
	CU3	0.94	8.00E+04	8.51E+04

DU1	0.94	7.00E+04	7.45E+04
DU2	0.94	2.20E+05	2.34E+05
DU3	0.94	1.70E+04	1.81E+04
EU1	0.94	3.00E+05	3.19E+05
EU2	0.94	2.80E+05	2.98E+05
EU3	0.94	1.30E+05	1.38E+05
FU1	0.94	7.00E+03	7.45E+03
FU2	0.94	1.10E+05	1.17E+05
FU3	0.94	1.70E+04	1.81E+04
AL1	0.94	8.00E+04	8.51E+04
AL2	0.94	3.50E+04	3.72E+04
AL3	0.94		0.00E+00
BL1	0.94	1.40E+05	1.49E+05
BL2	0.94	8.00E+04	8.51E+04
BL3	0.94	5.00E+05	5.32E+05
CL1	0.94		ERR
CL2	0.94	9.00E+04	9.57E+04
CL3	0.94	1.40E+04	1.49E+04
DL1	0.94	3.00E+04	3.19E+04
DL2	0.94	7.00E+04	7.45E+04
DL3	0.94	1.70E+04	1.81E+04
EL1	0.94	7.00E+03	7.45E+03
EL2	0.94	1.10E+05	1.17E+05
EL3	0.94	1.70E+03	1.81E+03
FL1	0.94	7.00E+03	7.45E+03
FL2	0.94		0.00E+00
FL3	0.94	9.00E+02	9.57E+02

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	BEACH SEGMENT					
KN132	AU1	0.91	2.30E+07	2.52E+07	9.30E+04	1.02E+05
Site #3	AU2	0.94	2.30E+07	2.44E+07	2.10E+05	2.22E+05
Time 0	AU3	0.84	2.30E+07	2.72E+07	2.10E+05	2.49E+05
Day 0	BU1	0.96	4.30E+06	4.46E+06	1.50E+04	1.56E+04
05/31/90	BU2	0.97	9.30E+05	9.63E+05	7.50E+05	7.77E+05
	BU3	0.96	4.30E+05	4.46E+05	2.10E+06	2.18E+06
	CU1	0.93	4.30E+06	4.62E+06	7.50E+04	8.05E+04
	CU2	0.94	2.30E+06	2.44E+06	2.10E+06	2.22E+06

	CU3	0.95	2.30E+06	2.43E+06	3.90E+06	4.12E+06
	DU1	0.97	4.30E+06	4.45E+06	2.10E+05	2.17E+05
	DU2	0.96	2.30E+06	2.40E+06	7.50E+04	7.84E+04
	DU3	0.95	9.30E+06	9.84E+06	4.30E+05	4.55E+05
	EU1	0.93	7.50E+05	8.11E+05	7.50E+04	8.11E+04
	EU2	0.94	9.30E+06	9.92E+06	7.50E+05	8.00E+05
	EU3	0.95	4.30E+06	4.51E+06	2.10E+06	2.20E+06
	FU1	0.91	7.50E+05	8.21E+05	2.30E+04	2.52E+04
	FU2	0.93	9.30E+05	1.00E+06		0.00E+00
	FU3	0.87	4.30E+05	4.96E+05	2.10E+05	2.42E+05

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN132	AU1	0.97	2.30E+07	2.38E+07	7.50E+05	7.77E+05
Site #3	AU2	0.97	4.30E+06	4.45E+06	1.50E+06	1.55E+06
Time 1	AU3	0.97	9.30E+06	9.61E+06	4.30E+05	4.44E+05
Day 2	BU1	0.96	2.30E+07	2.40E+07	1.50E+06	1.56E+06
06/04/90	BU2	0.97	4.30E+06	4.42E+06	2.00E+03	2.06E+03
	BU3	0.96	9.30E+06	9.64E+06	2.10E+06	2.18E+06
	CU1	0.95	1.50E+10	1.58E+10	4.30E+04	4.52E+04
	CU2	0.95	1.50E+06	1.58E+06	9.30E+06	9.78E+06
	CU3	0.97	2.30E+07	2.38E+07	1.50E+06	1.55E+06
	DU1	0.96	9.30E+06	9.69E+06	2.30E+05	2.40E+05
	DU2	0.97	3.90E+06	4.03E+06	7.50E+04	7.75E+04
	DU3	0.96	9.30E+06	9.67E+06	2.30E+05	2.39E+05
	EU1	0.97	2.30E+06	2.38E+06	2.10E+05	2.17E+05
	EU2	0.96	4.30E+06	4.47E+06	1.50E+05	1.56E+05
	EU3	0.95	9.30E+06	9.76E+06	1.50E+05	1.57E+05
	FU1	0.97	9.30E+05	9.61E+05	2.30E+05	2.38E+05
	FU2	0.95	4.30E+09	4.53E+09	9.30E+04	9.80E+04
	FU3	0.96	4.30E+06	4.47E+06	9.30E+05	9.67E+05

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN132	AU1	0.96	1.50E+07	1.57E+07	2.80E+05	2.93E+05
Site #3	AU2	0.94	2.30E+07	2.44E+07	1.10E+05	1.17E+05
Time 2	AU3	0.96	9.30E+06	9.68E+06	2.10E+06	2.19E+06
Day 4	BU1	0.97	4.30E+07	4.44E+07	9.30E+02	9.61E+02
06/06/90	BU2	0.96	4.30E+07	4.46E+07	7.50E+05	7.77E+05
	BU3	0.97	1.50E+07	1.55E+07	2.10E+06	2.17E+06
	CU1	0.97	1.20E+07	1.24E+07	7.50E+05	7.76E+05
	CU2	0.96	4.30E+07	4.50E+07	4.30E+07	4.50E+07
	CU3	0.94	2.30E+07	2.45E+07	9.30E+06	9.91E+06

	DU1	0.96	2.30E+06	2.39E+06	9.30E+06	9.67E+06
	DU2	0.96	9.30E+08	9.70E+08	9.30E+04	9.70E+04
	DU3	0.95	2.30E+07	2.42E+07	1.20E+05	1.26E+05
	EU1	1.00	4.30E+05	4.30E+05	3.50E+05	3.50E+05
	EU2	0.94	4.30E+06	4.58E+06	1.50E+05	1.60E+05
	EU3	0.95	2.30E+07	2.41E+07	1.20E+06	1.26E+06
	FU1	0.94	9.30E+06	9.91E+06	1.50E+05	1.60E+05
	FU2	0.95	4.30E+07	4.52E+07	9.30E+04	9.77E+04
	FU3	0.94	9.30E+05	9.91E+05	9.30E+04	9.91E+04

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN132	AU1	0.93	4.30E+07	4.63E+07	1.50E+07	1.62E+07
Site #3	AU2	0.96	2.30E+07	2.40E+07	1.50E+06	1.57E+06
Time 3	AU3	0.93	4.30E+07	4.63E+07	3.50E+06	3.77E+06
Day 8	BU1	0.95	4.30E+07	4.51E+07	2.10E+06	2.20E+06
06/10/90	BU2	0.94	4.30E+07	4.59E+07	1.50E+06	1.60E+06
	BU3	0.97	1.20E+08	1.23E+08	2.00E+05	2.05E+05
	CU1	0.95	2.30E+07	2.41E+07	7.50E+05	7.86E+05
	CU2	0.94	4.30E+07	4.57E+07	1.50E+07	1.60E+07
	CU3	0.96	7.50E+07	7.81E+07	4.30E+05	4.48E+05
	DU1	0.95	2.30E+07	2.42E+07	2.00E+04	2.10E+04
	DU2	0.95	2.30E+07	2.41E+07	1.50E+05	1.57E+05
	DU3	0.94	4.30E+06	4.56E+06	3.50E+05	3.71E+05
	EU1	0.93	4.30E+06	4.60E+06	2.10E+06	2.25E+06
	EU2	0.94		0.00E+00	2.10E+07	2.24E+07
	EU3	0.96	4.30E+05	4.50E+05	7.50E+05	7.85E+05
	FU1	0.84	1.20E+06	1.43E+06	9.40E+04	1.12E+05
	FU2	0.94	4.30E+06	4.56E+06	7.50E+05	7.96E+05
	FU3	0.95	2.30E+06	2.43E+06	4.30E+04	4.54E+04

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	BEACH SEGMENT	% Dry Wt.	MPN	Corr. MPN	Oil MPN	Corr. Oil
KN132	AU1	0.92	4.30E+06	4.69E+06	4.30E+05	4.69E+05
Site #3	AU2	0.91	4.30E+06	4.73E+06	9.30E+06	1.02E+07
Time 4	AU3	0.96	3.90E+07	4.08E+07	4.30E+04	4.50E+04
Day 16	BU1	0.96	2.30E+06	2.39E+06	4.30E+05	4.47E+05
07/01/90	BU2	0.96	9.30E+07	9.73E+07	9.30E+05	9.73E+05
	BU3	0.96	2.30E+07	2.40E+07	1.50E+06	1.57E+06
	CU1	0.94	9.30E+05	9.92E+05	9.30E+06	9.92E+06
	CU2	0.93	2.30E+06	2.48E+06	3.50E+05	3.77E+05
	CU3	0.94	9.30E+06	9.93E+06	9.30E+05	9.93E+05

	DU1	0.95	3.90E+05	4.12E+05	2.10E+05	2.22E+05
	DU2	0.96	9.30E+06	9.72E+06	1.50E+05	1.57E+05
	DU3	0.95	9.30E+05	9.76E+05	1.50E+05	1.57E+05
	EU1	0.92	4.30E+05	4.65E+05	1.50E+06	1.62E+06
	EU2	0.93	7.50E+04	8.10E+04	4.30E+05	4.64E+05
	EU3	0.95	2.30E+05	2.42E+05	2.10E+05	2.21E+05
	FU1	0.80	2.30E+05	2.88E+05	2.10E+04	2.63E+04
	FU2	0.85	1.50E+05	1.75E+05	4.30E+02	5.03E+02
	FU3	0.84	9.30E+05	1.11E+06	4.30E+03	5.13E+03

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	BEACH SEGMENT					
KN132	AU1	0.93	2.30E+06	2.46E+06	4.30E+06	4.60E+06
Site #3	AU2	0.92	1.50E+06	1.62E+06	7.50E+04	8.12E+04
Time 5	AU3	0.93	4.30E+06	4.61E+06	4.30E+05	4.61E+05
Day 29	BU1	0.96	2.30E+06	2.39E+06	4.30E+06	4.47E+06
07/01/90	BU2	0.96	9.30E+06	9.73E+06		
	BU3	0.97	2.30E+06	2.38E+06	9.30E+03	9.61E+03
	CU1	0.95	9.30E+06	9.78E+06	9.30E+04	9.78E+04
	CU2	0.94	3.90E+07	4.16E+07	4.30E+06	4.58E+06
	CU3	0.94	2.30E+07	2.44E+07	9.30E+04	9.88E+04
	DU1	0.95	2.30E+06	2.41E+06	2.30E+04	2.41E+04
	DU2	0.96	2.30E+06	2.39E+06	9.30E+05	9.67E+05
	DU3	0.97	7.50E+06	7.75E+06	3.90E+04	4.03E+04
	EU1	0.95	7.50E+06	7.89E+06		0.00E+00
	EU2	0.94	4.30E+06	4.55E+06	1.50E+05	1.59E+05
	EU3	0.95	2.30E+07	2.43E+07	7.50E+04	7.93E+04
	FU1	0.97	4.30E+06	4.41E+06	9.30E+05	9.55E+05
	FU2	0.97	2.30E+07	2.37E+07	1.20E+06	1.24E+06
	FU3	0.94	4.30E+07	4.59E+07	1.50E+05	1.60E+05

KN132B refertilized 7/11/90

KN132	AU1	0.97	2.40E+07	2.49E+07	7.00E+05	7.25E+05
Site #3	AU2	0.93		0.00E+00	8.00E+05	8.60E+05
Time 6	AU3	0.95	1.70E+08	1.78E+08	2.30E+06	2.41E+06
Day 4 Re-app.	BU1	0.94	2.40E+07	2.56E+07	2.30E+05	2.46E+05
07/15/90	BU2	0.93		0.00E+00	2.60E+05	2.79E+05
(Day 43)	BU3	0.97	3.00E+07	3.10E+07	1.30E+06	1.35E+06
	CU1	0.94		0.00E+00	2.80E+06	2.99E+06
	CU2	0.96		0.00E+00	1.70E+06	1.77E+06
	CU3	0.94	2.60E+07	2.77E+07	8.00E+06	8.51E+06

	DU1	0.96	5.00E+06	5.23E+06	7.00E+03	7.33E+03
	DU2	0.96	2.40E+07	2.50E+07	3.00E+04	3.12E+04
	DU3	0.93	2.40E+07	2.58E+07	3.00E+03	3.22E+03
	EU1	0.95	3.00E+06	3.16E+06	3.50E+03	3.69E+03
	EU2	0.94	5.00E+06	5.30E+06	2.10E+03	2.23E+03
	EU3	0.93	8.00E+06	8.61E+06	1.30E+04	1.40E+04
	FU1	0.92	7.00E+06	7.57E+06	9.00E+03	9.74E+03
	FU2	0.84	3.00E+05	3.56E+05	5.00E+03	5.94E+03
	FU3	0.86	5.00E+06	5.82E+06	3.30E+03	3.84E+03
KN132 Site #3 Time 7 Day 21 Re-app. 08/01/90 (Day 60)	AU1	0.96	1.70E+07	1.78E+07	5.00E+06	5.23E+06
	AU2	0.96	1.70E+07	1.77E+07	7.00E+05	7.27E+05
	AU3	0.91	1.70E+07	1.86E+07	5.00E+06	5.48E+06
	BU1	0.96	7.00E+06	7.26E+06	3.00E+06	3.11E+06
	BU2	0.96	8.00E+06	8.34E+06	5.00E+05	5.22E+05
	BU3	0.96	1.40E+06	1.46E+06	6.00E+05	6.25E+05
	CU1	0.94	1.30E+07	1.38E+07	3.00E+06	3.18E+06
	CU2	0.94	5.00E+07	5.30E+07	2.60E+05	2.76E+05
	CU3	0.95	9.00E+07	9.46E+07	8.00E+05	8.41E+05
	DU1	0.96	2.40E+06	2.51E+06	5.00E+03	5.22E+03
	DU2	0.94	2.40E+06	2.54E+06		0.00E+00
	DU3	0.96	3.00E+07	3.14E+07		0.00E+00
	EU1	0.96	3.00E+06	3.14E+06	1.70E+04	1.78E+04
	EU2	0.94	3.00E+06	3.19E+06	1.70E+04	1.81E+04
	EU3	0.96	5.00E+06	5.20E+06	2.70E+04	2.81E+04
	FU1	0.94	3.00E+05	3.19E+05	1.40E+04	1.49E+04
	FU2	0.95	2.40E+06	2.54E+06	5.00E+03	5.29E+03
	FU3	0.94	2.80E+06	2.97E+06	1.10E+05	1.17E+05
KN132 Site #3 Time 8 Day 56 Re-app. 09/05/90 (Day 95) Processed 9/7/90	AU1	0.94			5.00E+05	5.32E+05
	AU2	0.94			3.00E+05	3.19E+05
	AU3	0.94			1.70E+05	1.81E+05
	BU1	0.94			2.30E+06	2.45E+06
	BU2	0.94			1.30E+06	1.38E+06
	BU3	0.94			8.00E+06	8.51E+06
	CU1	0.94			1.70E+06	1.81E+06
	CU2	0.94			1.10E+06	1.17E+06
	CU3	0.94			5.00E+05	5.32E+05
	DU1	0.94			2.20E+05	2.34E+05
	DU2	0.94			7.00E+05	7.45E+05
	DU3	0.94			5.00E+05	5.32E+05

EU1	0.94	5.00E+05	5.32E+05
EU2	0.94	8.00E+05	8.51E+05
EU3	0.94		0.00E+00
FU1	0.94	2.80E+05	2.98E+05
FU2	0.94	2.20E+05	2.34E+05
FU3	0.94	7.00E+05	7.45E+05

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APPENDIX D3.
Data Tables from Oil Analyses

Section 1.	The need for filtration in estimating Total Extractable Hydrocarbon in sediments
Section 2.	Total Extractable Hydrocarbon in Sediment Samples
Section 3.	Distribution of Total Extractable Hydrocarbon in Sediments
Section 4.	Gas Chromatography Analyses
Section 5.	Hopane Analyses

APPENDIX D3, SECTION 1
The Need for Filtration in Estimating Total Extractable Hydrocarbon in Sediments

One of the parameters being measured in the joint ADEC/USEPA/Exxon Bioremediation Monitoring Program is the amount of Total Extractable Hydrocarbon in the sediments on the three monitoring beaches. This parameter was analyzed by Battelle Ocean Sciences using the Exxon Valdez Oil Spill Assessment Standard Operating Procedure EVC89-4 (Appendix SOP, Section 5), but subsequent chemical analyses revealed that this method often gave a substantial overestimate of the amount of Total Extractable Hydrocarbon in the samples. We have therefore modified the procedure to include filtration through a glass fiber filter with 99.98% efficiency at 0.3 um at step 5.1.6, which previously involved only filtration with glass wool and sodium sulfate.

Table I and Figure 1 show the gravimetric analyses of samples from KN-132B, while Figure 2 shows the ratio of unfiltered : filtered sample weight as a function of the filtered weight. For these samples, which are the combination of the three individual sediment samples taken around each well, the lack of the additional filtration leads to an overestimate of the amount of total extractable hydrocarbon by from 20 to 320%.

Table II and Figures 3 and 4 show the same analyses of the individual samples that were used to make the composite samples of Table I. One sample is now overestimated almost 8-fold by neglecting the filtration step.

Tables III and IV and Figures 5-8 repeat the analyses for the samples from KN-211E. In these data, the lack of filtration of the composite sample leads to an overestimate of more than 100% in some samples, and even higher overestimates in the individual samples.

Conclusions:

- Filtration with a 0.3um filter removes substantial amounts of silt from many organic solvent extracts of oiled sediments.

- Neglecting the filtration step can result in substantial overestimates of the oil loading, especially in lightly and moderately oiled samples (<10g/Kg)

APPENDIX D3, SECTION 1, TABLE 1

Effect of Filtration on the combined samples from KN-132B Day 0

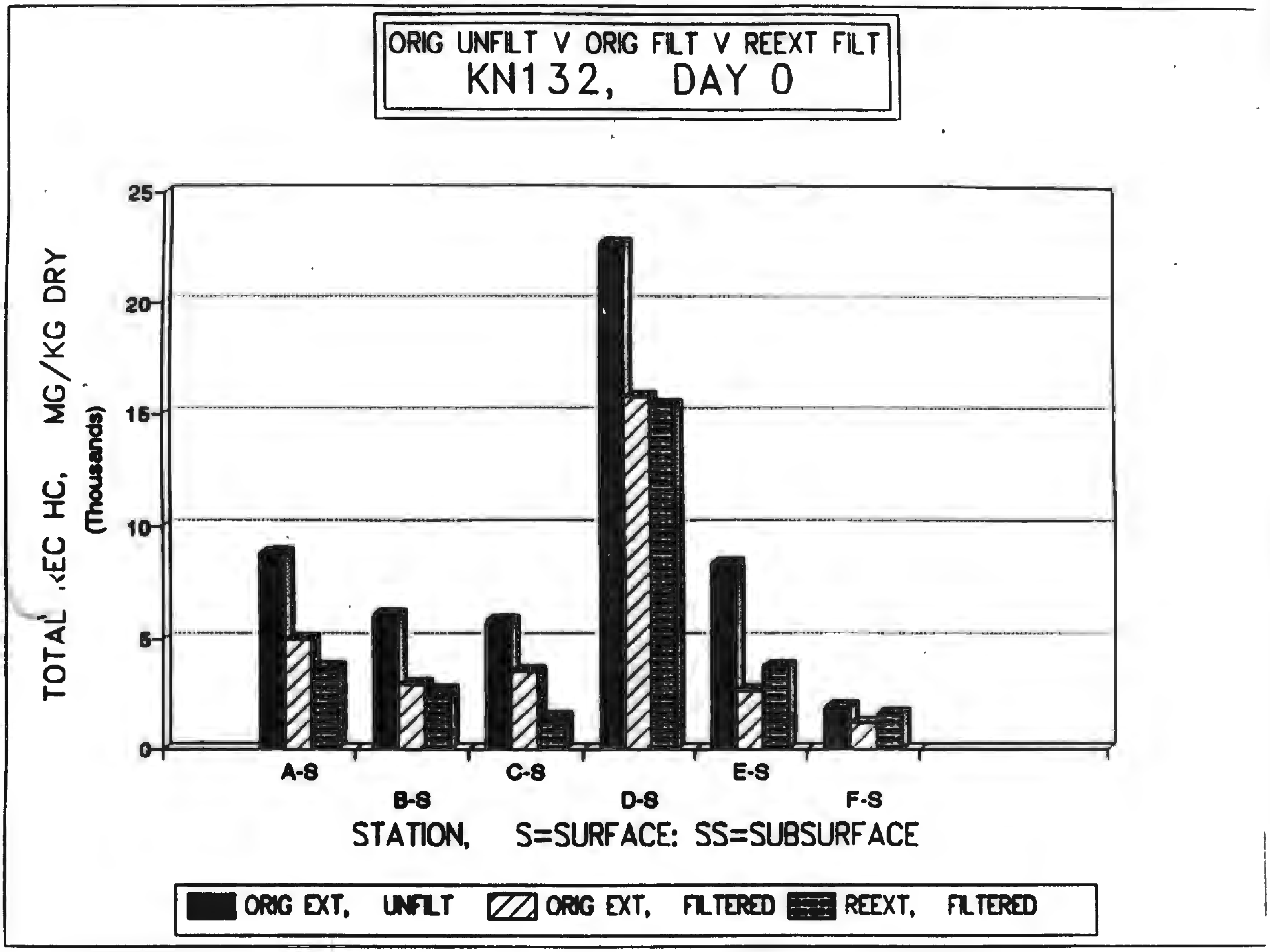
All units in mg/Kg dry weight of sediment

KN-132. PRECOLUMN TOTAL EXTRACTABLE HYDROCARBON, DAY 0.
ALL UNITS IN MG/KG DRY WEIGHT SEDIMENT.

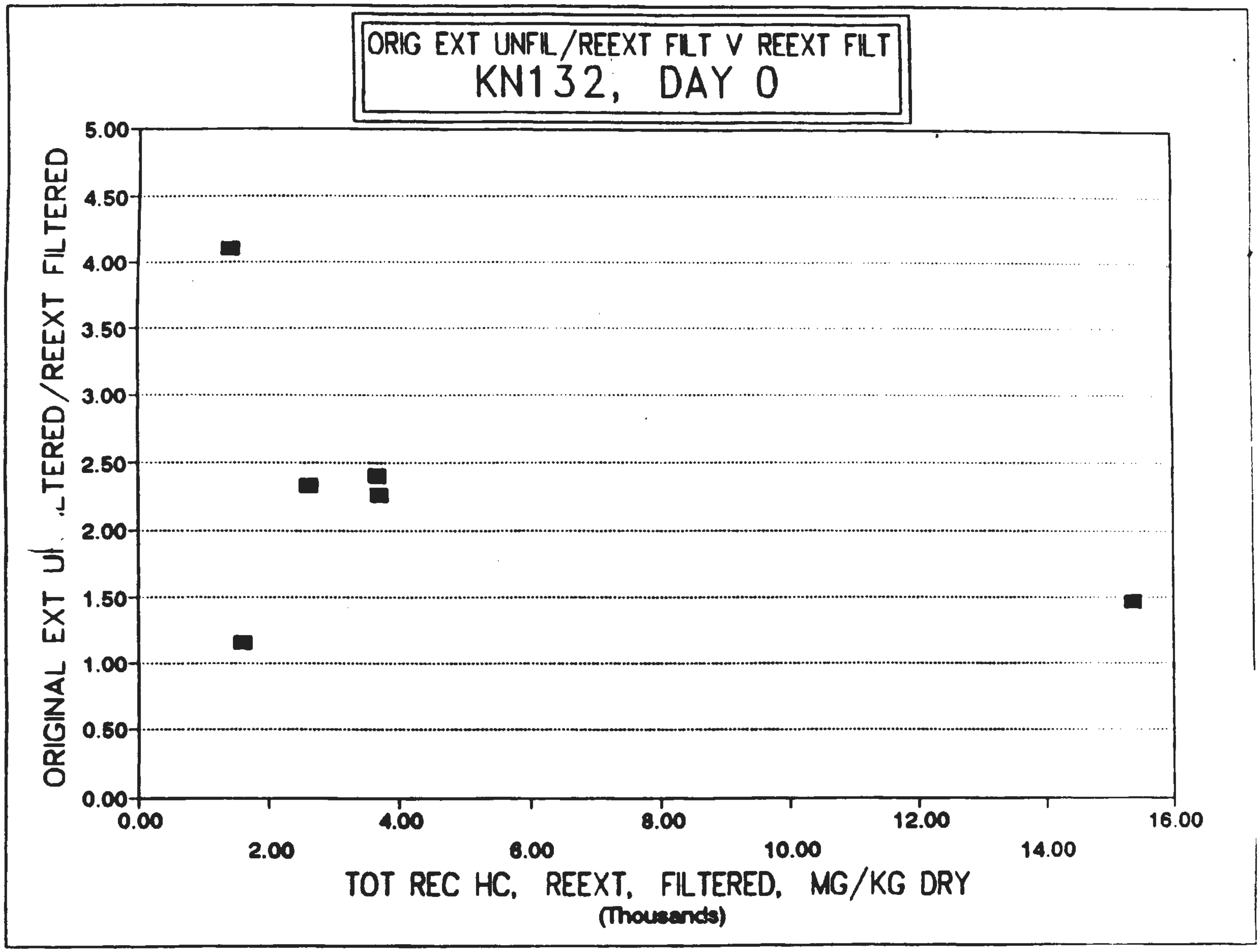
STATION	COL 1 ORIGINAL EXT. UNFILTERED * MG/KG DRY	COL 2 ORIGINAL EXT. FILTERED MG/KG DRY	COL 3 REEXT. FILTERED ** MG/KG DRY
A-S	8783.01	4998.83	3663.11
B-S	6083.94	2920.29	2611.60
C-S	5790.50	3464.00	1409.96
D-S	22644.39	15732.86	15373.86
E-S	8322.63	2614.68	3690.86
F-S	1850.62	1175.1	1597.52

* Sum of individual gravimetric weights.
** Actual weight of combined extracts.

APPENDIX D3, SECTION 1, Figure 1
Effect of Filtration on the combined samples from KN-132B, Day 0



APPENDIX D3, SECTION 1, Figure 2
Effect of Filtration on the combined samples from KN-132B Day 0



APPENDIX D3, SECTION 1, TABLE 2

Effect of Filtration on the individual samples from KN-132B Day 0

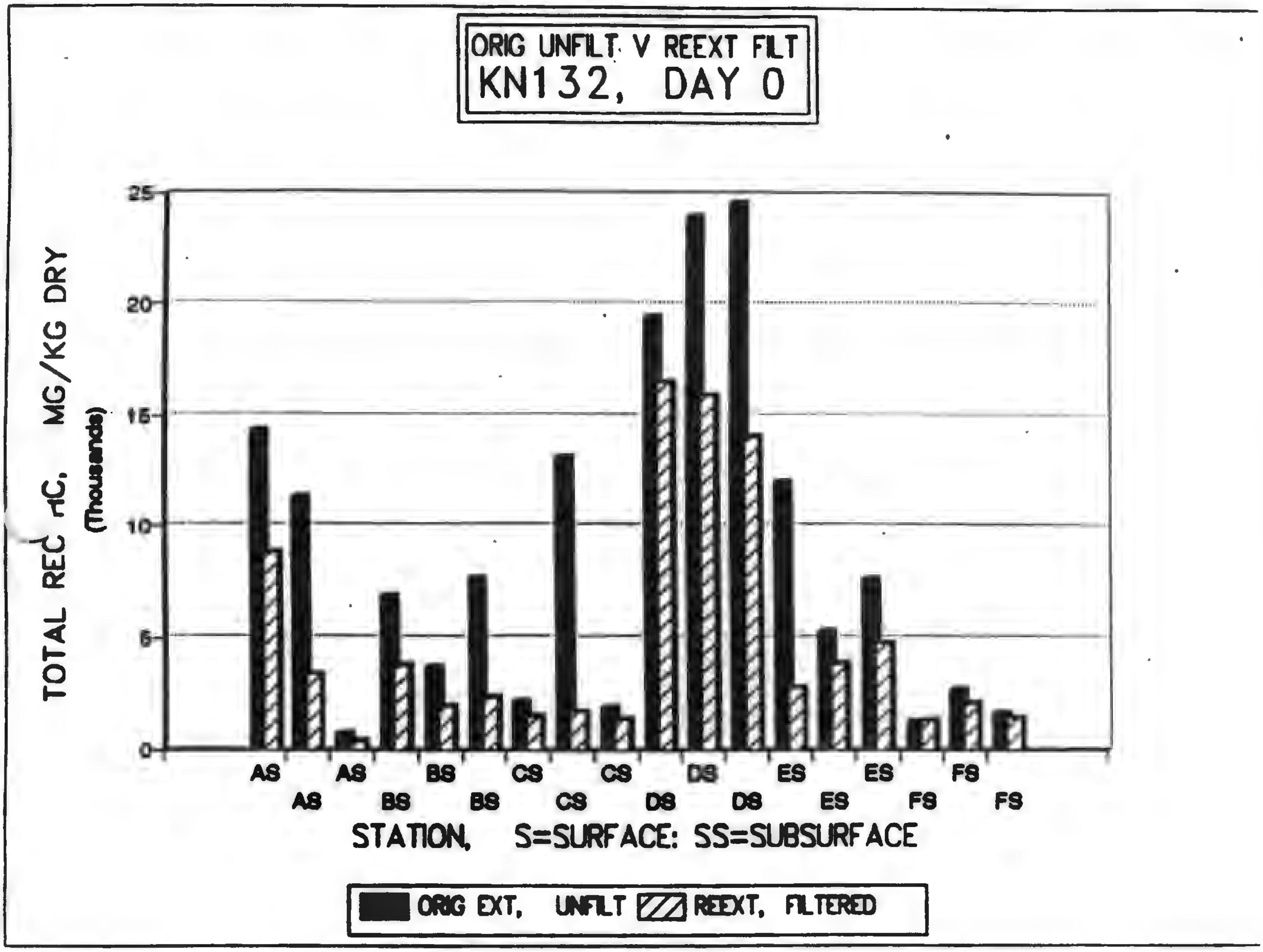
All units in mg/Kg dry weight of sediment

KN-132. PRECOLUMN TOTAL EXTRACTABLE HYDROCARBON, DAY 0.
ALL UNITS IN MG/KG DRY WEIGHT SEDIMENT.

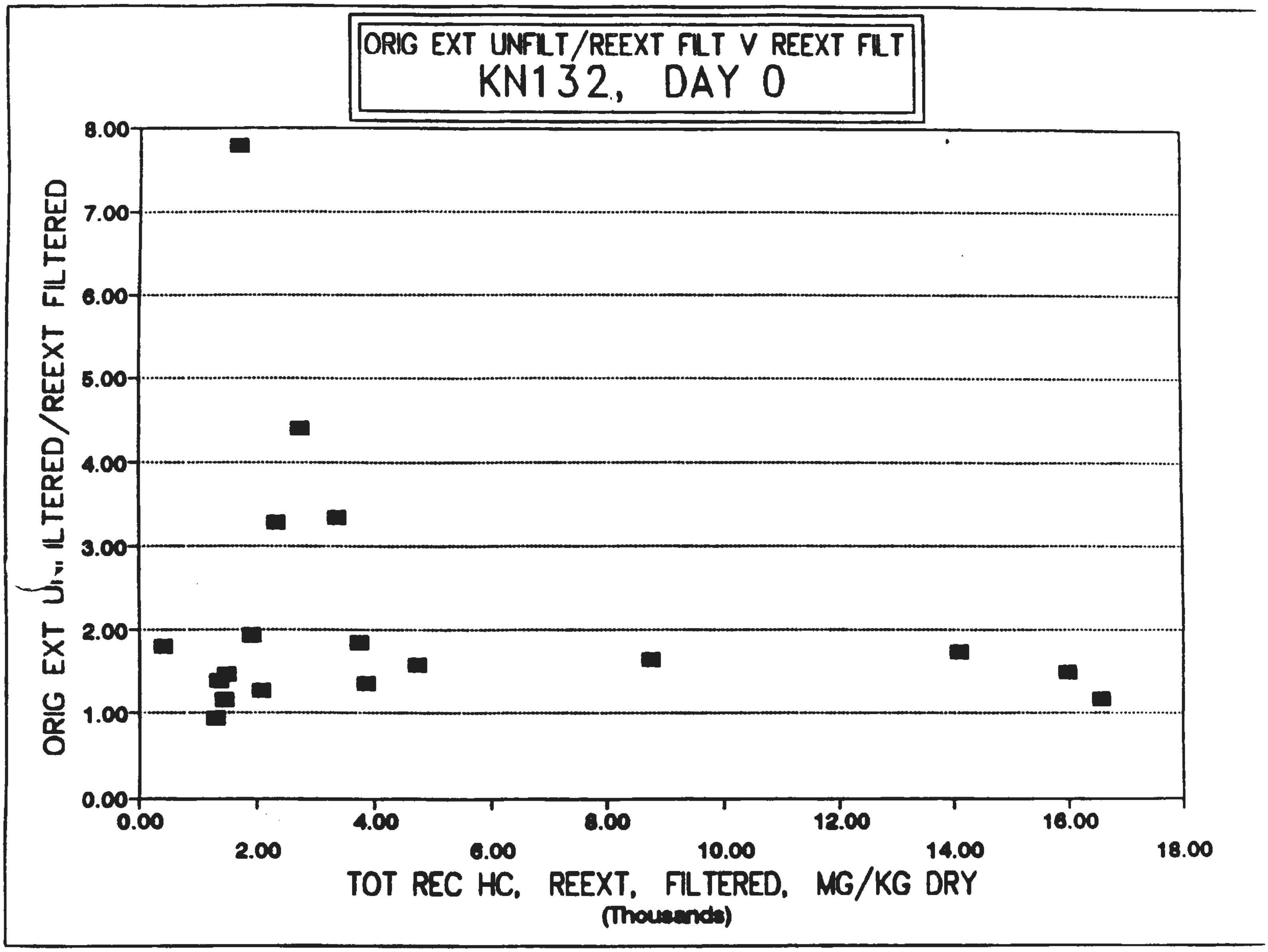
STATION	COL 1 ORIGINAL EXT. UNFILTERED * MG/KG DRY	COL 2 ORIGINAL EXT. FILTERED MG/KG DRY	COL 3 REEXT. FILTERED ** MG/KG DRY
AS	14380.25		8761.77
AS	11317.87		3382.55
AS	719.79		399.02
BS	6910.5		3746.99
BS	3710.67		1917.15
BS	7647.26		2322.4
CS	2182.61		1491.88
CS	13142.71		1685.1
CS	1875.22		1345.07
DS	19476.14		16554.23
DS	23913.79		15982.1
DS	24547.98		14086.36
ES	12082.45		2741.65
ES	5246.58		3837.68
ES	7547.17		4746.95
FS	1213.2		1279.69
FS	2651.33		2072.69
FS	1663.31		1435.56

* Sum of individual gravimetric weights.
** Actual weight of combined extracts.

APPENDIX D3, SECTION 1, Figure 3
Effect of Filtration on the individual samples from KN-132B Day 0



APPENDIX D3, SECTION 1, Figure 4
Effect of Filtration on the individual samples from KN-132B Day 0



APPENDIX D3, SECTION 1, TABLE 3

Effect of Filtration on the combined samples from KN-211E Day 0

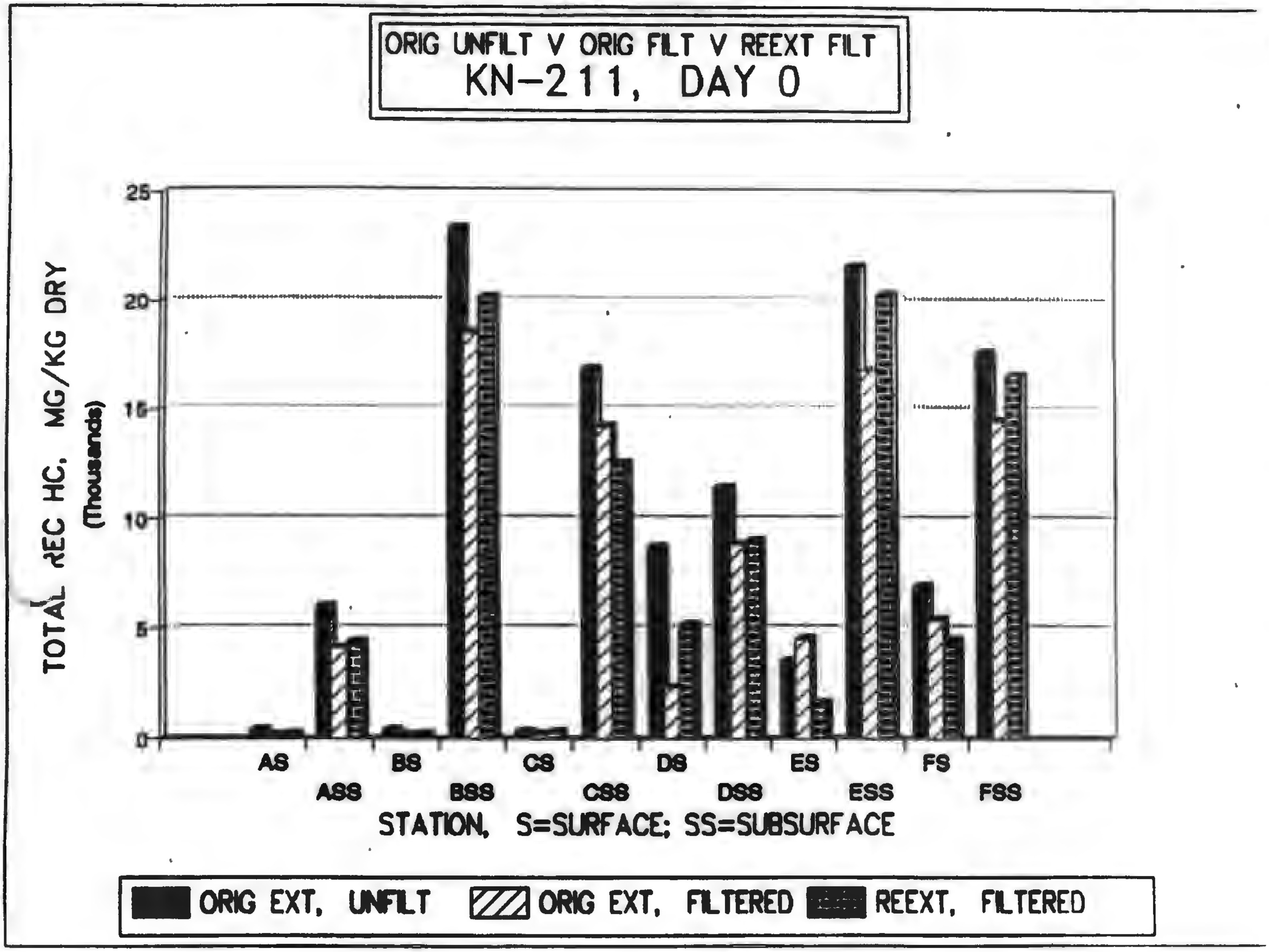
All units in mg/Kg dry weight of sediment

KN-211. PRECOLUMN TOTAL EXTRACTABLE HYDROCARBON, DAY 0.
ALL UNITS IN MG/KG DRY WEIGHT SEDIMENT.

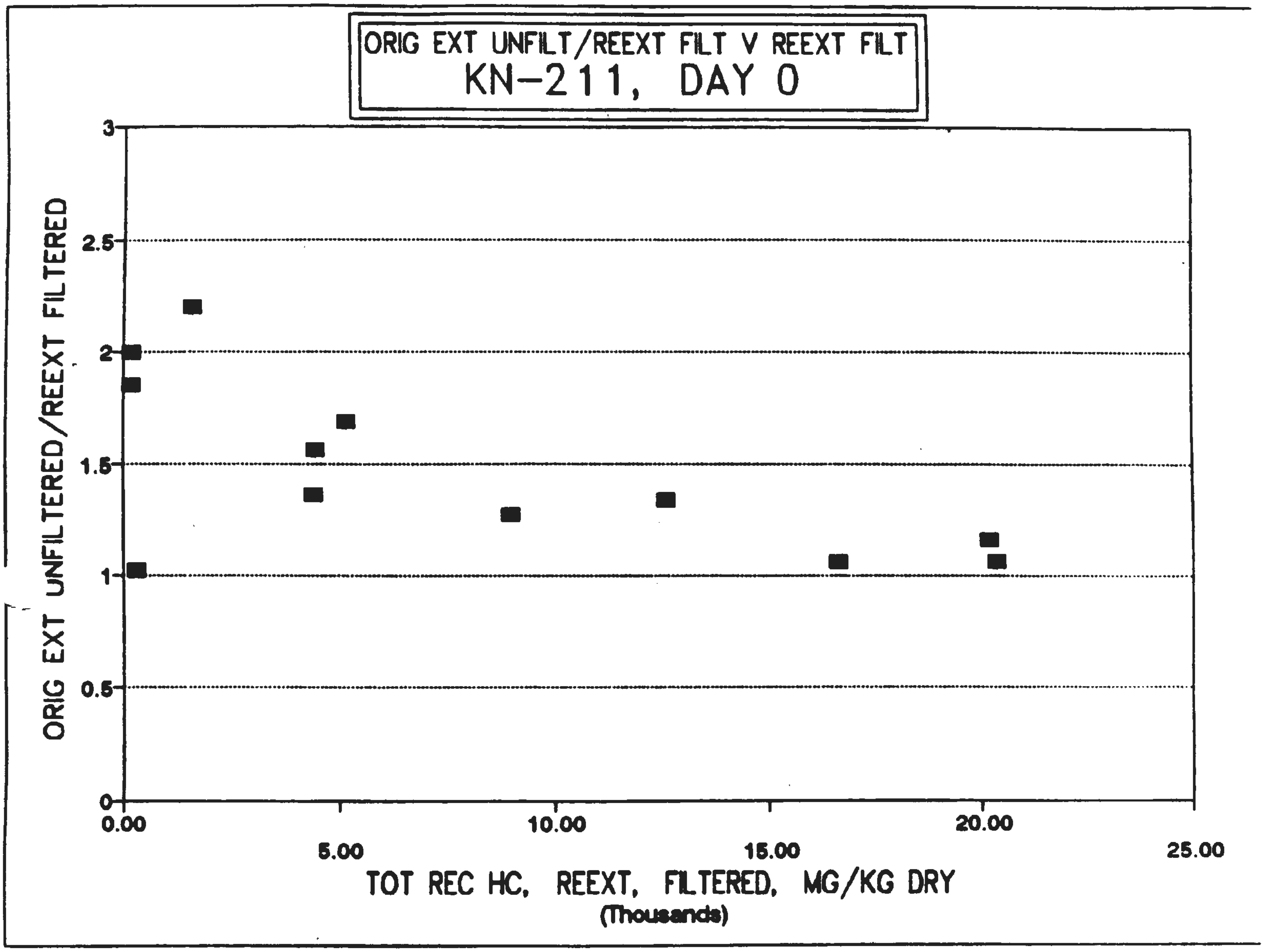
STATION	COL 1 ORIGINAL EXT. UNFILTERED * MG/KG DRY	COL 2 ORIGINAL EXT. FILTERED MG/KG DRY	COL 3 REEXT. FILTERED ** MG/KG DRY
AS	377.65	117.82	188.98
ASS	6020.69	4138.06	4401.52
BS	356.44	137.59	192.26
BSS	23369.44	18554.69	20189.08
CS	316.82	198.73	309.18
CSS	16920.46	14226.31	12578.62
DS	8714.23	2326.96	5164.87
DSS	11462.5	8826.71	9002.82
ES	3542.47	4569.42	1610.7
ESS	21650.13	16844.37	20359.17
FS	6965.91	5412.29	4467.82
FSS	17690.68	14548.02	16628.84

* Sum of individual gravimetric weights.
** Actual weight of combined extracts.

APPENDIX D3, SECTION 1, Figure 5
Effect of Filtration on the combined samples from KN-211E Day 0



APPENDIX D3, SECTION 1, Figure 6
Effect of Filtration on the combined samples from KN-211E Day 0



APPENDIX D3, SECTION 1, TABLE 4
Effect of Filtration on the individual samples from KN-211E Day 0

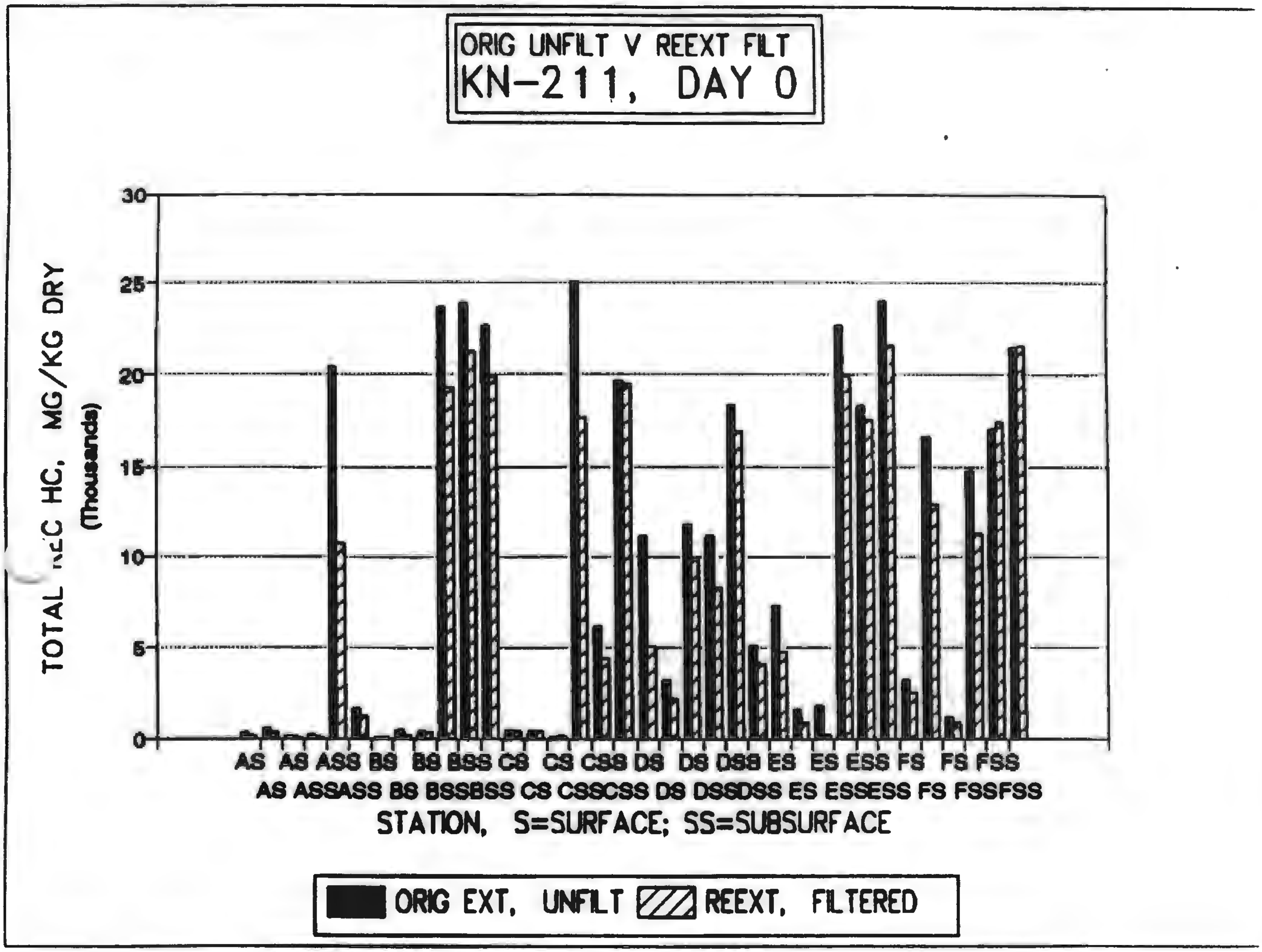
All units in mg/Kg dry weight of sediment

KN-211. PRECOLUMN TOTAL EXTRACTABLE HYDROCARBONS, DAY 0.
ALL VALUES IN MG/KG DRY WEIGHT SEDIMENT.

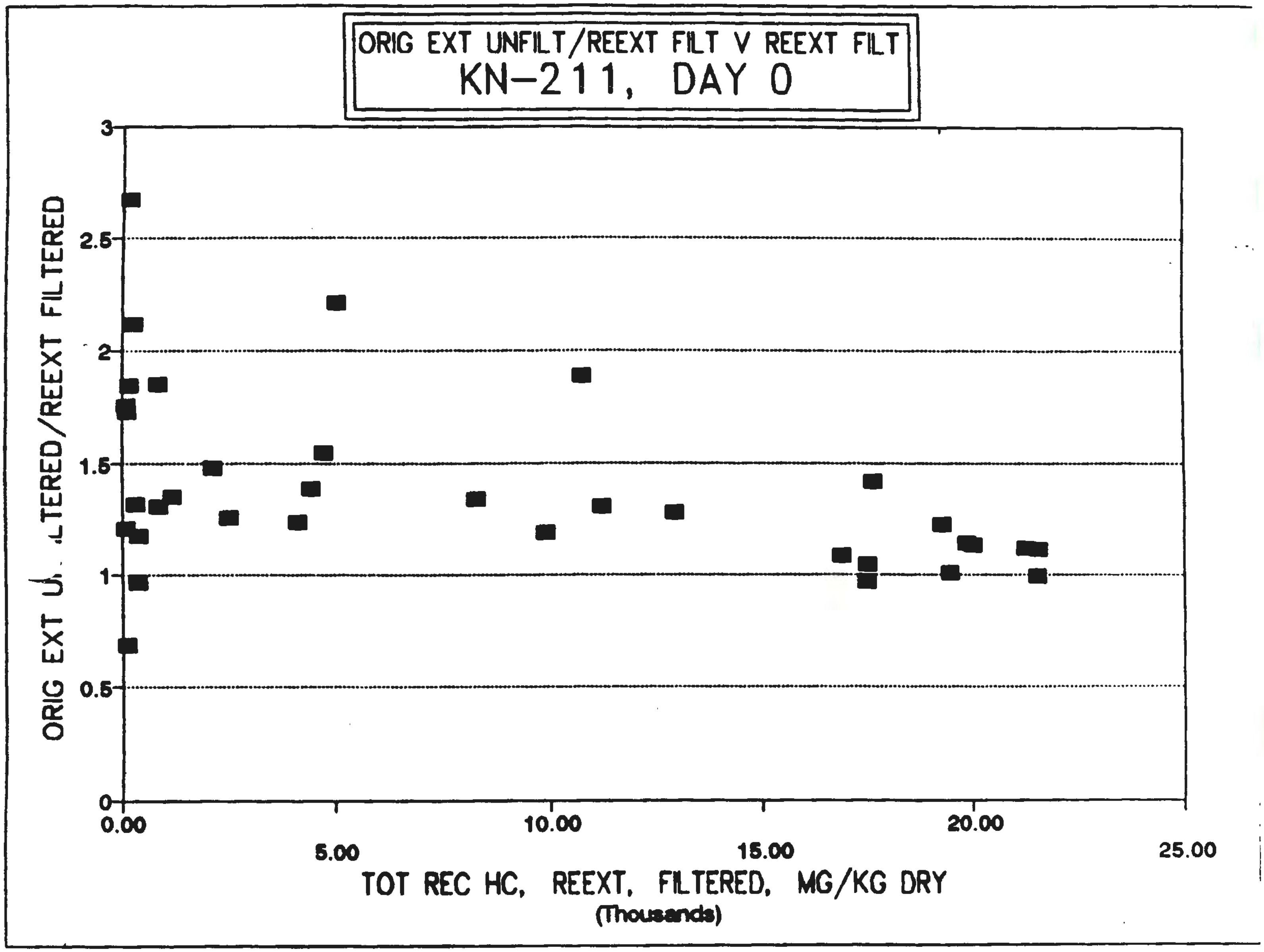
STATION	ORIG EXT. UNFILTERED * MG/KG DRY	REEXT. FILTERED ** MG/KG DRY
AS	287.99	155.83
AS	631.22	297.3
AS	200.57	114.13
ASS	242.34	140.5
ASS	20371.36	10753.06
ASS	1633.87	1204.19
BS	139.76	115.49
BS	451.06	168.75
BS	418.4	316.87
BSS	23594.79	19232.83
BSS	23844.94	21261.68
BSS	22650.95	19860.81
CS	486.11	412.66
CS	366.1	380.36
CS	102.8	148.4
CSS	25008.65	17613.64
CSS	6156.13	4436.33
CSS	19603.09	19442.96
DS	11169.08	5048.68
DS	3156.38	2135.92
DS	11765.23	9893.33
DSS	11152.51	8303.71
DSS	18264.06	16878.64
DSS	5072.46	4101.49
ES	7315.57	4726.89
ES	1591.47	858.43
ES	1744.64	249.13
ESS	22621.2	20000
ESS	18277.23	17474.99
ESS	23987.32	21554.96
FS	3182.14	2528.29
FS	16589.86	12953.37
FS	1137.98	871.1
FSS	14668.55	11203.75
FSS	16992.26	17463.62
FSS	21434.91	21538.46

* Sum of individual gravimetric weights.
** Actual weight of combined extracts.

APPENDIX D3, SECTION 1, Figure 7
Effect of Filtration on the individual samples from KN-211E Day 0



APPENDIX D3, SECTION 1, Figure 8
Effect of Filtration on the individual samples from KN-211E Day 0



APPENDIX D3, SECTION 2

Total Extractable Hydrocarbon in Sediment Samples

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 0

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
71PPT000131	IS79	A-S	242.00	0.02762	8761.77	4181.11	4124.96
71PPT000132	IS80	A-S	98.50	0.02912	3382.55		
71PPT000133	IS81	A-S	11.40	0.02857	399.02		
71PPT000134	IS82	B-S	109.00	0.02909	3746.99	2662.18	2660.42
71PPT000135	IS84	B-S	56.00	0.02921	1917.15		
71PPT000136	IS85	B-S	68.00	0.02928	2322.40		
71PPT000137	IS86	C-S	40.40	0.02708	1491.88	1507.35	1485.16
71PPT000138	IS87	C-S	32.00	0.01899	1685.10		
71PPT000139	IS88	C-S	38.20	0.02840	1345.07		
71PPT000140	IS89	D-S	319.00	0.01927	16554.23	15540.90	15545.85
71PPT000141	IS90	D-S	303.50	0.01899	15982.10		
71PPT000142	IS91	D-S	267.50	0.01899	14086.36		
71PPT000143	IS92	E-S	78.00	0.02845	2741.65	3775.43	3776.83
71PPT000144	IS93	E-S	104.50	0.02723	3837.68		
71PPT000145	IS94	E-S	136.00	0.02865	4746.95		
71PPT000146	IS95	F-S	36.40	0.02844	1279.89	1596.05	1600.00
71PPT000147	IS96	F-S	57.60	0.02779	2072.69		
71PPT000148	IS97	F-S	35.20	0.02452	1435.56		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 0

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
71PPT000-					
131,132,133	IS79,80,81	A-S	312.50	0.08531	3663.11
134,135,136	IS82,84,85	B-S	228.75	0.08759	2611.60
137,138,139	IS86,87,88	C-S	105.00	0.07447	1409.96
140,141,142	IS89,90,91	D-S	880.00	0.05724	15373.86
143,144,145	IS92,93,94	E-S	311.25	0.08433	3690.86
146,147,148	IS95,96,97	F-S	129.00	0.08075	1597.52

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 0

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
71PPT000-							
131,132,133	IS79,80,81	A-S	191.00	0.08531	2238.89	3663.11	38.88
134,135,136	IS82,84,85	B-S	37.50	0.08759	428.13	2611.60	83.61
137,138,139	IS86,87,88	C-S	60.60	0.07447	813.75	1409.96	42.29
140,141,142	IS89,90,91	D-S	435.00	0.05724	7599.58	15373.86	50.57
143,144,145	IS92,93,94	E-S	143.50	0.08433	1701.65	3690.86	53.90
146,147,148	IS95,96,97	F-S	70.00	0.08075	866.87	1597.52	45.74

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 29

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
71PPT000398	IR87	A-S	222.50	0.02800	7946.43	6842.31	6322.67
71PPT000399	IR88	A-S	39.00	0.02831	1377.61		
71PPT000340	IR89	A-S	217.00	0.01937	11202.89		
71PPT000401	IR90	B-S	198.00	0.02919	6783.14	5500.96	5483.98
71PPT000402	IR91	B-S	216.00	0.02899	7450.85		
71PPT000403	IR92	B-S	67.00	0.02953	2268.88		
71PPT000404	IR93	C-S	41.50	0.02873	1444.48	12696.77	11198.80
71PPT000405	IR94	C-S	392.50	0.01960	20025.51		
71PPT000406	IR95	C-S	328.75	0.01978	16620.32		
71PPT000408	IR97	D-S	372.50	0.01982	18794.15	12311.74	11509.55
71PPT000409	IR98	D-S	361.00	0.02915	12384.22		
71PPT000410	IR99	D-S	170.00	0.02953	5756.86		
71PPT000411	IS01	E-S	150.00	0.02886	5197.51	4782.15	4784.02
71PPT000412	IS02	E-S	150.00	0.02868	5230.13		
71PPT000413	IS03	E-S	112.00	0.02858	3918.82		
71PPT000414	IS04	F-S	26.60	0.02946	902.92	1237.04	1237.11
71PPT000415	IS05	F-S	44.60	0.02952	1510.84		
71PPT000416	IS06	F-S	38.00	0.02929	1297.37		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 29

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
71PPT000-					
398,399,340	IR87,88,89	A-S	498.75	0.07568	6590.25
401,402,403	IR90,91,92	B-S	551.25	0.08770	6285.63
404,405,406	IR93,94,95	C-S	795.00	0.06812	11670.58
408,409,410	IR97,98,99	D-S	952.50	0.07851	12132.21
411,412,413	IS01,02,03	E-S	407.50	0.08611	4732.32
414,415,416	IS04,05,06	F-S	110.00	0.08827	1246.18

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 29

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
71PPT000-							
398,399,340	IR87,88,89	A-S	332.50	0.07568	4393.50	6590.25	33.33
401,402,403	IR90,91,92	B-S	229.00	0.08770	2611.17	6285.63	58.46
404,405,406	IR93,94,95	C-S	559.00	0.06812	8206.11	11670.58	29.69
408,409,410	IR97,98,99	D-S	604.00	0.07851	7693.29	12132.21	36.59
411,412,413	IS01,02,03	E-S	198.00	0.08611	2299.38	4732.32	51.41
414,415,416	IS04,05,06	F-S	53.50	0.08827	606.09	1246.18	51.36

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 60

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
94PPT000085	IU77	A-S	53.20	0.02896	1837.02	2004.20	1993.10
94PPT000086	IU78	A-S	42.80	0.02977	1437.69		
94PPT000087	IU79	A-S	77.40	0.02827	2737.88		
94PPT000088	IU80	B-S	34.60	0.02874	1203.90	2708.30	2711.34
94PPT000089	IU81	B-S	173.50	0.02917	5947.89		
94PPT000090	IU82	B-S	28.60	0.02939	973.12		
94PPT000091	IU83	C-S	418.50	0.01832	22843.89	11161.58	9724.57
94PPT000092	IU84	C-S	175.50	0.01893	9271.00		
94PPT000093	IU85	C-S	38.00	0.02774	1369.86		
94PPT000095	IU87	D-S	372.50	0.02853	13056.43	12440.18	12426.92
94PPT000096	IU88	D-S	241.50	0.01931	12506.47		
94PPT000097	IU89	D-S	342.50	0.02913	11757.64		
94PPT000098	IU90	E-S	59.00	0.02863	2060.78	3322.82	3300.65
94PPT000099	IU91	E-S	127.00	0.02720	4669.12		
94PPT000100	IU92	E-S	90.00	0.02779	3238.58		
94PPT000101	IU93	F-S	27.00	0.02671	1010.86	1132.43	1135.14
94PPT000102	IU94	F-S	37.80	0.02853	1324.92		
94PPT000103	IU95	F-S	30.20	0.02845	1061.51		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 60

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
94PPT000-					
085,086,087	IU77,78,79	A-S	173.60	0.08700	1995.40
088,089,090	IU80,81,82	B-S	246.25	0.08729	2821.06
091,092,093	IU83,84,85	C-S	638.75	0.06499	9828.44
095,096,097	IU87,88,89	D-S	972.50	0.07698	12633.15
098,099,101	IU90,91,92	E-S	276.25	0.08362	3303.64
101,102,103	IU93,94,95	F-S	97.20	0.08369	1161.43

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 60

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
94PPT000-							
085,086,087	IU77,78,79	A-S	58.80	0.08700	675.90	1995.40	66.13
088,089,090	IU80,81,82	B-S	116.00	0.08729	1328.90	2821.06	52.89
091,092,093	IU83,84,85	C-S	428.80	0.06499	6597.20	9828.44	32.88
095,096,097	IU87,88,89	D-S	562.50	0.07698	7307.10	12633.15	42.16
098,099,101	IU90,91,92	E-S	66.00	0.08362	789.30	3303.64	76.11
101,102,103	IU93,94,95	F-S	42.00	0.08369	501.90	1161.43	56.79

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 95

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
94PPT000147	IW39	A-S	47.50	0.02878	1650.45	1881.40	1887.71
94PPT000148	IW40	A-S	43.25	0.02863	1510.65		
94PPT000149	IW41	A-S	73.50	0.02960	2483.11		
94PPT000150	IW42	B-S	23.80	0.02865	830.72	4737.35	3837.88
94PPT000151	IW43	B-S	235.00	0.01950	12051.28		
94PPT000152	IW44	B-S	39.25	0.02951	1330.06		
94PPT000153	IW45	C-S	276.00	0.01901	14518.67	12455.58	10900.74
94PPT000154	IW46	C-S	419.00	0.01970	21269.04		
94PPT000155	IW47	C-S	46.25	0.02929	1579.04		
94PPT000156	IW48	D-S	209.00	0.01939	10778.75	9354.35	8346.88
94PPT000157	IW49	D-S	69.00	0.02905	2375.22		
94PPT000158	IW50	D-S	287.00	0.01925	14909.09		
94PPT000159	IW51	E-S	27.75	0.02894	958.88	2763.97	2694.58
94PPT000160	IW52	E-S	138.50	0.02661	5204.81		
94PPT000161	IW53	E-S	62.25	0.02925	2128.21		
94PPT000162	IW54	F-S	12.30	0.02780	442.45	625.99	629.05
94PPT000163	IW55	F-S	10.60	0.02735	387.57		
94PPT000164	IW56	F-S	29.50	0.02815	1047.96		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 95

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
71PPT000-					
147,148,149	IW39,40,41	A-S	153.75	0.08701	1767.04
150,151,152	IW42,43,44	B-S	276.25	0.07766	3557.17
153,154,155	IW45,46,47	C-S	670.00	0.06799	9854.39
156,157,158	IW48,49,50	D-S	577.50	0.06768	8532.80
159,160,161	IW51,52,53	E-S	225.00	0.08480	2653.30
162,163,164	IW54,55,56	F-S	53.13	0.08329	637.83

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-132B Time Series 95

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
94PPT000-							
147,148,149	IW39,40,41	A-S	74.50	0.08701	856.22	1767.04	51.54
150,151,152	IW42,43,44	B-S	141.50	0.07766	1822.04	3557.17	48.78
153,154,155	IW45,46,47	C-S	502.50	0.06799	7390.79	9854.39	25.00
156,157,158	IW48,49,50	D-S	368.75	0.06768	5448.43	8532.80	36.15
159,160,161	IW51,52,53	E-S	98.50	0.08480	1161.56	2653.30	56.22
162,163,164	IW54,55,56	F-S	24.00	0.08329	288.15	637.83	54.82

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 0

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
71PPT000006	IM02-1	A-S	158.00	0.02872	5501.39	11614.93	11542.96
71PPT000010	IM04-1	A-S	571.00	0.02801	20385.58		
71PPT000012	IM06-1	A-S	257.00	0.02869	8957.83		
71PPT000007	IM03-1	A-SS	133.00	0.02748	4839.88	3823.97	3828.26
71PPT000011	IM05-1	A-SS	74.80	0.02715	2755.06		
71PPT000013	IM07-1	A-SS	106.50	0.02747	3876.96		
71PPT000014	IM08-1	B-S	244.50	0.02892	8454.36	4195.52	4196.38
71PPT000018	IM10-1	B-S	48.20	0.02902	1660.92		
71PPT000020	IM12-1	B-S	71.00	0.02873	2471.28		
71PPT000015	IM09-1	B-SS	26.50	0.02790	949.82	6174.88	6174.32
71PPT000019	IM11-1	B-SS	196.50	0.02754	7135.08		
71PPT000021	IM13-1	B-SS	292.00	0.02797	10439.76		
71PPT000022	IM14-1	C-S	39.50	0.02877	1372.96	1809.89	1809.22
71PPT000024	IM16-1	C-S	64.20	0.02863	2242.40		
71PPT000026	IM18-1	C-S	53.25	0.02935	1814.31		
71PPT000023	IM15-3	C-SS	147.40	0.01416	10409.60	5576.84	4698.42
71PPT000025	IM17-1	C-SS	156.50	0.02714	5766.40		
71PPT000027	IM19-1	C-SS	14.70	0.02651	554.51		
71PPT000028	IM21-1	D-S	94.00	0.02871	3274.12	12921.23	12727.38
71PPT000030	IM23-1	D-S	769.00	0.02765	27811.93		
71PPT000032	IM25-1	D-S	221.50	0.02885	7677.64		
71PPT000029	IM22-1	D-SS	246.50	0.02789	8838.29	6097.93	6111.31
71PPT000031	IM24-1	D-SS	179.00	0.02795	6404.29		
71PPT000033	IM26-1	D-SS	84.00	0.02753	3051.22		
71PPT000034	IM27-1	E-S	117.00	0.02836	4125.53	8912.73	8968.84
71PPT000036	IM29-1	E-S	614.50	0.02896	21218.92		
71PPT000038	IM31-1	E-S	40.00	0.02870	1393.73		
71PPT000035	IM28-1	E-SS	268.50	0.02842	9447.57	15800.72	15405.77
71PPT000037	IM30-1	E-SS	244.00	0.02775	8792.79		
71PPT000039	IM32-1	E-SS	748.00	0.02565	29161.79		
71PPT000040	IM33-1	F-S	134.50	0.02978	4516.45	4641.08	4629.10
71PPT000042	IM35-1	F-S	171.50	0.02850	6017.54		
71PPT000044	IM37-1	F-S	99.00	0.02921	3389.25		
71PPT000041	IM34-1	F-SS	73.25	0.02760	2653.99	4890.94	4935.60
71PPT000043	IM36-1	F-SS	38.80	0.02737	1417.61		
71PPT000045	IM38-1	F-SS	298.00	0.02811	10601.21		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 0

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
71PPT000-					
006,010,012	IM02-1,04-1,06-1	A-S	962.50	0.08542	11267.85
007,011,013	IM03-1,05-1,07-1	A-SS	307.50	0.08210	3745.43
014,018,020	IM08-1,10-1,12-1	B-S	359.38	0.08668	4146.00
015,019,021	IM09-1,11-1,13-1	B-SS	512.50	0.08341	6144.35
022,024,026	IM14-1,16-1,18-1	C-S	153.75	0.08675	1772.33
023,025,027	IM15-3,17-1,19-1	C-SS	312.50	0.06781	4608.46
028,030,032	IM21-1,23-1,25-1	D-S	1095.00	0.08521	12850.60
029,031,040	IM22-1,24-1,26-1	D-SS	487.50	0.08337	5847.43
034,036,038	IM27-1,29-1,31-1	E-S	740.00	0.08602	8602.65
035,037,039	IM28-1,30-1,32-1	E-SS	1205.00	0.08182	14727.45
040,042,044	IM33-1,35-1,37-1	F-S	395.00	0.08749	4514.80
041,043,045	IM34-1,36-1,38-1	F-SS	402.50	0.08307	4845.31

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 0

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
71PPT000-							
006,010,012	IM02-1,04-1,06-1	A-S	680.00	0.08542	7960.85	11267.85	29.35
007,011,013	IM03-1,05-1,07-1	A-SS	237.00	0.08210	2886.72	3745.43	22.93
014,018,020	IM08-1,10-1,12-1	B-S	238.75	0.08668	2754.38	4146.00	33.57
015,019,021	IM09-1,11-1,13-1	B-SS	372.50	0.08341	4465.89	6144.35	27.32
022,024,026	IM14-1,16-1,18-1	C-S	80.50	0.08675	927.95	1772.33	47.64
023,025,027	IM15-3,17-1,19-1	C-SS	228.00	0.06781	3362.34	4608.46	27.04
028,030,032	IM21-1,23-1,25-1	D-S	557.50	0.08521	6542.66	12850.60	49.09
029,031,040	IM22-1,24-1,26-1	D-SS	350.00	0.08337	4198.15	5847.43	28.21
034,036,038	IM27-1,29-1,31-1	E-S	607.50	0.08602	7062.31	8602.65	17.91
035,037,039	IM28-1,30-1,32-1	E-SS	977.50	0.08182	11946.96	14727.45	18.88
040,042,044	IM33-1,35-1,37-1	F-S	251.25	0.08749	2871.76	4514.80	36.39
041,043,045	IM34-1,36-1,38-1	F-SS	323.75	0.08307	3897.32	4845.31	19.57

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 32

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
71PPT000303	IQ51	A-S	76.50	0.02854	2680.45	5437.41	5447.79
71PPT000305	IQ55	A-S	117.50	0.02873	4089.80		
71PPT000307	IQ57	A-S	275.00	0.02882	9541.98		
71PPT000304	IQ52	A-SS	42.50	0.02723	1560.78	1432.91	1433.50
71PPT000306	IQ56	A-SS	26.50	0.02818	940.38		
71PPT000308	IQ58	A-SS	51.50	0.02865	1797.56		
71PPT000309	IQ59	B-S	415.00	0.01984	20917.34	8900.91	7471.19
71PPT000311	IQ61	B-S	78.50	0.02920	2688.36		
71PPT000313	IQ63	B-S	90.00	0.02906	3097.04		
71PPT000310	IQ60	B-SS	62.00	0.01760	3522.73	7890.51	7980.28
71PPT000312	IQ62	B-SS	272.50	0.01865	14611.26		
71PPT000314	IQ64	B-SS	102.50	0.01851	5537.55		
71PPT000315	IQ65	C-S	45.50	0.02903	1567.34	21179.90	15751.99
71PPT000317	IQ67	C-S	1126.00	0.01852	60799.14		
71PPT000319	IQ69	C-S	34.00	0.02898	1173.22		
71PPT000316	IQ66	C-SS	206.50	0.01901	10862.70	4469.48	3720.27
71PPT000318	IQ68	C-SS	30.00	0.02806	1069.14		
71PPT000320	IQ70	C-SS	40.40	0.02736	1476.61		
71PPT000321	IQ71	D-S	102.00	0.02860	3566.43	12634.04	11221.25
71PPT000323	IQ73	D-S	438.00	0.01844	23752.71		
71PPT000325	IQ75	D-S	201.50	0.01904	10582.98		
71PPT000322	IQ72	D-SS	49.50	0.02789	1774.83	1806.99	1639.45
71PPT000324	IQ74	D-SS	9.50	0.02793	340.14		
71PPT000326	IQ76	D-SS	64.50	0.01951	3306.00		
71PPT000327	IQ77	E-S	274.50	0.01884	14570.06	12249.06	10972.83
71PPT000329	IQ79	E-S	366.00	0.01903	19232.79		
71PPT000331	IQ81	E-S	82.50	0.02802	2944.33		
71PPT000328	IQ78	E-SS	28.00	0.02767	1011.93	9802.08	7642.75
71PPT000330	IQ80	E-SS	481.50	0.01820	26456.04		
71PPT000332	IQ82	E-SS	54.00	0.02786	1938.26		
71PPT000333	IQ83	F-S	193.00	0.01900	10157.89	9144.62	8587.55
71PPT000335	IQ85	F-S	153.50	0.02829	5425.95		
71PPT000337	IQ87	F-S	216.50	0.01827	11850.03		
71PPT000334	IQ84	F-SS	231.00	0.01973	11708.06	5673.18	5032.53
71PPT000336	IQ86	F-SS	88.00	0.02790	3154.12		
71PPT000338	IQ88	F-SS	59.50	0.02758	2157.36		

EXXON/ADEC/EPA - Bioremediation Study 1990

KN-135B Time Series 32

Battelle Ocean Sciences

Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
71PPT000-					
303,305,307	IQ51,55,57	A-S	451.50	0.08610	5243.90
304,306,308	IQ52,56,58	A-SS	125.00	0.08406	1487.03
309,311,313	IQ59,61,63	B-S	582.00	0.07810	7451.98
310,312,314	IQ60,62,64	B-SS	424.00	0.05475	7744.29
315,317,319	IQ65,67,69	C-S	1075.00	0.07653	14046.78
316,318,320	IQ66,68,70	C-SS	267.00	0.07443	3587.26
321,323,325	IQ71,73,75	D-S	727.50	0.06608	11009.38
322,324,326	IQ72,74,76	D-SS	120.63	0.07532	1601.50
327,329,331	IQ77,79,81	E-S	723.75	0.06589	10984.22
328,330,332	IQ78,80,82	E-SS	555.00	0.07373	7527.47
333,335,337	IQ83,85,87	F-S	587.50	0.06557	8959.89
334,336,338	IQ84,86,88	F-SS	389.38	0.07521	5177.17

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 32

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
71PPT000-							
303,305,307	IQ51,55,57	A-S	292.60	0.08610	3398.37	5243.90	35.19
304,306,308	IQ52,56,58	A-SS	96.20	0.08406	1144.42	1487.03	23.04
309,311,313	IQ59,61,63	B-S	392.80	0.07810	5029.45	7451.98	32.51
310,312,314	IQ60,62,64	B-SS	279.70	0.05475	5108.68	7744.29	34.03
315,317,319	IQ65,67,69	C-S	743.50	0.07653	9715.14	14046.78	30.84
316,318,320	IQ66,68,70	C-SS	210.80	0.07443	2832.19	3587.26	21.05
321,323,325	IQ71,73,75	D-S	491.00	0.06608	7430.39	11009.38	32.51
322,324,326	IQ72,74,76	D-SS	99.50	0.07532	1321.03	1601.50	17.51
327,329,331	IQ77,79,81	E-S	511.00	0.06589	7755.35	10984.22	29.40
328,330,332	IQ78,80,82	E-SS	448.00	0.07373	6076.22	7527.47	19.28
333,335,337	IQ83,85,87	F-S	435.00	0.06557	6634.13	8959.89	25.96
334,336,338	IQ84,86,88	F-SS	305.50	0.07521	4061.96	5177.17	21.54

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-1358 Time Series 70

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
94PPT000009	IU39	A-S	70.00	0.02851	2455.28	5729.29	5750.46
94PPT000011	IU41	A-S	72.00	0.02869	2509.59		
94PPT000013	IU43	A-S	353.00	0.02888	12222.29		
94PPT000010	IU40	A-SS	20.75	0.02705	767.10	2371.83	2353.26
94PPT000012	IU42	A-SS	21.00	0.02801	749.73		
94PPT000014	IU44	A-SS	151.50	0.02706	5598.67		
94PPT000015	IU45	B-S	307.50	0.02842	10819.85	6415.82	6360.16
94PPT000017	IU47	B-S	169.00	0.02817	5999.29		
94PPT000019	IU49	B-S	72.00	0.02965	2428.33		
94PPT000016	IU46	B-SS	35.00	0.02671	1310.37	3149.04	2910.91
94PPT000018	IU48	B-SS	77.50	0.02809	2758.99		
94PPT000020	IU50	B-SS	102.50	0.01906	5377.75		
94PPT000021	IU51	C-S	32.25	0.02836	1137.17	4042.38	4003.84
94PPT000023	IU53	C-S	256.50	0.02817	9105.43		
94PPT000025	IU55	C-S	55.50	0.02945	1884.55		
94PPT000022	IU52	C-SS	46.00	0.02648	1737.16	3495.73	2885.31
94PPT000024	IU54	C-SS	10.30	0.02745	375.23		
94PPT000026	IU56	C-SS	151.50	0.01809	8374.79		
94PPT000027	IU57	D-S	329.50	0.02038	16167.81	16414.38	15374.56
94PPT000029	IU59	D-S	246.00	0.02879	8544.63		
94PPT000031	IU61	D-S	483.50	0.01971	24530.70		
94PPT000028	IU58	D-SS	3.70	0.02774	133.38	843.76	846.41
94PPT000030	IU60	D-SS	25.40	0.02835	895.94		
94PPT000032	IU62	D-SS	42.10	0.02803	1501.96		
94PPT000033	IU63	E-S	72.00	0.02879	2500.87	6567.05	5576.07
94PPT000035	IU65	E-S	301.00	0.02005	15012.47		
94PPT000037	IU67	E-S	65.00	0.02971	2187.82		
94PPT000034	IU64	E-SS	280.00	0.01804	15521.06	13798.28	11514.26
94PPT000036	IU66	E-SS	42.90	0.03101	1383.42		
94PPT000038	IU68	E-SS	456.50	0.01864	24490.34		
94PPT000039	IU69	F-S	278.00	0.02889	9622.71	11952.53	11574.01
94PPT000041	IU71	F-S	327.00	0.01939	16864.36		
94PPT000043	IU73	F-S	196.50	0.02097	9370.53		
94PPT000040	IU70	F-SS	48.70	0.02799	1739.91	3371.62	3336.54
94PPT000042	IU72	F-SS	19.90	0.02786	714.29		
94PPT000044	IU74	F-SS	208.60	0.02723	7660.67		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 70

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
94PPT000-					
009,011,013	IU39,41,43	A-S	486.25	0.08608	5648.82
010,012,014	IU40,42,44	A-SS	202.50	0.08212	2465.90
015,017,109	IU45,47,49	B-S	551.25	0.08624	6392.05
016,018,020	IU46,48,50	B-SS	210.00	0.07386	2843.22
021,023,025	IU51,53,55	C-S	338.75	0.08599	3939.41
022,024,026	IU52,54,56	C-SS	205.00	0.07202	2846.43
027,029,031	IU57,59,61	D-S	1060.00	0.06888	15389.08
028,030,032	IU58,60,62	D-SS	67.75	0.08412	805.40
033,035,037	IU63,65,67	E-S	426.25	0.07855	5426.48
034,036,038	IU64,66,68	E-SS	777.50	0.06769	11486.19
039,041,043	IU69,71,73	F-S	795.00	0.06925	11480.14
040,042,044	IU70,72,74	F-SS	258.50	0.08308	3111.46

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 70

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
94PPT000-							
009,011,013	IU39,41,43	A-S	277.00	0.08608	3217.94	5648.82	43.03
010,012,014	IU40,42,44	A-SS	134.00	0.08212	1631.76	2465.90	33.83
015,017,109	IU45,47,49	B-S	290.00	0.08624	3362.71	6392.05	47.39
016,018,020	IU46,48,50	B-SS	144.50	0.07386	1956.40	2843.22	31.19
021,023,025	IU51,53,55	C-S	159.00	0.08599	1849.05	3939.41	53.06
022,024,026	IU52,54,56	C-SS	143.00	0.07202	1985.56	2846.43	30.24
027,029,031	IU57,59,61	D-S	789.00	0.06888	11454.70	15389.08	25.57
028,030,032	IU58,60,62	D-SS	49.50	0.08412	588.45	805.40	26.94
033,035,037	IU63,65,67	E-S	280.80	0.07855	3574.16	5426.48	34.13
034,036,038	IU64,66,68	E-SS	594.00	0.06769	8775.30	11486.19	23.60
039,041,043	IU69,71,73	F-S	572.00	0.06925	8259.93	11480.14	28.05
040,042,044	IU70,72,74	F-SS	204.00	0.08308	2455.46	3111.46	21.08

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 109

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
94PPT000166	IW58	A-S	178.75	0.02771	6450.74	8708.48	7644.66
94PPT000169	IW60	A-S	33.80	0.02838	1190.98		
94PPT000171	IW62	A-S	368.75	0.01995	18483.71		
94PPT000167	IW59	A-SS	27.60	0.02857	966.05	1200.69	1212.05
94PPT000170	IW61	A-SS	15.80	0.02769	570.60		
94PPT000172	IW63	A-SS	60.00	0.02905	2065.40		
94PPT000173	IW64	B-S	54.50	0.02996	1819.09	8245.52	8135.45
94PPT000175	IW66	B-S	437.50	0.02846	15372.45		
94PPT000177	IW68	B-S	213.75	0.02833	7545.01		
94PPT000174	IW65	B-SS	24.60	0.02722	903.75	814.92	813.88
94PPT000176	IW67	B-SS	13.80	0.02745	502.73		
94PPT000178	IW69	B-SS	28.20	0.02716	1038.29		
94PPT000179	IW70	C-S	268.75	0.02783	9656.85	5402.49	5377.46
94PPT000181	IW72	C-S	24.80	0.02842	872.62		
94PPT000183	IW74	C-S	168.75	0.02972	5677.99		
94PPT000180	IW71	C-SS	13.60	0.02748	494.91	1058.06	1055.08
94PPT000182	IW73	C-SS	3.20	0.02835	112.87		
94PPT000184	IW75	C-SS	71.50	0.02786	2566.4		
94PPT000185	IW76	D-S	191.00	0.02757	6927.82	11185.07	11020.95
94PPT000187	IW78	D-S	151.00	0.02833	5330.04		
94PPT000189	IW80	D-S	568.00	0.02667	21297.34		
94PPT000186	IW77	D-SS	17.75	0.02724	651.62	2367.51	2373.91
94PPT000188	IW79	D-SS	113.50	0.02756	4118.29		
94PPT000190	IW81	D-SS	65.50	0.02808	2332.62		
94PPT000191	IW82	E-S	146.00	0.02843	5135.42	5488.89	5374.77
94PPT000193	IW84	E-S	258.00	0.02709	9523.81		
94PPT000195	IW86	E-S	53.50	0.02960	1807.43		
94PPT000192	IW83	E-SS	71.00	0.02893	2454.2	2927.17	2927.54
94PPT000194	IW85	E-SS	119.50	0.02874	4157.97		
94PPT000196	IW87	E-SS	62.00	0.02858	2169.35		
94PPT000197	IW88	F-S	468.00	0.01895	24696.57	13452.48	12130.25
94PPT000199	IW90	F-S	97.00	0.02770	3501.81		
94PPT000201	IW92	F-S	370.00	0.03043	12159.05		
94PPT000198	IW89	F-SS	250.00	0.02721	9187.80	10181.41	9393.94
94PPT000200	IW91	F-SS	117.00	0.02866	4082.34		
94PPT000202	IW93	F-SS	346.00	0.02003	17274.09		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-135B Time Series 109

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
94PPT000-					
166,169,171	IW58,60,62	A-S	584.38	0.07604	7685.10
167,170,172	IW59,61,63	A-SS	106.00	0.08531	1242.53
173,175,177	IW64,66,68	B-S	700.00	0.08675	8069.16
174,176,178	IW65,67,69	B-SS	68.40	0.08182	835.98
179,181,183	IW70,72,74	C-S	468.75	0.08597	5452.48
180,182,184	IW71,73,75	C-SS	88.75	0.08369	1060.46
185,187,189	IW76,78,80	D-S	900.00	0.08257	10899.84
186,188,190	IW77,79,81	D-SS	193.75	0.08288	2337.72
191,193,195	IW82,84,86	E-S	452.50	0.08513	5315.40
192,194,196	IW83,85,87	E-SS	253.75	0.08625	2942.03
197,199,201	IW88,90,92	F-S	920.00	0.07708	11935.65
198,200,202	IW89,91,93	F-SS	695.00	0.07590	9156.79

EXXON/ADEC/EPA - Bioremediation Study 1990 | Battelle Ocean Sciences
KN-135B Time Series 109 | Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
94PPT000-							
166,169,171	IW58,60,62	A-S	387.00	0.07604	5089.43	7685.10	33.78
167,170,172	IW59,61,63	A-SS	61.80	0.08531	724.42	1242.53	41.70
173,175,177	IW64,66,68	B-S	431.00	0.08675	4968.30	8069.16	38.43
174,176,178	IW65,67,69	B-SS	42.80	0.08182	523.10	835.98	37.43
179,181,183	IW70,72,74	C-S	313.50	0.08597	3646.62	5452.48	33.12
180,182,184	IW71,73,75	C-SS	55.50	0.08369	663.16	1060.46	37.46
185,187,189	IW76,78,80	D-S	646.00	0.08257	7823.66	10899.84	28.22
186,188,190	IW77,79,81	D-SS	155.50	0.08288	1876.21	2337.72	19.74
191,193,195	IW82,84,86	E-S	285.00	0.08513	3347.82	5315.40	37.02
192,194,196	IW83,85,87	E-SS	199.00	0.08625	2307.25	2942.03	21.58
197,199,201	IW88,90,92	F-S	674.00	0.07708	8744.16	11935.65	26.74
198,200,202	IW89,91,93	F-SS	569.00	0.07590	7496.71	9156.79	18.13

EXXON/ADEC/EPA - Bioremediation Study 1990 — Battelle Ocean Sciences

KN-211E Time Series 0 — Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
71PPT000092	IS38	A-S	4.60	0.02952	155.83	189.09	188.96
71PPT000094	IS39	A-S	8.80	0.02960	297.30		
71PPT000102	IS40	A-S	3.40	0.02979	114.13		
71PPT000093	IS41	A-SS	307.00	0.02855	10753.06	4032.58	4387.81
71PPT000095	IS42	A-SS	23.00	0.01910	1204.19		
71PPT000103	IS43	A-SS	4.00	0.02847	140.50		
71PPT000096	IS44	B-S	3.40	0.02944	115.49	200.37	200.18
71PPT000104	IS45	B-S	5.00	0.02963	168.75		
71PPT000098	IS46	B-S	9.30	0.02935	316.87		
71PPT000097	IS47	B-SS	358.50	0.01864	19232.83	20118.44	20130.79
71PPT000105	IS48	B-SS	409.50	0.01926	21261.68		
71PPT000099	IS49	B-SS	371.00	0.01868	19860.81		
71PPT000100	IS50	C-S	11.60	0.02811	412.66	313.81	311.49
71PPT000106	IS51	C-S	11.00	0.02892	380.36		
71PPT000108	IS52	C-S	4.40	0.02965	148.40		
71PPT000101	IS53	C-SS	341.00	0.01936	17613.64	13830.97	12453.20
71PPT000107	IS54	C-SS	127.50	0.02874	4436.33		
71PPT000109	IS55	C-SS	363.00	0.01867	19442.96		
71PPT000110	IS56	D-S	140.00	0.02773	5048.68	5692.65	5181.05
71PPT000112	IS57	D-S	59.40	0.02781	2135.92		
71PPT000114	IS58	D-S	185.50	0.01875	9893.33		
71PPT000111	IS59	D-SS	163.50	0.01969	8303.71	9761.28	8911.33
71PPT000113	IS60	D-SS	318.50	0.01887	16878.64		
71PPT000115	IS61	D-SS	118.00	0.02877	4101.49		
71PPT000116	IS62	E-S	90.00	0.01904	4726.89	1944.82	1587.92
71PPT000118	IS63	E-S	24.80	0.02889	858.43		
71PPT000121	IS64	E-S	7.20	0.02890	249.13		
71PPT000117	IS65	E-SS	377.00	0.01885	20000.00	19676.98	19674.61
71PPT000120	IS66	E-SS	327.50	0.01874	17475.99		
71PPT000122	IS67	E-SS	402.00	0.01865	21554.96		
71PPT000123	IS68	F-S	71.50	0.02828	2528.29	5450.92	4564.76
71PPT000125	IS69	F-S	250.00	0.01930	12953.37		
71PPT000127	IS70	F-S	24.60	0.02824	871.10		
71PPT000124	IS71	F-SS	215.00	0.01919	11203.75	16735.28	16707.40
71PPT000126	IS72	F-SS	336.00	0.01924	17463.62		
71PPT000128	IS73	F-SS	406.00	0.01885	21538.46		
71PPT000129	IS74MS	A-S	2.60	0.02933	88.65		
71PPT000129	IS74SD	A-S	52.50	0.02935	1788.76		
71PPT000130	IS75B	A-SS	1.60	0.02839	56.36		
71PPT000130	IS75MS	A-SS	4.00	0.02880	138.89		
71PPT000130	IS75SD	A-SS	3.10	0.02911	106.49		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-211E Time Series 0

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
71PPT000-					
92,94,102	IS38,39,40	A-S	16.80	0.08890	188.98
93,95,103	IS41,42,43	A-SS	335.00	0.07611	4401.52
96,104,98	IS44,45,46	B-S	17.00	0.08842	192.26
97,105,99	IS47,48,49	B-SS	1142.50	0.05659	20189.08
100,106,108	IS50,51,52	C-S	26.80	0.08668	309.18
101,107,109	IS53,54,55	C-SS	840.00	0.06678	12578.62
110,112,114	IS56,57,58	D-S	383.75	0.07430	5164.87
111,113,115	IS59,60,61	D-SS	606.25	0.06734	9002.82
116,118,121	IS62,63,64	E-S	123.75	0.07683	1610.70
117,120,122	IS65,66,67	E-SS	1145.00	0.05624	20359.17
123,125,127	IS68,69,70	F-S	338.75	0.07582	4467.82
124,126,128	IS71,72,73	F-SS	952.50	0.05728	16628.84
129	IS74MS	A-S	2.74	0.02933	93.42
129	IS74SD	A-S	27.00	0.02935	919.93
130	IS75B	A-SS	1.62	0.02839	57.06
130	IS75MS	A-SS	4.22	0.02880	146.53
130	IS75SD	A-SS	2.88	0.02911	98.94

EXXON/ADEC/EPA - Bioremediation Study 1990
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Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
71PPT000-							
92,94,102	IS38,39,40	A-S	9.70	0.08890	109.11	188.98	42.26
93,95,103	IS41,42,43	A-SS	268.00	0.07611	3521.22	4401.52	20.00
96,104,98	IS44,45,46	B-S	9.60	0.08842	108.57	192.26	43.53
97,105,99	IS47,48,49	B-SS	974.00	0.05659	17211.52	20189.08	14.75
100,106,108	IS50,51,52	C-S	14.60	0.08668	168.44	309.18	45.52
101,107,109	IS53,54,55	C-SS	692.00	0.06678	10362.38	12578.62	17.62
110,112,114	IS56,57,58	D-S	260.00	0.07430	3499.33	5164.87	32.25
111,113,115	IS59,60,61	D-SS	498.00	0.06734	7395.31	9002.82	17.86
116,118,121	IS62,63,64	E-S	85.50	0.07683	1112.85	1610.70	30.91
117,120,122	IS65,66,67	E-SS	920.00	0.05624	16358.46	20359.17	19.65
123,125,127	IS68,69,70	F-S	271.30	0.07582	3577.55	4467.82	19.93
124,126,128	IS71,72,73	F-SS	249.00	0.05728	4347.07	16628.84	73.86
129	IS74MS	A-S	1.38	0.02933	47.05	93.42	49.64
129	IS74SD	A-S	13.25	0.02935	451.45	919.93	50.93
130	IS75B	A-SS	0.70	0.02839	26.07	57.06	54.32
130	IS75MS	A-SS	1.80	0.02880	63.19	146.53	56.87
130	IS75SD	A-SS	1.40	0.02911	47.41	98.94	52.08

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KN-211E Time Series 31

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
71PPT000341	IR33	A-S	17.60	0.02977	591.20	6689.34	6388.37
71PPT000342	IR34	A-S	7.10	0.02919	243.23		
71PPT000343	IR35	A-S	527.00	0.02740	19233.58		
71PPT000344	IR36	A-SS	6.50	0.02845	228.47	970.09	973.18
71PPT000345	IR37	A-SS	8.60	0.02835	303.35		
71PPT000346	IR38	A-SS	68.00	0.02859	2378.45		
71PPT000347	IR39	B-S	268.75	0.02874	9351.08	6914.66	6862.68
71PPT000348	IR40	B-S	323.75	0.02895	11183.07		
71PPT000349	IR41	B-S	6.20	0.02955	209.81		
71PPT000350	IR42	B-SS	767.50	0.02858	26854.44	17368.12	17408.74
71PPT000351	IR43	B-SS	182.50	0.02833	6441.93		
71PPT000352	IR44	B-SS	547.50	0.02911	18807.97		
71PPT000353	IR45	C-S	8.10	0.02875	281.74	601.10	599.68
71PPT000354	IR46	C-S	10.80	0.02935	367.97		
71PPT000355	IR47	C-S	33.20	0.02878	1153.58		
71PPT000356	IR48	C-SS	440.00	0.02771	15878.74	16259.29	16274.93
71PPT000357	IR49	C-SS	583.50	0.02840	20545.77		
71PPT000358	IR50	C-SS	347.50	0.02813	12353.36		
71PPT000359	IR53	D-S	55.50	0.02734	2029.99	5022.34	5036.87
71PPT000360	IR54	D-S	270.00	0.02807	9618.81		
71PPT000361	IR55	D-S	98.00	0.02867	3418.21		
71PPT000362	IR56	D-SS	470.00	0.02902	16195.73	14773.47	14870.54
71PPT000363	IR57	D-SS	197.50	0.02783	7096.66		
71PPT000364	IR58	D-SS	607.50	0.02889	21028.04		
71PPT000365	IR59	E-S	6.30	0.02860	220.28	4049.85	4049.76
71PPT000366	IR60	E-S	163.75	0.02870	5705.57		
71PPT000367	IR61	E-S	177.50	0.02852	6223.70		
71PPT000368	IR62	E-SS	515.00	0.02859	18013.29	19401.74	19380.99
71PPT000369	IR63	E-SS	577.50	0.02748	21015.28		
71PPT000370	IR64	E-SS	545.00	0.02842	19176.64		
71PPT000371	IR65	F-S	120.00	0.02846	4216.44	9145.77	9278.20
71PPT000372	IR66	F-S	578.75	0.02921	19813.42		
71PPT000373	IR67	F-S	95.00	0.02788	3407.46		
71PPT000374	IR68	F-SS	666.25	0.02813	23684.68	14756.00	14684.48
71PPT000375	IR69	F-SS	412.50	0.02895	14248.70		
71PPT000376	IR70	F-SS	182.50	0.02881	6334.61		

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Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
71PPT000-					
341,342,343	IR33,34,35	A-S	547.50	0.08637	6339.01
344,345,346	IR36,37,38	A-SS	85.20	0.08539	997.77
347,348,349	IR39,40,41	B-S	616.25	0.08724	7063.85
350,351,352	IR42,43,44	B-SS	1576.00	0.08602	18321.32
353,354,355	IR45,46,47	C-S	55.20	0.08688	635.36
356,357,358	IR48,49,50	C-SS	1396.00	0.08424	16571.70
359,360,361	IR53,54,55	D-S	427.50	0.08408	5084.44
362,363,364	IR56,57,58	D-SS	1312.00	0.08575	15300.29
365,366,367	IR59,60,61	E-S	356.25	0.08582	4151.13
368,369,370	IR62,63,64	E-SS	1655.00	0.08449	19588.12
371,372,373	IR65,66,67	F-S	802.50	0.08555	9380.48
374,375,376	IR68,69,70	F-SS	1270.00	0.08589	14786.35

EXXON/ADEC/EPA - Bioremediation Study 1990
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Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
71PPT000-							
341,342,343	IR33,34,35	A-S	435.00	0.08637	5036.47	6339.01	20.55
344,345,346	IR36,37,38	A-SS	63.40	0.08539	742.48	997.77	25.59
347,348,349	IR39,40,41	B-S	449.50	0.08724	5152.45	7063.85	27.06
350,351,352	IR42,43,44	B-SS	1254.00	0.08602	14578.01	18321.32	20.43
353,354,355	IR45,46,47	C-S	16.93	0.08688	194.9	635.36	69.32
356,357,358	IR48,49,50	C-SS	1174.00	0.08424	13936.37	16571.70	15.90
359,360,361	IR53,54,55	D-S	327.50	0.08408	3895.1	5084.44	23.39
362,363,364	IR56,57,58	D-SS	1118.00	0.08575	13037.9	15300.29	14.79
365,366,367	IR59,60,61	E-S	265.50	0.08582	3093.68	4151.13	25.47
368,369,370	IR62,63,64	E-SS	1406.00	0.08449	16641.02	19588.12	15.05
371,372,373	IR65,66,67	F-S	639.00	0.08555	7469.32	9380.48	20.37
374,375,376	IR68,69,70	F-SS	1076.00	0.08589	12527.65	14786.35	15.28

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Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
94PPT000047	IU01	A-S	82.50	0.02764	2984.80	1734.19	1703.49
94PPT000049	IU03	A-S	59.00	0.02880	2048.61		
94PPT000051	IU05	A-S	5.00	0.02956	169.15		
94PPT000048	IU02	A-SS	38.80	0.02855	1359.02	1667.00	1670.76
94PPT000050	IU04	A-SS	99.50	0.02862	3476.59		
94PPT000052	IU06	A-SS	4.70	0.02842	165.38		
94PPT000053	IU07	B-S	30.60	0.02910	1051.55	3707.45	2872.90
94PPT000055	IU09	B-S	193.00	0.01919	10057.32		
94PPT000057	IU11	B-S	0.40	0.02968	13.48		
94PPT000054	IU08	B-SS	338.00	0.01933	17485.77	15672.11	15659.75
94PPT000056	IU10	B-SS	353.40	0.01886	18738.07		
94PPT000058	IU12	B-SS	207.00	0.01918	10792.49		
94PPT000059	IU13	C-S	13.50	0.02879	.468.91	522.96	523.09
94PPT000061	IU15	C-S	10.60	0.02889	366.91		
94PPT000063	IU17	C-S	21.20	0.02892	733.06		
94PPT000060	IU14	C-SS	448.50	0.01869	23996.79	14241.28	14110.59
94PPT000062	IU16	C-SS	155.00	0.01958	7916.24		
94PPT000064	IU18	C-SS	208.00	0.01924	10810.81		
94PPT000065	IU19	D-S	104.00	0.02805	3707.66	1641.61	1627.34
94PPT000067	IU21	D-S	6.00	0.02939	204.15		
94PPT000069	IU23	D-S	27.25	0.02690	1013.01		
94PPT000066	IU20	D-SS	280.00	0.01924	14553.01	13262.51	13230.74
94PPT000068	IU22	D-SS	181.50	0.01969	9217.88		
94PPT000070	IU24	D-SS	308.00	0.01923	16016.64		
94PPT000071	IU25	E-S	167.00	0.02862	5835.08	2663.69	2666.36
94PPT000073	IU27	E-S	22.20	0.02799	793.14		
94PPT000075	IU29	E-S	40.00	0.02935	1362.86		
94PPT000072	IU26	E-SS	322.00	0.01866	17256.16	17388.94	17389.04
94PPT000074	IU28	E-SS	360.50	0.01946	18525.18		
94PPT000076	IU30	E-SS	320.50	0.01956	16385.48		
94PPT000077	IU31	F-S	15.70	0.02971	528.44	940.16	927.95
94PPT000079	IU33	F-S	59.00	0.02858	2064.38		
94PPT000081	IU35	F-S	6.70	0.02943	227.66		
94PPT000078	IU32	F-SS	313.00	0.01888	16578.39	13727.26	13737.43
94PPT000080	IU34	F-SS	285.00	0.01901	14992.11		
94PPT000082	IU36	F-SS	180.50	0.01878	9611.29		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-211E Time Series 62

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
94PPT000-					
047,049,051	IU01,03,05	A-S	142.50	0.08599	1657.17
048,050,052	IU02,04,06	A-SS	144.50	0.08558	1688.48
053,055,057	IU07,09,11	B-S	224.00	0.07797	2872.90
054,056,058	IU08,10,12	B-SS	935.00	0.05736	16300.56
059,061,063	IU13,15,17	C-S	44.00	0.08659	508.14
060,062,064	IU14,16,18	C-SS	822.00	0.05751	14293.17
065,067,069	IU19,21,23	D-S	135.00	0.08434	1600.66
066,068,070	IU20,22,24	D-SS	812.50	0.05816	13970.08
071,073,075	IU25,27,29	E-S	232.50	0.08597	2704.43
072,074,076	IU26,28,30	E-SS	1020.00	0.05768	17683.77
077,079,081	IU31,33,35	F-S	81.88	0.08772	933.37
078,080,082	IU32,34,36	F-SS	790.00	0.05668	13937.90

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-211E Time Series 62

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
94PPT000-							
047,049,051	IU01,03,05	A-S	78.00	0.08599	907.08	1657.17	45.26
048,050,052	IU02,04,06	A-SS	95.50	0.08558	1115.91	1688.48	33.91
053,055,057	IU07,09,11	B-S	143.00	0.07797	1834.04	2872.90	36.16
054,056,058	IU08,10,12	B-SS	776.00	0.05736	13528.59	16300.56	17.01
059,061,063	IU13,15,17	C-S	10.80	0.08659	124.73	508.14	75.45
060,062,064	IU14,16,18	C-SS	595.00	0.05751	10346.03	14293.17	27.62
065,067,069	IU19,21,23	D-S	77.00	0.08434	913.00	1600.66	43.00
066,068,070	IU20,22,24	D-SS	694.50	0.05816	11941.20	13970.08	14.50
071,073,075	IU25,27,29	E-S	131.00	0.08597	1523.80	2704.43	43.70
072,074,076	IU26,28,30	E-SS	888.50	0.05768	15404.00	17683.77	12.90
077,079,081	IU31,33,35	F-S	43.80	0.08772	498.70	933.37	46.60
078,080,082	IU32,34,36	F-SS	616.50	0.05668	10876.90	13937.90	22.00

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-211E Time Series 98

Battelle Ocean Sciences
Pre-column individual gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Sample Dry Weight (kg)	Total Oil/ Station (mg/kg)	Avg Oil/ Station (mg/kg)	Sum Oil/ Station (mg/kg)
94PPT000109	IW01	A-S	23.00	0.02918	788.21	524.86	524.04
94PPT000111	IW03	A-S	14.60	0.02932	497.95		
94PPT000113	IW05	A-S	8.50	0.02947	288.43		
94PPT000110	IW02	A-SS	1.35	0.02899	46.57	6775.35	5058.60
94PPT000112	IW04	A-SS	11.60	0.02891	401.25		
94PPT000114	IW06	A-SS	375.50	0.01889	19878.24		
94PPT000115	IW07	B-S	35.60	0.02971	1198.25	3141.57	2504.79
94PPT000117	IW09	B-S	6.00	0.02932	204.64		
94PPT000119	IW11	B-S	154.50	0.01926	8021.81		
94PPT000116	IW08	B-SS	386.50	0.01864	20734.98	21296.33	21289.75
94PPT000118	IW10	B-SS	407.50	0.01844	22098.70		
94PPT000120	IW12	B-SS	411.00	0.01952	21055.33		
94PPT000121	IW13	C-S	69.00	0.02892	2385.89	2298.51	2034.27
94PPT000123	IW15	C-S	5.20	0.02906	178.94		
94PPT000125	IW17	C-S	82.50	0.01905	4330.71		
94PPT000122	IW14	C-SS	234.00	0.01953	11981.57	10264.89	10193.89
94PPT000124	IW16	C-SS	66.60	0.01974	3373.86		
94PPT000126	IW18	C-SS	293.50	0.01901	15439.24		
94PPT000127	IW19	D-S	148.50	0.01867	7953.94	3505.63	2951.17
94PPT000129	IW21	D-S	11.30	0.02818	400.99		
94PPT000131	IW23	D-S	59.00	0.02729	2161.96		
94PPT000128	IW20	D-SS	299.00	0.01968	15193.09	13284.78	13323.28
94PPT000130	IW22	D-SS	346.25	0.01927	17968.34		
94PPT000132	IW24	D-SS	127.50	0.01905	6692.91		
94PPT000135	IW27	E-S	116.25	0.02724	4267.62	5867.46	5160.14
94PPT000137	IW29	E-S	240.00	0.01951	12301.38		
94PPT000139	IW31	E-S	28.80	0.02787	1033.37		
94PPT000134	IW26	E-SS	388.75	0.01832	21219.98	17066.15	17029.24
94PPT000136	IW28	E-SS	247.50	0.01881	13157.89		
94PPT000138	IW30	E-SS	318.75	0.01895	16820.58		
94PPT000133	IW25	F-S	75.00	0.02790	2688.17	4915.33	4800.50
94PPT000141	IW33	F-S	318.75	0.02716	11736.01		
94PPT000143	IW35	F-S	9.30	0.02890	321.80		
94PPT000140	IW32	F-SS	287.50	0.01878	15308.84	17081.94	17053.48
94PPT000142	IW34	F-SS	448.75	0.01878	23895.10		
94PPT000144	IW36	F-SS	230.00	0.01910	12041.88		

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-211E Time Series 98

Battelle Ocean Sciences
Pre-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Total Oil/Sample (mg/kg)
94PPT000-					
109,111,113	IW01,03,05	A-S	45.80	0.08796	520.69
110,112,114	IW02,04,06	A-SS	365.00	0.07678	4753.84
115,117,119	IW07,09,11	B-S	190.50	0.07829	2433.26
116,118,120	IW08,10,12	B-SS	1116.00	0.05661	19713.83
121,123,125	IW13,15,17	C-S	150.50	0.07702	1954.04
122,124,126	IW14,16,18	C-SS	563.75	0.05828	9673.13
127,129,131	IW19,21,23	D-S	225.00	0.07414	3034.80
128,130,132	IW20,22,24	D-SS	1023.75	0.05800	17650.86
135,137,139	IW27,29,31	E-S	410.63	0.07462	5502.88
134,136,138	IW26,28,30	E-SS	1002.50	0.05609	17873.06
133,141,143	IW25,33,35	F-S	434.38	0.08396	5173.59
140,142,144	IW32,34,36	F-SS	995.00	0.05666	17560.89

EXXON/ADEC/EPA - Bioremediation Study 1990
KN-211E Time Series 98

Battelle Ocean Sciences
Post-column, combined gravimetric analysis

Sample Field ID	Battelle ID	Station/ Depth	Total Oil (mg)	Total Sample Dry Weight/ Station (kg)	Post-column Total Oil Sample (mg/kg)	Pre-column Total Oil Sample (mg/kg)	% Polar Components
94PPT000-							
109,111,113	IW01,03,05	A-S	21.60	0.08796	245.57	520.69	52.84
110,112,114	IW02,04,06	A-SS	297.50	0.07678	3874.71	4753.84	18.49
115,117,119	IW07,09,11	B-S	125.00	0.07829	1596.63	2433.26	34.38
116,118,120	IW08,10,12	B-SS	920.00	0.05661	16251.55	19713.83	17.56
121,123,125	IW13,15,17	C-S	106.00	0.07702	1376.27	1954.04	29.57
122,124,126	IW14,16,18	C-SS	437.50	0.05828	7506.86	9673.13	22.39
127,129,131	IW19,21,23	D-S	162.75	0.07414	2195.17	3034.80	27.67
128,130,132	IW20,22,24	D-SS	847.00	0.05800	14603.45	17650.86	17.26
135,137,139	IW27,29,31	E-S	282.50	0.07462	3785.85	5502.88	31.20
134,136,138	IW26,28,30	E-SS	838.00	0.05609	14940.27	17873.06	16.41
133,141,143	IW25,33,35	F-S	309.50	0.08396	3686.28	5173.59	28.75
140,142,144	IW32,34,36	F-SS	823.00	0.05666	14525.24	17560.89	17.29

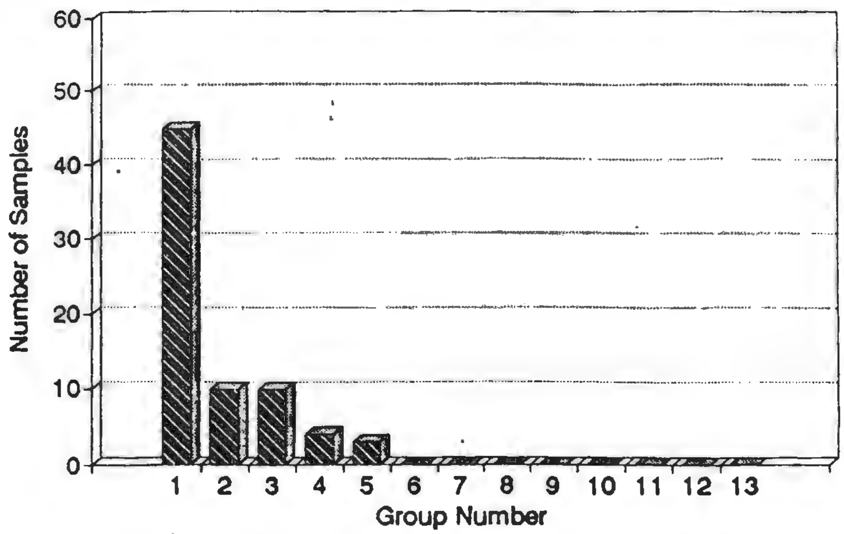
APPENDIX D3, SECTION 3

Distribution of Total Extractable Hydrocarbon in Sediment Samples

The graphs show the distribution histograms of the individual samples, with the data treated arithmetically, and as natural logarithms. The data are those presented in Tables 5-7 of the main report.

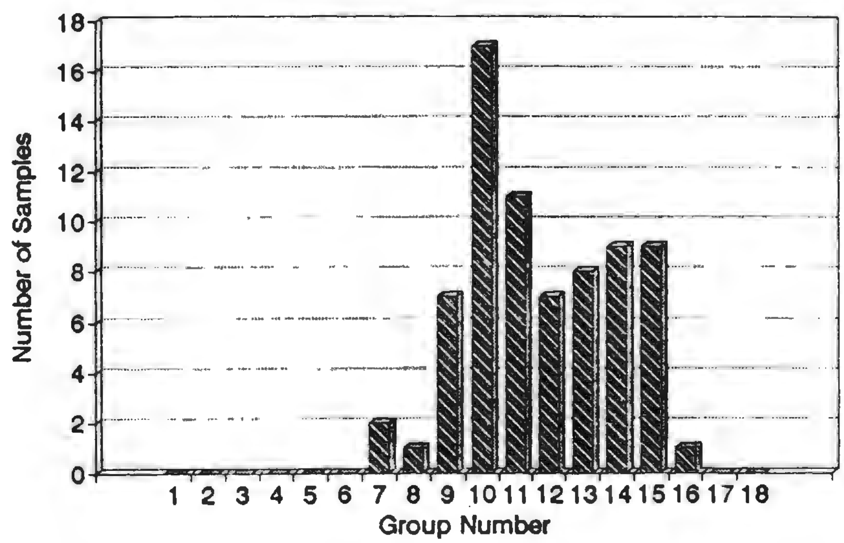
KN-132B, Surface, All Days

Group 1 is 0-5 g/Kg



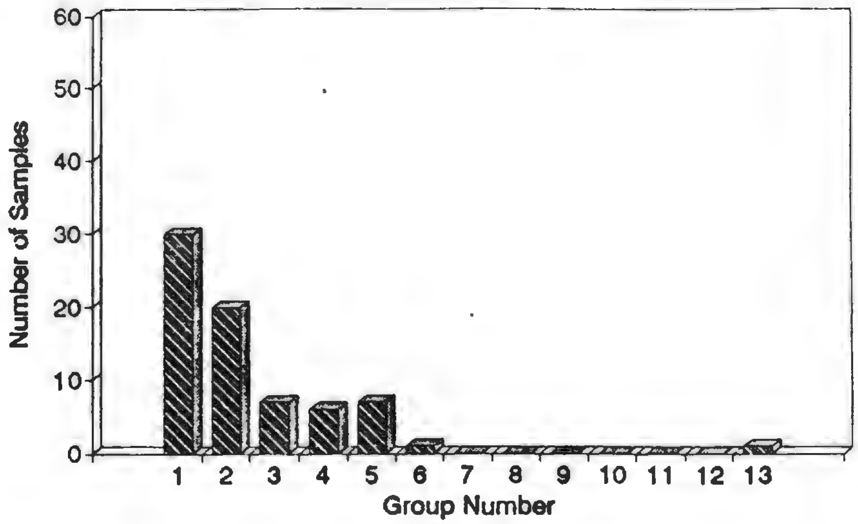
KN-132B, Surface, All Days

Natural Log, Group 1 is 2.5-3.0



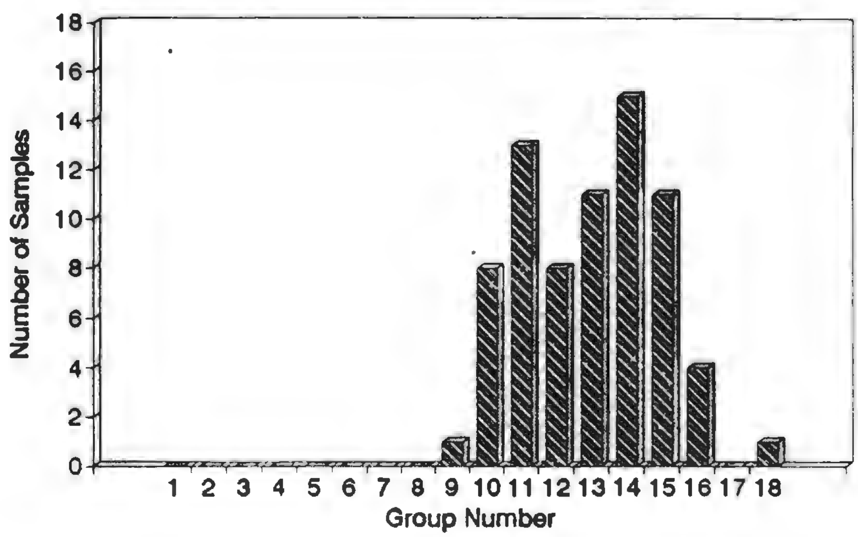
KN-135B, Surface, All Days

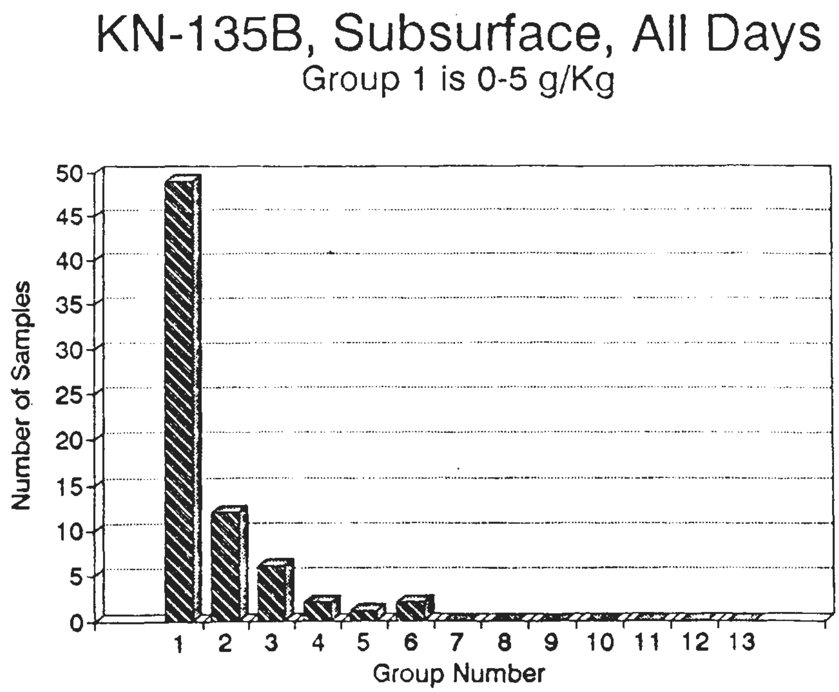
Group 1 is 0-5 g/Kg

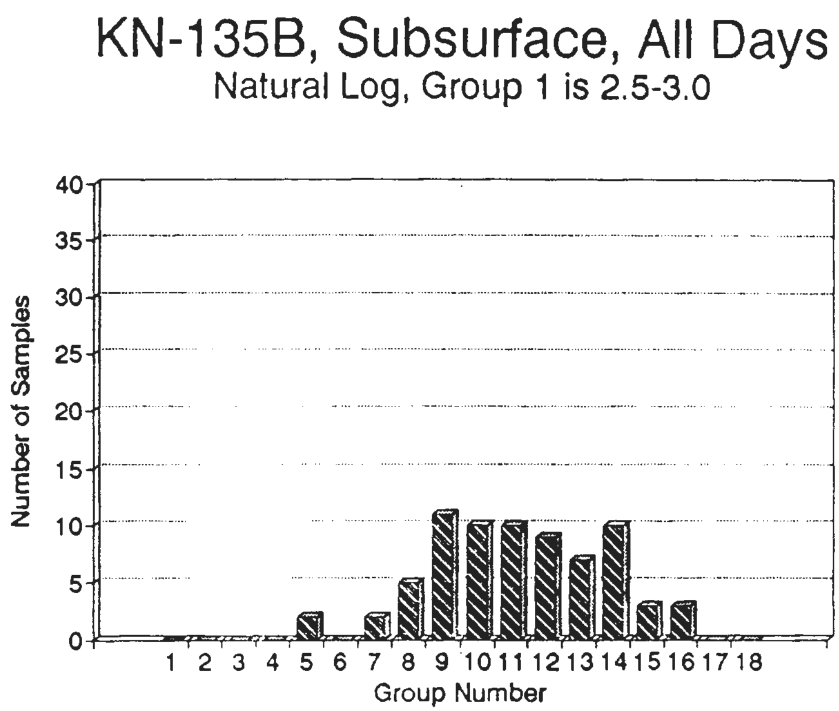


KN-135B, Surface, All Days

Natural Log, Group 1 is 2.5-3.0

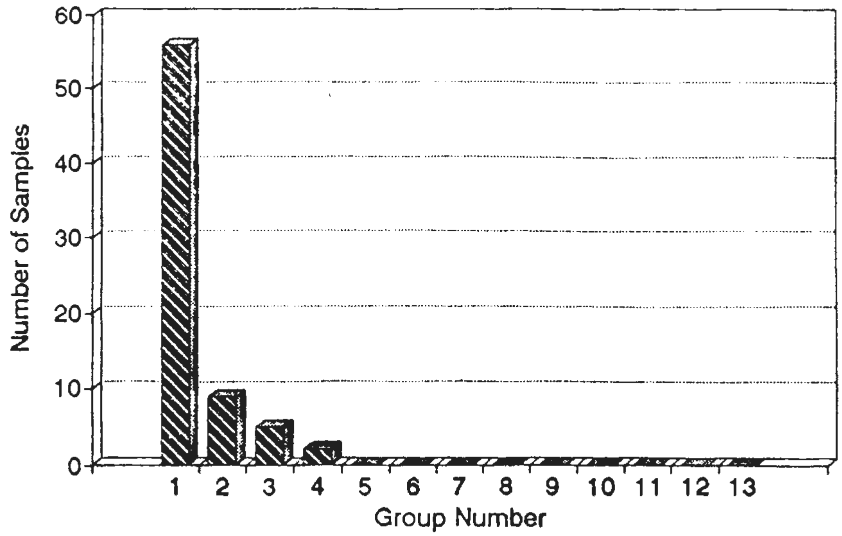



KN-135B, Subsurface, All Days
Group 1 is 0-5 g/Kg
Number of Samples
0
5
10
15
20
25
30
35
40
45
50
1 2 3 4 5 6 7 8 9 10 11 12 13
Group Number


KN-135B, Subsurface, All Days
Natural Log, Group 1 is 2.5-3.0
Number of Samples
0
5
10
15
20
25
30
35
40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Group Number

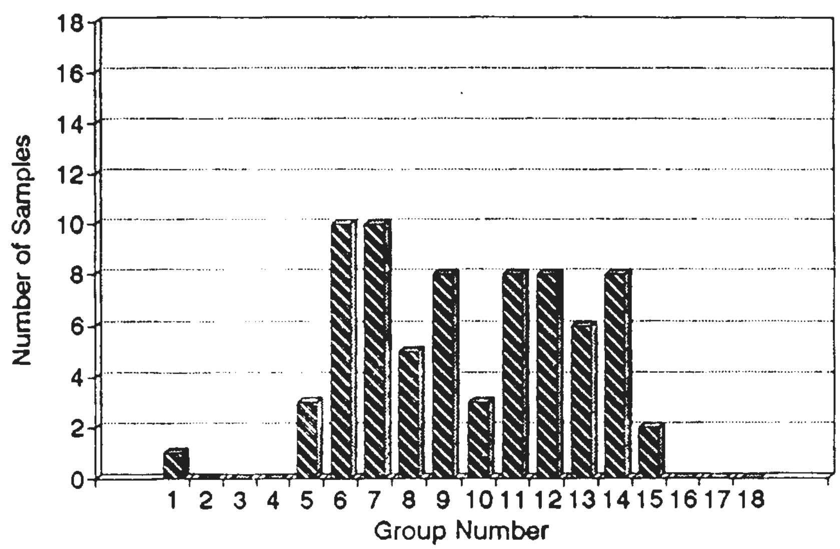
KN-211E, Surface, All Days

Group 1 is 0-5 g/Kg

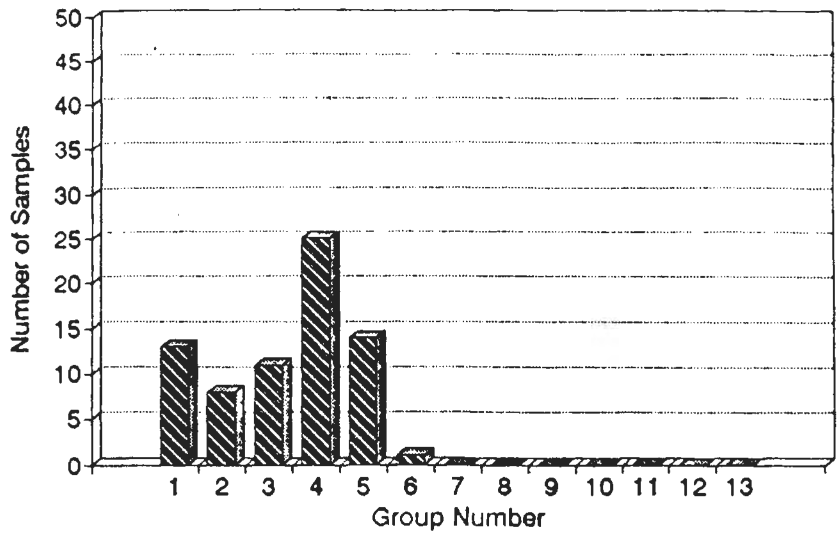


KN-211E, Surface, All Days

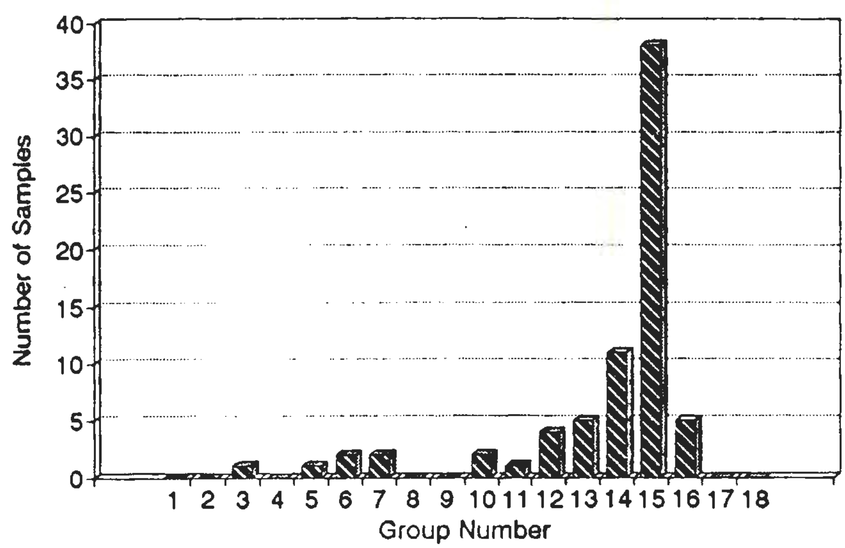
Natural Log, Group 1 is 2.5-3.0



KN-211E, Subsurface, All Days
Group 1 is 0-5 g/Kg



KN-211E, Subsurface, All Days
Natural Log, Group 1 is 2.5-3.0



APPENDIX D3, SECTION 4
Data Tables of Oil Analyses

Exxon Bioremmediation Project (N0531-2971)
Beach KN132 Time Series 0

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	B-S	C-S	D-S	E-S	F-S
Battelle Lab ID	IN81,82,83	IN84,85,86	IN87,88,89	IN90,91,92	IN93,94,95	IN96,97,98
C10	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND
C12	ND	ND	ND	ND	ND	ND
C13	ND	ND	ND	ND	ND	ND
C14	0.425	ND	0.258	1.389	ND	ND
C15	1.480	0.078	0.863	4.581	ND	0.041
C16	1.941	0.133	1.104	6.196	0.094	0.060
C17	2.784	0.240	1.404	7.920	0.173	0.120
Pristane	6.124	0.892	3.840	18.675	0.738	0.449
C18	3.500	0.306	2.180	12.623	0.233	0.137
Phytane	6.495	0.883	4.145	20.899	0.773	0.409
C19	2.800	0.306	1.609	9.862	0.231	0.146
C20	2.805	0.349	1.418	8.422	0.276	0.210
C21	3.075	0.661	1.786	9.748	0.455	0.054
C22	2.835	0.473	1.717	9.383	0.489	0.262
C23	2.656	0.344	1.508	9.276	0.354	0.136
C24	2.928	0.498	1.882	11.947	0.493	0.235
C25	3.138	0.492	1.878	12.991	0.479	0.225
C26	2.863	0.385	1.619	9.384	0.324	0.178
C27	2.364	0.324	1.367	7.773	0.279	0.140
C28	3.642	1.020	1.728	11.217	1.037	0.356
C29	2.870	0.644	1.768	8.154	0.803	0.241
C30	2.912	0.496	1.545	8.428	0.492	0.249
C31	1.984	0.369	1.204	6.311	0.396	0.155
C32	1.509	0.291	0.944	4.802	0.386	0.124
C33	1.970	0.601	1.555	5.970	0.773	0.341
C34	2.360	0.863	1.797	7.852	0.765	0.350
OTP (% Recovery)	82	80	81	77	83	84
Total H.C.	2130.02	687.59	1521.15	6344.44	831.67	446.36
Pristane/Phytane	0.94	1.01	0.93	0.89	0.95	1.10
C17/Pristane	0.45	0.27	0.37	0.42	0.23	0.27
C18/Phytane	0.54	0.35	0.53	0.60	0.30	0.33
TALK	52.84	8.87	31.13	174.23	8.53	3.76
LALK	15.74	1.41	8.84	50.99	1.01	0.71
LALK/TALK	0.30	0.16	0.28	0.29	0.12	0.19

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2971)
Beach KN132, Time Series 0

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/Kg Dry Weight

Reporting Limit= 0.01 mg/kg
521 Reference oil data in mg/kg oil.

Station ID-Depth:	A-S	B-S	C-S	D-S	E-S	F-S	NA	NA
Battelle Lab ID:	IN81,82,83	IN84,85,86	IN87,88,89	IN90,91,92	IN93,94,95	IN96,97,98	521 oil	521 oil
Analyte								
naphthalene	ND	ND	ND	ND	ND	ND	26.27	26.33
C1-naphthalenes	ND	ND	ND	ND	ND	ND	277.39	281.57
C2-naphthalenes	0.05	ND	0.03	0.09	ND	0.00	919.53	926.63
C3-naphthalenes	0.64	ND	0.36	1.48	0.03	0.03	1076.73	1090.16
C4-naphthalenes	2.12	0.25	1.29	6.13	0.13	0.13	882.64	890.76
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	75.67	79.80
C1-fluorenes	0.17	0.02	0.11	0.37	ND	0.01	241.14	246.72
C2-fluorenes	1.14	0.17	0.74	3.90	0.12	0.09	451.68	490.42
C3-fluorenes	1.48	0.33	1.03	5.14	0.23	0.19	468.53	480.09
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	ND	ND	ND	ND	311.52	313.70
C1-phenanthrenes/anthracenes	0.38	0.05	0.15	0.35	0.06	0.02	804.56	812.71
C2-phenanthrenes/anthracenes	2.41	0.52	1.49	7.49	0.39	0.27	1011.71	1021.54
C3-phenanthrenes/anthracenes	2.74	0.68	1.84	9.32	0.56	0.40	756.44	763.26
C4-phenanthrenes/anthracenes	1.72	0.57	ND	6.29	0.61	0.33	474.45	461.85
dibenzothiophene	ND	ND	ND	ND	ND	ND	249.34	254.34
C1-dibenzothiophenes	0.36	0.05	0.18	0.46	0.05	0.02	455.83	471.57
C2-dibenzothiophenes	2.69	0.57	1.65	8.77	0.41	0.26	864.51	886.27
C3-dibenzothiophenes	3.34	0.90	2.24	11.31	0.71	0.49	820.97	838.63
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.06	0.02	0.04	0.19	0.02	0.01	14.54	15.11
C1-fluoranthenes/pyrenes	0.50	0.14	0.34	1.33	0.15	0.06	113.06	118.93
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.38	0.15	0.25	0.97	0.14	0.05	57.46	60.05
C1-chrysenes	0.67	0.26	0.46	1.89	0.27	0.11	112.71	109.23
C2-chrysenes	0.93	0.35	0.65	2.47	0.37	0.19	173.17	168.00
C3-chrysenes	0.71	0.28	0.55	1.82	0.33	0.16	127.91	130.48
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.06	ND	0.04	0.15	0.02	0.01	8.63	8.72
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	0.01	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.04	0.02	0.03	0.09	0.03	0.01	5.75	5.44
Total PAH	22.57	5.32	13.47	70.02	4.63	2.84	10782.14	10952.31
C30a,B (hopane)	2.40	1.08	1.82	7.35	1.53	0.73	318.17	345.63
d8-naphthalene (% Rec):	73	57	63	82	64	61	106	104
d10-fluorene (% Rec):	82	69	78	87	76	69	101	101
d12-chrysene (% Rec):	88	75	81	89	77	69	96	95

ND = Not Detected
NA = Not Applicable

Exxon Bioremediation Project (N0531-2971)
Beach KN132 - Time Series 29

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	B-S	C-S	D-S	E-S	F-S	NA
Battelle Lab ID	IR87,88,89	IR90,91,92	IR93,94,95	IR97,98,99	IS01,02,03	IS04,05,06	521 oil
C10	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND	ND
C12	ND	ND	ND	ND	ND	ND	ND
C13	ND	ND	ND	ND	ND	ND	219.647
C14	0.455	ND	1.111	0.485	ND	ND	767.102
C15	1.450	ND	3.381	1.796	ND	ND	1489.993
C16	1.798	0.132	3.993	2.029	0.102	0.024	1930.046
C17	2.317	0.310	4.839	2.805	0.252	0.039	2478.727
Pristane	5.412	0.785	12.882	8.268	0.919	0.261	1526.736
C18	3.264	0.350	6.738	3.888	0.312	0.062	3102.561
Phytane	5.738	0.810	13.684	9.396	0.801	0.191	1626.569
C19	2.507	0.368	5.298	3.664	0.339	0.057	3664.348
C20	2.297	0.547	5.117	3.207	0.459	0.062	3229.352
C21	2.252	0.422	4.947	3.578	0.400	0.082	3114.174
C22	2.330	0.711	4.778	3.890	0.651	0.140	3035.105
C23	2.193	0.666	4.703	3.398	0.200	0.027	2705.964
C24	2.355	0.493	4.601	3.091	0.557	0.098	2542.130
C25	2.239	0.595	5.077	3.692	0.580	0.114	2248.327
C26	2.045	0.468	4.611	3.165	0.439	0.077	1931.222
C27	1.773	0.352	3.778	2.695	0.414	0.078	1427.298
C28	2.280	0.948	4.972	3.812	0.642	0.229	1118.152
C29	1.749	0.955	4.171	3.463	0.936	0.206	1017.787
C30	2.101	0.593	4.009	2.664	0.539	0.126	805.011
C31	1.462	0.348	3.530	2.233	0.405	0.089	692.901
C32	1.219	0.288	2.902	1.849	0.380	0.105	489.071
C33	1.603	0.778	3.424	2.652	0.845	0.207	540.465
C34	2.013	0.764	4.073	3.015	0.828	0.215	487.548
OTP (% Recovery)	62	56	72	69	68	63	82
Total HC	2047.76	1078.88	3934.88	3589.02	899.41	241.93	520743.99
Pristane/Phytane	0.94	0.97	0.94	0.88	1.15	1.36	0.94
C17/Pristane	0.43	0.39	0.38	0.34	0.27	0.15	1.62
C18/Phytane	0.57	0.43	0.49	0.41	0.39	0.33	1.91
TALK	41.70	10.09	90.05	61.07	9.28	2.04	39036.93
LALK	14.09	1.71	30.48	17.87	1.46	0.24	16881.78
LALK/TALK	0.34	0.17	0.34	0.29	0.16	0.12	0.43

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2971)
Beach KN132, Time Series 29

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/Kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth:	A-S	B-S	C-S	D-S	E-S	F-S	NA
Battelle Lab ID:	IR87,88,89	IR90,91,92	IR93,94,95	IR97,98,99	IS01,02,03	IS04,05,06	521 oil
Analyte							
naphthalene	ND	0.00	ND	ND	0.00	0.00	27.64
C1-naphthalenes	ND	ND	ND	ND	0.00	0.00	298.18
C2-naphthalenes	0.03	ND	0.08	ND	0.02	0.00	992.61
C3-naphthalenes	0.49	0.04	1.15	0.37	0.04	0.01	1162.65
C4-naphthalenes	1.97	0.27	4.77	3.44	0.19	0.03	962.68
acenaphthylene	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	81.77
C1-fluorenes	0.19	ND	0.26	ND	ND	ND	252.44
C2-fluorenes	1.16	0.24	2.36	2.01	0.15	0.02	511.45
C3-fluorenes	1.81	0.57	3.75	3.62	0.31	0.05	549.88
phenanthrene	ND	ND	ND	ND	0.01	0.00	339.05
anthracene	ND	ND	ND	ND	ND	ND	ND
C1-phenanthrenes/anthracenes	0.28	0.09	0.44	ND	0.10	0.01	884.16
C2-phenanthrenes/anthracenes	2.39	0.80	4.65	4.15	0.54	0.11	1198.64
C3-phenanthrenes/anthracenes	3.12	1.32	6.13	6.60	0.80	0.17	933.80
C4-phenanthrenes/anthracenes	1.95	0.95	3.33	3.99	0.56	0.12	486.57
dibenzothiophene	ND	ND	ND	ND	0.01	0.00	295.95
C1-dibenzothiophenes	0.28	0.05	0.48	0.16	0.05	0.01	509.95
C2-dibenzothiophenes	2.78	0.87	5.63	4.79	0.55	0.10	1028.53
C3-dibenzothiophenes	3.69	1.76	7.48	7.82	1.01	0.21	1002.02
fluoranthene	ND	ND	ND	ND	ND	ND	ND
pyrene	0.07	0.04	0.12	0.13	0.03	0.00	16.07
C1-fluoranthenes/pyrenes	0.52	0.29	0.94	0.94	0.21	0.03	142.89
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND
chrysene	0.38	0.31	0.61	0.63	0.27	0.04	62.24
C1-chrysenes	0.73	0.52	1.19	1.16	0.45	0.08	123.11
C2-chrysenes	1.11	0.76	1.79	1.74	0.65	0.13	197.16
C3-chrysenes	0.70	0.47	1.21	1.10	0.42	0.09	132.21
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.05	0.04	0.09	0.10	0.05	0.01	9.89
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	0.01	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	0.00	ND
benzo(g,h,i)perylene	0.03	0.03	0.05	0.06	0.03	0.01	4.98
Total PAH	23.74	9.42	46.51	42.81	6.45	1.24	12206.50
C30a,B (hopane)	2.32	1.91	3.61	3.96	2.06	0.45	308.77
Surrogate Recoveries							
d8-naphthalene	64	77	75	70	84	80	112
d10-fluorene	62	89	73	72	79	72	106
d12-chrysene	71	128	80	72	151	102	108

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2994)
Beach KN132 - Time Series 60

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weigh

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	B-S	C-S	D-S	E-S	F-S	
Battelle ID	IU77,78,79	IU80,81,82	IU83,84,85	IU87,88,89	IU90,91,92	IU93,94,95	521 oil
C10	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND	ND
C12	ND	ND	ND	ND	ND	ND	ND
C13	ND	ND	ND	ND	ND	ND	223.539
C14	ND	ND	2.111	ND	ND	ND	751.467
C15	ND	ND	5.598	ND	ND	ND	1447.781
C16	0.159	ND	6.885	ND	ND	ND	2054.517
C17	0.194	ND	7.537	ND	ND	0.062	2593.330
PRISTANE	0.428	0.780	13.500	4.696	0.371	0.345	1512.716
C18	0.347	ND	7.837	ND	ND	0.077	3524.861
PHYTANE	0.472	0.820	11.089	5.458	0.338	0.235	1942.190
C19	0.295	ND	7.285	ND	0.144	0.095	3590.389
C20	0.194	ND	6.430	ND	ND	0.060	3405.738
C21	0.231	ND	6.871	ND	0.112	0.070	3100.503
C22	0.263	ND	7.478	ND	0.235	0.132	3125.229
C23	0.345	ND	7.190	ND	0.213	ND	2781.902
C24	0.245	ND	6.526	ND	0.160	0.087	2585.491
C25	0.324	0.228	6.581	1.622	0.240	0.144	2306.754
C26	0.288	ND	5.959	1.400	0.174	0.105	2167.446
C27	0.273	ND	4.771	1.329	0.184	0.111	1441.866
C28	0.345	0.302	4.377	1.522	0.299	0.199	1381.074
C29	0.318	0.204	4.702	1.654	0.253	0.175	1091.070
C30	0.150	ND	3.742	ND	ND	0.131	822.188
C31	0.199	0.178	3.952	ND	0.166	0.116	754.899
C32	0.110	ND	2.571	ND	ND	0.066	523.001
C33	0.356	0.346	3.419	2.082	0.351	0.234	600.660
C34	0.326	0.372	3.084	ND	0.295	0.223	567.867
OTP (% Recovery)	D.O.	D.O.	90	91	D.O.	86	113
Total HC	421.33	813.51	4455.32	5088.72	447.05	295.18	569996.60
Pristane/Phytane	0.91	0.95	1.22	0.86	1.10	1.47	0.78
C17/Pristane	0.45	NA	0.56	NA	NA	0.18	1.71
C18/Phytane	0.74	NA	0.71	NA	NA	0.33	1.81
TALK	4.96	1.63	114.91	9.61	2.83	2.09	40841.57
LALK	1.19	NA	43.68	NA	0.14	0.29	17591.62
LALK/TALK	0.24	NA	0.38	NA	0.05	0.14	0.43

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

EXXON Bioremediation Study, N0531-2994
Beach KN132, Time Series 60

Battelle Ocean Sciences
Sediment PAH/Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	A-S	B-S	C-S	D-S	E-S	F-S	NA	NA
Battelle Lab ID:	IU77,78,79	IU80,81,82	IU83,84,85	IU89,87,88	IU90,91,92	IU93,94,95	521 oil	521 oil
Analyte								
naphthalene	0.01	ND	ND	ND	ND	0.00	28.81	29.41
C1-naphthalenes	ND	ND	ND	ND	ND	ND	302.51	305.93
C2-naphthalenes	ND	ND	0.45	ND	ND	ND	986.63	995.97
C3-naphthalenes	0.01	ND	2.26	0.18	ND	0.01	1153.95	1153.85
C4-naphthalenes	0.08	0.28	4.80	2.75	0.04	0.04	921.70	913.48
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	0.00	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	76.87	80.48
C1-fluorenes	ND	ND	0.50	ND	ND	ND	250.29	255.83
C2-fluorenes	0.05	0.21	2.43	2.01	0.05	0.03	491.80	474.37
C3-fluorenes	0.10	0.46	3.68	4.34	0.12	0.07	539.77	537.51
anthracene	0.00	ND	ND	ND	ND	ND	ND	ND
phenanthrene	0.03	ND	ND	0.23	ND	ND	336.42	355.97
C1-phenanthrenes/anthracenes	0.05	ND	0.83	ND	0.03	0.02	845.44	861.79
C2-phenanthrenes/anthracenes	0.22	0.43	4.35	4.18	0.18	0.12	1153.71	1172.78
C3-phenanthrenes/anthracenes	0.35	0.90	6.50	8.26	0.31	0.24	898.33	898.68
C4-phenanthrenes/anthracenes	0.35	0.79	4.30	6.52	0.34	0.21	549.76	556.79
dibenzothiophene	ND	ND	0.07	ND	ND	ND	292.83	313.24
C1-dibenzothiophenes	0.02	ND	0.80	ND	0.02	0.01	495.90	528.64
C2-dibenzothiophenes	0.20	0.55	5.82	4.44	0.15	0.11	990.59	1033.09
C3-dibenzothiophenes	0.38	1.11	8.01	9.05	0.33	0.25	948.33	978.15
fluoranthene	0.03	ND	ND	0.44	ND	ND	ND	ND
pyrene	0.03	0.03	0.11	0.42	0.01	0.00	13.95	15.55
C1-fluoranthenes/pyrenes	0.08	0.20	1.02	1.34	0.07	0.03	127.49	129.01
benzo(a)anthracene	0.01	ND	ND	ND	ND	ND	ND	ND
chrysene	0.09	0.16	0.57	0.83	0.10	0.03	62.26	77.95
C1-chrysenes	0.13	0.27	1.12	1.59	0.18	0.07	121.29	138.19
C2-chrysenes	0.18	0.40	1.62	2.33	0.26	0.11	179.90	195.31
C3-chrysenes	0.14	0.30	1.20	1.59	0.21	0.08	139.37	146.74
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.02	0.02	0.09	0.13	0.02	0.01	8.38	9.45
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	0.01	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.01	0.02	0.05	0.07	0.02	0.01	4.63	5.32
Total PAH	2.60	6.11	50.57	50.72	2.43	1.45	11920.93	12163.48
C30a,B (hopane)	0.68	0.89	3.57	4.92	0.82	0.51	311.53	326.84

Surrogate Recoveries

d8-naphthalene	98	105	89	101	55	94	119	121
d10-flourene	110	95	99	112	53	85	110	107
d12-chrysene	141	132	100	103	137	116	110	125

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2994)
Beach KN132 - Time Series 95

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	B-S	C-S	D-S	E-S	F-S	NA	NA
Battelle ID	IW39,40,41	IW42,43,44	IW45,46,47	IW48,49,50	IW51,52,53	IW54,55,56	521 oil	600 oil
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND	ND	ND
C12	ND	ND	ND	ND	ND	ND	37.180	ND
C13	ND	ND	ND	ND	ND	ND	220.210	ND
C14	ND	ND	1.324	0.885	ND	ND	973.121	ND
C15	ND	ND	4.172	3.388	ND	ND	1541.975	ND
C16	0.113	ND	5.366	4.140	ND	ND	1954.040	ND
C17	0.240	0.342	8.777	6.986	0.126	ND	3154.182	215.888
PRISTANE	0.615	1.655	12.310	12.174	0.555	0.297	1476.538	114.335
C18	0.207	0.237	6.126	4.806	0.096	ND	2931.367	762.965
PHYTANE	0.353	1.397	8.636	8.454	0.374	0.118	1642.220	486.240
C19	0.250	0.357	5.029	4.488	0.144	ND	3335.934	2196.463
C20	0.189	0.106	4.620	4.025	0.081	ND	3522.659	3226.176
C21	0.250	0.324	5.353	4.874	0.153	ND	2943.984	3124.676
C22	0.263	0.464	4.870	4.182	0.253	ND	2815.388	3012.502
C23	0.375	0.498	5.621	5.057	0.361	0.079	2706.625	2884.008
C24	0.283	0.508	5.128	5.047	0.377	0.070	2539.098	2774.050
C25	0.292	0.515	4.619	4.931	0.285	0.095	2216.801	2442.767
C26	0.270	0.436	3.798	4.689	0.203	0.066	1958.161	2271.844
C27	0.262	0.482	3.490	3.914	0.264	0.079	1424.452	1553.864
C28	ND	ND	2.343	3.145	ND	ND	1171.569	1330.399
C29	ND	ND	1.982	2.421	ND	ND	1002.036	1107.108
C30	ND	ND	2.979	3.058	ND	ND	780.742	849.645
C31	ND	ND	3.579	3.064	ND	ND	759.969	869.914
C32	ND	ND	2.344	1.927	ND	ND	486.791	557.889
C33	ND	ND	3.005	2.406	ND	ND	488.157	542.882
C34	ND	ND	3.298	2.627	ND	ND	504.866	635.857
OTP (% Recovery)	60.52	68.67	86.71	86.57	63.78	79.00	98.55	96.74
Total HC	477.25	1156.35	4732.98	3747.53	656.14	167.43	553904.42	495579.94
Pristane/Phytane	1.74	1.18	1.43	1.44	1.48	2.52	0.90	0.24
C17/Pristane	0.39	0.21	0.71	0.57	0.23	NA	2.14	1.89
C18/Phytane	0.59	0.17	0.71	0.57	0.26	NA	1.79	1.57
TALK	2.99	4.27	87.82	80.06	2.34	0.39	39469.31	30358.90
LALK	1.00	1.04	35.41	28.72	0.45	NA	17670.67	6401.49
LALK/TALK	0.33	0.24	0.40	0.36	0.19	NA	0.45	0.21

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2994)
Beach KN132, Time Series 95

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	A-S	B-S	C-S	D-S	E-S	F-S	NA	NA	NA	NA
Battelle Lab ID:	IW39,40,41	IW42,43,44	IW45,46,47	IW48,49,50	IW51,52,53	IW54,55,56	521 oil	521 oil	600 oil	600 oil
Analyte										
naphthalene	ND	ND	ND	ND	ND	0.00	23.93	24.46	2.85	2.75
C1-naphthalenes	ND	ND	ND	ND	ND	ND	296.38	300.6	3.75	2.74
C2-naphthalenes	ND	ND	0.59	ND	ND	ND	1033.03	1056.78	ND	ND
C3-naphthalenes	ND	0.12	2.09	0.38	ND	ND	1302.92	1306.21	18.02	21.79
C4-naphthalenes	ND	1.01	5.75	3.57	ND	ND	1126.85	1120.61	119.08	101.23
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	82.43	85.1	3.03	2.33
C1-fluorenes	ND	ND	0.57	ND	ND	ND	275.19	277.01	56.65	54.36
C2-fluorenes	ND	0.53	2.77	1.76	0.06	ND	577.54	568.94	321.08	308.69
C3-fluorenes	0.15	1.04	4.70	3.49	0.15	ND	707.8	696.61	657.6	643.47
anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	0.11	ND	ND	ND	339.41	333.73	142.82	141.05
C1-phenanthrenes/anthracenes	0.04	ND	0.86	ND	0.04	0.01	915.57	896.36	771.21	755.5
C2-phenanthrenes/anthracenes	0.19	0.87	4.19	2.76	0.23	0.08	1267.34	1243.26	1330.63	1280
C3-phenanthrenes/anthracenes	0.25	1.75	6.46	4.98	0.35	0.11	1006.2	912.77	1079.47	1028.67
C4-phenanthrenes/anthracenes	0.40	1.66	6.62	5.22	0.59	0.15	817.55	786.87	878.79	835.4
dibenzothiophene	ND	ND	0.07	ND	ND	ND	270.95	271.61	87.83	86.25
C1-dibenzothiophenes	0.02	0.06	0.77	ND	0.03	0.01	585.21	574.78	394.73	379.73
C2-dibenzothiophenes	0.14	0.98	5.29	3.69	0.19	0.06	1146.35	1102.99	1101.07	1048.59
C3-dibenzothiophenes	0.31	2.05	8.21	7.01	0.43	0.13	1145.92	1122	1238.67	1175.54
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.01	0.03	0.07	0.10	0.01	ND	8.09	9.1	9.58	11.29
C1-fluoranthenes/pyrenes	0.08	0.30	1.08	0.84	0.10	0.02	145.42	137.35	151.84	164.16
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.08	0.18	0.58	0.45	0.11	0.01	65.2	65.41	72.58	75.55
C1-chrysenes	0.15	0.41	1.44	1.10	0.19	0.03	145.58	146.6	156.06	168.69
C2-chrysenes	0.23	0.67	2.42	1.80	0.34	0.07	243.8	253.89	271.21	284.21
C3-chrysenes	0.21	0.45	1.77	1.28	0.28	0.06	175.53	177.21	209.85	192.16
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.01	0.02	0.08	0.05	ND	ND	7.66	7.1	8.78	8.92
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.01	0.02	0.05	0.04	0.01	0.00	4.56	4.4	5.26	4.66
Total PAH	2.30	12.16	56.55	38.52	3.12	0.75	13716.41	13481.75	9092.44	8777.73
C30a,B (Hopane)	0.73	1.09	3.48	2.52	0.91	0.27	287.76	295.62	314.71	330.1
Surrogate Recoveries										
d8-naphthalene	79	60	83	80	80	78	103	104	104	108
d10-fluorene	86	66	86	88	100	92	103	105	104	102
d12-chrysene	113	72	94	90	109	106	110	107	106	113

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2971)
Beach KN135 - Time Series 0

Battelle Ocean Sciences
Sediment PHC in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS	E-S	E-SS
Battelle Lab ID	IM02,04,06	IM03,05,07	IM08,10,12	IM09,11,13	IM14,16,18	IM15-3,17-1,19-1	IM21,23,25	IM22,24,26	IM27,29,31	IM28,30,32
C10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	0.199	ND	ND	0.631	0.171	ND	2.865
C12	1.680	0.583	ND	1.893	ND	0.918	4.978	1.838	0.575	11.103
C13	4.925	1.676	ND	4.397	ND	2.443	10.391	4.329	1.673	20.713
C14	9.149	2.976	0.177	6.743	0.047	4.100	14.958	6.745	3.271	25.179
C15	13.755	4.264	0.613	8.629	0.121	5.958	19.349	8.535	4.464	29.291
C16	15.107	4.247	0.659	8.706	0.161	5.703	18.963	8.839	6.105	28.955
C17	18.079	6.617	0.871	8.496	0.212	5.271	22.310	8.748	7.220	30.227
Pristane	19.132	7.115	3.122	8.159	0.540	8.559	20.563	9.408	8.172	21.639
C18	19.685	5.263	1.046	9.762	0.254	6.190	22.433	10.121	8.394	31.922
Phytane	18.736	5.635	3.102	7.964	0.465	8.300	20.597	9.245	8.365	21.358
C19	16.156	4.144	1.314	8.110	0.268	5.295	17.704	8.059	6.596	26.589
C20	16.991	4.626	0.887	8.193	0.474	4.225	18.954	8.471	6.732	26.983
C21	14.741	3.921	1.581	7.097	0.442	4.544	17.349	7.540	6.145	23.969
C22	14.343	3.672	1.409	6.726	0.331	4.709	16.278	7.232	5.979	22.400
C23	13.508	3.327	0.865	6.329	0.286	4.175	15.812	6.337	5.652	20.428
C24	13.396	3.663	1.297	6.026	0.331	4.171	15.120	6.435	5.659	18.892
C25	16.721	4.372	2.733	7.419	0.675	4.186	16.847	7.668	6.650	20.289
C26	11.964	3.097	1.177	5.228	0.259	3.970	12.084	5.544	5.571	15.395
C27	8.756	2.393	0.951	3.829	0.178	3.146	8.872	4.017	3.875	11.146
C28	10.340	3.022	1.230	3.941	0.514	3.558	9.100	4.346	4.017	12.003
C29	8.506	2.122	1.085	3.224	0.375	3.133	7.398	3.583	3.467	8.824
C30	6.004	2.178	0.946	2.518	0.416	2.501	7.853	3.367	3.431	6.823
C31	5.622	1.671	0.918	2.440	0.241	2.306	5.430	2.731	2.838	6.254
C32	3.766	1.192	0.792	1.717	0.248	1.726	4.111	1.876	2.006	4.394
C33	4.441	1.298	1.083	1.790	0.425	1.919	4.404	2.052	2.144	4.609
C34	5.711	1.806	1.169	1.732	0.464	1.930	6.389	2.560	2.776	5.867
OTP (% Recovery)	78	82	79	63	77	77	80	76	72	56
Total H.C.	5084.59	1562.67	1481.76	2007.17	455.55	2093.33	5992.33	2355.83	2190.76	5273.98
Pristane/Phytane	1.021	1.263	1.006	1.024	1.161	1.031	0.998	1.018	0.977	1.013
C17/Pristane	0.945	0.930	0.279	1.041	0.393	0.616	1.085	0.930	0.884	1.397
C18/Phytane	1.051	0.934	0.337	1.226	0.546	0.746	1.089	1.095	1.003	1.495
TALK	253.346	72.130	22.803	125.144	6.722	86.077	297.718	131.144	105.240	415.120
LALK	115.527	34.396	5.567	65.128	1.537	40.103	150.671	65.856	45.030	233.827
LALK/TALK	0.456	0.477	0.244	0.520	0.229	0.466	0.506	0.502	0.428	0.563

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2971)
Beach KN135 - Time Series 0

Battelle Ocean Sciences
Sediment PHC in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	F-S	F-SS	NA
Battelle Lab ID	IM33,35,37	IM34,36,38	521 oil
C10	ND	ND	ND
C11	ND	0.428	ND
C12	0.212	2.854	50.846
C13	0.631	5.947	249.901
C14	1.232	8.158	880.036
C15	1.923	10.039	1598.298
C16	1.636	10.019	2264.195
C17	1.968	10.496	2836.071
Pristane	4.390	8.782	1638.371
C18	1.780	11.142	3755.571
Phytane	3.944	8.573	2036.187
C19	2.022	9.365	3976.66
C20	2.163	9.391	3637.031
C21	2.030	8.123	3417.873
C22	1.733	7.880	3268.264
C23	1.368	6.996	2960.865
C24	1.619	6.873	2760.709
C25	3.030	7.753	2462.717
C26	1.576	5.806	2137.342
C27	1.182	4.221	1554.697
C28	1.425	3.955	1321.111
C29	1.222	3.560	1193.269
C30	1.074	2.773	933.216
C31	1.151	2.712	829.403
C32	0.855	1.845	578.019
C33	1.174	2.139	631.744
C34	1.217	1.932	690.837
OTP (% Recovery)	D.O.	72	101
Total H.C.	1503.82	2107.49	589798.99
Pristane/Phytane	1.113	1.024	0.805
C17/Pristane	0.448	1.195	1.731
C18/Phytane	0.451	1.300	1.844
TALK	34.223	144.404	43988.675
LALK	13.567	77.837	19248.609
LALK/TALK	0.396	0.539	0.438

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2971)
Beach KN135, Time Series 0

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth:	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS	E-S	E-SS
Battelle Lab ID:	IM02/04/06	IM03/05/07	IM08/10/12	IM09/11/13	IM14/16/18	IM15-3/17-1/19-1	IM21/23/25	IM22/24/26	IM27/29/31	IM28/30/32
Analyte										
naphthalene	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.01
C1-naphthalenes	0.08	ND	0.02	ND	0.02	0.01	ND	ND	0.28	0.12
C2-naphthalenes	1.21	0.06	0.06	0.17	0.04	0.12	0.21	0.12	1.63	1.34
C3-naphthalenes	4.35	0.51	0.36	1.63	0.05	0.98	1.68	1.62	2.71	6.94
C4-naphthalenes	6.32	1.67	1.19	2.88	0.13	3.24	6.57	3.18	2.72	8.77
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	0.00	ND	ND	ND	0.09	ND
C1-fluorenes	1.06	0.13	0.12	0.34	0.02	0.30	0.50	0.33	0.58	1.19
C2-fluorenes	3.43	0.85	0.66	1.40	0.09	1.52	3.44	1.52	1.60	3.99
C3-fluorenes	3.85	1.10	0.86	1.50	0.14	2.00	4.12	1.69	1.56	4.38
anthracene	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND
phenanthrene	0.30	ND	ND	ND	0.01	0.04	ND	ND	0.55	0.17
C1-phenanthrenes/anthracenes	2.32	0.22	0.20	0.60	0.06	0.23	ND	0.43	2.15	2.85
C2-phenanthrenes/anthracenes	6.91	1.60	1.33	2.62	0.27	2.65	5.33	2.77	3.67	8.15
C3-phenanthrenes/anthracenes	6.31	1.81	1.68	2.43	0.32	3.16	6.67	2.76	2.99	6.94
C4-phenanthrenes/anthracenes	4.22	1.07	1.28	1.45	0.33	2.14	4.36	1.63	1.94	3.94
dibenzothiophene	0.18	ND	ND	ND	0.01	ND	ND	ND	0.39	0.10
C1-dibenzothiophenes	1.87	0.19	0.17	0.48	0.04	0.20	0.31	0.43	1.31	2.22
C2-dibenzothiophenes	7.23	1.70	1.47	2.67	0.27	2.82	6.51	3.01	3.41	8.00
C3-dibenzothiophenes	7.87	2.06	1.90	2.88	0.38	3.53	8.19	3.25	3.51	8.09
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.13	0.03	0.04	0.05	0.01	0.06	0.15	0.06	0.06	0.12
C1-fluoranthenes/pyrenes	1.12	0.28	0.32	0.39	0.09	0.52	1.16	0.44	0.52	1.05
benzo(a)anthracene	ND	ND	ND	ND	ND	0.03	ND	ND	ND	ND
chrysene	0.98	0.20	0.27	0.30	0.12	0.31	1.05	0.37	0.50	0.88
C1-chrysenes	1.62	0.38	0.46	0.55	0.19	0.61	1.90	0.66	0.80	1.47
C2-chrysenes	2.13	0.53	0.69	0.71	0.25	0.84	2.51	0.87	1.04	2.06
C3-chrysenes	1.44	0.41	0.50	0.51	0.20	0.54	1.71	0.60	0.68	1.43
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.11	0.02	0.03	0.03	0.02	0.04	0.11	0.04	0.04	ND
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.07	0.02	0.02	0.03	0.01	0.02	0.08	0.02	0.04	ND
Total PAH	65.09	14.85	13.65	23.62	3.08	25.92	56.56	25.82	34.78	74.22
C30a,B (hopane)	4.44	1.21	1.76	1.48	0.83	1.47	5.00	1.81	2.31	3.88
Surrogate Recoveries										
d8-naphthalene	83	81	74	67	89	81	87	71	82	65
d10-fluorene	86	88	83	72	84	81	88	76	85	67
d12-chrysene	103	94	91	80	135	93	110	89	104	77

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2971)
Beach KN135, Time Series 0

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth:	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4
Battelle Lab ID:	IM33/35/37	IM34/36/38	521 oil	521 oil	521 oil	521 oil
Analyte						
naphthalene	0.01	0.01	26.77	24.16	33.22	32.96
C1-naphthalenes	0.02	ND	271.22	248.57	319.70	326.57
C2-naphthalenes	0.06	0.31	863.84	816.18	1065.49	1085.54
C3-naphthalenes	0.21	1.77	997.23	953.22	1257.26	1262.14
C4-naphthalenes	1.00	2.81	794.59	782.90	1044.45	1011.24
acenaphthylene	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	81.48	75.68	91.42	90.19
C1-fluorenes	ND	0.33	231.92	213.96	292.83	276.39
C2-fluorenes	0.51	1.32	436.72	440.56	559.70	522.59
C3-fluorenes	0.84	1.58	422.39	419.50	586.12	584.35
anthracene	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	310.58	284.25	354.18	362.52
C1-phenanthrenes/anthracenes	0.09	0.63	785.50	735.09	887.37	901.25
C2-phenanthrenes/anthracenes	1.00	2.57	934.28	927.44	1240.11	1236.38
C3-phenanthrenes/anthracenes	1.53	2.47	681.30	696.63	967.74	920.43
C4-phenanthrenes/anthracenes	1.25	1.65	419.33	423.45	627.16	526.06
dibenzothiophene	ND	ND	251.58	220.18	304.62	309.43
C1-dibenzothiophenes	0.09	0.50	463.03	409.37	499.37	511.12
C2-dibenzothiophenes	1.16	2.55	844.66	782.70	1003.68	998.40
C3-dibenzothiophenes	1.84	2.83	786.08	741.30	982.28	951.17
fluoranthene	ND	ND	ND	ND	ND	ND
pyrene	0.03	0.05	13.88	12.25	16.29	16.10
C1-fluoranthenes/pyrenes	0.29	0.39	110.38	105.76	139.66	136.37
benzo(a)anthracene	ND	ND	ND	ND	ND	ND
chrysene	0.20	0.25	85.74	62.21	64.87	79.15
C1-chrysenes	0.38	0.47	143.65	116.83	126.80	147.71
C2-chrysenes	0.57	0.64	195.50	166.49	198.92	206.10
C3-chrysenes	0.44	0.48	131.15	123.62	149.34	156.12
C4-chrysenes	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.03	ND	9.20	7.13	9.58	10.04
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.02	0.02	ND	ND	6.22	6.10
Total PAH	11.55	23.64	10292.00	9789.41	12828.38	12666.43
C30a,B (hopane)	1.55	1.39	321.53	328.35	362.97	367.29
Surrogate Recoveries						
d8-naphthalene	63	72	100	96	105	107
d10-fluorene	93	80	97	94	99	98
d12-chrysene	113	81	115	96	95	110

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 run with AS, ASS, BS, BSS, CS, DS, DSS, ES, ESS, FS and FSS.
Replicates 3 and 4 run with CSS.

Exxon Bioremediation Study (N0531-2971)
Beach KN135, Time Series 32

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/Kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS	E-S	E-SS
Battelle Lab ID:	IQ51/55/57	IQ52/56/58	IQ59/61/63	IQ60/62/64	IQ69/67/65	IQ70/68/66	IQ71/73/75	IQ72/74/76	IQ77/79/81	IQ78/80/82
Analyte										
naphthalene	0.00	0.00	0.01	ND	0.03	ND	0.01	ND	0.01	ND
C1-naphthalenes	0.01	0.00	0.03	ND	0.70	0.02	0.03	0.01	0.07	0.04
C2-naphthalenes	0.04	0.02	0.09	0.34	4.75	0.21	0.14	0.06	0.68	0.55
C3-naphthalenes	0.10	0.10	0.50	2.34	8.26	1.46	1.13	0.74	1.96	3.77
C4-naphthalenes	0.57	0.47	2.52	4.53	7.78	2.42	4.49	1.15	4.05	5.17
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	0.31	ND	ND	ND	ND	ND
C1-fluorenes	0.04	0.03	0.12	0.49	1.84	0.30	0.26	0.14	0.54	0.65
C2-fluorenes	0.35	0.23	1.31	2.08	3.99	1.09	2.07	0.51	2.26	2.30
C3-fluorenes	0.60	0.38	1.89	2.36	3.95	1.19	2.71	0.56	2.77	2.42
anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	ND	ND	1.67	0.04	ND	ND	0.24	ND
C1-phenanthrenes/anthracenes	0.09	0.04	0.24	0.85	6.40	0.55	0.17	0.23	1.66	1.42
C2-phenanthrenes/anthracenes	0.77	0.48	2.34	3.66	8.97	2.04	3.92	0.95	5.09	4.60
C3-phenanthrenes/anthracenes	1.14	0.59	3.21	3.33	6.48	1.84	4.66	0.83	5.09	4.01
C4-phenanthrenes/anthracenes	1.16	0.52	2.54	1.73	3.54	1.27	2.82	0.47	3.22	2.50
dibenzothiophene	ND	ND	ND	ND	1.26	0.02	ND	ND	0.16	0.04
C1-dibenzothiophenes	0.06	0.04	0.17	0.75	3.89	0.46	0.29	0.20	1.13	1.24
C2-dibenzothiophenes	0.88	0.53	2.63	3.79	8.62	2.02	4.86	1.00	5.43	4.79
C3-dibenzothiophenes	1.52	0.72	3.74	4.06	7.89	2.14	5.90	0.95	6.04	4.82
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.04	0.01	0.07	0.07	0.14	0.04	0.10	0.02	0.10	0.08
C1-fluoranthenes/pyrenes	0.32	0.11	0.58	0.56	1.10	0.30	0.79	0.14	0.83	0.63
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.26	0.08	0.37	0.53	1.22	0.22	0.75	0.12	0.76	0.53
C1-chrysenes	0.44	0.14	0.72	0.92	1.87	0.39	1.35	0.20	1.27	0.97
C2-chrysenes	0.69	0.21	1.06	1.21	2.25	0.52	1.73	0.25	1.67	1.21
C3-chrysenes	0.57	0.17	0.89	0.76	1.43	0.40	1.18	0.17	1.22	0.85
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.04	0.01	0.06	0.07	0.13	0.03	0.10	0.01	0.09	0.06
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.03	0.01	0.04	0.03	0.07	0.02	0.05	0.01	0.06	0.04
Total PAH	9.72	4.90	25.12	34.45	88.54	18.98	39.53	8.73	46.38	42.70
C30a,B (hopane)	1.92	0.50	2.43	2.24	3.96	1.08	3.17	0.48	3.79	2.35
Surrogate Recoveries										
d8-naphthalene	76	62	74	67	80	67	69	68	75	76
d10-fluorene	78	65	80	76	83	74	73	71	79	78
d12-chrysene	80	67	82	95	113	79	90	85	92	93

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2971)
Beach KN135, Time Series 32

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/Kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4
Battelle Lab ID:	1Q83/85/87	1Q84/86/88	521 oil	521 oil	521 oil	521 oil
Analyte						
naphthalene	0.01	0.00	28.20	28.32	32.81	33.50
C1-naphthalenes	0.04	ND	296.87	296.11	342.60	352.88
C2-naphthalenes	0.11	0.08	966.47	968.86	1087.18	1118.49
C3-naphthalenes	0.38	0.84	1131.90	1113.19	1239.90	1267.96
C4-naphthalenes	2.59	2.67	920.89	892.58	997.04	980.17
acenaphthylene	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	83.31	79.18	90.23	89.07
C1-fluorenes	ND	0.19	255.40	255.75	288.73	286.74
C2-fluorenes	1.30	1.19	455.93	473.98	534.90	508.23
C3-fluorenes	2.04	1.48	471.17	448.65	509.76	464.86
anthracene	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	332.96	338.06	376.01	396.50
C1-phenanthrenes/anthracenes	0.11	0.28	836.61	819.75	942.52	933.58
C2-phenanthrenes/anthracenes	2.44	2.09	1054.04	1034.15	1160.21	1103.98
C3-phenanthrenes/anthracenes	3.36	2.39	767.64	718.42	832.56	757.28
C4-phenanthrenes/anthracenes	2.40	1.50	444.78	388.06	501.98	462.45
dibenzothiophene	ND	ND	271.07	269.06	303.53	311.00
C1-dibenzothiophenes	0.16	0.24	484.94	481.96	550.12	557.43
C2-dibenzothiophenes	3.17	2.62	893.22	887.33	1025.36	1004.44
C3-dibenzothiophenes	4.27	2.99	835.93	798.10	939.07	860.14
fluoranthene	ND	ND	ND	ND	ND	ND
pyrene	0.09	0.05	14.23	13.52	16.17	14.26
C1-fluoranthenes/pyrenes	0.63	0.41	125.14	124.69	131.53	122.38
benzo(a)anthracene	ND	ND	ND	ND	ND	ND
chrysene	0.64	0.42	62.85	79.31	74.40	122.12
C1-chrysenes	1.18	0.73	111.76	135.81	134.94	203.88
C2-chrysenes	1.74	0.95	172.87	193.26	195.30	264.80
C3-chrysenes	1.05	0.61	131.51	144.29	155.03	159.03
C4-chrysenes	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.08	0.04	9.03	9.47	9.48	12.41
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.05	0.02	5.14	5.75	6.49	5.56
Total PAH	27.84	21.80	11163.86	10997.60	12477.84	12393.15
C30a,B (hopane)	3.06	1.45	322.58	327.16	346.23	353.43
Surrogate Recoveries						
d8-naphthalene	77	67	108	108	112	115
d10-fluorene	78	66	101	101	101	100
d12-chrysene	101	91	96	112	99	135

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 were run with AS, ASS, BS, BSS, CS and CSS.
Replicates 3 and 4 were run with DS, DSS, ES, ESS, FS, and FSS.

Exxon Bioremediation Project (N0531-2971)
Beach KN135 - Time Series 32

Battelle Ocean Sciences
Sediment PHC in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle ID	1Q51,55,57	1Q52,56,58	1Q59,61,63	1Q60,62,64	1Q65,67,69	1Q66,68,70	1Q71,73,75	1Q72,74,76
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	0.126	ND	0.114	ND	0.160
C12	ND	0.062	0.282	1.727	1.315	0.968	2.276	1.010
C13	ND	0.193	0.766	4.182	4.199	2.270	5.331	2.247
C14	ND	0.398	1.601	5.866	9.836	3.497	8.590	2.926
C15	0.204	0.651	2.679	7.717	15.900	4.748	11.501	3.639
C16	0.225	0.610	2.476	8.435	21.795	4.987	12.221	3.637
C17	0.457	0.792	2.805	8.632	24.048	4.956	11.284	3.534
PRISTANE	1.721	1.626	7.297	9.825	20.946	5.375	15.236	2.964
C18	0.576	0.779	4.126	9.985	29.079	5.934	13.185	4.046
PHYTANE	1.817	1.626	7.600	9.184	21.623	5.388	14.907	2.911
C19	0.606	0.700	3.005	7.624	26.688	4.869	11.122	3.475
C20	1.107	0.726	3.214	8.924	24.003	5.098	11.774	3.087
C21	0.913	0.742	2.947	7.391	21.767	4.327	10.314	2.893
C22	0.773	0.591	2.433	6.366	23.345	4.016	9.509	2.812
C23	0.510	0.498	2.473	5.519	22.441	3.689	8.157	2.586
C24	0.578	0.582	2.356	5.895	20.709	3.755	8.355	2.466
C25	0.745	0.602	2.404	5.772	21.170	3.826	7.907	2.289
C26	0.579	0.532	2.015	5.039	18.795	3.333	7.214	2.044
C27	0.451	0.423	1.554	3.390	13.115	2.264	5.592	1.474
C28	1.260	0.473	2.809	3.757	11.590	2.713	6.868	1.333
C29	0.969	0.458	1.821	3.308	10.972	2.274	5.063	1.177
C30	0.618	0.367	2.645	2.828	8.031	2.007	5.271	0.912
C31	0.404	0.356	1.754	2.494	7.383	1.669	3.867	0.877
C32	0.319	0.310	1.334	1.860	5.358	1.180	2.783	0.650
C33	0.882	0.407	1.771	2.046	5.431	1.304	3.130	0.713
C34	0.855	0.421	2.713	2.717	7.112	1.735	4.268	0.753
OTP (% Recovery)	84	79	79	64	82	69	70	82
Total HC	1477.078	541.898	2652.735	2485.822	5351.814	1408.427	4069.11	751.69
Pristane/Phytane	0.95	1.00	0.96	1.07	0.97	1.00	1.02	1.02
C17/Pristane	0.27	0.49	0.38	0.88	1.15	0.92	0.74	1.19
C18/Phytane	0.32	0.48	0.54	1.09	1.34	1.10	0.88	1.39
TALK	13.03	11.67	51.98	121.60	354.08	75.53	175.58	50.74
LALK	3.18	4.91	20.95	63.22	156.86	37.44	87.28	27.76
LALK/TALK	0.24	0.42	0.40	0.52	0.44	0.50	0.50	0.55

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2971)
Beach KN135 - Time Series 32

Battelle Ocean Sciences
Sediment PHC in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2
Battelle ID	IQ77,79,81	IQ78,80,82	IQ83,85,87	IQ84,86,88	521 oil	521 oil
C10	ND	ND	ND	ND	ND	ND
C11	ND	1.051	ND	0.321	ND	ND
C12	0.843	5.511	1.259	2.257	65.186	47.364
C13	2.265	11.441	3.292	5.182	219.291	259.307
C14	4.534	14.611	6.178	7.167	766.223	843.245
C15	6.978	17.597	8.419	9.006	1430.055	1717.353
C16	8.261	18.370	9.061	8.902	2039.292	2370.745
C17	8.927	17.250	8.496	8.839	2700.319	3015.708
PRISTANE	15.747	14.286	12.831	9.169	1513.487	1704.379
C18	11.748	19.737	10.100	10.249	3485.761	3927.072
PHYTANE	16.086	14.071	12.496	8.993	1902.760	2188.138
C19	9.201	16.709	8.152	8.222	3681.403	4200.302
C20	9.621	15.331	8.069	8.513	3656.178	3774.499
C21	8.027	14.016	6.972	7.723	3110.783	3684.107
C22	8.179	13.404	6.832	7.096	2954.145	3437.434
C23	7.797	12.177	6.524	6.763	2683.081	3093.378
C24	7.546	11.840	6.422	6.220	2512.689	2867.394
C25	7.954	12.332	6.421	6.619	2493.119	2699.059
C26	7.249	9.722	5.671	6.245	1966.643	2183.272
C27	5.936	7.103	4.281	4.015	1400.644	1577.293
C28	7.809	6.614	5.041	3.846	1215.554	1339.275
C29	6.189	5.642	3.817	3.492	1017.786	1179.108
C30	6.016	4.441	3.999	2.824	803.264	905.189
C31	4.822	4.360	3.303	2.694	753.193	849.828
C32	3.325	3.019	2.452	1.871	518.111	557.739
C33	3.694	3.184	2.663	2.031	545.161	620.237
C34	5.446	3.952	2.703	2.403	666.899	611.443
OTP (% Recovery)	73	75	76	69	97	103
Total HC	4009.32	3334.17	3495.00	2289.39	514313.780	571531.30
Pristane/Phytane	0.98	1.02	1.03	1.02	0.80	0.78
C17/Pristane	0.57	1.21	0.66	0.96	1.78	1.77
C18/Phytane	0.73	1.40	0.81	1.14	1.83	1.79
TALK	152.37	249.42	130.13	132.50	40684.78	45760.35
LALK	62.38	137.61	63.03	68.66	18043.71	20155.60
LALK/TALK	0.41	0.55	0.48	0.52	0.44	0.44

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Replicate 1 was run with AS, ASS, BS, BSS, CS, and CSS.
Replicate 2 was run with DS, DSS, ES, ESS, FS and FSS.

Exxon Bioremediation Project (N0531-2994) Battelle Ocean Sciences Reporting Limits= 0.1mg/kg
Beach KN135 - Time Series 70 Sediment PHC Data in mg/kg Dry Weight 521 Reference Oil data in mg/kg oil.

Station ID-Depth Battelle ID	A-S 1U39,41,43	A-SS 1U40,42,44	B-S 1U45,47,49	B-SS 1U46,48,50	C-S 1U51,53,55	C-SS 1U52,54,56	D-S 1U57,59,61	D-SS 1U58,60,62	E-S 1U63,65,67	E-SS 1U64,66,68
C10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.988
C12	ND	ND	ND	0.141	ND	0.266	3.930	0.211	1.145	10.159
C13	ND	0.147	0.169	0.370	0.049	0.639	11.595	0.630	2.858	20.367
C14	0.219	0.303	0.383	0.674	0.123	1.198	17.237	0.937	4.076	26.126
C15	0.600	0.673	0.953	1.286	0.369	1.876	22.771	1.307	5.367	31.537
C16	0.519	0.579	0.952	1.178	0.377	1.902	24.123	1.391	5.539	31.383
C17	0.673	0.710	1.397	1.353	0.621	1.749	19.443	1.139	4.364	28.291
PRISTANE	3.412	2.448	3.677	3.399	1.383	4.299	28.867	1.572	7.471	23.793
C18	1.042	0.894	1.480	1.705	0.597	2.286	25.521	1.511	6.045	33.960
PHYTANE	3.640	2.605	3.496	3.467	1.416	4.372	28.526	1.603	7.699	24.777
C19	0.919	0.725	1.383	1.332	0.652	1.816	19.806	1.213	4.856	28.722
C20	0.717	0.626	0.941	1.005	0.514	1.404	18.182	1.128	4.362	25.167
C21	0.693	0.607	1.161	1.063	0.509	1.313	17.884	1.012	4.170	24.449
C22	0.973	0.718	1.613	1.144	0.579	1.551	18.022	1.087	4.133	23.932
C23	0.989	0.636	1.349	1.110	0.589	1.352	16.492	0.966	3.880	21.460
C24	0.547	0.508	0.952	0.909	0.366	1.277	15.841	0.925	3.512	20.562
C25	0.869	0.690	1.347	1.049	0.476	1.352	15.751	0.948	3.689	19.178
C26	0.571	0.567	1.075	0.892	0.439	1.185	13.963	0.811	3.455	18.573
C27	0.448	0.434	0.715	0.702	0.249	0.941	10.012	0.619	2.511	12.577
C28	0.779	0.593	1.971	0.771	0.611	1.219	9.982	0.604	3.014	11.758
C29	0.837	0.606	1.272	0.814	0.627	1.033	10.168	0.550	2.381	10.402
C30	0.505	0.519	1.213	0.669	0.385	0.996	7.774	0.451	2.123	8.317
C31	0.700	0.502	1.205	0.898	0.264	1.111	7.218	0.474	1.900	8.193
C32	0.422	0.391	0.784	0.639	0.243	0.751	5.145	0.294	1.396	5.861
C33	0.940	0.639	1.440	1.096	0.611	0.969	6.595	0.441	1.923	6.271
C34	1.578	0.808	1.949	0.988	0.694	1.109	7.017	0.418	2.521	7.496
OTP (% Recovery)	79	81	83	80	71	78	85	97	79	80
Total HC	1902.22	1040.31	2150.49	1249.98	1146.80	1337.41	8137.40	420.05	2395.23	6597.11
Pristane/Phytane	0.94	0.94	1.05	0.98	0.98	0.98	1.01	0.98	0.97	0.96
C17/Pristane	0.20	0.29	0.38	0.40	0.45	0.41	0.67	0.72	0.58	1.19
C18/Phytane	0.29	0.34	0.42	0.49	0.42	0.52	0.89	0.94	0.79	1.37
TALK	15.54	12.88	25.70	21.79	9.94	29.30	324.47	19.07	79.22	436.73
LALK	4.69	4.66	7.66	9.04	3.30	13.14	162.61	9.47	38.61	237.70
LALK/TALK	0.30	0.36	0.30	0.42	0.33	0.45	0.50	0.50	0.49	0.54

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2994)   Battelle Ocean Sciences   Reporting Limits= 0.1mg/kg
Beach KN135 - Time Series 70   Sediment PHC Data in mg/kg Dry Weight   521 Reference Oil data in mg/kg oil.

Station ID-Depth	F-S	F-SS	Rep 1	Rep 2
Battelle ID	IU69,71,73	IU72,74,70	521 oil	521 oil
C10	ND	ND	ND	ND
C11	ND	0.239	ND	ND
C12	1.217	1.878	ND	ND
C13	3.747	4.460	211.622	222.760
C14	7.514	6.038	761.824	751.545
C15	10.995	7.686	1426.330	1450.310
C16	10.303	7.871	2049.101	2045.610
C17	10.090	6.650	2561.793	2554.990
PRISTANE	19.447	6.549	1524.497	1544.197
C18	12.211	7.612	3348.153	3172.452
PHYTANE	18.808	6.322	1867.565	1587.926
C19	10.000	6.660	3544.387	3570.994
C20	9.579	6.311	3380.998	3364.258
C21	10.847	5.728	3019.986	3072.327
C22	9.686	5.778	2985.356	3073.479
C23	9.675	5.279	2750.919	2776.303
C24	10.008	5.006	2535.708	2588.677
C25	8.450	4.781	2266.935	2314.342
C26	7.719	4.208	2065.290	2028.913
C27	6.146	3.254	1378.508	1455.797
C28	6.111	3.580	1316.252	1245.820
C29	5.535	2.602	1015.770	1063.641
C30	5.321	2.274	847.770	920.587
C31	4.781	2.187	749.236	849.204
C32	3.779	1.435	530.961	578.197
C33	5.001	1.577	590.505	609.781
C34	6.160	1.657	543.445	600.212
OTP (% Recovery)	81	85	114	117
Total HC	5782.34	1780.12	574601.06	574582.42
Pristane/Phytane	1.03	1.04	0.82	0.97
C17/Pristane	0.52	1.02	1.68	1.65
C18/Phytane	0.65	1.20	1.79	2.00
TALK	174.88	104.75	39880.85	40310.20
LALK	75.66	55.41	17284.21	17132.92
LALK/TALK	0.43	0.53	0.43	0.43

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Replicate 1 run with AS, ASS, BS, BSS, CS, and CSS.
Replicate 2 run with DS, DSS, ES, ESS, FS, FSS.

EXXON Bioremediation Study, N0531-2994
Beach KN135, Time Series 70

Battelle Ocean Sciences
Sediment PAH/Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle Lab ID:	IU39,41,43	IU40,42,44	IU45,47,49	IU46,48,50	IU51,53,55	IU52,54,56	IU57,59,61	IU58,60,62
Analyte								
naphthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
C1-naphthalenes	0.02	0.01	0.02	0.01	0.01	ND	0.07	0.01
C2-naphthalenes	0.06	0.02	0.10	0.04	0.04	0.05	0.17	0.01
C3-naphthalenes	0.24	0.11	0.62	0.24	0.09	0.46	2.44	0.12
C4-naphthalenes	1.29	0.79	1.89	1.27	0.71	1.56	9.88	0.51
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	ND	ND
C1-fluorenes	ND	ND	0.15	0.06	ND	0.11	0.59	0.03
C2-fluorenes	0.64	0.37	0.93	0.58	0.37	0.70	4.31	0.23
C3-fluorenes	1.21	0.77	1.47	1.00	0.82	1.14	6.56	0.34
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	ND	ND	0.02	ND	ND	ND
C1-phenanthrenes/anthracenes	0.08	0.05	0.26	0.07	ND	0.17	0.28	0.02
C2-phenanthrenes/anthracenes	1.27	0.72	1.75	1.05	0.66	1.34	7.67	0.40
C3-phenanthrenes/anthracenes	2.17	1.20	2.65	1.56	1.37	1.74	10.64	0.55
C4-phenanthrenes/anthracenes	1.90	0.96	2.19	1.21	1.15	1.17	6.98	0.36
dibenzothiophene	ND	ND	ND	ND	ND	ND	ND	ND
C1-dibenzothiophenes	0.10	0.05	0.21	0.08	0.05	0.13	0.48	0.03
C2-dibenzothiophenes	1.47	0.81	1.96	1.17	0.84	1.49	8.91	0.47
C3-dibenzothiophenes	2.43	1.34	2.92	1.71	1.55	1.93	12.05	0.59
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.05	0.03	0.06	0.03	0.03	0.03	0.18	0.01
C1-fluoranthenes/pyrenes	0.40	0.20	0.47	0.25	0.23	0.27	1.55	0.08
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.27	0.13	0.31	0.13	0.18	0.16	0.83	0.04
C1-chrysenes	0.53	0.26	0.58	0.28	0.34	0.34	1.73	0.08
C2-chrysenes	0.79	0.41	0.89	0.42	0.53	0.47	2.58	0.12
C3-chrysenes	0.66	0.31	0.72	0.34	0.40	0.34	1.94	0.10
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.04	0.02	0.04	0.02	0.03	0.02	0.12	0.01
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.03	0.01	0.04	0.01	0.02	0.01	0.05	0.00
Total PAH	15.65	8.56	20.24	11.54	9.44	13.65	80.05	4.09
C30a,B (hopane)	1.87	0.80	2.10	0.90	1.10	0.85	5.30	0.24
Surrogate Recoveries								
d8-naphthalene	67	65	78	58	55	66	89	93
d10-fluorene	81	76	87	73	64	72	97	108
d12-chrysene	82	76	83	69	71	75	95	111

ND = Not Detected
NA = Non Applicable

EXXON Bioremediation Study, N0531-2994
Beach KN135, Time Series 70

Battelle Ocean Sciences
Sediment PAH/Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4
Battelle Lab ID:	IU63,65,67	IU66,68,64	IU69,71,73	IU74,72,70	521 oil	521 oil	521 oil	521 oil
Analyte								
naphthalene	0.01	0.01	0.01	0.00	26.89	27.60	27.14	28.48
C1-naphthalenes	0.04	0.09	0.04	0.02	286.87	294.93	292.33	299.65
C2-naphthalenes	0.11	0.61	0.09	0.06	936.20	959.65	961.37	980.81
C3-naphthalenes	0.39	4.91	0.30	0.61	1097.60	1124.06	1146.09	1152.14
C4-naphthalenes	1.92	9.00	4.13	2.17	916.39	914.56	950.35	928.19
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	72.96	77.85	76.73	78.10
C1-fluorenes	ND	0.87	ND	0.14	245.81	248.13	254.34	249.35
C2-fluorenes	0.87	3.77	1.91	0.88	489.16	457.13	499.27	473.57
C3-fluorenes	1.51	4.96	3.71	1.29	530.32	541.55	554.44	510.02
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	ND	ND	319.87	335.97	325.53	334.00
C1-phenanthrenes/anthra	0.12	1.67	ND	0.20	805.95	836.22	823.14	828.07
C2-phenanthrenes/anthra	1.55	7.64	3.22	1.72	1095.92	1139.33	1109.37	1129.52
C3-phenanthrenes/anthra	2.57	8.09	6.45	2.14	866.00	864.18	890.57	823.13
C4-phenanthrenes/anthra	2.07	4.90	5.33	1.38	570.27	533.25	584.89	505.26
dibenzothiophene	ND	0.06	ND	ND	271.82	288.19	274.03	285.32
C1-dibenzothiophenes	0.13	1.34	0.13	0.19	455.92	488.62	458.36	478.02
C2-dibenzothiophenes	1.92	7.66	4.57	1.89	918.65	963.74	928.99	952.25
C3-dibenzothiophenes	3.01	8.84	7.76	2.42	877.44	923.10	905.49	856.58
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.05	0.13	0.13	0.04	13.93	14.48	13.62	13.70
C1-fluoranthenes/pyrene	0.46	1.17	1.04	0.30	123.52	123.32	128.22	127.67
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.28	0.60	0.59	0.17	55.81	67.41	57.31	69.70
C1-chrysenes	0.52	1.19	1.21	0.36	106.72	130.58	118.42	135.24
C2-chrysenes	0.81	1.77	1.82	0.52	167.40	186.95	192.85	185.45
C3-chrysenes	0.65	1.42	1.45	0.38	126.32	139.59	141.35	138.10
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.04	0.09	0.09	0.03	8.57	9.61	8.83	9.32
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.03	0.05	0.05	0.01	4.85	4.75	4.47	3.38
Total PAH	19.05	70.85	44.03	16.92	11391.15	11694.77	11727.51	11575.02
C30a,B	1.88	3.26	3.77	0.99	307.27	299.04	310.89	328.30
Surrogate Recoveries								
d8-naphthalene	72	77	81	76	119	121	116	121
d10-fluorene	83	86	90	86	111	108	112	113
d12-chrysene	81	86	88	85	109	120	111	125

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 were run with AS, ASS, BS, BSS, CS and CSS.
Replicates 3 and 4 were run with DS, DSS, ES, ESS, FS and FSS.

Exxon Bioremediation Project (N0531-2994)
Beach KN135 - Time Series 109

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle ID	IW58,60,62	IW59,61,63	IW64,66,68	IW65,67,69	IW70,72,74	IW71,73,75	IW76,78,80	IW77,79,81
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND	ND	ND
C12	ND	ND	ND	ND	ND	ND	ND	0.619
C13	ND	ND	ND	ND	ND	ND	ND	1.712
C14	ND	0.119	ND	ND	ND	ND	ND	2.738
C15	ND	0.127	ND	0.115	1.126	ND	ND	4.161
C16	ND	0.137	ND	0.110	1.112	ND	ND	3.546
C17	ND	0.242	1.036	0.205	1.662	ND	ND	5.034
PRISTANE	2.201	0.678	3.157	0.571	3.675	0.873	11.286	4.926
C18	ND	0.207	0.602	0.120	1.185	ND	ND	3.537
PHYTANE	2.704	0.660	2.756	0.446	4.290	0.701	9.468	3.219
C19	ND	0.116	ND	0.090	1.251	ND	ND	3.05
C20	ND	0.083	ND	0.066	0.849	ND	ND	2.893
C21	ND	0.160	ND	0.109	1.124	ND	ND	3.115
C22	ND	0.212	ND	0.102	1.005	ND	ND	2.993
C23	0.746	0.196	0.928	0.159	1.333	0.152	ND	2.82
C24	ND	0.147	ND	0.110	1.012	ND	ND	2.775
C25	ND	0.103	ND	0.100	1.029	ND	ND	2.53
C26	ND	0.111	ND	0.096	0.952	ND	ND	2.302
C27	ND	0.119	ND	0.100	0.882	ND	ND	1.824
C28	1.172	0.150	ND	ND	0.978	ND	ND	1.358
C29	ND	ND	ND	ND	ND	ND	ND	1.183
C30	ND	ND	ND	0.091	0.938	ND	ND	1.25
C31	ND	0.264	ND	0.138	1.322	ND	ND	0.966
C32	ND	0.151	ND	0.081	0.776	ND	ND	0.744
C33	ND	0.200	ND	0.097	1.224	ND	ND	0.529
C34	ND	0.236	ND	0.130	1.334	ND	ND	0.534
OTP (% Recovery)	90.93	70.98	92.25	79.51	88.01	107.51	121.13	89.61
Total HC	3408.66	488.44	3431.14	357.96	2763.42	516.88	5161.9	1298.60
Pristane/Phytane	0.81	1.03	1.15	1.28	0.86	1.25	1.19	1.53
C17/Pristane	NA	0.36	0.33	0.36	0.45	NA	NA	1.02
C18/Phytane	NA	0.31	0.22	0.27	0.28	NA	NA	1.10
TALK	1.92	3.08	2.57	2.02	21.09	0.15	NA	52.21
LALK	NA	1.03	1.64	0.71	7.19	NA	NA	27.29
LALK/TALK	NA	0.33	0.64	0.35	0.34	NA	NA	0.52

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2994)
Beach KN135 - Time Series 109

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4	NA	NA
Battelle ID	IW82,84,86	IW83,85,87	IW88,90,92	IW89,91,93	521 oil	521 oil	521 oil	521 oil	600 oil	600 oil
C10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12	ND	0.581	ND	4.278	48.779	ND	ND	ND	ND	ND
C13	ND	1.585	ND	9.19	206.318	140.423	117.936	196.841	ND	ND
C14	0.326	2.473	ND	12.772	941.150	455.330	273.038	990.318	ND	ND
C15	0.574	3.839	ND	18.641	1467.655	1230.630	1174.112	1579.288	ND	ND
C16	0.972	3.358	ND	15.281	1932.692	1622.455	1528.289	2107.256	ND	ND
C17	1.822	4.727	ND	22.708	2981.721	2758.354	2628.544	3257.894	218.408	173.986
PRISTANE	3.728	5.753	11.739	21.651	1392.417	1330.427	1248.395	1548.709	114.083	ND
C18	1.048	3.275	ND	15.496	2845.334	2405.282	2314.974	3060.944	785.490	764.893
PHYTANE	3.086	3.865	10.493	14.175	1595.864	1134.828	1035.321	1680.757	411.073	306.237
C19	0.595	2.486	ND	13.433	3203.009	2881.464	2755.598	3416.773	2226.348	2192.407
C20	0.389	3.367	ND	13.075	2956.250	2677.117	2570.497	3361.214	3481.960	3167.281
C21	0.899	2.676	ND	13.453	3063.731	2559.087	2449.411	2990.832	3123.168	3116.428
C22	0.94	2.416	ND	13.142	2681.604	2504.052	2406.926	2790.208	3129.705	2976.447
C23	1.206	2.551	ND	12.333	2502.674	2332.162	2239.907	2671.626	2963.148	2866.299
C24	1.042	2.451	ND	11.778	2402.525	2232.648	2133.094	2515.6	2836.385	2746.66
C25	1.184	2.279	ND	11.07	2091.249	1927.439	1864.391	2209.218	2477.412	2337.025
C26	0.855	2.036	ND	9.993	1861.194	1686.930	1658.842	1942.137	2187.013	2100.534
C27	0.856	1.68	ND	7.754	1338.262	1245.037	1209.270	1371.431	1589.389	1485.974
C28	0.446	1.28	ND	5.793	1058.037	942.849	892.851	1100.967	1163.216	1253.173
C29	0.49	1.091	ND	5.162	886.779	791.000	764.797	952.34	944.134	1023.977
C30	0.768	1.322	ND	5.66	725.298	723.616	708.235	796.934	900.729	886.412
C31	1.074	1.516	ND	4.367	729.375	549.297	530.390	769.315	1028.976	824.769
C32	0.692	0.956	ND	3.419	448.969	405.313	401.854	453.466	559.839	486.755
C33	0.831	0.704	ND	2.607	424.508	337.485	318.426	335.931	515.807	397.051
C34	0.973	0.982	ND	2.423	452.456	296.503	279.301	502.603	514.126	555.138
OTP (% Recovery)	88.68	94.23	89.29	94.80	96.94	83.75	77.95	103.14	98.05	106.56
Total HC	2155.26	1602.73	5645.23	5586.80	553960.89	428168.06	414556.88	559012.94	523135.35	472551.55
Pristane/Phytane	1.21	1.49	1.12	1.53	0.87	1.17	1.21	0.92	0.28	NA
C17/Pristane	0.49	0.82	NA	1.05	2.14	2.07	2.11	2.10	1.91	NA
C18/Phytane	0.34	0.85	NA	1.09	1.78	2.12	2.24	1.82	1.91	2.50
TALK	17.98	49.63	NA	233.83	37249.57	32704.47	31220.68	39373.14	30645.25	29355.21
LALK	5.73	25.69	NA	124.87	16582.91	14171.06	13362.99	17970.53	6712.21	6298.57
LALK/TALK	0.32	0.52	NA	0.53	0.45	0.43	0.43	0.46	0.22	0.21

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Replicate 1 was run with AS, ASS, BS, BSS, CS and CSS.
Replicates 2 and 3 were processed as sediment samples according to SOP EVC 89-4.
Replicate 4 was run with DS, DSS, ES, ESS, FS and FSS.

Exxon Bioremediation Study (N0531-2994)
Beach KN135, Time Series 109

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle Lab ID:	IW58,60,62	IW59,61,63	IW64,66,68	IW65,67,69	IW70,72,74	IW71,73,75	IW76,78,80	IW77,79,81
Analyte								
naphthalene	ND	ND	ND	0.00	ND	ND	ND	ND
C1-naphthalenes	ND	ND	ND	0.01	ND	ND	ND	ND
C2-naphthalenes	ND	0.04	ND	0.02	ND	ND	ND	ND
C3-naphthalenes	ND	0.08	0.48	0.06	0.39	0.07	ND	0.55
C4-naphthalenes	1.82	0.33	2.31	0.29	2.77	0.52	3.70	1.89
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	ND	ND
C1-fluorenes	ND	ND	ND	ND	ND	ND	ND	ND
C2-fluorenes	0.90	0.14	1.04	0.14	1.21	0.25	ND	0.75
C3-fluorenes	2.69	0.38	2.70	0.29	2.75	0.47	5.05	1.34
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	0.01	0.04	0.00	ND	ND	ND	ND
C1-phenanthrenes/anthracenes	ND	0.04	0.24	0.02	ND	ND	ND	ND
C2-phenanthrenes/anthracenes	1.37	0.26	1.88	0.24	2.32	0.40	2.73	1.27
C3-phenanthrenes/anthracenes	3.34	0.50	3.97	0.41	3.58	0.68	6.11	1.74
C4-phenanthrenes/anthracenes	4.34	0.61	4.69	0.45	3.47	0.68	6.31	1.63
dibenzothiophene	ND	ND	ND	ND	ND	ND	ND	ND
C1-dibenzothiophenes	0.09	0.03	0.19	0.02	0.12	ND	ND	0.11
C2-dibenzothiophenes	2.12	0.34	2.29	0.28	2.37	0.44	4.53	1.59
C3-dibenzothiophenes	4.99	0.72	4.98	0.51	4.25	0.80	8.20	2.40
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.09	0.01	0.09	0.01	0.06	0.01	ND	0.02
C1-fluoranthenes/pyrenes	0.81	0.11	0.85	0.08	0.55	0.12	1.10	0.31
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.52	0.07	0.49	0.04	0.33	0.06	0.73	0.14
C1-chrysenes	1.09	0.15	1.08	0.10	0.77	0.14	1.58	0.29
C2-chrysenes	2.07	0.29	2.11	0.18	1.45	0.27	2.90	0.56
C3-chrysenes	1.69	0.22	1.58	0.14	1.10	0.20	2.31	0.42
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.08	0.01	0.08	0.01	0.04	0.01	ND	0.02
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.06	0.01	0.05	0.00	0.03	0.01	ND	ND
Total PAH	28.06	4.35	31.13	3.31	27.55	5.12	45.25	15.03
C30a,B (Hopane)	3.18	0.42	3.32	0.29	2.05	0.36	4.36	0.72
Surrogate Recoveries:								
d8-naphthalene	91	84	95	94	93	131	116	74
d10-fluorene	94	94	92	98	90	133	120	87
d12-chrysene	100	106	99	101	97	158	144	93

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2994)
Beach KN135, Time Series 109

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2	NA	NA
Battelle Lab ID:	IW82,84,86	IW83,85,87	IW88,90,92	IW89,91,93	521 oil	521 oil	600 oil	600 oil
Analyte								
naphthalene	ND	ND	ND	ND	23.06	23.15	3.17	2.91
C1-naphthalenes	0.10	ND	ND	ND	285.50	278.94	5.00	4.33
C2-naphthalenes	0.64	ND	1.48	ND	975.44	959.77	ND	ND
C3-naphthalenes	1.18	0.41	3.40	2.15	1186.20	1194.55	11.69	16.99
C4-naphthalenes	1.85	1.71	6.58	7.32	1029.80	996.20	110.12	104.85
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	0.04	ND	ND	ND	76.10	75.72	2.12	2.36
C1-fluorenes	0.30	ND	0.97	ND	252.91	247.97	52.75	50.72
C2-fluorenes	1.05	0.70	2.84	3.06	492.65	502.09	286.77	285.84
C3-fluorenes	1.60	1.41	6.16	5.60	671.25	618.98	589.61	602.21
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	0.20	ND	0.33	ND	314.67	308.16	139.68	139.36
C1-phenanthrenes/anthracenes	0.92	0.14	2.21	ND	838.33	816.50	742.48	733.18
C2-phenanthrenes/anthracenes	2.31	1.31	6.37	5.13	1156.23	1099.72	1249.61	1237.25
C3-phenanthrenes/anthracenes	2.49	1.99	7.97	7.37	893.75	858.96	1008.59	995.99
C4-phenanthrenes/anthracenes	2.80	1.89	7.08	5.82	749.19	670.53	822.63	797.23
dibenzothiophene	0.13	ND	0.23	ND	256.38	245.46	84.51	87.25
C1-dibenzothiophenes	ND	0.11	1.53	0.54	536.00	520.88	379.69	375.47
C2-dibenzothiophenes	2.23	1.56	7.08	6.69	1015.17	977.77	1037.14	1025.32
C3-dibenzothiophenes	3.36	2.52	10.72	9.74	1013.23	942.30	1071.41	1117.73
fluoranthene	ND	ND	ND	ND	ND	3.19	3.62	3.51
pyrene	0.05	0.02	ND	0.11	10.21	10.39	12.53	12.85
C1-fluoranthenes/pyrenes	0.49	0.30	1.39	1.19	129.05	127.60	159.43	149.37
benzo(a)anthracene	ND	ND	ND	ND	8.48	8.40	11.07	ND
chrysene	0.32	0.17	0.80	0.57	69.74	65.98	85.11	74.66
C1-chrysenes	0.65	0.41	1.62	1.31	141.99	138.53	163.63	161.07
C2-chrysenes	1.01	0.74	2.92	2.64	235.82	235.66	275.64	275.96
C3-chrysenes	0.90	0.49	2.14	1.92	168.81	167.07	210.36	205.35
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	ND	0.02	ND	0.06	6.67	7.00	7.63	8.11
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.03	ND	ND	ND	4.15	4.34	5.85	5.24
Total PAH	24.66	15.91	73.84	61.21	12540.78	12105.81	8531.84	8475.11
C30a,B (Hopane)	2.18	0.90	4.67	3.06	283.35	289.58	292.13	314.86
Surrogate Recoveries:								
d8-naphthalene	76	88	85	90	101	98	108	111
d10-fluorene	88	93	96	99	96	97	102	102
d12-chrysene	94	104	103	108	102	105	112	111

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 were run with AS, ASS, BS, BSS, CS and CSS.

Exxon Bioremediation Study (N0531-2994)
Beach KN135, Time Series 109

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	Rep 3	Rep 4	NA	NA
Battelle Lab ID:	521 oil	521 oil	600 oil	600 oil
Analyte				
naphthalene	25.19	26.05	3.17	3.12
C1-naphthalenes	304.00	306.33	ND	ND
C2-naphthalenes	1030.94	1053.95	ND	ND
C3-naphthalenes	1272.15	1294.35	ND	ND
C4-naphthalenes	1097.36	906.84	121.50	109.77
acenaphthylene	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND
fluorene	73.73	80.65	ND	ND
C1-fluorenes	273.44	280.73	57.13	60.64
C2-fluorenes	533.70	573.19	302.00	320.96
C3-fluorenes	637.91	656.24	639.15	683.86
anthracene	ND	ND	ND	ND
phenanthrene	346.86	337.44	139.81	138.57
C1-phenanthrenes/anthracenes	926.98	913.29	751.67	753.74
C2-phenanthrenes/anthracenes	1282.23	1274.39	1293.98	1313.35
C3-phenanthrenes/anthracenes	993.23	972.20	1058.68	1035.96
C4-phenanthrenes/anthracenes	813.54	736.55	865.97	887.56
dibenzothiophene	277.71	269.29	84.89	84.99
C1-dibenzothiophenes	584.59	585.52	378.24	385.74
C2-dibenzothiophenes	1132.87	1137.11	1041.73	1085.25
C3-dibenzothiophenes	1133.26	1088.00	1143.15	1210.33
fluoranthene	ND	ND	ND	ND
pyrene	12.77	13.11	13.18	14.03
C1-fluoranthenes/pyrenes	141.70	137.39	162.18	157.77
benzo(a)anthracene	ND	ND	ND	ND
chrysene	66.28	68.23	72.52	75.17
C1-chrysenes	146.73	155.44	153.16	164.91
C2-chrysenes	261.21	253.87	286.81	300.02
C3-chrysenes	196.84	189.13	218.75	196.64
C4-chrysenes	ND	ND	ND	ND
benzo(b)fluoranthene	8.14	6.88	10.53	8.26
benzo(k)fluoranthene	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND
benzo(g,h,i)perylene	6.36	5.45	6.40	4.16
Total PAH	13579.72	13321.62	8804.60	8994.80
C30a,B (Hopane)	292.23	290.43	303.02	312.73
Surrogate Recoveries:				
d8-naphthalene	109	106	111	113
d10-fluorene	104	102	100	106
d12-chrysene	111	115	108	115

ND = Not Detected
NA Non Applicable

Replicates 3 and 4 were run with DS, DSS, ES, ESS, FS and FSS.

Exxon Bioremediation Project (N0531-2971)
Beach KN211 - Time Series 0

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle Lab ID	IN26-1,28-1,36-1	IN27-1,29,50	IN30-1,32,51-1	IN31,33,52	IN34,53,55-1	IN35,54,56	IN57,59,61	IN58,60,62
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	0.006	1.621	ND	4.120	ND	3.372	ND	2.450
C12	0.003	5.916	ND	15.133	ND	13.633	0.430	9.512
C13	ND	9.830	0.013	25.240	0.015	22.679	0.795	15.454
C14	ND	11.207	0.034	29.993	0.028	27.046	1.273	17.966
C15	0.005	12.821	0.053	36.982	0.046	31.825	1.763	20.962
C16	0.002	12.366	0.053	35.985	0.045	30.952	1.716	20.325
C17	0.004	11.729	0.054	33.653	0.051	29.566	1.791	19.498
Pristane	0.053	10.039	0.008	26.308	0.008	27.116	3.962	17.602
C18	0.006	13.151	0.058	36.485	0.053	32.942	2.388	21.704
Phytane	0.027	9.710	0.064	25.640	0.088	26.826	4.009	17.001
C19	0.003	10.912	0.050	31.093	0.056	27.711	1.753	17.934
C20	0.009	10.264	0.050	28.388	0.045	26.437	2.073	16.462
C21	0.019	9.732	0.061	25.411	0.063	24.381	1.577	15.244
C22	0.020	9.436	0.063	26.069	0.069	23.724	1.622	15.359
C23	0.013	8.382	0.043	23.381	0.040	21.658	1.615	13.521
C24	0.009	8.141	0.059	22.445	0.065	21.135	1.597	13.040
C25	0.015	7.863	0.057	21.350	0.065	22.497	1.912	12.787
C26	0.013	6.989	0.048	18.532	0.059	18.235	1.537	11.288
C27	0.009	5.229	0.038	13.800	0.048	13.346	1.313	8.124
C28	0.040	5.401	0.053	13.149	0.099	12.651	2.523	7.379
C29	0.028	4.070	0.050	10.536	0.092	11.318	1.510	6.928
C30	0.024	3.221	0.048	8.170	0.100	9.176	1.488	5.511
C31	0.022	3.180	0.037	7.772	0.073	8.055	1.196	5.200
C32	0.022	2.144	0.037	5.363	0.064	5.573	0.929	3.594
C33	0.035	2.365	0.061	5.680	0.101	5.939	1.299	3.882
C34	0.039	3.133	0.070	7.475	0.110	7.936	1.818	3.700
OTP (% Recovery)	70	88	84	58	89	83	75	80
Total Hydrocarbon	32.43	2707.34	59.77	6554.32	75.78	7310.61	1804.35	4769.22
Pristane/Phytane	1.923	1.034	0.125	1.026	0.091	1.01	0.99	1.04
C17/Pristane	0.080	1.168	6.750	1.279	6.375	1.09	0.45	1.11
C18/Phytane	0.231	1.354	0.906	1.423	0.602	1.23	0.60	1.28
TALK	0.348	179.105	1.090	486.205	1.387	451.79	35.91	287.82
LALK	0.040	99.818	0.365	277.071	0.339	246.16	13.98	162.27
LALK/TALK	0.115	0.557	0.335	0.570	0.244	0.54	0.39	0.56

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2971)
Beach KN211 - Time Series 0

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	E-S	E-SS	F-S	F-SS
Battelle Lab ID	IN63,65,67	IN64,66,68	IN69,71,73	IN70,72,74
C10	ND	0.526	ND	ND
C11	ND	8.731	0.526	7.955
C12	ND	27.499	4.868	26.417
C13	0.099	40.030	8.669	38.250
C14	0.775	43.772	10.560	42.329
C15	0.615	50.851	11.958	48.651
C16	0.523	47.246	11.730	46.090
C17	0.631	43.809	11.022	41.998
Pristane	2.231	30.567	11.253	32.775
C18	0.907	47.495	12.813	47.369
Phytane	2.315	29.925	10.866	32.139
C19	0.645	40.380	10.628	40.055
C20	0.682	43.320	9.303	37.044
C21	0.728	35.464	8.965	35.198
C22	0.700	32.819	8.902	33.273
C23	0.559	29.332	8.141	29.695
C24	0.698	28.053	7.848	28.528
C25	0.935	28.512	7.770	27.655
C26	0.701	22.528	6.860	23.330
C27	0.593	16.420	5.135	16.990
C28	1.192	16.948	5.627	15.185
C29	0.893	12.241	4.668	13.443
C30	0.753	9.994	3.947	10.628
C31	0.653	10.050	3.238	9.818
C32	0.553	6.236	2.163	6.559
C33	0.811	6.355	2.426	6.927
C34	0.993	8.106	2.893	7.959
OTP (% Recovery)	81	69	79	87
Total Hydrocarbon	1015.45	8170.36	3005.44	8446.86
Pristane/Phytane	0.96	1.02	1.04	1.02
C17/Pristane	0.28	1.43	0.98	1.28
C18/Phytane	0.39	1.59	1.18	1.47
TALK	15.64	656.72	170.66	641.35
LALK	4.88	393.66	92.08	376.16
LALK/TALK	0.31	0.60	0.54	0.59

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2971)
Beach KN211, Time Series 0

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth:	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS	E-S	E-SS
Battelle Lab ID:	IN26-1/28-1/36-1	IN27-1/29/50	IN30-1/32/51	IN31/52/33	IN34/53/55-1	IN35/54/56	IN57/59/61	IN58/60/62	IN63/65/67	IN64/66/68
Analyte										
naphthalene	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.03
C1-naphthalenes	0.00	ND	0.00	ND	0.00	ND	ND	ND	ND	ND
C2-naphthalenes	0.00	0.71	0.00	1.91	0.00	1.13	0.06	1.10	ND	3.72
C3-naphthalenes	0.00	3.93	0.01	9.21	0.01	7.33	0.38	4.37	0.14	15.79
C4-naphthalenes	0.01	3.89	0.02	10.71	0.02	11.08	1.50	6.72	0.85	17.71
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C1-fluorenes	ND	0.53	0.00	1.45	0.00	1.26	0.11	0.81	ND	2.69
C2-fluorenes	0.00	1.69	0.01	4.67	0.01	4.58	0.67	2.91	0.37	7.78
C3-fluorenes	0.01	2.00	0.01	4.94	0.02	6.07	1.10	3.60	0.72	8.48
anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	0.00	0.21	ND	ND	ND	0.15	ND	0.30
C1-phenanthrenes/anthrac	0.00	1.23	0.01	4.07	0.01	2.84	0.27	1.88	ND	5.66
C2-phenanthrenes/anthrac	0.01	3.44	0.03	9.13	0.04	9.33	1.40	5.80	0.77	14.43
C3-phenanthrenes/anthrac	0.01	3.06	0.03	7.65	0.04	9.21	1.82	5.62	1.11	12.34
C4-phenanthrenes/anthrac	0.02	1.90	0.02	4.54	0.04	6.16	1.51	3.80	0.94	7.53
dibenzothiophene	ND	ND	0.00	0.13	ND	ND	ND	0.07	ND	0.20
C1-dibenzothiophenes	0.00	0.95	0.01	2.97	0.01	2.24	0.21	1.31	0.06	4.69
C2-dibenzothiophenes	0.01	3.53	0.03	8.95	0.03	9.27	1.45	5.69	0.98	14.78
C3-dibenzothiophenes	0.01	3.68	0.03	9.09	0.04	10.29	2.02	6.45	1.40	14.09
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.00	0.06	0.00	0.15	0.00	0.17	0.03	0.08	0.03	0.22
C1-fluoranthenes/pyrenes	0.01	0.51	0.01	1.20	0.01	1.41	0.37	0.93	0.22	1.96
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.01	0.36	0.01	0.86	0.01	0.70	0.23	0.43	0.16	1.05
C1-chrysenes	0.01	0.67	0.01	1.56	0.02	1.36	0.43	0.86	0.31	1.86
C2-chrysenes	0.02	0.88	0.02	2.16	0.03	2.05	0.71	1.31	0.46	2.82
C3-chrysenes	0.02	0.66	0.02	1.58	0.03	1.76	0.69	1.09	0.38	2.21
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.00	0.04	0.00	0.12	0.00	0.11	0.03	0.07	0.03	0.14
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.00	0.03	0.00	0.07	0.00	0.07	0.04	0.05	0.02	0.09
Total PAH	0.14	33.76	0.32	87.35	0.37	88.43	15.03	55.11	8.93	140.56
C30a,B (hopane)	0.05	1.58	0.09	4.06	0.13	4.53	2.21	3.25	1.12	5.55
d8-naphthalene (% Rec):	63	80	78	58	88	83	66	71	70	90
d10-fluorene (% Rec):	75	87	82	56	88	89	78	81	76	92
d12-chrysene (% Rec):	97	98	87	62	94	81	72	73	82	89

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2971)
Beach KN211, Time Series 0

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth:	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	NA
Battelle Lab ID:	IN69/71/73	IN70/72/74	521 oil	521 oil	521 oil	521 oil	521 oil	521 oil	600 oil
Analyte									
naphthalene	0.01	0.03	26.27	26.33	25.03	26.02	27.18	28.49	2.47
C1-naphthalenes	ND	ND	277.39	281.57	266.25	271.56	288.15	311.78	3.43
C2-naphthalenes	0.21	4.09	919.53	926.63	880.08	910.39	957.22	985.17	4.53
C3-naphthalenes	1.88	14.42	1076.73	1090.16	1051.28	1076.17	1146.53	1141.04	13.89
C4-naphthalenes	4.31	15.81	882.64	890.76	870.06	872.74	957.95	921.97	90.85
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	75.67	79.80	68.89	70.99	76.82	86.64	2.55
C1-fluorenes	0.45	2.27	241.14	246.72	229.68	244.51	260.59	269.13	54.83
C2-fluorenes	1.84	6.44	451.68	490.42	462.07	463.04	521.76	502.18	274.40
C3-fluorenes	2.32	7.27	468.53	480.09	491.46	471.94	516.82	532.29	458.47
anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	0.23	311.52	313.70	297.60	307.49	320.70	344.49	139.09
C1-phenanthrenes/anthracenes	0.70	4.93	804.56	812.71	774.65	767.87	815.98	860.14	649.72
C2-phenanthrenes/anthracenes	3.67	12.37	1011.71	1021.54	978.76	967.88	1063.32	1066.27	1027.40
C3-phenanthrenes/anthracenes	3.60	11.17	756.44	763.26	740.75	721.85	817.71	775.01	797.11
C4-phenanthrenes/anthracenes	2.47	5.29	474.45	461.85	444.85	435.88	499.81	485.21	494.05
dibenzothiophene	ND	0.22	249.34	254.34	237.41	248.17	260.47	279.67	84.08
C1-dibenzothiophenes	0.70	3.56	455.83	471.57	444.43	456.75	489.06	525.17	314.80
C2-dibenzothiophenes	3.98	11.65	864.51	886.27	835.87	850.08	929.60	976.04	842.19
C3-dibenzothiophenes	4.29	12.02	820.97	838.63	804.84	792.73	894.67	903.30	854.68
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.07	0.2	14.54	15.11	12.91	12.24	14.78	14.53	13.06
C1-fluoranthenes/pyrenes	0.60	1.56	113.06	118.93	107.22	113.01	130.14	123.49	123.70
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.40	1.11	57.46	60.05	56.60	70.93	60.56	83.46	74.86
C1-chrysenes	0.69	2.13	112.71	109.23	109.74	127.33	112.57	149.34	139.20
C2-chrysenes	1.01	2.87	173.17	168.00	162.35	176.58	168.90	201.25	200.18
C3-chrysenes	0.77	2.07	127.91	130.48	123.14	128.12	135.65	140.66	153.92
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.05	0.13	8.63	8.72	8.71	8.54	7.57	11.74	9.88
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.03	0.08	5.75	5.44	4.89	4.55	5.27	4.79	4.64
Total PAH	34.04	121.92	10782.14	10952.31	10489.51	10597.36	11479.78	11723.24	6828.01
C30a,B (hopane)	2.04	4.69	318.17	345.63	317.02	309.94	322.72	317.83	373.50
d8-naphthalene (% Rec):	76	90	106	104	99	102	105	110	99
d10-fluorene (% Rec):	81	86	101	101	99	99	105	102	101
d12-chrysene (% Rec):	90	106	96	95	96	107	96	112	103

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 run with stations BS and CS.
Replicates 3 and 4 run with AS, ASS and BS.
Replicates 5 and 6 run with CSS, DS, ES, ESS, FS and FSS.

Exxon Bioremediation Project (N0531-2971)
Beach KN211 - Time Series 31

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-SS	C-SS	D-S	D-SS
Battelle Lab ID	IR33,34,35	IR36,37,38	IR39,40,41	IR42,43,44	IR45,46,47	IR48,49,50	IR53,54,55	IR56,57,58
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	0.044	ND	5.819	ND	2.478	ND	6.073
C12	0.319	0.344	2.129	22.788	ND	13.271	0.526	21.956
C13	0.678	0.686	3.588	36.571	ND	21.886	0.978	33.809
C14	1.479	0.868	5.253	42.272	ND	25.266	1.660	36.861
C15	2.511	1.111	6.962	49.082	ND	30.438	2.490	41.042
C16	2.377	1.150	6.959	50.000	ND	31.811	2.512	40.141
C17	2.325	1.045	6.720	45.665	0.018	28.984	2.438	36.931
PRISTANE	8.493	1.338	10.718	40.639	0.071	30.119	5.425	29.363
C18	2.658	1.202	7.882	52.567	0.019	32.344	3.226	40.248
PHYTANE	8.129	1.294	10.357	39.373	0.054	29.023	5.616	27.745
C19	2.415	1.062	6.360	43.325	0.024	27.251	2.366	33.696
C20	2.034	0.964	5.635	38.199	0.022	24.258	2.098	31.414
C21	2.464	0.841	5.683	38.276	ND	23.584	2.480	28.367
C22	2.046	0.871	5.489	35.009	0.047	22.514	2.141	27.650
C23	2.028	0.757	4.854	32.249	0.023	20.610	1.968	25.192
C24	1.833	0.727	4.819	30.698	0.030	19.381	2.002	23.937
C25	2.174	0.738	5.088	29.313	0.045	18.850	2.202	22.184
C26	2.011	0.676	4.453	25.775	0.032	17.193	1.959	19.840
C27	1.650	0.541	3.557	19.708	0.033	13.398	1.733	14.612
C28	2.592	0.590	3.826	18.768	0.052	13.350	2.214	13.738
C29	2.025	0.546	3.349	16.146	0.050	12.268	1.740	11.366
C30	2.399	0.459	2.778	12.699	ND	9.331	1.865	8.903
C31	1.834	0.392	2.864	12.246	0.032	8.299	1.462	7.983
C32	1.484	0.294	1.854	8.434	0.030	5.845	1.155	5.563
C33	1.742	0.335	2.278	8.856	0.076	6.328	1.525	5.738
C34	2.086	0.429	2.467	11.119	0.074	7.616	1.796	4.748
OTP (% Recovery)	74	97	77	102	66	83	79	84
Total Hydrocarbon	2645.81	389.57	2996.74	10985.29	78.47	8089.86	2040.01	7602.20
Pristane/Phytane	1.04	1.03	1.03	1.03	1.33	1.04	0.97	1.06
C17/Pristane	0.27	0.78	0.63	1.12	0.25	0.96	0.45	1.26
C18/Phytane	0.33	0.93	0.76	1.34	0.35	1.11	0.57	1.45
TALK	45.16	16.67	104.85	685.58	0.61	436.55	44.54	541.99
LALK	16.80	8.48	51.49	386.29	0.08	237.99	18.29	322.17
LALK/TALK	0.37	0.51	0.49	0.56	0.14	0.55	0.41	0.59

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2971)
Beach KN211 - Time Series 31

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2
Battelle Lab ID	IR59,60,61	IR62,63,64	IR65,66,67	IR68,69,70	521 oil	521 oil
C10	ND	ND	ND	ND	ND	ND
C11	ND	5.973	ND	5.717	ND	ND
C12	ND	24.293	1.600	20.221	46.798	43.240
C13	ND	40.262	3.589	30.571	232.721	256.744
C14	ND	44.490	5.379	32.865	868.494	779.554
C15	ND	50.362	7.822	37.907	1695.590	1550.219
C16	ND	51.133	7.225	36.336	2315.533	2241.748
C17	0.185	45.677	7.185	34.298	2782.244	2727.324
PRISTANE	1.300	38.404	12.163	27.875	1696.382	1641.540
C18	0.148	50.177	7.488	33.324	3852.863	3908.006
PHYTANE	1.661	36.909	10.666	23.072	2174.276	2102.117
C19	0.200	42.399	6.534	31.392	4003.271	3994.833
C20	ND	37.500	5.902	27.624	3718.107	3583.176
C21	ND	35.501	6.201	26.106	3398.828	3412.025
C22	0.240	35.209	6.283	26.106	3317.275	3250.479
C23	0.352	31.772	5.413	23.727	2996.178	2890.269
C24	0.221	30.102	5.458	22.461	2801.664	2694.679
C25	0.370	28.263	5.642	20.728	2507.748	2382.012
C26	0.335	24.701	5.448	18.544	2145.326	2078.487
C27	0.312	18.636	4.355	14.185	1538.947	1498.591
C28	0.560	16.166	4.064	13.172	1306.359	1384.811
C29	0.614	14.060	4.119	10.736	1127.951	1119.699
C30	0.404	10.766	3.256	8.790	921.715	873.122
C31	0.434	10.282	3.080	7.722	854.912	801.683
C32	0.443	7.358	2.040	5.252	559.887	551.978
C33	0.823	7.722	2.658	5.710	621.890	612.739
C34	0.850	6.761	2.500	5.040	742.495	599.575
OTP (% Recovery)	43	86	79	77	94	89
Total Hydrocarbon	1281.81	9241.03	3451.87	6660.98	581736.21	577602.66
Pristane/Phytane	0.78	1.04	1.14	1.21	0.78	0.78
C17/Pristane	0.14	1.19	0.59	1.23	1.64	1.66
C18/Phytane	0.09	1.36	0.70	1.44	1.77	1.86
TALK	6.49	669.56	113.24	498.53	44356.80	43234.99
LALK	0.53	392.27	52.73	290.25	19515.62	19084.84
LALK/TALK	0.08	0.59	0.47	0.58	0.44	0.44

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Replicate 1 was run with AS, ASS, BS, BSS, CS, and CSS.
Replicate 2 was run with DS, DSS, ES, ESS, FS, FSS.

Exxon Bioremediation Study (N0531-2971)
Beach KN211, Time Series 31

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/Kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle Lab ID	IR33,34,35	IR36,37,38	IR39,40,41	IR42,43,44	IR45,46,47	IR48,49,50	IR53,54,55	IR56,57,58
Analyte								
naphthalene	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.01
C1-naphthalenes	ND	ND	ND	ND	0.00	ND	ND	ND
C2-naphthalenes	0.07	0.02	0.68	2.51	0.00	1.82	0.06	1.64
C3-naphthalenes	0.72	0.26	2.49	13.80	0.00	9.85	0.67	10.92
C4-naphthalenes	2.52	0.53	4.39	17.86	0.02	13.37	2.30	13.62
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	0.07	ND	ND	ND	0.01
fluorene	ND	ND	ND	ND	ND	ND	ND	ND
C1-fluorenes	0.15	0.04	0.49	2.19	ND	1.54	0.15	1.71
C2-fluorenes	1.18	0.22	1.84	7.93	0.01	5.82	1.05	5.75
C3-fluorenes	2.14	0.36	2.59	10.30	0.02	7.76	1.70	7.09
phenanthrene	ND	ND	0.09	0.22	ND	ND	ND	ND
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
C1-phenanthrenes/anthracene	0.43	0.11	1.10	5.37	0.00	3.38	0.17	3.56
C2-phenanthrenes/anthracene	2.81	0.51	3.98	15.67	0.03	11.29	1.88	11.00
C3-phenanthrenes/anthracene	3.51	0.55	4.24	15.54	0.05	10.76	2.54	10.60
C4-phenanthrenes/anthracene	1.77	0.32	2.55	8.52	0.05	5.33	1.73	5.79
dibenzothiophene	ND	ND	0.07	0.18	ND	ND	ND	0.08
C1-dibenzothiophenes	0.41	0.10	0.91	4.22	0.00	2.64	0.19	2.81
C2-dibenzothiophenes	3.17	0.55	4.24	15.71	0.03	11.62	2.20	10.77
C3-dibenzothiophenes	4.60	0.67	5.11	17.57	0.06	13.14	3.11	11.83
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.08	0.01	0.08	0.28	0.00	0.21	0.05	0.18
C1-fluoranthenes/pyrenes	0.70	0.10	0.73	2.53	0.02	1.87	0.49	1.71
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.39	0.06	0.43	1.19	0.01	0.95	0.26	0.79
C1-chrysenes	0.78	0.11	0.80	2.30	0.02	ND	0.51	1.55
C2-chrysenes	1.25	0.17	1.29	3.80	0.04	2.86	0.90	2.79
C3-chrysenes	0.85	0.11	0.84	2.61	0.04	1.98	0.64	1.70
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.06	0.01	0.06	0.19	0.00	0.13	0.04	0.12
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.04	0.01	0.04	0.11	0.00	0.08	0.03	0.07
Total PAH	27.64	4.79	39.04	150.68	0.42	106.43	20.68	106.12
C30a,B (hopane)	2.43	0.28	2.18	6.77	0.16	5.33	1.80	4.26
Surrogate Recoveries								
d8-naphthalene	83	91	82	104	36	90	74	84
d10-fluorene	82	87	78	108	73	92	79	89
d12-chrysene	93	116	88	112	85	94	82	88

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2971)
Beach KN211, Time Series 31

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/Kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4
Battelle Lab ID	IR59,60,61	IR62,63,64	IR65,66,67	IR68,69,70	521 oil *	521 oil *	521 oil *	521 oil *
Analyte								
naphthalene	0.00	0.02	0.00	0.01	32.52	30.49	28.41	28.01
C1-naphthalenes	ND	ND	ND	ND	326.03	317.17	304.44	298.84
C2-naphthalenes	ND	2.11	0.15	1.52	1109.13	1070.43	1031.74	1020.53
C3-naphthalenes	0.13	11.14	1.82	10.12	1319.80	1279.30	1258.19	1241.53
C4-naphthalenes	1.09	16.81	5.22	13.08	1085.63	1060.66	1084.56	1044.61
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	89.89	85.13	88.25	82.01
C1-fluorenes	ND	1.89	0.43	1.73	302.37	277.07	287.31	283.77
C2-fluorenes	0.55	7.45	2.45	5.86	612.29	565.86	558.59	552.45
C3-fluorenes	1.00	9.21	3.36	6.57	683.01	650.67	657.68	613.09
phenanthrene	ND	0.21	ND	ND	369.12	359.79	341.32	337.41
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
C1-phenanthrenes/anthracen	ND	3.68	0.47	2.95	955.03	932.60	894.88	882.71
C2-phenanthrenes/anthracen	0.96	12.82	4.27	10.00	1295.88	1270.80	1247.27	1189.66
C3-phenanthrenes/anthracen	1.61	13.36	5.30	10.08	1031.66	1007.70	984.89	959.53
C4-phenanthrenes/anthracen	1.12	7.67	3.38	5.19	589.03	555.43	457.19	514.60
dibenzothiophene	ND	0.12	ND	0.05	339.47	313.75	299.29	289.32
C1-dibenzothiophenes	0.05	2.83	0.51	2.38	600.43	545.15	505.42	492.72
C2-dibenzothiophenes	1.15	12.68	4.63	9.81	1198.98	1106.02	1036.93	1016.65
C3-dibenzothiophenes	1.99	14.81	6.02	11.08	1166.27	1080.39	1035.40	1010.07
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.04	0.23	0.11	0.17	17.66	18.36	20.03	15.44
C1-fluoranthenes/pyrenes	0.36	2.06	0.85	1.47	161.76	147.99	137.84	149.32
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.20	0.92	0.42	0.68	69.89	72.94	60.24	59.58
C1-chrysenes	0.41	1.73	0.83	1.39	142.27	138.29	114.39	117.61
C2-chrysenes	0.73	2.93	1.48	2.22	218.42	216.18	182.09	198.15
C3-chrysenes	0.53	2.49	1.07	1.73	154.99	152.49	124.73	142.88
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.03	0.15	0.07	0.10	9.93	10.57	9.04	9.70
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.02	0.07	0.04	0.06	5.56	5.51	5.45	4.70
Total PAH	11.98	127.39	42.90	98.26	13887.04	13270.74	12755.57	12554.88
C30a,B (hopane)	1.57	5.74	3.08	4.00	358.24	402.30	345.82	385.17
Surrogate Recoveries								
d8-naphthalene	76	82	76	81	96	94	90	88
d10-fluorene	98	93	93	90	95	93	93	91
d12-chrysene	105	85	93	84	92	95	82	88

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 were run with AS, ASS, BS, BSS, CS, CSS, DS and DSS.
Replicates 3 and 4 were run with DS, DSS, ES, ESS, FS and FSS.

* The hopane analyses for these runs were unusually high and not used in determining the amount of total oil biodegraded on KN-211E, Day 31 depicted in the table in the text entitled "Estimated Amounts of Oil Biodegrades Since Beaching. KN-211E". Rather the mean hopane concentration of all the other analyses of 521 oil, 303.59 mg/kg (314.95 mg/kg surrogate corrected), was used.

Exxon Bioremediation Project (N0531-2994)
Beach KN211 - Time Series 62

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle ID	IU01,03,05	IU02,04,06	IU07,09,11	IU08,10,12	IU13,15,17	IU14,16,18	IU19,21,23	IU20,22,24
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	ND	ND	5.189
C12	ND	ND	ND	12.791	0.012	10.703	ND	19.433
C13	ND	ND	ND	20.940	ND	17.682	ND	28.641
C14	ND	ND	0.250	28.248	ND	22.805	0.034	32.081
C15	ND	0.231	0.626	35.996	0.016	28.998	0.108	36.067
C16	ND	0.246	0.532	33.791	0.022	27.072	0.101	36.392
C17	ND	0.363	0.667	33.036	0.031	27.417	0.120	33.476
PRISTANE	0.477	1.445	2.782	37.126	0.050	27.559	0.570	30.597
C18	ND	0.329	0.595	32.349	0.042	27.004	0.116	35.581
PHYTANE	0.417	1.177	2.317	25.719	0.044	20.387	0.506	29.239
C19	ND	0.303	0.424	31.359	0.042	23.507	0.064	31.217
C20	ND	0.273	0.422	27.091	0.029	22.363	0.136	28.068
C21	ND	0.310	0.521	27.078	0.030	22.385	0.138	25.989
C22	ND	0.298	0.566	26.943	0.039	22.527	0.212	25.060
C23	ND	0.305	0.551	24.772	0.054	20.251	0.129	22.707
C24	ND	0.308	0.540	23.226	0.059	19.650	0.097	21.534
C25	0.170	0.394	0.616	22.183	0.063	18.301	0.194	20.450
C26	ND	0.383	0.516	19.482	0.049	16.488	0.128	18.961
C27	0.084	0.373	0.463	15.429	0.040	13.243	0.146	13.779
C28	ND	0.404	0.507	11.951	0.067	10.848	0.353	11.561
C29	0.172	0.434	0.575	12.205	0.058	10.372	0.355	10.590
C30	ND	0.367	0.490	10.929	0.045	9.094	0.250	9.061
C31	0.149	0.429	0.560	8.927	0.041	8.291	0.249	8.921
C32	0.127	0.335	0.495	6.419	0.037	5.476	0.229	6.150
C33	0.382	0.562	0.791	7.372	0.084	6.848	0.438	7.734
C34	0.435	0.599	0.876	6.642	0.091	5.380	0.467	7.037
OTP (% Recovery)	D.O.	85	57	87	91	80	83	93
Total HC	478.30	647.10	1155.89	9273.87	64.18	7154.09	444.62	8303.47
Pristane/Phytane	1.14	1.23	1.20	1.44	1.14	1.35	1.13	1.05
C17/Pristane	NA	0.25	0.24	0.89	0.62	0.99	0.21	1.09
C18/Phytane	NA	0.28	0.26	1.26	0.95	1.32	0.23	1.22
TALK	1.52	7.25	11.58	479.16	0.95	396.71	4.06	495.68
LALK	NA	1.75	3.52	255.60	0.19	207.55	0.68	286.15
LALK/TALK	NA	0.24	0.30	0.53	0.20	0.52	0.17	0.58

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

EXXON Bioremdiation Study, N0531-2994
Beach KN211, Time Series 62

Battelle Ocean Sciences
Sediment PAH/Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4
Battelle Lab ID:	IU25,27,29	IU26,28,30	IU31,33,35	IU32,34,36	521 oil	521 oil	521 oil	521 oil
Analyte								
naphthalene	ND	0.02	ND	0.01	29.39	28.67	26.23	23.13
C1-naphthalenes	ND	ND	ND	ND	306.94	297.42	280.35	260.10
C2-naphthalenes	ND	0.77	ND	1.31	993.33	975.89	938.11	904.00
C3-naphthalenes	0.02	6.46	0.01	8.09	1187.00	1159.94	1156.94	1124.47
C4-naphthalenes	0.29	13.80	0.03	12.22	948.90	954.29	970.66	962.59
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	83.87	78.46	80.42	72.80
C1-fluorenes	ND	1.24	ND	1.33	265.97	260.32	262.70	273.53
C2-fluorenes	0.15	5.92	0.02	4.96	509.54	497.38	533.89	520.88
C3-fluorenes	0.31	8.39	ND	6.48	591.51	548.96	596.91	565.96
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	ND	0.12	340.48	337.06	321.76	305.08
C1-phenanthrenes/anthra	ND	2.12	0.01	2.62	844.98	835.95	820.22	798.95
C2-phenanthrenes/anthra	0.30	12.16	0.04	9.45	1161.23	1150.72	1148.16	1047.05
C3-phenanthrenes/anthra	0.48	13.90	0.05	10.08	909.50	894.35	919.86	838.22
C4-phenanthrenes/anthra	0.52	8.66	0.10	6.28	552.92	555.11	559.58	513.87
dibenzothiophene	ND	ND	ND	ND	288.03	280.48	270.82	254.00
C1-dibenzothiophenes	ND	1.64	0.01	1.83	485.31	470.76	460.69	424.76
C2-dibenzothiophenes	0.34	12.31	0.03	9.13	979.41	940.42	947.35	834.69
C3-dibenzothiophenes	0.59	15.14	0.06	10.50	923.28	909.17	942.38	819.98
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.01	0.25	0.00	0.17	15.53	13.99	14.15	11.72
C1-fluoranthenes/pyrene	0.15	2.23	0.03	1.43	129.96	137.20	133.62	116.45
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.14	1.19	0.04	0.73	67.71	63.04	53.01	55.68
C1-chrysenes	0.24	2.47	0.06	1.45	131.33	122.03	112.74	119.10
C2-chrysenes	0.33	3.50	0.09	2.23	192.38	185.75	167.86	171.44
C3-chrysenes	0.32	2.69	0.09	1.82	145.24	146.66	137.09	141.54
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.02	0.17	ND	0.11	9.29	9.08	8.51	9.31
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	0.01	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.02	0.08	0.01	0.06	4.94	4.98	4.43	3.20
Total PAH	4.22	115.11	0.66	92.43	12097.94	11858.08	11868.43	11172.49
C30a,B (hopane)	1.13	5.92	0.50	4.13	319.43	304.74	328.30	326.86
Surrogate Recoveries								
d8-naphthalene	DO	107	106	90	114	115	104	98
d10-fluorene	DO	116	96	101	107	105	111	114
d12-chrysene	DO	120	112	95	114	109	104	113

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 were run with AS, ASS, BS, BSS, CS and CSS.
Replicates 3 and 4 were run with DS, DSS, ES, ESS, FS and FSS.

EXXON Bioremdiation Study, N0531-2994
Beach KN211, Time Series 62

Battelle Ocean Sciences
Sediment PAH/Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle Lab ID:	IU01,03,05	IU02,04,06	IU07,09,11	IU08,10,12	IU13,15,17	IU14,16,18	IU19,21,23	IU20,22,24
Analyte								
naphthalene	ND	ND	ND	ND	0.00	ND	0.00	0.02
C1-naphthalenes	ND	ND	ND	ND	0.00	ND	0.00	ND
C2-naphthalenes	0.01	ND	ND	1.32	ND	1.03	ND	1.24
C3-naphthalenes	0.04	0.07	0.08	8.43	0.00	6.81	0.02	6.85
C4-naphthalenes	0.13	0.38	0.76	14.31	0.01	10.76	0.19	11.47
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	ND	ND
C1-fluorenes	ND	ND	ND	1.44	ND	1.20	ND	1.18
C2-fluorenes	0.06	0.17	0.39	5.90	ND	4.39	0.08	4.69
C3-fluorenes	0.16	0.36	0.82	8.85	ND	6.45	0.16	6.55
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	ND	ND	ND	ND	ND	0.14
C1-phenanthrenes/anthracenes	0.04	0.03	0.03	3.36	0.00	1.91	0.01	2.59
C2-phenanthrenes/anthracenes	0.16	0.39	0.83	12.48	0.01	9.34	0.20	9.69
C3-phenanthrenes/anthracenes	0.27	0.62	1.36	13.57	0.02	9.32	0.28	9.57
C4-phenanthrenes/anthracenes	0.38	0.58	1.26	10.26	0.03	6.69	0.26	5.94
dibenzothiophene	ND	ND	ND	ND	ND	ND	ND	0.08
C1-dibenzothiophenes	0.02	0.03	0.05	2.46	0.00	1.74	0.01	1.85
C2-dibenzothiophenes	0.15	0.41	0.93	12.07	0.01	8.82	0.21	9.48
C3-dibenzothiophenes	0.35	0.71	1.56	14.35	0.02	10.13	0.32	11.00
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.01	0.02	0.03	0.24	0.00	0.17	0.01	0.16
C1-fluoranthenes/pyrenes	0.09	0.15	0.27	2.19	0.01	1.40	0.08	1.57
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.07	0.08	0.13	0.90	0.01	0.67	0.08	0.89
C1-chrysenes	0.13	0.16	0.29	1.92	0.01	1.44	0.13	1.81
C2-chrysenes	0.24	0.27	0.43	3.26	0.02	2.29	0.19	2.59
C3-chrysenes	0.21	0.22	0.38	2.36	0.02	1.77	0.18	1.84
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.01	0.01	0.02	0.13	0.00	0.10	0.01	0.12
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	0.00	ND
benzo(g,h,i)perylene	0.01	0.01	0.02	ND	0.00	ND	0.01	0.07
Total PAH	2.56	4.67	9.63	119.78	0.16	86.43	2.42	91.40
C30a,B (hopane)	0.71	0.65	1.01	5.53	0.12	4.16	0.70	4.68
Surrogate Recoveries								
d8-naphthalene	98	68	48	95	81	80	100	103
d10-fluorene	85	81	60	108	95	90	88	106
d12-chrysene	118	77	55	103	97	87	132	108

ND = Not Detected
NA = Non Applicable

EXXON Bioremdiation Study, N0531-2994
Beach KN211, Time Series 62

Battelle Ocean Sciences
Sediment PAH/Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2	Rep 3	Rep 4
Battelle Lab ID:	1U25,27,29	1U26,28,30	1U31,33,35	1U32,34,36	521 oil	521 oil	521 oil	521 oil
Analyte								
naphthalene	ND	0.02	ND	0.01	29.39	28.67	26.23	23.13
C1-naphthalenes	ND	ND	ND	ND	306.94	297.42	280.35	260.10
C2-naphthalenes	ND	0.77	ND	1.31	993.33	975.89	938.11	904.00
C3-naphthalenes	0.02	6.46	0.01	8.09	1187.00	1159.94	1156.94	1124.47
C4-naphthalenes	0.29	13.80	0.03	12.22	948.90	954.29	970.66	962.59
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	83.87	78.46	80.42	72.80
C1-fluorenes	ND	1.24	ND	1.33	265.97	260.32	262.70	273.53
C2-fluorenes	0.15	5.92	0.02	4.96	509.54	497.38	533.89	520.88
C3-fluorenes	0.31	8.39	ND	6.48	591.51	548.96	596.91	565.96
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
phenanthrene	ND	ND	ND	0.12	340.48	337.06	321.76	305.08
C1-phenanthrenes/anthra	ND	2.12	0.01	2.62	844.98	835.95	820.22	798.95
C2-phenanthrenes/anthra	0.30	12.16	0.04	9.45	1161.23	1150.72	1148.16	1047.05
C3-phenanthrenes/anthra	0.48	13.90	0.05	10.08	909.50	894.35	919.86	838.22
C4-phenanthrenes/anthra	0.52	8.66	0.10	6.28	552.92	555.11	559.58	513.87
dibenzothiophene	ND	ND	ND	ND	288.03	280.48	270.82	254.00
C1-dibenzothiophenes	ND	1.64	0.01	1.83	485.31	470.76	460.69	424.76
C2-dibenzothiophenes	0.34	12.31	0.03	9.13	979.41	940.42	947.35	834.69
C3-dibenzothiophenes	0.59	15.14	0.06	10.50	923.28	909.17	942.38	819.98
fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
pyrene	0.01	0.25	0.00	0.17	15.53	13.99	14.15	11.72
C1-fluoranthenes/pyrene	0.15	2.23	0.03	1.43	129.96	137.20	133.62	116.45
benzo(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
chrysene	0.14	1.19	0.04	0.73	67.71	63.04	53.01	55.68
C1-chrysenes	0.24	2.47	0.06	1.45	131.33	122.03	112.74	119.10
C2-chrysenes	0.33	3.50	0.09	2.23	192.38	185.75	167.86	171.44
C3-chrysenes	0.32	2.69	0.09	1.82	145.24	146.66	137.09	141.54
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.02	0.17	ND	0.11	9.29	9.08	8.51	9.31
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	0.01	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.02	0.08	0.01	0.06	4.94	4.98	4.43	3.20
Total PAH	4.22	115.11	0.66	92.43	12097.94	11858.08	11868.43	11172.49
C30a,B (hopane)	1.13	5.92	0.50	4.13	319.43	304.74	328.30	326.86
Surrogate Recoveries								
d8-naphthalene	DO	107	106	90	114	115	104	98
d10-fluorene	DO	116	96	101	107	105	111	114
d12-chrysene	DO	120	112	95	114	109	104	113

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 were run with AS, ASS, BS, BSS, CS and CSS.
Replicates 3 and 4 were run with DS, DSS, ES, ESS, FS and FSS.

Exxon Bioremediation Project (N0531-2994)
Beach KN211 - Time Series 98

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle ID	IW01,03,05	IW02,04,06	IW07,09,11	IW08,10,12	IW13,15,17	IW14,16,18	IW19,21,23	IW20,22,24
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	ND	ND	1.133	ND	ND
C12	ND	1.538	0.175	10.928	ND	5.354	0.508	19.393
C13	ND	2.754	0.239	17.923	ND	7.690	1.277	29.127
C14	ND	3.814	0.373	26.506	0.219	9.481	1.747	35.15
C15	ND	5.823	0.792	38.872	0.351	13.770	2.717	46.536
C16	ND	5.651	0.816	36.759	0.313	14.446	2.436	40.75
C17	ND	7.789	1.111	55.828	0.621	18.229	3.413	53.354
PRISTANE	0.075	10.234	2.090	47.378	1.730	18.967	4.603	41.719
C18	ND	5.227	0.845	33.973	0.388	14.344	2.242	36.185
PHYTANE	0.080	6.354	1.869	25.467	1.393	15.670	2.793	25.687
C19	ND	4.450	0.635	33.156	0.297	11.734	1.918	29.471
C20	ND	4.049	0.541	29.260	0.281	9.777	1.767	33.38
C21	ND	4.408	0.651	30.359	0.387	10.440	2.01	31.13
C22	ND	4.194	0.500	26.501	0.511	10.474	1.896	29.394
C23	0.051	4.202	0.746	26.747	0.477	9.760	2.051	28.431
C24	ND	3.960	0.596	23.395	0.515	9.939	1.903	26.734
C25	ND	3.814	0.670	21.699	0.368	9.320	1.771	24.738
C26	ND	3:490	0.549	19.048	0.340	8.737	1.684	22.209
C27	ND	2.705	0.456	15.045	0.333	6.711	1.412	17.104
C28	ND	2.122	0.293	10.681	0.162	7.169	0.976	13.059
C29	ND	2.007	0.177	8.900	0.155	5.622	0.778	10.865
C30	ND	2.246	0.411	10.356	0.316	5.085	0.977	11.149
C31	ND	3.057	0.528	7.365	0.538	5.383	1.195	11.709
C32	0.138	1.994	0.305	7.682	0.303	3.755	0.607	5.668
C33	0.118	2.135	0.360	8.843	0.341	3.658	0.916	6.817
C34	0.124	1.978	0.568	8.299	0.488	3.437	0.914	6.852
OTP (% Recovery)	68.50	75.66	86.45	70.94	85.60	85.79	91.58	83.23
Total HC	131.73	2763.86	1044.98	10792.34	872.09	5434.22	1444.19	11096.86
Pristane/Phytane	0.94	1.61	1.12	1.86	1.24	1.21	1.65	1.62
C17/Pristane	NA	0.76	0.53	1.18	0.36	0.96	0.74	1.28
C18/Phytane	NA	0.82	0.45	1.33	0.28	0.92	0.80	1.41
TALK	0.43	83.41	12.34	508.13	7.70	205.45	37.12	569.21
LALK	NA	41.10	5.53	283.21	2.47	105.96	18.03	323.35
LALK/TALK	NA	0.49	0.45	0.56	0.32	0.52	0.49	0.57

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Project (N0531-2994)
Beach KN211 - Time Series 98

Battelle Ocean Sciences
Sediment PHC Data in mg/kg Dry Weight

Reporting Limits= 0.1mg/kg
521 Reference Oil data in mg/kg oil.

Station ID-Depth Battelle ID	E-S IW27,29,31	E-SS IW26,28,30	F-S IW25,33,35	F-SS IW32,34,36	Rep 1 521 oil	Rep 2 521 oil	NA 600 oil	NA 600 oil
C10	ND	ND	ND	ND	ND	ND	ND	ND
C11	ND	ND	ND	3.816	ND	ND	ND	ND
C12	ND	21.123	ND	17.653	44.101	ND	ND	ND
C13	ND	33.579	ND	26.394	235.619	226.299	ND	ND
C14	ND	41.029	ND	31.085	1032.193	977.766	ND	ND
C15	0.904	55.923	ND	42.115	1656.685	1600.826	ND	ND
C16	1.071	49.233	ND	36.271	2129.682	2092.346	ND	ND
C17	2.043	65.069	ND	49.671	3328.500	3115.61	209.953	214.313
PRISTANE	5.812	45.767	4.732	39.037	1577.449	1455.008	98.350	120.012
C18	1.247	45.085	ND	31.83	3335.617	3078.007	825.720	865.109
PHYTANE	4.326	33.089	3.367	23.177	1859.888	1698.866	546.647	556.65
C19	1.341	38.813	ND	31.888	3571.641	3438.489	2284.586	2330.554
C20	0.996	37.934	ND	27.582	3494.107	3335.001	3488.224	3024.598
C21	1.28	37.49	ND	28.098	3103.271	3055.4	3256.865	3638.966
C22	1.239	36.458	ND	26.908	3016.245	2911.084	3141.642	3229.256
C23	1.663	34.467	ND	26.54	2896.285	2731.308	3019.863	3118.362
C24	1.395	33.891	ND	25.145	2709.905	2616.861	2897.862	2974.038
C25	1.471	29.273	ND	22.773	2350.143	2291.286	2527.982	2584.168
C26	1.362	26.611	ND	20.581	2089.872	2157.147	2228.879	2255.257
C27	1.284	20.33	ND	15.471	1493.142	1390.325	1626.896	1640.348
C28	0.796	15.459	ND	11.671	1205.309	1166.987	1362.372	1159.739
C29	0.746	12.518	ND	9.738	1097.491	1023.135	1139.660	1154.05
C30	1.233	12.279	ND	9.867	840.580	819.234	904.966	960.81
C31	1.376	8.427	ND	7.325	874.683	764.038	947.788	976.04
C32	0.871	6.325	ND	5.648	494.416	480.422	576.136	584.839
C33	ND	4.349	ND	ND	516.631	453.853	445.012	524.284
C34	ND	ND	ND	ND	503.232	538.094	530.063	562.912
OTP (% Recovery)	89.49	84.72	D.O.	81.00	101.80	106.78	95.27	102.19
Total HC	2636.52	11505.37	2332.70	10837.71	602713.64	600778.12	522748.82	543816.83
Pristane/Phytane	1.34	1.38	1.41	1.68	0.85	0.86	0.18	0.22
C17/Pristane	0.35	1.42	NA	1.27	2.11	2.14	2.13	1.79
C18/Phytane	0.29	1.36	NA	1.37	1.79	1.81	1.51	1.55
TALK	22.32	665.67	NA	508.07	42019.35	40263.52	31414.47	31797.64
LALK	7.60	387.79	NA	298.31	18828.15	17864.34	6808.48	6434.57
LALK/TALK	0.34	0.58	NA	0.59	0.45	0.44	0.22	0.20

TALK = Total n-Alkanes (C10 - C34)
LALK = Light n-Alkanes (C10 - C20)

ND = Not Detected
NA = Non Applicable

Replicate 1 was run with AS, ASS, BS, BSS, CS and CSS.
Replicate 2 was run with DS, DSS, ES, ESS, FS and FSS.

Exxon Bioremediation Study (N0531-2994)
Beach KN211, Time Series 98

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	A-S	A-SS	B-S	B-SS	C-S	C-SS	D-S	D-SS
Battelle Lab ID:	IW01,03,05	IW02,04,06	IW07,09,11	IW08,10,12	IW13,15,17	IW14,16,18	IW19,21,23	IW20,22,24
Analyte								
naphthalene	ND	ND	ND	ND	ND	ND	ND	ND
C1-naphthalenes	ND	ND	ND	ND	ND	ND	ND	ND
C2-naphthalenes	ND	ND	0.06	1.47	0.02	0.43	ND	ND
C3-naphthalenes	ND	0.68	0.23	8.56	0.09	2.23	ND	5.96
C4-naphthalenes	0.02	2.96	0.84	16.83	0.64	5.81	1.45	17.93
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	0.05	ND	ND
fluorene	ND	ND	ND	ND	ND	ND	ND	ND
C1-fluorenes	ND	0.16	0.07	1.69	ND	0.51	ND	1.24
C2-fluorenes	ND	1.32	0.45	7.82	0.32	2.66	0.60	6.21
C3-fluorenes	0.04	2.36	0.85	10.07	0.62	3.93	1.14	10.01
phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
C1-phenanthrenes/anthracenes	ND	0.25	0.13	2.81	0.04	0.92	ND	1.79
C2-phenanthrenes/anthracenes	0.04	2.65	0.87	15.90	0.63	5.63	1.07	11.78
C3-phenanthrenes/anthracenes	0.08	3.69	1.34	17.54	1.06	6.93	1.63	13.62
C4-phenanthrenes/anthracenes	0.07	2.14	0.89	9.38	0.67	3.91	1.46	12.62
dibenzothiophene	ND	ND	0.01	ND	ND	ND	ND	ND
C1-dibenzothiophenes	ND	0.25	0.12	2.84	0.05	0.91	ND	1.68
C2-dibenzothiophenes	0.04	3.16	0.97	15.27	0.75	6.03	1.24	13.29
C3-dibenzothiophenes	0.09	4.27	1.54	19.15	1.23	8.08	1.99	16.86
fluoranthene	0.00	ND	ND	ND	ND	0.03	ND	ND
pyrene	0.00	0.06	0.02	0.23	0.02	0.10	0.03	0.18
C1-fluoranthenes/pyrenes	0.02	0.54	0.22	2.22	0.16	0.93	0.29	2.11
benzo(a)anthracene	ND	0.03	0.01	ND	0.01	0.06	ND	ND
chrysene	0.02	0.28	0.12	1.09	0.11	0.56	0.17	1.13
C1-chrysenes	0.03	0.61	0.26	2.64	0.22	1.19	0.40	2.66
C2-chrysenes	0.05	0.90	0.39	3.94	0.37	1.85	0.69	4.24
C3-chrysenes	0.06	0.73	0.35	3.00	0.28	1.46	0.50	3.64
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.00	0.03	0.02	ND	0.01	0.06	ND	ND
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	0.00	0.02	0.01	ND	0.01	0.04	0.02	ND
Total PAH	0.58	27.08	9.77	142.45	7.31	54.33	12.69	126.95
C30a,B (Hopane)	0.21	1.54	0.84	6.18	0.75	3.10	1.21	5.37
Surrogate Recoveries								
d8-naphthalene	65	73	79	72	81	83	88	87
d10-fluorene	81	78	88	82	85	85	92	90
d12-chrysene	91	78	83	92	87	89	106	104

ND = Not Detected
NA = Non Applicable

Exxon Bioremediation Study (N0531-2994)
Beach KN211, Time Series 98

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	E-S	E-SS	F-S	F-SS	Rep 1	Rep 2	NA	NA
Battelle Lab ID:	IW27,29,31	IW26,28,30	IW25,33,35	IW32,34,36	521 oil	521 oil	600 oil	600 oil
Analyte								
naphthalene	ND	ND	ND	ND	25.42	25.86	3.08	3.01
C1-naphthalenes	ND	ND	ND	ND	279.82	284.17	3.09	3.09
C2-naphthalenes	ND	2.23	ND	2.35	930.37	932.98	ND	ND
C3-naphthalenes	ND	9.22	ND	10.52	1110.41	1085.29	10.63	11.05
C4-naphthalenes	1.89	18.45	1.22	17.52	954.23	905.31	74.22	71.15
acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
fluorene	ND	ND	ND	ND	87.92	85.61	2.76	2.83
C1-fluorenes	ND	1.68	ND	1.99	321.76	293.49	58.64	55.65
C2-fluorenes	0.80	7.39	0.55	7.13	631.54	592.15	331.50	326.09
C3-fluorenes	2.04	11.15	1.56	10.58	721.24	675.53	658.74	588.73
phenanthrene	ND	ND	ND	ND	342.29	334.83	140.98	138
anthracene	ND	ND	ND	ND	ND	ND	ND	ND
C1-phenanthrenes/anthracenes	ND	2.81	ND	2.89	964.31	935.46	781.68	749.99
C2-phenanthrenes/anthracenes	ND	14.43	1.34	13.13	1312.37	1229.92	1314.59	1241.7
C3-phenanthrenes/anthracenes	3.13	15.25	2.32	14.59	1088.94	995.17	1124.66	1040.69
C4-phenanthrenes/anthracenes	3.24	12.70	2.48	12.16	561.25	484.51	568.70	536.57
dibenzothiophene	ND	ND	ND	ND	276.97	281.03	85.50	85.9
C1-dibenzothiophenes	ND	2.60	0.08	2.89	576.94	552.55	373.06	359.56
C2-dibenzothiophenes	2.06	15.54	1.69	14.00	1192.92	1104.93	1113.13	1040.34
C3-dibenzothiophenes	3.90	19.00	3.13	17.21	1157.21	1077.08	1176.06	1090.11
fluoranthene	ND	ND	ND	ND	4.63	4.24	4.84	4.19
pyrene	ND	0.23	0.04	ND	13.27	12.64	14.32	14.04
C1-fluoranthenes/pyrenes	0.59	2.45	0.49	2.24	144.46	129.51	158.82	133.76
benzo(a)anthracene	ND	ND	ND	ND	7.96	9.29	7.90	9.07
chrysene	0.32	1.24	0.30	1.19	65.38	72.35	71.11	74.61
C1-chrysenes	0.79	2.68	0.68	2.72	129.88	145.46	138.55	153.06
C2-chrysenes	1.26	4.58	1.13	5.06	202.40	207.91	214.82	224.39
C3-chrysenes	1.08	3.47	0.91	3.51	154.06	158.07	182.59	179.1
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo(b)fluoranthene	0.04	0.13	0.04	0.13	7.61	7.84	8.75	8.7
benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
benzo(g,h,i)perylene	ND	ND	0.03	ND	4.94	6.02	4.26	6.11
Total PAH	21.14	147.23	17.99	141.81	13270.49	12629.20	8626.99	8151.49
C30a,B (Hopane)	2.11	5.36	2.16	5.64	323.66	335.15	353.76	344.83
Surrogate Recoveries								
d8-naphthalene	82	81	141	87	99	102	103	103
d10-fluorene	88	97	100	93	105	104	105	104
d12-chrysene	100	112	213	111	100	106	99	107

ND = Not Detected
NA = Non Applicable

Replicates 1 and 2 were run with AS, ASS, BS, BSS, CS and CSS.

Exxon Bioremediation Study (N0531-2994)
Beach KN211, Time Series 98

Battelle Ocean Sciences
Sediment PAH & Hopane Data in mg/kg Dry Weight

Reporting Limits= 0.01mg/kg
521 Reference Oil data in mg/kg oil.

Station-Depth:	Rep 3	Rep 4	NA	NA
Battelle Lab ID:	521 oil	521 oil	600 oil	600 oil
Analyte				
naphthalene	24.06	24.82	3.11	2.96
C1-naphthalenes	292.40	312.69	5.59	4.43
C2-naphthalenes	1034.87	1088.86	ND	ND
C3-naphthalenes	1299.18	1342.32	18.36	21.69
C4-naphthalenes	1116.89	1143.37	111.59	109.94
acenaphthylene	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND
fluorene	81.15	84.93	3.11	2.82
C1-fluorenes	272.77	296.07	59.72	54.22
C2-fluorenes	564.84	578.08	316.79	322.95
C3-fluorenes	657.98	669.09	679.42	630.27
phenanthrene	ND	ND	ND	ND
anthracene	340.10	339.25	144.84	143.33
C1-phenanthrenes/anthracenes	911.31	908.14	788.46	771.78
C2-phenanthrenes/anthracenes	1261.89	1242.35	1343.36	1303.22
C3-phenanthrenes/anthracenes	1003.58	905.14	1003.89	1093.66
C4-phenanthrenes/anthracenes	790.30	776.47	872.31	847.95
dibenzothiophene	272.29	279.07	89.33	85.31
C1-dibenzothiophenes	571.59	576.51	400.48	391.46
C2-dibenzothiophenes	1107.59	1112.02	1103.39	1074.80
C3-dibenzothiophenes	1058.39	1109.61	1169.62	1178.15
fluoranthene	4.16	ND	3.76	2.70
pyrene	12.03	12.48	12.87	12.55
C1-fluoranthenes/pyrenes	138.03	133.35	159.60	146.14
benzo(a)anthracene	6.52	8.88	11.27	9.87
chrysene	68.42	72.76	82.11	78.57
C1-chrysenes	147.24	160.04	176.05	171.94
C2-chrysenes	252.46	268.40	280.37	305.92
C3-chrysenes	192.45	186.74	213.45	205.26
C4-chrysenes	ND	ND	ND	ND
benzo(b)fluoranthene	6.95	7.80	8.30	9.29
benzo(k)fluoranthene	ND	ND	ND	ND
benzo(a)pyrene	ND	ND	ND	ND
indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
dibenzo(a,h)anthracene	ND	ND	ND	ND
benzo(g,h,i)perylene	4.61	4.60	5.32	4.83
Total PAH	13494.05	13643.84	9066.47	8986.01
C30a,B (Hopane)	290.79	302.22	344.39	357.29
Surrogate Recoveries				
d8-naphthalene	103	109	111	108
d10-fluorene	106	104	104	104
d12-chrysene	115	116	119	118

ND = Not Detected
NA = Non Applicable

Replicates 3 and 4 were run with DS, DSS, ES, ESS, FS and FSS.

APPENDIX D3, SECTION 5
Hopane Analyses

As part of the Quality Assurance and Quality Control of the Gas Chromatography of the oil samples in this program, artificially weathered Prudhoe Bay crude oil is run before and after each batch of samples. This weathered oil had been treated so as to have lost 30% of its initial weight by evaporation; since this was done under conditions equivalent to 521 F, the oil is known as 521 oil. A single sample of fresh Prudhoe Bay crude oil is also included in each run.

Table 1 lists the concentrations of hopane determined in these replicate samples, and the surrogate corrected data are shown graphically in Figures 1 and 2. The standard deviation of the measurements of hopane in the 521 oil is 12% of the mean, indicating acceptable reproducibility. As shown in Figure 1, the reproducibility within a given experimental series is very much better, and calculations were always based on the standards run with each batch of samples. One series of standards, batches 17 and 18, gave very high values, and these were excluded from the analysis. Calculations for this series of samples used the average hopane concentration of all the other standards.

The average of all the samples indicates that the 521 oil is 30.05% depleted in total hydrocarbon weight with respect to unweathered oil, which is in excellent agreement with the known depletion (30.33 % loss by weight). This marginal underestimate is probably attributable to a small loss of the most highly volatile components of Prudhoe Bay crude oil during handling. Table 1 and Figures 1 and 2 also include analyses of oil that has been artificially weathered under conditions equivalent to 600 F. The calculated depletion in hydrocarbon of 36% may be compared with that measured during evaporation (39.48%).

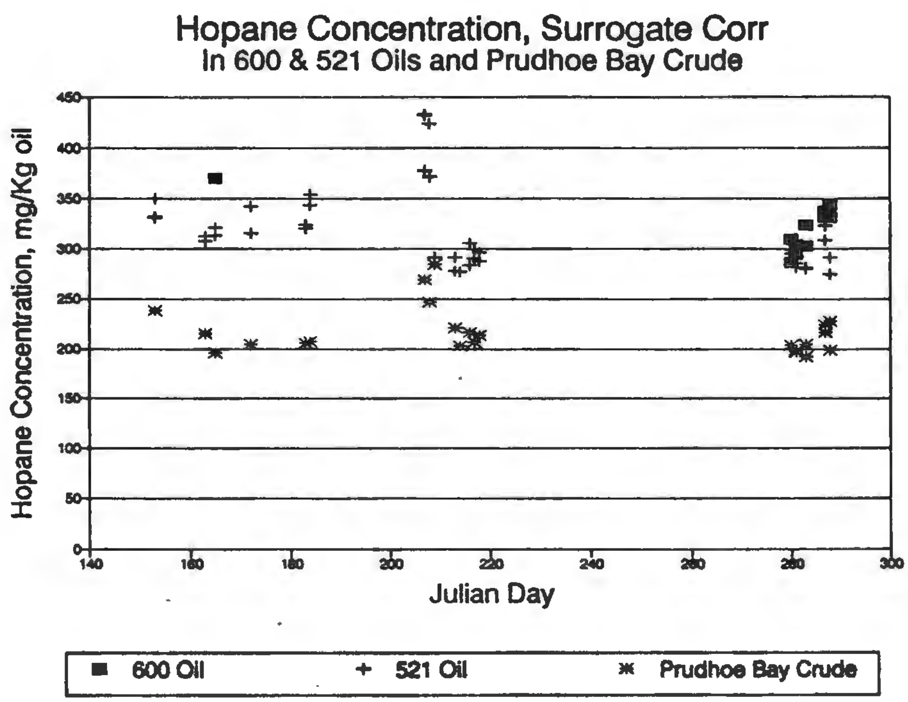
APPENDIX D3, SECTION 5, TABLE 1
Hopane Concentrations in Reference Oils

Beach	Day	Batch	Rep	D10% Rec	Raw [Hopane] 521 Oil	Surr corr [Hopane] 521 Oil	Raw [Hopane] PBC Oil	Surr corr [Hopane] PBC Oil	D10 % PBC	Raw [Hopane] 600 Oil	Surr corr [Hopane] 600 Oil	D10% 600 Oil
135	0	1	1	97	321.53	331.47423	233.25	238.0102	98			
135	0	1	2	94	328.35	349.30851						
211	0	3	1	105	322.72	307.35238	227.95	215.04717	106			
211	0	3	2	102	317.83	311.59804						
211	0	2	1	99	317.02	320.22222	209.19	195.50467	107	373.5	369.802	101
211	0	2	2	99	309.94	313.07071						
132	0	6	1	101	318.17	315.0198	199.88	203.95918	98			
132	0	6	2	101	345.63	342.20792						
135	32	15	1	101	322.58	319.38614	215.35	205.09524	105			
135	32	15	2	101	327.16	323.92079						
135	32	16	1	101	346.23	342.80198	227.43	206.75455	110			
135	32	16	2	100	353.43	353.43						
211	31	17	1	95	358.24	377.09474	244.83	269.04396	91			
211	31	17	2	93	402.30	432.58065						
211	31	18	1	93	345.82	371.84946	229.1	246.34409	93			
211	31	18	2	91	385.17	423.26374						
132	29	19	1	106	308.77	291.29245	230.24	284.24691	81			
135	70	21	1	112	310.89	277.58036	251.75	220.83333	114			
135	70	21	2	113	328.30	290.53097						
135	70	20	1	111	307.27	276.81982	224.93	202.63964	111			
135	70	20	2	108	299.04	276.88889						
132	60	22	1	110	311.53	283.20909	237.18	215.61818	110			
132	60	22	2	107	326.84	305.45794						
211	61	23	1	107	319.43	298.53271	225.15	206.55963	109			
211	61	23	2	105	304.74	290.22857						
211	61	24	1	111	328.30	295.76577	236.79	213.32432	111			
211	61	24	2	114	326.86	286.7193						
135	109	25	1	96	283.35	295.15625	211.9	203.75	104	292.13	286.402	102
135	109	25	2	97	289.58	298.53608	205.88	203.84158	101	314.86	308.6863	102
135	109	26	1	104	292.23	280.99038	202.26	198.29412	102	303.02	303.02	100
135	109	26	2	102	290.43	284.73529	201	197.05882	102	312.73	295.0283	106
132	95	27	1	103	287.76	279.37864	205.38	191.94393	107	314.71	302.6058	104
132	95	27	2	105	295.62	281.54286	213	204.80769	104	330.1	323.6275	102
211	97	28	1	105	323.66	308.24762	217.78	215.62376	101	353.76	336.9143	105
211	97	28	2	104	335.15	322.25962	233	224.03846	104	344.83	331.5673	104
211	97	29	1	106	290.79	274.33019	229.44	227.16832	101	344.39	331.1442	104
211	97	29	2	104	302.22	290.59615	210	198.11321	106	357.29	343.5481	104

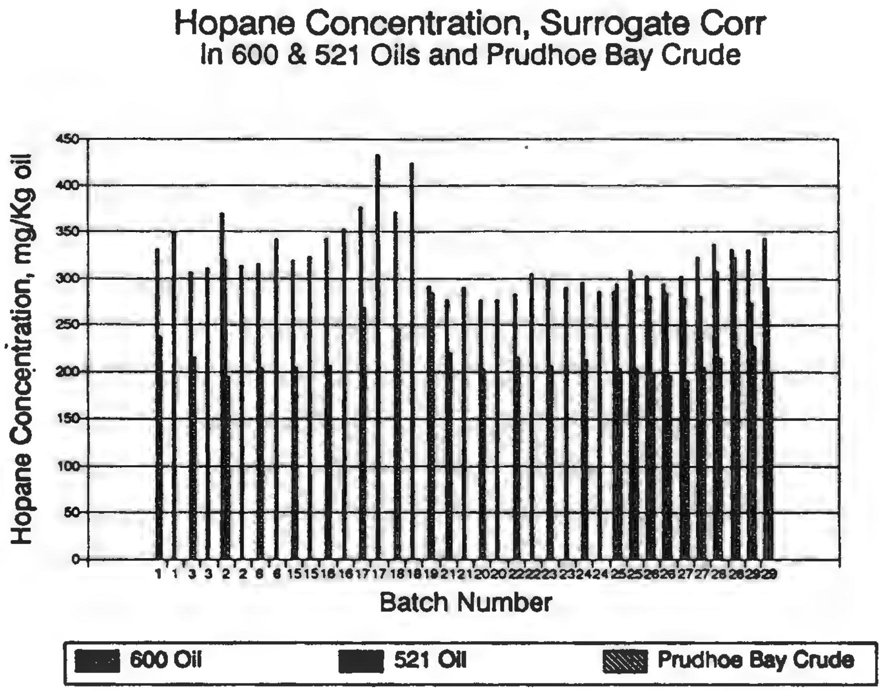
Note for batches 25+ the rep 2 for PBC was itself the average of two runs.

	Raw [Hopane] 521 Oil	Surr corr [Hopane] 521 Oil	Raw [Hopane] PBC Oil	Surr corr [Hopane] PBC Oil
Mean	321.213	314.14541	221.7775	216.15087
sd	25.53229	37.970938	14.095	22.47975
se	4.20	6.24	2.88	4.59
n=	37.00	37.00	24.00	24.00
Mean less batches 17,18	314.95	303.59	220.40	212.37

APPENDIX D3, SECTION 5, FIGURE 1
Hopane Concentrations in Reference Oils



APPENDIX D3, SECTION 5, FIGURE 2
Hopane Concentrations in Reference Oils



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APPENDIX D4.
Data Tables from Offshore Water Analyses

TABLE 1. Total Petroleum Hydrocarbon in Nearshore Water

TABLE 2. Fertilizer Nutrients in Nearshore Water

Section 1. Final Laboratory Report of the Toxicity Tests

APPENDIX D4, TABLE 1

TOTAL PETROLEUM HYDROCARBON IN NEARSHORE WATER

SAMPFID	type	BEACH		REP	DAY	DATE	TPH	TPHQ	UNITS
71TPH000009	SAMP	KN135	RR	1	0	19-MAY-90		ND	MG/L
71TPH000010	SAMP	KN135	RR	2	0	19-MAY-90	0.3		MG/L
71TPH000011	SAMP	KN135	RR	3	0	19-MAY-90		ND	MG/L
71TPH000012	SAMP	KN135	T	1	0	19-MAY-90		ND	MG/L
71TPH000013	SAMP	KN135	T	2	0	19-MAY-90		ND	MG/L
71TPH000014	SAMP	KN135	T	3	0	19-MAY-90		ND	MG/L
71TPH000015	SAMP	KN135	R	1	0	19-MAY-90		ND	MG/L
71TPH000016	SAMP	KN135	R	2	0	19-MAY-90		ND	MG/L
71TPH000017	SAMP	KN135	R	3	0	19-MAY-90		ND	MG/L
1455	MB							ND	MG/L
71TPH000018	SAMP	KN135	T	1	0	20-MAY-90		ND	MG/L
71TPH000019	SAMP	KN135	T	2	0	20-MAY-90		ND	MG/L
71TPH000020	SAMP	KN135	T	3	0	20-MAY-90		ND	MG/L
71TPH000021	SAMP	KN135	R	1	0	20-MAY-90	0.2		MG/L
71TPH000022	SAMP	KN135	R	2	0	20-MAY-90	0.25		MG/L
71TPH000023	SAMP	KN135	R	3	0	20-MAY-90		ND	MG/L
71TPH000024	SAMP	KN135	RR	1	0	20-MAY-90		ND	MG/L
71TPH000025	SAMP	KN135	RR	2	0	20-MAY-90		ND	MG/L
71TPH000026	SAMP	KN135	RR	3	0	20-MAY-90		ND	MG/L
1476	MB							ND	MG/L
71TPH000027	SAMP	KN135	T	1	2	23-MAY-90		ND	MG/L
71TPH000028	SAMP	KN135	T	2	2	23-MAY-90	0.21		MG/L
71TPH000029	SAMP	KN135	T	3	2	23-MAY-90	0.3		MG/L
71TPH000030	SAMP	KN135	R	1	2	23-MAY-90	0.24		MG/L
71TPH000031	SAMP	KN135	R	2	2	23-MAY-90		ND	MG/L
71TPH000032	SAMP	KN135	R	3	2	23-MAY-90	0.21		MG/L
71TPH000033	SAMP	KN135	RR	1	2	23-MAY-90		ND	MG/L
71TPH000034	SAMP	KN135	RR	2	2	23-MAY-90	0.4		MG/L
71TPH000035	SAMP	KN135	RR	3	2	23-MAY-90	0.41		MG/L
71TPH000036	DUP MSS)	KN135	T	NA	2	23-MAY-90	2.99		MG/L
71TPH000037MS	MSSD	KN135	T	NA	2	23-MAY-90	2.97		MG/L
71TPH000037SD	MSSD	KN135	T	NA	2	23-MAY-90		ND	MG/L
71TPH000038	FB	KN135	T	NA	2	23-MAY-90		ND	MG/L
1528	MB							ND	MG/L
71TPH000039	SAMP	KN135	T	1	4	25-MAY-90		ND	MG/L
71TPH000040	SAMP	KN135	T	2	4	25-MAY-90		ND	MG/L
71TPH000041	SAMP	KN135	T	3	4	25-MAY-90		ND	MG/L
71TPH000042	SAMP	KN135	R	1	4	25-MAY-90		ND	MG/L
71TPH000043	SAMP	KN135	R	2	4	25-MAY-90		ND	MG/L
71TPH000044	SAMP	KN135	R	3	4	25-MAY-90		ND	MG/L
71TPH000046	SAMP	KN135	RR	1	4	25-MAY-90		ND	MG/L
71TPH000047	SAMP	KN135	RR	2	4	25-MAY-90		ND	MG/L
71TPH000048	SAMP	KN135	RR	3	4	25-MAY-90		ND	MG/L
1563	MB							ND	MG/L
71TPH000050	SAMP	KN211	T	1	0	26-MAY-90		ND	MG/L
71TPH000051	SAMP	KN211	T	2	0	26-MAY-90		ND	MG/L
71TPH000052	SAMP	KN211	T	3	0	26-MAY-90		ND	MG/L
71TPH000053	SAMP	KN211	R	1	0	26-MAY-90		ND	MG/L
71TPH000054	SAMP	KN211	R	2	0	26-MAY-90		ND	MG/L
71TPH000055	SAMP	KN211	R	3	0	26-MAY-90		ND	MG/L
71TPH000056	DUP	KN211	R	NA	0	26-MAY-90		ND	MG/L
71TPH000057MS	MSSD	KN211	R	NA	0	26-MAY-90	2.49		MG/L
71TPH000057SD	MSSD	KN211	R	NA	0	26-MAY-90	1.98		MG/L
71TPH000058	SAMP	KN211	R	1	0	26-MAY-90		ND	MG/L
71TPH000059	SAMP	KN211	RR	2	0	26-MAY-90		ND	MG/L
71TPH000060	SAMP	KN211	RR	3	0	26-MAY-90		ND	MG/L
1574	MB							ND	MG/L
71TPH000062	SAMP	KN135	T	1	8	29-MAY-90		ND	MG/L
71TPH000063	SAMP	KN135	T	2	8	29-MAY-90		ND	MG/L
71TPH000064	SAMP	KN135	T	3	8	29-MAY-90		ND	MG/L
71TPH000065	SAMP	KN135	R	1	8	29-MAY-90		ND	MG/L

APPENDIX D4, TABLE 1 (continued)
TOTAL PETROLEUM HYDROCARBON IN NEARSHORE WATER

SAMPFID	type	BEACH		REP	DAY	DATE	TPH	TPHQ	UNITS
71TPH000066	SAMP	KN135	R	2	8	29-MAY-90		ND	MG/L
71TPH000067	SAMP	KN135	R	3	8	29-MAY-90		ND	MG/L
71TPH000068	SAMP	KN135	RR	1	8	29-MAY-90		ND	MG/L
71TPH000069	SAMP	KN135	RR	2	8	29-MAY-90		ND	MG/L
71TPH000070	SAMP	KN135	RR	3	8	29-MAY-90		ND	MG/L
1614	MB							ND	MG/L
71TPH000071	SAMP	KN132	T	1	0	31-MAY-90		ND	MG/L
71TPH000072	SAMP	KN132	T	2	0	31-MAY-90		ND	MG/L
71TPH000073	SAMP	KN132	T	3	0	31-MAY-90		ND	MG/L
71TPH000074	SAMP	KN132	R	1	0	31-MAY-90		ND	MG/L
71TPH000075	SAMP	KN132	R	2	0	31-MAY-90		ND	MG/L
71TPH000076	SAMP	KN132	R	3	0	31-MAY-90		ND	MG/L
71TPH000077	SAMP	KN132	RR	1	0	31-MAY-90		ND	MG/L
71TPH000078	SAMP	KN132	RR	2	0	31-MAY-90		ND	MG/L
71TPH000079	SAMP	KN132	RR	3	0	31-MAY-90		ND	MG/L
71TPH000080MS	MSSD	KN132	T	NA	0	31-MAY-90	2.73		MG/L
71TPH000080SD	MSSD	KN132	T	NA	0	31-MAY-90	2.39		MG/L
71TPH000081	DUP	KN132	T	NA	0	31-MAY-90		ND	MG/L
71TPH000082	FB	KN132	T	NA	0	31-MAY-90		ND	MG/L
1654	MB							ND	MG/L
71TPH000083	SAMP	KN211	T	1	4	03-JUN-90		ND	MG/L
71TPH000084	SAMP	KN211	T	2	4	03-JUN-90		ND	MG/L
71TPH000085	SAMP	KN211	T	3	4	03-JUN-90		ND	MG/L
71TPH000086	SAMP	KN211	R	1	4	03-JUN-90		ND	MG/L
71TPH000087	SAMP	KN211	R	2	4	03-JUN-90	0.24		MG/L
71TPH000088	SAMP	KN211	R	3	4	03-JUN-90		ND	MG/L
71TPH000089	SAMP	KN211	T	1	2	01-JUN-90		ND	MG/L
71TPH000090	SAMP	KN211	T	2	2	01-JUN-90		ND	MG/L
71TPH000091	SAMP	KN211	T	3	2	01-JUN-90	0.21		MG/L
71TPH000092	SAMP	KN211	R	1	2	01-JUN-90		ND	MG/L
71TPH000093	SAMP	KN211	R	2	2	01-JUN-90	0.23		MG/L
1680	MB							ND	MG/L
71TPH000094	SAMP	KN211	R	3	2	01-JUN-90		ND	MG/L
71TPH000095	SAMP	KN211	RR	1	2	01-JUN-90		ND	MG/L
71TPH000096	SAMP	KN211	RR	2	2	01-JUN-90		ND	MG/L
71TPH000097	SAMP	KN211	RR	3	2	01-JUN-90		ND	MG/L
71TPH000098	SAMP	KN211	RR	1	4	03-JUN-90		ND	MG/L
71TPH000099	SAMP	KN211	RR	2	4	03-JUN-90		ND	MG/L
71TPH000100	SAMP	KN211	RR	3	4	03-JUN-90		ND	MG/L
71TPH000101	DUP	KN211	T	NA	4	03-JUN-90		ND	MG/L
71TPH000102	FB	KN211	NA	NA	4	03-JUN-90		ND	MG/L
71TPH000103MS	MSSD	KN211	T	NA	4	03-JUN-90	3.12		MG/L
71TPH000103SD	MSSD	KN211	T	NA	4	03-JUN-90	3.32		MG/L
71TPH000104	SAMP	KN132	T	1	2	04-JUN-90	0.29		MG/L
71TPH000105	SAMP	KN132	T	2	2	04-JUN-90		ND	MG/L
71TPH000106	SAMP	KN132	T	3	2	04-JUN-90		ND	MG/L
71TPH000107	SAMP	KN132	RR	1	2	04-JUN-90		ND	MG/L
71TPH000108	SAMP	KN132	RR	2	2	04-JUN-90		ND	MG/L
71TPH000109	SAMP	KN132	R	3	2	04-JUN-90		ND	MG/L
71TPH000110	SAMP	KN132	RR	1	2	04-JUN-90		ND	MG/L
71TPH000111	SAMP	KN132	RR	2	2	04-JUN-90		ND	MG/L
71TPH000112	SAMP	KN132	RR	3	2	04-JUN-90		ND	MG/L
1688	MB							ND	MG/L
71TPH000113	SAMP	KN135	T	1	15	05-JUN-90	0.23		MG/L
71TPH000114	SAMP	KN135	T	2	15	05-JUN-90	0.23		MG/L
71TPH000115	SAMP	KN135	T	3	15	05-JUN-90		ND	MG/L
71TPH000116	SAMP	KN135	R	1	15	05-JUN-90		ND	MG/L
71TPH000117	SAMP	KN135	R	2	15	05-JUN-90		ND	MG/L
71TPH000118	SAMP	KN135	R	3	15	05-JUN-90		ND	MG/L
71TPH000119	SAMP	KN135	RR	1	15	05-JUN-90		ND	MG/L
71TPH000120	SAMP	KN135	RR	2	15	05-JUN-90		ND	MG/L
71TPH000121	SAMP	KN135	RR	3	15	05-JUN-90		ND	MG/L
71TPH000122	FB	KN135	T	NA	15	05-JUN-90		ND	MG/L
71TPH000123MS	MSSD	KN135	T	NA	15	05-JUN-90	2.73		MG/L
71TPH000123SD	MSSD	KN135	T	NA	15	05-JUN-90	2.62		MG/L
71TPH000124	SAMP	KN132	T	1	4	06-JUN-90		ND	MG/L

APPENDIX D4, TABLE 1 (continued)
TOTAL PETROLEUM HYDROCARBON IN NEARSHORE WATER

SAMPFID	type	BEACH		REP	DAY	DATE	TPH	TPHQ	UNITS
71TPH000125	SAMP	KN132	T	2	4	06-JUN-90		ND	MG/L
71TPH000126	SAMP	KN132	T	3	4	06-JUN-90		ND	MG/L
71TPH000127	SAMP	KN132	R	1	4	06-JUN-90		ND	MG/L
71TPH000128	SAMP	KN132	R	2	4	06-JUN-90		ND	MG/L
71TPH000129	SAMP	KN132	R	3	4	06-JUN-90		ND	MG/L
71TPH000130	SAMP	KN132	RR	1	4	06-JUN-90		ND	MG/L
71TPH000131	SAMP	KN132	RR	2	4	06-JUN-90		ND	MG/L
71TPH000132	SAMP	KN132	RR	3	4	06-JUN-90		ND	MG/L
71TPH000133	SAMP	KN211	T	1	8	07-JUN-90		ND	MG/L
71TPH000134	SAMP	KN211	T	2	8	07-JUN-90		ND	MG/L
71TPH000135	SAMP	KN211	T	3	8	07-JUN-90		ND	MG/L
71TPH000136	SAMP	KN211	R	1	8	07-JUN-90		ND	MG/L
71TPH000137	SAMP	KN211	R	2	8	07-JUN-90		ND	MG/L
71TPH000138	SAMP	KN211	R	3	8	07-JUN-90		ND	MG/L
71TPH000139	SAMP	KN211	RR	1	8	07-JUN-90		ND	MG/L
71TPH000140	SAMP	KN211	RR	2	8	07-JUN-90		ND	MG/L
71TPH000141	SAMP	KN211	RR	3	8	07-JUN-90		ND	MG/L
71TPH000142	DUP	KN211	R	1	8	07-JUN-90		ND	MG/L
71TPH000143MS	MSSD	KN211	R	1	8	07-JUN-90	2.44		MG/L
71TPH000143SD	MSSD	KN211	R	1	8	07-JUN-90	2.16		MG/L
71TPH000144	FB	KN211		NA	8	07-JUN-90			MG/L
1794	MB							ND	MG/L
71TPH000145	SAMP	KN132	T	1	8	10-JUN-90		ND	MG/L
71TPH000146	SAMP	KN132	T	2	8	10-JUN-90		ND	MG/L
71TPH000147	SAMP	KN132	T	3	8	10-JUN-90		ND	MG/L
71TPH000148	SAMP	KN132	R	1	8	10-JUN-90		ND	MG/L
71TPH000149	SAMP	KN132	R	2	8	10-JUN-90		ND	MG/L
71TPH000150	SAMP	KN132	R	3	8	10-JUN-90		ND	MG/L
71TPH000151	SAMP	KN132	RR	1	8	10-JUN-90		ND	MG/L
71TPH000152	SAMP	KN132	RR	2	8	10-JUN-90		ND	MG/L
71TPH000153	SAMP	KN132	RR	3	8	10-JUN-90		ND	MG/L
1795	MB							ND	MG/L
71TPH000154	SAMP	KN211	T	1	16	10-JUN-90		ND	MG/L
71TPH000155	SAMP	KN211	T	2	16	15-JUN-90		ND	MG/L
71TPH000156	SAMP	KN211	T	3	16	15-JUN-90		ND	MG/L
71TPH000157	SAMP	KN211	R	1	16	15-JUN-90		ND	MG/L
71TPH000158	SAMP	KN211	R	2	16	15-JUN-90		ND	MG/L
71TPH000159	SAMP	KN211	R	3	16	15-JUN-90		ND	MG/L
71TPH000160	SAMP	KN211	RR	1	16	15-JUN-90		ND	MG/L
71TPH000161	SAMP	KN211	RR	2	16	15-JUN-90		ND	MG/L
71TPH000162	SAMP	KN211	RR	3	16	15-JUN-90		ND	MG/L
1929	MB							ND	MG/L
71TPH000163	SAMP	KN132	T	1	16	18-JUN-90		ND	MG/L
71TPH000164	SAMP	KN132	T	2	16	18-JUN-90		ND	MG/L
71TPH000165	SAMP	KN132	T	3	16	18-JUN-90		ND	MG/L
71TPH000166	SAMP	KN132	R	1	16	18-JUN-90		ND	MG/L
71TPH000167	SAMP	KN132	R	2	16	18-JUN-90		ND	MG/L
71TPH000168	SAMP	KN132	R	3	16	18-JUN-90		ND	MG/L
71TPH000169	SAMP	KN132	RR	1	16	18-JUN-90		ND	MG/L
71TPH000170	SAMP	KN132	RR	2	16	18-JUN-90		ND	MG/L
71TPH000171	SAMP	KN132	RR	3	16	18-JUN-90		ND	MG/L
71TPH000172	DUP	KN132	T	1	16	18-JUN-90		ND	MG/L
71TPH000174MS	MSSD	KN132	T	1	16	18-JUN-90	2.89		MG/L
71TPH000174SD	MSSD	KN132	T	1	16	18-JUN-90	2.42		MG/L
71TPH000175	FB	KN132		NA	16	18-JUN-90		ND	MG/L
1958	MB							ND	MG/L
71TPH000185	SAMP	KN135	T	1	32	22-JUN-90		ND	MG/L
71TPH000186	SAMP	KN135	T	2	32	22-JUN-90		ND	MG/L
71TPH000187	SAMP	KN135	T	3	32	22-JUN-90		ND	MG/L
71TPH000188	SAMP	KN135	R	1	32	22-JUN-90		ND	MG/L
71TPH000189	SAMP	KN135	R	2	32	22-JUN-90		ND	MG/L
71TPH000190	SAMP	KN135	R	3	32	22-JUN-90		ND	MG/L
71TPH000191	SAMP	KN135	RR	1	32	22-JUN-90		ND	MG/L
71TPH000192	SAMP	KN135	RR	2	32	22-JUN-90		ND	MG/L
71TPH000193	SAMP	KN135	RR	3	32	22-JUN-90		ND	MG/L
2036	MB							ND	MG/L

APPENDIX D4, TABLE 1 (continued)
TOTAL PETROLEUM HYDROCARBON IN NEARSHORE WATER

SAMPFID	type	BEACH		REP	DAY	DATE	TPH	TPHQ	UNITS
71TPH000194	SAMP	KN211	T	1	31	30-JUN-90		ND	MG/L
71TPH000195	SAMP	KN211	T	2	31	30-JUN-90		ND	MG/L
71TPH000196	SAMP	KN211	T	3	31	30-JUN-90		ND	MG/L
71TPH000197	SAMP	KN211	R	1	31	30-JUN-90		ND	MG/L
71TPH000198	SAMP	KN211	R	2	31	30-JUN-90		ND	MG/L
71TPH000199	SAMP	KN211	R	3	31	30-JUN-90		ND	MG/L
71TPH000200	SAMP	KN211	RR	1	31	30-JUN-90		ND	MG/L
71TPH000201	SAMP	KN211	RR	2	31	30-JUN-90		ND	MG/L
71TPH000202	SAMP	KN211	RR	3	31	30-JUN-90		ND	MG/L
71TPH000203	DUP	KN211	T	1	31	30-JUN-90		ND	MG/L
71TPH000204MS	MSSD	KN211	T	1	31	30-JUN-90	2.89		MG/L
71TPH000204SD	MSSD	KN211	T	1	31	30-JUN-90	3.22		MG/L
71TPH000205	FB	KN211		NA	31	30-JUN-90		ND	MG/L
71TPH000206	SAMP	KN132	T	1	29	30-JUN-90		ND	MG/L
71TPH000207	SAMP	KN132	T	2	29	30-JUN-90		ND	MG/L
71TPH000208	SAMP	KN132	T	3	29	30-JUN-90	0.24		MG/L
71TPH000209	SAMP	KN132	R	1	29	30-JUN-90		ND	MG/L
71TPH000210	SAMP	KN132	R	2	29	30-JUN-90		ND	MG/L
71TPH000211	SAMP	KN132	R	3	29	30-JUN-90		ND	MG/L
71TPH000212	SAMP	KN132	RR	1	29	30-JUN-90		ND	MG/L
71TPH000213	SAMP	KN132	RR	2	29	30-JUN-90		ND	MG/L
71TPH000214	SAMP	KN132	RR	3	29	30-JUN-90		ND	MG/L
2211	MB							ND	MG/L

APPENDIX D4, TABLE 2

FERTILIZER NUTRIENTS IN NEARSHORE WATER

PRELIMINARY DATA

Bioremediation Monitoring Program

Nutrients are reported in uM (micro-moles per liter)

SAMPFID	BEACH	FERT/ UNFERT	TIME	DEPTH	NO3+NO2	NH4	PO4
71NSR000001	KN135	F	0 H	0.5 M	0.21	0.71	0.26
71NSR000005	KN135	F	1 H	0.5 M	0.25	0.45	0.14
71NSR000007	KN135	F	7 H	0.5 M	3.5	5	0.15
71NSR000008	KN135	F	19 H	0.5 M	6.33	7.79	0.32
71NSR000010	KN135	F	32 H	0.5 M	3.37	4	0.23
71NSR000011	KN135	F	57 H	0.5 M	10.37	16.89	0.48
71NSR000013	KN135	F	82 H	0.5 M	2.16	2.43	0.17
71NSR000014	KN135	F	1 H	0.5 M	0.26	0.7	0.09
71NSR000015	KN135	F	19 H	0.5 M	3.24	4.55	0.16
71NSR000016	KN135	F	32 H	0.5 M	2.55	3.27	0.15
71NSR000018	KN135	F	57 H	0.5 M	10.59	16.86	0.46
71NSR000019	KN135	F	82 H	0.5 M	6.23	7.48	0.43
71NSR000003	KN135	U	0 H	0.5 M	0.78	2.93	0.39
71NSR000009	KN135	U	19 H	0.5 M	0.4	0.84	
71NSR000012	KN135	U	57 H	0.5 M	0.41	0.87	0.15
71NSR000020	KN211	F	0 H	0.5 M	0.67	1.24	0.25
71NSR000022	KN211	F	0 H	0.5 M	0.22	1.11	0.21
71NSR000023	KN211	F	1 H	0.5 M	0.69	1.32	0.21
71NSR000024	KN211	F	7 H	0.5 M	26.39	34.98	1.74
71NSR000025	KN211	F	19 H	0.5 M	15.11	16.85	1.01
71NSR000027	KN211	F	32 H	0.5 M	2.7	3.27	0.36
71NSR000028	KN211	F	57 H	0.5 M	0.98	1.38	0.18
71NSR000029	KN211	F	19 H	0.5 M	17.52	19.74	1.14
71NSR000031	KN211	F	57 H	0.5 M	1.44	3.5	0.29
71NSR000032	KN211	F	82 H	0.5 M	1.29	0.8	0.12
71NSR000033	KN211	F	82 H	0.5 M	0.93	0.97	0.07
71NSR000021	KN211	U	0 H	0.5 M	0.12	0.28	0.19
71NSR000026	KN211	U	19 H	0.5 M	0.55	1.03	0.25
71NSR000030	KN211	U	57 H	0.5 M	1.02	1.44	0.27
71NSR000034	KN132	F	0 H	0.5 M	0.43	2.03	0.13
71NSR000036	KN132	F	0 H	0.5 M	0.31	1.16	0.12
71NSR000037	KN132	F	1 H	0.5 M	0.52	1.23	0.16
71NSR000038	KN132	F	7 H	0.5 M	0.39	0.91	0.15
71NSR000039	KN132	F	19 H	0.5 M	1.45	2.37	0.17
71NSR000041	KN132	F	19 H	0.5 M	1.58	1.39	0.17
71NSR000042	KN132	F	32 H	0.5 M	0.73	1.16	0.2
71NSR000043	KN132	F	32 H	0.5 M	0.32	0.82	0.16
71NSR000044	KN132	F	57 H	0.5 M	0.41	0.57	0.08
71NSR000045	KN132	F	57 H	0.5 M	0.11	0.7	0.07
71NSR000047	KN132	F	82 H	0.5 M	0.26	0.29	0.14
71NSR000048	KN132	F	82 H	0.5 M	0.27	0.37	0.14
71NSR000035	KN132	U	0 H	0.5 M	0.12	0.5	0.11
71NSR000040	KN132	U	19 H	0.5 M	0.23	1.23	0.12
71NSR000046	KN132	U	57 H	0.5 M	0.09	0.39	0.04

RESULTS OF AQUATIC BIOASSAYS ON WATER SAMPLES TAKEN AT VARYING TIMES OFF TREATED AND CONTROL BEACH AREAS IN PRINCE WILLIAM SOUND

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July 5, 1990

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1.0
INTRODUCTION

The EPA and Exxon Corporation are currently evaluating the potential for bioremediation of oiled beaches in Prince William Sound resulting from the Exxon Valdez Oil Spill of 1989. MEC Analytical Systems was requested by the EPA to conduct aquatic bioassays on water samples taken at varying times off treated and control beach areas. The bioassays were performed using the mysid shrimp, *Mysidopsis bahia* in a four day acute toxicity test. This species was selected due to its previously documented sensitivity to the test chemicals. The following report presents the results of those studies.

The studies were conducted at the MEC Analytical Systems Bioassay Laboratory in Tiburon, California. The project was managed by Dr. Kurt Kline.

2.0
METHODS

2.1 TEST PROTOCOLS

Maintenance of and procedures for *Mysidopsis bahia* are described in EPA (1985). The test was static with no renewals of the test solutions.

2.2 TEST SOLUTION PREPARATION

Water samples from site KN - 135 were received at MEC on May 23 through 26, 1990 (Appendix Table 1). Water samples from site KN - 211 were received at MEC laboratories on May 31 through June 4, 1990 (Appendix Table 1). Water samples from site KN - 132 were received at MEC laboratories on June 4 through June 8, 1990 (Appendix Table 1). Two gallons of each sample were received each day. Samples were delivered in coolers at 4°C and were maintained in refrigeration at 4°C until used.

The diluent used for this study was laboratory seawater (from San Francisco Bay) which had been filtered at 50 and 5 μm and UV-sterilized. The concentrations of the test site water samples used were 6.25, 12.5, 25, 50, and 100%. The control sites were tested at 100% only.

2.3 SUMMARY OF BIOASSAY TEST PROCEDURES

2.3.1 *Mysidopsis bahia* Testing

Mysid shrimp less than fourteen days old were used for testing. The test animals were obtained from Aquatox, Hot Springs, AK. The test was carried out in 250 ml beakers containing 200 ml of test solution and ten shrimp per beaker. Three replicates were run for each treatment (concentration). The shrimp were fed 0.1 ml of an *Artemia* nauplii suspension (340-350 nauplii per 0.1 ml) two times daily during testing. Water quality measurements were made at the end of each 24-hour exposure for the four day duration of testing as well as on freshly made test solutions on Day 0. Testing was conducted at 20 ± 2°C with a photoperiod of fourteen hours light and ten hours dark. Initial total ammonia was measured on the 100% concentration only on Day 0 and that data is presented in Appendix Table 1.

2.3.2 Criteria for Test Acceptability

The criteria used to determine test acceptability was the following:

Mysidopsis bahia

1. Control survival to exceed 80%

2.4 DATA ANALYSIS

At the conclusion of all tests a statistical evaluation of test species survival of *Mysidopsis* was performed using Dunnett's test (ANOVA) with Bonferroni's adjustment if necessary. The effect on mortality was considered to be a statistically significant difference ($P < 0.05$) between the mean values for the test organisms and the mean values for control organisms at the end of the test (EPA, 1985).

The No Observed Effect Concentration (NOEC) is the highest exposure where no adverse effects were observed. The Lowest Observed Effect Concentration (LOEC) is the lowest exposure where statistically significant effects on the test species were observed. The Maximum Allowable Toxic Concentration (MATC) is the geometric mean of the NOEC and the LOEC. The lowest NOEC values of the two tested effects is reported as the NOEC for the test.

3.0 RESULTS

Tables 1 to 3 summarize the results of the bioassays. Tables 4, 5, and 6 present the test conditions. Appendix Tables 2 through 4 summarize the water quality data. Appendix Tables 5 through 7 show the complete toxicity testing results.

3.1 KN - 135 RESULTS

Water quality parameters in all of the tests were acceptable. Dissolved oxygen was well above 40% saturation (3.3 mg/L at 25°C) and salinity was maintained at 30 ± 2 ppt. Total ammonia ranged from 0.17 to 0.47 ppm for the control sites and from 0.21 to 0.88 for the test sites. No significant toxicity was found in any water samples during this test period (Table 1).

3.2 KN - 211 RESULTS

Water quality parameters in all of the tests were acceptable. Dissolved oxygen was well above 40% saturation (3.3 mg/L at 25°C) and salinity was maintained at 30 ± 2 ppt. Total ammonia ranged between 0.11 and 0.56 ppm for the test sites, and 0.10 and 0.44 ppm at the control sites. No significant toxicity was found in any water samples during this test period (Table 2).

3.3 KN - 132 RESULTS

Water quality parameters in all of the tests were acceptable. Dissolved oxygen was well above 40% saturation (3.3 mg/L at 25°C) and salinity was maintained at 30 ± 2 ppt. Total ammonia ranged between 0.13 and 0.58 ppm for the controls, and 0.17 and 0.56 ppm at the test sites. No significant toxicity was found except in the 100% concentration of the pretreatment sample (Table 3).

TABLE 1

SUMMARY OF RESULTS
SITE KN - 135

Concentration (%)	Percent Mortality At Test Hours: Pretreatment	1 Hour	7 Hour	19 Hour	32 Hour	57 Hour	82 Hour
Laboratory Control	3.3	3.3	3.3	6.7	6.7	6.7	3.3
6.25	3.3	0.0	13.3	3.3	3.3	10.0	3.3
12.5	0.0	6.7	3.3	10.0	3.3	6.7	3.3
25	6.7	0.0	3.3	10.0	10.0	3.3	3.3
50	0.0	3.3	10.0	6.7	3.3	6.7	0.0
100	0.0	10.0	10.0	0.0	6.7	0.0	0.0
LC50	> 100%	> 100%	> 100%	> 100%	> 100%	> 100%	> 100%
NOEC	100%	100%	100%	100%	100%	100%	100%

Concentration (%)	Percent Mortality for Control Hours: Pretreatment	19 Hours	57 Hours
Laboratory Control	3.3	6.7	6.7
Site Control	0.0	3.3	6.7
NOEC	100%	100%	100%

NOEC: No Observable Effects Concentration.

TABLE 2

SUMMARY OF RESULTS
SITE KN - 211

Concentration (%)	Pretreatment	1 Hour	7 Hour	19 Hour	32 Hour	57 Hour	82 Hour
	Percent Mortality At Test Hours						
Laboratory Control	0.0	0.0	0.0	0.0	0.0	3.3	3.3
6.25	3.3	3.3	3.3	3.3	6.7	0.0	0.0
12.5	3.3	5.0	3.3	3.3	0.0	3.3	6.7
25	0.0	3.3	10.0	3.3	3.3	0.0	3.3
50	0.0	6.7	10.0	6.7	6.7	0.0	3.3
100	3.3	10.0	3.3	3.3	3.3	6.7	6.7
LC50	> 100%	> 100%	> 100%	> 100%	> 100%	> 100%	> 100%
NOEC	100%	100%	100%	100%	100%	100%	100%

Concentration (%)	Pretreatment	19 hours	57 hours
	Percent Mortality for Control Hours		
Laboratory Control	0.0	0.0	3.3
Site Control	10.0	0.0	3.3
NOEC	100%	100%	100%

NOEC: No Observable Effects Concentration.

TABLE 3

SUMMARY OF RESULTS
SITE KN - 132

Concentration (%)	Percent Mortality At Test Hours						
	Pretreatment	1 Hour	7 Hour	19 Hour	32 Hour	57 Hour	82 Hour
Laboratory Control	0.0	0.0	0.0	0.0	6.7	0.0	0.0
6.25	6.7	6.7	0.0	3.3	3.3	0.0	3.3
12.5	3.3	0.0	0.0	3.3	3.3	13.3	6.7
25	0.0	3.3	3.3	6.7	0.0	6.7	0.0
50	3.3	3.3	3.3	3.3	3.3	13.3	3.3
100	16.7*	10.0	6.7	6.7	3.3	3.3	3.3
LC50	> 100%	> 100%	> 100%	> 100%	> 100%	> 100%	> 100%
NOEC	50%	100%	100%	100%	100%	100%	100%

Concentration (%)	Percent Mortality for Control Hours		
	Pretreatment	19 Hours	57 Hours
Laboratory Control	0.0	0.0	0.0
Site Control	0.0	0.0	3.3
NOEC	100%	100%	100%

* Significant statistical difference.
NOEC: No Observable Effects Concentration.

TABLE 4

KN - 135
SUMMARY OF TEST CONDITIONS
FOR THE MYSID SHRIMP
Mysidopsis bahia

Parameter	Data
Test type	Static Renewal (Acute)
Duration	4 days
Test Photoperiod	14 hour light: 10 hour dark
Start Date	5/23/90, 5/24/90, 5/25/90, 5/26/90
Completion Date	5/27/90, 5/28/90, 5/29/90, 5/30/90
Control water	30 ± 2 ppt San Francisco Bay seawater
Test Temperature	20 ± 2°C
Organisms per container	10
Test chamber/Exposure volume	250 ml beaker/200 ml
Number of Test Containers	3 per concentration
Sample Storage Conditions	4°C in the dark
Organism	
Test Species	*Mysidopsis bahia*
Source	Aquatox, Hot Springs, AK
Date Acquired	5/18/90, 5/25/90
Age	5-10 days
Diet	Newly hatched *Artemia* nauplii (0.1 ml twice daily)

TABLE 5

KN - 211
SUMMARY OF TEST CONDITIONS
FOR THE MYSID SHRIMP
Mysidopsis bahia

Parameter	Data
Test type	Static Renewal (Acute)
Duration	4 days
Test Photoperiod	14 hour light: 10 hour dark
Start Date	5/31/90, 6/1/90, 6/2/90, 6/3/90, 6/4/90
Completion Date	6/4/90, 6/5/90, 6/6/90, 6/6/90, 6/8/90
Control water	30 ± 2 ppt San Francisco Bay seawater
Test Temperature	20 ± 2°C
Organisms per container	10
Test chamber/Exposure volume	250 ml beaker/200 ml
Number of Replicates	3 per concentration
Sample Storage Conditions	4°C in the dark
Organism	
Test Species	*Mysidopsis bahia*
Source	Aquatox, Hot Springs, AK
Date Acquired	5/25/90, 5/30/90
Age	6-7 days old
Diet	Newly hatched *Artemia* nauplii (0.1 ml, twice daily)

TABLE 6

KN - 132
SUMMARY OF TEST CONDITIONS
FOR THE MYSID SHRIMP
Mysidopsis bahia

Parameter	Data
Test type	Static Renewal (Acute)
Duration	4 days
Test Photoperiod	14 hour light: 10 hour dark
Start Date	6/4/90, 6/5/90, 6/6/90, 6/8/90
Completion Date	6/8/90, 6/9/90, 6/10/90, 6/12/90
Control water	30 ± 2 ppt San Francisco Bay seawater
Test Temperature	20 ± 1°C
Organisms per container	10
Test chamber/Exposure volume	250 ml beaker/200 ml
Number of Replicates	3 per concentration
Sample Storage Conditions	4°C in the dark
Organism	
Test Species	*Mysidopsis bahia*
Source	Aquatox, Hot Springs, AK
Date Acquired	5/30/90, 6/7/90
Age	6-7 days old
Diet	Newly hatched *Artemia* nauplii (0.1 ml twice daily)

4.0 REFERENCES

EPA. 1985. Methods for measuring the acute toxicity of effluents to freshwater and marine organisms, third edition. Peltier, W.H. and C.I. Weber, eds. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH, EPA/600/4-85/013.

APPENDIX A

ANALYTICAL DATA

APPENDIX TABLE 1

SAMPLE IDENTIFICATIONS AND INITIAL AMMONIA CONCENTRATIONS

Date Received	Sample Designation	Total Ammonia mg/L	Sample Description	Date Sampled
SITE KN - 135				
5/23/90	Control 1	0.47	KN135R - 0 Hour	5/21/90
5/23/90	Test 1	0.71	KN135T - 0 Hour	5/21/90
5/23/90	Test 2	0.79	KN135T - 1 Hour	5/21/90
5/23/90	Test 3	0.88	KN135T - 7 Hour	5/22/90
5/24/90	Control 2	0.17	KN135R - 19 Hour	5/22/90
5/24/90	Test 4	0.22	KN135T - 19 Hour	5/23/90
5/24/90	Test 5	0.21	KN135T - 32 Hour	5/23/90
5/25/90	Control 3	0.43	KN135R - 57 Hour	5/24/90
5/25/90	Test 6	0.46	KN135T - 57 Hour	5/24/90
5/26/90	Test 7	0.28	KN135T - 82 Hour	5/25/90
SITE KN - 211				
5/31/90	Control 1	0.10	KN211R - 0 Hours	5/30/90
5/31/90	Test 1	0.11	KN211T - 0 Hours	5/30/90
5/31/90	Test 2	0.15	KN211T - 1 Hours	5/30/90
6/1/90	Test 3	0.48	KN211T - 7 Hours	5/30/90
6/2/90	Control 2	0.29	KN211R - 19 Hours	5/31/90
6/2/90	Test 4	0.16	KN211T - 19 Hours	5/31/90
6/3/90	Test 5	0.14	KN211T - 32 Hours	5/31/90
6/4/90	Control 3	0.44	KN211R - 57 Hours	6/2/90
6/4/90	Test 6	0.56	KN211T - 57 Hours	6/2/90
6/4/90	Test 7	0.55	KN211T - 82 Hours	6/3/90
SITE KN - 132				
6/4/90	Control 1	0.36	KN132R - 0 hour	6/2/90
6/4/90	Control 2	0.58	KN132R - 19 Hour	6/3/90
6/4/90	Test 1	0.56	KN132T - 0 Hour	6/2/90
6/4/90	Test 2	0.40	KN132T - 1 Hour	6/2/90
6/4/90	Test 3	0.44	KN132T - 7 Hour	6/2/90
6/4/90	Test 4	0.49	KN132T - 19 Hour	6/3/90
6/5/90	Test 5	0.29	KN132T - 32 Hour	6/4/90
6/6/90	Control 3	0.13	KN132R - 57 Hour	6/5/90
6/6/90	Test 6	0.17	KN132T - 57 Hour	6/5/90
6/8/90	Test 7	0.20	KN132T - 82 Hour	6/6/90

APPENDIX TABLE 2

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
Site KN - 135

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
Laboratory	1	21.1	6.9	7.69	28	18.0	6.9	7.79	30	18.5	5.7	7.81	30	19.2	5.8	7.79	30	21.2	4.7	7.83	30
Control	2	21.9	6.8	7.74		18.0	6.9	7.80		18.5	5.6	7.87		19.1	5.8	7.81		21.2	4.6	7.84	
	3	21.4	6.8	7.76		18.0	6.8	7.81		18.5	5.5	7.89		18.9	5.5	7.80		21.2	4.6	7.84	
Pretreatment	1	21.1	10.2	8.26	31	18.0	7.0	8.04	30	18.5	5.4	7.98	30	18.8	5.5	7.79	30	21.0	4.2	7.74	30
Control	2	21.0	10.2	8.27		18.0	7.1	8.05		18.5	5.3	7.99		18.7	5.5	7.79		21.0	4.2	7.76	
	3	19.9	10.2	8.28		18.0	7.1	8.09		18.5	5.7	8.07		18.3	5.7	7.87		21.0	4.2	7.80	
Pretreatment Test																					
6.25	1	21.9	6.6	7.83	30	18.0	6.8	7.89	30	18.8	4.6	7.85	30	19.3	4.9	7.81	30	21.2	4.5	7.81	30
	2	22.0	6.8	7.83		18.0	6.8	7.90		18.8	4.8	7.90		19.2	4.4	7.79		21.2	4.4	7.83	
	3	21.5	6.7	7.83		18.3	6.8	7.89		18.9	4.6	7.82		19.1	4.4	7.80		21.3	4.4	7.82	
12.5	1	22.0	7.0	7.87	29	18.8	6.7	7.87	30	19.0	4.2	7.77	30	19.0	4.8	7.81	30	21.3	4.3	7.79	30
	2	22.0	6.9	7.88		18.8	6.7	7.86		18.9	4.2	7.77		19.0	4.7	7.79		21.2	4.2	7.80	
	3	22.0	7.1	7.88		19.0	6.7	7.88		18.8	4.4	7.82		19.0	5.1	7.85		21.1	4.2	7.85	
25	1	21.9	7.3	7.94	28	18.2	6.7	7.94	30	18.8	4.6	7.83	30	19.2	4.9	7.84	30	21.0	4.5	7.85	30
	2	22.0	7.3	7.94		18.2	6.8	7.95		18.6	4.2	7.80		19.1	4.9	7.80		21.1	4.4	7.81	
	3	21.9	7.5	7.94		18.5	6.8	7.95		18.8	4.5	7.85		19.0	4.7	7.81		21.2	4.2	7.80	
50	1	21.0	8.1	8.07	28	18.7	6.8	7.96	30	18.8	4.7	7.86	30	18.9	4.9	7.82	30	21.1	4.2	7.81	30
	2	21.6	8.2	8.07		18.9	6.9	7.98		18.8	4.2	7.81		18.8	4.7	7.79		21.1	4.2	7.80	
	3	21.1	8.2	8.08		18.9	6.9	7.97		18.6	4.4	7.82		18.8	4.8	7.83		20.9	4.2	7.81	
100	1	21.0	9.7	8.30	29	18.3	7.0	8.08	30	18.8	4.7	7.85	31	19.0	5.2	7.83	30	21.0	4.2	7.82	30
	2	21.2	9.8	8.30		18.2	7.0	8.12		18.8	5.0	7.97		19.0	5.1	7.85		21.1	4.3	7.85	
	3	21.0	9.7	8.31		18.2	7.0	8.09		18.9	4.7	7.92		18.9	5.1	7.86		21.1	4.3	7.83	
Min		19.9	6.6	7.69	28	18.0	6.7	7.79	30	18.5	4.2	7.77	30	18.3	4.4	7.79	30	20.9	4.2	7.74	30
Max		22.0	10.2	8.31	31	19.0	7.1	8.12	30	19.0	5.7	8.07	31	19.3	5.8	7.87	30	21.3	4.7	7.85	30

APPENDIX TABLE 2 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
Site KN - 135

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
1 Hour Test																					
6.25	1	21.0	7.1	7.83	30	18.2	6.6	7.92	30	18.8	5.0	7.87	30	18.9	5.3	7.88	30	21.3	4.3	7.83	30
	2	21.1	7.0	7.83		18.1	6.6	7.87		18.8	5.2	7.88		18.9	5.1	7.86		21.2	4.3	7.84	
	3	21.1	7.0	7.83		18.0	6.5	7.86		18.9	5.7	7.93		18.9	5.2	7.89		21.1	4.4	7.86	
12.5	1	20.9	7.0	7.88	28	18.1	6.5	7.88	30	18.8	5.8	7.97	30	18.8	5.3	7.90	30	21.1	4.5	7.90	30
	2	21.0	6.9	7.89		18.4	6.4	7.91		18.6	5.1	7.91		18.7	5.3	7.85		21.0	4.6	7.89	
	3	20.9	7.0	7.89		18.7	6.5	7.92		18.5	5.4	7.91		18.6	5.2	7.88		21.0	4.6	7.86	
25	1	21.8	7.2	7.95	28	18.0	6.7	7.95	30	18.8	4.9	7.86	30	19.0	5.3	7.87	30	21.2	4.7	7.84	30
	2	21.5	7.5	7.96		18.1	6.7	7.95		18.7	4.8	7.87		18.9	5.2	7.84		21.3	4.7	7.82	
	3	21.6	7.6	7.96		18.1	6.8	7.96		18.7	5.8	7.93		18.9	5.1	7.87		21.2	4.7	7.80	
50	1	22.0	8.0	8.08	30	18.3	6.9	8.00	30	18.6	5.2	7.92	30	18.9	5.1	7.81	30	21.2	4.3	7.78	30
	2	21.3	8.2	8.08		18.4	6.9	8.00		18.7	5.5	7.93		18.7	4.8	7.83		21.1	4.3	7.80	
	3	21.5	8.1	8.09		18.6	6.9	8.00		18.5	5.4	7.93		18.5	4.9	7.85		21.1	4.2	7.81	
100	1	21.8	9.9	8.30	30	18.0	7.1	8.13	30	18.9	4.5	7.91	31	19.0	5.2	7.85	30	21.1	4.7	7.80	30
	2	21.5	10.0	8.32		18.0	7.1	8.12		18.8	4.3	7.85		18.9	4.7	7.82		21.2	4.5	7.79	
	3	21.7	10.2	8.32		18.1	7.1	8.11		18.6	4.4	7.84		18.8	4.7	7.81		21.0	4.2	7.77	
Min		20.9	6.9	7.83	28	18.0	6.4	7.86	30	18.5	4.3	7.84	30	18.5	4.7	7.81	30	21.0	4.2	7.77	30
Max		22.0	10.2	8.32	30	18.7	7.1	8.13	30	18.9	5.8	7.97	31	19.0	5.3	7.90	30	21.3	4.7	7.90	30

APPENDIX TABLE 2 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
Site KN - 135

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
7 Hour Test																					
6.25	1	21.1	7.0	7.86	29	18.0	6.2	7.89	30	19.0	4.5	7.86	30	19.0	5.2	7.89	30	21.2	4.5	7.78	30
	2	21.4	7.0	7.85		18.0	6.2	7.90		18.9	5.4	7.89		19.0	5.2	7.90		21.2	4.2	7.78	
	3	21.0	6.9	7.85		18.0	6.3	7.91		18.8	5.8	7.94		19.0	5.5	7.95		21.1	4.3	7.82	
12.5	1	20.9	7.0	7.86	30	18.1	6.5	7.92	30	18.8	4.9	7.81	30	18.9	5.6	7.93	30	21.1	4.4	7.87	30
	2	20.2	7.0	7.88		18.1	6.5	7.91		18.7	4.3	7.80		18.8	4.6	7.82		21.1	4.5	7.85	
	3	21.0	7.0	7.88		18.2	6.5	7.90		18.6	4.9	7.82		18.5	5.3	7.86		21.0	4.5	7.85	
25	1	21.5	7.2	7.93	28	18.0	6.8	7.95	30	19.0	5.4	7.78	30	19.2	5.7	7.91	30	21.0	4.5	7.87	30
	2	21.5	7.3	7.94		18.0	6.8	7.94		18.9	5.3	7.81		19.2	5.1	7.88		21.2	4.6	7.86	
	3	21.6	7.3	7.93		18.0	6.8	7.95		18.7	5.4	7.86		19.1	5.1	7.90		21.2	4.7	7.86	
50	1	20.9	7.5	8.05	28	18.1	6.8	7.97	29	18.9	5.4	7.84	29	19.0	5.4	7.91	29	21.1	4.7	7.87	NT
	2	21.0	7.5	8.05		18.3	6.9	7.97		18.7	5.4	7.80		18.9	5.5	7.90		21.0	4.7	7.86	
	3	21.0	7.7	8.05		18.8	6.8	7.97		18.8	4.5	7.88		18.9	5.4	7.89		21.0	4.6	7.86	
100	1	21.1	9.2	8.28	30	18.0	6.9	8.06	29	19.0	5.2	7.85	28	19.1	5.5	7.85	28	21.1	4.7	7.82	NT
	2	21.2	9.5	8.29		18.0	6.9	8.07		18.8	4.4	7.83		19.1	4.8	7.79		21.2	4.7	7.80	
	3	21.1	9.5	8.29		18.0	6.8	8.07		18.6	4.9	7.84		19.1	4.8	7.79		21.2	4.5	7.78	
Min		20.2	6.9	7.85	28	18.0	6.2	7.89	29	18.6	4.3	7.78	28	18.5	4.6	7.79	28	21.0	4.2	7.78	30
Max		21.6	9.5	8.29	30	18.8	6.9	8.07	30	19.0	5.8	7.94	30	19.2	5.7	7.95	30	21.2	4.7	7.87	30

APPENDIX TABLE 2 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
Site KN - 135

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
Laboratory	1	20.1	7.6	7.82	30	19.5	5.4	7.89	30	20.0	5.0	7.85	30	21.7	5.0	7.91	30	20.1	4.6	7.87	30
Control	2					19.7	4.8	7.84		20.0	5.2	7.87		21.7	5.0	7.90		20.1	4.4	7.87	
	3					19.5	4.3	7.80		19.8	5.3	7.88		21.7	5.1	7.90		20.1	4.1	7.85	
19 Hour	1	19.3	9.8	8.39	28	19.8	5.8	8.04	26	20.0	5.4	7.91	26	21.9	5.2	7.86	28	20.5	4.5	7.73	28
Control	2					19.8	5.7	8.03		20.0	5.4	7.89		22.0	5.3	7.88		20.5	4.2	7.73	
	3					19.6	6.1	8.10		19.8	5.8	7.93		22.0	5.3	7.91		20.5	4.8	7.84	
19 Hour Test																					
6.25	1	19.6	7.9	7.96	30	19.5	6.3	8.01	30	19.9	6.0	7.99	30	21.5	5.5	8.08	30	20.2	5.7	8.10	30
	2					19.5	5.8	7.97		19.9	6.0	7.98		21.6	5.5	8.04		20.3	4.9	8.00	
	3					19.6	5.5	7.92		19.8	6.0	7.99		21.7	5.6	8.04		20.2	4.9	8.00	
12.5	1	19.0	8.0	7.98	29	19.8	5.5	7.91	29	19.9	6.1	7.98	30	21.7	5.6	8.00	29	20.5	4.5	7.95	30
	2					19.7	5.3	7.92		19.9	6.0	7.97		21.8	5.6	7.98		20.5	4.1	7.88	
	3					19.8	5.3	7.92		20.0	6.0	7.97		21.8	5.7	7.99		20.4	4.2	7.91	
25	1	18.0	8.0	8.04	28	19.6	5.1	7.87	28	19.9	5.4	7.91	29	21.7	5.2	7.96	29	20.3	4.6	7.92	30
	2					19.8	5.2	7.88		20.0	5.4	7.91		22.0	5.2	7.91		20.2	4.4	7.79	
	3					19.8	5.4	7.90		20.0	5.4	7.91		22.0	5.2	7.91		20.4	4.4	7.84	
50	1	18.7	8.4	8.15	28	19.9	5.7	7.97	28	20.0	5.4	7.94	28	21.9	5.2	7.92	28	20.4	4.2	7.80	30
	2					20.0	5.4	7.91		20.0	5.6	7.89		21.9	5.3	7.89		20.4	3.9	7.78	
	3					19.8	5.1	7.87		19.9	5.5	7.90		22.0	5.3	7.90		20.3	4.1	7.86	
100	1	18.6	9.9	8.40	28	19.8	4.8	7.87	27	19.8	5.5	7.87	27	21.9	5.3	7.87	28	20.5	4.2	7.82	28
	2					19.5	4.3	7.80		20.0	4.8	7.77		21.9	5.0	7.84		20.5	3.9	7.73	
	3					19.8	4.4	7.90		20.1	5.1	7.83		22.0	5.0	7.81		20.6	3.7	7.72	
Min		18.0	7.6	7.82	28	19.5	4.3	7.80	26	19.8	4.8	7.77	26	21.5	5.0	7.81	28	20.1	3.7	7.72	28
Max		20.1	9.9	8.40	30	20.0	6.3	8.10	30	20.1	6.1	7.99	30	22.0	5.7	8.08	30	20.6	5.7	8.10	30

APPENDIX TABLE 2 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
Site KN - 135

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
32 Hour Test																					
6.25	1	19.7	7.8	8.00	29	19.8	5.7	7.91	29	19.8	5.9	7.94	30	21.8	5.6	8.00	30	20.5	4.3	7.88	30
	2					19.6	5.6	7.89		20.0	5.7	7.94		21.9	5.5	7.98		20.5	4.0	7.82	
	3					19.5	5.6	7.89		20.0	5.6	7.92		22.0	5.5	7.96		20.5	4.2	7.82	
12.5	1	19.1	8.0	8.01	29	19.7	5.3	7.85	29	20.0	5.5	7.90	30	22.0	5.5	7.95	30	20.5	4.2	7.83	30
	2					19.7	5.9	7.93		20.0	5.7	7.95		22.0	5.6	7.95		20.5	4.4	7.85	
	3					19.6	6.3	8.01		19.8	6.0	7.98		22.0	5.6	7.97		20.4	4.2	7.89	
25	1	18.3	8.4	8.06	29	19.7	5.8	7.93	29	19.8	6.2	7.96	30	22.0	5.6	7.96	30	20.6	4.1	7.85	30
	2					19.7	5.5	7.89		20.0	5.6	7.91		22.0	5.5	7.92		20.6	4.0	7.78	
	3					19.8	5.7	7.93		20.0	5.6	7.93		22.0	5.5	7.93		20.5	4.1	7.82	
50	1	19.6	9.0	8.15	29	19.5	5.6	7.92	29	20.0	5.4	7.89	29	22.0	5.2	7.89	29	20.4	4.4	7.86	30
	2					19.6	5.5	7.93		19.8	5.5	7.92		22.0	5.2	7.92		20.2	4.3	7.80	
	3					19.7	5.7	7.97		19.8	5.9	7.94		22.6	5.3	7.94		20.2	4.6	7.92	
100	1	18.9	9.9	8.38	30	19.8	6.1	8.05	28	19.9	5.6	7.92	28	21.9	5.4	7.92	28	20.3	4.6	7.84	30
	2					19.7	5.8	8.03		20.0	5.5	7.92		21.9	5.3	7.92		20.3	4.3	7.81	
	3					19.8	5.9	8.05		20.0	5.5	7.93		22.0	5.2	7.93		20.2	4.0	7.80	
Min		18.3	7.8	8.00	29	19.5	5.3	7.85	28	19.8	5.4	7.89	28	21.8	5.2	7.89	28	20.2	4.0	7.78	30
Max		19.7	9.9	8.38	30	19.8	6.3	8.05	29	20.0	6.2	7.98	30	22.6	5.6	8.00	30	20.6	4.6	7.92	30

APPENDIX TABLE 2 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
Site KN - 135

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
Laboratory	1	21.0	7.4	7.93	30	18.9	6.1	7.99	30	21.0	6.0	7.93	30	19.0	5.7	7.98	30	18.7	5.2	7.88	30
Control	2					18.9	6.2	8.02		21.0	6.1	7.95		19.1	5.0	7.92		18.7	5.6	7.94	
	3					18.8	5.5	7.94		21.0	5.8	7.93		19.1	4.3	7.84		18.5	5.1	7.88	
57 Hour	1	18.1	9.5	8.23	30	18.7	6.3	8.11	28	21.2	6.0	7.91	29	19.1	4.1	7.69	30	18.5	5.1	7.77	29
Control	2					18.3	6.4	8.12		21.3	6.0	7.92		19.2	4.2	7.72		18.5	5.2	7.80	
	3					18.0	6.4	8.09		21.2	6.0	7.91		19.0	4.2	7.77		18.2	4.9	7.83	
57 Hour Test																					
6.25	1	21.0	7.7	7.61	30	19.0	6.5	8.06	30	21.2	6.0	7.86	30	19.2	5.1	7.89	30	19.0	5.5	7.84	30
	2					19.0	6.5	8.05		21.3	6.2	7.86		19.2	4.9	7.87		18.8	5.3	7.88	
	3					19.0	6.4	8.06		21.3	6.2	7.89		19.3	5.0	7.96		18.8	5.5	8.00	
12.5	1	20.5	7.8	7.76	30	18.8	6.5	8.06	29	21.1	6.1	7.89	29	19.3	5.0	7.92	30	18.8	5.3	7.95	30
	2					18.8	6.5	8.03		21.0	6.0	7.87		19.1	5.1	7.87		18.6	5.4	7.93	
	3					18.3	6.9	8.09		21.0	6.2	7.89		19.0	4.9	7.86		18.5	5.0	7.90	
25	1	19.5	8.1	7.90	30	18.9	5.3	7.96	29	21.1	6.0	7.76	29	19.2	4.3	7.79	30	18.8	5.5	7.95	30
	2					19.0	5.4	7.97		21.1	5.9	7.74		19.1	3.7	7.70		18.8	4.5	7.82	
	3					19.0	5.6	7.99		21.1	5.5	7.73		19.2	3.8	7.69		18.8	4.7	7.84	
50	1	19.0	8.5	7.98	30	18.7	6.5	8.08	28	21.0	5.9	7.76	29	19.2	3.8	7.70	30	18.5	5.0	7.88	30
	2					18.5	5.6	7.95		21.0	5.6	7.74		19.2	3.9	7.69		18.5	4.8	7.86	
	3					18.1	6.1	8.01		21.0	5.8	7.74		19.0	4.3	7.73		18.4	5.2	7.90	
100	1	18.5	9.8	8.16	30	18.8	6.1	8.06	28	21.1	5.8	7.77	29	19.1	4.2	7.71	30	18.9	5.8	7.91	30
	2					18.8	6.1	8.12		21.2	5.8	7.81		19.1	4.1	7.71		18.8	5.1	7.89	
	3					18.7	6.2	8.10		21.1	5.8	7.82		19.1	4.1	7.68		18.6	5.3	7.87	
Min		18.1	7.4	7.61	30	18.0	5.3	7.94	28	21.0	5.5	7.73	29	19.0	3.7	7.68	30	18.2	4.5	7.77	29
Max		21.0	9.8	8.23	30	19.0	6.9	8.12	30	21.3	6.2	7.95	30	19.3	5.7	7.98	30	19.0	5.8	8.00	30

APPENDIX TABLE 2 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
Site KN - 135

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
Laboratory	1	21.3	7.8	7.83	30	21.2	6.3	8.05	30	20.1	5.8	7.85	30	18.5	5.4	7.96	31	20.2	5.5	7.82	31
Control	2					21.3	6.2	8.04		20.0	5.3	7.86		18.5	5.6	8.00		20.4	5.0	7.86	
	3					21.3	6.2	8.04		20.0	5.1	7.87		18.7	5.3	7.96		20.6	4.7	7.81	
82 Hour Test																					
6.25	1	21.0	7.9	7.86	30	21.2	6.4	8.04	30	20.0	5.1	7.86	30	18.8	5.9	8.01	31	20.2	5.2	7.66	31
	2					21.2	6.3	8.05		20.0	5.0	7.86		18.8	5.5	7.97		20.4	4.3	7.74	
	3					21.2	6.2	8.07		19.9	4.9	7.84		18.6	5.5	7.94		20.5	3.9	7.73	
12.5	1	20.3	7.9	7.90	30	21.3	6.2	8.04	30	19.8	4.9	7.81	30	18.6	4.7	7.87	31	20.5	4.0	7.70	31
	2					21.1	6.1	8.04		19.8	4.8	7.83		18.5	5.4	7.93		20.2	4.5	7.76	
	3					21.0	6.1	8.04		20.0	4.9	7.82		18.5	5.5	7.95		20.2	4.6	7.79	
25	1	21.3	8.1	7.94	30	21.3	6.1	8.07	30	20.0	5.0	7.83	30	18.8	5.0	7.87	31	20.2	4.1	7.73	31
	2					21.2	6.0	8.06		20.0	4.3	7.76		18.7	4.2	7.78		20.2	3.4	7.68	
	3					21.2	6.0	8.05		20.0	4.0	7.68		18.8	3.8	7.74		20.5	3.4	7.65	
50	1	22.0	8.3	8.01	30	21.1	5.7	8.05	30	19.6	4.4	7.81	30	18.7	4.0	7.77	30	20.5	3.5	7.64	31
	2					21.2	5.6	8.03		19.6	4.7	7.75		18.6	4.5	7.79		20.2	3.6	7.66	
	3					21.2	5.6	8.04		19.8	4.8	7.83		18.6	5.0	7.84		20.2	4.0	7.68	
100	1	21.1	8.9	8.16	30	21.0	5.7	8.15	30	20.0	4.4	7.78	30	18.5	4.0	7.68	30	20.1	4.3	7.64	30
	2					21.0	5.8	8.17		20.0	5.0	7.90		18.6	5.6	7.91		20.2	5.5	7.79	
	3					21.0	5.8	8.20		20.0	5.1	7.92		18.5	5.4	7.88		20.5	5.4	7.77	
Min		20.3	7.8	7.83	30	21.0	5.6	8.03	30	19.6	4.0	7.68	30	18.5	3.8	7.68	30	20.1	3.4	7.64	30
Max		22.0	8.9	8.16	30	21.3	6.4	8.20	30	20.1	5.8	7.92	30	18.8	5.9	8.01	31	20.6	5.5	7.86	31

APPENDIX TABLE 3

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 211

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
Laboratory	1	20.4	7.9	7.72	30	21.0	7.0	7.99	30	20.7	5.9	7.87	30	21.1	5.2	7.86	30	20.5	5.3	7.86	30
Control	2					20.8	7.1	7.99		20.8	5.8	7.89		21.0	4.6	7.78		20.9	4.8	7.78	
	3					20.6	7.1	7.97		20.8	5.8	7.90		20.6	5.4	7.85		20.8	4.8	7.79	
Pretreatment	1	18.7	9.5	8.22	30	20.8	7.0	8.16	30	20.6	5.9	7.90	30	21.6	2.4	7.59	30	20.4	4.8	7.61	30
Control	2					20.5	7.2	8.17		20.6	5.8	7.91		21.3	2.7	7.53		20.6	4.1	7.66	
	3					20.0	7.3	8.14		20.6	5.5	7.91		20.9	4.8	7.73		20.6	4.4	7.72	
Pretreatment Test																					
6.25	1	20.0	7.9	7.92	30	20.9	6.5	7.90	30	20.8	5.5	7.82	30	21.1	5.8	7.90	30	21.0	6.1	7.82	30
	2					20.9	6.7	7.93		20.8	5.3	7.80		21.0	5.3	7.84		21.0	6.1	7.73	
	3					20.8	6.8	7.97		20.8	5.3	7.81		21.0	5.5	7.88		21.0	6.0	7.72	
12.5	1	19.9	7.8	7.91	30	20.6	7.0	7.99	30	20.7	5.2	7.84	30	20.9	5.6	7.91	30	21.0	6.0	7.77	30
	2					20.6	7.0	7.99		20.7	5.2	7.81		20.6	5.2	7.86		21.0	5.9	7.76	
	3					20.5	6.8	7.97		20.7	5.2	7.87		20.9	5.3	7.86		20.9	5.9	7.22	
25	1	19.2	8.0	7.98	30	21.0	7.0	8.00	30	20.9	5.4	7.95	30	21.8	5.6	7.94	30	20.6	6.0	7.93	30
	2					20.9	7.1	8.01		20.9	5.5	7.99		21.8	5.9	7.98		20.7	6.1	7.98	
	3					20.9	7.1	8.03		20.9	5.6	7.97		21.7	5.4	7.92		20.8	5.5	7.90	
50	1	18.2	8.5	8.10	30	20.8	7.1	8.06	30	20.8	5.9	7.96	30	21.7	5.4	7.88	30	20.7	5.0	7.87	30
	2					20.8	7.2	8.08		20.8	5.9	7.95		21.5	5.1	7.85		20.6	5.6	7.71	
	3					20.6	7.2	8.07		20.8	5.9	7.93		21.0	5.6	7.89		20.6	5.6	7.83	
100	1	18.1	8.6	8.27	30	21.0	7.2	8.13	30	21.0	5.8	7.94	30	21.1	5.2	7.86	30	20.9	5.7	7.85	30
	2					20.9	7.1	8.13		21.0	5.7	7.96		21.2	5.2	7.85		20.8	5.9	7.82	
	3					20.9	7.1	8.12		20.9	5.6	7.96		21.2	5.4	7.89		20.7	5.6	7.82	
Min		18.1	7.8	7.72	30	20.0	6.5	7.90	30	20.6	5.2	7.80	30	20.6	2.4	7.53	30	20.4	4.1	7.22	30
Max		20.4	9.5	8.27	30	21.0	7.3	8.17	30	21.0	5.9	7.99	30	21.8	5.9	7.98	30	21.0	6.1	7.98	30

APPEN..X TABLE 3 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 211

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
1 Hour Test																					
6.25	1	20.2	7.9	7.96	30	20.9	7.0	8.01	30	20.9	5.5	7.91	30	21.5	5.5	7.89	30	20.5	6.0	7.97	30
	2					20.9	7.1	8.00		20.9	5.4	7.90		21.6	5.3	7.86		20.5	5.3	7.88	
	3					20.9	6.9	7.99		20.9	5.3	7.89		21.6	4.6	7.79		20.5	5.3	7.85	
12.5	1	19.9	7.9	7.98	30	21.0	6.8	7.99	30	20.9	5.3	7.89	30	21.0	5.3	7.93	30	20.9	5.4	7.90	30
	2					20.8	7.2	8.01		20.9	5.2	7.92		21.2	5.5	7.93		21.0	5.6	7.91	
	3					20.8	7.0	8.00		20.9	5.3	7.92		21.1	5.4	7.88		21.0	5.5	7.90	
25	1	19.2	8.1	8.04	30	20.9	7.1	8.02	30	20.9	5.4	7.88	30	21.0	5.3	7.83	30	20.9	5.5	7.86	30
	2					20.9	7.0	8.03		20.9	5.4	7.84		21.0	5.4	7.86		20.8	6.4	7.91	
	3					20.8	7.1	8.05		20.9	5.4	7.84		20.6	5.3	7.86		20.2	5.6	7.90	
50	1	18.0	8.8	8.20	30	21.0	7.2	8.10	30	20.8	5.2	7.86	30	21.2	5.4	7.88	30	20.5	5.0	7.83	30
	2					20.9	7.3	8.10		20.7	5.1	7.91		21.3	4.9	7.85		20.5	5.3	7.86	
	3					20.9	7.2	8.10		20.7	5.1	7.90		21.5	4.8	7.79		20.5	5.3	7.86	
100	1	18.2	10.7	8.41	30	20.9	7.3	8.20	30	20.7	5.2	7.86	30	21.4	4.4	7.74	30	20.3	5.3	7.79	30
	2					20.8	7.2	8.21		20.6	5.2	7.90		21.4	4.7	7.81		20.2	5.4	7.84	
	3					20.6	7.2	8.21		20.6	5.2	7.90		21.0	5.3	7.82		20.0	5.7	7.89	
Min		18.0	7.9	7.96	30	20.6	6.8	7.99	30	20.6	5.1	7.84	30	20.6	4.4	7.74	30	20.0	5.0	7.79	30
Max		20.2	10.7	8.41	30	21.0	7.3	8.21	30	20.9	5.5	7.92	30	21.6	5.5	7.93	30	21.0	6.4	7.97	30

APPENDIX TABLE 3 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 211

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
7 Hour Test																					
6.25	1	18.1	8.0	7.71	30	21.1	7.1	8.01	30	20.7	5.4	7.93	30	21.1	5.5	7.89	30	20.9	5.9	7.98	30
	2					21.1	7.2	8.00		20.7	5.4	7.92		21.0	5.4	7.90		20.8	4.8	7.94	
	3					20.9	7.1	8.02		20.6	5.5	7.93		21.0	5.6	7.93		20.8	4.5	7.98	
12.5	1	20.0	8.2	7.86	30	20.9	6.9	8.03	30	20.6	5.6	7.94	30	21.0	5.5	7.94	30	20.6	4.6	7.96	30
	2					20.8	7.0	8.04		20.6	5.5	7.92		21.0	5.7	7.96		20.5	4.6	7.97	
	3					20.6	7.1	8.04		20.6	5.5	7.90		20.6	5.8	7.95		20.5	4.7	7.96	
25	1	19.0	8.6	7.98	30	21.0	7.1	8.03	30	20.8	5.7	7.97	30	21.5	5.4	7.90	30	20.2	6.0	7.95	30
	2					21.0	7.2	8.04		20.8	5.9	7.97		21.5	5.3	7.86		20.5	6.1	7.89	
	3					20.9	7.0	8.04		20.8	5.9	7.96		21.4	5.2	7.82		20.3	5.7	7.89	
50	1	22.0	9.0	8.07	30	21.0	7.0	8.09	30	20.8	5.9	7.93	30	21.4	5.0	7.81	30	20.4	5.6	7.89	30
	2					20.9	7.0	8.08		20.8	5.9	7.89		21.3	4.8	7.88		20.2	4.3	7.92	
	3					20.9	7.1	8.09		20.7	5.8	7.85		21.1	5.0	7.81		20.0	5.0	7.91	
100	1	19.0	10.6	8.37	30	21.2	7.3	8.17	30	20.9	5.8	7.98	30	20.7	5.6	7.92	30	20.5	5.5	7.95	30
	2					21.2	7.2	8.16		20.9	5.7	7.97		20.9	5.7	7.88		20.2	5.4	7.94	
	3					21.0	7.3	8.17		20.9	5.7	7.94		21.1	5.3	7.85		20.3	5.3	7.92	
Min		18.1	8.0	7.71	30	20.6	6.9	8.00	30	20.6	5.4	7.85	30	20.6	4.8	7.81	30	20.0	4.3	7.89	30
Max		22.0	10.6	8.37	30	21.2	7.3	8.17	30	20.9	5.9	7.98	30	21.5	5.8	7.96	30	20.9	6.1	7.98	30

APPEN...X TABLE 3 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 211

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
Laboratory	1	19.1	8.0	7.87	31	21.8	6.2	7.98	30	22.0	5.5	7.92	30	21.2	5.7	7.90	30	21.4	6.0	7.97	30
Control	2					21.8	6.1	7.97		22.0	5.2	7.89		21.2	5.4	7.86		21.8	4.3	7.76	
	3					21.8	6.1	7.95		22.1	5.3	7.91		21.3	5.6	7.92		21.8	5.0	7.88	
19 Hour	1	18.3	8.9	8.24	30	21.7	6.0	7.93	30	21.8	4.3	7.82	30	21.5	5.7	7.82	30	21.4	4.0	7.70	30
Control	2					21.7	6.1	7.94		21.7	4.3	7.77		21.3	5.4	7.78		21.5	4.1	7.70	
	3					21.6	6.1	7.99		21.8	4.5	7.78		21.2	5.6	7.83		21.2	4.9	7.82	
19 Hour Test																					
6.25	1	18.8	8.0	7.88	30	21.7	6.0	7.95	30	21.7	5.2	7.90	30	21.5	6.2	7.80	29	21.7	5.8	8.00	30
	2					21.6	6.0	7.94		21.7	5.2	7.88		21.5	6.3	7.87		21.7	5.9	8.02	
	3					21.7	6.0	7.94		21.6	5.3	7.94		21.4	6.3	7.88		21.7	5.7	7.99	
12.5	1	18.7	8.1	7.90	30	21.6	5.9	7.96	30	21.7	5.0	7.84	30	21.4	5.5	7.83	29	21.4	5.2	7.89	30
	2					21.3	5.8	7.94		21.7	4.8	7.86		21.2	5.4	7.81		21.4	5.3	7.91	
	3					21.2	5.8	7.95		21.5	5.1	7.91		21.2	5.7	7.86		21.2	5.0	7.88	
25	1	18.3	8.1	7.96	30	21.5	5.8	7.95	30	22.1	5.1	7.89	30	21.2	6.0	7.89	29	21.9	5.6	7.96	30
	2					21.6	5.8	7.97		22.1	5.1	7.89		21.1	5.9	7.90		21.9	5.2	7.92	
	3					21.6	5.9	7.95		22.0	5.1	7.82		21.1	5.9	7.88		21.8	5.5	7.95	
50	1	18.0	8.2	8.05	30	21.6	5.7	7.92	30	22.0	5.1	7.88	30	21.0	6.1	7.89	30	21.4	5.5	7.94	30
	2					21.4	5.8	7.94		22.0	5.4	7.96		21.0	6.3	7.96		21.5	5.6	7.97	
	3					21.3	5.7	7.93		21.9	5.7	7.99		20.6	6.4	7.95		21.4	5.9	8.02	
100	1	18.1	8.7	8.21	30	21.3	5.7	8.05	30	21.8	5.5	7.98	30	21.5	6.0	7.91	30	21.8	5.8	7.96	30
	2					21.4	5.7	8.09		21.9	5.5	7.99		21.8	6.0	7.93		21.8	5.5	7.95	
	3					21.4	5.7	8.12		21.9	5.6	8.00		21.6	6.1	7.95		21.8	5.7	8.00	
Min		18.0	8.0	7.87	30	21.2	5.7	7.92	30	21.5	4.3	7.77	30	20.6	5.4	7.78	29	21.2	4.0	7.70	30
Max		19.1	8.9	8.24	31	21.8	6.2	8.12	30	22.1	5.7	8.00	30	21.8	6.4	7.96	30	21.9	6.0	8.02	30

APPENDIX TABLE 3 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 211

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
Laboratory	1	20.0	7.4	7.84	29	21.5	6.6	8.06	30	21.5	6.6	8.06	30	21.4	6.1	7.86	30	20.0	4.8	7.67	30
Control	2					22.0	6.5	8.05		21.2	6.7	8.06		21.3	6.0	7.98		20.0	4.7	7.78	
	3					22.0	6.6	8.06		21.2	6.7	8.08		21.3	6.0	8.00		20.0	4.8	7.81	
32 Hour Test																					
6.25	1	19.0	7.5	7.97	29	22.0	6.4	8.06	30	21.2	6.5	8.05	28	21.6	5.5	7.98	30	20.1	3.9	7.77	30
	2					22.0	6.4	8.06		21.2	6.4	8.03		21.5	4.6	7.87		20.0	3.8	7.71	
	3					22.1	6.4	8.06		21.2	6.3	8.05		21.6	5.2	7.94		20.0	4.1	7.74	
12.5	1	19.8	7.6	8.00	30	22.0	6.4	8.08	30	21.0	6.5	8.03	29	21.4	5.7	8.00	30	20.1	4.0	7.80	30
	2					22.0	6.4	8.07		21.0	6.4	8.02		21.4	5.6	7.97		19.9	4.9	7.78	
	3					21.9	6.5	8.06		21.0	6.4	8.01		21.4	5.5	7.97		20.0	4.6	7.79	
25	1	19.2	7.9	8.06	31	21.6	6.6	8.07	30	21.6	6.3	8.02	28	21.7	5.5	7.97	30	20.1	4.3	7.78	30
	2					21.6	6.5	8.08		21.7	6.3	7.99		21.6	5.5	7.96		19.9	4.2	7.80	
	3					21.6	6.4	8.08		21.7	6.3	8.00		21.6	5.8	7.99		19.9	4.3	7.80	
50	1	18.5	8.3	8.20	31	21.9	6.4	8.12	30	21.6	6.3	8.00	30	21.4	5.0	7.87	30	20.1	4.0	7.74	30
	2					21.7	6.3	8.12		21.4	6.5	8.03		21.3	5.9	8.01		19.9	4.3	7.80	
	3					21.6	6.5	8.12		21.3	6.5	8.05		21.3	6.0	8.04		19.9	4.5	7.84	
100	1	18.9	9.0	8.34	32	21.8	6.4	8.13	30	21.2	6.6	8.04	30	21.4	6.1	8.06	30	19.8	4.4	7.86	30
	2					21.7	6.5	8.17		21.1	6.6	8.05		21.4	6.1	8.07		19.8	4.9	7.88	
	3					21.8	6.5	8.18		21.2	6.5	8.09		21.4	6.3	8.10		19.9	4.9	7.86	
Min		18.5	7.5	7.97	29	21.6	6.3	8.06	30	21.0	6.3	7.99	28	21.3	4.6	7.87	30	19.8	3.8	7.71	30
Max		19.8	9.0	8.34	32	22.1	6.6	8.18	30	21.7	6.6	8.09	30	21.7	6.3	8.10	30	20.1	4.9	7.88	30

APPENDIX TABLE 3 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 211

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
Laboratory Control	1	18.0	7.4	7.83	30	21.2	6.5	7.99	29	21.3	6.1	8.01	30	20.2	4.4	7.80	30	20.6	3.4	7.75	30
	2					21.1	6.6	7.96		21.2	5.9	7.99		20.2	4.3	7.82		20.7	3.5	7.77	
	3					21.0	6.6	7.98		21.3	5.7	7.98		20.3	4.0	7.75		20.7	3.5	7.75	
57 Hour Control	1	18.3	10.0	8.30	30	21.0	6.8	8.18	29	21.2	6.0	8.05	30	20.5	4.3	7.81	30	20.6	3.0	7.67	30
	2					20.8	6.8	8.18		21.2	5.8	8.03		20.6	4.1	7.79		20.8	3.1	7.63	
	3					20.6	6.7	8.18		21.1	5.8	8.05		20.7	4.7	7.86		20.7	3.1	7.71	
57 Hour Test 6.25	1	18.0	7.9	7.93	30	21.0	6.6	7.88	28	21.3	5.9	7.97	30	20.5	4.2	7.84	30	20.7	4.1	7.80	30
	2					21.0	6.6	7.96		21.4	6.0	7.99		20.5	4.1	7.71		20.5	4.1	7.80	
	3					21.0	6.7	7.97		21.3	6.2	8.02		20.6	4.1	7.77		20.6	3.8	7.79	
12.5	1	18.0	7.7	7.94	30	20.9	7.0	8.02	28	21.3	6.0	8.02	30	20.6	4.5	7.89	30	20.9	3.4	7.78	30
	2					20.6	7.0	8.06		21.3	5.8	8.01		20.5	4.8	7.96		20.8	3.4	7.83	
	3					20.3	6.4	8.00		21.0	5.8	8.02		20.5	4.6	7.92		20.7	3.4	7.83	
25	1	18.0	7.9	8.01	30	21.5	6.3	8.03	28	21.5	6.2	8.02	30	20.4	4.1	7.84	29	20.7	3.1	7.75	30
	2					21.5	6.7	8.02		21.7	5.9	7.99		20.4	3.9	7.80		20.6	2.8	7.69	
	3					21.4	6.7	8.05		21.5	5.9	8.02		20.5	4.1	7.85		20.7	2.8	7.70	
50	1	18.0	8.5	8.11	30	21.3	6.9	8.12	29	21.2	6.3	8.09	30	20.5	4.1	7.88	29	20.8	2.9	7.70	30
	2					21.0	7.0	8.08		21.3	5.9	8.00		20.5	4.5	7.85		20.8	3.1	7.71	
	3					21.0	6.9	8.10		21.1	6.1	8.09		20.5	4.3	7.90		20.7	3.0	7.74	
100	1	22.0	9.6	8.25	30	21.0	6.9	8.15	29	21.5	5.4	7.96	30	20.4	4.4	7.67	29	20.9	3.2	7.64	30
	2					21.0	6.7	8.12		21.7	5.6	8.00		20.3	4.6	7.87		20.7	2.5	7.62	
	3					21.0	6.7	8.17		21.6	5.8	8.04		20.3	5.1	7.93		20.5	2.7	7.66	
Min		18.0	7.4	7.83	30	20.3	6.3	7.88	28	21.0	5.4	7.96	30	20.2	3.9	7.67	29	20.5	2.5	7.62	30
Max		22.0	10.0	8.30	30	21.5	7.0	8.18	29	21.7	6.3	8.09	30	20.7	5.1	7.96	30	20.9	4.1	7.83	30

APPENDIX TABLE 3 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 211

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
82 Hour Test																					
6.25	1	19.0	7.9	8.02	30	21.5	7.0	8.09	29	21.4	6.2	8.07	30	20.7	3.8	7.80	30	20.9	3.5	7.76	30
	2					21.5	6.4	8.06		21.5	6.0	8.04		20.7	4.2	7.88		20.9	3.3	7.78	
	3					21.5	6.7	8.08		21.4	6.1	8.07		20.8	4.3	7.85		20.6	3.4	7.78	
12.5	1	18.2	8.0	8.04	30	21.2	6.7	8.08	29	21.3	5.2	7.96	30	20.6	3.8	7.78	30	20.5	3.5	7.72	30
	2					21.2	7.0	8.11		21.3	6.3	8.12		20.6	4.6	7.95		20.6	3.3	7.83	
	3					21.0	6.9	8.09		21.0	6.1	8.06		20.6	4.7	7.89		20.7	3.4	7.77	
25	1	18.0	8.1	8.11	30	21.7	6.6	8.07	29	21.4	6.0	8.03	30	20.6	3.6	7.74	30	20.8	3.6	7.78	30
	2					21.2	6.9	8.12		21.4	6.2	8.10		20.6	3.8	7.78		20.8	3.6	7.80	
	3					21.0	6.8	8.11		21.4	6.2	8.07		20.6	3.3	7.77		20.9	3.2	7.74	
50	1	18.0	8.2	8.21	30	21.0	6.8	8.14	28	21.3	6.1	8.07	30	20.3	3.6	7.74	30	20.8	3.3	7.69	30
	2					21.1	7.1	8.18		21.3	6.0	8.09		20.3	3.9	7.80		20.7	3.4	7.71	
	3					20.6	7.2	8.17		21.1	6.1	8.12		20.3	4.0	7.88		20.6	3.4	7.76	
100	1	18.0	10.0	8.34	31	21.5	7.0	8.23	29	21.4	4.9	7.95	30	20.2	3.0	7.61	30	20.6	3.7	7.74	30
	2					21.5	7.0	8.22		21.3	5.4	8.05		20.2	3.6	7.76		20.7	4.2	7.78	
	3					21.4	7.0	8.24		21.3	5.5	8.05		20.3	4.5	7.83		20.9	3.9	7.74	
Min		18.0	7.9	8.02	30	20.6	6.4	8.06	28	21.0	4.9	7.95	30	20.2	3.0	7.61	30	20.5	3.2	7.69	30
Max		19.0	10.0	8.34	31	21.7	7.2	8.24	29	21.5	6.3	8.12	30	20.8	4.7	7.95	30	20.9	4.2	7.83	30

APPENDIX TABLE 4

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
Laboratory	1	18.7	7.6	7.76	30	21.5	6.5	8.04	29	21.3	6.2	7.99	30	21.3	3.7	7.65	30	20.8	3.0	7.48	31
Control	2					21.5	6.6	8.01		21.2	6.5	8.01		21.3	3.9	7.80		20.7	3.0	7.59	
	3					21.5	6.6	8.00		21.3	6.3	7.99		21.3	3.8	7.76		20.5	3.3	7.58	
Pretreatment	1	18.5	9.4	8.31	27	22.0	6.6	8.22	28	21.3	6.1	8.05	29	21.1	3.1	7.61	29	20.5	3.3	7.54	30
Control	2					21.4	6.7	8.22		21.1	6.1	8.04		21.0	3.3	7.60		20.8	3.3	7.50	
	3					20.9	6.8	8.20		21.0	6.3	8.02		21.0	4.1	7.79		20.7	3.3	7.57	
19 Hour	1	18.0	9.5	8.33	27	21.6	6.6	8.19	28	20.9	6.2	7.98	29	20.9	4.1	7.68	29	20.5	3.5	7.60	30
Control	2					21.5	6.6	8.18		21.0	6.2	7.98		20.9	3.5	7.57		20.5	3.0	7.52	
	3					21.3	6.7	8.19		21.0	6.1	8.00		20.8	3.5	7.61		20.5	3.2	7.54	
Min		18.0	7.6	7.76	27	20.9	6.5	8.00	28	20.9	6.1	7.98	29	20.8	3.1	7.57	29	20.5	3.0	7.48	30
Max		18.7	9.5	8.33	30	22.0	6.8	8.22	29	21.3	6.5	8.05	30	21.3	4.1	7.80	30	20.8	3.5	7.60	31

APPENDIX TABLE 4 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
Pretreatment Test																					
6.25	1	19.1	7.5	7.92	29	21.5	6.3	7.91	28	21.2	5.9	7.92	30	21.3	3.5	7.70	30	20.2	2.9	7.70	29
	2					21.0	6.4	8.02		21.4	5.9	7.99		21.3	3.8	7.86		21.3	3.0	7.75	
	3					21.2	6.4	7.99		21.4	6.3	8.03		21.3	4.5	7.82		21.1	3.1	7.73	
12.5	1	18.5	7.7	7.96	29	21.3	6.3	8.01	28	21.1	6.5	8.07	30	21.2	4.1	7.87	30	21.0	3.3	7.79	30
	2					21.3	6.4	8.03		21.0	6.5	8.09		21.2	4.5	7.92		21.0	3.3	7.81	
	3					21.2	6.4	8.00		20.8	6.6	8.05		21.2	4.2	7.86		21.0	3.1	7.76	
25	1	18.0	8.0	8.02	30	21.8	6.4	8.01	29	21.2	5.9	7.97	30	21.2	3.4	7.69	30	21.3	2.9	7.68	30
	2					21.5	6.4	8.02		21.1	6.0	7.98		21.2	3.6	7.69		21.3	2.6	7.65	
	3					21.8	6.5	8.04		21.0	6.3	8.04		21.2	3.8	7.72		21.1	2.8	7.63	
50	1	18.0	8.4	8.12	30	21.6	6.5	8.08	29	21.4	5.8	8.00	29	21.0	3.5	7.74	29	21.1	2.6	7.65	29
	2					21.7	6.5	8.09		21.7	5.9	8.02		21.1	3.5	7.75		21.0	2.5	7.65	
	3					21.5	6.5	8.10		21.6	5.8	7.97		21.1	3.6	7.78		20.9	2.7	7.68	
100	1	18.3	9.5	8.32	28	21.1	6.6	8.16	28	21.4	6.4	8.02	29	21.2	3.8	7.69	29	21.3	2.6	7.61	29
	2					21.2	6.6	8.17		21.8	6.0	8.02		21.1	3.0	7.60		21.2	2.4	7.54	
	3					21.5	6.6	8.18		21.8	6.0	8.01		21.1	4.3	7.78		21.1	2.2	7.53	
Min		18.0	7.5	7.92	28	21.0	6.3	7.91	28	20.8	5.8	7.92	29	21.0	3.0	7.60	29	20.2	2.2	7.53	29
Max		19.1	9.5	8.32	30	21.8	6.6	8.18	29	21.8	6.6	8.09	30	21.3	4.5	7.92	30	21.3	3.3	7.81	30

APPENDIX TABLE 4 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
1 Hour Test																					
6.25	1	18.1	8.0	7.98	30	21.9	6.6	8.05	29	21.4	5.9	7.97	30	21.0	NT	7.71	30	21.2	3.4	7.74	30
	2					22.0	6.5	8.02		21.8	6.0	7.99		21.0	NT	7.73		21.2	3.0	7.72	
	3					22.0	6.3	8.01		21.7	6.1	8.00		21.0	NT	7.72		21.1	3.0	7.67	
12.5	1	18.0	8.0	7.99	30	21.9	6.4	8.05	29	21.2	5.9	8.02	30	21.0	NT	7.81	30	21.1	3.1	7.75	30
	2					21.9	6.5	8.02		21.2	6.1	8.03		21.0	NT	7.79		21.0	3.2	7.74	
	3					21.5	6.2	8.00		21.0	6.3	8.05		21.0	NT	7.83		20.9	3.1	7.75	
25	1	18.0	8.1	8.03	30	21.5	6.3	8.04	29	21.5	6.5	8.04	30	21.0	NT	7.78	30	21.3	3.3	7.72	30
	2					21.3	6.3	8.06		21.6	6.3	8.04		21.0	NT	7.66		21.1	2.9	7.65	
	3					21.4	6.5	8.05		21.5	6.3	8.02		21.0	NT	7.64		21.0	2.9	7.62	
50	1	18.0	8.6	8.13	30	21.4	6.5	8.09	29	21.2	6.3	8.08	29	21.0	NT	7.76	29	21.0	3.2	7.70	29
	2					21.3	6.5	8.10		21.1	6.4	8.08		21.0	NT	7.68		20.9	2.6	7.64	
	3					20.9	6.6	8.08		21.1	6.4	8.03		21.0	NT	7.64		20.8	2.8	7.58	
100	1	18	9.6	8.37	28	21.8	6.7	8.16	28	21.5	6.1	8.00	29	21.0	NT	7.67	29	21.1	2.8	7.58	29
	2					21.9	6.7	8.18		21.5	6.0	8.03		21.0	NT	7.54		21.1	2.4	7.52	
	3					21.9	6.7	8.20		21.4	6.1	8.07		21.0	NT	7.67		20.8	2.4	7.51	
Min		18.0	8.0	7.98	28	20.9	6.2	8.00	28	21.0	5.9	7.97	29	21.0	NT	7.54	29	20.8	2.4	7.51	29
Max		18.1	9.6	8.37	30	22.0	6.7	8.20	29	21.8	6.5	8.08	30	21.0	NT	7.83	30	21.3	3.4	7.75	30

Note: NT = Not taken.

APPENDIX TABLE 4 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
7 Hour Test																					
6.25	1	18.2	8.0	7.96	30	22.0	6.7	8.01	29	21.5	6.2	8.00	30	20.8	4.3	7.77	30	21.2	2.7	7.64	29
	2					21.9	6.4	8.00		21.5	6.1	7.99		20.9	4.1	7.76		21.0	2.9	7.65	
	3					21.9	6.6	8.02		21.4	6.0	8.02		20.9	3.9	7.84		21.0	2.9	7.69	
12.5	1	18.1	7.9	7.98	30	21.0	6.6	8.05	29	21.2	6.2	8.06	30	21.0	4.5	7.91	30	21.0	2.9	7.72	30
	2					21.5	6.4	8.03		21.2	6.0	7.99		21.0	4.4	7.79		21.0	3.0	7.70	
	3					21.6	6.5	8.04		21.1	6.1	8.05		21.0	4.4	7.87		20.8	3.2	7.74	
25	1	18.8	8.1	8.03	30	21.5	6.7	8.05	29	21.4	6.1	7.99	30	20.8	4.2	7.68	30	21.1	3.1	7.66	30
	2					21.4	6.5	8.04		21.5	6.1	8.00		20.8	4.3	7.72		21.0	3.2	7.66	
	3					21.5	6.7	8.05		21.4	6.3	8.05		20.8	4.6	7.79		20.9	3.3	7.69	
50	1	19.0	8.7	8.13	29	21.5	6.7	8.09	28	21.3	6.1	8.04	29	20.9	4.0	7.70	30	21.0	3.1	7.65	29
	2					21.3	6.6	8.11		21.2	6.2	8.05		21.0	4.2	7.85		20.8	3.1	7.72	
	3					20.9	6.7	8.09		21.1	6.4	8.07		21.0	5.6	7.94		21.0	3.4	7.76	
100	1	18.5	9.8	8.37	28	21.8	6.6	8.17	28	21.3	6.2	8.02	29	20.8	3.5	7.61	29	20.9	2.5	7.60	29
	2					21.9	6.7	8.20		21.4	6.2	8.08		20.8	3.1	7.66		21.0	2.6	7.53	
	3					21.9	6.7	8.20		21.2	6.3	8.09		20.8	4.3	7.88		21.0	2.5	7.55	
Min		18.1	7.9	7.96	28	20.9	6.4	8.00	28	21.1	6.0	7.99	29	20.8	3.1	7.61	29	20.8	2.5	7.53	29
Max		19.0	9.8	8.37	30	22.0	6.7	8.20	29	21.5	6.4	8.09	30	21.0	5.6	7.94	30	21.2	3.4	7.76	30

APPENDIX TABLE 4 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
19 Hour Test																					
6.25	1	18.9	7.8	7.89	29	21.5	6.4	8.03	29	21.6	6.0	7.99	30	20.8	3.7	7.68	30	21.1	2.6	7.54	29
	2					21.4	6.5	8.01		21.5	6.1	7.98		20.9	3.8	7.67		21.0	2.6	7.59	
	3					21.4	6.5	8.03		21.3	6.1	8.00		20.9	3.6	7.79		21.1	2.7	7.65	
12.5	1	18.5	8.0	7.93	30	21.3	6.3	8.02	29	21.3	6.2	7.98	29	21.0	3.6	7.78	30	20.9	2.5	7.62	30
	2					21.1	6.6	8.05		21.3	6.0	8.06		21.0	3.6	7.83		21.0	2.7	7.67	
	3					21.0	6.6	8.05		21.1	6.3	8.05		21.0	4.9	7.84		21.0	3.3	7.73	
25	1	18.0	8.1	7.99	28	21.9	6.7	8.03	29	21.3	6.0	8.00	29	20.9	4.6	7.75	29	21.2	3.5	7.71	30
	2					21.8	6.6	8.05		21.3	6.5	8.06		20.9	4.2	7.73		21.1	3.0	7.67	
	3					21.9	6.6	8.05		21.3	6.4	8.06		20.9	3.9	7.70		21.0	3.2	7.65	
50	1	18.8	8.7	8.10	28	21.8	6.7	8.10	28	21.3	6.1	8.01	29	21.0	4.2	7.68	29	20.9	2.7	7.61	29
	2					21.7	6.7	8.08		21.2	6.1	8.01		21.0	3.8	7.65		21.0	2.8	7.59	
	3					21.6	6.6	8.11		21.1	6.3	8.07		21.0	4.7	7.87		21.0	3.0	7.68	
100	1	18.0	9.7	8.32	26	21.6	6.7	8.17	26	21.3	6.2	8.03	28	20.8	4.2	7.65	28	21.2	2.7	7.53	26
	2					21.5	6.8	8.16		21.2	6.3	8.04		20.8	3.9	7.61		21.0	2.4	7.49	
	3					21.9	6.8	8.16		21.2	6.1	8.00		20.9	3.0	7.50		21.0	2.5	7.49	
Min		18.0	7.8	7.89	26	21.0	6.3	8.01	26	21.1	6.0	7.98	28	20.8	3.0	7.50	28	20.9	2.4	7.49	26
Max		18.9	9.7	8.32	30	21.9	6.8	8.17	29	21.6	6.5	8.07	30	21.0	4.9	7.87	30	21.2	3.5	7.73	30

APPENDIX TABLE 4 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
Laboratory	1	18.3	7.5	7.79	29	21.3	6.3	7.88	29	20.7	3.4	7.74	29	21.1	3.5	7.70	29	21.8	5.0	7.73	28
Control	2					21.2	6.4	7.98		20.8	3.5	7.74		21.0	3.7	7.70		21.9	5.0	7.74	
	3					21.1	6.5	7.99		20.8	3.1	7.77		21.1	3.8	7.73		21.9	5.0	7.77	
32 Hour Test																					
6.25	1	18.2	7.5	7.83	29	20.9	6.2	8.01	29	20.9	3.0	7.63	29	21.1	3.7	7.73	28	21.9	5.0	7.82	28
	2					21.1	6.2	7.99		20.9	3.8	7.74		21.1	3.7	7.74		21.9	5.0	7.83	
	3					21.2	6.2	8.01		20.9	3.5	7.74		21.0	3.8	7.79		22.0	5.0	7.92	
12.5	1	18.0	7.3	7.86	29	21.2	6.2	8.03	29	20.6	3.9	7.78	29	21.1	3.8	7.80	28	22.0	5.3	7.92	28
	2					21.2	6.3	8.04		20.6	4.1	7.83		21.0	3.7	7.80		22.0	5.2	7.91	
	3					21.1	6.0	8.02		20.6	4.3	7.83		21.1	3.7	7.82		22.0	5.3	7.90	
25	1	18.0	7.7	7.94	28	21.5	6.2	8.03	29	20.7	3.9	7.73	28	21.1	3.5	7.74	28	22.0	5.2	7.80	28
	2					21.4	6.3	8.06		20.8	4.0	7.78		21.2	3.7	7.74		22.0	5.1	7.77	
	3					21.3	6.4	8.06		20.8	3.9	7.80		21.0	3.8	7.78		21.9	5.1	7.79	
50	1	18.0	8.0	8.02	28	21.3	6.6	8.12	29	20.2	4.0	7.79	28	21.1	3.3	7.71	28	21.9	5.1	7.80	28
	2					21.2	6.6	8.13		20.3	4.8	7.89		21.0	3.6	7.76		21.9	5.1	7.82	
	3					21.1	6.7	8.12		20.3	4.7	7.83		21.1	3.7	7.76		21.9	5.2	7.81	
100	1	18.0	8.8	8.21	28	21.4	6.4	8.14	29	20.5	3.2	7.71	28	20.9	3.1	7.67	27	22.0	5.2	7.81	26
	2					21.4	6.5	8.16		20.5	3.3	7.72		21.0	3.2	7.68		22.0	5.2	7.80	
	3					21.3	6.7	8.19		20.5	4.4	7.72		21.0	3.1	7.62		22.0	5.3	7.82	
Min		18.0	7.3	7.79	28	20.9	6.0	7.88	29	20.2	3.0	7.63	28	20.9	3.1	7.62	27	21.8	5.0	7.73	26
Max		18.3	8.8	8.21	29	21.5	6.7	8.19	29	20.9	4.8	7.89	29	21.2	3.8	7.82	29	22.0	5.3	7.92	28

APPENDIX TABLE 4 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration (%)	Rep	Day 0 °C	Day 0 DO	Day 0 pH	Day 0 Sal	Day 1 °C	Day 1 DO	Day 1 pH	Day 1 Sal	Day 2 °C	Day 2 DO	Day 2 pH	Day 2 Sal	Day 3 °C	Day 3 DO	Day 3 pH	Day 3 Sal	Day 4 °C	Day 4 DO	Day 4 pH	Day 4 Sal
Laboratory Control	1	20.1	7.5	7.97	29	20.3	5.2	7.87	29	20.5	4.0	7.80	29	21.9	5.5	7.87	28	21.2	5.2	7.83	29
	2					20.2	5.3	7.86		20.6	4.2	7.81		21.9	5.4	7.91		21.2	5.6	8.00	
	3					20.3	5.7	7.89		20.6	4.5	7.82		21.9	5.3	7.95		21.0	5.9	8.03	
57 Hour Control	1	18.0	7.9	8.31	26	20.4	5.0	7.88	27	20.8	3.2	7.59	28	21.9	5.3	7.88	28	21.4	5.3	7.89	28
	2					20.4	5.5	7.95		20.9	3.0	7.58		22.0	5.2	7.82		21.4	5.3	7.86	
	3					20.5	5.6	7.96		20.9	3.1	7.61		22.0	5.0	7.81		21.3	5.5	7.90	
57 Hour Test 6.25	1	20.0	7.7	8.04	28	20.2	5.2	7.88	28	20.9	3.4	7.66	26	22.0	5.1	7.80	27	21.2	5.4	7.92	27
	2					20.1	5.2	7.89		20.9	3.4	7.68		22.0	5.1	7.81		21.5	5.3	7.93	
	3					20.1	5.3	7.90		20.9	3.7	7.73		22.0	5.1	7.81		21.5	5.1	7.99	
12.5	1	20.0	7.8	8.10	28	20.3	5.1	7.90	28	20.9	3.3	7.68	28	22.0	5.2	7.84	27	21.4	5.5	7.93	27
	2					20.3	4.9	7.89		21.0	3.0	7.65		21.9	5.2	7.88		21.4	5.3	7.92	
	3					20.3	4.9	7.91		21.0	3.2	7.70		21.9	5.3	7.90		21.3	5.3	7.97	
25	1	19.5	7.8	8.15	28	20.2	5.9	7.97	28	20.8	3.7	7.76	28	22.0	5.2	7.89	27	21.2	5.3	7.95	27
	2					20.2	5.5	7.95		20.9	4.1	7.80		22.0	5.1	7.87		21.3	5.6	8.00	
	3					20.2	5.5	7.94		20.9	4.1	7.80		22.0	5.1	7.86		21.5	5.9	8.05	
50	1	18.2	7.9	8.23	27	20.4	4.9	7.92	28	21.0	3.3	7.67	28	22.0	5.0	7.82	27	21.5	5.5	7.95	27
	2					20.4	5.1	7.98		21.9	3.3	7.67		21.9	5.0	7.83		21.5	5.6	7.98	
	3					20.4	5.5	8.00		21.0	3.4	7.72		21.9	5.1	7.82		21.4	5.6	8.01	
100	1	19.0	8.4	8.39	26	20.1	6.1	8.06	27	20.7	3.3	7.69	26	22.0	5.1	7.80	26	21.2	5.8	7.96	27
	2					20.1	6.1	8.05		20.6	3.6	7.71		22.0	5.2	7.81		21.3	5.8	7.97	
	3					20.1	5.6	8.00		20.7	3.7	7.69		22.0	5.1	7.80		21.3	5.9	7.98	
Min		18.0	7.5	7.97	26	20.1	4.9	7.86	27	20.5	3.0	7.58	26	21.9	5.0	7.80	26	21.0	5.1	7.83	27
Max		20.1	8.4	8.39	29	20.5	6.1	8.06	29	21.9	4.5	7.82	29	22.0	5.5	7.95	28	21.5	5.9	8.05	29

APPENDIX TABLE 4 (Cont'd)

Mysidopsis bahia
SUMMARY OF WATER QUALITY MEASUREMENTS
SITE KN - 132

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(%)	Rep	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal	°C	DO	pH	Sal
Laboratory	1	21.0	5.9	7.74	30	21.9	6.3	7.96	20	21.4	5.7	7.79	28	20.2	4.8	7.67	28	21.6	5.2	7.80	28
Control	2					22.0	6.3	7.96		21.4	6.1	7.96		20.2	4.6	7.81		21.6	5.4	7.83	
	3					22.0	6.3	7.97		21.3	6.1	8.00		19.9	5.0	7.82		21.5	5.5	7.87	
82 Hour Test																					
6.25	1	18.0	6.1	7.83	30	21.9	6.5	7.96	28	21.5	6.2	8.05	28	20.8	6.0	7.58	28	21.5	5.9	7.90	28
	2					21.9	6.4	7.99		21.3	6.1	7.98		20.7	5.9	7.70		21.6	5.5	7.90	
	3					21.9	6.3	7.99		21.5	6.1	8.01		20.6	5.9	7.74		21.7	5.4	7.83	
12.5	1	18.5	6.1	7.86	30	21.9	6.3	7.99	28	21.6	6.2	8.03	28	20.5	5.8	7.78	28	21.5	5.6	7.85	28
	2					21.9	6.3	7.99		21.6	6.2	8.05		20.6	5.2	7.78		21.6	5.6	7.90	
	3					21.9	6.4	7.99		21.6	6.4	8.60		20.4	5.4	7.74		21.3	5.5	7.87	
25	1	18.7	6.6	7.93	29	22.0	6.4	7.95	28	21.4	6.3	8.07	28	20.2	5.8	7.74	28	21.9	5.2	7.88	28
	2					22.0	6.4	7.93		21.5	6.3	8.08		20.2	5.6	7.83		21.9	5.4	7.89	
	3					22.0	6.4	7.92		21.5	6.1	8.05		20.3	5.4	7.78		21.9	5.3	7.87	
50	1	20.0	6.8	8.05	28	22.0	6.4	7.93	27	21.5	6.0	8.05	27	20.2	5.3	7.73	26	21.8	5.4	7.86	28
	2					22.0	6.4	7.94		21.3	6.2	8.07		20.2	5.0	7.73		21.8	5.4	7.86	
	3					22.0	6.4	7.95		21.3	6.1	8.05		20.0	5.3	7.72		21.8	5.6	7.84	
100	1	20.0	8.0	8.28	26	22.0	6.4	8.15	26	21.3	6.1	8.04	26	20.5	4.8	7.70	26	21.5	5.6	7.85	28
	2					22.0	6.5	8.16		21.4	6.0	8.05		20.6	5.3	7.68		21.8	5.9	7.83	
	3					22.0	6.5	8.15		21.5	6.0	8.05		20.7	5.5	7.70		21.9	5.5	7.80	
Min		18.0	5.9	7.74	26	21.9	6.3	7.92	20	21.3	5.7	8.04	26	19.9	4.6	7.58	26	21.3	5.2	7.80	28
Max		21.0	8.0	8.28	30	22.0	6.5	8.16	28	21.6	6.4	8.08	28	20.8	6.0	7.83	28	21.9	5.9	7.90	28

APPENDIX TABLE 5

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 135

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
Laboratory Control	1	10	10	10	9	9	90
	2	10	10	10	10	10	100
	3	11	11	11	11	11	100
Pretreatment Control	1	11	11	11	11	11	100
	2	11	11	11	11	11	100
	3	10	10	10	10	10	100
Pretreatment Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100
12.5	1	12	12	12	12	12	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	9	9	90
	3	10	10	9	9	9	90
50	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	11	11	11	11	11	100
1 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	10	100
	2	10	10	9	9	9	90
	3	10	10	9	9	9	90
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
50	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	9	9	9	9	90
100	1	10	10	10	10	10	100
	2	10	10	9	9	8	80
	3	10	9	9	9	9	90

APPENDIX TABLE 5 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 135

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
7 Hour Test							
6.25	1	10	10	10	9	9	90
	2	10	10	10	8	8	80
	3	10	10	9	9	9	90
12.5	1	10	10	9	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	9	9	90
	3	10	10	10	10	10	100
50	1	10	10	10	8	8	80
	2	10	10	10	10	10	100
	3	10	10	10	9	9	90
100	1	10	10	10	10	9	90
	2	10	10	10	10	9	90
	3	10	10	10	10	9	90
Laboratory Control	1	10	9	9	9	9	90
	2	10	10	10	9	9	90
	3	10	10	10	10	10	100
19 Hour Control	1	10	10	9	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
19 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	9	9	9	9	9	100
12.5	1	10	7	7	7	7	70
	2	10	10	10	10	10	100
	3	9	9	9	9	9	100
25	1	10	9	9	9	9	90
	2	10	10	10	10	9	90
	3	9	9	9	9	8	88.9
50	1	10	10	10	10	10	100
	2	9	8	8	8	8	88.9
	3	9	8	8	8	8	88.9
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100

APPENDIX TABLE 5 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 135

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
32 Hour Test							
6.25	1	10	10	9	9	9	90
	2	10	10	10	10	10	100
	3	9	9	9	9	9	100
12.5	1	10	10	10	10	9	90
	2	9	9	9	9	9	100
	3	9	9	9	9	9	100
25	1	10	9	8	8	8	80
	2	10	10	9	9	9	90
	3	9	9	9	9	9	100
50	1	10	10	10	10	10	100
	2	9	9	9	9	9	100
	3	9	9	9	8	8	88.9
100	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	10	10	10	10	9	90
Laboratory Control	1	10	10	10	10	10	100
	2	10	10	9	9	9	90
	3	10	10	9	9	9	90
57 Hour Control	1	10	10	10	10	10	100
	2	10	10	10	9	9	90
	3	10	10	10	9	9	90
57 Hour Test							
6.25	1	11	10	10	10	10	90.9
	2	11	11	10	10	10	90.9
	3	10	10	10	10	9	90
12.5	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	9	9	9	9	90
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	9	9	90
50	1	10	10	10	10	10	100
	2	10	10	9	9	9	90
	3	10	10	10	10	9	90
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100

APPENDIX TABLE 5 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 135

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
Laboratory	1	10	10	10	10	10	100
Control	2	10	10	10	9	9	90
	3	10	10	10	10	10	100
82 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	9	9	9	90
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	9	9	90
50	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100

APPENDIX TABLE 6

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 211

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
Laboratory Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
Pretreatment Control	1	10	9	9	7	7	70
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
Pretreatment Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
12.5	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	9	9	9	9	90
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
50	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
100	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100
1 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
12.5	1	20	19	19	19	19	95
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	9	9	9	90
50	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	10	10	10	9	9	90
100	1	10	8	8	8	8	80
	2	10	10	10	9	9	90
	3	10	10	10	10	10	100

APPENDIX TABLE 6 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 211

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
7 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	9	9	8	8	80
	2	10	10	10	10	10	100
	3	10	10	10	9	9	90
50	1	10	10	10	10	9	90
	2	10	9	9	9	8	80
	3	10	10	10	10	10	100
100	1	10	10	10	10	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
Laboratory Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
19 Hour Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
19 Hour Test							
6.25	1	10	10	9	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	10	10	10	10	10	100
50	1	11	11	11	11	11	100
	2	10	9	9	8	8	80
	3	10	10	10	10	10	100
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	9	9	9	90

APPENDIX TABLE 6 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 211

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
Laboratory Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
32 Hour Test							
6.25	1	10	10	10	10	9	90
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	10	10	10	10	10	100
50	1	10	10	9	9	9	90
	2	10	10	10	10	10	100
	3	10	10	9	9	9	90
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
Laboratory Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
57 Hour Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
57 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
12.5	1	10	10	10	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
50	1	10	10	10	10	10	100
	2	9	9	9	9	9	100
	3	10	10	10	10	10	100
100	1	10	10	10	10	9	90
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100

APPENDIX TABLE 6 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 211

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
82 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	10	10	10	9	90
25	1	10	10	10	10	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
50	1	10	10	10	10	10	100
	2	9	9	9	9	9	100
	3	10	10	9	9	9	90
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	8	8	8	8	80

APPENDIX TABLE 7

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 132

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
Laboratory Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
Pretreatment Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
19 Hour Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
Pretreatment Test							
6.25	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	10	9	9	9	9	90
12.5	1	10	10	10	10	10	100
	2	10	10	10	9	9	90
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
50	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	10	10	10	10	10	100
100	1	10	10	10	10	8	80
	2	10	10	10	10	9	90
	3	10	9	9	8	8	80
1 Hour Test							
6.25	1	10	10	10	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
12.5	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	9	9	9	9	90
50	1	10	10	10	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
100	1	10	10	10	10	9	90
	2	10	10	10	10	8	80
	3	10	10	10	10	10	100

APPENDIX TABLE 7 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 132

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
7 Hour Test							
6.25	1	10	10	10	10	10	100
	2	12	12	12	12	12	100
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100
50	1	10	10	10	10	10	100
	2	10	9	9	9	9	90
	3	10	10	10	10	10	100
100	1	10	9	9	9	9	90
	2	10	10	10	10	9	90
	3	10	10	10	10	10	100
19 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
12.5	1	10	10	10	10	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	9	9	9	9	90
50	1	10	9	9	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
100	1	10	10	10	10	10	100
	2	10	10	10	10	9	90
	3	10	9	9	9	9	90

APPENDIX TABLE 7 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 132

Concentration (%)	Rep.	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival
Laboratory Control	1	10	9	9	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	9	9	90
32 Hour Test							
6.25	1	10	10	10	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	10	100
	2	10	10	10	9	9	90
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
50	1	10	10	10	10	10	100
	2	10	10	10	9	9	90
	3	10	10	10	10	10	100
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	9	9	90
Laboratory Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
57 Hour Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90
57 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
12.5	1	10	10	10	10	9	90
	2	10	10	10	10	8	80
	3	10	10	10	10	9	90
25	1	10	10	10	10	9	90
	2	10	10	10	10	10	100
	3	10	9	9	9	9	90
50	1	10	9	9	9	8	80
	2	10	10	10	10	9	90
	3	10	10	10	10	9	90
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	9	90

APPENDIX TABLE 7 (Cont'd)

Mysidopsis bahia
SUMMARY OF SURVIVAL DATA
SITE KN - 132

Laboratory Control	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
82 Hour Test							
6.25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	9	9	9	90
12.5	1	10	10	9	9	9	90
	2	10	10	10	9	9	90
	3	10	10	10	10	10	100
25	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
50	1	10	10	10	9	9	90
	2	10	10	10	10	10	100
	3	10	10	10	10	10	100
100	1	10	10	10	10	10	100
	2	10	10	10	10	10	100
	3	10	9	9	9	9	90