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Final Report:

DELAWARE RIVER COMPREHENSIVE NAVIGATION STUDY - MAIN CHANNEL DEEPENING PROJECT BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENTS

August 1995

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DELAWARE RIVER COMPREHENSIVE NAVIGATION STUDY
MAIN CHANNEL DEEPENING PROJECT
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENTS

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EXECUTIVE SUMMARY

As part of its proposal to deepen and modify the existing Philadelphia to the Sea Delaware River Shipping Channel, the Philadelphia District of the U.S. Army Corps of Engineers will be disposing of dredged material in upland sites along the river and using it for various beneficial purposes in Delaware Bay. In the Corps-prepared Environmental Impact Statement for this project, several environmental concerns were identified that require additional investigation. The chemical quality of project sediments and any potential impact to aquatic resources during dredging and disposal operations is one concern. This study effort is to collect biological effects-based testing data which can be used to assess potential impacts associated with project implementation.

A total of 45 sediment samples and six water samples were collected from representative dredging locations selected by the Corps of Engineers in the Federal navigation channel. Water column bioassays, whole sediment bioassays, and bioaccumulation tests on specified species were conducted. Both freshwater and estuarine sites were tested. The riverine section of the project area was defined as the navigation channel from Beckett Street Terminal in Camden, New Jersey to Bend T, located adjacent to Artificial Island, New Jersey. The Delaware Estuary below Artificial Island was considered Delaware Bay.

Testing involved 29 riverine sediment samples, ten bay samples and six candidate beneficial use (reference) sites. Chemical and geotechnical analyses were also performed to characterize the sediment. Sufficient sediment to run all biological chemical and geotechnical tests was collected at all sample locations except one. At the Chester Range location, only rock and very small quantities of gravel were found in the area.

Acute water column bioassays were conducted on the elutriates of sediment samples and river water to assess the potential effects associated with dredging and upland dredged material disposal activities on aquatic resources. Test organisms for freshwater site bioassays were fathead minnow (Pimephales promelas), a water flea (Ceriodaphnia dubia), and a freshwater amphipod (Hyalella azteca). Estuary test organisms included sheepshead minnow (Cyprinodon variegatus), mysid shrimp (Mysidopsis bahia), and American oyster (Crassostrea virginica). Whole sediment bioassays were performed to assess the potential effects of sediment placement on aquatic resources residing at the proposed beneficial use sites. Test organisms for the whole sediment bioassays were the amphipod (Ampelisca abdita), the clam worm (Nereis virens), and the hardshell clam (Mercenaria mercenaria). To assess the potential for bioaccumulation of sediment contaminants from dredged material placed in open water for beneficial use options in Delaware Bay, five bioaccumulation tests on the hard shell clam (Mercenaria mercenaria) were conducted.

Results of the water column bioassays, after 48 hours of exposure, indicated 100% survival of all six organisms at all test concentrations as well as in both the lab water and water controls. For the whole sediment bioassays, 100% survival was recorded, after 10 days of exposure, for all three species in all test, reference, and control sediment. Statistical evaluation of the data for the above two tests was unnecessary due to the absence of mortality.

For the bioaccumulation tests, clam mortality was observed during the final stages of testing, due possibly to starvation since the testing protocol requires that the specimens not be fed during testing. Chemical analyses of the clam tissue determined that all pesticides, PCBs and semivolatile compounds analyzed were either absent from the samples or concentrations were below the quantifiable limit of the testing methods used for clams exposed to dredged material from the Delaware Bay sites as well as the beneficial use site sediments. Analyses were performed for 12 metals; seven were found in quantifiable concentrations in

one or more samples. Concentrations of arsenic, chromium, lead and mercury were below analytical detection limits for all Delaware Bay sites. Based on testing data, the selenium and copper concentrations detected should not pose a human health problem.

Standard reference toxicity (SRT) testing was conducted for all test species and was done concurrently with whole sediment and water column bioassays. The results of the SRT bioassays fell well within the acceptance ranges for all species. Therefore, all test organisms were judged suitable for toxicity testing.

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACOE), Philadelphia District, is proposing to modify the existing Philadelphia to the Sea, Federal Navigation Channel by deepening the channel from 40 feet at mean low water to 45 feet. Dredged material would be disposed of at several upland sites along the river and used for various beneficial purposes in Delaware Bay. Beneficial uses currently under investigation include sand stockpiling in the Bay for future beach nourishment activities along Delaware Bay shorelines, wetland creation at locations where wetlands have been lost through erosion, and island creation for habitat purposes. Several candidate sites have been selected for each option. The USACOE prepared an Environmental Impact Statement for this project which identified several environmental concerns that require additional investigation. One concern is the chemical quality of project sediments and the potential impact to aquatic resources during dredging and dredged material disposal operations, and implementation of beneficial use options. The intent of this investigation was to collect biological effects based testing data which can be used to assess potential impacts associated with project implementation.

Field crews collected 45 sediment samples and six water samples. Water column bioassays, whole sediment bioassays, and bioaccumulation tests were conducted on specified species. Testing involved 29 riverine sediment samples, ten bay samples, and six candidate beneficial use (reference) sites (Table 1). Chemical and geotechnical analyses were also performed to characterize the sediment. Samples were collected in the Delaware River Shipping Channel from the Beckett Street Terminal, located in Camden, New Jersey, to the lower portion of Delaware Bay.

1.1 Water Column Bioassays

In the riverine section of the project area, dredged material would be placed in several confined upland dredged material disposal sites. Sediment quality concerns in this portion of the project involve sediment-bound toxics released at the point of dredging and associated with the discharge of effluent from the disposal sites. In the Delaware Bay portion of the project area, dredged sediments will be used for various beneficial uses. Sediment quality concerns in this area include turbidity generated at the point of dredging and impacts associated with open water placement of dredged sediments. To assess the potential effects associated with dredging and upland dredged material disposal activities on aquatic resources, acute water column bioassays were conducted on the elutriate of sediment samples and river water.

1.2 Whole Sediment Bioassays

In Delaware Bay, dredged sediments will be used for various beneficial uses that involve placement of sediment in the open water environment. Whole sediment bioassays were performed to assess the potential effects of sediment placement on aquatic resources residing at the proposed beneficial use sites.

1.3 Bioaccumulation Tests

To assess the potential for bioaccumulation of sediment contaminants from sediments placed in open water for beneficial use options in Delaware Bay, five bioaccumulation tests were conducted. Of the ten sediment samples collected from the Delaware Bay navigation channel, the five samples with the highest percentage of fine-grain silts and clays were used as the test sediments.

Table 1: USACOE Sediment and Water Sample Location Coordinates

Sample Location	Target Latitude	Target Longitude	Actual Latitude	Actual Longitude
Sediment Collection - Freshwater Locations				
Beckett Street Terminal	(no coordinates)*		39°56'13.760"	75°07'59.695"
Range M	(no coordinates)*		39°53'56.140"	75°08'03.732"
Bend AF	39°53'12.94"	75°08'34.47"	39°53'12.824"	75°08'33.976"
W. Horseshoe Range	39°52'52.95"	75°10'22.32"	39°52'52.616"	75°10'22.148"
Bend G	39°52'45.89"	75°10'53.45"	39°52'46.011"	75°10'53.246"
Mifflin Range	39°51'59.93"	75°13'10.31"	39°51'59.845"	75°13'10.113"
Bend H	39°51'22.66"	75°14'31.21"	39°51'22.660"	75°14'31.210"
Billingsport Range	(no coordinates)*		39°51'04.968"	75°15'01.420"
Bend I	39°51'01.82"	75°15'45.46"	39°51'01.496"	75°15'45.324"
Tinicum Range	39°50'54.71"	75°17'27.20"	39°50'54.919"	75°17'27.075"
Bend J	39°50'47.41"	75°20'00.33"	39°50'47.584"	75°20'03.007"
Eddystone Range	(no coordinates)*		39°50'42.485"	75°20'23.100"
Bend K	39°50'23.41"	75°20'58.78"	39°50'23.970"	75°20'58.799"
Chester Range	39°49'42.94"	75°22'19.56"	(no sample collected)	
Bend L	39°49'12.43"	75°22'57.15"	39°49'12.430"	75°22'57.150"
Marcus Hook Range	39°48'25.77"	75°24'45.66"	39°48'25.625"	75°24'46.021"
Bend M	39°46'47.39"	75°27'33.58"	39°46'47.471"	75°27'33.561"
Bellevue Range	39°45'49.94"	75°28'40.21"	39°45'49.947"	75°28'40.219"
Bend N	39°44'17.96"	75°29'44.31"	39°44'17.962"	75°29'44.810"
Cherry Island Range	39°42'34.23"	75°30'38.07"	39°42'34.046"	75°30'37.899"
Bend O	39°40'35.32"	75°31'31.32"	39°40'34.938"	75°31'30.561"
Deepwater Point Range	39°39'15.37"	75°32'48.00"	39°39'15.153"	75°32'47.776"
Bend PQ	39°37'01.91"	75°34'33.62"	39°37'01.680"	75°34'33.563"
New Castle Range	39°34'07.37"	75°32'59.09"	39°34'07.662"	75°32'59.090"
Bend R	39°33'07.19"	75°32'33.84"	39°33'07.352"	75°32'33.676"
Reedy Island Range	(no coordinates)*		39°30'57.372"	75°33'14.940"
Bend S	39°29'05.47"	75°33'38.37"	39°29'05.443"	75°33'38.714"
Baker Range	39°28'07.37"	75°33'44.67"	39°28'07.416"	75°33'44.556"
Bend T	39°27'25.87"	75°33'30.61"	39°27'25.987"	75°33'30.224"
Sediment Collection - Estuarine Locations				
Delaware Bay 1	39°20'42.56"	75°25'57.70"	39°20'42.524"	75°25'57.818"
Delaware Bay 2	39°17'29.02"	75°22'18.37"	39°17'29.206"	75°22'18.466"
Delaware Bay 3	39°14'57.79"	75°19'15.37"	39°14'57.663"	75°19'15.330"
Delaware Bay 4	39°13'02.60"	75°17'40.56"	39°13'02.600"	75°17'40.560"
Delaware Bay 5	39°08'47.18"	75°14'29.63"	39°08'47.063"	75°14'29.212"
Delaware Bay 6	39°06'06.44"	75°12'01.87"	39°06'05.846"	75°12'01.473"
Delaware Bay 7	39°05'00.63"	75°11'04.67"	39°05'00.816"	75°11'05.024"
Delaware Bay 8	39°00'09.53"	75°08'26.07"	39°00'09.241"	75°08'26.126"
Delaware Bay 9	38°55'34.63"	75°06'03.53"	38°55'34.280"	75°06'03.248"
Delaware Bay 10	38°54'20.00"	75°04'90.00"	38°54'19.910	75°04'09.057"

Table 1 (Continued)

Sample Location	Target Latitude	Target Longitude	Actual Latitude	Actual Longitude
Sediment Collection - Estuarine Locations (continued)				
Beneficial Use Site 1	(Site C13 Island Creation - no coordinates)*		39°25'47.605"	75°28'20.617"
Beneficial Use Site 2	(Site LC9 Wetland Creation - no coordinates)*		39°10'08.287"	75°24'01.169"
Beneficial Use Site 3	(Site FR28 Sand Stock Pile - no coordinates)*		39°05'06.851"	75°20'24.820"
Beneficial Use Site 4A	(Site PN1-A Wetland Creation - no coordinates)*		39°12'08.052"	75°04'16.092"
Beneficial Use Site 4B	39°11'07.019"	75°07'29.485"	(Site PN1-B Wetland Creation - no coordinates)*	
Beneficial Use Site 5	(Site I3 Island Creation - no coordinates)*		39°00'15.711"	75°12'20.654"
Beneficial Use Site 6	(Site MS19 Sand Stock Pile - no coordinates)*		38°54'08.293"	75°16'19.769"
Water Collection Locations				
Mifflin Range Water Sample	39°52'33.72"	75°12'08.26"	39°52'33.720"	75°12'08.260"
Chester Range Water Sample	39°49'26.75"	75°22'40.85"	39°49'26.963"	75°22'40.430"
Bellevue Range Water Sample	39°46'27.38"	75°28'06.55"	39°46'27.380"	75°28'06.555"
Deepwater Range Water Sample	39°37'55.35"	75°34'21.57"	39°37'55.350"	75°34'21.570"
Baker Range Water Sample	39°28'19.22"	75°33'46.33"	39°28'19.325"	75°33'46.135"
Miah Maull Range Water Sample	39°09'37.31"	75°15'14.55"	39°09'37.418"	75°15'14.274"

*No coordinates given - site position determined by sampling crews.

1.4 Species Selection

The species employed in the bioassays and bioaccumulation testing are shown below:

Water Column Bioassays

Freshwater Sites	Estuarine Sites
Fathead minnow (Pimephales promelas)	Sheepshead Minnow (Cyprinodon variegatus)
Water flea (Ceriodaphnia dubia)	Mysid shrimp (Mysidopsis bahia)
Amphipod (Hyalella azteca)	American oyster (Crassostrea virginica)

Whole Sediment Bioassays

All Test Sites

Amphipod
Ampelisca abdita
Clam worm
Nereis virens
Hardshell clam
Mercenaria mercenaria

Bioaccumulation Tests

All Test Sites

Hardshell clam
Mercenaria mercenaria

These species were selected because they are recommended by the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, and the American Society for Testing and Materials for use in sediment bioassay and bioaccumulation studies. All inhabit the Delaware River or Bay. The hardshell clam is particularly well-suited to the bioaccumulation testing because it is a commercially and recreationally important species in Delaware Bay and is used as a human food resource.

Initially, the striped bass (Morone saxatilis) was to be used as the fish species in water column bioassays for both freshwater and estuarine sites. However, this species breeds once annually (in the spring) and juveniles of sufficiently small size to conduct the bioassays would not be available at the time of testing. Therefore, the fathead minnow and sheepshead minnow, both widely used in bioassays, were selected.

As shown above, separate groups of species were selected for freshwater and estuarine sites for water column bioassays. The 29 Delaware River sites were considered freshwater and, therefore, the freshwater species were used in the bioassays of sediment collected at these locations. They are identified in Table 1. It is understood that several of the sites in the lower river undergo transition from freshwater to low salinity conditions on an annual basis. However, it is important to note that the selected freshwater bioassay species are known to tolerate mild salinity (Weber 1991) and that their use in testing sediment collected at lower river sites does not compromise the validity of the effort.

2.0 MATERIALS AND METHODS

2.1 Sample Collection

Samples were collected from representative dredging locations selected by the USACOE in the Delaware River shipping channel from the Beckett Street Terminal, Camden, New Jersey, to the lower portion of Delaware Bay (Figures 1 and 2). The riverine section of the project area is defined as the navigation channel from Beckett Street Terminal to Bend T, located adjacent to Artificial Island, New Jersey. The Delaware Estuary below Artificial Island was considered Delaware Bay. Six reference samples were also collected from candidate beneficial use sites in the Delaware Bay. The USACOE target sample locations and coordinates are listed in Table 1. Copies of the field logs for all sampling are contained in Appendix A.

A Trimble Prolite six-channel Differential Global Positioning System with a TDC1 Datalogger and a CSI MBX1 Beacon Data Receiver was used to locate all sample points (Table 1). For some of the sediment sampling locations, no pre-specified coordinates were given. In these cases the coordinates were chosen by the project manager/crew leader. Prior to beginning the field sampling effort, a Position Accuracy Calibration Procedure Report was filed with the USACOE. A copy is included in Appendix B.

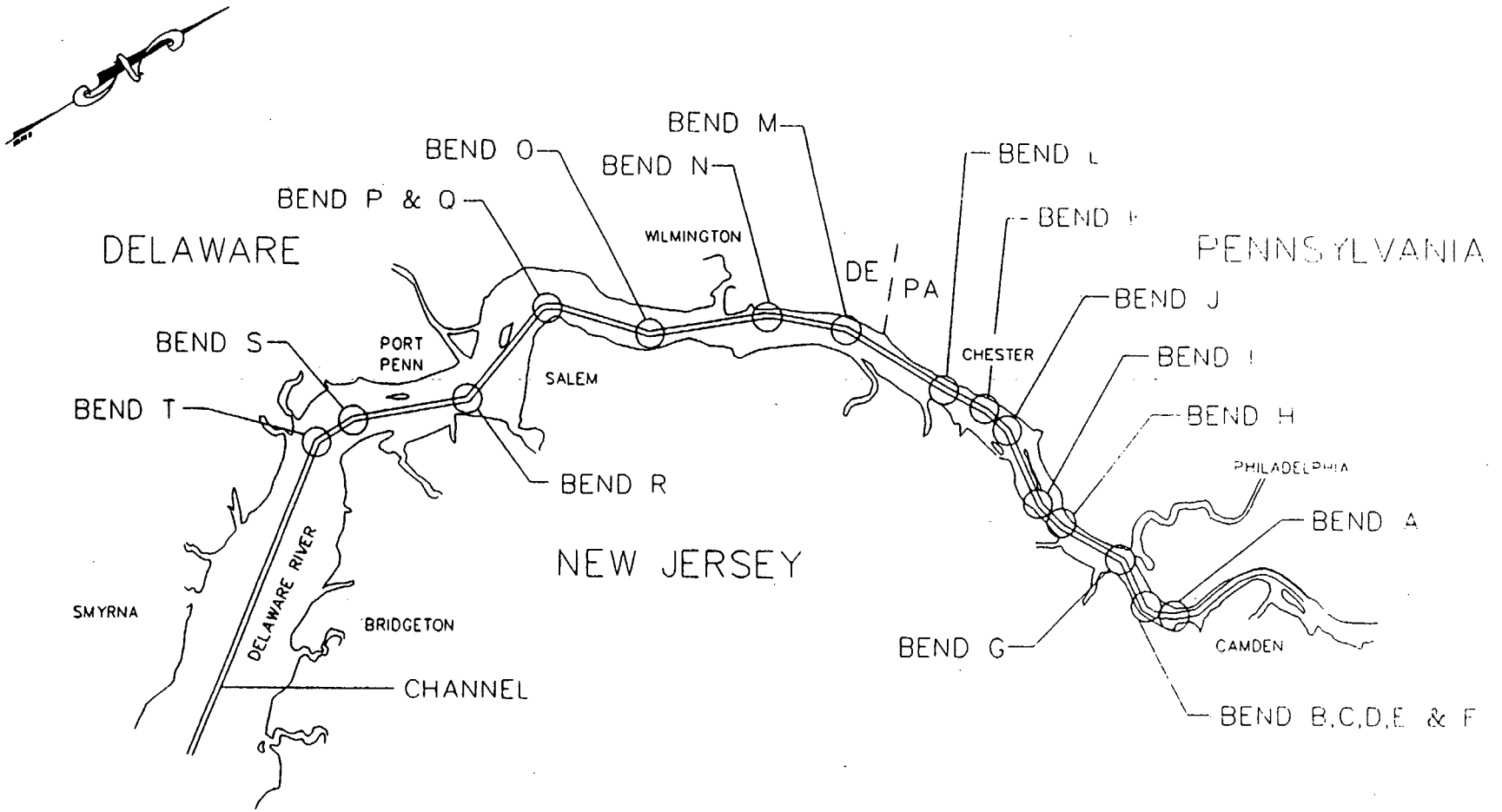
Sediment samples were collected from the river bottom with two types of grab samplers, the PONAR Grab and the Wildco-Petersen Grab. Although both units are capable of penetrating a minimum of 6 inches into the bottom substrate, most samples were collected using the Petersen Grab. Its larger size and greater weight allowed better penetration in gravelly and sandy substrate and more effective sampling in strong tidal currents.

Sufficient sediment to run all biological, chemical and geotechnical tests was collected at all sample locations except one. The sample volume fluctuated from 10 to 15 gallons, depending upon the consistency of the sediment and the needs of the bioassay laboratory. Of 45 sites, only the Chester Range sediment was not sampled successfully. Several hours of sampling, as well as expansion of the sample area, produced no usable sample. Only rock and very small quantities of gravel were found in the area.

The sediment samples were handled using appropriate stainless steel implements (grabs, trowels, bowls, etc.). After each sample was collected, the implements were cleaned in the following sequence: non-phosphate detergent and tap water rinse, deionized water rinse, 10% nitric acid rinse, deionized water rinse, hexane rinse, deionized water rinse, acetone rinse, and a final deionized water rinse.

After collection, sediment samples used for chemical analysis were placed in appropriately washed glass storage containers. Samples used for bioassay were placed into decontaminated and lined five-gallon plastic buckets, and geotechnical samples were placed in double-lined Ziplock baggies. All sample containers were clearly labeled with the sample location and time, then placed on ice. Upon delivery to the laboratory, the samples were stored in a refrigerated cooler at 4°Celsius until testing was initiated.

A sufficient quantity of water for all biological and chemical tests was collected from each of the six water sample locations with a non-contaminating peristaltic pump. Prior to collection of water at each site, the pump and tubing were flushed with the equivalent of ten times the volume of the collection tubing. The sample tube intake was then positioned at least five meters away from potential contamination sources at mid-depth.



DELAWARE RIVER
COMPREHENSIVE NAVIGATION
STUDY
MAIN CHANNEL
DEEPENING
BEND WIDENING
LOCATIONS
PHILADELPHIA DISTRICT,
CORPS OF ENGINEERS

SCALE: APPROX. 1"=7 MI.

FIGURE 1

BEND WIDENING SEDIMENT/WATER SAMPLE LOCATIONS ON THE DELAWARE RIVER 1993.

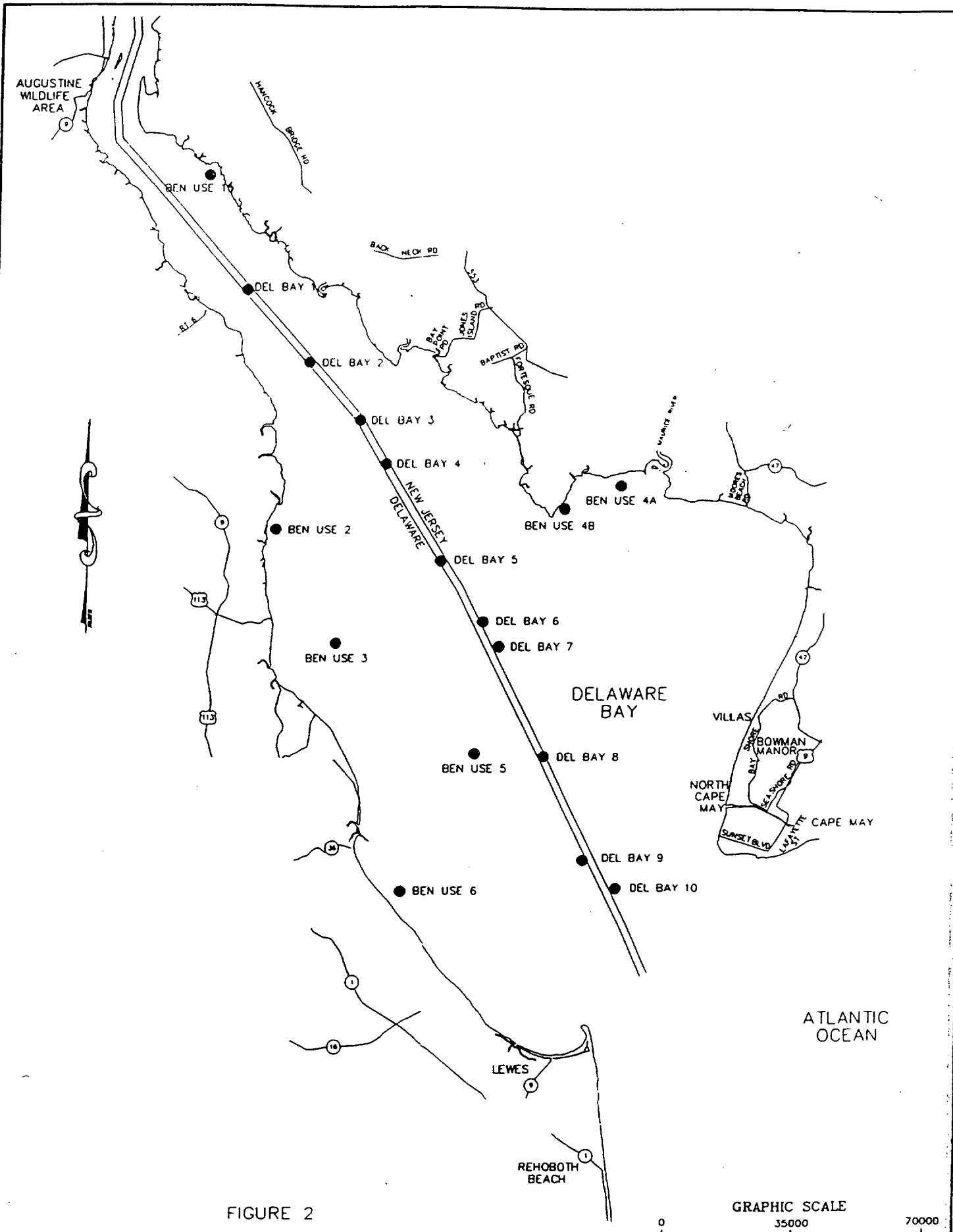


FIGURE 2

DELAWARE BAY AND BENEFICIAL USE SITES
SEDIMENT/WATER SAMPLE LOCATIONS DURING 1993

All water samples were stored in appropriate sample containers clearly labeled with the sample location and time and placed on ice. In the laboratory, the samples were kept at 4° Celsius until laboratory analysis was conducted.

2.2 Geotechnical Analyses

Each sediment sample was transported to the soils laboratory where grain size analyses were conducted employing procedures outlined in ASTM Method D2487. In addition, total organic carbon was measured through loss on ignition.

2.3 Materials - Water Column Bioassays

2.3.1 Freshwater Sites

Test organisms for the freshwater site bioassays were fathead minnow (Pimephales promelas), a freshwater cladoceran (Ceriodaphnia dubia), and a freshwater amphipod (Hyalella azteca). Larval fathead minnows used in testing were obtained from Aquatic Research Organisms (ARO), a commercial laboratory located in Hampton, New Hampshire. The minnows were hatched the morning prior to test initiation at the commercial laboratory, placed in a cubitainer containing culture water, and shipped overnight to the aquatic testing laboratory. Minnows were acclimated to laboratory environmental conditions for several hours before test initiation. No larval mortality was observed during the acclimation period. The larvae were approximately 24 hours old at test initiation.

Stock cultures of freshwater cladocera were obtained from ARO. The morning prior to test initiation adult C. dubia were placed in a cubitainer containing 20% dilute mineral water (DMW) culture media and shipped overnight to the laboratory. A sufficient number of adults were placed in the cubitainer to yield enough neonates to begin testing upon their arrival at the laboratory.

Juvenile H. azteca used in testing were obtained from ARO. The stock was originally obtained by ARO from the U.S. Fish and Wildlife Service, and the lot number of the organisms used in testing was 100093Ha. The organisms were placed in a cubitainer containing culture water and shipped overnight to the laboratory RMC. The amphipods were acclimated to laboratory conditions for 2 days prior to test initiation, and were approximately eight days old at the start of the test.

Delaware River water collected from the sample sites was used to prepare the sediment elutriates and the elutriate dilutions. Each sediment sample site had a corresponding Delaware River site from which water samples were obtained (see Table 2). Laboratory control water consisted of dilute mineral water (20% DMW) prepared according to procedures outlined in US EPA (1989a). Distilled water was decanted through a deionizing column (Barnstead mixed bed) and diluted in a ratio of two parts Perrier water to eight parts deionized water. The DMW was aerated for at least 24 hours prior to use as either acclimation water or control water.

2.3.2 Estuarine Sites

Test organisms for the estuarine sites were sheepshead minnow (Cyprinodon variegatus), mysid shrimp (Mysidopsis bahia), and American Oyster (Crassostrea virginica). Juvenile sheepshead minnow used in testing were obtained from ARO. The minnows were placed in a cubitainer containing culture water and

Table 2: Sediment/Water Samples for Water Column Bioassays

Sediment Sample	Water Sample
Beckett Street Terminal	Mifflin Range
Range M	"
Bend AF	"
W. Horseshoe Range	"
Bend G	"
Mifflin Range	"
Bend H	"
Billingsport Range	"
Bend I	Chester Range
Tinicum Range	"
Bend J	"
Eddystone Range	"
Bend K	"
Chester Range	"
Bend L	"
Marcus Hook Range	Bellevue Range
Bend M	"
Bellevue Range	"
Bend N	"
Cherry Island Range	Deepwater Range
Bend O	"
Deepwater Point Range	"
Bend PQ	"
New Castle Range	"
Bend R	"
Reedy Island Range	Baker Range
Bend S	"
Baker Range	"
Bend T	"
Delaware Bay 1	"
Delaware Bay 2	Miah Maull
Delaware Bay 3	"
Delaware Bay 4	"
Delaware Bay 5	"
Delaware Bay 6	"
Delaware Bay 7	"
Delaware Bay 8	"
Delaware Bay 9	"
Delaware Bay 10	"

shipped to the laboratory. The fish were acclimated to test salinity and laboratory conditions for one day prior to test initiation.

Larval mysid shrimp used in testing were obtained from ARO. The organisms were placed in a cubitainer containing culture water and shipped overnight to the laboratory. The mysids were acclimated to laboratory conditions for several hours prior to test initiation. The mysids were four days old at test initiation.

Adult oysters in spawning condition were obtained through ARO. The oysters were collected from the southern Chesapeake Bay and were conditioned to the proper salinity. The organisms were then placed in a cooler packed with ice and shipped overnight to the laboratory. The organisms were acclimated to laboratory conditions for 24 hours, after which they were induced to spawn. Fertilized embryos were used to initiate the tests approximately two hours after fertilization.

Delaware River or Bay water collected from the Baker Range and Miah Maull sites was used to prepare the elutriate and the elutriate dilutions. Each estuarine sediment sample was paired with a representative Delaware River or Bay water sample (Table 2).

Artificial sea water, prepared according to procedures outlined in US EPA (1989a), was used as the control water. Forty Fathoms artificial sea salt was used to prepare artificial sea water with a salinity of 25 ± 2 parts per trillion (ppt). The sea water was aerated prior to use as overlying water.

2.4 Materials - Whole Sediment Bioassays

Test organisms for whole sediment bioassays were the amphipod Ampelisca abdita, the clam worm Nereis virens, and hardshell clam Mercenaria mercenaria. Immature A. abdita were field collected by East Coast Amphipod, a commercial laboratory located in Kingston, Rhode Island. The amphipods were collected in Fishing Cove, Wickford Harbor by Christopher McManis. The organisms were placed in plastic jars containing site water and site sediment and shipped overnight to the laboratory. The amphipods were acclimated to laboratory test temperatures and salinity for 24 hours prior to test initiation. No mortality was observed during the acclimation period. The organisms were sieved using a 0.5 millimeters (mm) mesh and randomly distributed into the test chambers. The amphipods were of approximately uniform size at test initiation, with a size range of two to four mm.

N. virens were field collected by ARO in Maine. The worms were packed in seaweed to keep them moist and shipped overnight to the laboratory. The worms were acclimated to laboratory conditions for two days prior to test initiation. Minimal mortality was observed during the acclimation period. The worms were of approximately uniform size at test initiation, with an average length of 6.3 centimeters (cms).

Hard shell clams (M. mercenaria) were obtained through ARO. The clams were collected from the southern Chesapeake Bay, packed in newspaper in a cooler, and shipped overnight to the laboratory. The organisms were acclimated to laboratory conditions for 24 hours. The clams were of approximately uniform size at test initiation, with an average hinge length of two to four cm.

Water used over the sediment consisted of artificial sea water prepared according to procedures outlined in US EPA (1989a). Forty Fathoms artificial sea salt was used to prepare water with a salinity of 25 ± 2 ppt. The artificial sea water was aerated prior to use.

Control sediment used for the control test was collected from the same site and at the same time the test organisms were collected.

Reference sediments for the whole sediment bioassays were collected from the six beneficial use sites. See Table 3 to match Delaware Bay test sites with corresponding beneficial use sites.

2.5 Materials - Bioaccumulation Tests

Hard shell clams (M. mercenaria) field collected by ARO from the southern Chesapeake Bay were the test organisms for the bioaccumulation tests. The clams were packed in newspaper to keep them moist and shipped overnight to the laboratory. The clams were acclimated to laboratory conditions for 24 hours prior to test initiation. No mortality was observed during the acclimation period. The clams were of approximately uniform size at test initiation, with an average hinge length of two to four cm.

Artificial sea water was used as the overlying water for the bioaccumulation tests. The artificial sea water was prepared according to procedures outlined in US EPA (1989a) and was used as the water source in the toxicity tests. Forty Fathoms artificial sea salt was used to prepare artificial sea water with a salinity of 25 ± 2 ppt. The sea water was aerated prior to use.

The material tested was sediment collected from candidate channel enlargement sites in Delaware Bay. The five sites with the greatest percentage of silt and clay were selected as the test sites. These five sites were then paired with their corresponding beneficial use site (Table 4).

2.6 Methods - Water Column Bioassays

Forty-eight hour static acute water column bioassays of sediment elutriates were conducted for 28 riverine points and ten bay samples. Freshwater test organisms included fathead minnow (Pimephales promelas), water flea (Ceriodaphnia dubia), and the amphipod Hyalella azteca. Estuarine test organisms included sheepshead minnow (Cyprinodon variegatus), American oyster (Crassostrea virginica), and mysid shrimp (Mysidopsis bahia).

Sediment elutriates were prepared at the laboratory environmental chemistry laboratory (RMC Analytics) in a sediment-to-water ratio of 1:4 on a volume basis. Two dilutions were prepared from the 100% elutriate sample using unfiltered river water, 10% and 5%. Subsamples of each dilution, unfiltered river or bay water and laboratory control water, were analyzed for total suspended solids (Table 5). Laboratory Certificates of Analysis are contained in Appendix C.

The tests consisted of two controls, laboratory water and unfiltered river or bay water, and a series of elutriate dilutions to which the organisms were exposed for 48 hours. Three concentrations of elutriate were tested, 100%, 10%, and 5%. Five replicates of each dilution and the controls were set up. The test temperature was maintained at 25 ± 2°C. Salinity of the bay tests was maintained at 25 ± 2 ppt.

Temperature, dissolved oxygen, pH, ammonia, and salinity were monitored in one replicate of each bioassay test dilution at the start of the test and at test termination (Tables 6 through 8). Dissolved oxygen was measured with a YSI Model 51 meter, salinity with a YSI Model 33 S-C-T meter, ammonia with a La Motte test kit, and temperature and pH with a Corning deluxe field system meter.

Table 3: Test/Reference Sediment Samples for Whole Sediment Bioassays

Test Sediment	Sediment Type	Reference Sediment	Beneficial Use Option
Delaware Bay #1	Silt	BUS[1] 2	Wetland Creation
Delaware Bay #2	Sand	BUS 1	Island Creation
Delaware Bay #3	Silt	BUS 2	Wetland Creation
Delaware Bay #4	Sand	BUS 3	Sand Stockpile
Delaware Bay #5	Sand	BUS 3	Sand Stockpile
Delaware Bay #6	Sand	BUS 5	Island Creation
Delaware Bay #7	Silt	BUS 4	Wetland Creation
Delaware Bay #8	Sand	BUS 5	Island Creation
Delaware Bay #9	Sand	BUS 6	Sand Stockpile
Delaware Bay #10	Sand	BUS 6	Sand Stockpile

[1]Beneficial Use Site

Table 4: Delaware Bay Sediment - Percent Silt and Clay

	Percent Silt and Clay	Bioaccumulation Test Sample	Beneficial Use Site
Delaware Bay #1	97.2	1	2
Delaware Bay #2	0.4		
Delaware Bay #3	0.7		
Delaware Bay #4	8.9	3	3
Delaware Bay #5	59.9	2	3
Delaware Bay #6	5.1	4	5
Delaware Bay #7	0.5		
Delaware Bay #8	0.3		
Delaware Bay #9	0.4		
Delaware Bay #10	2.3	5	6

Table 5: Physical Data/Elutriate Total Suspended Solids

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 48 hour Acute Water Column Bioassays
DATE: 10 September 1993 through 12 November 1993
DATA: Total Suspended Solids (mg/L)

Sample	Result (mg/L)
Laboratory water	9
Mifflin Range water	14
Beckett Street Terminal - 5%	53
Beckett Street Terminal - 10%	165
Beckett Street Terminal - 100%	1,530
Range M - 5%	33
Range M - 10%	274
Range M - 100%	308
Bend AF - 5%	11
Bend AF - 10%	30
Bend AF - 100%	408
W. Horseshoe Range - 5%	11
W. Horseshoe Range - 10%	23
W. Horseshoe Range - 100	28
Bend G - 5%	16
Bend G - 10%	10
Bend G - 100%	434
Mifflin Range - 5%	13
Mifflin Range - 10%	17
Mifflin Range - 100%	372
Bend H - 5%	14
Bend H - 10%	126
Bend H - 100%	1,840
Billingsport Range - 5%	19
Billingsport Range - 10%	31
Billingsport Range - 100%	1,310
Chester Range Water	4
Bend I - 5%	11
Bend I - 10%	17
Bend I - 100%	231
Tinicum Range - 5%	10
Tinicum Range - 10%	19
Tinicum Range - 100%	131
Bend J - 5%	15
Bend J - 10%	20
Bend J - 100%	37
Eddystone Range - 5%	14
Eddystone Range - 10%	16
Eddystone Range - 100%	156

Table 5: (Continued)

Sample	Result (mg/L)
Bend K - 5%	21
Bend K - 10%	29
Bend K - 100%	592
Bend L - 5%	21
Bend L - 10%	32
Bend L - 100%	406
Bellevue Range Water	13
Marcus Hook Range - 5%	13
Marcus Hook Range - 10%	16
Marcus Hook Range - 100%	102
Bend M - 5%	6
Bend M - 10%	4
Bend M - 100%	28
Bellevue Range - 5%	5
Bellevue Range - 10%	22
Bellevue Range - 100%	31
Bend N - 5%	24
Bend N - 10%	32
Bend N - 100%	324
Deepwater Range Water	23
Cherry Island Range - 5%	40
Cherry Island Range - 10%	40
Cherry Island Range - 100%	30
Bend O - 5%	38
Bend O - 10%	37
Bend O - 100%	29
Deepwater Pt. Range - 5%	39
Deepwater Pt. Range - 10%	40
Deepwater Pt. Range - 100%	138
Bend PQ - 5%	54
Bend PQ - 10%	67
Bend PQ - 100%	171
New Castle Range - 5%	40
New Castle Range - 10%	55
New Castle Range - 100%	276
Bend R - 5%	56
Bend R - 10%	47
Bend R - 100%	414
Baker Range Water	18
Reedy Island Range - 5%	30
Reedy Island Range - 10%	33
Reedy Island Range - 100%	166

Table 5: (Continued)

Sample	Result (mg/L)
Bend S - 5%	36
Bend S - 10%	39
Bend S - 100%	144
Baker Range - 5%	33
Baker Range - 10%	38
Baker Range - 100%	210
Bend T - 5%	32
Bend T - 10%	39
Bend T - 100%	209
Delaware Bay #1 - 5%	23
Delaware Bay #1 - 10%	36
Delaware Bay #1 - 100%	839
Miah Maull Range Water	42
Delaware Bay #2 - 5%	69
Delaware Bay #2 - 10%	63
Delaware Bay #2 - 100%	326
Delaware Bay #3 - 5%	50
Delaware Bay #3 - 10%	54
Delaware Bay #3 - 100%	161
Delaware Bay #4 - 5%	126
Delaware Bay #4 - 10%	59
Delaware Bay #4 - 100%	84
Delaware Bay #5 - 5%	50
Delaware Bay #5 - 10%	68
Delaware Bay #5 - 100%	88
Delaware Bay #6 - 5%	52
Delaware Bay #6 - 10%	22
Delaware Bay #6 - 100%	123
Delaware Bay #7 - 5%	56
Delaware Bay #7 - 10%	50
Delaware Bay #7 - 100%	129
Delaware Bay #8 - 5%	86
Delaware Bay #8 - 10%	91
Delaware Bay #8 - 100%	286
Delaware Bay #9 - 5%	64
Delaware Bay #9 - 10%	119
Delaware Bay #9 - 100%	259
Delaware Bay #10 - 5%	197
Delaware Bay #10 - 10%	105
Delaware Bay #10 - 100%	265

Table 6: Physical/Chemical Measurements - Water Sample Control Sites (Freshwater and Estuarine)

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 48-hour Acute Water Column Bioassays
DATE: 8 September thru 14 November 1993
DATA: Temperature (C), Dissolved oxygen (mg/L), pH, Salinity (ppt), and Ammonia nitrogen (ppm).

FRESHWATER Time	Lab Control	Mifflin Range	Chester Range	Bellevue Range	Deepwater Range	Baker Range	ESTUARINE Time	Lab Control	Miah Maull Range
Fathead Minnow							**Sheepshead Minnow**		
0 hour							**0 hour**		
Temp	26.2	25.8	25.2	26.0	24.8	25.1	Temp	25.6	25.3
D.O.	8.0	8.0	8.0	7.9	8.2	8.0	D.O.	6.2	6.2
pH	7.97	7.50	7.73	7.73	7.84	7.97	pH	8.03	8.00
Salinity	0.00	0.00	0.4	0.8	1.5	7.6	Salinity	18.2	17.5
Ammonia	0.00	0.03	0.03	<0.02	0.08	0.04	Ammonia	0.00	0.02
48 hour							**48 hour**		
Temp	26.0	25.2	25.6	26.1	24.6	24.7	Temp	25.4	25.4
D.O.	7.8	7.8	7.6	7.6	7.8	7.6	D.O.	5.8	5.8
pH	7.99	7.54	7.69	7.81	7.60	7.84	pH	7.90	7.96
Salinity	0.00	0.00	0.4	0.8	1.5	7.6	Salinity	18.2	17.5
Ammonia	0.00	0.03	0.03	<0.02	0.08	0.04	Ammonia	0.00	0.02
Ceriodaphnia dubia							**American Oyster**		
0 hour							**0 hour**		
Temp	26.2	25.8	25.2	26.0	24.8	25.1	Temp	25.6	25.3
D.O.	8.0	8.0	8.0	7.9	8.2	8.0	D.O.	6.2	6.2
pH	7.97	7.50	7.73	7.73	7.84	7.97	pH	8.03	8.00
Salinity	0.00	0.00	0.4	0.8	1.5	7.6	Salinity	18.2	17.5
Ammonia	0.00	0.03	0.03	<0.02	0.08	0.04	Ammonia	0.00	0.02
48 hour							**48 hour**		
Temp	25.9	25.0	25.1	25.8	24.5	25.0	Temp	25.5	25.6
D.O.	7.9	7.9	7.9	7.8	8.1	7.9	D.O.	6.2	6.2
pH	7.96	7.49	7.70	7.76	7.81	7.91	pH	8.01	8.00
Salinity	0.00	0.00	0.4	0.8	1.5	7.6	Salinity	18.2	17.5
Ammonia	0.00	0.03	0.03	<0.02	0.08	0.04	Ammonia	0.00	0.02
Hyalella azteca							**Mysid Shrimp**		
0 hour							**0 hour**		
Temp	26.2	25.8	25.2	26.0	24.8	25.1	Temp	25.6	25.3
D.O.	8.0	8.0	8.0	7.9	8.2	8.0	D.O.	6.2	6.2
pH	7.97	7.50	7.73	7.73	7.84	7.97	pH	8.03	8.00
Salinity	0.00	0.00	0.4	0.8	1.5	7.6	Salinity	18.2	17.5
Ammonia	0.00	0.03	0.03	<0.02	0.08	0.04	Ammonia	0.00	0.02
48 hour							**48 hour**		
Temp	25.8	25.1	25.2	25.8	24.4	24.9	Temp	25.4	25.6
D.O.	7.9	7.9	7.8	7.8	8.0	7.8	D.O.	6.0	6.0
pH	7.98	7.51	7.69	7.78	7.76	7.89	pH	8.00	7.98
Salinity	0.00	0.00	0.4	0.8	1.5	7.6	Salinity	18.2	17.5
Ammonia	0.00	0.03	0.03	<0.02	0.08	0.04	Ammonia	0.00	0.02

Table 7: Physical/Chemical Measurements - Freshwater Water Column Sample Sites

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 48-hour Acute Water Column Bioassays
DATE: September 8 thru October 23, 1993
DATA: Temperature (C), Dissolved oxygen (mg/L), pH, Salinity (ppt), and Ammonia nitrogen (ppm).

	Beckett Street			Range M			Bend AF			W. Horseshoe Range		
Time	5%	10%	100%	5%	10%	100%	5%	10%	100%	5%	10%	100%
Fathead Minnow												
0 hour												
Temp	25.7	25.0	24.5	25.2	25.0	24.3	25.4	25.3	24.4	25.4	25.3	24.4
D.O.	8.0	8.0	7.6	8.0	8.0	7.8	8.0	8.0	7.7	8.0	8.0	7.6
pH	7.45	7.46	7.08	7.43	7.45	7.25	7.55	7.57	7.31	7.64	7.60	7.56
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.05	0.5	0.03	0.03	0.4	0.03	0.04	0.45	0.03	0.05	0.30
48 hour												
Temp	25.2	25.3	25.0	25.1	25.1	25.1	25.0	25.1	25.0	25.2	25.2	25.1
D.O.	7.6	7.6	7.0	7.5	7.6	7.3	7.6	7.5	7.1	7.6	7.5	7.1
pH	7.49	7.49	7.12	7.51	7.54	7.31	7.57	7.63	7.43	7.67	7.65	7.61
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.04	0.05	0.5	0.03	0.03	0.4	0.03	0.04	0.45	0.03	0.04	0.30
Ceriodaphnia dubia												
0 hour												
Temp	25.7	25.0	24.5	25.2	25.0	24.3	25.4	25.3	24.4	25.4	25.3	24.4
D.O.	8.0	8.0	7.6	8.0	8.0	7.8	8.0	8.0	7.7	8.0	8.0	7.6
pH	7.45	7.46	7.08	7.43	7.45	7.25	7.55	7.57	7.31	7.64	7.60	7.56
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.05	0.5	0.03	0.03	0.4	0.03	0.04	0.45	0.03	0.05	0.30
48 hour												
Temp	25.3	25.3	25.1	24.9	24.9	24.9	24.9	24.9	24.8	25.0	24.9	24.9
D.O.	7.9	7.9	7.5	7.9	7.9	7.7	7.9	7.9	7.6	7.9	7.9	7.5
pH	7.41	7.43	7.03	7.40	7.42	7.22	7.54	7.56	7.32	7.61	7.59	7.54
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.05	0.5	0.03	0.03	0.4	0.03	0.04	0.45	0.03	0.04	0.3
Hyalella azteca												
0 hour												
Temp	25.7	25.0	24.5	25.2	25.0	24.3	25.4	25.3	24.4	25.4	25.3	24.4
D.O.	8.0	8.0	7.6	8.0	8.0	7.8	8.0	8.0	7.7	8.0	8.0	7.6
pH	7.45	7.46	7.08	7.43	7.45	7.25	7.55	7.57	7.31	7.64	7.60	7.56
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.05	0.5	0.03	0.03	0.4	0.03	0.04	0.45	0.03	0.05	0.30
48 hour												
Temp	25.2	25.3	25.0	25.0	24.9	24.8	25.0	24.9	24.8	25.0	25.0	24.9
D.O.	7.9	7.9	7.5	7.9	7.9	7.7	7.9	7.9	7.6	7.9	7.9	7.5
pH	7.47	7.45	7.10	7.46	7.47	7.27	7.55	7.54	7.37	7.65	7.63	7.54
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.05	0.5	0.03	0.03	0.4	0.03	0.04	0.45	0.03	0.04	0.3

Table 7: (Continued)

Time	Bend G 5%	Bend G 10%	Bend G 100%	Mifflin Range 5%	Mifflin Range 10%	Mifflin Range 100%	Bend H 5%	Bend H 10%	Bend H 100%	Billingsport Range 5%	Billingsport Range 10%	Billingsport Range 100%
Fathead Minnow												
0 hour												
Temp	25.0	25.2	24.5	25.0	24.8	24.5	24.4	24.2	24.4	24.5	24.4	24.6
D.O.	8.0	8.0	7.7	8.0	8.0	7.7	8.0	8.0	7.7	8.0	8.0	7.6
pH	7.49	7.53	7.32	7.51	7.54	7.24	7.53	7.47	7.12	7.47	7.51	7.38
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.04	0.3	0.03	0.03	0.4	0.03	0.03	0.2	0.03	0.03	0.25
48 hour												
Temp	25.1	25.1	25.0	25.2	25.2	25.2	25.1	25.2	25.1	25.0	25.0	25.0
D.O.	7.6	7.4	7.0	7.5	7.5	7.2	7.6	7.5	7.3	7.5	7.5	7.0
pH	7.53	7.53	7.37	7.49	7.53	7.27	7.56	7.51	7.19	7.52	7.5	7.41
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.05	0.3	0.03	0.04	0.4	0.03	0.03	0.2	0.03	0.03	0.25
Ceriodaphnia dubia												
0 hour												
Temp	25.0	25.2	24.5	25.0	24.8	24.5	24.4	24.2	24.4	24.5	24.4	24.6
D.O.	8.0	8.0	7.7	8.0	8.0	7.7	8.0	8.0	7.7	8.0	8.0	7.6
pH	7.49	7.53	7.32	7.51	7.54	7.24	7.53	7.47	7.12	7.47	7.51	7.38
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.04	0.3	0.03	0.03	0.4	0.03	0.03	0.2	0.03	0.03	0.25
48 hour												
Temp	25.1	25.0	25.0	25.1	25.0	24.9	25.0	25.1	25.2	24.9	24.9	24.9
D.O.	7.9	7.9	7.6	7.9	7.9	7.6	7.9	7.9	7.6	7.9	7.9	7.5
pH	7.47	7.50	7.33	7.53	7.52	7.25	7.50	7.48	7.14	7.47	7.50	7.39
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.04	0.3	0.03	0.03	0.4	0.03	0.03	0.2	0.03	0.03	0.25
Hyalella azteca												
0 hour												
Temp	25.0	25.2	24.5	25.0	24.8	24.5	24.4	24.2	24.4	24.5	24.4	24.6
D.O.	8.0	8.0	7.7	8.0	8.0	7.7	8.0	8.0	7.7	8.0	8.0	7.6
pH	7.49	7.53	7.32	7.51	7.54	7.24	7.53	7.47	7.12	7.47	7.51	7.38
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.04	0.3	0.03	0.03	0.4	0.03	0.03	0.2	0.03	0.03	0.25
48 hour												
Temp	25.1	25.1	25.0	25.1	25.0	25.1	24.9	25.1	25.1	25.0	25.0	24.9
D.O.	7.9	7.9	7.6	7.9	7.9	7.6	7.9	7.9	7.6	7.9	7.9	7.5
pH	7.52	7.51	7.34	7.50	7.50	7.30	7.54	7.46	7.15	7.43	7.49	7.41
Salinity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.03	0.04	0.3	0.03	0.03	0.4	0.03	0.03	0.2	0.03	0.03	0.25

Table 7: (Continued)

Time	Bend I 5%	Bend I 10%	Bend I 100%	Tinicum Range 5%	Tinicum Range 10%	Tinicum Range 100%	Bend J 5%	Bend J 10%	Bend J 100%	Eddystone Range 5%	Eddystone Range 10%	Eddystone Range 100%
Fathead Minnow												
0 hour												
Temp	25.2	25.2	25.4	25.3	25.4	25.6	25.2	25.3	25.5	25.3	25.3	25.3
D.O.	8.0	7.9	7.8	8.0	8.0	7.9	8.0	8.0	8.0	8.0	8.0	8.0
pH	7.68	7.61	7.47	7.69	7.64	7.59	7.69	7.66	7.54	7.7	7.68	7.65
Salinity	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ammonia	0.04	0.06	0.5	0.03	0.04	0.45	0.03	0.04	0.14	0.03	0.03	0.08
48 hour												
Temp	25.7	25.7	25.8	25.6	25.7	25.7	25.6	25.6	25.6	25.6	25.6	25.5
D.O.	7.5	7.5	7.3	7.6	7.5	7.3	7.6	7.6	7.5	7.5	7.6	7.4
pH	7.63	7.54	7.35	7.60	7.57	7.46	7.61	7.59	7.49	7.65	7.61	7.57
Salinity	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ammonia	0.04	0.06	0.5	0.03	0.04	0.45	0.03	0.04	0.14	0.03	0.03	0.08
Ceriodaphnia dubia												
0 hour												
Temp	25.2	25.2	25.4	25.3	25.4	25.6	25.2	25.3	25.5	25.3	25.3	25.3
D.O.	8.0	7.9	7.8	8.0	8.0	7.9	8.0	8.0	8.0	8.0	8.0	8.0
pH	7.68	7.61	7.47	7.69	7.64	7.59	7.69	7.66	7.54	7.7	7.68	7.65
Salinity	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ammonia	0.04	0.06	0.50	0.03	0.04	0.45	0.03	0.04	0.14	0.03	0.03	0.08
48 hour												
Temp	25.3	25.4	25.5	25.2	25.1	25.2	25.0	25.1	25.1	25.3	25.4	25.4
D.O.	7.9	7.8	7.7	7.9	7.9	7.8	7.9	7.9	7.9	7.9	7.9	7.9
pH	7.65	7.59	7.45	7.65	7.61	7.55	7.66	7.63	7.51	7.67	7.65	7.64
Salinity	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ammonia	0.04	0.06	0.5	0.03	0.04	0.45	0.03	0.04	0.14	0.03	0.03	0.08
Hyalella azteca												
0 hour												
Temp	25.2	25.2	25.4	25.3	25.4	25.6	25.2	25.3	25.5	25.3	25.3	25.3
D.O.	8.0	7.9	7.8	8.0	8.0	7.9	8.0	8.0	8.0	8.0	8.0	8.0
pH	7.68	7.61	7.47	7.69	7.64	7.59	7.69	7.66	7.54	7.7	7.68	7.65
Salinity	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ammonia	0.04	0.06	0.50	0.03	0.04	0.45	0.03	0.04	0.14	0.03	0.03	0.08
48 hour												
Temp	25.3	25.3	25.3	25.3	25.3	25.2	24.9	24.9	25.0	25.3	25.5	25.5
D.O.	7.9	7.8	7.7	7.9	7.9	7.8	7.9	7.8	7.8	7.9	7.9	7.9
pH	7.64	7.56	7.41	7.62	7.59	7.51	7.62	7.60	7.49	7.67	7.62	7.60
Salinity	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ammonia	0.04	0.06	0.5	0.03	0.04	0.45	0.03	0.04	0.14	0.03	0.03	0.08

Table 7: (Continued)

Time	Bend K 5%	Bend K 10%	Bend K 100%	Chester Range 5%	Chester Range 10%	Chester Range 100%	Bend L 5%	Bend L 10%	Bend L 100%	Marcus Hook Range 5%	Marcus Hook Range 10%	Marcus Hook Range 100%
Fathead Minnow												
0 hour												
Temp	25.2	25.2	25.4	0.00	0.00	0.00	25.2	25.3	25.5	25.7	25.8	25.1
D.O.	7.9	7.8	7.6	0.00	0.00	0.00	7.9	7.9	7.7	7.9	7.8	7.6
pH	7.71	7.68	7.63	0.00	0.00	0.00	7.72	7.69	7.61	7.84	7.86	7.80
Salinity	0.4	0.4	0.4	0.00	0.00	0.00	0.4	0.4	0.4	0.8	0.8	0.8
Ammonia	0.03	0.04	0.30	0.00	0.00	0.00	0.03	0.03	0.20	0.02	0.03	0.45
48 hour												
Temp	25.6	25.6	25.6	0.00	0.00	0.00	25.6	25.7	25.7	26.2	26.3	26.3
D.O.	7.5	7.4	7.0	0.00	0.00	0.00	7.5	7.5	7.1	7.6	7.5	7.3
pH	7.67	7.62	7.53	0.00	0.00	0.00	7.64	7.58	7.50	8.14	8.47	8.45
Salinity	0.4	0.4	0.4	0.00	0.00	0.00	0.4	0.4	0.4	0.8	0.8	0.8
Ammonia	0.03	0.04	0.30	0.00	0.00	0.00	0.03	0.03	0.20	0.02	0.04	0.45
Ceriodaphnia dubia												
0 hour												
Temp	25.2	25.2	25.4	0.00	0.00	0.00	25.2	25.3	25.5	25.7	25.8	25.1
D.O.	7.9	7.8	7.6	0.00	0.00	0.00	7.9	7.9	7.7	7.9	7.8	7.6
pH	7.71	7.68	7.63	0.00	0.00	0.00	7.72	7.69	7.61	7.84	7.86	7.80
Salinity	0.4	0.4	0.4	0.00	0.00	0.00	0.4	0.4	0.4	0.8	0.8	0.8
Ammonia	0.03	0.04	0.30	0.00	0.00	0.00	0.03	0.03	0.20	0.02	0.03	0.45
48 hour												
Temp	25.3	25.2	25.3	0.00	0.00	0.00	25.1	25.0	24.9	25.9	25.8	25.8
D.O.	7.8	7.7	7.5	0.00	0.00	0.00	7.8	7.8	7.6	7.8	7.8	7.5
pH	7.69	7.66	7.60	0.00	0.00	0.00	7.69	7.64	7.57	7.83	7.85	7.81
Salinity	0.4	0.4	0.4	0.00	0.00	0.00	0.4	0.4	0.4	0.8	0.8	0.8
Ammonia	0.03	0.04	0.30	0.00	0.00	0.00	0.03	0.03	0.20	0.02	0.03	0.45
Hyalella azteca												
0 hour												
Temp	25.2	25.2	25.4	0.00	0.00	0.00	25.2	25.3	25.5	25.7	25.8	25.1
D.O.	7.9	7.8	7.6	0.00	0.00	0.00	7.9	7.9	7.7	7.9	7.8	7.6
pH	7.71	7.68	7.63	0.00	0.00	0.00	7.72	7.69	7.61	7.84	7.86	7.80
Salinity	0.4	0.4	0.4	0.00	0.00	0.00	0.4	0.4	0.4	0.8	0.8	0.8
Ammonia	0.03	0.04	0.30	0.00	0.00	0.00	0.03	0.03	0.20	0.02	0.03	0.45
48 hour												
Temp	25.4	25.4	25.3	0.00	0.00	0.00	25.0	25.0	25.0	25.9	25.8	25.8
D.O.	7.8	7.6	7.4	0.00	0.00	0.00	7.8	7.8	7.5	7.8	7.8	7.5
pH	7.67	7.61	7.56	0.00	0.00	0.00	7.65	7.60	7.51	7.86	7.87	7.85
Salinity	0.4	0.4	0.4	0.00	0.00	0.00	0.4	0.4	0.4	0.8	0.8	0.8
Ammonia	0.03	0.04	0.30	0.00	0.00	0.00	0.03	0.03	0.20	0.02	0.03	0.45

Table 7: (Continued)

Time	Bend M 5%	Bend M 10%	Bend M 100%	Bellevue Range 5%	Bellevue Range 10%	Bellevue Range 100%	Bend N 5%	Bend N 10%	Bend N 100%	Cherry Island Range 5%	Cherry Island Range 10%	Cherry Island Range 100%
Fathead Minnow												
0 hour												
Temp	25.5	25.6	25.0	25.8	25.7	25.2	25.9	25.7	25.1	24.8	24.7	24.2
D.O.	7.9	7.8	7.7	7.9	7.8	7.7	7.9	7.8	7.8	8.2	8.0	7.9
pH	7.93	7.83	7.26	7.69	7.74	7.21	7.80	7.77	7.36	7.83	7.86	7.77
Salinity	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.5
Ammonia	0.02	0.04	0.40	0.03	0.04	0.50	0.02	0.02	0.20	0.20	0.40	1.0
48 hour												
Temp	26.5	26.1	26.2	26.3	26.3	26.3	26.3	26.3	26.0	24.5	24.4	24.4
D.O.	7.7	7.6	7.4	7.6	7.6	7.1	7.5	7.5	7.5	7.8	7.6	7.5
pH	8.13	8.06	7.83	7.90	7.93	7.59	7.68	7.75	7.74	7.67	7.65	7.54
Salinity	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.5
Ammonia	0.03	0.05	0.40	0.03	0.05	0.50	0.02	0.03	0.20	0.20	0.40	1.0
Ceriodaphnia dubia												
0 hour												
Temp	25.5	25.6	25.0	25.8	25.7	25.2	25.9	25.7	25.1	24.8	24.7	24.2
D.O.	7.9	7.8	7.7	7.9	7.8	7.7	7.9	7.8	7.8	8.2	8.0	7.9
pH	7.93	7.83	7.26	7.69	7.74	7.21	7.80	7.77	7.36	7.83	7.86	7.77
Salinity	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.5
Ammonia	0.02	0.04	0.40	0.03	0.04	0.50	0.02	0.02	0.20	0.20	0.40	1.0
48 hour												
Temp	25.9	25.9	25.9	25.9	25.9	26.0	26.0	26.0	26.0	24.6	24.6	24.7
D.O.	7.8	7.7	7.6	7.8	7.8	7.6	7.8	7.8	7.7	8.1	7.9	7.8
pH	7.91	7.82	7.30	7.71	7.73	7.33	7.78	7.76	7.41	7.80	7.81	7.71
Salinity	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.5
Ammonia	0.02	0.04	0.4	0.03	0.04	0.5	0.02	0.02	0.2	0.2	0.4	1.0
Hyalella azteca												
0 hour												
Temp	25.5	25.6	25.0	25.8	25.7	25.2	25.9	25.7	25.1	24.8	24.7	24.2
D.O.	7.9	7.8	7.7	7.9	7.8	7.7	7.9	7.8	7.8	8.2	8.0	7.9
pH	7.93	7.83	7.26	7.69	7.74	7.21	7.80	7.77	7.36	7.83	7.86	7.77
Salinity	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.5
Ammonia	0.02	0.04	0.40	0.03	0.04	0.50	0.02	0.02	0.20	0.20	0.40	1.0
48 hour												
Temp	25.9	25.9	25.9	26.0	26.0	26.0	25.9	26.0	25.9	24.5	24.5	24.5
D.O.	7.8	7.7	7.6	7.8	7.7	7.6	7.8	7.7	7.6	8.0	7.9	7.7
pH	7.90	7.79	7.36	7.74	7.76	7.40	7.73	7.74	7.43	7.79	7.80	7.71
Salinity	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.5
Ammonia	0.02	0.04	0.4	0.03	0.04	0.5	0.02	0.02	0.2	0.2	0.4	1.0

Table 7: (Continued)

Time	Bend O 5%	Bend O 10%	Bend O 100%	Deepwater Point Range 5%	Deepwater Point Range 10%	Deepwater Point Range 100%	Bend PQ 5%	Bend PQ 10%	Bend PQ 100%	New Castle Range 5%	New Castle Range 10%	New Castle Range 100%
Fathead Minnow												
0 hour												
Temp	24.8	24.8	24.4	24.7	24.7	24.0	24.8	24.7	24.6	24.6	24.7	24.6
D.O.	8.2	8.1	8.0	8.1	7.9	7.5	8.2	8.2	8.1	8.0	8.0	8.0
pH	7.80	7.78	7.73	7.81	7.80	7.79	7.80	7.75	7.68	7.82	7.79	7.74
Salinity	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ammonia	0.2	0.4	1.0	0.2	0.6	>1.0	0.08	0.14	0.4	0.2	0.4	1.0
48 hour												
Temp	24.5	24.5	24.5	24.4	24.3	24.5	24.5	24.3	24.3	24.6	24.5	24.5
D.O.	7.6	7.6	7.6	7.5	7.4	7.0	7.8	7.7	7.6	7.6	7.6	7.5
pH	7.65	7.61	7.53	7.68	7.68	7.66	7.66	7.63	7.59	7.67	7.67	7.68
Salinity	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ammonia	0.2	0.4	1.0	0.2	0.6	>1.0	0.08	0.14	0.4	0.2	0.4	1.0
Ceriodaphnia dubia												
0 hour												
Temp	24.8	24.8	24.4	24.7	24.7	24.0	24.8	24.7	24.6	24.6	24.7	24.6
D.O.	8.2	8.1	8.0	8.1	7.9	7.5	8.2	8.2	8.1	8.0	8.0	8.0
pH	7.80	7.78	7.73	7.81	7.80	7.79	7.80	7.75	7.68	7.82	7.79	7.74
Salinity	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ammonia	0.2	0.4	1.0	0.2	0.6	>1.0	0.08	0.14	0.4	0.2	0.4	1.0
48 hour												
Temp	24.5	24.5	24.6	24.4	24.4	24.6	24.4	24.6	24.5	24.6	24.6	24.8
D.O.	8.1	8.0	7.9	8.0	7.8	7.4	8.0	8.1	8.0	7.9	7.9	7.9
pH	7.76	7.71	7.67	7.77	7.74	7.73	7.75	7.70	7.61	7.76	7.73	7.69
Salinity	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ammonia	0.2	0.4	1.0	0.2	0.6	>1.0	0.08	0.14	0.4	0.2	0.4	1.0
Hyalella azteca												
0 hour												
Temp	24.8	24.8	24.4	24.7	24.7	24.0	24.8	24.7	24.6	24.6	24.7	24.6
D.O.	8.2	8.1	8.0	8.1	7.9	7.5	8.2	8.2	8.1	8.0	8.0	8.0
pH	7.80	7.78	7.73	7.81	7.80	7.79	7.80	7.75	7.68	7.82	7.79	7.74
Salinity	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ammonia	0.2	0.4	1.0	0.2	0.6	>1.0	0.08	0.14	0.4	0.2	0.4	1.0
48 hour												
Temp	24.5	24.5	24.5	24.5	24.6	24.6	24.4	24.5	24.6	24.5	24.6	24.7
D.O.	8.0	8.0	7.9	8.0	7.8	7.3	8.0	8.0	7.9	7.9	7.9	7.8
pH	7.75	7.72	7.64	7.74	7.75	7.73	7.73	7.71	7.63	7.74	7.74	7.68
Salinity	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ammonia	0.2	0.4	1.0	0.2	0.6	>1.0	0.08	0.14	0.4	0.2	0.4	1.0

Table 7: (Continued)

Time	Bend R			Reedy Island Range			Bend S			Baker Range		
	5%	10%	100%	5%	10%	100%	5%	10%	100%	5%	10%	100%
Fathead Minnow												
0 hour												
Temp	24.7	24.5	24.3	25.0	24.8	24.0	24.9	24.8	24.6	25.0	24.7	24.3
D.O.	8.1	8.0	7.9	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
pH	7.79	7.73	7.63	7.91	7.94	7.95	7.90	7.93	7.87	7.92	7.94	7.93
Salinity	1.5	1.5	1.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Ammonia	0.2	0.4	1.0	0.04	0.14	1.0	0.04	0.08	0.8	0.04	0.04	0.5
48 hour												
Temp	24.6	24.6	24.5	24.5	24.6	24.4	24.5	24.5	24.4	24.1	24.2	24.5
D.O.	7.6	7.5	7.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.4	7.0
pH	7.63	7.59	7.50	7.83	7.85	7.82	7.82	7.87	7.84	7.89	7.86	7.85
Salinity	1.5	1.5	1.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Ammonia	0.2	0.4	1.0	0.04	0.14	1.0	0.04	0.08	0.8	0.04	0.04	0.5
Ceriodaphnia dubia												
0 hour												
Temp	24.7	24.5	24.3	25.0	24.8	24.0	24.9	24.8	24.6	25.0	24.7	24.3
D.O.	8.1	8.0	7.9	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
pH	7.79	7.73	7.63	7.91	7.94	7.95	7.90	7.93	7.87	7.92	7.94	7.93
Salinity	1.5	1.5	1.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Ammonia	0.2	0.4	1.0	0.04	0.14	1.0	0.04	0.08	0.8	0.04	0.04	0.5
48 hour												
Temp	24.5	24.5	24.6	24.9	24.8	24.6	24.7	24.6	24.6	24.5	24.6	24.6
D.O.	8.0	7.9	7.8	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
pH	7.73	7.67	7.59	7.89	7.90	7.91	7.87	7.90	7.85	7.88	7.90	7.87
Salinity	1.5	1.5	1.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Ammonia	0.2	0.4	1.0	0.04	0.14	1.0	0.04	0.08	0.8	0.04	0.04	0.5
Hyalella azteca												
0 hour												
Temp	24.7	24.5	24.3	25.0	24.8	24.0	24.9	24.8	24.6	25.0	24.7	24.3
D.O.	8.1	8.0	7.9	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
pH	7.79	7.73	7.63	7.91	7.94	7.95	7.90	7.93	7.87	7.92	7.94	7.93
Salinity	1.5	1.5	1.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Ammonia	0.2	0.4	1.0	0.04	0.14	1.0	0.04	0.08	0.8	0.04	0.04	0.5
48 hour												
Temp	24.5	24.5	24.7	24.9	24.8	24.8	24.7	24.7	24.6	24.6	24.5	24.7
D.O.	8.0	7.9	7.8	7.9	7.9	7.8	7.9	7.8	7.8	7.8	7.8	7.8
pH	7.72	7.66	7.56	7.89	7.89	7.89	7.84	7.87	7.82	7.89	7.89	7.86
Salinity	1.5	1.5	1.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Ammonia	0.2	0.4	1.0	0.04	0.14	1.0	0.04	0.08	0.8	0.04	0.04	0.5

Table 7: (Continued)

Time	5%	Bend T 10%	100%
Fathead Minnow			
0 hour			
Temp	24.9	24.6	24.2
D.O.	8.0	8.0	8.0
pH	7.97	7.98	7.88
Salinity	7.6	7.6	7.6
Ammonia	0.04	0.14	1.0
48 hour			
Temp	24.4	24.4	24.5
D.O.	7.6	7.6	7.6
pH	7.87	7.85	7.80
Salinity	7.6	7.6	7.6
Ammonia	0.04	0.14	1.0
Ceriodaphnia dubia			
0 hour			
Temp	24.9	24.6	24.2
D.O.	8.0	8.0	8.0
pH	7.97	7.98	7.88
Salinity	7.6	7.6	7.6
Ammonia	0.04	0.14	1.0
48 hour			
Temp	24.6	24.5	24.5
D.O.	7.9	7.9	7.9
pH	7.92	7.91	7.87
Salinity	7.6	7.6	7.6
Ammonia	0.04	0.14	1.0
Hyalella azteca			
0 hour			
Temp	24.9	24.6	24.2
D.O.	8.0	8.0	8.0
pH	7.97	7.98	7.88
Salinity	7.6	7.6	7.6
Ammonia	0.04	0.14	1.0
48 hour			
Temp	24.5	24.6	24.5
D.O.	7.9	7.8	7.9
pH	7.87	7.89	7.85
Salinity	7.6	7.6	7.6
Ammonia	0.04	0.14	1.0

Table 8: Physical/Chemical Measurements - Estuarine Water Column Sample Sites

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 48-hour Acute Water Column Bioassays
DATE: 5 November thru 14 November 1993
DATA: Temperature (C), Dissolved oxygen (mg/L), pH, Salinity (ppt), and Ammonia nitrogen (ppm).

	Delaware Bay #1			Delaware Bay #2			Delaware Bay #3			Delaware Bay #4		
Time	5%	10%	100%	5%	10%	100%	5%	10%	100%	5%	10%	100%
Sheepshead Minnow												
0 hour												
Temp	25.4	25.6	26.0	25.5	25.5	25.7	25.6	25.5	25.9	25.4	25.4	25.6
D.O.	6.0	6.1	6.1	6.1	6.0	5.9	6.1	6.1	6.1	6.0	6.0	5.9
pH	8.06	8.09	7.96	8.08	8.10	8.14	8.07	8.11	8.20	8.17	8.17	8.22
Salinity	17.5	18.0	19.5	18.0	18.0	20.0	17.5	17.5	18.0	17.5	17.5	18.0
Ammonia	0.02	0.02	0.8	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
48 hour												
Temp	25.4	25.5	25.6	25.5	25.7	25.6	25.4	25.4	25.3	25.7	25.6	25.5
D.O.	5.7	5.7	5.7	5.7	5.5	5.4	5.8	5.8	5.7	5.6	5.5	5.2
pH	8.00	8.00	7.91	7.98	8.01	8.03	7.97	7.99	8.07	8.09	8.10	8.10
Salinity	17.5	18.0	19.5	18.0	18.0	20.0	17.5	17.5	18.0	17.5	17.5	18.0
Ammonia	0.02	0.02	0.9	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.03	0.03
American Oyster												
0 hour												
Temp	25.4	25.6	26.0	25.5	25.5	25.7	25.6	25.5	25.9	25.4	25.4	25.6
D.O.	6.0	6.1	6.1	6.1	6.0	5.9	6.1	6.1	6.1	6.0	6.0	5.9
pH	8.06	8.09	7.96	8.08	8.10	8.14	8.07	8.11	8.20	8.17	8.17	8.22
Salinity	17.5	18.0	19.5	18.0	18.0	20.0	17.5	17.5	18.0	17.5	17.5	18.0
Ammonia	0.02	0.02	0.8	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
48 hour												
Temp	25.3	25.4	25.5	25.5	25.6	25.5	25.6	25.5	25.5	25.4	25.6	25.5
D.O.	6.0	6.1	6.1	6.1	6.0	5.9	6.1	6.1	6.1	6.0	6.0	5.9
pH	8.04	8.08	7.97	8.06	8.07	8.10	8.06	8.07	8.16	8.15	8.14	8.18
Salinity	17.5	18.0	19.5	18.0	18.0	20.0	17.5	17.5	18.0	17.5	17.5	18.0
Ammonia	0.02	0.02	0.8	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mysid Shrimp												
0 hour												
Temp	25.4	25.6	26.0	25.5	25.5	25.7	25.6	25.5	25.9	25.4	25.4	25.6
D.O.	6.0	6.1	6.1	6.1	6.0	5.9	6.1	6.1	6.1	6.0	6.0	5.9
pH	8.06	8.09	7.96	8.08	8.10	8.14	8.07	8.11	8.20	8.17	8.17	8.22
Salinity	17.5	18.0	19.5	18.0	18.0	20.0	17.5	17.5	18.0	17.5	17.5	18.0
Ammonia	0.02	0.02	0.8	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
48 hour												
Temp	25.4	25.4	25.4	25.4	25.5	25.5	25.6	25.6	25.5	25.5	25.5	25.4
D.O.	5.9	6.0	6.0	6.0	5.9	5.7	5.9	5.9	5.9	5.9	5.9	5.7
pH	8.02	8.03	7.93	8.05	8.08	8.07	8.01	8.01	8.13	8.13	8.11	8.15
Salinity	17.5	18.0	19.5	18.0	18.0	20.0	17.5	17.5	18.0	17.5	17.5	18.0
Ammonia	0.02	0.02	0.8	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Table. 8: (Continued)

Time	Delaware Bay #5			Delaware Bay #6			Delaware Bay #7			Delaware Bay #8		
	5%	10%	100%	5%	10%	100%	5%	10%	100%	5%	10%	100%
Sheepshead Minnow												
0 hour												
Temp	25.3	25.5	25.8	24.4	24.2	24.2	24.0	24.1	24.1	24.0	24.1	24.2
D.O.	6.1	6.0	6.3	6.1	6.0	6.2	6.0	6.0	6.0	6.0	6.0	6.2
pH	8.17	8.16	8.23	8.06	8.06	8.05	8.08	8.08	8.00	8.10	8.13	8.14
Salinity	17.5	18.0	18.0	18.0	19.0	19.0	18.0	18.0	19.0	18.0	19.0	20.0
Ammonia	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.04	0.08
48 hour												
Temp	25.5	25.5	25.3	24.9	25.0	24.8	24.7	24.6	24.7	24.9	24.6	24.7
D.O.	5.8	5.7	5.9	5.6	5.7	5.7	5.7	5.6	5.7	5.5	5.6	5.5
pH	8.06	8.04	8.11	7.96	7.96	7.92	8.00	7.97	7.89	8.02	8.04	8.04
Salinity	17.5	18.0	18.0	18.0	19.0	19.0	18.0	18.0	19.0	18.0	19.0	20.0
Ammonia	0.02	0.02	0.04	0.02	0.02	0.08	0.02	0.02	0.04	0.02	0.04	1.0
American Oyster												
0 hour												
Temp	25.3	25.5	25.8	24.4	24.2	24.2	24.0	24.1	24.1	24.0	24.1	24.2
D.O.	6.1	6.0	6.3	6.1	6.0	6.2	6.0	6.0	6.0	6.0	6.0	6.2
pH	8.17	8.16	8.23	8.06	8.06	8.05	8.08	8.08	8.00	8.10	8.13	8.14
Salinity	17.5	18.0	18.0	18.0	19.0	19.0	18.0	18.0	19.0	18.0	19.0	20.0
Ammonia	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.04	0.08
48 hour												
Temp	25.3	25.5	25.4	25.0	25.0	24.9	24.8	24.7	24.6	25.0	24.9	24.9
D.O.	6.1	6.0	6.2	6.1	6.0	6.2	6.0	6.0	6.0	6.0	6.0	6.2
pH	8.14	8.14	8.18	8.02	8.03	8.00	8.07	8.08	8.01	8.09	8.10	8.12
Salinity	17.5	18.0	18.0	18.0	19.0	19.0	18.0	18.0	19.0	18.0	19.0	20.0
Ammonia	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.04	0.08
Mysid Shrimp												
0 hour												
Temp	25.3	25.5	25.8	24.4	24.2	24.2	24.0	24.1	24.1	24.0	24.1	24.2
D.O.	6.1	6.0	6.3	6.1	6.0	6.2	6.0	6.0	6.0	6.0	6.0	6.2
pH	8.17	8.16	8.23	8.06	8.06	8.05	8.08	8.08	8.00	8.10	8.13	8.14
Salinity	17.5	18.0	18.0	18.0	19.0	19.0	18.0	18.0	19.0	18.0	19.0	20.0
Ammonia	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.04	0.08
48 hour												
Temp	25.4	25.6	25.6	24.8	24.9	24.8	24.9	24.9	24.7	24.8	24.8	24.7
D.O.	6.0	5.9	6.1	6.0	5.9	6.0	6.0	5.9	5.9	5.9	5.9	6.0
pH	8.11	8.13	8.18	8.00	8.00	7.96	8.03	8.01	7.96	8.01	8.01	8.04
Salinity	17.5	18.0	18.0	18.0	19.0	19.0	18.0	18.0	19.0	18.0	19.0	20.0
Ammonia	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.04	0.08

Table 8: (Continued)

Time	Delaware Bay #9 5%	10%	100%	Delaware Bay #10 5%	10%	100%
Sheepshead Minnow						
0 hour						
Temp	24.1	24.0	24.0	24.0	24.1	24.1
D.O.	6.1	6.0	5.9	6.0	6.2	6.2
pH	8.13	8.13	8.12	8.13	8.14	8.10
Salinity	18.5	20.0	22.5	18.0	21.5	25.5
Ammonia	0.02	0.04	0.08	0.02	0.02	0.02
48 hour						
Temp	24.6	24.6	24.6	24.8	24.7	24.7
D.O.	5.5	5.5	5.3	5.7	5.6	5.7
pH	8.01	8.02	8.02	8.00	8.02	8.00
Salinity	18.5	20.0	22.5	18.0	21.5	25.5
Ammonia	0.02	0.04	1.0	0.02	0.02	0.02
American Oyster						
0 hour						
Temp	24.1	24.0	24.0	24.0	24.1	24.1
D.O.	6.1	6.0	5.9	6.0	6.2	6.2
pH	8.13	8.13	8.12	8.13	8.14	8.10
Salinity	18.5	20.0	22.5	18.0	21.5	25.5
Ammonia	0.02	0.04	0.08	0.02	0.02	0.02
48 hour						
Temp	24.7	24.6	24.6	24.9	24.8	24.8
D.O.	6.1	6.0	5.9	6.0	6.2	6.2
pH	8.11	8.12	8.10	8.13	8.11	8.10
Salinity	18.5	20.0	22.5	18.0	21.5	25.5
Ammonia	0.02	0.04	0.08	0.02	0.02	0.02
Mysid Shrimp						
0 hour						
Temp	24.1	24.0	24.0	24.0	24.1	24.1
D.O.	6.1	6.0	5.9	6.0	6.2	6.2
pH	8.13	8.13	8.12	8.13	8.14	8.10
Salinity	18.5	20.0	22.5	18.0	21.5	25.5
Ammonia	0.02	0.04	0.08	0.02	0.02	0.02
48 hour						
Temp	24.7	24.7	24.7	24.7	24.6	24.8
D.O.	6.0	5.9	5.7	5.9	6.0	6.0
pH	8.07	8.07	8.04	8.07	8.07	8.05
Salinity	18.5	20.0	22.5	18.0	21.5	25.5
Ammonia	0.02	0.04	0.08	0.02	0.02	0.02

2.6.1 Freshwater Sites

The test methods followed the guidelines outlined in the US EPA and USACOE (1991) document titled, Evaluation of Dredged Material Proposed for Ocean Disposal which is often referred to as the "Green Book". Twenty-eight static water column toxicity tests were initiated between 5 and 14 October 1993.

Acute static 48-hour water column reference toxicant tests were performed using fathead minnow, C. dubia, and H. azteca. For the minnow, the toxicant was potassium chloride and the 48-hour LC_{50} was 1237 mg/L KCl. For C. dubia, the toxicant was potassium chloride, and the 48 hour LC_{50} was 273.2 mg/L KCl. For H. azteca, the toxicant was potassium chloride, and the 48-hour LC_{50} was 223.7 mg/L KCl.

The fathead minnows were tested in 500 cubic centimeter (cc) disposable plastic beakers, and the volume of test solution in each test chamber was 250 milliliters (ml). Ten test organisms were placed in each test vessel for a total of 50 test organisms for each dilution. The number of organisms in each vessel that died or showed signs of stress was recorded at 0, 4, 24, and 48 hours (Table 9).

The freshwater cladocerans were tested in 30 ml disposable plastic cups, and the volume of test solution in each test chamber was 15 ml. Only specimens less than 24 hours old at test initiation were used. Ten test organisms were placed in each test vessel for a total of 50 test organisms for each dilution. The number of organisms in each vessel that died or showed signs of stress was recorded at 0, 4, 24, and 48 hours (Table 9).

The amphipods were tested in 500 ml disposable plastic beakers and the volume of test solution in each test chamber was 250 ml. Ten test organisms were placed in each test vessel for a total of 50 test organisms for each dilution. The number of organisms in each vessel that died or showed signs of stress was recorded at 0, 4, 24, and 48 hours (Table 9).

2.6.2 Estuarine Sites

The test methods followed the guidelines outlined in US EPA and USACOE (1991) for sheepshead minnow (C. variegatus) and mysid shrimp (M. bahia). The test methods for American Oyster (C. virginica) followed the guidelines outlined in ASTM (1989), a guidance document entitled, Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Mollusks. Ten static water column toxicity tests were initiated between 5 and 12 November 1993.

Acute static 48-hour water column reference toxicant tests were run using sheepshead minnow, American oyster, and mysid shrimp. For the minnow, the toxicant was potassium chloride, for the American oyster the toxicant was copper sulfate, and for the mysid shrimp the toxicant was potassium chloride.

The minnows were tested in 500 cc disposable plastic beakers, and the volume of test solution in each test chamber was 250 ml. Ten test organisms were placed in each test vessel for a total of 50 test organisms for each dilution. The number of organisms in each vessel that died or showed signs of stress was recorded at 0, 4, 24, and 48 hours (Table 10).

For the American oyster, five replicates of each dilution and the controls were set up using 30 ml disposable plastic beakers. The volume of test solution in each chamber was 15 ml. Approximately two hours after fertilization, equal volumes (1 ml) of homogeneously mixed embryo suspension were placed in each test

Table 9: Percent Survival - Freshwater Water Column Bioassays

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 48-hour Acute Water Column Bioassays
DATE: 8 September through 14 November 1993

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
Fathead minnow			
Lab control	50	50	100
Mifflin Range water	50	50	100
Beckett Street - 5%	50	50	100
Beckett Street - 10%	50	50	100
Beckett Street - 100%	50	50	100
Range M - 5%	50	50	100
Range M - 10%	50	50	100
Range M - 100%	50	50	100
Bend AF - 5%	50	50	100
Bend AF - 10%	50	50	100
Bend AF - 100%	50	50	100
W. Horseshoe Range - 5%	50	50	100
W. Horseshoe Range - 10% 50	50	100	
W. Horseshoe Range - 100%50	50	100	
Bend G - 5%	50	50	100
Bend G - 10%	50	50	100
Bend G - 100%	50	50	100
Mifflin Range - 5%	50	50	100
Mifflin Range - 10%	50	50	100
Mifflin Range - 100%	50	50	100
Bend H - 5%	50	50	100
Bend H - 10%	50	50	100
Bend H - 100%	50	50	100
Billingsport Range - 5%	50	50	100
Billingsport Range - 10%	50	50	100
Billingsport Range - 100%	50	50	100
Chester Range water	50	50	100
Bend I - 5%	50	50	100
Bend I - 10%	50	50	100
Bend I - 100%	50	50	100
Tinicum Range - 5%	50	50	100
Tinicum Range - 10%	50	50	100
Tinicum Range - 100%	50	50	100
Bend J - 5%	50	50	100
Bend J - 10%	50	50	100
Bend J - 100%	50	50	100

Table 9: (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
Fathead minnow (continued)			
Baker Range Water	50	50	100
Reedy Island Range - 5%	50	50	100
Reedy Island Range - 10%	50	50	100
Reedy Island Range - 100% 50	50	100	
Bend S - 5%	50	50	100
Bend S - 10%	50	50	100
Bend S - 100%	50	50	100
Baker Range - 5%	50	50	100
Baker Range - 10%	50	50	100
Baker Range - 100%	50	50	100
Bend T - 5%	50	50	100
Bend T - 10%	50	50	100
Bend T - 100%	50	50	100
Hyalella azteca			
Lab control	50	50	100
Mifflin Range water	50	50	100
Beckett Street - 5%	50	50	100
Beckett Street - 10%	50	50	100
Beckett Street - 100%	50	50	100
Range M - 5%	50	50	100
Range M - 10%	50	50	100
Range M - 100%	50	50	100
Bend AF - 5%	50	50	100
Bend AF - 10%	50	50	100
Bend AF - 100%	50	50	100
W. Horseshoe Range - 5%	50	50	100
W. Horseshoe Range - 10% 50	50	100	
W. Horseshoe Range - 100%50	50	100	
Bend G - 5%	50	50	100
Bend G - 10%	50	50	100
Bend G - 100%	50	50	100
Mifflin Range - 5%	50	50	100
Mifflin Range - 10%	50	50	100
Mifflin Range - 100%	50	50	100
Bend H - 5%	50	50	100
Bend H - 10%	50	50	100
Bend H - 100%	50	50	100
Billingsport Range - 5%	50	50	100
Billingsport Range - 10%	50	50	100
Billingsport Range - 100%	50	50	100

Table 9: (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
Fathead minnow (continued)			
Eddystone Range - 5%	50	50	100
Eddystone Range - 10%	50	50	100
Eddystone Range - 100%	50	50	100
Bend K - 5%	50	50	100
Bend K - 10%	50	50	100
Bend K - 100%	50	50	100
Bend L - 5%	50	50	100
Bend L - 10%	50	50	100
Bend L - 100%	50	50	100
Bellevue Range Water	50	50	100
Marcus Hook Range - 5%	50	50	100
Marcus Hook Range - 10%	50	50	100
Marcus Hook Range - 100%50	50	100	
Bend M - 5%	50	50	100
Bend M - 10%	50	50	100
Bend M - 100%	50	50	100
Bellevue Range - 5%	50	50	100
Bellevue Range - 10%	50	50	100
Bellevue Range - 100%	50	50	100
Bend N - 5%	50	50	100
Bend N - 10%	50	50	100
Bend N - 100%	50	50	100
Deepwater Range Water	50	50	100
Cherry Island Range - 5%	50	50	100
Cherry Island Range - 10%	50	50	100
Cherry Island Range - 100%50	50	100	
Bend O - 5%	50	50	100
Bend O - 10%	50	50	100
Bend O - 100%	50	50	100
Deepwater Pt. Range - 5%	50	50	100
Deepwater Pt. Range - 10% 50	50	100	
Deepwater Pt. Range - 100%50	50	100	
Bend PQ - 5%	50	50	100
Bend PQ - 10%	50	50	100
Bend PQ - 100%	50	50	100
New Castle Range - 5%	50	50	100
New Castle Range - 10%	50	50	100
New Castle Range - 100%	50	50	100
Bend R - 5%	50	50	100
Bend R - 10%	50	50	100
Bend R - 100%	50	50	100

Table 9: (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
Hyalella azteca (continued)			
Chester Range water	50	50	100
Bend I - 5%	50	50	100
Bend I - 10%	50	50	100
Bend I - 100%	50	50	100
Tinicum Range - 5%	50	50	100
Tinicum Range - 10%	50	50	100
Tinicum Range - 100%	50	50	100
Bend J - 5%	50	50	100
Bend J - 10%	50	50	100
Bend J - 100%	50	50	100
Eddystone Range - 5%	50	50	100
Eddystone Range - 10%	50	50	100
Eddystone Range - 100%	50	50	100
Bend K - 5%	50	50	100
Bend K - 10%	50	50	100
Bend K - 100%	50	50	100
Bend L - 5%	50	50	100
Bend L - 10%	50	50	100
Bend L - 100%	50	50	100
Bellevue Range Water	50	50	100
Marcus Hook Range - 5%	50	50	100
Marcus Hook Range - 10%	50	50	100
Marcus Hook Range - 100%50	50	100	
Bend M - 5%	50	50	100
Bend M - 10%	50	50	100
Bend M - 100%	50	50	100
Bellevue Range - 5%	50	50	100
Bellevue Range - 10%	50	50	100
Bellevue Range - 100%	50	50	100
Bend N - 5%	50	50	100
Bend N - 10%	50	50	100
Bend N - 100%	50	50	100
Deepwater Range Water	50	50	100
Cherry Island Range - 5%	50	50	100
Cherry Island Range - 10%	50	50	100
Cherry Island Range - 100%50	50	100	
Bend O - 5%	50	50	100
Bend O - 10%	50	50	100
Bend O - 100%	50	50	100
Deepwater Pt. Range - 5%	50	50	100
Deepwater Pt. Range - 10% 50	50	100	
Deepwater Pt. Range - 100%50	50	100	

Table 9: (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
Hyalella azteca (continued)			
Bend PQ - 5%	50	50	100
Bend PQ - 10%	50	50	100
Bend PQ - 100%	50	50	100
New Castle Range - 5%	50	50	100
New Castle Range - 10%	50	50	100
New Castle Range - 100%	50	50	100
Bend R - 5%	50	50	100
Bend R - 10%	50	50	100
Bend R - 100%	50	50	100
Baker Range Water	50	50	100
Reedy Island Range - 5%	50	50	100
Reedy Island Range - 10%	50	50	100
Reedy Island Range - 100% 50	50	100	
Bend S - 5%	50	50	100
Bend S - 10%	50	50	100
Bend S - 100%	50	50	100
Baker Range - 5%	50	50	100
Baker Range - 10%	50	50	100
Baker Range - 100%	50	50	100
Bend T - 5%	50	50	100
Bend T - 10%	50	50	100
Bend T - 100%	50	50	100
C. dubia			
Lab control	50	50	100
Mifflin Range water	50	50	100
Beckett Street - 5%	50	50	100
Beckett Street - 10%	50	50	100
Beckett Street - 100%	50	50	100
Range M - 5%	50	50	100
Range M - 10%	50	50	100
Range M - 100%	50	50	100
Bend AF - 5%	50	50	100
Bend AF - 10%	50	50	100
Bend AF - 100%	50	50	100
W. Horseshoe Range - 5%	50	50	100
W. Horseshoe Range - 10% 50	50	100	
W. Horseshoe Range - 100%50	50	100	
Bend G - 5%	50	50	100
Bend G - 10%	50	50	100
Bend G - 100%	50	50	100

Table 9: (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
C. dubia (continued)			
Mifflin Range - 5%	50	50	100
Mifflin Range - 10%	50	50	100
Mifflin Range - 100%	50	50	100
Bend H - 5%	50	50	100
Bend H - 10%	50	50	100
Bend H - 100%	50	50	100
Billingsport Range - 5%	50	50	100
Billingsport Range - 10%	50	50	100
Billingsport Range - 100%	50	50	100
Chester Range water	50	50	100
Bend I - 5%	50	50	100
Bend I - 10%	50	50	100
Bend I - 100%	50	50	100
Tinicum Range - 5%	50	50	100
Tinicum Range - 10%	50	50	100
Tinicum Range - 100%	50	50	100
Bend J - 5%	50	50	100
Bend J - 10%	50	50	100
Bend J - 100%	50	50	100
Eddystone Range - 5%	50	50	100
Eddystone Range - 10%	50	50	100
Eddystone Range - 100%	50	50	100
Bend K - 5%	50	50	100
Bend K - 10%	50	50	100
Bend K - 100%	50	50	100
Bend L - 5%	50	50	100
Bend L - 10%	50	50	100
Bend L - 100%	50	50	100
Bellevue Range Water	50	50	100
Marcus Hook Range - 5%	50	50	100
Marcus Hook Range - 10%	50	50	100
Marcus Hook Range - 100%50	50	100	
Bend M - 5%	50	50	100
Bend M - 10%	50	50	100
Bend M - 100%	50	50	100
Bellevue Range - 5%	50	50	100
Bellevue Range - 10%	50	50	100
Bellevue Range - 100%	50	50	100
Bend N - 5%	50	50	100
Bend N - 10%	50	50	100
Bend N - 100%	50	50	100

Table 9: (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
C. dubia (continued)			
Deepwater Range Water	50	50	100
Cherry Island Range - 5%	50	50	100
Cherry Island Range - 10%	50	50	100
Cherry Island Range - 100%50	50	100	
Bend O - 5%	50	50	100
Bend O - 10%	50	50	100
Bend O - 100%	50	50	100
Deepwater Pt. Range - 5%	50	50	100
Deepwater Pt. Range - 10% 50	50	100	
Deepwater Pt. Range - 100%50	50	100	
Bend PQ - 5%	50	50	100
Bend PQ - 10%	50	50	100
Bend PQ - 100%	50	50	100
New Castle Range - 5%	50	50	100
New Castle Range - 10%	50	50	100
New Castle Range - 100%	50	50	100
Bend R - 5%	50	50	100
Bend R - 10%	50	50	100
Bend R - 100%	50	50	100
Baker Range Water	50	50	100
Reedy Island Range - 5%	50	50	100
Reedy Island Range - 10%	50	50	100
Reedy Island Range - 100% 50	50	100	
Bend S - 5%	50	50	100
Bend S - 10%	50	50	100
Bend S - 100%	50	50	100
Baker Range - 5%	50	50	100
Baker Range - 10%	50	50	100
Baker Range - 100%	50	50	100
Bend T - 5%	50	50	100
Bend T - 10%	50	50	100
Bend T - 100%	50	50	100

Table 10: Percent Survival - Estuarine Water Column Bioassays

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 48-hour Acute Water Column Bioassays
DATE: 8 September through 14 November 1993

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
Sheepshead minnow			
Lab control	50	50	100
Baker Range Water	50	50	100
Del. Bay #1 - 5%	50	50	100
Del. Bay #1 - 10%	50	50	100
Del. Bay #1 - 100%	50	50	100
Lab control	50	50	100
Miah Maull Range Water	50	50	100
Del. Bay #2 - 5%	50	50	100
Del. Bay #2 - 10%	50	50	100
Del. Bay #2 - 100%	50	50	100
Del. Bay #3 - 5%	50	50	100
Del. Bay #3 - 10%	50	50	100
Del. Bay #3 - 100%	50	50	100
Del. Bay #4 - 5%	50	50	100
Del. Bay #4 - 10%	50	50	100
Del. Bay #4 - 100%	50	50	100
Del. Bay #5 - 5%	50	50	100
Del. Bay #5 - 10%	50	50	100
Del. Bay #5 - 100%	50	50	100
Del. Bay #6 - 5%	50	50	100
Del. Bay #6 - 10%	50	50	100
Del. Bay #6 - 100%	50	50	100
Del. Bay #7 - 5%	50	50	100
Del. Bay #7 - 10%	50	50	100
Del. Bay #7 - 100%	50	50	100
Del. Bay #8 - 5%	50	50	100
Del. Bay #8 - 10%	50	50	100
Del. Bay #8 - 100%	50	50	100
Del. Bay #9 - 5%	50	50	100
Del. Bay #9 - 10%	50	50	100
Del. Bay #9 - 100%	50	50	100
Del. Bay #10 - 5%	50	50	100
Del. Bay #10 - 10%	50	50	100
Del. Bay #10 - 100%	50	50	100

Table 10: (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
American oyster			
Lab control	50	50	100
Baker Range Water	50	50	100
Del. Bay #1 - 5%	50	50	100
Del. Bay #1 - 10%	50	50	100
Del. Bay #1 - 100%	50	50	100
Lab control	50	50	100
Miah Maull Range Water	50	50	100
Del. Bay #2 - 5%	50	50	100
Del. Bay #2 - 10%	50	50	100
Del. Bay #2 - 100%	50	50	100
Del. Bay #3 - 5%	50	50	100
Del. Bay #3 - 10%	50	50	100
Del. Bay #3 - 100%	50	50	100
Del. Bay #4 - 5%	50	50	100
Del. Bay #4 - 10%	50	50	100
Del. Bay #4 - 100%	50	50	100
Del. Bay #5 - 5%	50	50	100
Del. Bay #5 - 10%	50	50	100
Del. Bay #5 - 100%	50	50	100
Del. Bay #6 - 5%	50	50	100
Del. Bay #6 - 10%	50	50	100
Del. Bay #6 - 100%	50	50	100
Del. Bay #7 - 5%	50	50	100
Del. Bay #7 - 10%	50	50	100
Del. Bay #7 - 100%	50	50	100
Del. Bay #8 - 5%	50	50	100
Del. Bay #8 - 10%	50	50	100
Del. Bay #8 - 100%	50	50	100
Del. Bay #9 - 5%	50	50	100
Del. Bay #9 - 10%	50	50	100
Del. Bay #9 - 100%	50	50	100
Del. Bay #10 - 5%	50	50	100
Del. Bay #10 - 10%	50	50	100
Del. Bay #10 - 100%	50	50	100

Table 10 (Continued)

Test Organism/Sample	Total Number of Organisms at Start (5 Replicates)	Number of Live Organisms at 48 hours	Sample Percent Survival
Mysid shrimp			
Lab control	50	50	100
Baker Range Water	50	50	100
Del. Bay #1 - 5%	50	50	100
Del. Bay #1 - 10%	50	50	100
Del. Bay #1 - 100%	50	50	100
Lab control	50	50	100
Miah Maull Range Water	50	50	100
Del. Bay #2 - 5%	50	50	100
Del. Bay #2 - 10%	50	50	100
Del. Bay #2 - 100%	50	50	100
Del. Bay #3 - 5%	50	50	100
Del. Bay #3 - 10%	50	50	100
Del. Bay #3 - 100%	50	50	100
Del. Bay #4 - 5%	50	50	100
Del. Bay #4 - 10%	50	50	100
Del. Bay #4 - 100%	50	50	100
Del. Bay #5 - 5%	50	50	100
Del. Bay #5 - 10%	50	50	100
Del. Bay #5 - 100%	50	50	100
Del. Bay #6 - 5%	50	50	100
Del. Bay #6 - 10%	50	50	100
Del. Bay #6 - 100%	50	50	100
Del. Bay #7 - 5%	50	50	100
Del. Bay #7 - 10%	50	50	100
Del. Bay #7 - 100%	50	50	100
Del. Bay #8 - 5%	50	50	100
Del. Bay #8 - 10%	50	50	100
Del. Bay #8 - 100%	50	50	100
Del. Bay #9 - 5%	50	50	100
Del. Bay #9 - 10%	50	50	100
Del. Bay #9 - 100%	50	50	100
Del. Bay #10 - 5%	50	50	100
Del. Bay #10 - 10%	50	50	100
Del. Bay #10 - 100%	50	50	100

solution. Forty-eight hours after test initiation, the solution in each test chamber was mixed and removed. Each sample was then examined to enumerate the number of live larvae (Table 10).

The mysids were tested in 500 ml disposable plastic beakers. The volume of test solution in each test chamber was 250 ml. Ten organisms were placed in each test vessel for a total of 50 test organisms for each test dilution. The number and percentage of organisms in each vessel, including controls, that died or showed signs of stress was recorded at the end of 0, 4, 24, and 48 hours (Table 10).

2.7 Methods - Whole Sediment Bioassays

Ten-day static acute whole sediment toxicity tests were conducted for ten bay sample points and six beneficial use sites. The test organisms included the amphipod (Ampelisca abdita), the clam worm (Nereis virens), and the hardshell clam (Mercenaria mercenaria).

The samples for the sediment toxicity tests were stored at 4°C until they were brought up to room temperature 24 hours before preparation of the test sediment. The samples were initially gross sieved using a 1.00 mm stainless steel sieve to remove larger material, macroinvertebrates, and interstitial water. All samples were fairly uniform in composition. Each sample was then homogenized by placing the sample in a decontaminated, stainless steel bowl and thoroughly mixed using a stainless steel spoon. The samples were then placed in the test cups and allowed to settle for 24 hours before the test organisms were introduced.

Water quality parameters were monitored daily in each treatment. These parameters included water column temperature, pH, dissolved oxygen, ammonia, and salinity (Tables 11 and 12). Dissolved oxygen was measured with a YSI Model 51 meter, salinity with a YSI Model 33 S-C-T meter, ammonia with a La Motte test kit, and temperature and pH with a Corning deluxe field system meter. Acute static 48-hour water column reference toxicant tests were run for A. abdita, N. virens and M. mercenaria with potassium chloride as the toxicant.

2.7.1 Ampelisca abdita

The test methods followed the procedures provided in ASTM (1990), Standard Guide for Conducting 10-day Static Sediment Toxicity Tests with Marine and Estuarine Amphipods and US EPA and USACOE (1991). ASTM (1990) recommends that A. abdita be tested at salinities of 28 to 35 ppt and temperatures of 20 to 25°C. A. abdita inhabits fine-grained sediments, therefore, due to the nature of the samples, a grain size control was not needed.

Immature A. abdita were exposed to the sediment samples for ten days under static renewal conditions. A. abdita were exposed in groups of 20 in 500 ml plastic beakers containing two to three centimeters of sediment. Overlying water (laboratory prepared water) was used to fill the test beaker to 500 ml. Five replicate test chambers (20 organisms per replicate) were prepared for each sediment sample. Control and reference samples were also tested using the sample methods. Test chambers were placed in a temperature controlled environment maintained at 25 ± 1°C. The light regime was 16 hours light, eight hours dark.

The toxicity test was initiated (Day 0, 12 November 1993) when the amphipods were distributed to each test chamber. Test animals were not fed throughout the ten days. Seventy-five percent of the overlying water was renewed every 48 hours in order to maintain water quality.

Table 11: Physical/Chemical Measurements - Whole Sediment Bioassay Delaware Bay Sites

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 10-Day Whole Sediment Bioassays
DATE: 12 November through 22 November 1993
DATA: Temperature (C), Dissolved oxygen (mg/L), pH, Salinity (ppt), and Ammonia nitrogen (ppm).

Time	Lab Control	Delaware Bay #1	Delaware Bay #2	Delaware Bay #3	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #7	Delaware Bay #8	Delaware Bay #9	Delaware Bay #10
Ampelisca sp.											
Day 0											
Temp	24.5	24.3	24.2	24.4	24.4	24.3	24.3	24.5	24.3	24.4	24.2
D.O.	6.3	6.2	6.3	6.1	6.2	6.2	6.2	6.1	6.2	6.2	6.3
pH	7.81	7.84	7.86	7.80	7.60	7.74	7.78	7.78	7.79	7.83	7.84
Salinity	26.0	25.3	25.0	25.0	24.0	25.5	25.0	25.0	25.0	25.0	25.5
Ammonia	0.08	0.30	0.30	0.20	0.20	0.08	0.08	0.02	0.02	0.02	0.02
Day 1											
Temp	24.8	24.6	24.7	25.0	25.0	24.9	24.8	25.1	24.6	24.7	24.9
D.O.	6.1	6.1	6.1	6.0	6.1	6.1	6.1	6.1	6.0	6.0	6.1
pH	7.83	7.86	7.86	7.78	7.63	7.71	7.76	7.78	7.76	7.79	7.81
Salinity	26.0	25.3	25.0	25.0	24.0	25.5	25.0	25.0	25.0	25.0	25.5
Ammonia	0.08	0.60	0.30	0.30	0.40	0.14	0.14	0.14	0.14	0.08	0.08
Day 2											
Temp	25.0	25.2	25.1	25.0	24.9	25.2	25.0	25.1	25.1	25.1	25.1
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.85	7.83	7.86	7.80	7.76	7.79	7.81	7.83	7.84	7.83	7.86
Salinity	25.5	25.5	25.5	25.5	25.5	25.0	25.0	25.5	25.5	25.5	25.0
Ammonia	0.04	0.14	0.14	0.20	0.20	0.14	0.14	0.04	0.04	0.02	0.02
Day 3											
Temp	25.2	25.2	25.4	25.5	25.3	25.4	25.5	25.3	25.2	25.4	25.6
D.O.	6.0	6.0	6.0	6.0	6.0	6.1	6.0	6.1	6.0	6.0	6.0
pH	7.84	7.83	7.85	7.82	7.78	7.79	7.79	7.81	7.85	7.85	7.84
Salinity	25.5	26.0	25.5	25.5	25.5	25.5	25.5	26.0	25.5	26.0	25.0
Ammonia	0.08	0.14	0.30	0.40	0.60	0.30	0.40	0.14	0.08	0.08	0.06
Day 4											
Temp	24.6	24.5	24.9	24.7	24.4	24.5	24.5	24.6	24.5	24.7	24.6
D.O.	6.3	6.3	6.3	6.4	6.3	6.3	6.3	6.3	6.4	6.3	6.3
pH	7.87	7.87	7.84	7.83	7.78	7.76	7.79	7.81	7.82	7.85	7.84
Salinity	26.5	26.5	26.0	26.0	26.5	26.5	26.0	26.5	26.5	26.5	26.0
Ammonia	0.08	0.08	0.14	0.30	0.30	0.20	0.20	0.08	0.08	0.04	0.04

Table 11: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #2	Delaware Bay #3	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #7	Delaware Bay #8	Delaware Bay #9	Delaware Bay #10
Ampelisca sp. (continued)											
Day 5											
Temp	24.3	24.4	24.5	24.4	24.4	24.6	24.5	24.3	24.3	24.4	24.4
D.O.	6.1	6.2	6.2	6.2	6.1	6.1	6.1	6.2	6.1	6.2	6.1
pH	7.83	7.85	7.82	7.78	7.74	7.74	7.79	7.81	7.86	7.81	7.82
Salinity	26.5	26.5	26.0	26.5	26.5	26.5	26.0	26.5	26.5	26.5	26.0
Ammonia	0.14	0.08	0.30	0.40	0.50	0.40	0.80	0.20	0.30	0.40	0.40
Day 6											
Temp	24.2	24.1	24.0	24.4	24.3	24.1	24.2	24.0	24.2	24.4	24.3
D.O.	6.4	6.5	6.5	6.4	6.4	6.5	6.5	6.5	6.4	6.3	6.4
pH	7.83	7.82	7.76	7.80	7.84	7.85	7.78	7.78	7.80	7.81	7.82
Salinity	25.6	25.8	25.5	25.5	25.5	25.7	25.7	25.7	25.7	25.7	25.6
Ammonia	0.04	0.04	0.08	0.14	0.20	0.20	0.08	0.08	0.04	0.04	0.02
Day 7											
Temp	24.9	25.3	25.2	25.0	24.9	25.1	25.0	25.2	25.3	25.0	25.1
D.O.	6.2	6.1	6.1	6.1	6.2	6.2	6.1	6.1	6.1	6.2	6.1
pH	7.78	7.76	7.78	7.80	7.79	7.81	7.78	7.80	7.75	7.81	7.79
Salinity	25.5	26.0	25.5	25.5	26.0	26.0	26.0	26.0	26.0	25.5	25.5
Ammonia	0.08	0.14	0.14	0.30	0.40	0.80	0.20	0.30	0.20	0.14	0.30
Day 8											
Temp	25.6	25.9	25.6	25.7	25.7	25.8	25.6	25.7	25.6	25.8	25.9
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.81	7.80	7.79	7.82	7.83	7.86	7.83	7.80	7.81	7.80	7.85
Salinity	25.0	25.0	24.5	24.5	24.5	25.0	24.5	24.5	25.0	24.5	25.0
Ammonia	0.04	0.02	0.04	0.08	0.14	0.08	0.04	0.04	0.04	0.04	0.02
Day 9											
Temp	25.9	26.0	26.1	25.8	25.8	25.8	25.9	26.0	25.7	25.8	26.0
D.O.	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.1	6.1
pH	7.78	7.78	7.75	7.80	7.80	7.84	7.79	7.76	7.77	7.76	7.81
Salinity	25.5	25.0	25.0	25.0	25.0	25.0	24.5	25.0	25.5	25.0	25.0
Ammonia	0.14	0.08	0.08	0.20	0.30	0.14	0.14	0.08	0.08	0.14	0.14
Day 10											
Temp	25.6	25.7	25.8	25.8	25.8	25.7	25.7	25.9	25.6	25.7	25.8
D.O.	5.8	5.9	5.9	5.7	5.8	5.9	5.9	5.7	5.7	5.8	5.9
pH	7.73	7.75	7.69	7.74	7.78	7.78	7.70	7.72	7.75	7.71	7.77
Salinity	25.5	25.5	25.5	25.5	25.5	25.5	25.0	25.0	25.5	25.0	25.5
Ammonia	0.50	<1.0	<1.0	<1.0	0.95	0.75	0.80	0.60	0.50	<1.0	<1.0

Table 11: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #2	Delaware Bay #3	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #7	Delaware Bay #8	Delaware Bay #9	Delaware Bay #10
Nereis virens											
Day 0											
Temp	24.6	24.2	24.3	24.3	24.4	24.2	24.4	24.4	24.3	24.3	24.3
D.O.	6.1	6.2	6.2	6.3	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.87	7.84	7.86	7.83	7.60	7.76	7.76	7.74	7.81	7.81	7.85
Salinity	25.5	25.5	25.0	25.0	24.0	25.5	25.5	26.0	26.0	25.0	25.5
Ammonia	0.40	0.30	0.40	03.0	0.20	0.14	0.04	0.04	0.04	0.02	0.02
Day 1											
Temp	25.0	24.9	25.1	24.8	24.8	25.1	25.0	24.8	24.9	24.9	25.0
D.O.	5.9	6.0	6.0	5.9	5.9	6.0	6.0	6.1	6.1	6.2	6.1
pH	7.69	7.72	7.76	7.76	7.65	7.70	7.80	7.67	7.66	7.69	7.70
Salinity	26.0	25.5	25.0	25.5	24.5	25.0	26.0	26.0	26.0	25.5	25.5
Ammonia	<1.0	<1.0	<1.0	0.80	<1.0	0.80	0.80	0.60	0.40	0.50	0.60
Day 2											
Temp	24.2	24.4	24.3	24.5	24.2	24.3	24.4	24.3	24.4	24.1	24.2
D.O.	6.2	6.3	6.3	6.2	6.2	6.3	6.2	6.2	6.2	6.2	6.3
pH	7.84	7.86	7.85	7.84	7.71	7.78	7.80	7.78	7.78	7.84	7.85
Salinity	25.0	25.0	25.5	25.5	25.0	25.5	25.5	25.5	25.0	25.5	25.5
Ammonia	0.60	0.20	0.40	0.40	0.30	0.30	0.14	0.14	0.08	0.08	0.04
Day 3											
Temp	25.0	24.9	24.9	24.9	24.9	25.0	25.1	25.0	25.0	25.1	24.8
D.O.	5.7	5.6	5.7	5.8	5.6	5.6	5.7	5.6	5.6	5.7	5.6
pH	7.64	7.68	7.69	7.57	7.56	7.60	7.67	7.65	7.60	7.67	7.64
Salinity	25.5	25.5	26.0	25.5	25.0	25.5	25.5	25.5	25.5	25.5	26.0
Ammonia	<1.0	0.85	0.75	<1.0	0.80	0.75	0.50	0.75	0.63	0.63	0.75
Day 4											
Temp	24.7	24.8	24.5	24.6	24.7	24.7	24.8	24.8	24.6	24.6	24.6
D.O.	6.3	6.3	6.3	6.2	6.2	6.2	6.3	6.2	6.2	6.2	6.2
pH	7.86	7.89	7.83	7.85	7.79	7.78	7.76	7.78	7.83	7.86	7.86
Salinity	26.0	26.5	26.5	26.0	26.5	26.5	26.5	26.0	26.5	26.5	26.5
Ammonia	0.40	0.30	0.40	0.40	0.30	0.20	0.20	0.14	0.08	0.04	0.08

Table 11: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #2	Delaware Bay #3	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #7	Delaware Bay #8	Delaware Bay #9	Delaware Bay #10
Nereis virens (continued)											
Day 5											
Temp	24.5	24.5	24.6	24.4	24.3	24.3	24.3	24.4	24.3	24.4	24.2
D.O.	5.7	5.7	5.6	5.6	5.7	5.4	5.3	5.7	5.7	5.6	5.5
pH	7.61	7.65	7.60	7.62	7.59	7.59	7.60	7.57	7.64	7.67	7.68
Salinity	26.0	26.5	26.0	26.0	26.5	26.5	26.5	26.5	26.5	26.5	26.5
Ammonia	<1.0	<1.0	<1.0	0.75	<1.0	0.75	0.75	0.40	0.40	0.65	0.75
Day 6											
Temp	24.0	24.1	24.1	24.1	24.3	24.0	24.3	24.2	24.2	24.2	24.3
D.O.	6.3	6.3	6.4	6.4	6.3	6.4	6.3	6.4	6.4	6.4	6.3
pH	7.85	7.85	7.80	7.83	7.81	7.85	7.79	7.81	7.83	7.84	7.83
Salinity	25.5	25.5	25.5	25.5	25.5	25.7	25.7	25.5	25.5	25.5	25.5
Ammonia	0.30	0.20	0.20	0.30	0.14	0.20	0.30	0.08	0.08	0.08	0.14
Day 7											
Temp	25.1	25.0	25.2	25.3	25.3	25.2	25.2	25.2	25.4	25.1	25.1
D.O.	5.9	5.6	5.6	5.7	5.8	5.7	5.6	5.6	5.5	5.6	5.6
pH	7.69	7.72	7.71	7.73	7.68	7.66	7.64	7.65	7.69	7.73	7.75
Salinity	26.0	26.0	25.5	25.5	25.5	26.0	26.0	25.5	25.5	25.5	26.0
Ammonia	<1.0	<1.0	<1.0	0.75	0.75	0.80	<1.0	0.65	0.40	0.75	0.80
Day 8											
Temp	25.7	25.8	25.8	25.9	25.9	25.7	25.8	25.7	25.8	25.8	25.7
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.84	7.82	7.76	7.84	7.87	7.89	7.84	7.83	7.79	7.84	7.86
Salinity	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	24.5
Ammonia	0.30	0.20	0.20	0.40	0.20	0.20	0.30	0.08	0.08	0.08	0.08
Day 9											
Temp	26.1	26.0	25.9	26.0	26.1	25.8	25.9	26.9	26.1	26.0	26.1
D.O.	5.7	5.5	5.6	5.5	5.6	5.6	5.5	5.5	5.4	5.4	5.5
pH	7.69	7.69	7.64	7.70	7.72	7.75	7.70	7.74	7.69	7.71	7.67
Salinity	25.5	25.5	25.0	25.0	25.5	25.5	25.5	25.0	25.0	25.0	25.0
Ammonia	<1.0	<1.0	<1.0	0.75	0.80	0.80	0.80	0.75	0.50	0.80	<1.0
Day 10											
Temp	25.8	25.9	25.7	25.8	25.6	25.6	25.6	25.7	25.8	25.9	25.8
D.O.	5.1	5.0	5.2	5.2	5.0	5.0	5.1	5.1	5.2	5.1	5.0
pH	7.55	7.56	7.57	7.58	7.56	7.56	7.58	7.54	7.61	7.60	7.60
Salinity	26.0	26.0	26.0	25.5	25.5	25.5	26.0	26.0	26.0	25.5	25.5
Ammonia	1.0	1.0	>1.0	<1.0	<1.0	<1.0	1.0	0.80	0.80	>1.0	<1.0

Table 11: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #2	Delaware Bay #3	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #7	Delaware Bay #8	Delaware Bay #9	Delaware Bay #10
Mercenaria mercenaria											
Day 0											
Temp	24.3	24.0	24.5	24.2	24.3	24.1	24.4	24.6	24.0	24.2	24.3
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.84	7.86	7.83	7.80	7.53	7.74	7.76	7.76	7.79	7.83	7.85
Salinity	25.3	25.3	25.0	25.0	23.5	26.0	25.0	25.5	25.5	25.0	25.5
Ammonia	0.14	0.03	0.30	0.20	0.20	0.08	0.04	0.04	0.04	0.02	0.02
Day 1											
Temp	24.6	24.7	24.6	24.5	24.8	24.6	24.7	24.9	25.0	24.8	24.4
D.O.	6.2	6.2	6.1	6.1	6.2	6.1	6.3	6.2	6.2	6.1	6.3
pH	7.80	7.59	7.76	7.73	7.68	7.76	7.53	7.59	7.60	7.80	7.85
Salinity	25.3	25.3	25.0	25.0	23.5	25.8	25.0	25.5	26.0	25.0	25.5
Ammonia	0.40	0.80	0.80	0.80	0.80	0.20	0.40	0.30	0.40	0.30	0.30
Day 2											
Temp	24.4	24.3	24.4	24.4	24.3	24.3	24.4	24.4	24.3	24.4	24.3
D.O.	6.4	6.3	6.3	6.4	6.2	6.2	6.3	6.3	6.3	6.3	6.2
pH	7.81	7.84	7.87	7.87	7.76	7.74	7.81	7.82	7.79	7.83	7.83
Salinity	25.0	25.0	25.5	25.5	25.0	25.0	25.5	25.5	25.0	25.0	25.5
Ammonia	0.20	0.20	0.30	0.14	0.20	0.08	0.04	0.04	0.04	0.04	0.04
Day 3											
Temp	24.7	24.8	24.9	24.8	24.8	24.8	24.7	24.7	24.9	24.9	25.0
D.O.	6.1	6.2	6.1	6.0	6.0	6.0	6.0	6.0	6.1	6.1	6.0
pH	7.78	7.80	7.82	7.84	7.78	7.78	7.81	7.79	7.80	7.80	7.78
Salinity	25.0	25.0	25.5	25.5	25.0	25.0	26.0	25.5	25.0	25.0	25.5
Ammonia	0.40	0.80	0.80	0.40	0.80	0.14	0.30	0.40	0.40	0.40	0.30
Day 4											
Temp	24.5	24.6	24.6	24.8	24.7	24.8	24.8	24.7	24.8	24.7	24.6
D.O.	6.3	6.2	6.2	6.3	6.3	6.3	6.2	6.2	6.3	6.3	6.3
pH	7.84	7.86	7.90	7.87	7.78	7.76	7.78	7.83	7.81	7.85	7.87
Salinity	25.0	25.5	26.0	25.5	25.0	25.5	25.0	25.0	25.0	25.0	25.5
Ammonia	0.20	0.30	0.20	0.20	0.20	0.08	0.04	0.04	0.08	0.02	0.02
Day 5											
Temp	24.7	24.7	24.8	24.6	24.6	24.6	24.7	24.5	24.5	24.6	24.5
D.O.	6.0	6.0	6.0	6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.1
pH	7.80	7.81	7.85	7.84	7.78	7.78	7.75	7.79	7.76	7.81	7.80
Salinity	25.0	25.5	25.5	25.5	25.5	25.5	25.0	25.0	25.0	25.0	25.5
Ammonia	0.60	0.60	0.75	0.40	0.75	0.20	0.20	0.20	0.30	0.40	0.30

Table 11: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #2	Delaware Bay #3	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #7	Delaware Bay #8	Delaware Bay #9	Delaware Bay #10
Mercenaria mercenaria (continued)											
Day 6											
Temp	24.1	24.3	24.2	24.2	24.1	24.0	24.3	24.2	24.4	24.2	24.3
D.O.	6.5	6.4	6.4	6.4	6.5	6.4	6.3	6.3	6.4	6.4	6.4
pH	7.81	7.80	7.82	7.78	7.76	7.83	7.81	7.84	7.86	7.87	7.82
Salinity	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Ammonia	0.20	0.20	0.30	0.20	0.30	0.14	0.08	0.04	0.08	0.04	0.04
Day 7											
Temp	25.0	25.0	25.0	25.0	25.1	25.1	25.3	25.3	25.2	25.3	24.9
D.O.	6.1	6.0	6.0	6.0	6.1	6.2	6.1	6.0	6.1	6.2	6.0
pH	7.76	7.76	7.79	7.78	7.76	7.80	7.80	7.82	7.83	7.85	7.80
Salinity	25.5	25.5	26.0	25.5	25.5	25.5	25.5	26.0	25.5	25.5	25.5
Ammonia	0.40	0.40	0.80	0.75	0.80	0.30	0.30	0.30	0.30	0.30	0.30
Day 8											
Temp	25.6	25.8	25.7	25.9	25.9	25.9	25.9	26.1	25.9	25.9	25.9
D.O.	6.2	6.2	6.2	6.1	6.0	6.3	6.0	6.1	6.1	6.1	6.1
pH	7.86	7.80	7.80	7.81	7.82	7.86	7.81	7.83	7.81	7.80	7.87
Salinity	26.0	26.0	26.0	25.5	26.0	25.7	26.0	25.7	25.7	26.0	26.0
Ammonia	0.30	0.30	0.30	0.30	0.20	0.20	0.14	0.08	0.08	0.04	0.08
Day 9											
Temp	26.0	26.0	26.0	26.0	26.1	26.1	25.9	25.9	26.0	26.0	25.9
D.O.	5.9	6.0	6.0	6.0	5.9	6.1	5.9	5.9	6.0	5.9	6.0
pH	7.81	7.78	7.78	7.78	7.80	7.82	7.79	7.80	7.79	7.77	7.83
Salinity	26.0	26.0	26.0	25.5	26.0	26.0	26.0	25.5	25.5	26.0	26.0
Ammonia	0.65	0.50	0.80	0.80	0.80	0.40	0.40	0.50	0.50	0.40	0.65
Day 10											
Temp	25.7	25.8	25.8	26.0	26.1	25.9	25.9	25.6	25.7	25.8	25.9
D.O.	5.7	5.7	5.5	5.6	5.7	5.7	5.7	5.5	5.6	5.3	5.7
pH	7.76	7.71	7.72	7.72	7.74	7.76	7.71	7.72	7.72	7.70	7.73
Salinity	26.0	26.3	25.8	26.0	26.0	26.0	26.0	25.5	26.0	25.7	26.0
Ammonia	0.80	0.75	0.80	<1.0	0.80	0.50	0.65	0.75	0.50	0.65	0.75

Table 12: Physical/Chemical Measurements - Whole Sediment Bioassay Beneficial Use Sites

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 10-Day Whole Sediment Bioassays
DATE: 12 November through 22 November 1993
DATA: Temperature (C), Dissolved oxygen (mg/L), pH, Salinity (ppt), and Ammonia nitrogen (ppm).

Time	Lab Control	Beneficial Use Site #1	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #4	Beneficial Use Site #5	Beneficial Use Site #6
Ampelisca sp.							
Day 0							
Temp	24.5	24.4	24.4	24.5	24.3	24.2	24.3
D.O.	6.3	6.3	6.2	6.2	6.2	6.2	6.2
pH	7.81	7.80	7.78	7.82	7.84	7.82	7.86
Salinity	26.0	25.5	25.5	25.5	25.0	25.0	25.5
Ammonia	0.08	0.02	0.30	0.08	0.04	0.04	0.08
Day 1							
Temp	24.8	24.5	25.0	25.2	24.9	25.0	25.1
D.O.	6.1	6.2	6.1	6.1	6.1	6.1	6.1
pH	7.83	7.81	7.80	7.79	7.83	7.83	7.84
Salinity	26.0	25.5	25.5	25.5	25.0	25.0	25.5
Ammonia	0.08	0.14	0.60	0.14	0.08	0.14	0.20
Day 2							
Temp	25.0	25.3	25.1	25.0	25.0	25.2	25.3
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.85	7.82	7.79	7.81	7.83	7.82	7.84
Salinity	25.5	25.0	25.5	25.5	25.5	25.0	25.0
Ammonia	0.04	0.02	0.04	0.04	0.02	0.02	0.02
Day 3							
Temp	25.2	25.5	25.4	25.4	25.2	25.3	25.5
D.O.	6.0	6.0	6.0	6.0	6.0	6.0	6.0
pH	7.84	7.80	7.80	7.77	7.79	7.80	7.81
Salinity	25.5	25.5	25.5	26.0	25.5	25.5	25.5
Ammonia	0.08	0.04	0.06	0.14	0.08	0.08	0.04
Day 4							
Temp	24.6	24.5	24.5	24.6	24.5	24.5	24.6
D.O.	6.3	6.4	6.3	6.3	6.3	6.3	6.3
pH	7.87	7.84	7.81	7.83	7.80	7.79	7.81
Salinity	26.5	26.0	26.0	26.5	26.5	26.5	26.5
Ammonia	0.08	0.04	0.08	0.04	0.02	0.04	0.04

Table 12: (Continued)

Time	Lab Control	Beneficial Use Site #1	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #4	Beneficial Use Site #5	Beneficial Use Site #6
Ampelisca sp. (continued)							
Day 5							
Temp	24.3	24.3	24.4	24.3	24.5	24.2	24.3
D.O.	6.1	6.2	6.2	6.2	6.1	6.1	6.1
pH	7.83	7.80	7.83	7.83	7.77	7.78	7.78
Salinity	26.5	26.5	26.5	26.5	26.5	26.5	26.5
Ammonia	0.14	0.40	0.40	0.30	0.30	0.30	0.40
Day 6							
Temp	24.2	24.2	24.1	24.1	24.2	24.3	24.2
D.O.	6.4	6.4	6.4	6.4	6.5	6.4	6.4
pH	7.83	7.78	7.80	7.84	7.82	7.84	7.81
Salinity	25.6	25.5	25.5	25.7	25.7	25.7	25.7
Ammonia	0.04	0.02	0.04	0.04	0.08	0.04	0.04
Day 7							
Temp	24.9	24.9	24.9	25.1	25.2	25.2	25.0
D.O.	6.2	6.2	6.1	6.1	6.2	6.1	6.1
pH	7.78	7.79	7.83	7.86	7.80	7.78	7.84
Salinity	25.5	25.5	26.0	26.0	25.5	26.0	26.0
Ammonia	0.08	0.20	0.20	0.20	0.40	0.14	0.40
Day 8							
Temp	25.6	25.5	25.6	25.7	25.9	25.6	25.8
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.81	7.80	7.83	7.86	7.81	7.82	7.86
Salinity	25.0	24.5	24.5	25.0	24.5	24.5	25.0
Ammonia	0.04	0.02	0.02	0.04	0.04	0.04	0.04
Day 9							
Temp	25.9	26.1	25.9	25.8	25.9	25.8	25.9
D.O.	6.0	6.0	6.1	6.1	6.0	6.0	6.0
pH	7.78	7.81	7.82	7.80	7.77	7.79	7.83
Salinity	25.5	24.5	24.5	25.0	25.0	25.0	25.0
Ammonia	0.14	0.04	0.08	0.14	0.14	0.08	0.20
Day 10							
Temp	25.6	25.6	25.6	25.7	25.6	25.6	25.8
D.O.	5.8	5.9	5.8	5.9	5.9	5.8	5.7
pH	7.73	7.76	7.74	7.70	7.67	7.71	7.76
Salinity	25.5	25.5	25.0	25.0	25.5	26.0	25.5
Ammonia	0.50	0.40	0.50	0.40	0.60	0.80	<1.0

Table 12: (Continued)

Time	Lab Control	Beneficial Use Site #1	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #4	Beneficial Use Site #5	Beneficial Use Site #6
Nereis virens							
Day 0							
Temp	24.6	24.3	24.1	24.5	24.4	24.3	24.2
D.O.	6.1	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.87	7.79	7.79	7.82	7.84	7.83	7.85
Salinity	25.5	25.5	25.0	25.0	25.0	25.5	25.5
Ammonia	0.40	0.02	0.40	0.02	0.02	0.02	0.14
Day 1							
Temp	25.0	25.0	25.1	24.8	24.9	24.7	24.8
D.O.	5.9	6.0	5.9	6.0	5.9	5.9	6.2
pH	7.69	7.80	7.71	7.74	7.76	7.78	7.78
Salinity	26.0	25.5	25.0	25.0	25.5	25.5	25.5
Ammonia	<1.0	0.60	0.75	0.80	<1.0	<1.0	0.75
Day 2							
Temp	24.2	24.2	24.2	24.3	24.4	24.1	24.3
D.O.	6.2	6.2	6.2	6.2	6.2	6.3	6.2
pH	7.84	7.82	7.80	7.85	7.86	7.80	7.82
Salinity	25.0	25.0	25.0	25.5	25.5	25.5	25.5
Ammonia	0.60	0.04	0.60	0.08	0.08	0.04	0.14
Day 3							
Temp	25.0	25.1	25.1	25.0	25.0	25.0	25.0
D.O.	5.7	5.7	5.6	5.6	5.7	5.6	5.6
pH	7.64	7.61	7.68	7.67	7.63	7.61	7.60
Salinity	25.5	25.5	25.0	25.5	25.5	25.5	25.5
Ammonia	<1.0	0.75	<1.0	0.80	0.80	0.80	0.80
Day 4							
Temp	24.7	24.5	24.6	24.6	24.7	24.7	24.6
D.O.	6.3	6.3	6.4	6.3	6.2	6.3	6.3
pH	7.86	7.87	7.82	7.79	7.82	7.82	7.85
Salinity	26.0	26.5	26.0	26.0	26.5	26.5	26.5
Ammonia	0.40	0.14	0.14	0.04	0.04	0.08	0.08
Day 5							
Temp	24.5	24.2	24.2	24.3	24.2	24.3	24.4
D.O.	5.7	5.6	5.7	5.6	5.6	5.6	5.6
pH	7.61	7.64	7.61	7.70	7.71	7.73	7.69
Salinity	26.0	26.5	26.0	26.0	26.5	26.5	26.5
Ammonia	<1.0	0.80	0.80	0.65	0.50	0.75	0.75

Table 12: (Continued)

Time	Lab Control	Beneficial Use Site #1	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #4	Beneficial Use Site #5	Beneficial Use Site #6
Nereis virens (continued)							
Day 6							
Temp	24.0	24.4	24.4	24.2	24.1	24.2	24.3
D.O.	6.3	6.3	6.3	6.4	6.4	6.4	6.3
pH	7.85	7.81	7.81	7.82	7.85	7.81	7.79
Salinity	25.5	25.5	25.7	26.0	25.5	25.7	25.5
Ammonia	0.30	0.14	0.14	0.08	0.04	0.04	0.14
Day 7							
Temp	25.1	25.2	25.3	25.3	25.4	25.2	25.3
D.O.	5.9	5.7	5.8	5.7	5.5	5.6	5.6
pH	7.69	7.67	7.69	7.66	7.67	7.70	7.62
Salinity	26.0	25.5	25.5	26.0	26.0	25.5	25.5
Ammonia	<1.0	0.80	<1.0	0.50	0.75	<1.0	<1.0
Day 8							
Temp	25.7	25.7	25.9	25.8	25.9	25.7	26.0
D.O.	6.2	6.2	6.1	6.1	6.2	6.2	6.0
pH	7.84	7.84	7.86	7.86	7.84	7.83	7.82
Salinity	25.0	24.5	25.0	25.0	25.0	25.0	25.0
Ammonia	0.30	0.20	0.20	0.14	0.14	0.04	0.08
Day 9							
Temp	26.1	25.9	25.9	26.0	25.9	26.0	26.0
D.O.	5.7	5.6	5.6	5.4	5.5	5.4	5.4
pH	7.69	7.65	7.66	7.68	7.69	7.69	7.70
Salinity	25.5	24.5	25.0	25.0	25.0	25.0	25.0
Ammonia	<1.0	0.80	0.75	0.65	0.75	0.80	0.80
Day 10							
Temp	25.8	25.7	25.7	25.7	25.7	25.8	25.8
D.O.	5.1	5.0	5.1	5.2	5.1	5.1	5.2
pH	7.55	7.59	7.58	7.51	7.52	7.56	7.54
Salinity	26.0	25.0	25.0	25.0	25.5	25.5	25.5
Ammonia	1.0	1.0	>1.0	<1.0	<1.0	<1.0	<1.0
Mercenaria mercenaria (continued)							
Day 0							
Temp	24.3	24.4	24.2	24.3	24.3	24.1	24.1
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.84	7.79	7.75	7.83	7.84	7.80	7.86
Salinity	25.3	25.0	25.0	25.0	25.0	26.0	25.5
Ammonia	0.14	0.02	0.30	0.02	0.02	0.02	0.14

Table 12: (Continued)

Time	Lab Control	Beneficial Use Site #1	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #4	Beneficial Use Site #5	Beneficial Use Site #6
Mercenaria mercenaria (continued)							
Day 1							
Temp	24.6	24.7	24.6	24.9	24.8	24.7	24.5
D.O.	6.2	6.0	6.2	6.0	6.1	6.0	6.1
pH	7.80	7.81	7.73	7.53	7.78	7.45	7.63
Salinity	25.3	25.0	25.0	25.0	25.0	27.0	26.0
Ammonia	0.40	0.60	0.60	0.40	0.40	0.40	0.20
Day 2							
Temp	24.4	24.4	24.4	2.43	24.4	24.2	24.4
D.O.	6.4	6.3	6.3	6.3	6.2	6.3	6.3
pH	7.81	7.84	7.83	7.87	7.85	7.83	7.85
Salinity	25.0	25.5	25.5	25.0	25.0	25.5	25.0
Ammonia	0.20	0.02	0.30	0.04	0.02	0.02	0.02
Day 3							
Temp	24.7	25.0	25.0	24.9	25.1	24.8	24.9
D.O.	6.1	6.0	6.0	6.1	6.0	6.0	6.0
pH	7.78	7.78	7.80	7.80	7.76	7.77	7.81
Salinity	25.0	25.5	25.5	25.5	25.0	25.5	25.0
Ammonia	0.40	0.60	0.80	0.40	0.30	0.30	0.30
Day 4							
Temp	24.5	24.8	24.7	24.6	24.7	24.8	24.8
D.O.	6.3	6.3	6.3	6.2	6.3	6.3	6.3
pH	7.84	7.84	7.85	7.82	7.80	7.78	7.82
Salinity	25.0	25.5	25.5	26.0	25.5	25.5	25.5
Ammonia	0.20	0.02	0.20	0.04	0.04	0.02	0.02
Day 5							
Temp	24.7	24.6	24.5	24.5	24.6	24.7	24.4
D.O.	6.0	6.1	6.0	6.0	6.1	6.0	6.1
pH	7.80	7.80	7.82	7.77	7.76	7.73	7.80
Salinity	25.0	25.5	25.5	26.0	25.5	25.5	25.5
Ammonia	0.60	0.75	0.75	0.30	0.20	0.20	0.20
Day 6							
Temp	24.1	24.3	24.2	24.2	24.2	24.2	24.2
D.O.	6.5	6.3	6.3	6.4	6.3	6.3	6.4
pH	7.81	7.79	7.83	7.80	7.87	7.84	7.84
Salinity	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Ammonia	0.20	0.04	0.30	0.04	0.04	0.04	0.04

Table 12: (Continued)

Time	Lab Control	Beneficial Use Site #1	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #4	Beneficial Use Site #5	Beneficial Use Site #6
Mercenaria mercenaria (continued)							
Day 7							
Temp	25.0	25.0	25.1	25.1	25.3	25.2	25.2
D.O.	6.1	6.0	6.0	6.1	6.1	6.1	6.1
pH	7.76	7.75	7.79	7.76	7.83	7.81	7.80
Salinity	25.5	25.5	25.5	25.5	25.5	25.5	26.0
Ammonia	0.40	0.80	0.80	0.20	0.30	0.30	0.20
Day 8							
Temp	25.6	26.0	25.7	25.6	25.8	25.9	25.9
D.O.	6.2	6.1	6.2	6.2	6.2	6.3	6.2
pH	7.86	7.82	7.83	7.85	7.82	7.86	7.84
Salinity	26.0	26.0	26.0	26.0	26.0	25.5	25.5
Ammonia	0.30	0.04	0.40	0.04	0.02	0.02	0.04
Day 9							
Temp	26.0	25.9	25.9	26.0	26.0	25.9	25.9
D.O.	5.9	6.0	6.1	6.0	6.0	6.1	6.1
pH	7.81	7.80	7.80	7.82	7.79	7.82	7.80
Salinity	26.0	26.0	26.0	26.0	26.0	25.5	26.0
Ammonia	0.65	0.75	0.75	0.75	0.30	0.30	0.30
Day 10							
Temp	25.7	26.0	26.0	26.1	25.9	26.0	25.8
D.O.	5.7	5.6	5.7	5.9	5.7	5.8	5.9
pH	7.76	7.72	7.73	7.75	7.72	7.72	7.73
Salinity	26.0	26.0	26.0	26.0	26.0	25.7	26.0
Ammonia	0.80	0.80	<1.0	<1.0	0.50	0.50	0.50

The test was terminated at the end of ten days. Survival counts were taken by sieving the contents of the test chambers. Each test chamber was swirled and the contents poured onto a 0.5 mm sieve. Material retained on the screen was washed into a sorting tray with clean water. The total numbers of live and dead amphipods were recorded (Table 13).

2.7.2 Nereis virens

The test methods followed the draft guidance document ASTM (1992) and US EPA and USACOE (1991). Immature N. virens were exposed to the sediment samples for ten days under static renewal conditions. N. virens were exposed in groups of 20 in two-gallon plastic containers containing three centimeters of sediment. Overlying water (laboratory prepared water) was used to fill the test aquaria to 7,500 ml. Five replicate test chambers (20 organisms per replicate) were prepared for each sediment sample. Control and reference samples were also tested using the same methods. Test chambers were placed in a temperature controlled environment maintained at 25 ± 1 °C. The light regime was 16 hours light, eight hours dark.

The toxicity test was initiated (Day 0, 12 November 1993) when the polychaetes were distributed to each test chamber. Test animals were not fed throughout the 10 days. Seventy-five percent of the overlying water was renewed every 48 hours in order to maintain water quality. Gentle single bubble aeration was provided to each test chamber in order to maintain sufficient dissolved oxygen levels.

The test was terminated at the end of ten days. Survival counts were taken by inspecting the contents of the test chambers for live and dead polychaetes (Table 14).

2.7.3 Mercenaria mercenaria

The test methods followed the guidelines outlined in the US EPA (1989b) and US EPA and USACOE (1991). M. mercenaria were exposed to the sediment samples for 10 days under static renewal conditions. M. mercenaria were exposed in groups of 10 in two-gallon plastic containers containing three centimeters of sediment. Overlying water (laboratory prepared water) was used to fill the test aquaria to 7,500 ml. Five replicate test chambers (ten organisms per replicate) were prepared for each sediment sample. Control and reference samples were also tested using the same methods. Test chambers were placed in a temperature controlled environment maintained at 25 ± 1 °C. The light regime was 16 hours light, eight hours dark.

The toxicity test was initiated (Day 0, 12 November 1993) when the bivalve mollusks were distributed to each test chamber. Test animals were not fed throughout the ten days. Seventy-five percent of the overlying water was renewed every 48 hours in order to maintain water quality. Gentle single bubble aeration was provided to each test chamber in order to maintain sufficient dissolved oxygen levels.

The test was terminated at the end of 10 days. The total numbers of live and dead mollusks were recorded (Table 15).

2.8 Methods - Bioaccumulation Tests

The 28-day static bioaccumulation tests were conducted for five bay study sites and four corresponding beneficial use sites. The test organism was the hardshell clam M. mercenaria. The static test method for Mercenaria mercenaria followed the guidelines outlined in US EPA (1989b) and US EPA and USACOE (1991).

Table 13: Percent Survival - Whole Sediment Bioassays - Ampelisca sp.

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 10-Day Static Renewal Sediment Toxicity Test
DATE: 12 through 22 November 1993

Sample Number	Test Chamber Number	Number of Organisms at Start	Number of Organisms at 10 days	Sample Percent Survival
Control	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Reference	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #1	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #2	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #3	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #4	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	

Table 13: (Continued)

Sample Number	Test Chamber Number	Number of Organisms at Start	Number of Organisms at 10 days	Sample Percent Survival
Delaware Bay #5	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #6	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #7	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #8	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #9	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #10	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	

Table 14: Percent Survival - Whole Sediment Bioassays - N. virens

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 10-Day Static Renewal Sediment Toxicity Test
DATE: 12 through 22 November 1993

Sample Number	Test Chamber Number	Number of Organisms at Start	Number of Organisms at 10 days	Sample Percent Survival
Control	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Reference	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #1	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #2	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #3	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #4	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	

Table 14: (Continued)

Sample Number	Test Chamber Number	Number of Organisms at Start	Number of Organisms at 10 days	Sample Percent Survival
Delaware Bay #5	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #6	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #7	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #8	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #9	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	
Delaware Bay #10	1	20	20	100%
	2	20	20	
	3	20	20	
	4	20	20	
	5	20	20	

Table 15: Percent Survival - Whole Sediment Bioassays - M. mercenaria

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 10-Day Static Renewal Sediment Toxicity Test
DATE: 12 through 22 November 1993

Sample Number	Test Chamber Number	Number of Organisms at Start	Number of Organisms at 10 days	Sample Percent Survival
Control	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Reference	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #1	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #2	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #3	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #4	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	

Table 15: (Continued)

Sample Number	Test Chamber Number	Number of Organisms at Start	Number of Organisms at 10 days	Sample Percent Survival
Delaware Bay #5	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #6	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #7	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #8	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #9	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	
Delaware Bay #10	1	10	10	100%
	2	10	10	
	3	10	10	
	4	10	10	
	5	10	10	

The samples for the sediment bioaccumulation tests were stored at 4°C until they were brought up to room temperature 24 hours before preparation of the test sediment. The samples were initially gross sieved using a 1.00 mm stainless steel sieve to remove large organic material, macroinvertebrates, and interstitial water. All samples were fairly uniform in composition. Each sample was then homogenized by placing the sample in a stainless steel bowl and thoroughly mixing it using a stainless steel spoon. The samples were then placed in the test cups and allowed to settle for 24 hours.

M. mercenaria were exposed to the sediment samples for 28 days under static renewal conditions in groups of ten in two-gallon plastic containers containing three centimeters of sediment. Laboratory prepared water was used to fill the test aquaria to 7,500 ml. Five replicate test chambers (10 clams per replicate) were prepared for each sediment sample. Control and reference samples were also tested using the same methods. Tests chambers were placed in a temperature controlled environment maintained at 25 ± 1°C. The light regime was 16 hours light, eight hours dark.

The test was initiated on 12 November 1993 when the bivalve mollusks were distributed to each test chamber. Test animals were not fed during the test. Seventy-five percent of the overlying water was renewed every 48 hours in order to maintain water quality. Gentle single bubble aeration was provided to each test chamber in order to maintain sufficient dissolved oxygen levels. Water column temperature, pH, dissolved oxygen, ammonia, and salinity were monitored daily (Table 16).

Acute static 48-hour water column reference toxicant tests were run using M. mercenaria. The toxicant was potassium chloride and the 48 hour LC_{50} for M. mercenaria was 827.8 mg/L KCl.

The bioaccumulation test was terminated at the end of 28 days. Clams that died during the test period were removed and discarded daily. Surviving individuals were placed in clean, sediment-free water for 24 hours to purge their digestive tracts. The clams were not fed during this purging period. Fecal material was siphoned from the purging chamber twice during the 24-hour period. After the purging period, the clam tissue was removed from the shell, combined among replicates for each sample, and frozen until analysis was initiated for the chemical constituents listed in Table 17. Prior to chemical analyses, the clam tissue samples were thawed and homogenized in a stainless steel blender.

Table 16: Physical/Chemical Measurements - Bioaccumulation Tests

CLIENT: U.S. Army Corps of Engineers, Philadelphia District
TEST: 28-Day Bioaccumulation Test
DATE: 12 November through 10 December 1993
DATA: Temperature (C), Dissolved oxygen (mg/L), pH, Salinity (ppt), and Ammonia nitrogen (ppm).

Time	Lab Control	Delaware Bay #1	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #10	Control Site	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #5	Beneficial Use Site #6
Mercenaria mercenaria											
Day 0											
Temp	24.3	24.0	24.3	24.1	24.4	24.3	24.3	24.2	24.3	24.1	24.1
D.O.	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
pH	7.84	7.86	7.53	7.74	7.76	7.85	7.84	7.75	7.83	7.80	7.86
Salinity	25.3	25.3	23.5	26.0	25.0	25.5	25.3	25.0	25.0	26.0	25.5
Ammonia	0.14	0.30	0.20	0.08	0.04	0.02	0.14	0.30	0.02	0.02	0.14
Day 1											
Temp	24.6	24.7	24.8	24.6	24.7	24.4	24.6	24.6	24.9	24.7	24.5
D.O.	6.2	6.2	6.2	6.1	6.3	6.3	6.2	6.2	6.0	6.0	6.1
pH	7.80	7.59	7.68	7.76	7.53	7.85	7.80	7.73	7.53	7.45	7.63
Salinity	25.3	25.3	23.5	25.8	25.0	25.5	25.3	25.0	25.0	27.0	26.0
Ammonia	0.40	0.80	0.80	0.20	0.40	0.30	0.40	0.60	0.40	0.40	0.20
Day 2											
Temp	24.4	24.3	24.3	24.3	24.4	24.3	24.4	24.4	24.3	24.2	24.4
D.O.	6.4	6.3	6.2	6.2	6.3	6.2	6.4	6.3	6.3	6.3	6.3
pH	7.81	7.84	7.76	7.74	7.81	7.83	7.81	7.83	7.87	7.83	7.85
Salinity	25.0	25.0	25.0	25.0	25.5	25.5	25.0	25.5	25.0	25.5	25.0
Ammonia	0.20	0.20	0.20	0.08	0.04	0.04	0.20	0.30	0.04	0.02	0.02
Day 3											
Temp	24.7	24.8	24.8	24.8	24.7	25.0	24.7	25.0	24.9	24.8	24.9
D.O.	6.1	6.2	6.0	6.0	6.0	6.0	6.1	6.0	6.1	6.0	6.0
pH	7.78	7.80	7.78	7.78	7.81	7.78	7.78	7.80	7.80	7.77	7.81
Salinity	25.0	25.0	25.0	25.0	26.0	25.5	25.0	25.5	25.5	25.5	25.0
Ammonia	0.40	0.80	0.80	0.14	0.30	0.30	0.40	0.80	0.40	0.30	0.30

Table 16: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #10	Control Site	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #5	Beneficial Use Site #6
Day 4											
Temp	24.5	24.6	24.7	24.8	24.8	24.6	24.5	24.7	24.6	24.8	24.8
D.O.	6.3	6.2	6.3	6.3	6.2	6.3	6.3	6.3	6.2	6.3	6.3
pH	7.84	7.86	7.78	7.76	7.78	7.87	7.84	7.85	7.82	7.78	7.82
Salinity	25.0	25.5	25.0	25.5	25.0	25.5	25.0	25.5	26.0	25.5	25.5
Ammonia	0.20	0.30	0.20	0.08	0.04	0.02	0.20	0.20	0.04	0.02	0.02
Day 5											
Temp	24.7	24.7	24.6	24.6	24.7	24.5	24.7	24.5	24.5	24.7	24.4
D.O.	6.0	6.0	6.1	6.1	6.0	6.1	6.0	6.0	6.0	6.0	6.1
pH	7.80	7.81	7.78	7.78	7.75	7.80	7.80	7.82	7.77	7.73	7.80
Salinity	25.0	25.5	25.5	25.5	25.0	25.5	25.0	25.5	26.0	25.5	25.5
Ammonia	0.60	0.60	0.75	0.20	0.20	0.30	0.60	0.75	0.30	0.20	0.20
Day 6											
Temp	24.1	24.3	24.1	24.0	24.3	24.3	24.1	24.2	24.2	24.2	24.2
D.O.	6.5	6.4	6.5	6.4	6.3	6.4	6.5	6.3	6.4	6.3	6.4
pH	7.81	7.80	7.76	7.83	7.81	7.82	7.81	7.83	7.80	7.84	7.84
Salinity	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Ammonia	0.20	0.20	0.30	0.14	0.08	0.04	0.20	0.30	0.04	0.04	0.04
Day 7											
Temp	25.0	25.0	25.1	25.1	25.3	24.9	25.0	25.1	25.1	25.2	25.2
D.O.	6.1	6.0	6.1	6.2	6.1	6.0	6.1	6.0	6.1	6.1	6.1
pH	7.76	7.76	7.76	7.80	7.80	7.80	7.76	7.79	7.76	7.81	7.80
Salinity	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	26.0
Ammonia	0.40	0.40	0.80	0.30	0.30	0.30	0.40	0.80	0.20	0.30	0.20
Day 8											
Temp	25.6	25.8	25.9	25.9	25.9	25.9	25.6	25.7	25.6	25.9	25.9
D.O.	6.2	6.2	6.0	6.3	6.0	6.1	6.2	6.2	6.2	6.3	6.2
pH	7.86	7.80	7.82	7.86	7.81	7.87	7.86	7.83	7.85	7.86	7.84
Salinity	26.0	26.0	26.0	25.7	26.0	26.0	26.0	26.0	26.0	25.5	25.5
Ammonia	0.30	0.30	0.20	0.20	0.14	0.08	0.30	0.40	0.04	0.02	0.04

Table 16: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #10	Control Site	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #5	Beneficial Use Site #6
Day 9											
Temp	26.0	26.0	26.1	26.1	25.9	25.9	26.0	25.9	26.0	25.9	25.9
D.O.	5.9	6.0	5.9	6.1	5.9	6.0	5.9	6.1	6.0	6.1	6.1
pH	7.81	7.78	7.80	7.82	7.79	7.83	7.81	7.80	7.82	7.82	7.80
Salinity	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	25.5	26.0Ammonia
	0.65	0.50	0.80	0.40	0.40	0.65	0.65	0.75	0.75	0.30	0.30
Day 10											
Temp	25.7	25.8	26.1	25.9	25.9	25.9	25.7	26.0	26.1	26.0	25.8
D.O.	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.9	5.8	5.9
pH	7.76	7.71	7.74	7.76	7.71	7.73	7.76	7.73	7.75	7.72	7.73
Salinity	26.0	26.3	26.0	26.0	26.0	26.0	26.0	26.0	26.0	25.7	26.0
Ammonia	0.80	0.75	0.80	0.50	0.65	0.75	0.80	<1.0	<1.0	0.50	0.50
Day 11											
Temp	24.5	24.7	24.6	24.4	24.5	24.3	24.5	24.6	24.5	24.4	24.4
D.O.	6.2	6.3	6.4	6.3	6.1	6.2	6.2	6.3	6.3	6.4	6.4
pH	7.78	7.76	7.83	7.81	7.77	7.78	7.78	7.84	7.82	7.78	7.76
Salinity	27.0	27.0	27.0	26.5	27.0	27.0	27.0	27.0	26.5	26.5	26.5
Ammonia	0.50	0.75	0.40	0.20	0.14	0.14	0.50	0.40	0.20	0.30	0.20
Day 12											
Temp	24.9	24.6	24.7	24.5	24.8	24.6	24.9	24.8	24.7	24.5	24.7
D.O.	6.3	6.3	6.4	6.4	6.3	6.4	6.3	6.4	6.4	6.3	6.4
pH	7.83	7.79	7.87	7.83	7.81	7.80	7.83	7.87	7.86	7.82	7.74
Salinity	27.0	27.0	27.0	26.5	26.7	27.0	27.0	27.0	26.5	26.5	26.7
Ammonia	0.40	0.40	0.20	0.08	0.08	0.02	0.40	0.30	0.08	0.14	0.14
Day 13											
Temp	25.4	25.1	25.3	25.5	25.6	25.2	25.4	25.3	25.4	25.4	25.5
D.O.	6.2	6.2	6.3	6.3	6.4	6.2	6.2	6.3	6.3	6.3	6.3
pH	7.80	7.80	7.84	7.82	7.79	7.81	7.80	7.85	7.83	7.81	7.80
Salinity	27.0	27.0	26.7	26.7	27.0	27.0	27.0	27.0	26.7	26.5	27.0
Ammonia	0.40	0.50	0.40	0.20	0.20	0.14	0.40	0.50	0.14	0.20	0.20

Table 16: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #10	Control Site	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #5	Beneficial Use Site #6
Day 14											
Temp	25.0	25.1	24.9	24.9	25.0	25.3	25.0	25.2	25.1	25.4	25.3
D.O.	6.4	6.4	6.3	6.5	6.4	6.3	6.4	6.3	6.4	6.4	6.4
pH	7.85	7.83	7.85	7.85	7.87	7.83	7.85	7.84	7.83	7.78	7.87
Salinity	26.5	26.3	26.7	26.5	26.5	26.5	26.5	26.0	26.5	26.3	26.5
Ammonia	0.40	0.20	0.08	0.08	0.02	0.14	0.40	0.20	0.08	0.02	0.14
Day 15											
Temp	24.7	24.5	24.6	24.7	24.6	24.5	24.7	24.9	24.8	24.7	24.8
D.O.	6.4	6.3	6.4	6.3	6.3	6.3	6.4	6.3	6.3	6.3	6.3
pH	7.81	7.85	7.82	7.83	7.81	7.78	7.81	7.83	7.81	7.78	7.83
Salinity	26.5	26.5	27.0	27.0	26.5	26.5	26.5	26.5	27.0	26.5	26.7
Ammonia	0.50	0.30	0.08	0.14	0.04	0.14	0.50	0.30	0.20	0.30	0.20
Day 16											
Temp	25.4	25.6	25.3	25.4	25.5	25.7	25.4	25.7	25.7	25.6	25.7
D.O.	6.4	6.3	6.4	6.4	6.4	6.3	6.4	6.4	6.4	6.3	6.4
pH	7.83	7.80	7.83	7.87	7.83	7.83	7.83	7.81	7.87	7.86	7.86
Salinity	27.0	27.0	26.7	26.7	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Ammonia	0.20	0.20	0.14	0.14	0.04	0.20	0.20	0.20	0.14	0.02	0.02
Day 17											
Temp	25.7	25.6	25.8	26.0	26.0	25.9	25.7	25.9	25.9	26.0	25.9
D.O.	6.5	6.5	6.3	6.3	6.4	6.4	6.5	6.3	6.3	6.4	6.4
pH	7.81	7.76	7.85	7.85	7.85	7.77	7.81	7.80	7.87	7.84	7.81
Salinity	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Ammonia	0.40	0.30	0.14	0.20	0.14	0.30	0.40	0.40	0.20	0.14	0.08
Day 18											
Temp	24.9	25.1	25.2	25.3	25.3	25.3	24.9	25.4	25.4	25.4	25.4
D.O.	6.4	6.4	6.4	6.3	6.3	6.4	6.4	6.4	6.4	6.4	6.4
pH	7.86	7.83	7.80	7.92	7.90	7.84	7.86	7.84	7.84	7.94	7.86
Salinity	25.7	26.0	25.7	25.5	25.7	26.0	25.7	25.7	26.0	25.7	26.0
Ammonia	0.20	0.20	0.08	0.08	0.04	0.14	0.20	0.30	0.14	0.08	0.02

Table 16: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #10	Control Site	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #5	Beneficial Use Site #6
Day 19											
Temp	24.6	24.5	24.7	24.6	24.5	24.7	24.6	24.8	24.6	24.5	24.6
D.O.	6.3	6.3	6.3	6.3	6.3	6.4	6.3	6.3	6.3	6.4	6.3
pH	7.81	7.81	7.81	7.86	7.85	7.81	7.81	7.82	7.84	7.89	7.84
Salinity	26.0	26.0	25.7	25.7	26.0	26.0	26.0	26.0	26.0	25.7	26.0
Ammonia	0.30	0.30	0.20	0.14	0.20	0.20	0.30	0.50	0.30	0.20	0.14
Day 20											
Temp	25.1	25.2	24.9	25.0	25.2	25.0	25.1	25.1	25.0	25.0	24.9
D.O.	6.3	6.3	6.4	6.4	6.3	6.3	6.3	6.4	6.3	6.4	6.3
pH	7.84	7.81	7.83	7.87	7.87	7.81	7.84	7.86	7.85	7.89	7.87
Salinity	25.0	25.3	25.5	25.0	25.3	25.5	25.0	25.5	25.3	25.3	25.0
Ammonia	0.20	0.14	0.14	0.14	0.08	0.20	0.20	0.40	0.30	0.14	0.08
Day 21											
Temp	24.9	24.7	24.9	25.0	25.1	24.9	24.9	25.0	25.0	25.1	24.9
D.O.	6.3	6.3	6.4	6.3	6.3	6.3	6.3	6.4	6.4	6.3	6.3
pH	7.80	7.78	7.79	7.82	7.83	7.81	7.80	7.82	7.84	7.84	7.85
Salinity	25.0	25.5	25.5	25.5	25.5	25.5	25.0	25.5	25.3	25.3	25.3
Ammonia	0.40	0.30	0.30	0.20	0.30	0.30	0.40	0.50	0.30	0.30	0.20
Day 22											
Temp	25.0	25.3	25.2	25.2	25.3	25.1	25.0	25.2	25.3	25.2	25.3
D.O.	6.4	6.4	6.4	6.3	6.4	6.3	6.4	6.3	6.3	6.4	6.3
pH	7.86	7.84	7.87	7.89	7.91	7.90	7.86	7.87	7.85	7.86	7.88
Salinity	25.5	25.0	25.3	25.7	25.4	25.4	25.5	25.3	25.7	25.5	25.5
Ammonia	0.20	0.20	0.08	0.14	0.08	0.04	0.20	0.30	0.08	0.08	0.02
Day 23											
Temp	25.4	25.6	25.7	25.6	25.6	25.5	25.4	25.8	25.7	25.8	25.6
D.O.	6.3	6.3	6.3	6.3	6.3	6.4	6.3	6.3	6.2	6.2	6.2
pH	7.81	7.83	7.85	7.84	7.86	7.84	7.81	7.86	7.81	7.82	7.82
Salinity	25.5	26.0	25.5	26.0	26.0	27.0	25.5	26.5	26.5	27.0	27.0
Ammonia	0.30	0.30	0.14	0.20	0.14	0.20	0.30	0.50	0.20	0.14	0.08

Table 16: (Continued)

Time	Lab Control	Delaware Bay #1	Delaware Bay #4	Delaware Bay #5	Delaware Bay #6	Delaware Bay #10	Control Site	Beneficial Use Site #2	Beneficial Use Site #3	Beneficial Use Site #5	Beneficial Use Site #6
Day 24											
Temp	26.0	26.2	26.1	25.9	25.9	26.0	26.0	25.9	25.9	26.0	25.9
D.O.	6.2	6.3	6.3	6.3	6.2	6.3	6.2	6.2	6.3	6.4	6.3
pH	7.84	7.82	7.85	7.84	7.87	7.86	7.84	7.84	7.81	7.83	7.83
Salinity	27.0	26.5	26.7	26.7	26.7	27.0	27.0	26.7	26.5	26.7	27.0
Ammonia	0.20	0.20	0.14	0.08	0.08	0.08	0.20	0.40	0.14	0.04	0.04
Day 25											
Temp	25.8	25.8	26.1	26.2	26.0	25.9	25.8	25.9	25.9	25.9	25.9
D.O.	6.3	6.3	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.2
pH	7.81	7.79	7.82	7.82	7.82	7.80	7.81	7.79	7.80	7.79	7.80
Salinity	27.3	26.7	27.0	26.7	27.0	27.0	27.3	26.5	26.5	27.0	27.0
Ammonia	0.40	0.40	0.20	0.20	0.20	0.14	0.40	0.75	0.20	0.20	0.20
Day 26											
Temp	25.8	25.9	25.8	25.6	25.3	25.2	25.8	26.0	25.6	25.9	25.9
D.O.	6.4	6.5	6.5	6.3	6.4	6.4	6.4	6.4	6.3	6.4	6.3
pH	7.88	7.87	7.89	7.92	7.90	7.86	7.88	7.87	7.89	7.90	7.86
Salinity	26.0	25.7	26.0	26.3	25.7	25.5	26.0	25.7	26.0	26.0	26.3
Ammonia	0.20	0.30	0.20	0.14	0.14	0.04	0.20	0.30	0.08	0.02	0.02
Day 27											
Temp	26.3	26.1	25.9	26.0	25.9	26.2	26.3	25.9	26.0	25.8	25.9
D.O.	6.3	6.3	6.3	6.3	6.3	6.2	6.3	6.2	6.2	6.3	6.3
pH	7.85	7.83	7.84	7.87	7.85	7.84	7.85	7.83	7.82	7.83	7.81
Salinity	26.0	26.0	26.3	26.3	26.0	25.7	26.0	26.0	26.0	26.0	26.5
Ammonia	0.40	0.40	0.30	0.30	0.20	0.08	0.40	0.60	0.14	0.08	0.08
Day 28											
Temp	25.8	26.0	25.7	25.8	25.9	25.9	25.8	25.8	25.9	25.9	26.0
D.O.	6.3	6.3	6.2	6.2	6.3	6.2	6.3	6.2	6.2	6.2	6.2
pH	7.80	7.78	7.79	7.76	7.78	7.79	7.80	7.80	7.75	7.74	7.77
Salinity	26.3	26.5	27.0	26.5	26.5	26.3	26.3	26.0	26.5	26.0	26.5
Ammonia	0.40	0.80	0.50	0.65	0.40	0.20	0.40	<1.0	0.40	0.20	0.30

Table 17: Parameter List for Chemical Analysis of Mollusk Tissue

Metals

antimony
arsenic
beryllium
cadmium
chromium
copper
lead
mercury
nickel
selenium
silver
thallium
zinc

Pesticides

aldrin
dieldrin
chlordane
DDT, DDE, and DDD
endosulfan
endrin
endrin aldehyde
heptachlor
alpha-hexachlorocyclohexane
beta-hexachlorocyclohexane
toxaphene
mirex
methoxychlor
parathion
malathion
guthion
demeton
heptachlor epoxide
delta-hexachlorocyclohexane
gamma-hexachlorocyclohexane

Polychlorinated Biphenyls (PCB) as Arochlors

PCB-1242
PCB-1254
PCB-1221
PCB-1232
PCB-1248
PCB-1260
PCB-1016

Low Molecular Weight Polynuclear Aromatic Hydrocarbons (PAH)

acenaphthene
naphthalene
acenaphthylene
anthracene
phenanthrene
fluorene

High Molecular Weight (PAH)

fluoranthene
benzo (a) anthracene
benzo (a) pyrene
benzo (b) fluoranthene
benzo (k) fluoranthene
chrysene
benzo (ghi) perylene
dibenzo (a,h) anthracene
ideno (1,2,3-cd) pyrene
pyrene

3.0 RESULTS

3.1 Geotechnical Analyses

The geotechnical analyses (grain size and total organic carbon) were conducted to characterize the sediments and to assist in selection of sites for bioaccumulation testing. The results of these analyses are not discussed in this report. However, all data are contained in Appendices D and E of this report.

3.2 Water Column Bioassays

After 48 hours of exposure, **100% survival** was recorded for all six organisms at all test concentrations, and in both the lab water and water controls. With no mortality observed, statistical evaluation of the data was unnecessary. Bioassay testing results are provided for water column and all other bioassays in Appendix F.

3.3 Whole Sediment Bioassays

After ten days of exposure **100% survival** was recorded for all three species in all test, reference, and control sediment. Statistical evaluation was unnecessary due to the absence of mortality.

3.4 Bioaccumulation Tests

Clam mortality was observed during the final stages of testing, possibly due to starvation since the specimens were not fed during testing. Upon examination at the conclusion of the test, even the live clams appeared flaccid and emaciated. Analytical results of the tissue testing are found in Appendix G.

Chemical analyses of the clam tissue determined that all pesticides and PCBs as well as all semivolatile compounds analyzed were either absent from the samples or concentrations were below the quantifiable limit of the methods employed for clams exposed to the material to be dredged from the Delaware Bay (DB) sites as well as those exposed to disposal area Beneficial Use (BU) site sediments. Analyses were performed for 12 metals; seven were found in quantifiable concentrations in one or more samples (Table 18).

Initially, per the evaluation guidance contained in US EPA and USACOE (1991), the metals data were reviewed in comparison to Food and Drug Administration (FDA) Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food. Mercury is the only metal for which an FDA action level has been established (1 mg/kg). The maximum mercury concentration measured in this study, and the only value above the minimum detection limit of 0.07 mg/kg, was 0.47 mg/kg at BU Site 2. Concentrations of arsenic, chromium, lead, and mercury were below analytical detection limits for all DB sites.

Since FDA action levels have not been established for the other metals detected, additional data evaluation involved comparison of contaminant concentrations in clams exposed to DB sediments with those exposed to reference sediment (BU sites) and control sediment (sediment from the Chesapeake Bay location where the clams were collected). Tissue concentrations of the seven detected metals in clams exposed to the material to be dredged exceeded the tissue concentration for the corresponding reference sediment (BU sites) in only three instances: selenium at DB Sites 1 and 5 and copper at DB Site 6. The selenium concentrations were 0.342 mg/kg at DB1 and 0.256 mg/kg at DB5 as compared to <0.200 mg/kg at BU2 and BU3. The single copper concentration that was higher at a Bay dredging site than its paired Beneficial Use site was measured at 1.91 mg/kg at DB6 as compared to 1.64 mg/kg at BU5.

Table 18: Metals concentration (mg/kg - wet weight) of hard shell clam tissue from 28-day bioaccumulation tests of paired Delaware Bay dredging and beneficial use sites.

	Control	DB Site 1	BU Site 2	DB Site 4	BU Site 3	DB Site 5	BU Site 3	DB Site 6	BU Site 5	DB Site 10	BU Site 6
Arsenic	0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2
Chromium	<1.00	<1.00	1.04	<1.00	<1.00	<1.00	<1.00	<1.00	1.16	<1.00	1.02
Copper	2.34	1.39	1.76	1.85	1.95	1.73	1.95	1.91	1.64	1.82	2.31
Lead	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	2.42
Mercury	<0.07	<0.07	0.47	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Selenium	0.454	0.342	<0.200	<0.200	<0.200	0.256	<0.200	<0.200	<0.200	<0.200	<0.200
Zinc	13.2	10.5	12.7	11.8	15.5	10.3	15.5	11.2	12.1	11.8	16.0

NOTE: DB designates Delaware Bay; BU designates Beneficial Use

Based on these test data, neither selenium nor copper should be a human health problem. The selenium concentration in the DB1 and DB5 tissues are at the lower end of the range reported for "bivalve" mollusk (0.1 to 0.9 mg/kg) as a human food source reported in FDA (1982a and 1982b). Selenium also tends to have a low bioaccumulation tendency in marine shellfish or crustaceans and presents a low hazard to humans relative to other metals, such as mercury and lead (EPA 1978).

The copper concentration in clams exposed to sediment from DB6 and the other candidate dredge sites can be compared to the copper content of hard shell clam tissue taken from Chincoteague Bay, Maryland (Murphy 1990) and hard shell clams taken from 30 sites in lower Chesapeake Bay (Larsen 1979). The concentration at DB6 (1.91 mg/kg), which was also the highest concentration of any DB dredging site, was below the 2.9 to 5.5 mg/kg range reported by Murphy (1990) and near the mid-point of the average concentration reported by Larsen (1979) (Table 19). Although copper has a high bioaccumulative tendency in marine shellfish or crustaceans, it constitutes a relatively low human health hazard (EPA 1978).

Metals concentrations measured in control tissue (clams exposed for the duration of the test to sediment from the Chesapeake Bay location at which the clams were collected) exceeded those in DB site test tissue in all instances (Table 18). However, the results do not indicate gross contamination of the control sediment since these tissue concentrations fall within the range of acceptable background tissue concentrations for test organisms given in EPA (1989b) and compare favorably with hard clam tissue data from other East Coast studies of non-heavily polluted sites (Table 19).

3.5 Standard Reference Toxicity Testing

Standard reference toxicity (SRT) testing was conducted for all test species. Testing was conducted concurrently with whole sediment and water column bioassays. The laboratory routinely conducts SRT testing for Pimephales promelas, Ceriodaphnia dubia, and Mysidopsis bahia, and thus maintains control charts within the laboratory. Control charts for Cyprinodon variegatus, Ampelisca abdita, and Hyallela azteca are maintained by the supplier, Aquatic Research Organisms. The results of in-house SRT data were compared to the commercial control charts and found good agreement between the two. The results of the SRT bioassays fell well within the acceptance ranges for all species. Therefore, all test organisms were judged suitable for toxicity testing.

Control charts for Mercenaria mercenaria, Nereis virens, and Crassostrea virginica were not generated by the laboratory or its commercial supplier. SRT protocols for these species are not yet well established. Also, these organisms are not routinely used in acute toxicity testing and are field collected on an as needed basis.

Table 19: Metals concentrations (mg/kg wet weight) of hard shell clam tissue from 28-day bioaccumulation test control tissue compared to representative organism tissue residues from other East Coast sites

	Control	Various East Coast Sites[a]	Chincoteague Bay, Chesapeake Bay[b]	Great Bay, New Jersey[c]	Lower Chesapeake Bay Region[d]
Arsenic	0.5	1.5 - 3.9	0.39 - 2.52	NA	NA
Chromium	<1.00	0.26 - 2.5	<0.1 - <0.5	0.01 - 0.74	NA
Copper	2.34	0.1 - 7.2	2.91 - 5.51	NA	1.0 - 3.7
Lead	<2.00	<0.6 - 2.6	<0.5 - 1.3	0.01 - 0.83	NA
Mercury	<0.07	<0.05 - 1.2	0.025 - 0.42	0.04 - 0.14	NA
Selenium	0.454	NA	NA	NA	NA
Zinc	13.2	2.4 - 30	11.6 - 15.8	NA	7.5 - 35.5

NA = not available

[a] = EPA (1989b). Range of approximate acceptable background tissue concentrations for test organisms.

[b] = Murphy (1990). Range of three samples collected in 1981 and 1984.

[c] = pers. comm. J.E. Mumman, NJDEPE, 2 March 1994. Range of eight samples collected 1981 through 1984.

[d] = Larsen (1979). Samples taken 1972 and 1973 at 30 sites, 11 replicates per site. Range of sample means.

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RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 8-24-93 RMC JOB#:
COLLECTOR(S): [illegible] PROJECT MGR.:
RANGE(S): [illegible] water sample
WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Partly Cloudy, wind 10 [illegible]

		COMMENTS
Site:	[illegible] Range	
Database:	CMH	
Tide:	Ebb tide	Collected [illegible] sediment
Start Time:	1150	
RTCM:	15-100	
PDOP:	3.9	
Records:	125	
Depth:	44'	
Latitude:	39°46'25.625'	
Longitude:	75°3[illegible]'46.03[illegible]	
End Time:	1233	

		COMMENTS
Site:	BEND [illegible]	
Database:	EBENDM	
Tide:	Ebb, but slowing	Collected 5 gal. of sediment
Start Time:	1335	
RTCM:	15→143	
PDOP:	3.3	
Records:	128	
Depth:	26'	
Latitude:	39°46'47.471"	
Longitude:	75°27'33.561"	
End Time:	1446	

		COMMENTS
Site:		
Database:		
Tide:		
Start Time:		
RTCM:		
PDOP:		
Records:		
Depth:		
Latitude:		
Longitude:		
End Time:		

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 8-5-98 RMC JOB#: 4710

COLLECTOR(S): Pete, Kim, Jen PROJECT MGR.: R.M.Kling

RANGE(S): Bellevue Range Water Sample

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny - wind 0-5 mph

Site:	BELL. 1D
Database:	BELL1D
Tide:	MAX FLOOD SLACK
Start Time:	0902
RTCM:	1 → 139
PDOP:	3.4
Records:	139
Depth:	28'
Latitude:	39° 44' 17.962"
Longitude:	75° 28' 24.810'
End Time:	0935

COMMENTS

N/A

5 gals of Sed

Site:	BELLEVUE RANGE
Database:	BBELLVUE
Tide:	FLOOD SLACK → Ebb
Start Time:	1010
RTCM:	67 - 194
PDOP:	2.9
Records:	127
Depth:	52'
Latitude:	39°45'49.944
Longitude:	75°28'40.219'
End Time:	1100

COMMENTS

N/A

5 gals of Sed.

Site:	BELLEVUE RANGE WATERSAMPLE
Database:	BELLWAR
Tide:	Ebb
Start Time:	1113
RTCM:	1-68 + 110-180
PDOP:	3.3
Records:	138
Depth:	49'
Latitude:	39°46'27.380
Longitude:	75°28'06.535
End Time:	1145

COMMENTS

SAMPLE POINT BEKAN AT REQUIRED LAT/LON AND THEN DRIFTED WITH CURRENT/TIDE, TIC SAMPLE CONTAINERS WERE FILLED.

45 gals of water (3 drums)

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: [illegible] RMC JOB#: 4710

COLLECTOR(S): [illegible] PROJECT MGR.: R.M.Kling

RANGE(S): [illegible]

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny - Wind 0-5 mph

Site:	BENDL
Database:	BENDL
Tide:	Max Ebb
Start Time:	1330
RTCM:	1-137
PDOP:	3.4
Records:	137
Depth:	47'
Latitude:	39°49'12.436
Longitude:	75°22'57.153"
End Time:	1610

COMMENTS

Epi sediments

Site:	CHESTER RANGE
Database:	—
Tide:	MAX Ebb
Start Time:	1628
RTCM:	—
PDOP:	—
Records:	—
Depth:	46'
Latitude:	—
Longitude:	—
End Time:	1730

COMMENTS

Site situated under/near Commodore Barry Bridge - unable to attain GPS lock. Unable to get representative samples - Substrate all rock - extended area by ~ 500 ft in all directions still no sample.

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 8-26-93 RMC JOB#: 4710
COLLECTOR(S): [illegible] PROJECT MGR.: R.M.Kling
RANGE(S): [illegible]
WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny - 0-5 [illegible]

		COMMENTS
Site:	BEND K	[illegible] silt and [illegible]
Database:	BBENDK	
Tide:	Flood -> [illegible]	
Start Time:	0840	
RTCM:	1 -> 160	
PDOP:	4.9	
Records:	160	
Depth:	37.0'	
Latitude:	39°50'23.970	
Longitude:	75°20'5[illegible]	
End Time:	0930	

		COMMENTS
Site:	CHESTER RANGE	Attempted to sample site again still unable to collect nothing but rocks. Used Ponar [illegible] and pipe dredge - no [illegible]
Database:		
Tide:	FLOOD SLACK	
Start Time:	0930	
RTCM:		
PDOP:		
Records:		
Depth:		
Latitude:		
Longitude:		
End Time:	1100	

		COMMENTS
Site:	EDDYSTONE RANGE	20' off center Scale of sediment
Database:	BEDDY	
Tide:	HIGH SLACK -> EBB	
Start Time:	1122	
RTCM:	13 -> 165	
PDOP:	3.5	
Records:	152	
Depth:	53.0'	
Latitude:	39°50'42.485"	
Longitude:	75°20'23.100"	
End Time:	1200	

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: [illegible] RMC JOB#: 4710

COLLECTOR(S): [illegible] PROJECT MGR.: R.M.Kling

RANGE(S): [illegible]

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): [illegible]

		COMMENTS
Site:	BENO I	24' off [illegible]
Database:	[illegible]	
Tide:	EBB → [illegible]	
Start Time:	1316	5 gals. of sediment collected.
RTCM:	1 → 144	
PDOP:	4.0	
Records:	144	
Depth:	48.0	
Latitude:	39° [illegible]' 47.574	
Longitude:	75° 20' 03.007"	
End Time:	1405	

		COMMENTS
Site:	BENO I	
Database:	BBENOI	
Tide:	MAX. EBB	
Start Time:	1515	
RTCM:	1 → 158	5 gal. of sediment collected.
PDOP:	2.4	
Records:	158	
Depth:	40.0'	
Latitude:	39° 51' 01.496"	
Longitude:	75° 15' 45.324"	
End Time:	1600	

		COMMENTS
Site:	TINICUM RANGE	
Database:	BTINICUM	
Tide:	EBB SLACK	
Start Time:	1613	5 gals of sediment collected
RTCM:	1 → 133	
PDOP:	4.4	
Records:	133	
Depth:	46.0'	
Latitude:	39° 50' 54.919"	
Longitude:	75° 17' 27.075"	
End Time:	1720	

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: [illegible] RMC JOB#: 4710

COLLECTOR(S): [illegible] PROJECT MGR.: R.M.Kling

RANGE(S): CHESTER [illegible]

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): [illegible]

Site:	[illegible]
Database:	[illegible]
Tide:	[illegible]
Start Time:	[illegible]
RTCM:	[illegible]
PDOP:	[illegible]
Records:	[illegible]
Depth:	[illegible]
Latitude:	[illegible]
Longitude:	[illegible]
End Time:	1800

COMMENTS

[illegible]

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: _____ RMC JOB#: 4710

COLLECTOR(S): _____ PROJECT MGR.: R.M.Kling

RANGE(S): _____

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): _____

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	1 → 2
PDOP:	
Records:	
Depth:	3
Latitude:	
Longitude:	69
End Time:	1300

COMMENTS: Collected 5 gals of Sediment

Site:	
Database:	BBENDAE
Tide:	FLOOD TIDE
Start Time:	
RTCM:	1 → 120
PDOP:	2.1
Records:	120
Depth:	7/20'
Latitude:	39° 53' 56"
Longitude:	75° 08' 03.732
End Time:	1355

COMMENTS: Collected 5 gals of Sediment.

Site:	BEND AE
Database:	BBENDAE
Tide:	FLOOD TIDE
Start Time:	1419
RTCM:	30 → 156
PDOP:	3.8
Records:	126
Depth:	25 ft
Latitude:	39° 53' 12.824"
Longitude:	75° 08' 33.976"
End Time:	1456

COMMENTS: Collected 5 gals of sediment.

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: [illegible] RMC JOB#: 4710
COLLECTOR(S): [illegible] PROJECT MGR.: R.M.Kling
RANGE(S): [illegible]
WEATHER CONDITIONS (Lt/heavy rain,windy,etc): [illegible]

		COMMENTS
Site:	[illegible]	Intermittent [illegible]
Database:	[illegible]	
Tide:	[illegible]	
Start Time:	[illegible]	
RTCM:	[illegible]; 100→115; [illegible]	
PDOP:	[illegible]	
Records:	~ 226	
Depth:		
Latitude:	[illegible]	Collected 5 gals of sediment
Longitude:	75° 10' 22.[illegible]	
End Time:	1700	

		COMMENTS
Site:	[illegible]	[illegible]
Database:	[illegible]	
Tide:	[illegible]	
Start Time:	[illegible]	
RTCM:	[illegible]-315	
PDOP:	[illegible]	
Records:	234	
Depth:	~ 50	
Latitude:	39° [illegible]	Collected (4) 15 gals drums of water.
Longitude:	[illegible]	
End Time:	[illegible]	

		COMMENTS
Site:		
Database:		
Tide:		
Start Time:		
RTCM:		
PDOP:		
Records:		
Depth:		
Latitude:		
Longitude:		
End Time:		

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: _____ RMC JOB#: 4710

COLLECTOR(S): KMK, CAF, DRT PROJECT MGR.: R.M.Kling

RANGE(S): Mifflin Water Range

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Overcast, cold

Site:	R. LINGSPORT RANGE
Database:	BBILLINS
Tide:	Ebb
Start Time:	1215
RTCM:	13 → 220
PDOP:	3.0
Records:	207
Depth:	50'
Latitude:	39°51'04.961"
Longitude:	75°15'01.420"
End Time:	1247

COMMENTS

Collected 5 gals of sediment

Site:	Bend H
Database:	BBENDH
Tide:	Ebb
Start Time:	1303
RTCM:	1 → 65 ; 85 → 115; 150 → 205
PDOP:	3.1
Records:	154
Depth:	40'
Latitude:	39°51'22.660"
Longitude:	75°14'31.210"
End Time:	1335

COMMENTS

Collected 5 gals of sediment

Site:	Mifflin Range
Database:	BMIFFLIN
Tide:	Ebb SLACK
Start Time:	1348
RTCM:	1 → 123
PDOP:	4.2
Records:	123
Depth:	40'
Latitude:	39° 51' 59.845
Longitude:	75° 13' 10.113
End Time:	1420

COMMENTS

Collected 5 gals of sediment

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 9/21/93 RMC JOB#: 4710

COLLECTOR(S): RMK CAF DRT PROJECT MGR.: R.M.Kling

RANGE(S): Mifflin Range Water Sample

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Overcast, cold

Site:	BEND G.
Database:	BBENDG
Tide:	Flood
Start Time:	1440
RTCM:	1 → 143
PDOP:	4.5
Records:	143
Depth:	35'
Latitude:	39° 52' 46.011"
Longitude:	75° 10' 53.246"
End Time:	1515

COMMENTS

Collected [illegible] Edwin

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10/5/93 RMC JOB#: 4710

COLLECTOR(S): DRJ, JSD, RMK PROJECT MGR.: R.M.Kling

RANGE(S): Deepwater Range H20

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny warm - Windy & Rough

Site:	Deepwater Range H_2O
Database:	BDEEPH2O
Tide:	Max. Flood
Start Time:	1336
RTCM:	59 → 146
PDOP:	4.0
Records:	87
Depth:	~35'
Latitude:	39° 37' 55.350
Longitude:	75° 34' 21.570
End Time:	1355

COMMENTS

Drifted w/ current after recording starting point.

Collected (3) 15 gal drums of water Total 45 gals. of water

Site:	Bend 6
Database:	BBENDO
Tide:	Flood
Start Time:	1458
RTCM:	1 → 160
PDOP:	3.3
Records:	160
Depth:	35'
Latitude:	39° 40' 34.538
Longitude:	75° 31' 30.561
End Time:	1645

COMMENTS

Took long time to get RTCM and position. Very windy & rough collected 5 gals of sediment

Site:	Cherry Island Flats
Database:	BCHERRYI
Tide:	Flood slack
Start Time:	1700
RTCM:	1 → 123
PDOP:	2.6
Records:	123
Depth:	40'
Latitude:	39° 42' 34.046"
Longitude:	75° 30' 37.895"
End Time:	1745

COMMENTS

Collected 5 gals of sediment.

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-6-93 RMC JOB#: 4710

COLLECTOR(S): RMK, DRJ, JSD PROJECT MGR.: R.M.Kling

RANGE(S): Deepwater Range Site Samples

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny, calm, warm

Site:	Deepwater Point Range
Database:	BDEEPWAT
Tide:	Low Ebb
Start Time:	1042
RTCM:	3 → 77 (in 1000) from to stop records
PDOP:	4.3
Records:	Over a 1000
Depth:	40'
Latitude:	39°39' 15.153"
Longitude:	75°32' 47.776"
End Time:	1115

COMMENTS

River conditions excellent
"like glass"
Collected 5 gals. of sediment

Site:	Bend PQ
Database:	BBENDPQ
Tide:	Low Slack
Start Time:	1129
RTCM:	1 → 95 ; 1 → 38
PDOP:	3.0
Records:	133
Depth:	32'
Latitude:	39°37' 01.680"
Longitude:	75°34' 33.563"
End Time:	1146

COMMENTS

Sampling conditions still great - Smooth, calm.
Collected 5 gals of sediment

Site:	New Castle Range
Database:	BNEWCAST
Tide:	Flood
Start Time:	1213
RTCM:	1 → 207
PDOP:	3.2
Records:	207
Depth:	55'
Latitude:	39° 34' 07.662"
Longitude:	75° 32' 54.050"
End Time:	1230

COMMENTS

Sampling conditions still great.
Collected 5 gals of sediment

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-6-93 RMC JOB#: 4710

COLLECTOR(S): RMK, JSD, DRJ PROJECT MGR.: R.M.Kling

RANGE(S): Deepwater Range Water Sample

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny - wind increasing

Site:	B and R
Database:	BGENGR
Tide:	Max flood
Start Time:	1440
RTCM:	1-127
PDOP:	3.4
Records:	127
Depth:	59'
Latitude:	39° 33' 07.352"
Longitude:	75° 32' 33.676
End Time:	1510

COMMENTS

Wind increasing - getting rougher.

Collected 5 gal of sediment

Water Temp - 14.0°C
Salinity - 2.5 ppt
Conductivity - 360 μmhos

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-6-13 RMC JOB#: 4710

COLLECTOR(S): RMK JSD DRJ PROJECT MGR.: R.M.Kling

RANGE(S): Cohen Range Water Sample Area

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny — Windy → 10-15 mph

Site:	Bend S
Database:	BBENDS
Tide:	Flood
Start Time:	1610
RTCM:	1 → 127
PDOP:	4.4
Records:	127
Depth:	55'
Latitude:	39°29'05.443"
Longitude:	75°33'38.714"
End Time:	1645

COMMENTS

Rough water - difficult time getting point and sampling - 2'-3' swells.
Collected 5 gals of sediment

Site:	Reedy Island Range
Database:	BREEDYIS
Tide:	Flood slack
Start Time:	1710
RTCM:	1 → 75; 82 → 125
PDOP:	4.1
Records:	122
Depth:	54'
Latitude:	39°30'57.372"
Longitude:	75°33'14.940
End Time:	1745

COMMENTS

Very Rough - difficult weighting - had trouble returning to shore - took in lots of water -
Collected 5 gals of sediment

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-7-93 RMC JOB#: 4710

COLLECTOR(S): RMK, JSD, DRT PROJECT MGR.: R.M.King

RANGE(S): Baker Range Water Sample

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny, winds - @ 5-10 mph

		COMMENTS
Site:	Bend T	Wind against tide - "choppy"
Database:	BBENDT	
Tide:	Ebb Low - Slack	Drifted in & out of range do to wind & current.
Start Time:	1050	
RTCM:	1 → 147	Collected 5 gals of sed.
PDOP:	6.3	
Records:	147	
Depth:	55'	
Latitude:	39° 27' 25.987	
Longitude:	75° 33' 30.024	
End Time:	1130	

		COMMENTS
Site:	Baker Range	wind dropped to 0-5 mph.
Database:	BBAKERRA	collected 5 gals. of sediment
Tide:	Ebb Slack	
Start Time:	1140	
RTCM:	1 → 167	
PDOP:	3.1	
Records:	167	
Depth:	57'	
Latitude:	39° 28' 07.416"	
Longitude:	75° 33' 44.556"	
End Time:	1225	

		COMMENTS
Site:	Baker Range Water Sample	Kept losing satellite connection. RTCM
Database:	BAKERH2O	
Tide:	Flood (Low)	Collected (4) 15 drums of water.
Start Time:	1235	
RTCM:	186 - 385	Drifted w/ current for sample collection
PDOP:	4.5	
Records:	199	
Depth:	~55'	Temp - 19.0°C
Latitude:	39° 28' 19.325"	Sal - 4.5 ppt
Longitude:	75° 33' 46.135"	Cnd - 700
End Time:	1245	

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-18-93 RMC JOB#: 4710

COLLECTOR(S): RMK, DRJ PROJECT MGR.: R.M.Kling

RANGE(S): Mich Wall Range Water Sample Area

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny → overcast - windy

		COMMENTS
Site:	Industrial Use Site # 6	[illegible] collected 10 gal + [illegible]
Database:	GENSITE6	
Tide:	Ebb	
Start Time:	1326	
RTCM:	1-145	
PDOP:	3.8	Samples [illegible] from commercial work boat - SENECA
Records:	145	
Depth:	15'	
Latitude:	38°54' 08.293	
Longitude:	75°16' 19.769	Owner - Don Evans.
End Time:	1410	

		COMMENTS
Site:	Delaware Bay #9	High winds - fast tide - alot of boat movement - in & out of range. Initial set up w/ in range
Database:	DELBAY9	
Tide:	Ebb-max	
Start Time:	1600	
RTCM:	145→285	
PDOP:	2.5	
Records:	140	(3) 5 gal buckets + sample containers.
Depth:	43'	
Latitude:	38°53' 34.280"	
Longitude:	75°06' 03.248"	
End Time:	1455	

		COMMENTS
Site:	Delaware Bay #10	Collected only (2) 5 gal buckets of sediment. Peterson grab not working - needs repaired. cable support broke - Lots of movement due to winds + chop.
Database:	DELBAY10	
Tide:	Ebb → SLACK	
Start Time:	1750	
RTCM:	1→151	
PDOP:	3.8	
Records:	151	
Depth:	45.0'	
Latitude:	38°54' 19.910"	
Longitude:	75°04' 09.057"	
End Time:	1911	

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10/19/93 RMC JOB#: 4710

COLLECTOR(S): [illegible], DRJ PROJECT MGR.: R.M.Kling

RANGE(S): Miah Maull Water Sample Range Area

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Overcast - rough water - [illegible]

		COMMENTS
Site:	Miah Maull Range water	Winds @ [illegible] mph
Database:	MIAH H2O	Collected 2, 5 gal drums of water
Tide:	Flood	
Start Time:	1204	
RTCM:	1 → 406	Recorded [illegible] antenna [illegible]
PDOP:	2.4	on 6.25 unit @ beginning of
Records:	406	data capture.
Depth:	~46'	Drifted w/ current for
Latitude:	39° 09' 37.416"	sampling.
Longitude:	75° 15' 14.274"	
End Time:	1017	

		COMMENTS
Site:	Delaware Bay #5	Collected (3) 5 gal Buckets of sediment
Database:	DELBAY5	
Tide:	Flood → Slack	
Start Time:	1300	
RTCM:	100 - 248	
PDOP:	3.7	
Records:	148	
Depth:	47.0'	
Latitude:	39° 08' 47.063"	
Longitude:	75° 14' 29.212"	
End Time:	1434	

		COMMENTS
Site:	Delaware Bay # 6	Very Bad conditions; unable to lock on to position for
Database:	DELBAY6	were set at proper position
Tide:	Flood Slack	but lost data point.
Start Time:	1505-1537	Collected (3) 5 gal Buckets of sediment.
RTCM:	N/A	
PDOP:	N/A	
Records:	N/A	
Depth:	47.0	
Latitude:	39° 06' 05.846"	
Longitude:	75° 12' 01.473"	
End Time:	1709	

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-20-93 RMC JOB#: 4710

COLLECTOR(S): RMK, DRT PROJECT MGR.: R.M.Kling

RANGE(S): [illegible] Range Wide [illegible] Area

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): [illegible] 10[illegible]

		COMMENTS
Site:	Beneficial Use Site # 5	F[illegible]
Database:	BENUSE5	[illegible]
Tide:	Flood	[illegible] this time.
Start Time:	1120	(2) 5 gal bucket of sediment
RTCM:	1 → 1550	
PDOP:	2.7	
Records:	1550	
Depth:	10	
Latitude:	39° 00' [illegible]	
Longitude:	75° 12' 20.65[illegible]	
End Time:	1215	

		COMMENTS
Site:	Beneficial Use site # 3	Very foggy, but calm
Database:	BENUSE3	light drizzle.
Tide:	Flood → slack	Unable to do more
Start Time:	1352	sampling due to foggy &
RTCM:	1 → 145	alot of ship traffic
PDOP:	3.3	returned to dock @ 1830
Records:	145	(2) 5 gal Buckets of Sediment
Depth:	16.0'	
Latitude:	39° 05' 06.851"	
Longitude:	75° 20' 24.820"	
End Time:	1428	

		COMMENTS
Site:		
Database:		
Tide:		
Start Time:		
RTCM:		
PDOP:		
Records:		
Depth:		
Latitude:		
Longitude:		
End Time:		

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-2-9[illegible] RMC JOB#: 4710

COLLECTOR(S): [illegible] PROJECT MGR.: R.M.Kling

RANGE(S): [illegible]

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny but windy 10-[illegible] mph (NW)

		COMMENTS
Site:	[illegible]	Separate water [illegible] than other [illegible] Bay Sites. (3) 5 gal Buckets of Sediment.
Database:	DELBAY[illegible]	
Tide:	Ebb	
Start Time:	104[illegible]	
RTCM:	1 → 188	
PDOP:	3.2	
Records:	188	
Depth:	52.0'	
Latitude:	39°20'42.5[illegible]"	
Longitude:	75°25'57.818"	
End Time:	1152	

		COMMENTS
Site:		
Database:		
Tide:		
Start Time:		
RTCM:		
PDOP:		
Records:		
Depth:		
Latitude:		
Longitude:		
End Time:		

		COMMENTS
Site:		
Database:		
Tide:		
Start Time:		
RTCM:		
PDOP:		
Records:		
Depth:		
Latitude:		
Longitude:		
End Time:		

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-22-93 RMC JOB#: 4710

COLLECTOR(S): [illegible] PROJECT MGR.: R.M.Kling

RANGE(S): Miah Maull Range Water Sample

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): rain and wind, 10-15 MPH NW

Site:	Delaware Bay #2
Database:	DELBAY2
Tide:	[illegible]
Start Time:	1245
RTCM:	1 ⇒ 130
PDOP:	4.0
Records:	130
Depth:	44.0'
Latitude:	39°17'24.256"
Longitude:	75°22'18.966"
End Time:	1435

COMMENTS

[illegible] heavy rain
[illegible] and repositioned
3 times for drops

(3) 5 gal buckets of sediment

Site:	Delaware Bay #3
Database:	DELBAY3
Tide:	Flood
Start Time:	1530
RTCM:	1 ⇒ 120
PDOP:	2.6
Records:	120
Depth:	56.0'
Latitude:	39° 14' 57.663"
Longitude:	75° 19' 15.330"
End Time:	1730

COMMENTS

Very rough - unable to [illegible] Site #2.
Shuttled samples to Woodland Beach w/ RMC Boat.
(3) 5 gal buckets of sed

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 10-29-93 RMC JOB#: 4710

COLLECTOR(S): RMK, DRJ PROJECT MGR.: R.M.Kling

RANGE(S): Mich Mandl Range with Sample

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny — 5-10 mph winds

		COMMENTS
Site:	Delaware Bay #8	Had trouble setting anchor place in sed 3 times for [illegible] - (Strong tides). (3) 5 gal buckets of Sediment
Database:	DEL BAY 8	
Tide:	High Slack	
Start Time:	1645	
RTCM:	1 → 167	
PDOP:	2.8	
Records:	167	
Depth:	45'	
Latitude:	39°00'09.24"	
Longitude:	75°08'26.126"	
End Time:	1130	

		COMMENTS
Site:	Delaware Bay #7	15 gals of sed
Database:	DELBAY7	
Tide:	EBB → MAX EBB	
Start Time:	1228	
RTCM:	40 → 160	
PDOP:	3.9	
Records:	120	
Depth:	48'	
Latitude:	39°05'00.816"	
Longitude:	75°11'05.024"	
End Time:	1345	

		COMMENTS
Site:	Delaware Bay #4	This was last Del Bay site. Have 3 Beneficial Use sites left.
Database:	DELBAY4	
Tide:	EBB	
Start Time:	1542	
RTCM:	1-127	
PDOP:	4.1	
Records:	127	
Depth:	41.0'	
Latitude:	39°13'02.600	
Longitude:	75°17'40.560	15 gals of sediment collected.
End Time:	1705	

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U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 11 & 93 RMC JOB#: 4710

COLLECTOR(S): Cmk JRJ PROJECT MGR.: R.M.Kling

RANGE(S): Mud Hook [illegible] Sta. 6

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Clear Sunny, no wind

Site:	Beneficial Use Site #1
Database:	BENSITE1
Tide:	EBB (Low)
Start Time:	1110
RTCM:	1-175
PDOP:	3.5
Records:	175
Depth:	9.0
Latitude:	39° 19' 53.072"
Longitude:	75° 28' 16.626"
End Time:	1134

COMMENTS

Excellent sampling conditions.

Sample is silt or some mud.

(2) 5 gal buckets collected

Site:	Beneficial Use Site #2
Database:	BENSITE2
Tide:	Flood
Start Time:	1230
RTCM:	1 → 135
PDOP:	3.8
Records:	135
Depth:	6.0
Latitude:	39° 10' 08.287"
Longitude:	75° 24' 01.169"
End Time:	1310

COMMENTS

All sediment is silt.

(2) 5 gal buckets collected.

Site:	
Database:	
Tide:	
Start Time:	
RTCM:	
PDOP:	
Records:	
Depth:	
Latitude:	
Longitude:	
End Time:	

COMMENTS

RMC ENVIRONMENTAL SERVICES, INC.

U.S.A.C.E LOWER DELAWARE RIVER & BAY
BIOLOGICAL EFFECTS BASED TESTING OF CHANNEL SEDIMENT

DATE: 11 9 13 RMC JOB#: 4710

COLLECTOR(S): RMK, JKT PROJECT MGR.: R.M.Kling

RANGE(S): Miah Maull Range Water Sample

WEATHER CONDITIONS (Lt/heavy rain,windy,etc): Sunny, Clear, no wind

		COMMENTS
Site:	Beneficial Use Site #4B	Easy sampling again, excellent sampling conditions. (1) 5 gal Bucket.
Database:	BENUSE4B	
Tide:	Low Slack	
Start Time:	1200	
RTCM:	1→126	
PDOP:	3.7	
Records:	126	
Depth:	6.0'	
Latitude:	39° 11' 07. 019"	
Longitude:	75° 07' 29. 485"	
End Time:	1212	

		COMMENTS
Site:	Beneficial Use Site #4A	This is last sample point for this project (1) 5 gal Bucket. Beneficial Use Site #4 is a split location ∴ we sampled at both sites, (1) 5 gal bucket each, then composited the samples for bioassay, TOC and grain size.
Database:	BENUSE4A	
Tide:	Low Slack	
Start Time:	1222	
RTCM:	1-120	
PDOP:	3.9	
Records:	120	
Depth:	6.0'	
Latitude:	39° 12' 08. 052"	
Longitude:	75° 04' 16. 092"	
End Time:	1237	

		COMMENTS
Site:		
Database:		
Tide:		
Start Time:		
RTCM:		
PDOP:		
Records:		
Depth:		
Latitude:		
Longitude:		
End Time:		

RMC ENVIRONMENTAL SERVICES, Inc.

RMC ENVIRONMENTAL SERVICES

3450 Schuylkill Road
Spring City, PA 19475

215•948•4700
215•948•4752 FAX

TO: Tricia Faust (via fax)
US Army Corps of Engineers, Environmental Division

FROM: Gregg S. Sermarini
RMC Environmental Services, Inc.

DATE: July 23, 1993

RE: POSITION ACCURACY CALIBRATION PROCEDURE REPORT
Delaware River Main Channel Deepening Project

For the purposes of positioning the boat and recording sampling locations throughout the project, Differential Global Positioning Systems (DGPS) equipment will be utilized. This equipment consists of a Trimble ProLite 6-channel GPS system with a TDC1 datalogger, and a CSI MBX1 Beacon Data Receiver. The Real-Time Correction data will be received from the US Coast Guard, Cape Henlopen beacon (298.00 KHz). This system will provide +/- 5 meter accuracy in the field, and +/- 2 to 5 meter accuracy upon post-processing of position data. This will satisfy the Corps' accuracy requirement of +/- 50 feet.

On July 20 and 21, 1993, in order to verify the functionality of the system, two first-order National Ocean Survey benchmarks were recovered which bracket the study area:

Station Name	Station Location	Station Id
RADIO	Cape Henlopen Point, DE	1083
CAPE MAY RM 1	Cape May Point, NJ	1002

Each station was occupied for approximately three minutes, logging real-time corrected GPS data at a rate of one position per second, yielding a minimum of 180 positions. Using Trimble's PFINDER software, the position data recorded at each benchmark was averaged to generate a single point in NAD 27 datum for comparison with the benchmark. The results are shown below.

Station Name: RADIO

Benchmark		Averaged DGPS		
Latitude (N) dd mm ss.sss	Longitude (W) ddd mm ss.sss	Latitude (N) dd mm ss.sss	Longitude (W) ddd mm ss.sss	Error (ft.)
38 47 24.892	075 05 28.820	38 47 25.010	075 05 28.826	11.99

Station Name: CAPE MAY RM1

Benchmark		Averaged DGPS		
Latitude (N) dd mm ss.sss	Longitude (W) ddd mm ss.sss	Latitude (N) dd mm ss.sss	Longitude (W) ddd mm ss.sss	Error (ft.)
38 55 59.033	074 57 37.107	38 55 58.958	074 57 37.155	8.53

The level of accuracy demonstrated above will guarantee positions to be within +/- 50 feet in the field. DGPS position data will be used to navigate to the various sampling areas, and will then be logged at each individual sampling location. This data will be recorded on AutoCad mapping of the Delaware Bay. At the conclusion of the field work, a final accuracy check will be made by again recording positions at one of the above benchmarks. The results of this final check will be submitted with the final report.

cc: Tony DePasquale, USACOE (via fax)
Jack Urie, Greely-Polhemus Group (via fax)

CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/14/93
P.O. Number: N/A

RMC Number : 12540
Sample Description: BECKETT ST. TERMINAL 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	53 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12541
Sample Description: BECKETT ST. TERMINAL 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	165 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12542
Sample Description: BECKETT ST. TERMINAL 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	1530 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
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REPORT DESCRIPTION : 04710-11

RMC Number : 12553
Sample Description: RANGE M 5%

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	33 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12554
Sample Description: RANGE M 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	274 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12555
Sample Description: RANGE M 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	308 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12543
Sample Description: BEND AF 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	11 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12544
Sample Description: BEND AF 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	30 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12545
Sample Description: BEND AF 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	408 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12546
Sample Description: W. HORSESHOE RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	11 MG/L	10/08/93	LMS	EPA 160.2

Approved By:
Twila E. Dixon
Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12547
Sample Description: W. HORSESHOE RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	23 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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Army Corps of Engineers
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12548
Sample Description: W. HORSESHOE RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	28 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12550
Sample Description: BEND G 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	16 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12551
Sample Description: BEND G 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	10 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12552
Sample Description: BEND G 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	434 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12556
Sample Description: MIFFLIN RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	13 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12557
Sample Description: MIFFLIN RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	17 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12558
Sample Description: MIFFLIN RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	372 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12559
Sample Description: BEND H 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	14 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933732
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/12/93
P.O. Number: N/A

RMC Number : 12560
Sample Description: BEND H 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	126 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933732
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/12/93
P.O. Number: N/A

RMC Number : 12561
Sample Description: BEND H 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	1840 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933732
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/12/93
P.O. Number: N/A

RMC Number : 12562
Sample Description: BILLINGS PORT RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	19 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933732
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/12/93
P.O. Number: N/A

RMC Number : 12563
Sample Description: BILLINGS PORT RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	31 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933732
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/12/93
P.O. Number: N/A

RMC Number : 12564
Sample Description: BILLINGS PORT RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	1310 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11535
Sample Description: CHESTER RANGE WATER

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	4 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11536
Sample Description: BEND 1 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	11 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11537
Sample Description: BEND 1 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	17 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11538
Sample Description: BEND I 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	231 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11539
Sample Description: TINICUM RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	10 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11540
Sample Description: TINICUM RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	19 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11541
Sample Description: TINICUM RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	131 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11542
Sample Description: BEND J 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	15 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11543
Sample Description: BEND J 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	20 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11544
Sample Description: BEND J 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	37 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11545
Sample Description: EDDYSTONE RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	14 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11546
Sample Description: EDDYSTONE RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	16 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11547
Sample Description: EDDYSTONE RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	156 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
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Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11548
Sample Description: BEND K 5%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	21 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11549
Sample Description: BEND K 10%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	29 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11550
Sample Description: BEND K 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	592 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11551
Sample Description: BEND L 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	21 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11552
Sample Description: BEND L 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	32 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933465
Sample Date: 09/16/93 at 17:30
Sampled By : MEM
Received : 09/17/93
Reported : 09/23/93
P.O. Number: N/A

RMC Number : 11553
Sample Description: BEND L 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	406 MG/L	09/22/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11161
Sample Description: REF H2O- BELLAVUE RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	13 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11162
Sample Description: MARCUS HOOK 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	13 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11163
Sample Description: MARCUS HOOK 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	16 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11164
Sample Description: MARCUS HOOK 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	102 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11165
Sample Description: BEND M 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	6 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11166
Sample Description: BEND M 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	4 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11167
Sample Description: BEND M 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	28 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11168
Sample Description: BELLAVUE RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	5 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11169
Sample Description: BELLAVUE RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	22 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11170
Sample Description: BELLAVUE RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	31 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 11171
Sample Description: BEND N 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	24 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 11172
Sample Description: BEND N 10%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	32 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 11173
Sample Description: BEND N 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	324 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13635
Sample Description: DEEPWATER RANGE H2O

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	23 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13636
Sample Description: CHERRY ISLAND RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	40 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13637
Sample Description: CHERRY ISLAND RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	40 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13638
Sample Description: CHERRY ISLAND RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	30 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13639
Sample Description: BEND O 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	38 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13640
Sample Description: BEND O 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	37 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13641
Sample Description: BEND O 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	29 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13642
Sample Description: DEEPWATER POINT RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	39 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13643
Sample Description: DEEPWATER POINT RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	40 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13644
Sample Description: DEEPWATER POINT RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	138 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13645
Sample Description: BEND PQ 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	54 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13646
Sample Description: BEND PO 10%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	67 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13647
Sample Description: BEND PQ 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	171 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13648
Sample Description: NEW CASTLE RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	40 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13649
Sample Description: NEW CASTLE RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	55 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13650
Sample Description: NEW CASTLE RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	276 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13651
Sample Description: BEND R 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	56 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13652
Sample Description: BEND R 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	47 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934080
Sample Date: 10/22/93
Sampled By : JAM
Received : 10/28/93
Reported : 11/03/93
P.O. Number: N/A

RMC Number : 13653
Sample Description: BEND R 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	414 MG/L	11/01/93	MFB	EPA 160.2

Approved By:

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 10/20/93
P.O. Number: SPRING CITY

RMC Number : 13177
Sample Description: BAKER RANGE H20

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	18 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 13178
Sample Description: REEDY ISLAND RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	30 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 13179
Sample Description: REEDY ISLAND RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	33 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 13180
Sample Description: REEDY ISLAND RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	166 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 13181
Sample Description: BEND S 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	36 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 13182
Sample Description: BEND S 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	39 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 12/20/93
P.O. Number: N/A

RMC Number : 13183
Sample Description: BEND S 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	144 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 10/20/93
P.O. Number: SPRING CITY

RMC Number : 13184
Sample Description: BAKER RANGE 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	33 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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Laboratory Manager

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 10/20/93
P.O. Number: SPRING CITY

RMC Number : 13185
Sample Description: BAKER RANGE 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	38 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 10/20/93
P.O. Number: SPRING CITY

RMC Number : 13186
Sample Description: BAKER RANGE 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	210 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
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REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 10/20/93
P.O. Number: SPRING CITY

RMC Number : 13187
Sample Description: BEND T 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	32 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 10/20/93
P.O. Number: SPRING CITY

RMC Number : 13188
Sample Description: BEND T 10%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	39 MG/L	10/19/93	MFB	EPA 160.2

Approved By:
Twila E. Dixon
Twila E. Dixon
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933932
Sample Date: 10/14/93
Sampled By : N/A
Received : 10/15/93
Reported : 10/20/93
P.O. Number: SPRING CITY

RMC Number : 13189
Sample Description: BEND T 100%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	209 MG/L	10/19/93	MFB	EPA 160.2

Approved By:

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Twila E. Dixon
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14508
Sample Description: DEL BAY 1 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	23 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
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RMC Analytics

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14509
Sample Description: DEL BAY 1 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	36 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14510
Sample Description: DEL BAY 1 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	839 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14507
Sample Description: MIAH MULL REF H2O

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	42 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14511
Sample Description: DEL BAY 2 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	69 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14512
Sample Description: DEL BAY 2 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	63 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14513
Sample Description: DEL BAY 2 100%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	326 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14514
Sample Description: DEL BAY 3 5%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	50 MG/L	11/12/93	MFB	EPA 160.2

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14515
Sample Description: DEL BAY 3 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	54 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14516
Sample Description: DEL BAY 3 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	161 MG/L	11/12/93	MFB	EPA 160.2

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14517
Sample Description: DEL BAY 4 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	126 MG/L	11/12/93	MFB	EPA 160.2

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REPORT DESCRIPTION : 04710-11

RMC Number : 14518
Sample Description: DEL BAY 4 10%

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	59 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14519
Sample Description: DEL BAY 4 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	84 MG/L	11/12/93	MFB	EPA 160.2

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14520
Sample Description: DEL BAY 5 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	50 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14521
Sample Description: DEL BAY 5 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	68 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934345
Sample Date: 11/05/93
Sampled By : JAM
Received : 11/11/93
Reported : 11/15/93
P.O. Number: N/A

RMC Number : 14522
Sample Description: DEL BAY 5 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	88 MG/L	11/12/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14791
Sample Description: DEL BAY 6 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	52 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14792
Sample Description: DEL BAY 6 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	22 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14793
Sample Description: DEL BAY 6 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	123 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14794
Sample Description: DEL BAY 7 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	56 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14795
Sample Description: DEL BAY 7 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	50 MG/L	11/19/93	MFB	EPA 160.2

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14796
Sample Description: DEL BAY 7 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	129 MG/L	11/19/93	MFB	EPA 160.2

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14797
Sample Description: DEL BAY 8 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	86 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14798
Sample Description: DEL BAY 8 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	91 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14799
Sample Description: DEL BAY 8 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	286 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14800
Sample Description: DEL BAY 9 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	64 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14801
Sample Description: DEL BAY 9 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	119 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14802
Sample Description: DEL BAY 9 100%

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	TOTAL SUSPENDED SOLIDS	259 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14803
Sample Description: DEL BAY 10 5%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	197 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14804
Sample Description: DEL BAY 10 10%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	105 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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REPORT DESCRIPTION : 04710-11

Report No. : 934436
Sample Date: 11/12/93
Sampled By : JAM
Received : 11/17/93
Reported : 11/23/93
P.O. Number: N/A

RMC Number : 14805
Sample Description: DEL BAY 10 100%

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	265 MG/L	11/19/93	MFB	EPA 160.2

Approved By:

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TRI-COUNTY BUSINESS CAMPUS • 88 ROBINSON STREET • POTTSTOWN, PA 19464 • 215-327-4850 • FAX 215-327-4852

CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933342
Sample Date: 09/10/93 at 12:00
Sampled By : MEM
Received : 09/10/93
Reported : 09/13/93
P.O. Number: N/A

RMC Number : 11160
Sample Description: LAB H2O

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	9 MG/L	09/12/93	MFB	EPA 160.2

Approved By:

Twila E. Dixon

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Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 933731
Sample Date: 10/06/93
Sampled By : MEM
Received : 10/07/93
Reported : 10/13/93
P.O. Number: N/A

RMC Number : 12549
Sample Description: MIFFLIN RANGE WATER

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	TOTAL SUSPENDED SOLIDS	14 MG/L	10/08/93	LMS	EPA 160.2

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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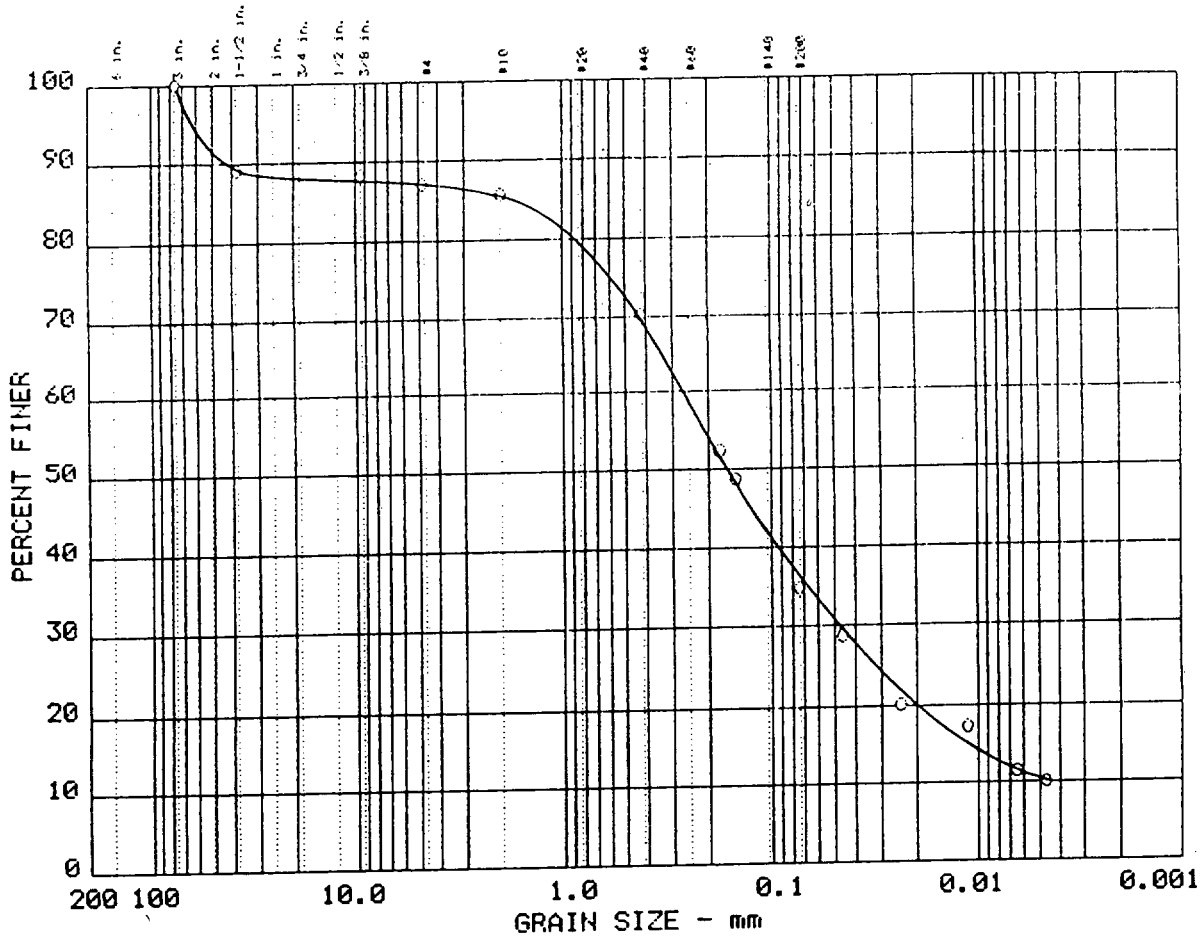
CO: NA • CT: PH-0667 • DE: REC-PA • MD: 150 • MA: PA060 • MI: REC-PA • NH: 25391-A • NJ: 77434 • PA: 46-253 • VA: 00298 • WI: 999902530

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
○	1					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○		

Project No.: 1153
Project: DELAWARE RIVER
○ Location: BECKETT ST TERMINAL

Date: 10-15-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 1

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: BECKETT ST TERMINAL
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1143.70
Tare = 0.00
Dry sample weight = 1143.70
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
3 inches	0.00	0.00	100.0
1.5 inches	125.20	0.00	89.1
0.375 inches	9.70	0.00	88.2
# 4	13.00	0.00	87.1
# 10	0.97	0.00	85.7
# 40	10.57	0.00	70.3
# 80	12.36	0.00	52.4
# 100	2.53	0.00	48.7
# 200	9.65	0.00	34.7

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 85.7
Weight of hydrometer sample: 60
Calculated biased weight= 70.04
Table of composite correction values:

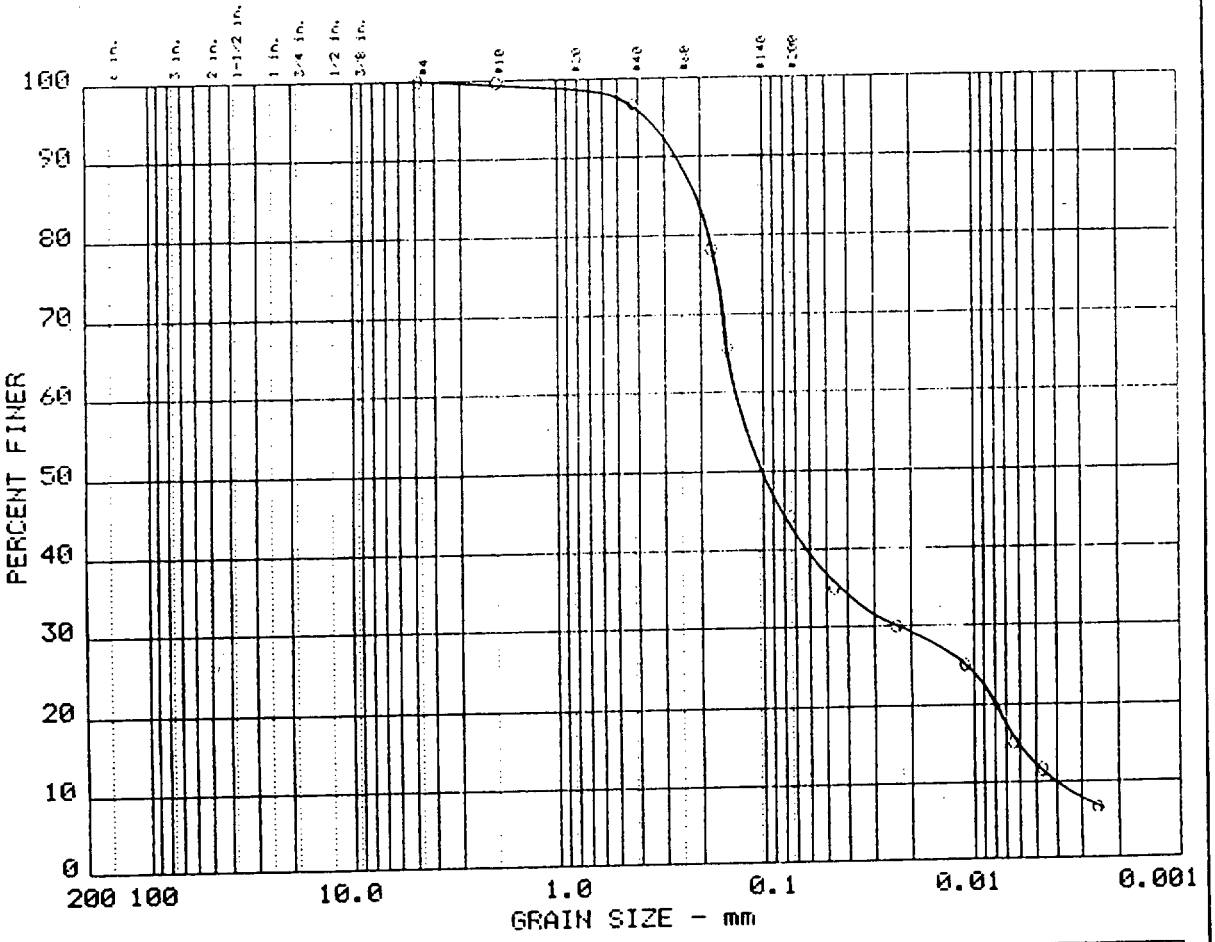
Temp, deg C:	23.0	22.5	22.0	21.5
Comp. corr:	- 3.9	- 4.0	- 4.2	- 4.3

Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	24.0	20.1	0.0132	24.0	12.4	0.0463	28.7
4.0	23.0	18.0	14.1	0.0132	18.0	13.3	0.0240	20.1
19.0	22.5	16.0	12.1	0.0132	16.0	13.7	0.0112	17.3
60.0	22.0	12.0	8.1	0.0133	12.0	14.3	0.0065	11.6
120.0	21.5	11.0	7.1	0.0134	11.0	14.5	0.0047	10.1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	8					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: RANGE M

Date: 10-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 8

Date: 10-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: RANGE M
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.19	0.00	99.7
# 40	1.89	0.00	96.5
# 80	11.02	0.00	78.2
# 100	7.57	0.00	65.6
# 200	12.87	0.00	44.1

Hydrometer Analysis Data

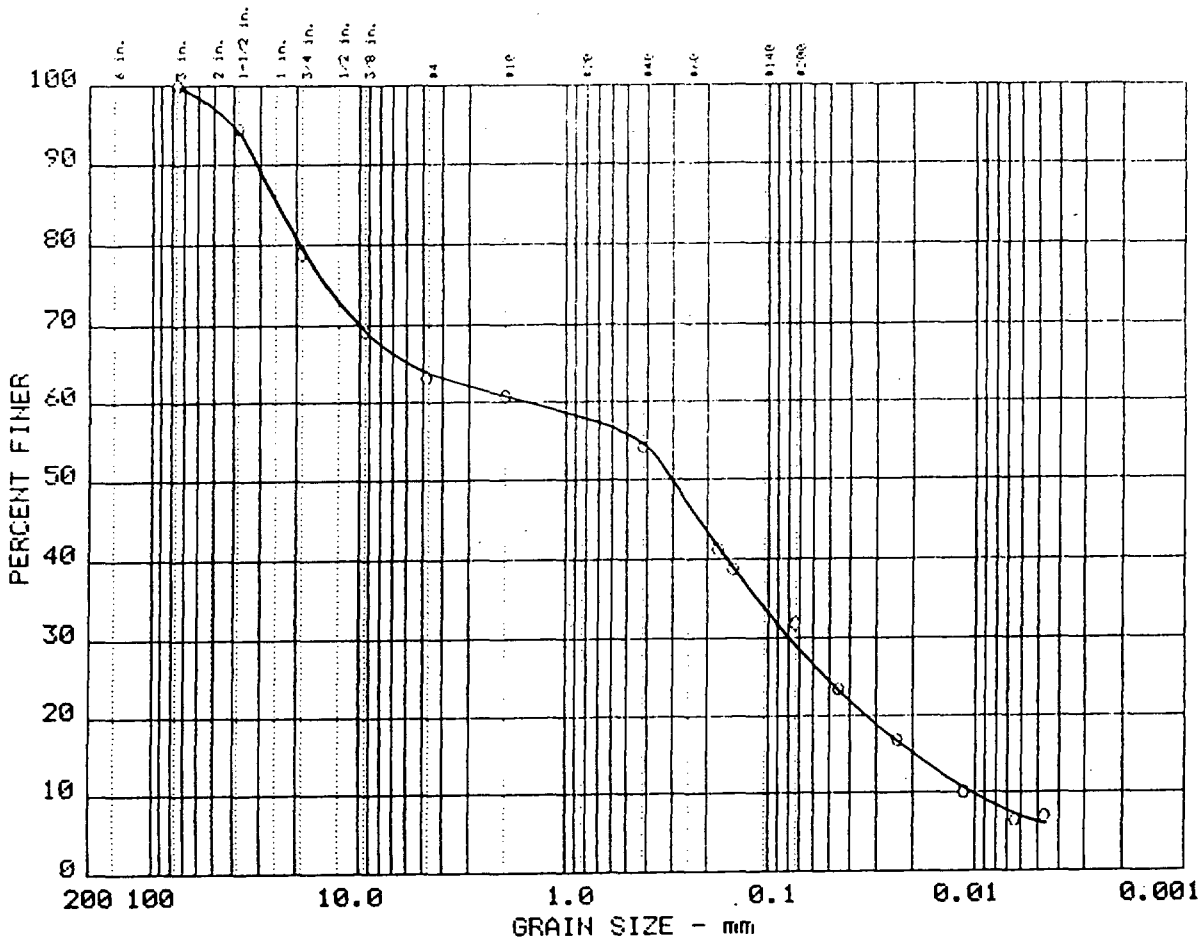
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	22.5	22.0	21.0	20.0
Comp. corr:	- 4.0	- 4.2	- 4.5	- 4.8

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	25.0	21.0	0.0132	25.0	12.2	0.0462	35.0
4.0	22.5	22.0	18.0	0.0132	22.0	12.7	0.0236	30.0
19.0	22.0	19.0	15.0	0.0133	19.0	13.2	0.0111	25.0
60.0	22.0	13.0	9.0	0.0133	13.0	14.2	0.0065	15.0
120.0	21.0	11.0	7.0	0.0135	11.0	14.5	0.0047	11.7
435.0	20.0	8.0	4.0	0.0136	8.0	15.0	0.0025	6.7

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	9					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE RIVER
O Location: BEND AF

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 9

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: BEND AF
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1584.90
Tare = 0.00
Dry sample weight = 1584.90
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve		Weight retained	Sieve tare	Percent finer
3	inches	0.00	0.00	100.0
1.5	inches	88.10	0.00	94.4
0.75	inches	246.80	0.00	78.9
0.375	inches	153.00	0.00	69.2
# 4		95.30	0.00	63.2
# 10		2.26	0.00	60.8
# 40		6.24	0.00	54.2
# 80		12.34	0.00	41.3
# 100		2.47	0.00	38.6
# 200		6.47	0.00	31.8

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 60.8
Weight of hydrometer sample: 60
Calculated biased weight= 98.65
Table of composite correction values:

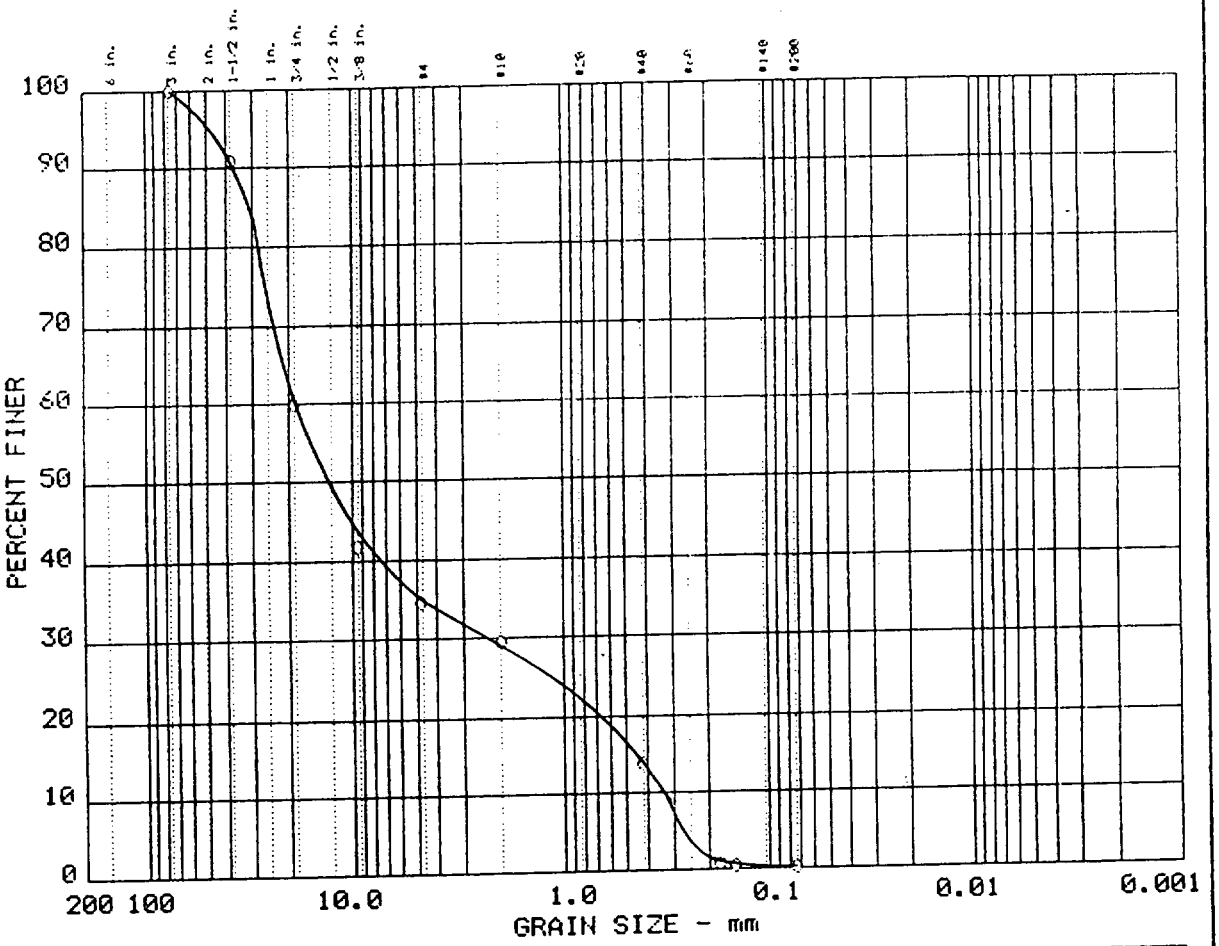
Temp, deg C:	22.5	23.0	21.0
Comp. corr:	- 4.0	- 3.9	- 4.5

Meniscus correction only= 0

Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	27.0	23.0	0.0132	27.0	11.9	0.0456	23.3
4.0	22.5	20.5	16.5	0.0132	20.5	12.9	0.0238	16.7
19.0	22.5	14.0	10.0	0.0132	14.0	14.0	0.0114	10.1
60.0	23.0	11.0	6.5	0.0132	11.0	14.5	0.0065	6.6
120.0	21.0	11.0	7.0	0.0135	11.0	14.5	0.0047	7.1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
O	6					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE RIVER
O Location: WEST HORSESHOE RANGE

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 6

ate: 10-15-1993
roject No.: 1153
roject: DELAWARE RIVER

Sample Data

ocation of Sample: WEST HORSESHOE RANGE
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

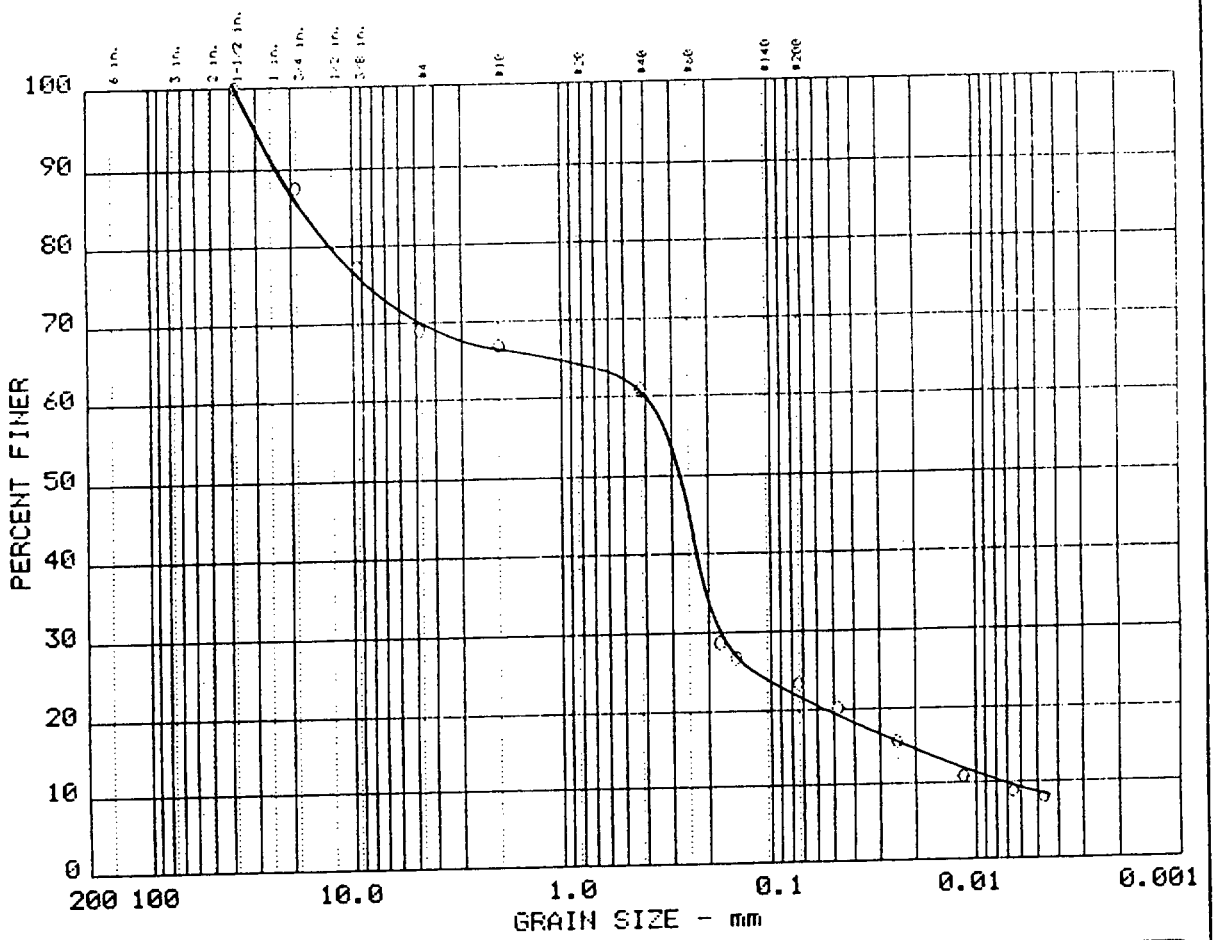
Mechanical Analysis Data

	Initial
ry sample and tare=	1652.90
are =	0.00
ry sample weight =	1652.90

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
3 inches	0.00	0.00	100.0
1.5 inches	153.80	0.00	90.7
0.75 inches	508.40	0.00	59.9
0.375 inches	301.70	0.00	41.7
# 4	117.20	0.00	34.6
# 10	85.90	0.00	29.4
# 40	258.30	0.00	13.8
# 80	214.90	0.00	0.8
# 100	4.50	0.00	0.5
# 200	4.20	0.00	0.2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75	% GRAVEL	% SAND	% SILT	% CLAY
O	1					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND G

Date: 10-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 1

Date: 10-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND G
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1113.80
Tare = 0.00
Dry sample weight = 1113.80
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	138.20	0.00	87.6
0.375 inches	114.70	0.00	77.3
# 4	92.80	0.00	69.0
# 10	1.88	0.00	66.8
# 40	5.06	0.00	61.0
# 80	28.10	0.00	28.7
# 100	1.68	0.00	26.8
# 200	2.91	0.00	23.4

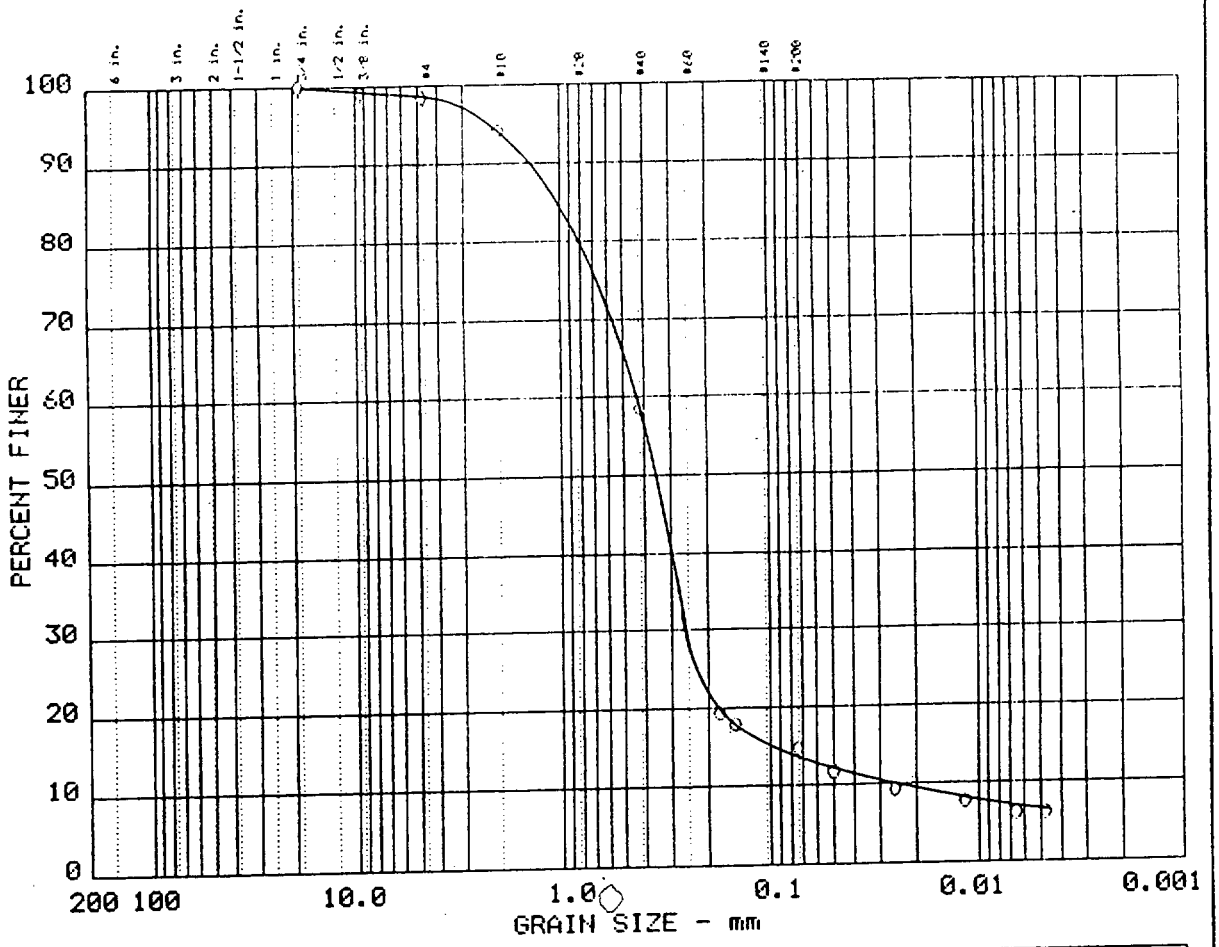
Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 69.0
Weight of hydrometer sample: 60
Calculated biased weight= 87.00
Table of composite correction values:
Temp, deg C: 21.0 21.5
Comp. corr: - 4.5 - 4.3
Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.0	22.0	17.5	0.0135	22.0	12.7	0.0480	20.1
4.0	21.0	18.0	13.5	0.0135	18.0	13.3	0.0246	15.5
19.0	21.0	14.0	9.5	0.0135	14.0	14.0	0.0116	10.9
60.0	21.5	12.0	7.7	0.0134	12.0	14.3	0.0065	8.9
120.0	21.0	11.5	7.0	0.0135	11.5	14.4	0.0047	8.0

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	11					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE RIVER
O Location: MIFFLIN RANGE

Date: 10-15-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 11

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: MIFFLIN RANGE
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1043.70
Tare = 0.00
Dry sample weight = 1043.70
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	8.30	0.00	99.2
# 4	7.20	0.00	98.5
# 10	2.68	0.00	94.1
# 40	21.68	0.00	58.5
# 80	23.90	0.00	19.3
# 100	0.88	0.00	17.8
# 200	1.87	0.00	14.8

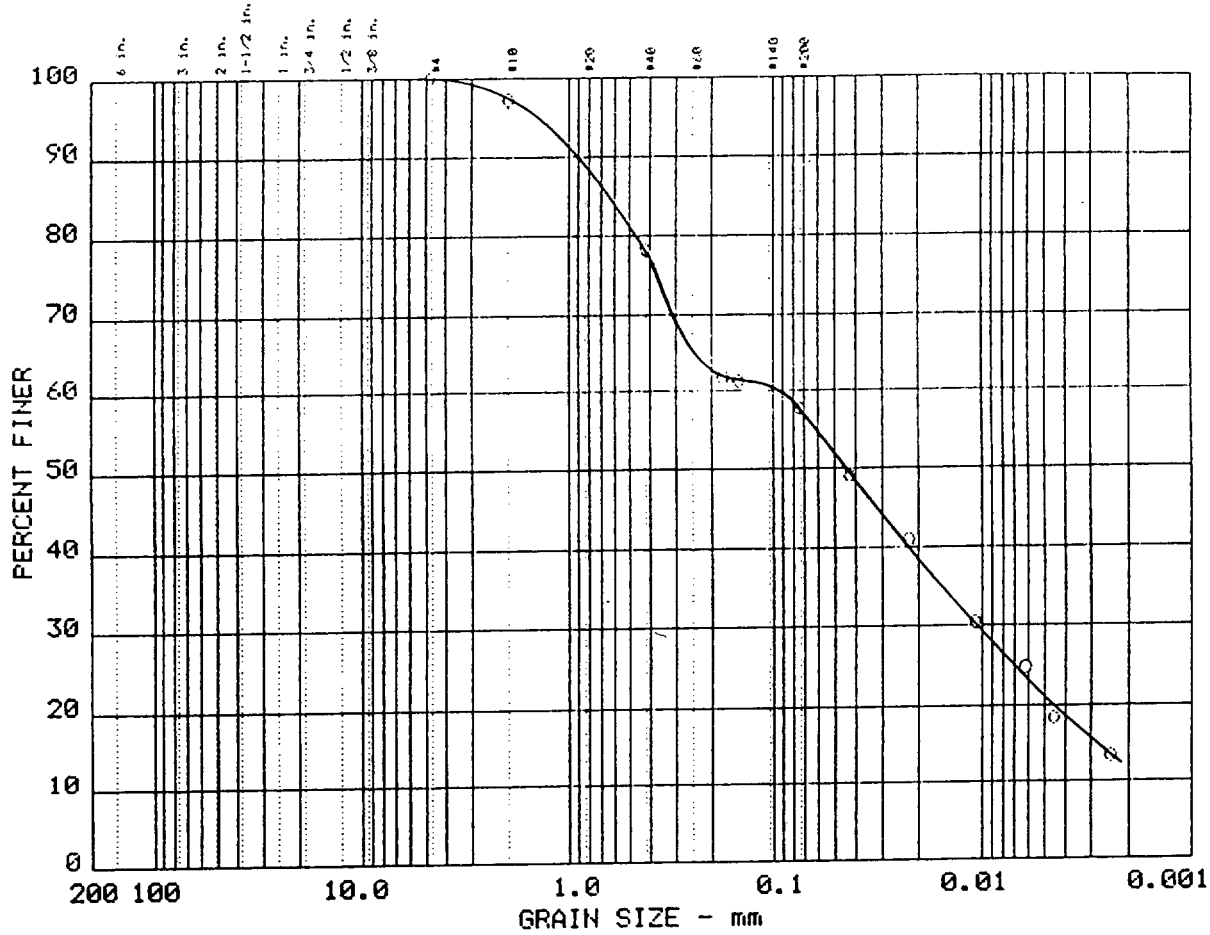
Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 94.1
Weight of hydrometer sample: 60
Calculated biased weight= 63.75
Table of composite correction values:
Temp, deg C: 22.5 21.0
Comp. corr: - 4.0 - 4.5
Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	11.5	7.5	0.0132	11.5	14.4	0.0503	11.8
4.0	22.5	10.0	6.0	0.0132	10.0	14.7	0.0253	9.4
19.0	22.5	9.0	5.0	0.0132	9.0	14.8	0.0117	7.8
60.0	22.5	8.0	4.0	0.0132	8.0	15.0	0.0066	6.3
120.0	21.0	8.0	4.0	0.0135	8.0	15.0	0.0048	6.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
O	2					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE RIVER
O Location: BEND H

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 2

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: BEND H
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	1.75	0.00	97.1
# 40	11.30	0.00	78.3
# 80	9.84	0.00	61.9
# 100	0.33	0.00	61.3
# 200	2.15	0.00	57.7

Hydrometer Analysis Data

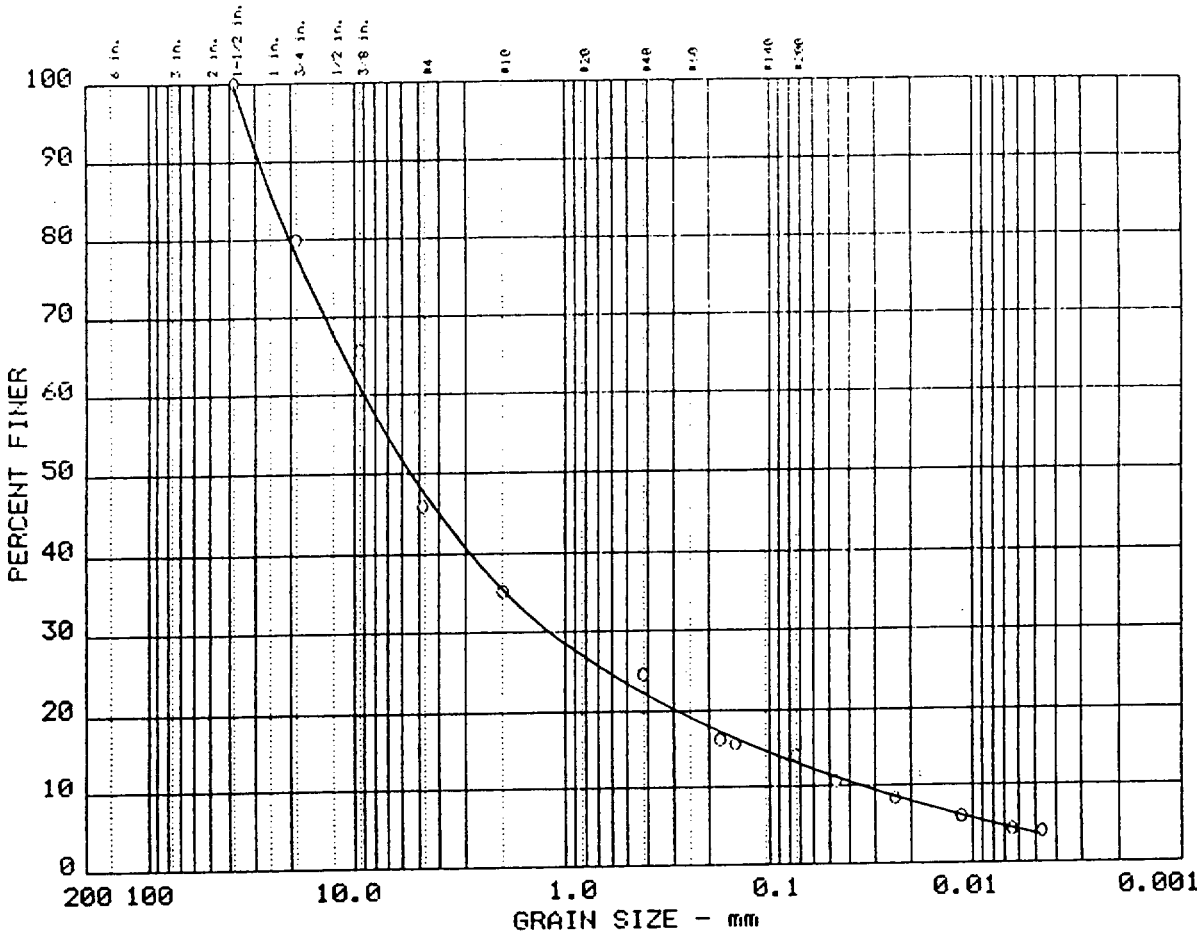
Separation sieve is number 10
Percent -# 10 based on complete sample= 97.1
Weight of hydrometer sample: 60
Calculated biased weight= 61.80
Table of composite correction values:

Temp, deg C:	23.5	23.0	22.5	21.5
Comp. corr:	- 3.7	- 3.9	- 4.0	- 4.3

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.5	34.0	30.3	0.0131	34.0	10.7	0.0429	49.0
4.0	23.5	29.0	25.3	0.0131	29.0	11.5	0.0222	40.9
19.0	23.0	22.5	18.8	0.0132	22.5	12.6	0.0107	30.4
60.0	22.5	19.0	15.3	0.0132	19.0	13.2	0.0062	24.8
120.0	21.5	15.0	11.3	0.0134	15.0	13.8	0.0046	18.3
435.0	21.5	12.0	8.3	0.0134	12.0	14.3	0.0024	13.4

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
○	8					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○		

Project No.: 1153
Project: DELAWARE RIVER
○ Location: BILLINGSPORT RANGE

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 8

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: BILLINGSPORT RANGE
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1273.10
Tare = 0.00
Dry sample weight = 1273.10
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	255.80	0.00	79.9
0.375 inches	181.30	0.00	65.7
# 4	252.30	0.00	45.8
# 10	14.00	0.00	35.2
# 40	13.89	0.00	24.5
# 80	10.90	0.00	16.2
# 100	0.76	0.00	15.6
# 200	1.92	0.00	14.2

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 35.2
Weight of hydrometer sample: 60
Calculated biased weight= 170.69
Table of composite correction values:

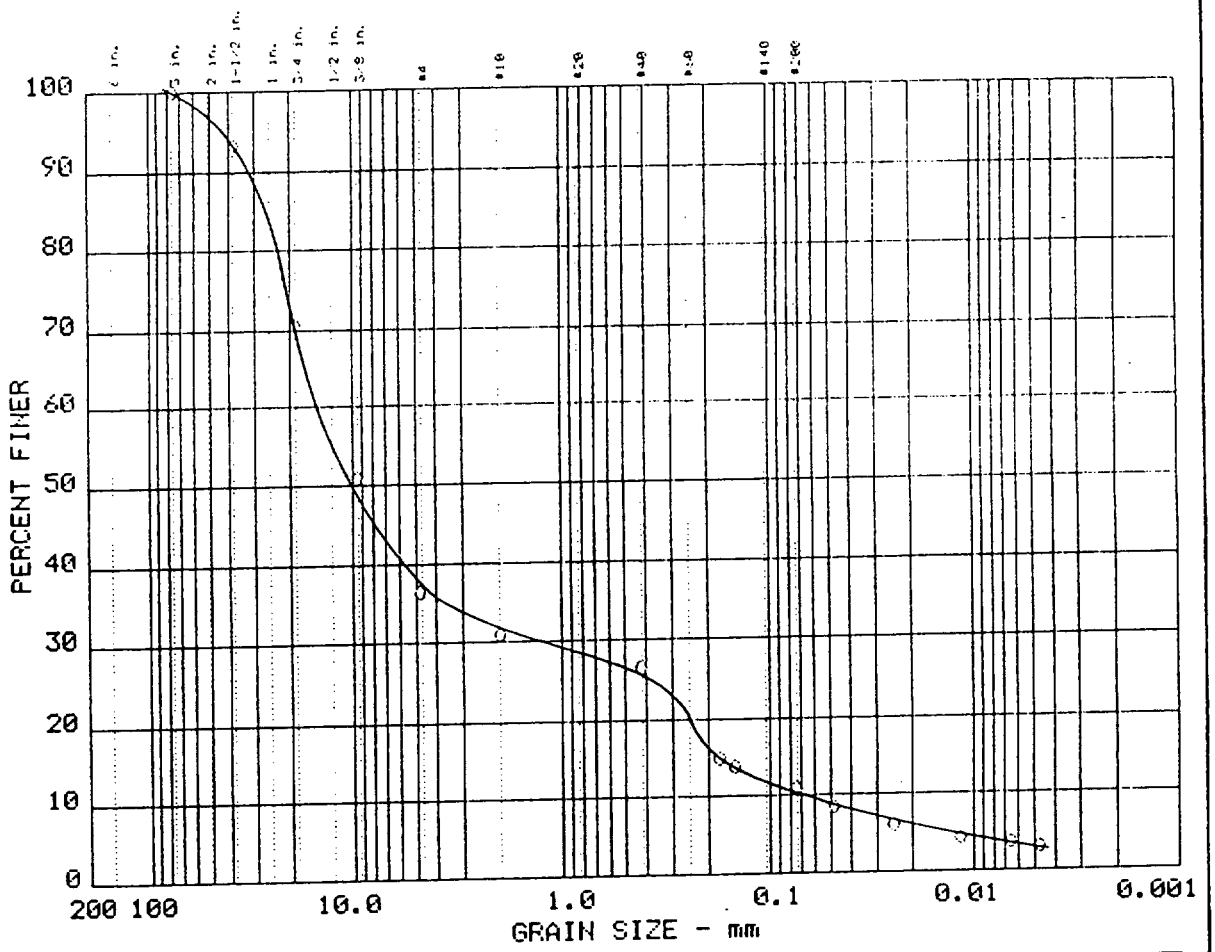
Temp, deg C:	23.5	23.0	21.5
Comp. corr:	- 3.7	- 3.9	- 4.3

Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.5	22.0	18.3	0.0131	22.0	12.7	0.0466	10.7
4.0	23.5	18.0	14.3	0.0131	18.0	13.3	0.0239	8.4
19.0	23.0	14.0	10.3	0.0132	14.0	14.0	0.0113	6.0
60.0	23.0	11.0	7.3	0.0132	11.0	14.5	0.0065	4.3
120.0	21.5	10.5	6.8	0.0134	10.5	14.6	0.0047	4.0

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75_	% GRAVEL	% SAND	% SILT	% CLAY
O	6					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND I

Date: 10-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 6

Date: 10-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND I
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1356.70
Tare = 0.00
Dry sample weight = 1356.70
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
3 inches	0.00	0.00	100.0
1.5 inches	94.20	0.00	93.1
0.75 inches	304.60	0.00	70.6
0.375 inches	266.30	0.00	51.0
# 4	197.50	0.00	36.4
# 10	9.07	0.00	30.9
# 40	7.25	0.00	26.5
# 80	19.21	0.00	14.9
# 100	1.77	0.00	13.8
# 200	4.58	0.00	11.0

Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 36.4
Weight of hydrometer sample: 60
Calculated biased weight= 164.75
Table of composite correction values:

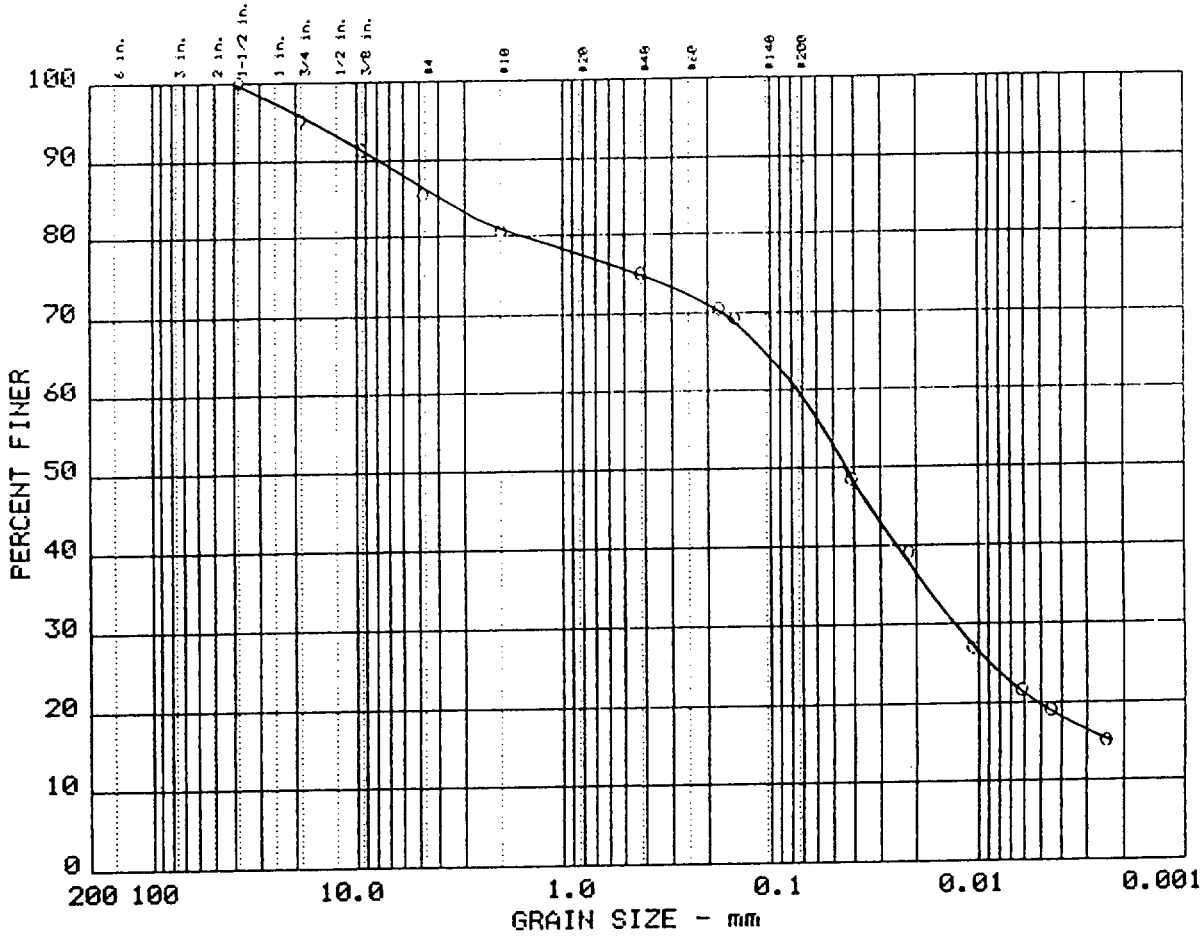
Temp, deg C:	22.5	22.0	21.0
Comp. corr:	- 4.0	- 4.2	- 4.5

Meniscus correction only= 0

Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	18.0	14.0	0.0132	18.0	13.3	0.0484	8.5
4.0	22.5	14.0	10.0	0.0132	14.0	14.0	0.0248	6.1
19.0	22.0	11.0	7.0	0.0133	11.0	14.5	0.0116	4.2
60.0	22.0	10.0	6.0	0.0133	10.0	14.7	0.0066	3.6
120.0	21.0	9.0	5.0	0.0135	9.0	14.8	0.0047	3.0

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	4					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O	*	

Project No.: 1153
Project: DELAWARE RIVER
O Location: TINICUM

Date: 10-15-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 4

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: TINICUM
Sample Description:
USCS Class: *
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 766.20
Tare = 0.00
Dry sample weight = 766.20
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	37.30	0.00	95.1
0.375 inches	29.70	0.00	91.3
# 4	43.10	0.00	85.6
# 10	3.53	0.00	80.6
# 40	3.89	0.00	75.0
# 80	3.18	0.00	70.5
# 100	0.94	0.00	69.2
# 200	6.50	0.00	59.9

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 80.6
Weight of hydrometer sample: 60
Calculated biased weight= 74.45
Table of composite correction values:

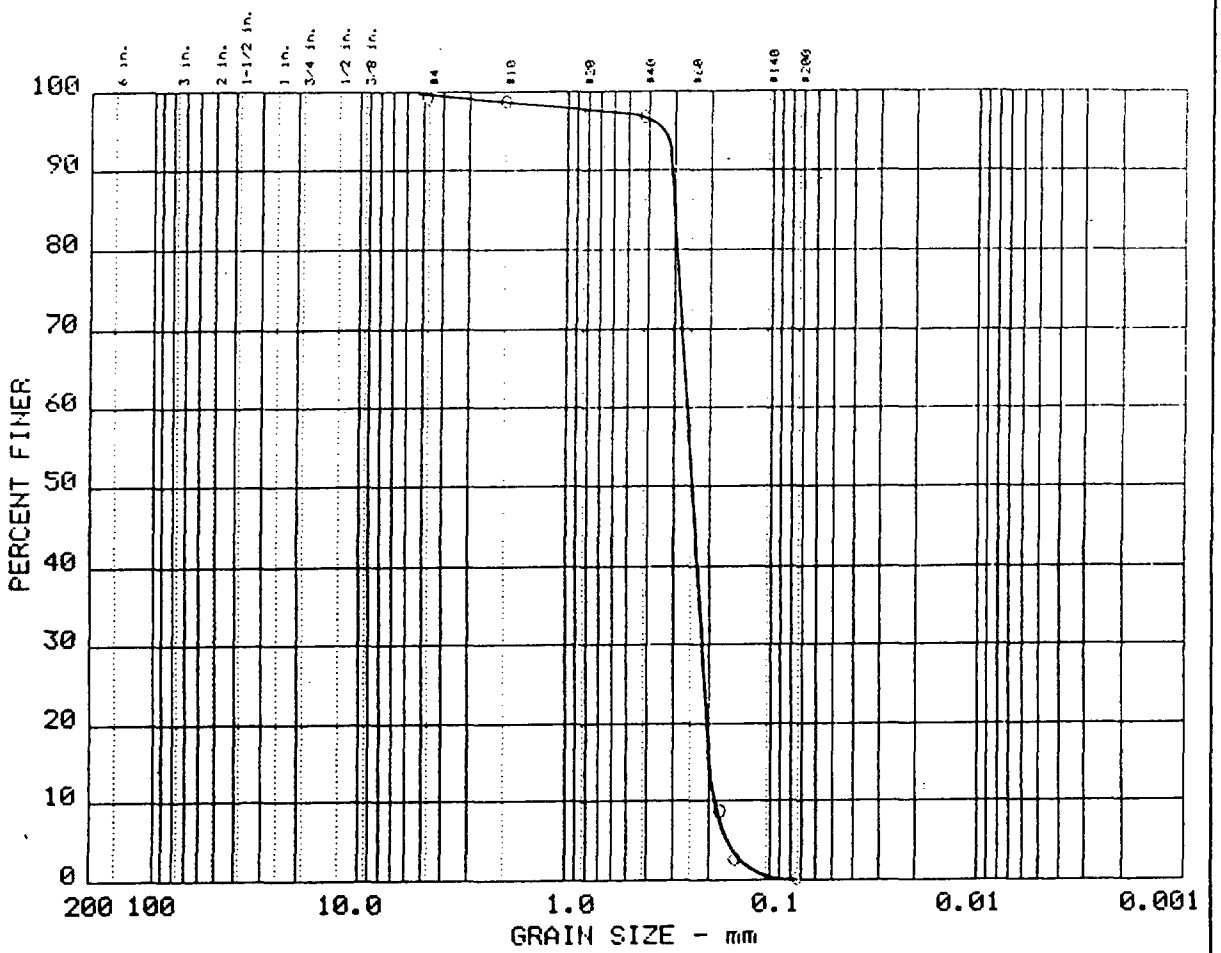
Temp, deg C:	23.0	22.0	21.0	20.0
Comp. corr:	- 3.9	- 4.2	- 4.5	- 4.8

Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	40.0	36.1	0.0132	40.0	9.7	0.0411	48.5
4.0	23.0	33.0	29.1	0.0132	33.0	10.9	0.0217	39.1
19.0	23.0	24.0	20.1	0.0132	24.0	12.4	0.0106	27.0
60.0	22.0	20.0	16.1	0.0133	20.0	13.0	0.0062	21.6
120.0	21.0	18.0	14.1	0.0135	18.0	13.3	0.0045	18.9
435.0	20.0	15.0	11.1	0.0136	15.0	13.8	0.0024	14.9

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
○	5					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

	MATERIAL DESCRIPTION	USCS	AASHTO
○			

Project No.: 1153
Project: DELAWARE RIVER
○ Location: BEND J

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 5

ate: 10-15-1993
roject No.: 1153
roject: DELAWARE RIVER

Sample Data

ocation of Sample: BEND J
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

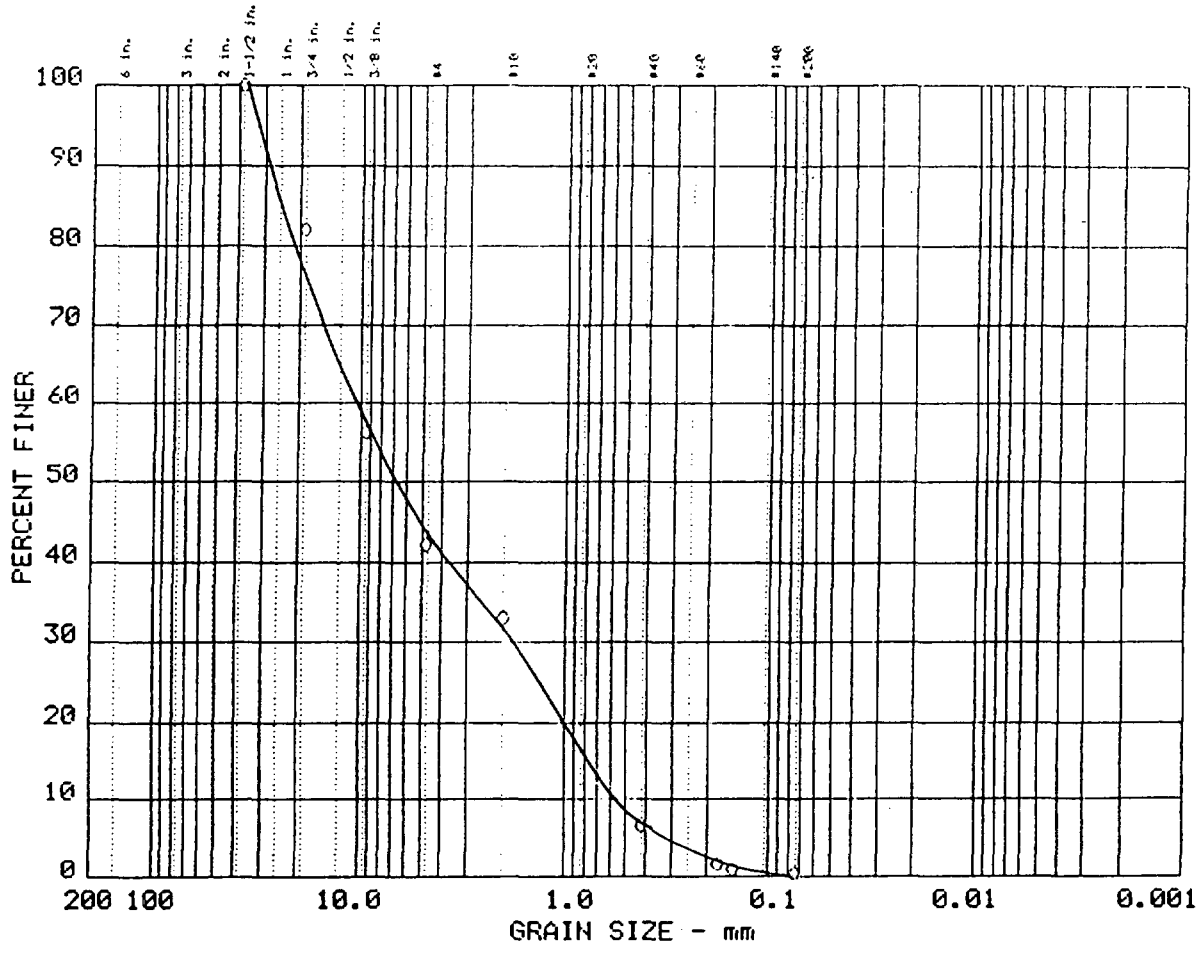
Mechanical Analysis Data

	Initial
ry sample and tare=	250.00
are =	0.00
ry sample weight =	250.00

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	1.80	0.00	99.3
# 10	1.40	0.00	98.7
# 40	4.90	0.00	96.8
# 80	220.00	0.00	8.8
# 100	15.20	0.00	2.7
# 200	6.30	0.00	0.2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
O	7					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE RIVER
O Location: EDDYSTONE RANGE

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 7

ate: 10-15-1993
roject No.: 1153
roject: DELAWARE RIVER

Sample Data

ocation of Sample: EDDYSTONE RANGE
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

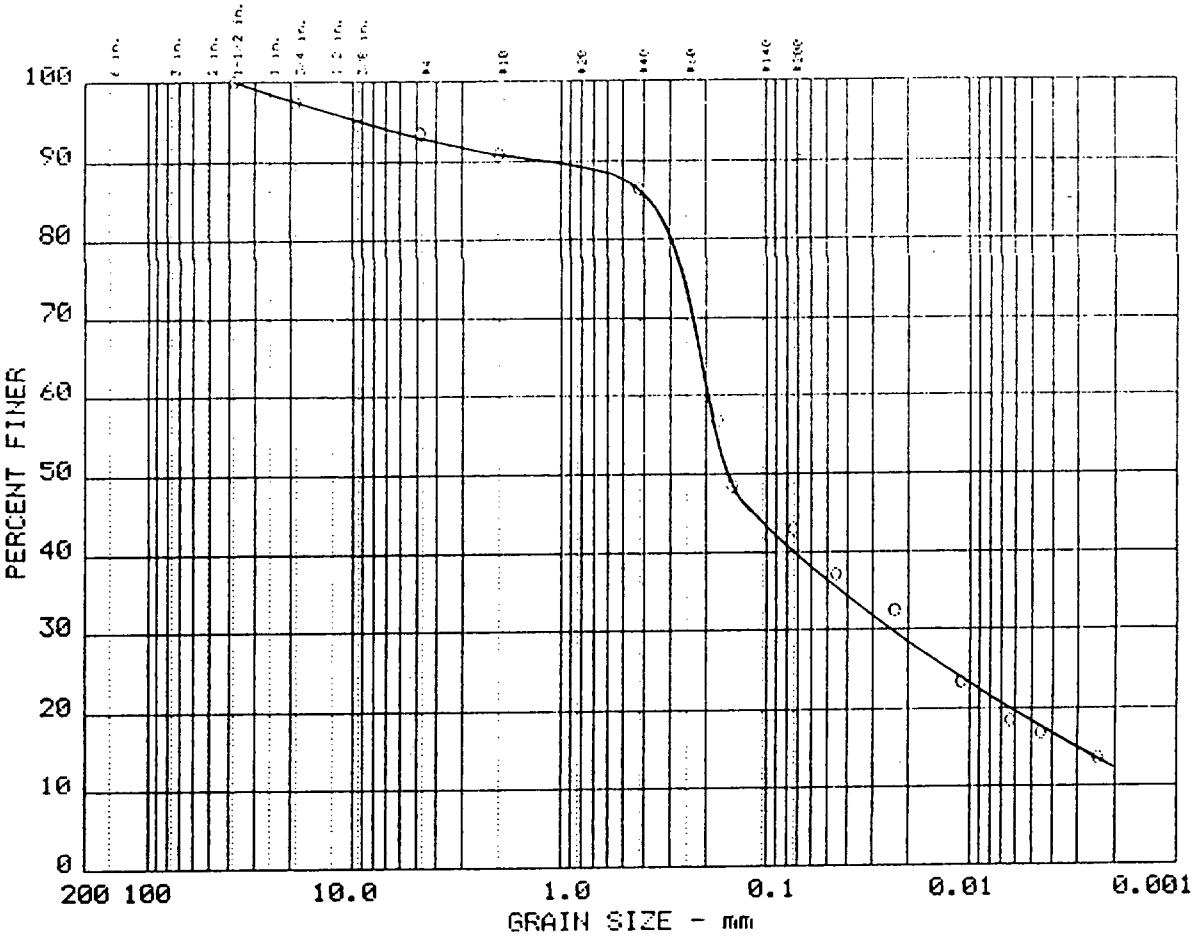
Mechanical Analysis Data

	Initial
ry sample and tare=	1977.60
are =	0.00
ry sample weight =	1977.60

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	353.50	0.00	82.1
0.375 inches	509.40	0.00	56.4
# 4	279.60	0.00	42.2
# 10	182.00	0.00	33.0
# 40	520.20	0.00	6.7
# 80	100.30	0.00	1.6
# 100	13.60	0.00	1.0
# 200	11.70	0.00	0.4

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75_	% GRAVEL	% SAND	% SILT	% CLAY
O	2					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND K

Date: 10-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 2

Date: 10-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND K
Sample Description:
USCS Class:
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	738.70
Tare =	0.00
Dry sample weight =	738.70

Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	19.70	0.00	97.3
0.375 inches	19.80	0.00	94.7
# 4	8.80	0.00	93.5
# 10	1.67	0.00	90.9
# 40	2.87	0.00	86.4
# 80	19.00	0.00	56.8
# 100	5.35	0.00	48.5
# 200	3.55	0.00	42.9

Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 93.5
Weight of hydrometer sample: 60
Calculated biased weight= 64.20
Table of composite correction values:

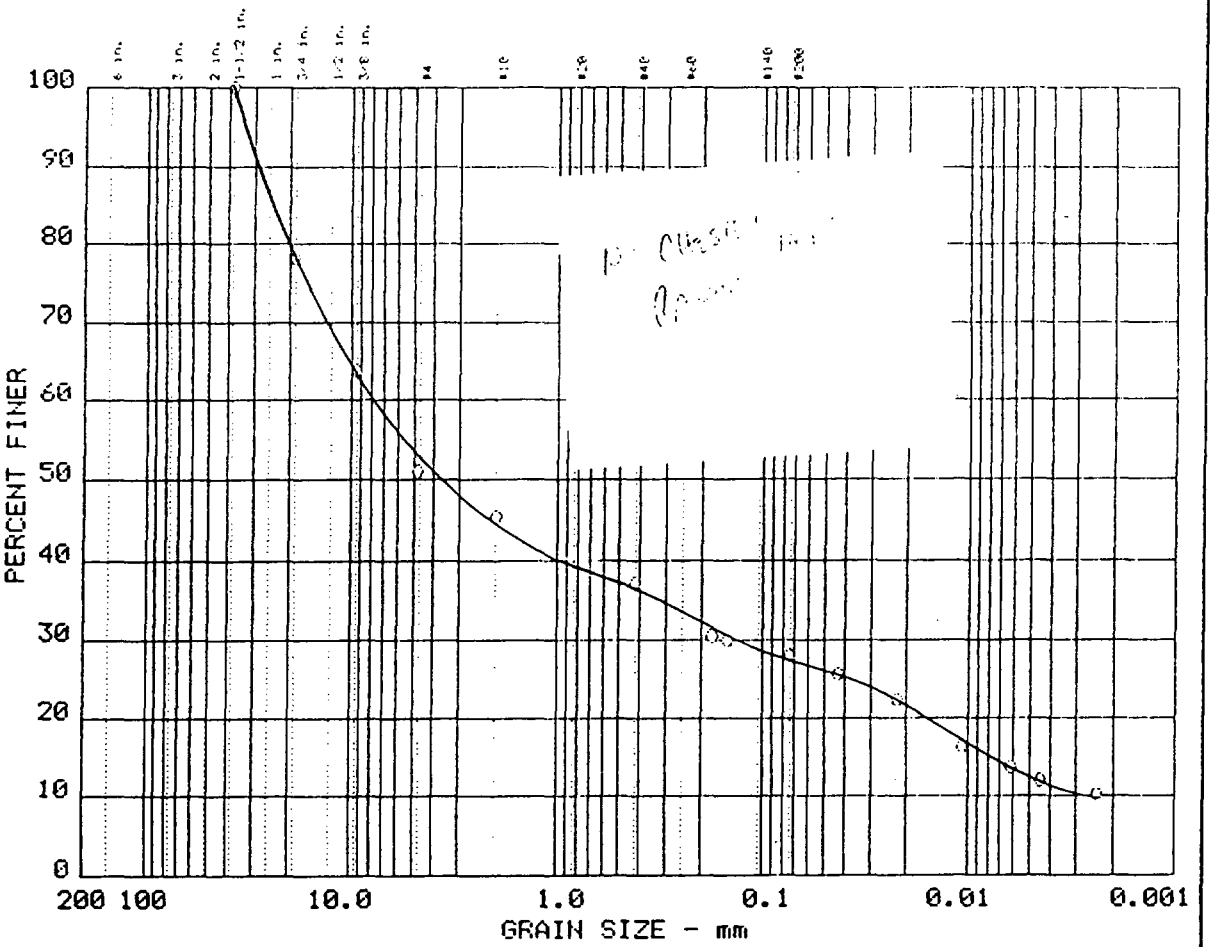
Temp, deg C:	22.0	22.5
Comp. corr:	- 4.2	- 4.0

Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	28.0	23.8	0.0133	28.0	11.7	0.0456	37.1
4.0	22.0	25.0	20.8	0.0133	25.0	12.2	0.0233	32.4
19.0	22.5	19.0	15.0	0.0132	19.0	13.2	0.0110	23.4
60.0	22.0	16.0	11.8	0.0133	16.0	13.7	0.0064	18.4
120.0	22.0	15.0	10.8	0.0133	15.0	13.8	0.0045	16.8
435.0	22.0	13.0	8.8	0.0133	13.0	14.2	0.0024	13.7

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	2					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O			24.27	7.85	4.37	0.151				

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND L

Date: 10-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 2

Date: 10-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND L
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1099.00
Tare = 0.00
Dry sample weight = 1099.00
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	240.50	0.00	78.1
0.375 inches	157.50	0.00	63.8
# 4	140.00	0.00	51.0
# 10	6.62	0.00	45.4
# 40	9.77	0.00	37.1
# 80	7.76	0.00	30.5
# 100	0.65	0.00	29.9
# 200	2.22	0.00	28.1

Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 51.0
Weight of hydrometer sample: 60
Calculated biased weight= 117.54
Table of composite correction values:

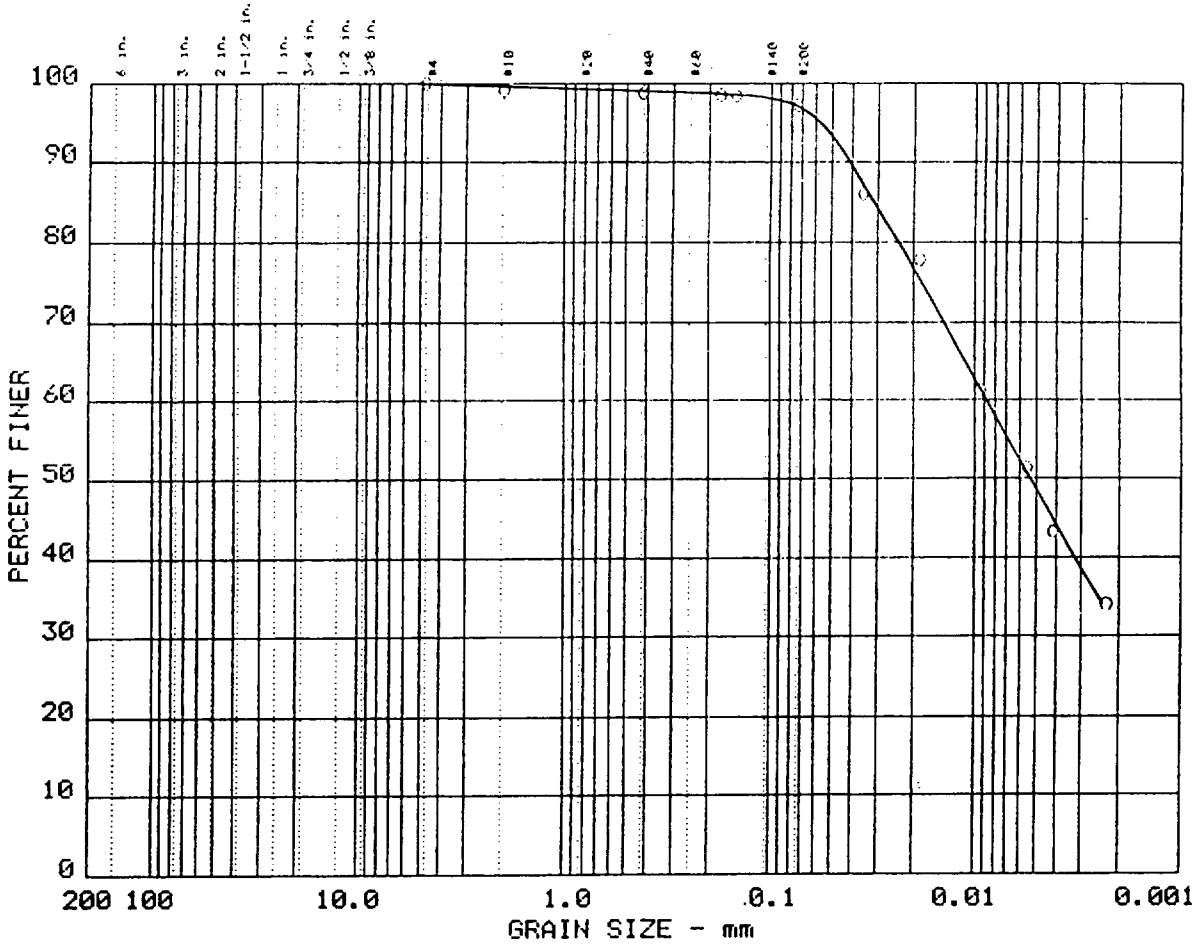
Temp, deg C:	23.0	22.5	22.0	21.5	20.0
Comp. corr:	- 3.9	- 4.0	- 4.2	- 4.3	- 4.8

Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	34.0	30.1	0.0132	34.0	10.7	0.0431	25.6
4.0	23.0	30.0	26.1	0.0132	30.0	11.4	0.0222	22.2
19.0	22.5	23.0	19.1	0.0132	23.0	12.5	0.0108	16.2
60.0	22.0	20.0	16.1	0.0133	20.0	13.0	0.0062	13.7
120.0	21.5	18.0	14.1	0.0134	18.0	13.3	0.0045	12.0
435.0	20.0	16.0	12.1	0.0136	16.0	13.7	0.0024	10.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O	12					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE RIVER
O Location: MARCUS HOOK

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 12

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: MARCUS HOOK
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.50	0.00	99.2
# 40	0.22	0.00	98.8
# 80	0.15	0.00	98.6
# 100	0.07	0.00	98.4
# 200	0.75	0.00	97.2

Hydrometer Analysis Data

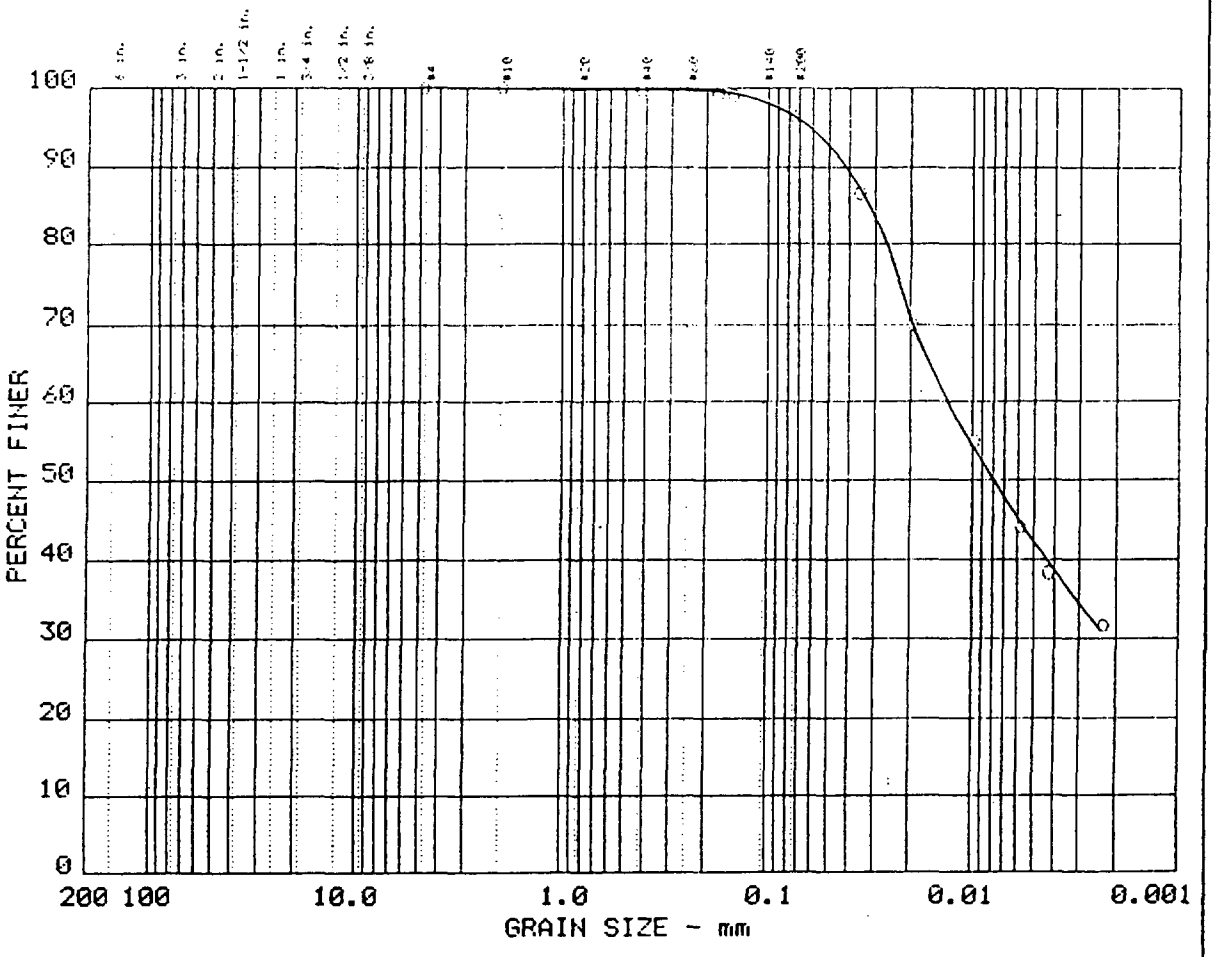
Separation sieve is number 10
Percent -# 10 based on complete sample= 99.2
Weight of hydrometer sample: 60
Calculated biased weight= 60.50
Table of composite correction values:

Temp, deg C:	23.0	22.5	21.0	20.0
Comp. corr:	- 3.9	- 4.0	- 4.5	- 4.8

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	56.0	52.1	0.0132	56.0	7.1	0.0351	86.1
4.0	23.0	51.0	47.1	0.0132	51.0	7.9	0.0185	77.8
19.0	22.5	41.0	37.1	0.0132	41.0	9.6	0.0094	61.3
60.0	22.5	35.0	31.1	0.0132	35.0	10.6	0.0056	51.4
120.0	21.0	30.0	26.1	0.0135	30.0	11.4	0.0042	43.1
435.0	20.0	24.5	20.6	0.0136	24.5	12.3	0.0023	34.0

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○	1					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

	MATERIAL DESCRIPTION	USCS	AASHTO
○		*	

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: BEND M

Date: 10-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 1

Date: 10-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND M
Sample Description:
USCS Class: *
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.02	0.00	100.0
# 40	0.24	0.00	99.6
# 80	0.25	0.00	99.2
# 100	0.10	0.00	99.0
# 200	1.67	0.00	96.2

Hydrometer Analysis Data

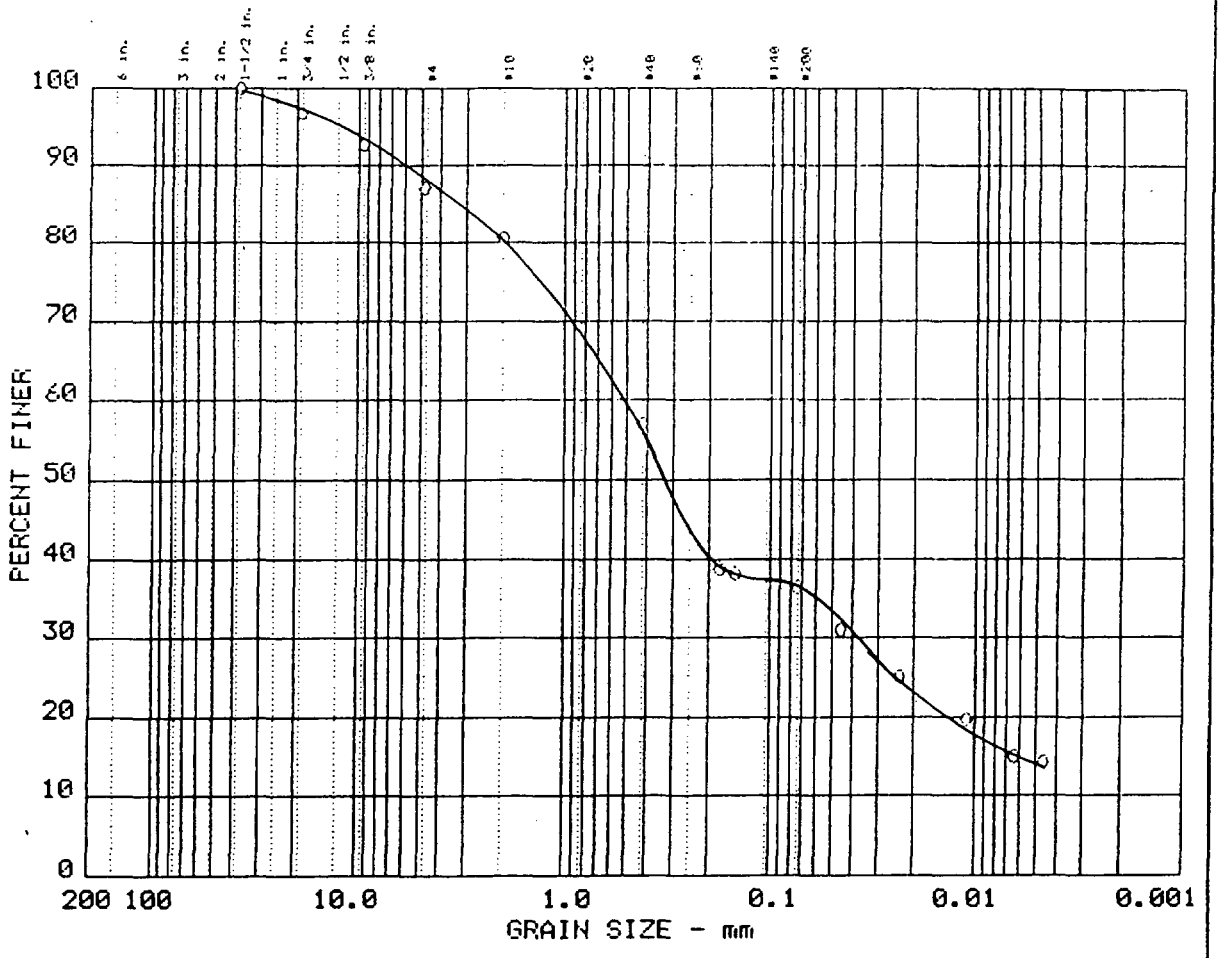
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	22.5	22.0	21.0	20.0
Comp. corr:	- 4.0	- 4.2	- 4.5	- 4.8

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	56.0	52.0	0.0132	56.0	7.1	0.0353	86.7
4.0	22.5	46.0	42.0	0.0132	46.0	8.8	0.0196	70.0
19.0	22.0	37.0	33.0	0.0133	37.0	10.2	0.0098	55.0
60.0	22.0	30.5	26.5	0.0133	30.5	11.3	0.0058	44.2
120.0	21.0	27.0	23.0	0.0135	27.0	11.9	0.0042	38.3
435.0	20.0	23.0	19.0	0.0136	23.0	12.5	0.0023	31.7

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
O	10					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE RIVER
O Location: BELLVUE RANGE

Date: 10-15-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 10

Date: 10-15-1993
Project No.: 1153
Project: DELAWARE RIVER

Sample Data

Location of Sample: BELLVUE RANGE
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 728.70
Tare = 0.00
Dry sample weight = 728.70
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	24.20	0.00	96.7
0.375 inches	31.00	0.00	92.4
# 4	38.60	0.00	87.1
# 10	4.51	0.00	80.6
# 40	16.28	0.00	56.9
# 80	12.54	0.00	38.7
# 100	0.40	0.00	38.1
# 200	1.20	0.00	36.4

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 80.6
Weight of hydrometer sample: 60
Calculated biased weight= 74.46
Table of composite correction values:

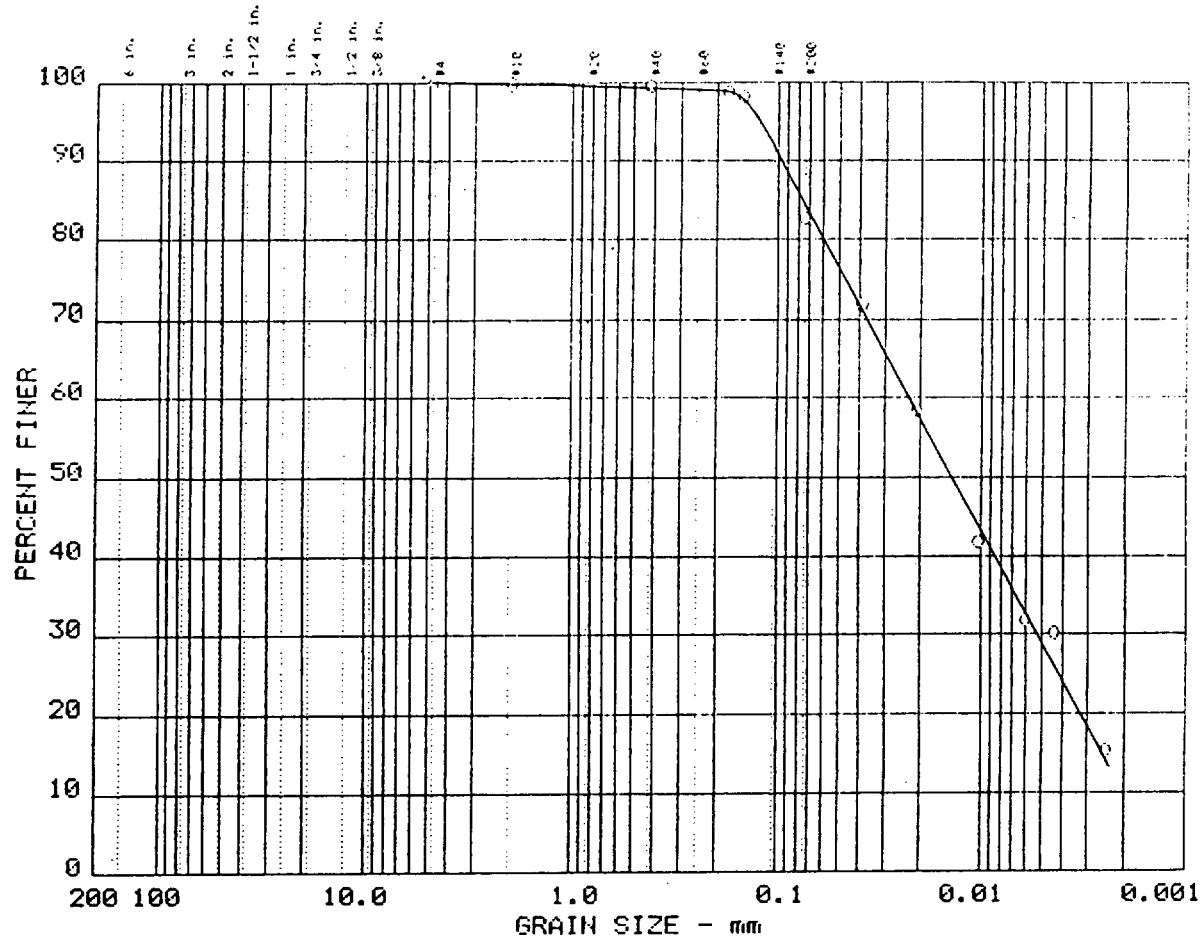
Temp, deg C:	23.0	22.0	21.0
Comp. corr:	- 3.9	- 4.2	- 4.5

Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	27.0	23.1	0.0132	27.0	11.9	0.0454	31.0
4.0	23.0	22.5	18.6	0.0132	22.5	12.6	0.0234	25.0
19.0	23.0	18.5	14.6	0.0132	18.5	13.3	0.0110	19.6
60.0	22.0	15.0	11.1	0.0133	15.0	13.8	0.0064	14.9
120.0	21.0	14.5	10.6	0.0135	14.5	13.9	0.0046	14.2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75_	% GRAVEL	% SAND	% SILT	% CLAY
O	7					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND N

Date: 10-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 7

Date: 10-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND N
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	60.00
Tare =	0.00
Dry sample weight =	60.00

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.09	0.00	99.9
# 40	0.16	0.00	99.6
# 80	0.48	0.00	98.8
# 100	0.34	0.00	98.2
# 200	9.31	0.00	82.7

Hydrometer Analysis Data

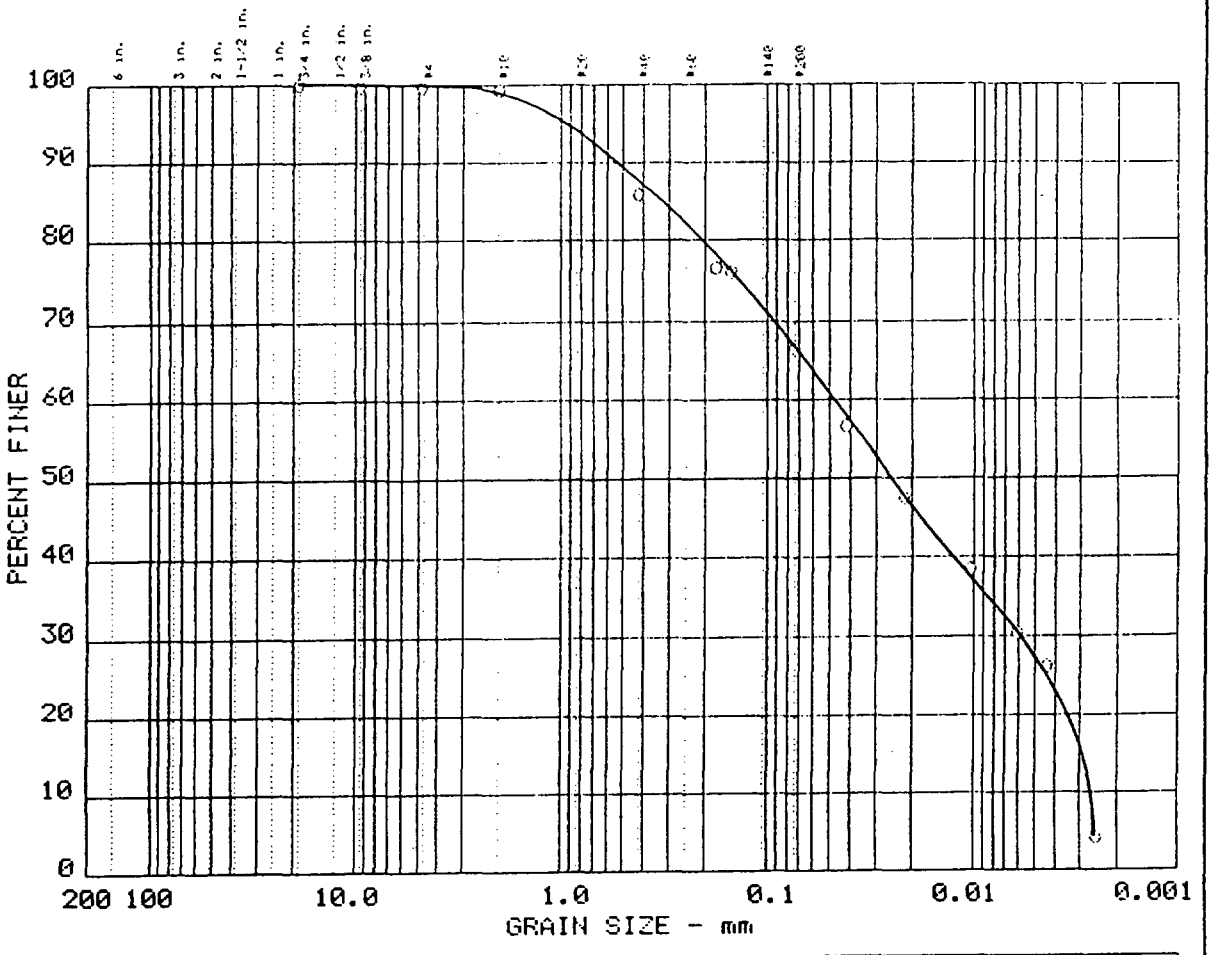
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	23.0	22.5	22.0	21.0	20.0
Comp. corr:	- 3.9	- 4.0	- 4.2	- 4.5	- 4.8

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	47.0	43.1	0.0132	47.0	8.6	0.0386	71.8
4.0	23.0	39.0	35.1	0.0132	39.0	9.9	0.0207	58.5
19.0	22.5	29.0	25.1	0.0132	29.0	11.5	0.0103	41.8
60.0	22.0	23.0	19.1	0.0133	23.0	12.5	0.0061	31.8
120.0	21.0	22.0	18.1	0.0135	22.0	12.7	0.0044	30.2
435.0	20.0	13.0	9.1	0.0136	13.0	14.2	0.0025	15.2

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: B CHERRY ISLAND FLATS

Date: 10-29-1993

Remarks:

LESNY & KITLINSKI ASSOCIATES

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 5

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: B CHERRY ISLAND FLATS
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 389.40
Tare = 0.00
Dry sample weight = 389.40
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	0.90	0.00	99.8
# 4	0.50	0.00	99.6
# 10	0.23	0.00	99.3
# 40	8.10	0.00	85.8
# 80	5.60	0.00	76.5
# 100	0.33	0.00	76.0
# 200	5.70	0.00	66.5

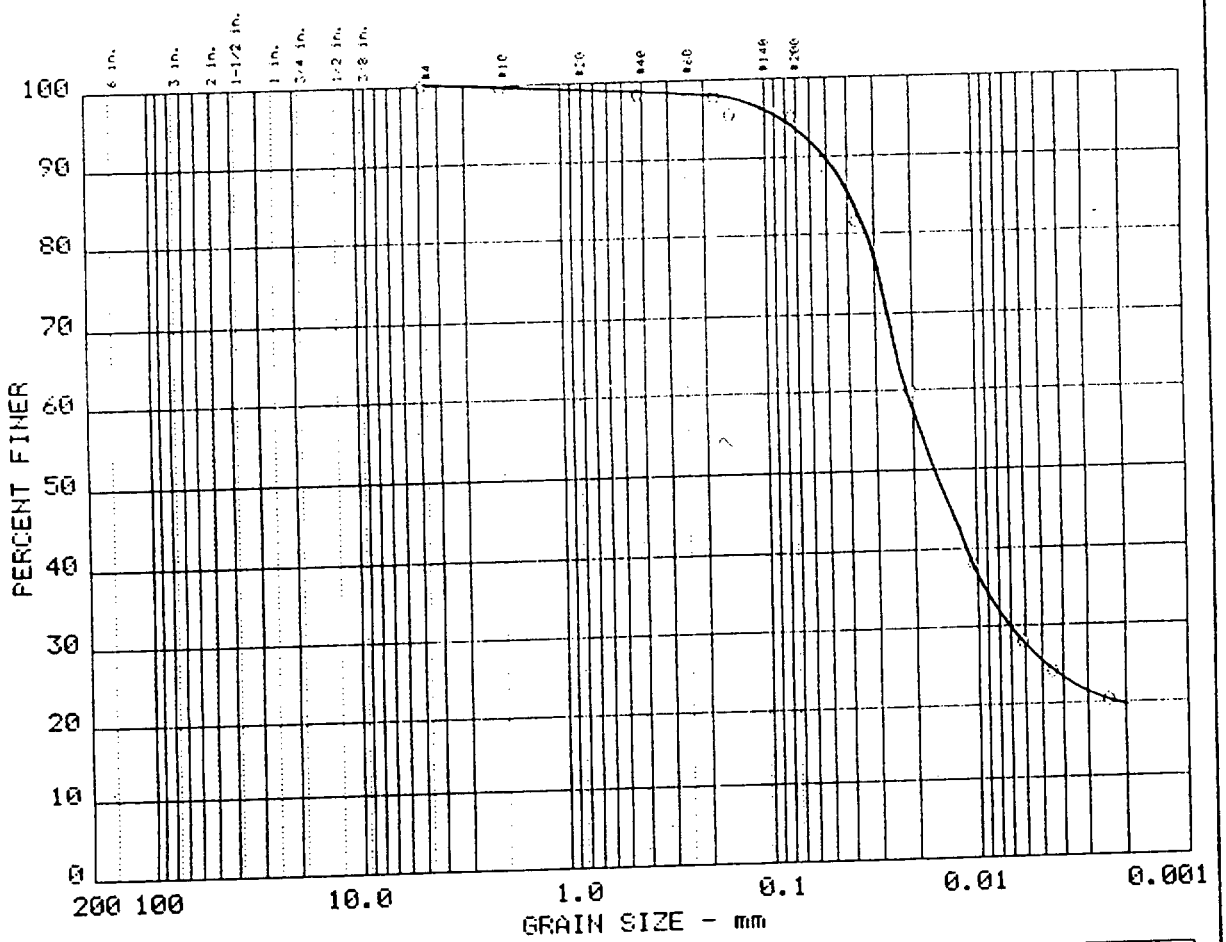
Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 99.6
Weight of hydrometer sample: 60
Calculated biased weight= 60.22
Table of composite correction values:
Temp, deg C: 21.0 22.0 23.0
Comp. corr: - 4.5 - 4.2 - 3.9
Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	38.0	34.1	0.0132	38.0	10.1	0.0418	56.6
4.0	23.0	32.5	28.6	0.0132	32.5	11.0	0.0218	47.5
19.0	23.0	27.0	23.1	0.0132	27.0	11.9	0.0104	38.4
60.0	22.0	22.5	18.3	0.0133	22.5	12.6	0.0061	30.4
120.0	22.0	20.0	15.8	0.0133	20.0	13.0	0.0044	26.2
435.0	21.0	7.0	2.5	0.0135	7.0	15.1	0.0025	4.2

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND O

Date: 10-29-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 16

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND O
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.30	0.00	99.5
# 40	0.72	0.00	98.3
# 80	0.28	0.00	97.8
# 100	1.40	0.00	95.5
# 200	0.26	0.00	95.1

Hydrometer Analysis Data

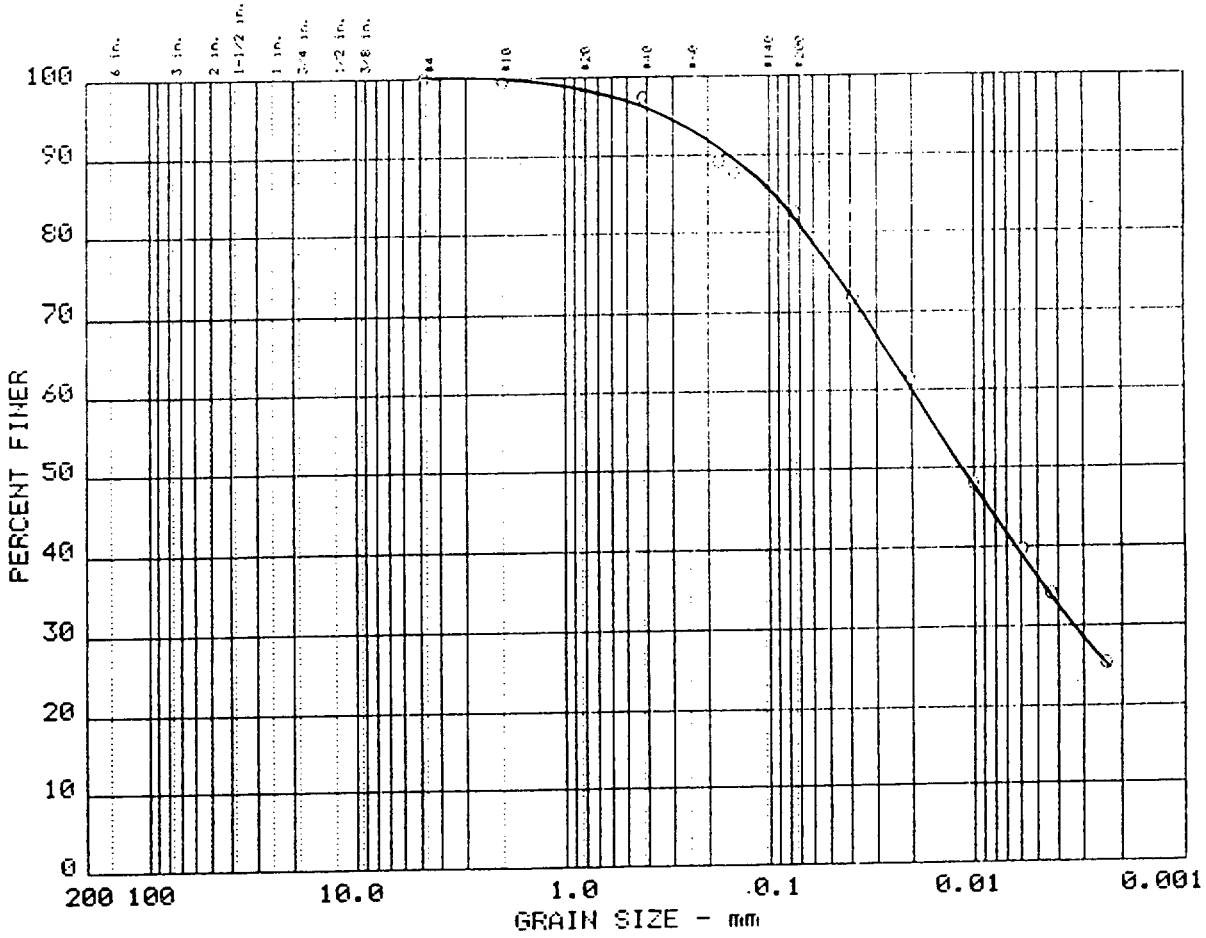
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	20.0	21.0	22.0	22.5
Comp. corr:	- 4.8	- 4.5	- 4.2	- 4.0

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	53.0	49.0	0.0132	53.0	7.6	0.0365	81.7
4.0	22.5	40.0	36.0	0.0132	40.0	9.7	0.0207	60.0
19.0	22.0	27.0	22.8	0.0133	27.0	11.9	0.0105	38.0
60.0	22.0	21.0	16.8	0.0133	21.0	12.9	0.0062	28.0
120.0	21.0	19.0	14.5	0.0135	19.0	13.2	0.0045	24.2
435.0	20.0	17.0	12.2	0.0136	17.0	13.5	0.0024	20.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: B DEEP WATER

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 18

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: B DEEP WATER
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.31	0.00	99.5
# 40	1.30	0.00	97.3
# 80	4.90	0.00	89.2
# 100	0.86	0.00	87.7
# 200	3.13	0.00	82.5

Hydrometer Analysis Data

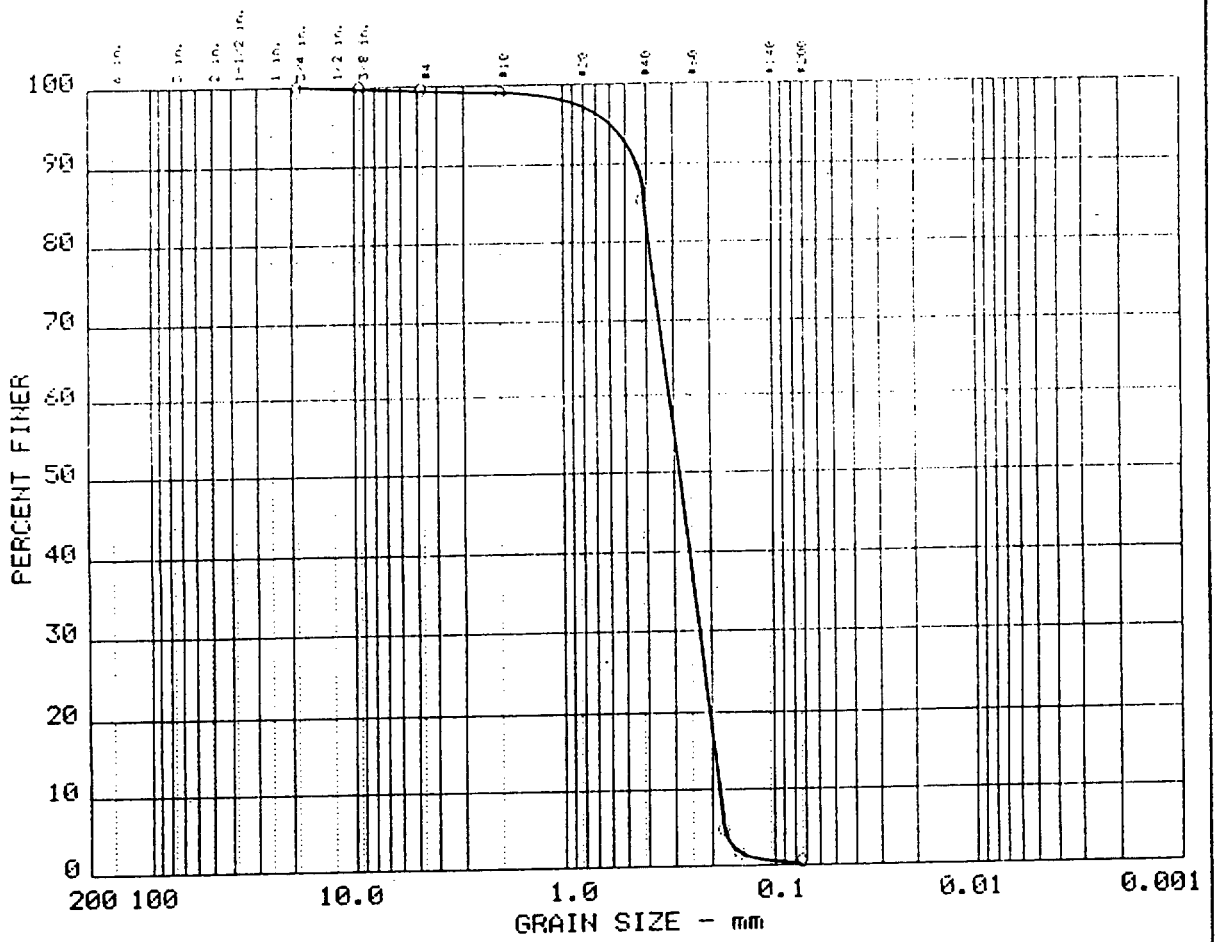
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	20.0	21.0	22.0	22.5
Comp. corr:	- 4.8	- 4.5	- 4.2	- 4.0

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	47.0	43.0	0.0132	47.0	8.6	0.0388	71.7
4.0	22.5	41.0	37.0	0.0132	41.0	9.6	0.0205	61.7
19.0	22.0	33.0	28.8	0.0133	33.0	10.9	0.0101	48.0
60.0	22.0	28.0	23.8	0.0133	28.0	11.7	0.0059	39.7
120.0	21.0	25.0	20.5	0.0135	25.0	12.2	0.0043	34.2
435.0	20.0	20.0	15.2	0.0136	20.0	13.0	0.0024	25.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND PQ

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 17

ate: 10-29-1993
roject No.: 1153
roject: DELAWARE BAY SEDIMENT

Sample Data

ocation of Sample: BEND PQ
ample Description:
CS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

Mechanical Analysis Data

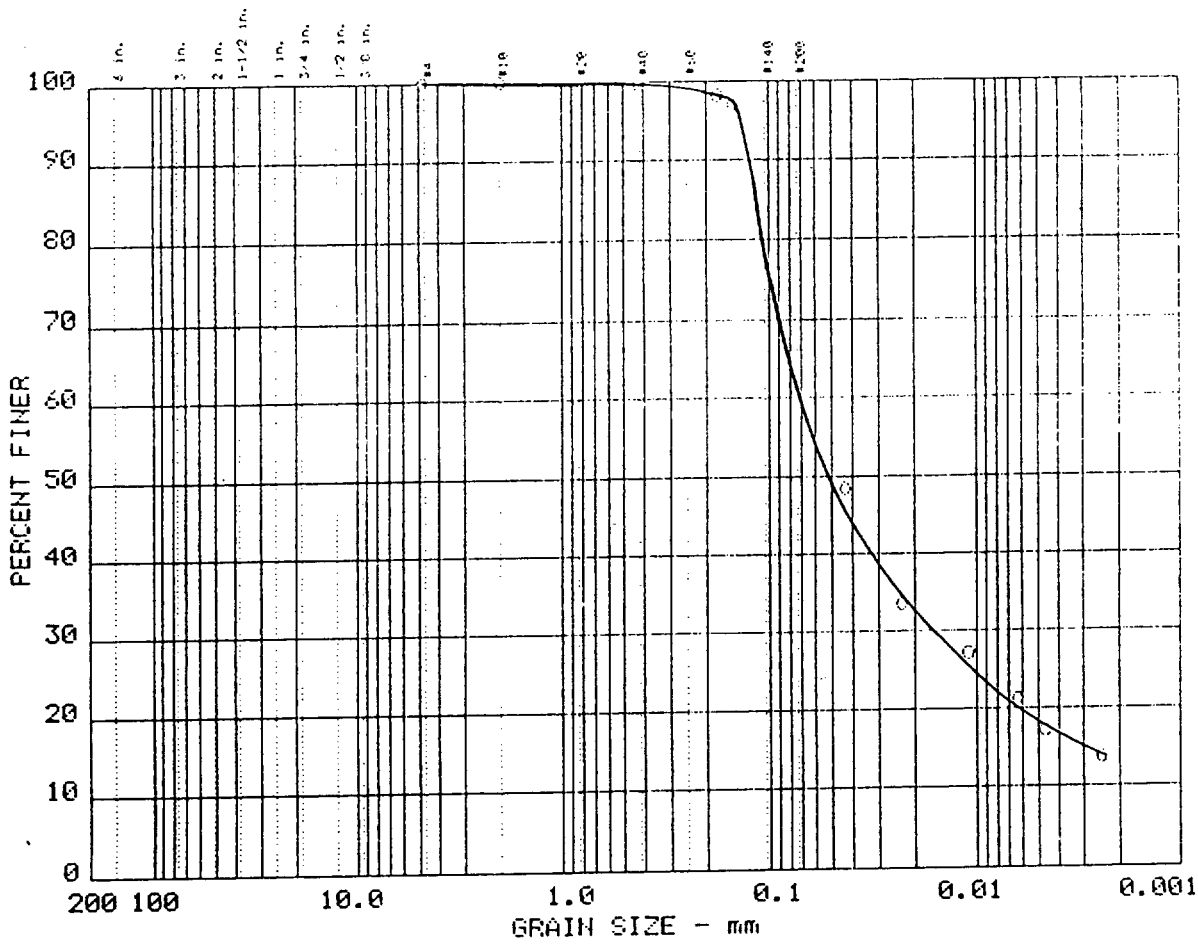
	Initial
ry sample and tare	= 1281.90
are	= 0.00
ry sample weight	= 1281.90

ample split on number 4 sieve
olit sample data:
Sample and tare = 250 Tare = 0 Sample weight = 250

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	0.90	0.00	99.9
# 4	3.80	0.00	99.6
# 10	1.60	0.00	99.0
# 40	34.00	0.00	85.4
# 80	202.30	0.00	4.8
# 100	8.10	0.00	1.6
# 200	2.50	0.00	0.6

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: NEW CASTLE RANGE

Date: 10-29-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 20

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: NEW CASTLE RANGE
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.00	0.00	100.0
# 40	0.30	0.00	99.5
# 80	0.75	0.00	98.3
# 100	0.82	0.00	96.9
# 200	21.77	0.00	60.6

Hydrometer Analysis Data

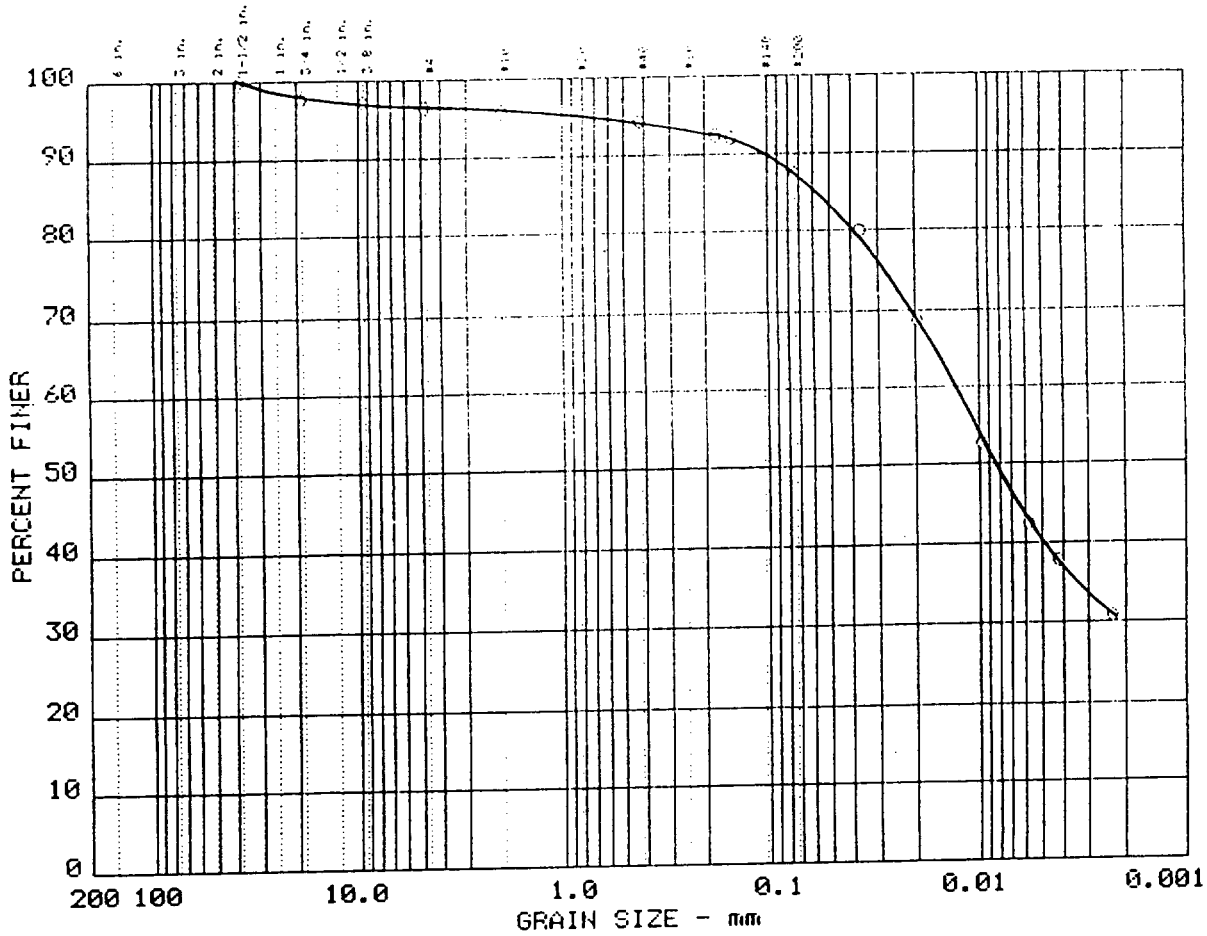
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	20.0	21.5	22.0	23.0
Comp. corr:	- 4.8	- 4.3	- 4.2	- 3.9

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	33.0	29.1	0.0132	33.0	10.9	0.0434	48.5
4.0	23.0	24.0	20.1	0.0132	24.0	12.4	0.0231	33.5
19.0	22.0	20.5	16.3	0.0133	20.5	12.9	0.0110	27.2
60.0	21.5	17.0	12.7	0.0134	17.0	13.5	0.0064	21.2
120.0	20.0	15.0	10.2	0.0136	15.0	13.8	0.0046	17.0
435.0	20.0	13.0	8.2	0.0136	13.0	14.2	0.0025	13.7

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

	MATERIAL DESCRIPTION	USCS	AASHTO
○			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: BEND R

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 6

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND R
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 525.00
Tare = 0.00
Dry sample weight = 525.00
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	12.60	0.00	97.6
0.375 inches	2.70	0.00	97.1
# 4	4.00	0.00	96.3
# 10	0.38	0.00	95.7
# 40	0.92	0.00	94.2
# 80	1.18	0.00	92.3
# 100	0.22	0.00	92.0
# 200	2.83	0.00	87.4

Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 96.3
Weight of hydrometer sample: 60
Calculated biased weight= 62.29
Table of composite correction values:

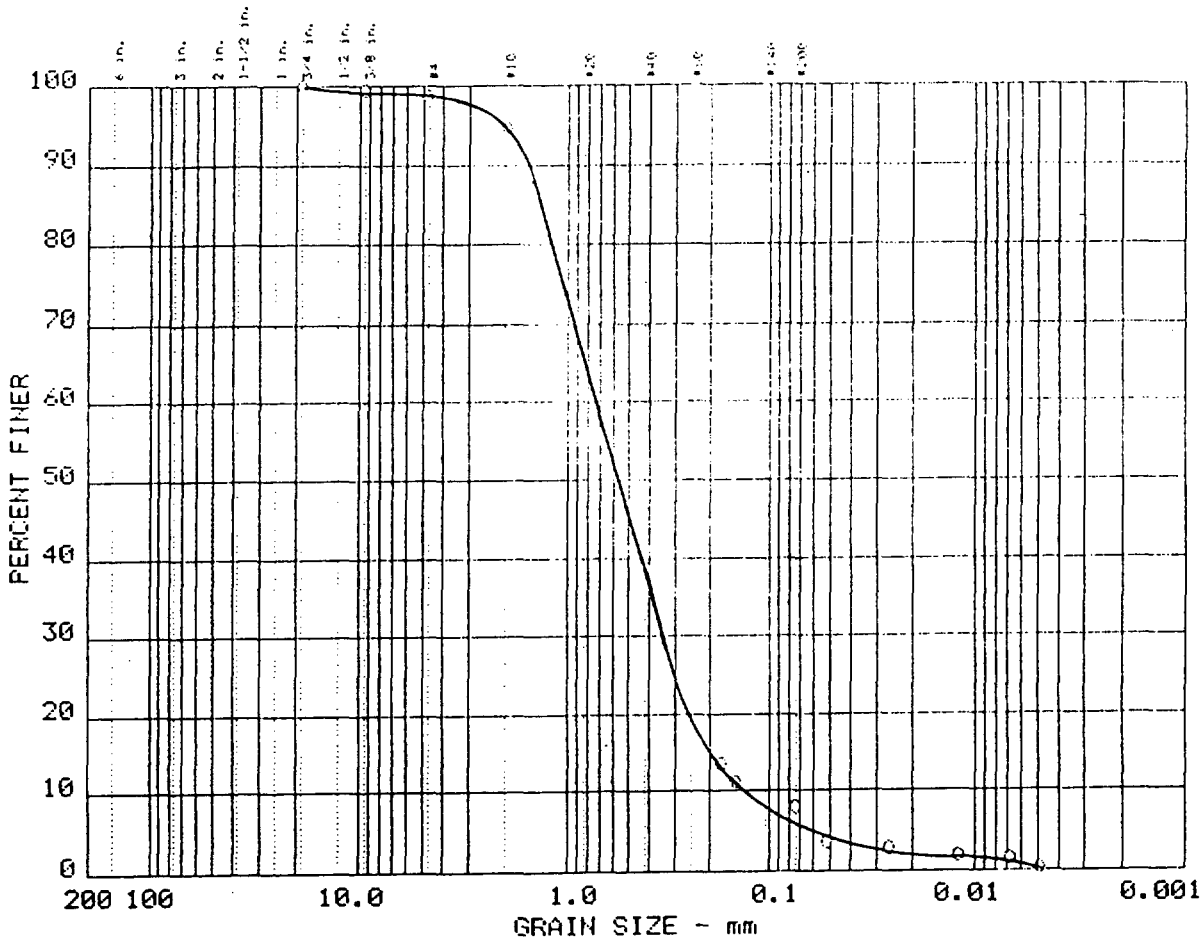
Temp, deg C:	20.0	21.0	22.0
Comp. corr:	- 4.8	- 4.5	- 4.2

Meniscus correction only= 0
Specific gravity of solids= 2.65

Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	54.0	49.8	0.0133	54.0	7.4	0.0363	79.9
4.0	22.0	47.0	42.8	0.0133	47.0	8.6	0.0195	68.7
19.0	22.0	37.0	32.8	0.0133	37.0	10.2	0.0098	52.7
60.0	21.0	31.0	26.5	0.0135	31.0	11.2	0.0058	42.5
120.0	21.0	28.0	23.5	0.0135	28.0	11.7	0.0042	37.7
435.0	20.0	24.0	19.2	0.0136	24.0	12.4	0.0023	30.8

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

	MATERIAL DESCRIPTION	USCS	AASHTO
○			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: REEDY ISLAND RANGE

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 19

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: REEDY ISLAND RANGE
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1101.00
Tare = 0.00
Dry sample weight = 1101.00
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	6.20	0.00	99.4
# 4	8.30	0.00	98.7
# 10	2.48	0.00	94.6
# 40	33.93	0.00	38.8
# 80	15.37	0.00	13.5
# 100	1.41	0.00	11.2
# 200	1.94	0.00	8.0

Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 98.7
Weight of hydrometer sample: 60
Calculated biased weight= 60.80
Table of composite correction values:

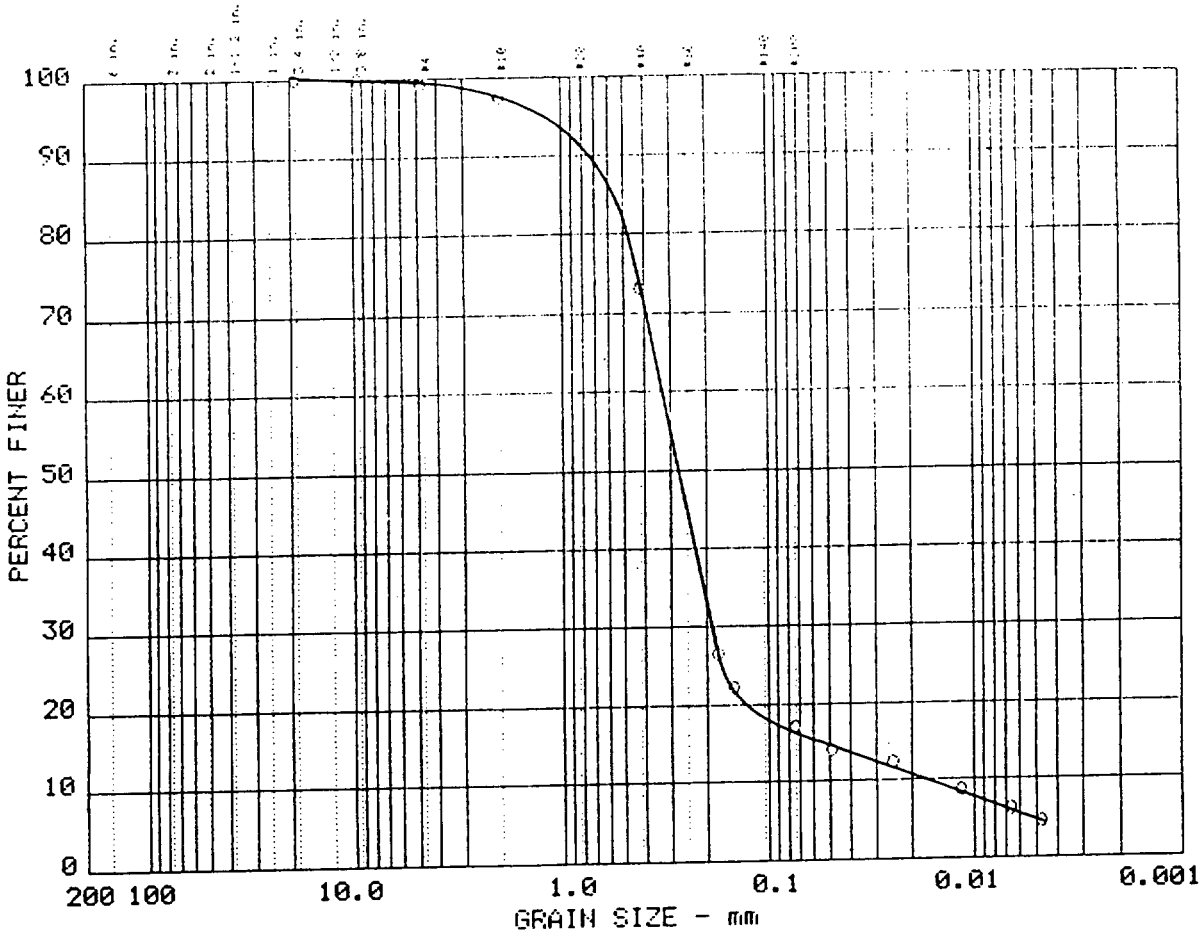
Temp, deg C:	20.0	21.0	21.5	22.0
Comp. corr:	- 4.8	- 4.5	- 4.3	- 4.2

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	6.5	2.3	0.0133	6.5	15.2	0.0520	3.8
4.0	22.0	6.0	1.8	0.0133	6.0	15.3	0.0261	3.0
19.0	21.5	5.5	1.2	0.0134	5.5	15.4	0.0121	2.0
60.0	21.0	5.5	1.0	0.0135	5.5	15.4	0.0068	1.6
120.0	20.0	5.0	0.2	0.0136	5.0	15.5	0.0049	0.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: BEND S

Date: 10-29-1993

Remarks:

LESNY & KITLINSKI ASSOCIATES

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 3

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND S
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	980.50
Tare =	0.00
Dry sample weight =	980.50

Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	1.30	0.00	99.9
# 4	6.80	0.00	99.2
# 10	1.08	0.00	97.4
# 40	14.65	0.00	73.2
# 80	28.20	0.00	26.6
# 100	2.61	0.00	22.2
# 200	3.13	0.00	17.1

Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 99.2
Weight of hydrometer sample: 60
Calculated biased weight= 60.50
Table of composite correction values:

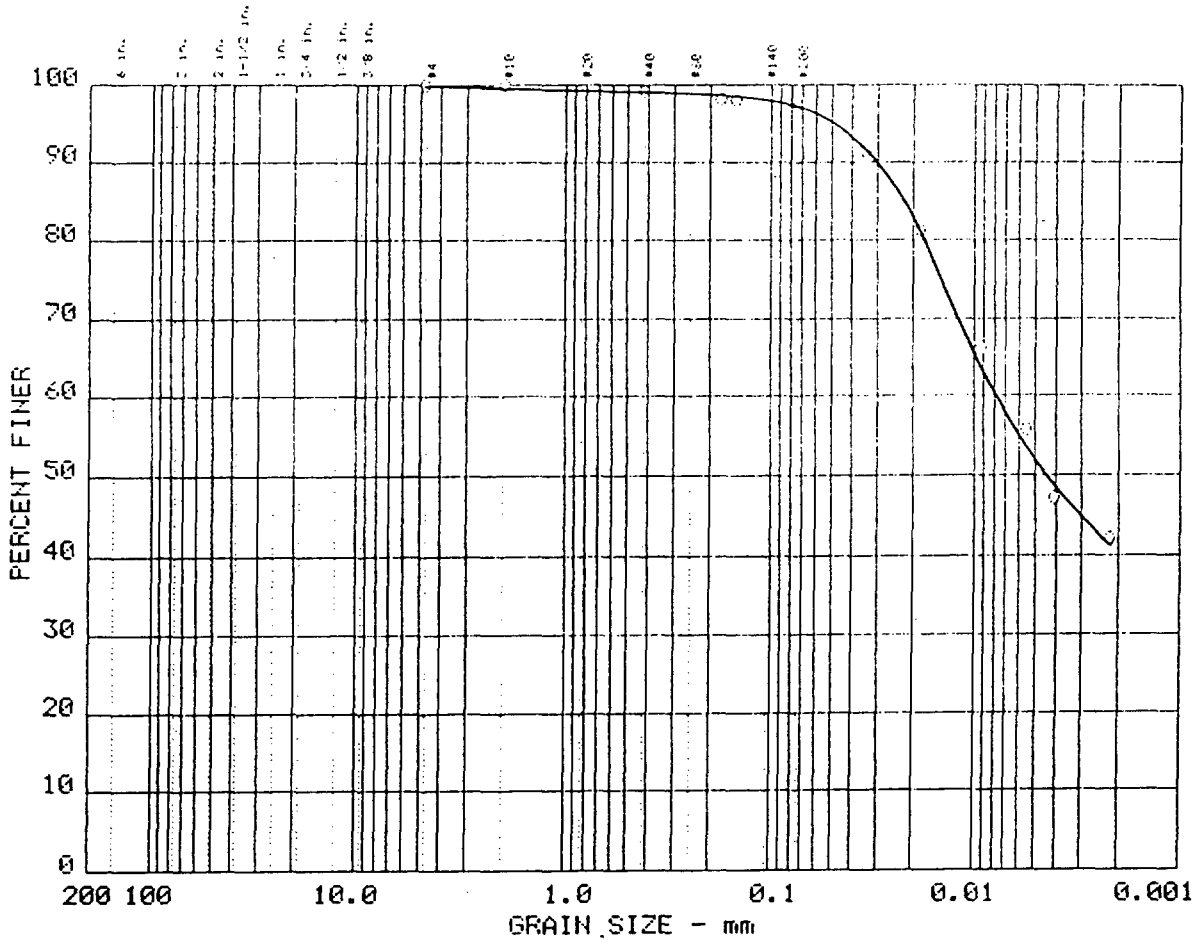
Temp, deg C:	22.0	23.5	24.0
Comp. corr:	- 4.2	- 3.7	- 3.5

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	24.0	12.0	8.5	0.0130	12.0	14.3	0.0493	14.0
4.0	24.0	11.0	7.5	0.0130	11.0	14.5	0.0248	12.4
19.0	23.5	9.0	5.3	0.0131	9.0	14.8	0.0116	8.8
60.0	22.0	8.0	3.8	0.0133	8.0	15.0	0.0067	6.3
120.0	22.0	7.0	2.8	0.0133	7.0	15.1	0.0047	4.6

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BAKER RANGE

Date: 10-29-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 14

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BAKER RANGE
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.00	0.00	100.0
# 40	0.47	0.00	99.2
# 80	0.60	0.00	98.2
# 100	0.12	0.00	98.0
# 200	0.40	0.00	97.4

Hydrometer Analysis Data

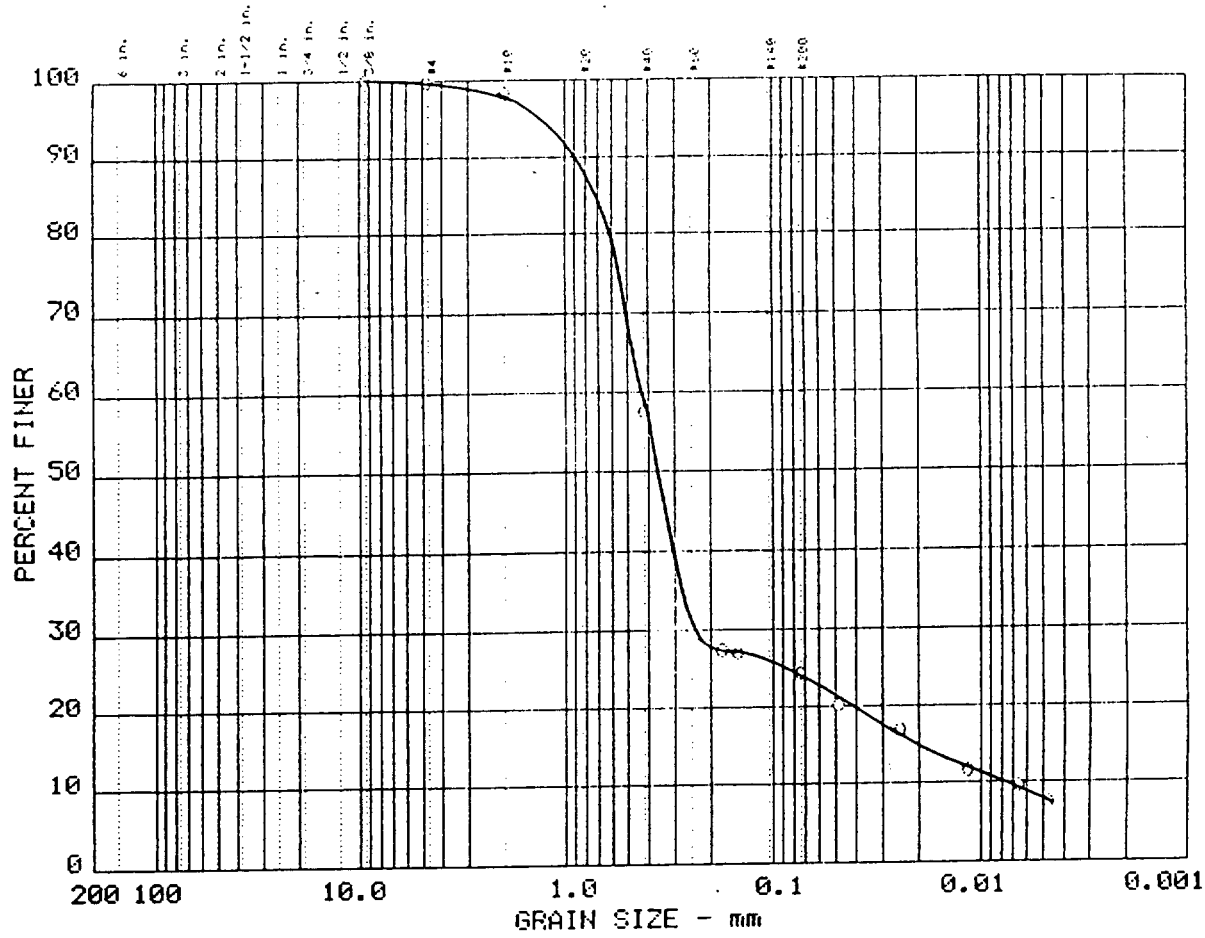
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	20.0	20.5	21.0	21.5	22.0
Comp. corr:	- 4.8	- 4.7	- 4.5	- 4.3	- 4.2

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	59.0	54.8	0.0133	59.0	6.6	0.0343	91.3
4.0	22.0	53.0	48.8	0.0133	53.0	7.6	0.0184	81.3
19.0	21.5	44.0	39.7	0.0134	44.0	9.1	0.0093	66.2
60.0	21.0	38.0	33.5	0.0135	38.0	10.1	0.0055	55.8
120.0	20.5	33.0	28.3	0.0136	33.0	10.9	0.0041	47.2
435.0	20.0	30.0	25.2	0.0136	30.0	11.4	0.0022	42.0

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BEND T

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 15

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BEND T
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 851.50
Tare = 0.00
Dry sample weight = 851.50
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.375 inches	0.00	0.00	100.0
# 4	2.20	0.00	99.7
# 10	0.90	0.00	98.2
# 40	24.47	0.00	57.6
# 80	18.15	0.00	27.4
# 100	0.25	0.00	27.0
# 200	1.58	0.00	24.4

Hydrometer Analysis Data

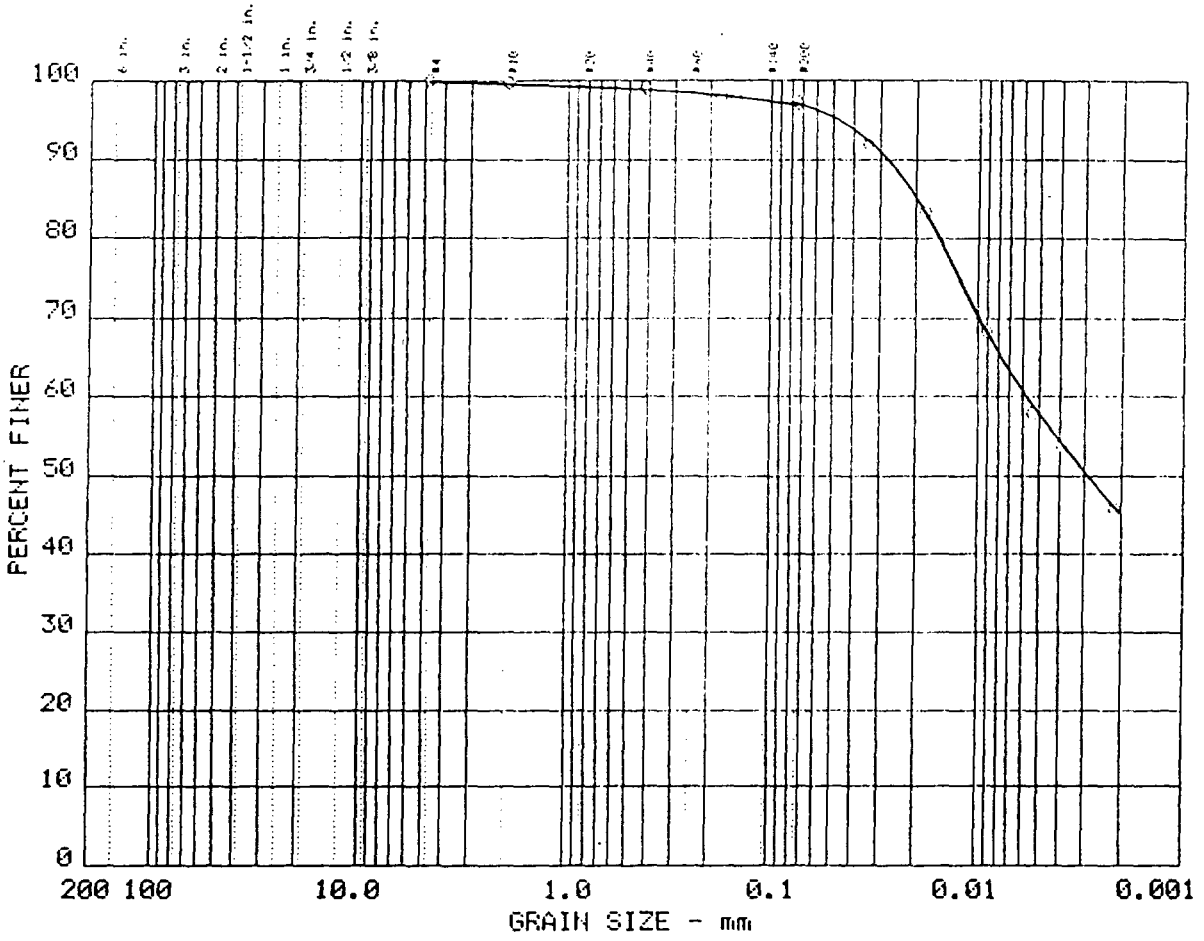
Separation sieve is number 4
Percent -# 4 based on complete sample= 99.7
Weight of hydrometer sample: 60
Calculated biased weight= 60.16
Table of composite correction values:

Temp, deg C:	21.0	22.0	22.5	23.0
Comp. corr:	- 4.5	- 4.2	- 4.0	- 3.9

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	16.0	12.1	0.0132	16.0	13.7	0.0487	20.1
4.0	23.0	14.0	10.1	0.0132	14.0	14.0	0.0246	16.8
19.0	22.5	11.0	7.0	0.0132	11.0	14.5	0.0116	11.6
60.0	22.0	10.0	5.8	0.0133	10.0	14.7	0.0066	9.6
120.0	21.0	9.0	4.5	0.0135	9.0	14.8	0.0047	7.5

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: DELAWARE BAY #1

Date: 10-29-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 1

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: DELAWARE BAY #1
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.16	0.00	99.7
# 40	0.35	0.00	99.2
# 80	0.73	0.00	97.9
# 100	0.11	0.00	97.8
# 200	0.36	0.00	97.2

Hydrometer Analysis Data

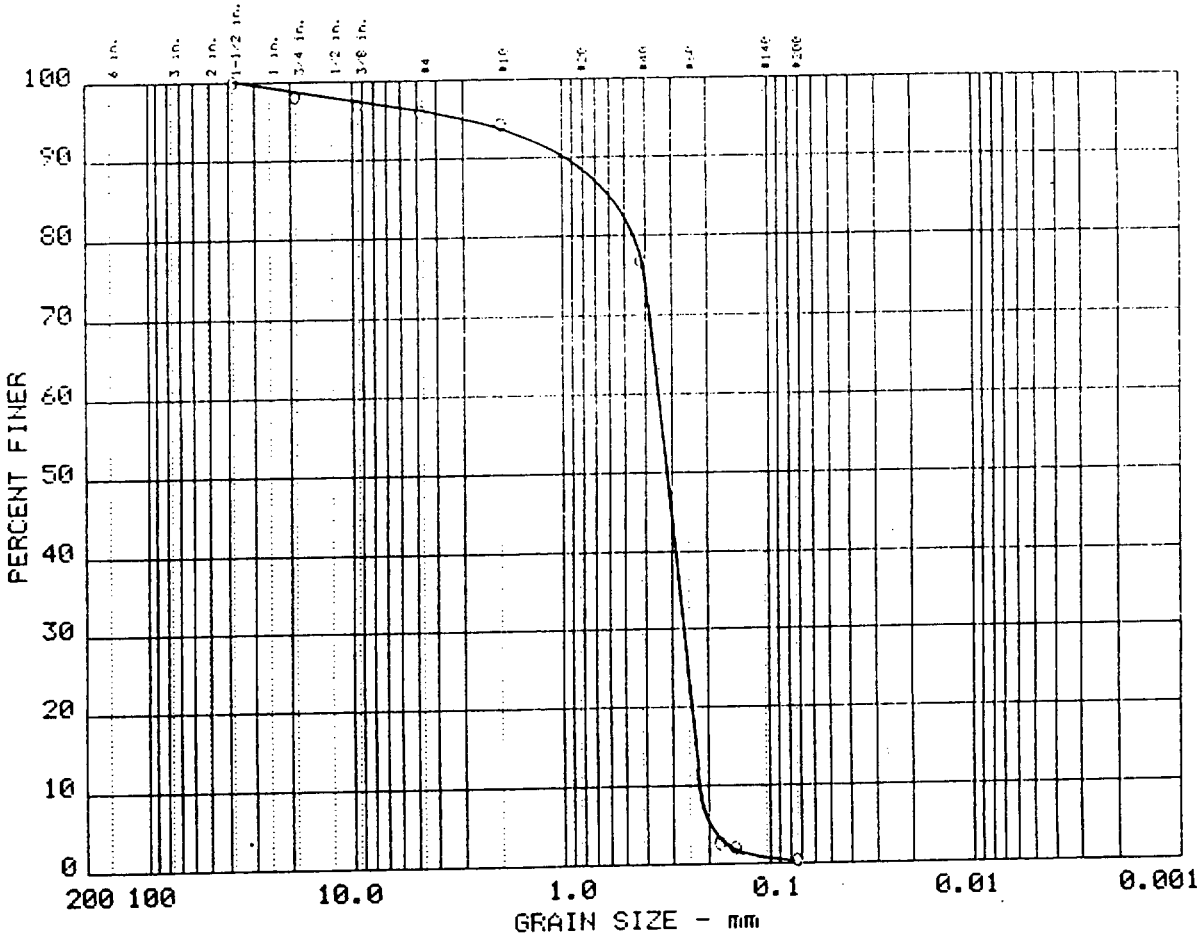
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	21.0	22.0	22.5	23.0
Comp. corr:	- 4.5	- 4.2	- 4.0	- 3.9

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	59.0	55.1	0.0132	59.0	6.6	0.0339	91.8
4.0	23.0	54.0	50.1	0.0132	54.0	7.4	0.0180	83.5
19.0	22.5	45.0	41.0	0.0132	45.0	8.9	0.0091	68.3
60.0	22.0	39.0	34.8	0.0133	39.0	9.9	0.0054	58.0
120.0	22.0	36.5	32.3	0.0133	36.5	10.3	0.0039	53.8
435.0	21.0	32.0	27.5	0.0135	32.0	11.0	0.0021	45.8

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

	MATERIAL DESCRIPTION	USCS	AASHTO
○			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: DELAWARE BAY #2

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 2

ıte: 10-29-1993
·oject No.: 1153
·oject: DELAWARE BAY SEDIMENT

Sample Data

›cation of Sample: DELAWARE BAY #2
ımple Description:
ɔCS Class: Liquid limit:
\SHTO Class: Plasticity index:

Notes

ɜmarks:

ig. No.:

Mechanical Analysis Data

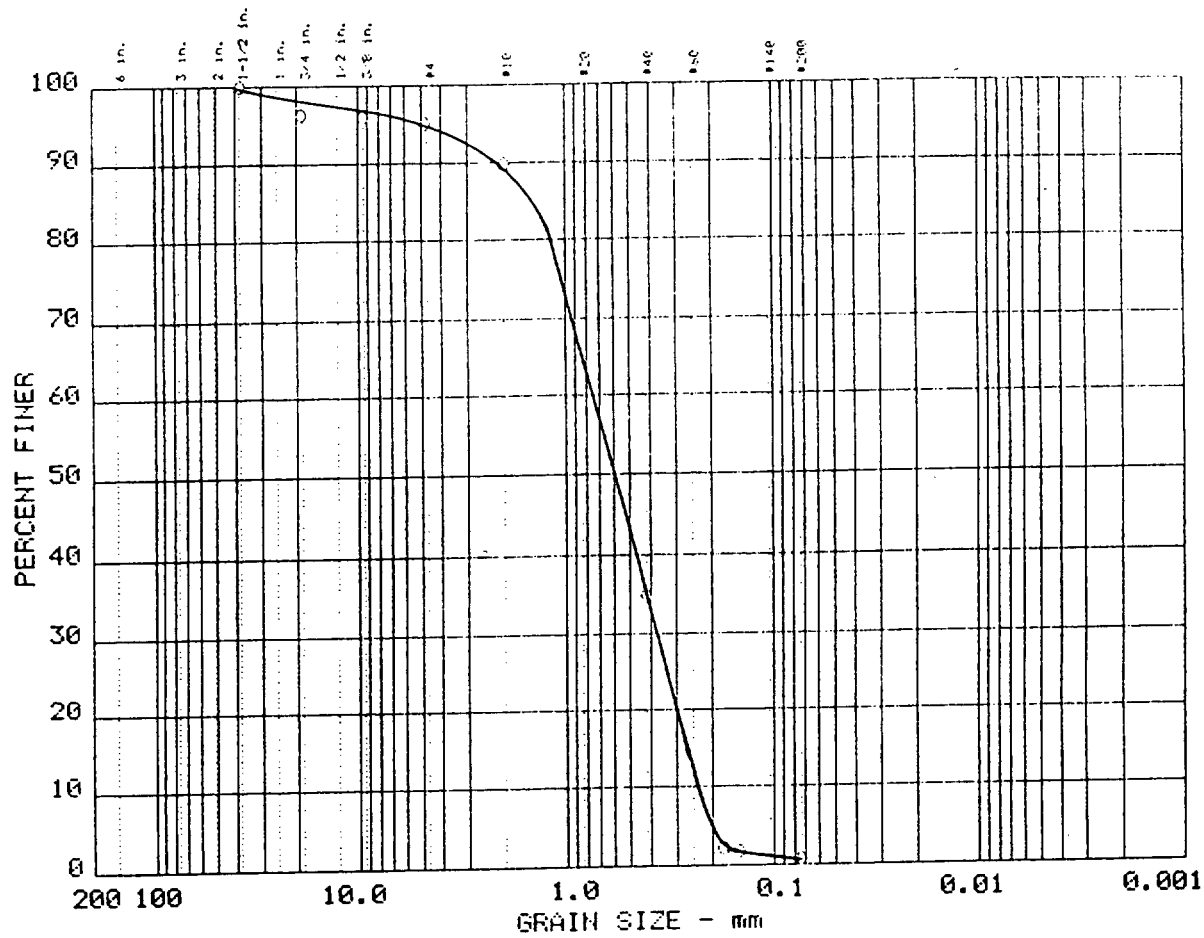
	Initial
ry sample and tare=	1013.00
are =	0.00
ry sample weight =	1013.00

ample split on number 4 sieve
plit sample data:
Sample and tare = 500 Tare = 0 Sample weight = 500

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	19.20	0.00	98.1
0.375 inches	12.30	0.00	96.9
# 4	10.20	0.00	95.9
# 10	8.80	0.00	94.2
# 40	90.40	0.00	76.9
# 80	387.20	0.00	2.6
# 100	3.20	0.00	2.0
# 200	8.10	0.00	0.4

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O	*	

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: DELAWARE BAY #3

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 4

ate: 10-29-1993
roject No.: 1153
roject: DELAWARE BAY SEDIMENT

Sample Data

ocation of Sample: DELAWARE BAY #3
ample Description:
SCS Class: *
ASHTO Class:
Liquid limit:
Plasticity index:

Notes

emarks:

ig. No.:

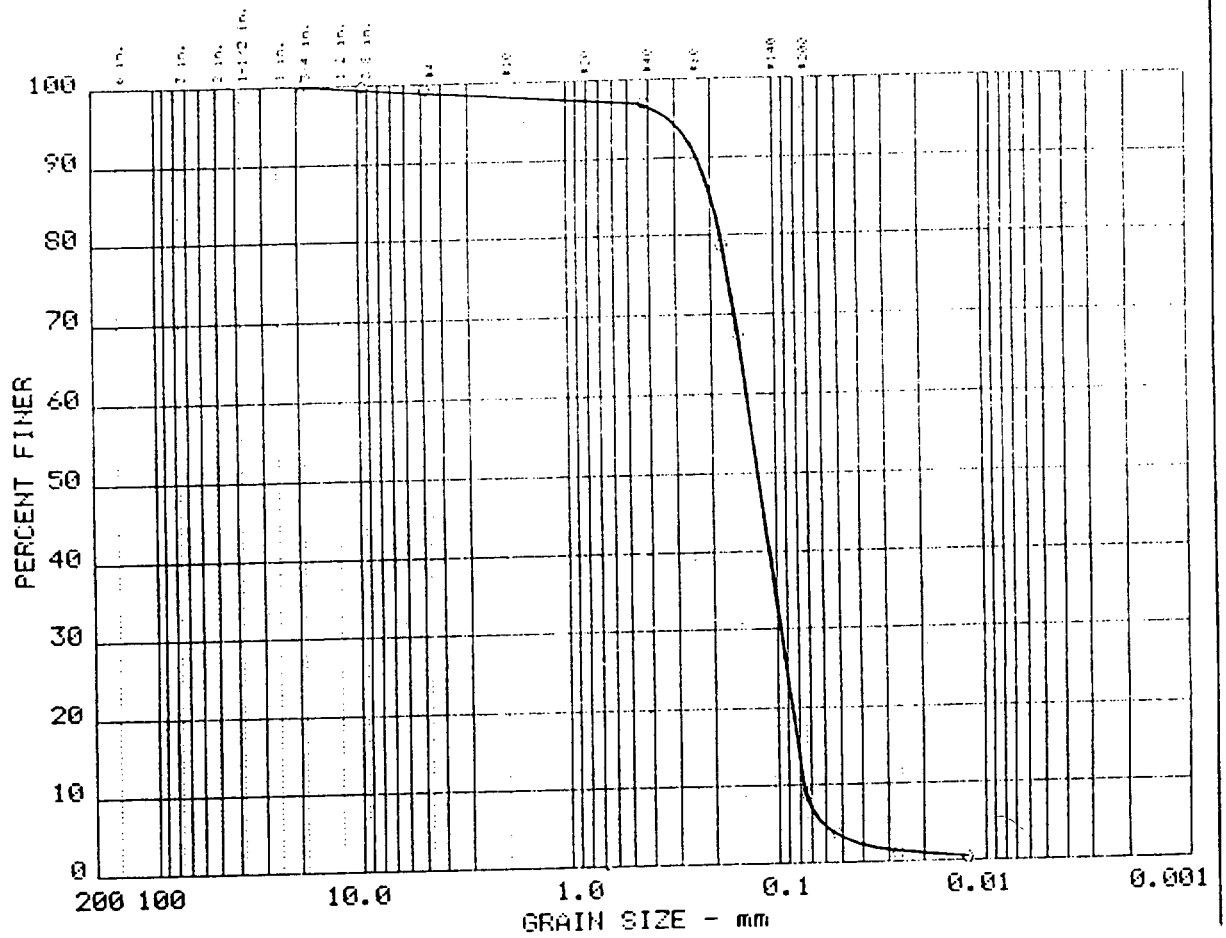
Mechanical Analysis Data

Initial
ry sample and tare= 1211.20
are = 0.00
ry sample weight = 1211.20
ample split on number 4 sieve
plit sample data:
Sample and tare = 500 Tare = 0 Sample weight = 500

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	45.50	0.00	96.2
0.375 inches	4.60	0.00	95.9
# 4	10.40	0.00	95.0
# 10	27.70	0.00	89.7
# 40	287.70	0.00	35.1
# 80	173.00	0.00	2.2
# 100	2.60	0.00	1.7
# 200	5.20	0.00	0.7

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: DELAWARE BAY #4

Date: 11-04-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 1

te: 11-04-1993
oject No.: 1153
oject: DELAWARE BAY SEDIMENT

Sample Data

cation of Sample: DELAWARE BAY #4
mple Description:
CS Class: Liquid limit:
SHTO Class: Plasticity index:

Notes

marks:

g. No.:

Mechanical Analysis Data

Initial
y sample and tare= 1073.00
re = 0.00
y sample weight = 1073.00
mple split on number 4 sieve
lit sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

eve tare method

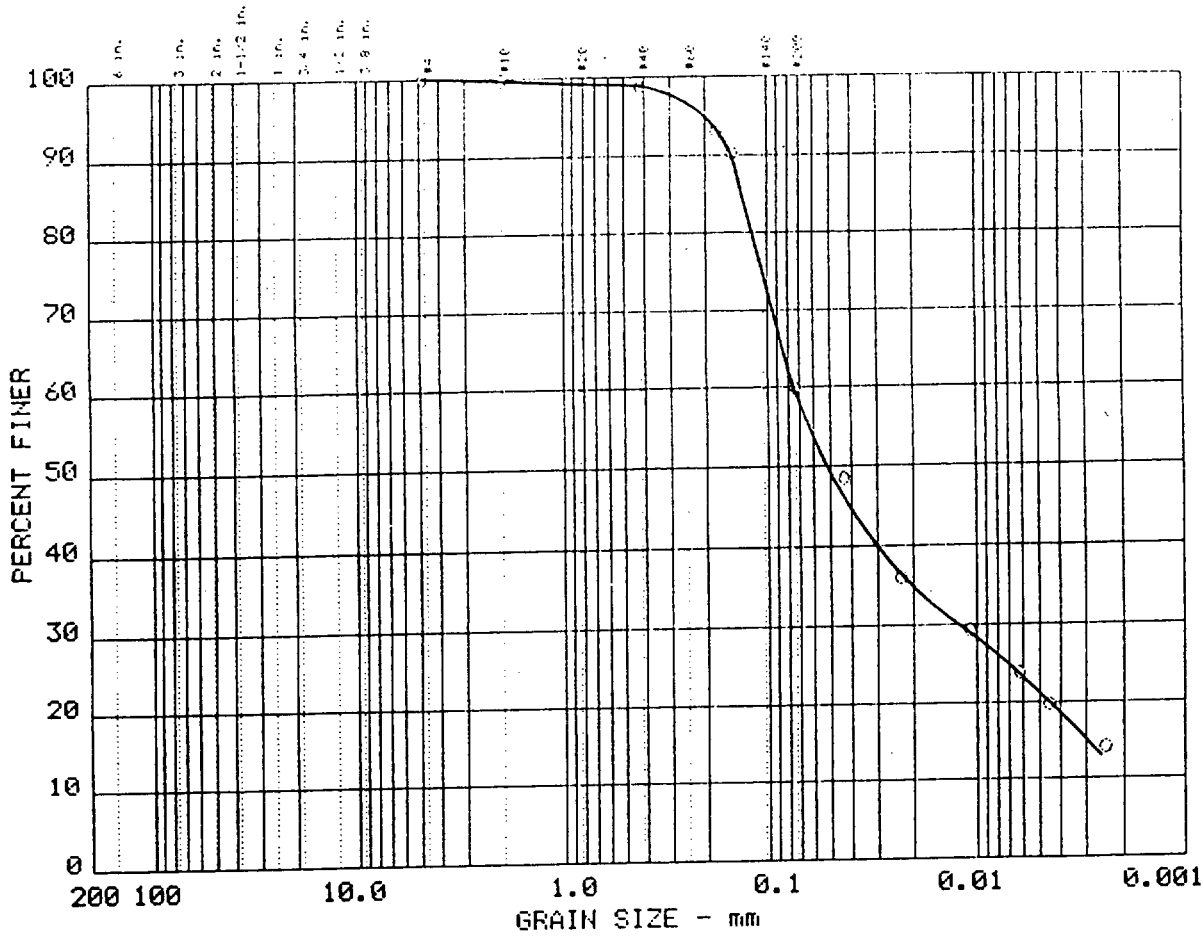
Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	3.40	0.00	99.7
# 4	4.70	0.00	99.2
# 40	1.42	0.00	96.9
# 80	11.00	0.00	78.7
# 100	6.82	0.00	67.4
# 200	35.40	0.00	8.9

Hydrometer Analysis Data

paration sieve is number 4
rcent -# 4 based on complete sample= 99.2
ight of hydrometer sample: 60
lculated biased weight= 60.46
ble of composite correction values:
Temp, deg C: 20.0
Comp. corr: - 4.8
niscus correction only= 0
ecific gravity of solids= 2.65
ecific gravity correction factor= 1.000
drometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.0	7.0	2.2	0.0136	7.0	15.1	0.0531	3.6
4.0	20.0	5.5	0.7	0.0136	5.5	15.4	0.0268	1.2
19.0	20.0	5.0	0.2	0.0136	5.0	15.5	0.0123	0.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: DELAWARE BAY #5

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 7

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: DELAWARE BAY #5
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.15	0.00	99.8
# 40	0.65	0.00	98.7
# 80	3.48	0.00	92.9
# 100	1.60	0.00	90.2
# 200	18.17	0.00	59.9

Hydrometer Analysis Data

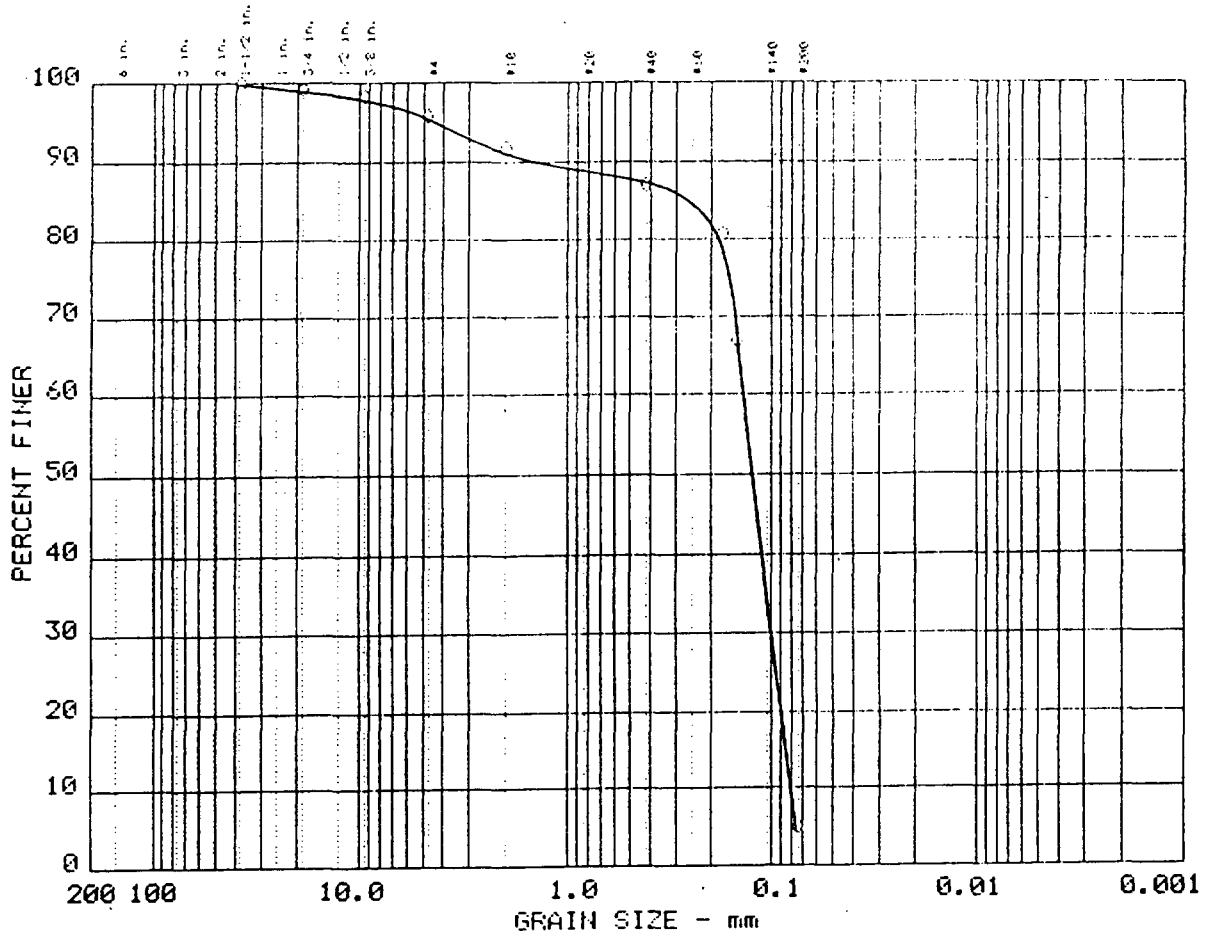
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	21.0	22.0	23.0
Comp. corr:	- 4.5	- 4.2	- 3.9

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	33.0	29.1	0.0132	33.0	10.9	0.0434	48.5
4.0	23.0	25.5	21.6	0.0132	25.5	12.1	0.0229	36.0
19.0	23.0	21.5	17.6	0.0132	21.5	12.8	0.0108	29.3
60.0	22.0	18.5	14.3	0.0133	18.5	13.3	0.0063	23.8
120.0	22.0	16.0	11.8	0.0133	16.0	13.7	0.0045	19.7
435.0	21.0	13.0	8.5	0.0135	13.0	14.2	0.0024	14.2

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75㎜	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: DELAWARE BAY #6

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 8

ate: 10-29-1993
roject No.: 1153
roject: DELAWARE BAY SEDIMENT

Sample Data

ocation of Sample: DELAWARE BAY #6
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

Mechanical Analysis Data

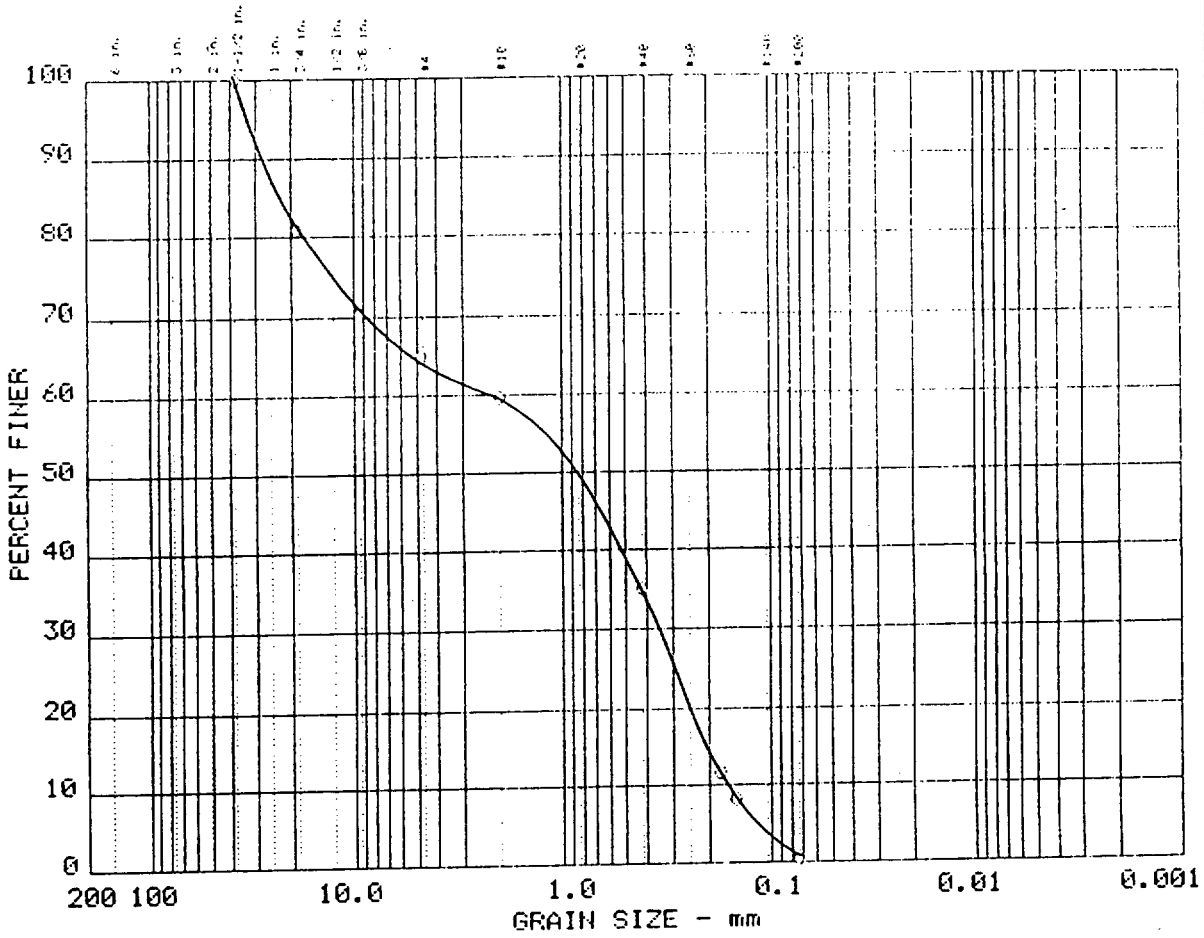
	Initial
ry sample and tare=	850.70
are =	0.00
ry sample weight =	850.70

ample split on number 4 sieve
plit sample data:
Sample and tare = 250 Tare = 0 Sample weight = 250

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	6.80	0.00	99.2
0.375 inches	7.20	0.00	98.4
# 4	22.20	0.00	95.7
# 10	10.70	0.00	91.6
# 40	11.80	0.00	87.1
# 80	16.60	0.00	80.8
# 100	36.00	0.00	67.0
# 200	161.50	0.00	5.1

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

MATERIAL DESCRIPTION	USCS	AASHTO
O		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: DELAWARE BAY #7

Date: 11-04-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 2

te: 11-04-1993
oject No.: 1153
oject: DELAWARE BAY SEDIMENT

Sample Data

cation of Sample: DELAWARE BAY #7
mple Description:
CS Class: Liquid limit:
SHTO Class: Plasticity index:

Notes

marks:

g. No.:

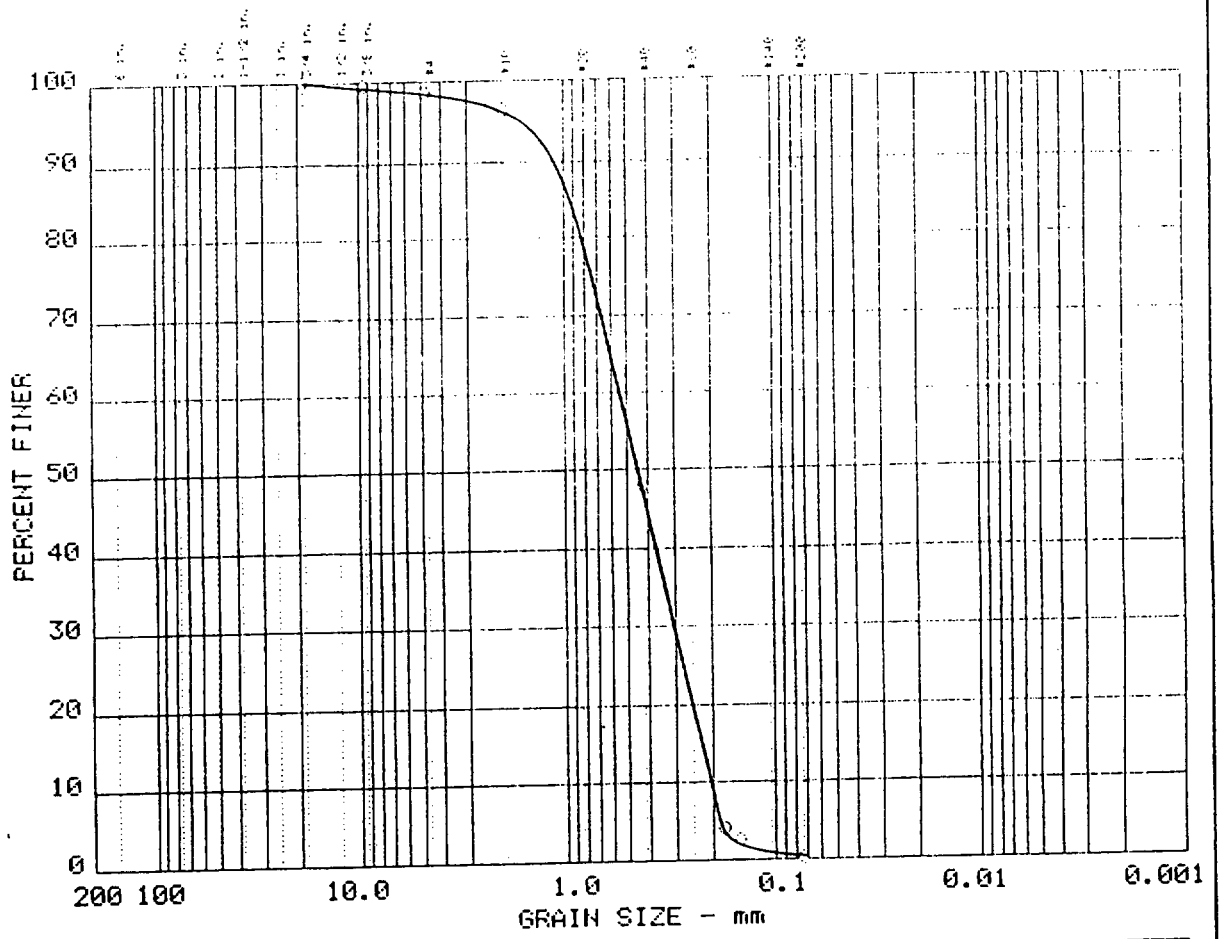
Mechanical Analysis Data

Initial
y sample and tare= 1440.00
re = 0.00
y sample weight = 1440.00
mple split on number 4 sieve
lit sample data:
Sample and tare = 500 Tare = 0 Sample weight = 500

eve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	274.20	0.00	81.0
0.375 inches	152.70	0.00	70.4
# 4	78.50	0.00	64.9
# 10	40.00	0.00	59.7
# 40	190.50	0.00	35.0
# 80	179.30	0.00	11.7
# 100	26.30	0.00	8.3
# 200	60.20	0.00	0.5

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: DELAWARE BAY #8

Date: 11-04-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 3

te: 11-04-1993
oject No.: 1153
oject: DELAWARE BAY SEDIMENT

Sample Data

cation of Sample: DELAWARE BAY #8
mple Description:
CS Class: Liquid limit:
SHTO Class: Plasticity index:

Notes

marks:

g. No.:

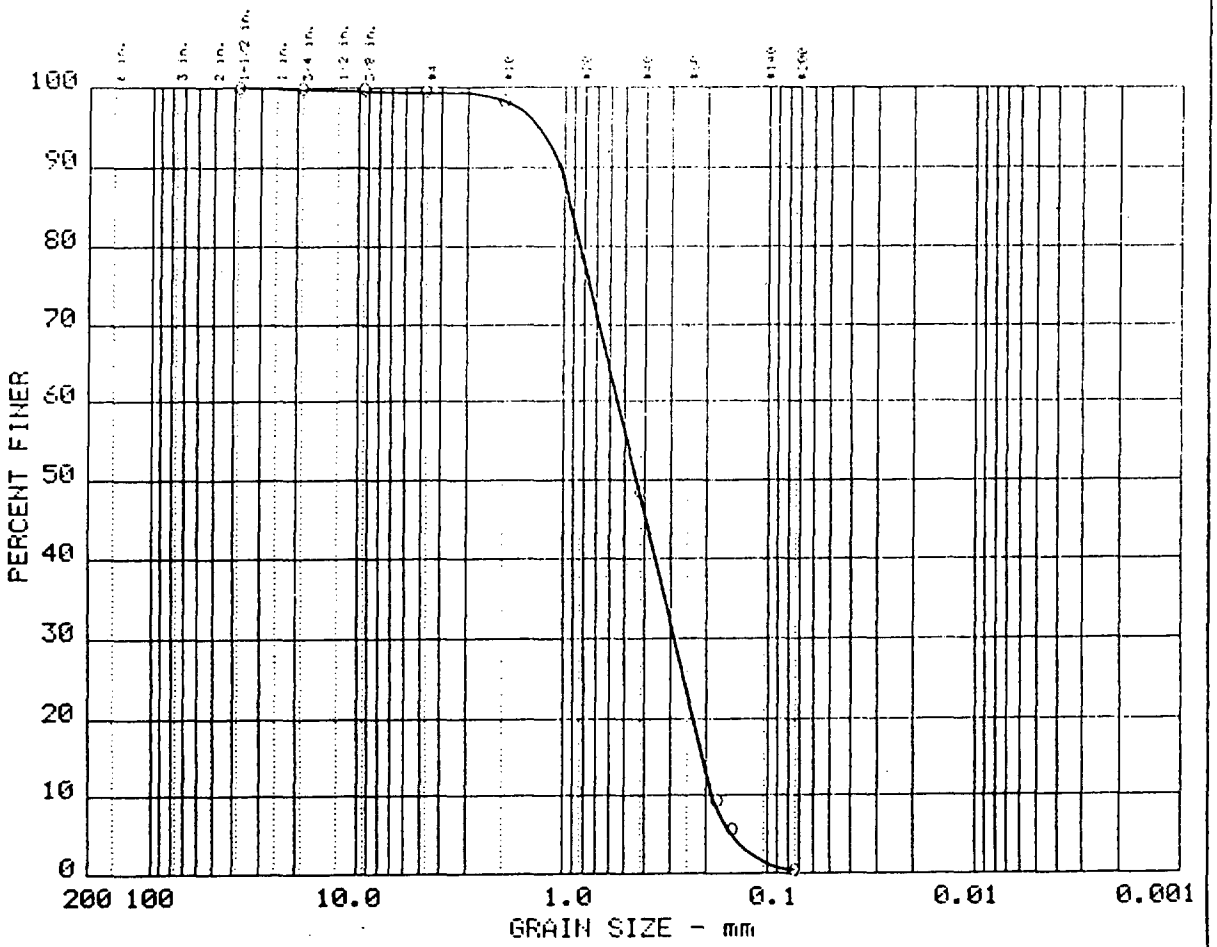
Mechanical Analysis Data

Initial
y sample and tare= 1318.80
re = 0.00
y sample weight = 1318.80
mple split on number 4 sieve
lit sample data:
Sample and tare = 500 Tare = 0 Sample weight = 500

eve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	6.00	0.00	99.5
# 4	12.00	0.00	98.6
# 10	11.40	0.00	96.4
# 40	245.10	0.00	48.0
# 80	222.20	0.00	4.2
# 100	7.80	0.00	2.7
# 200	12.10	0.00	0.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: DELAWARE BAY #9

Date: 10-29-1993

KLESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 9

ate: 10-29-1993
roject No.: 1153
roject: DELAWARE BAY SEDIMENT

Sample Data

ocation of Sample: DELAWARE BAY #9
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

Mechanical Analysis Data

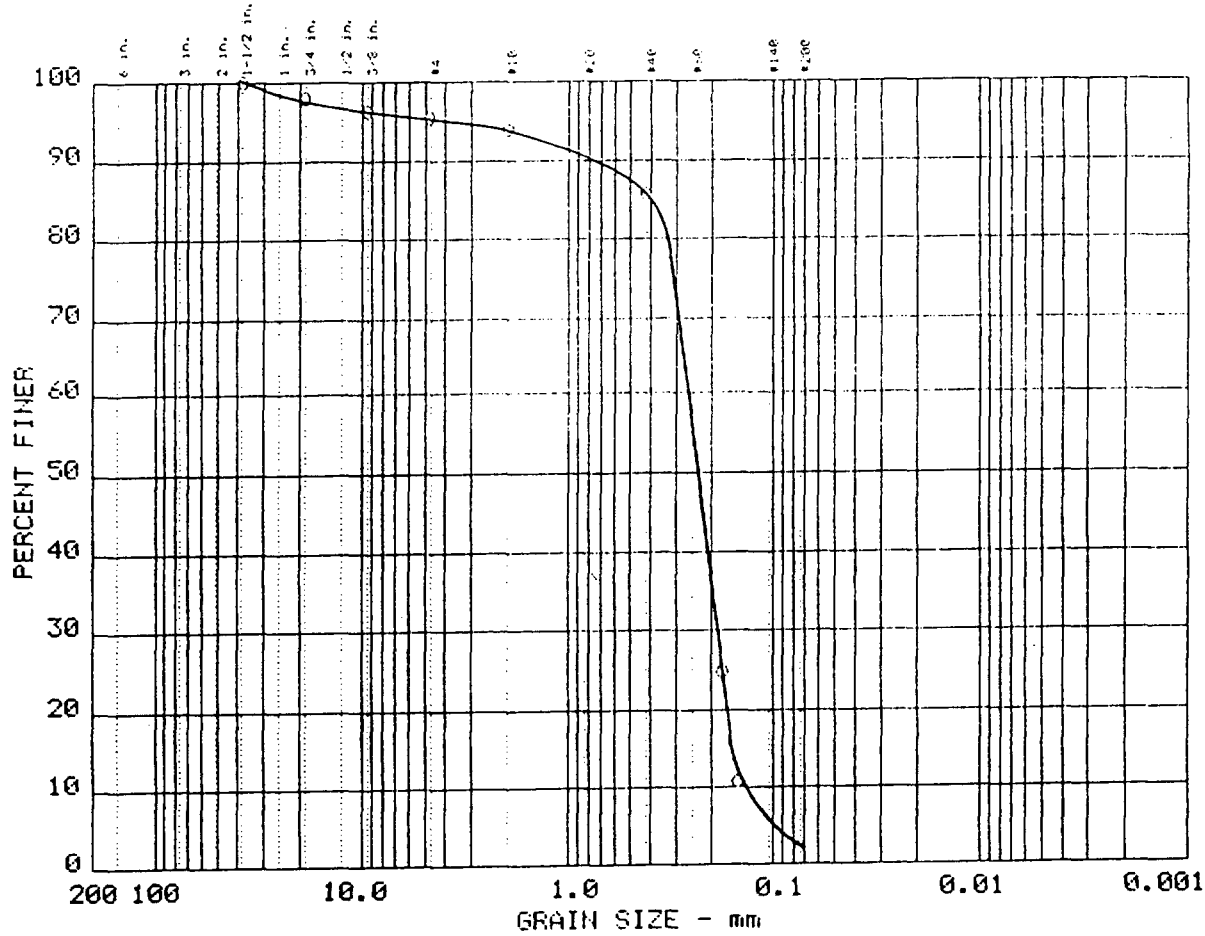
	Initial
ry sample and tare=	1476.40
are =	0.00
ry sample weight =	1476.40

ample split on number 4 sieve
plit sample data:
Sample and tare = 500 Tare = 0 Sample weight = 500

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	1.40	0.00	99.9
0.375 inches	0.90	0.00	99.8
# 4	4.40	0.00	99.5
# 10	6.60	0.00	98.2
# 40	249.50	0.00	48.6
# 80	197.00	0.00	9.3
# 100	18.80	0.00	5.6
# 200	25.90	0.00	0.4

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: DELAWARE BAY #10

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 10

ate: 10-29-1993
roject No.: 1153
roject: DELAWARE BAY SEDIMENT

Sample Data

ocation of Sample: DELAWARE BAY #10
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

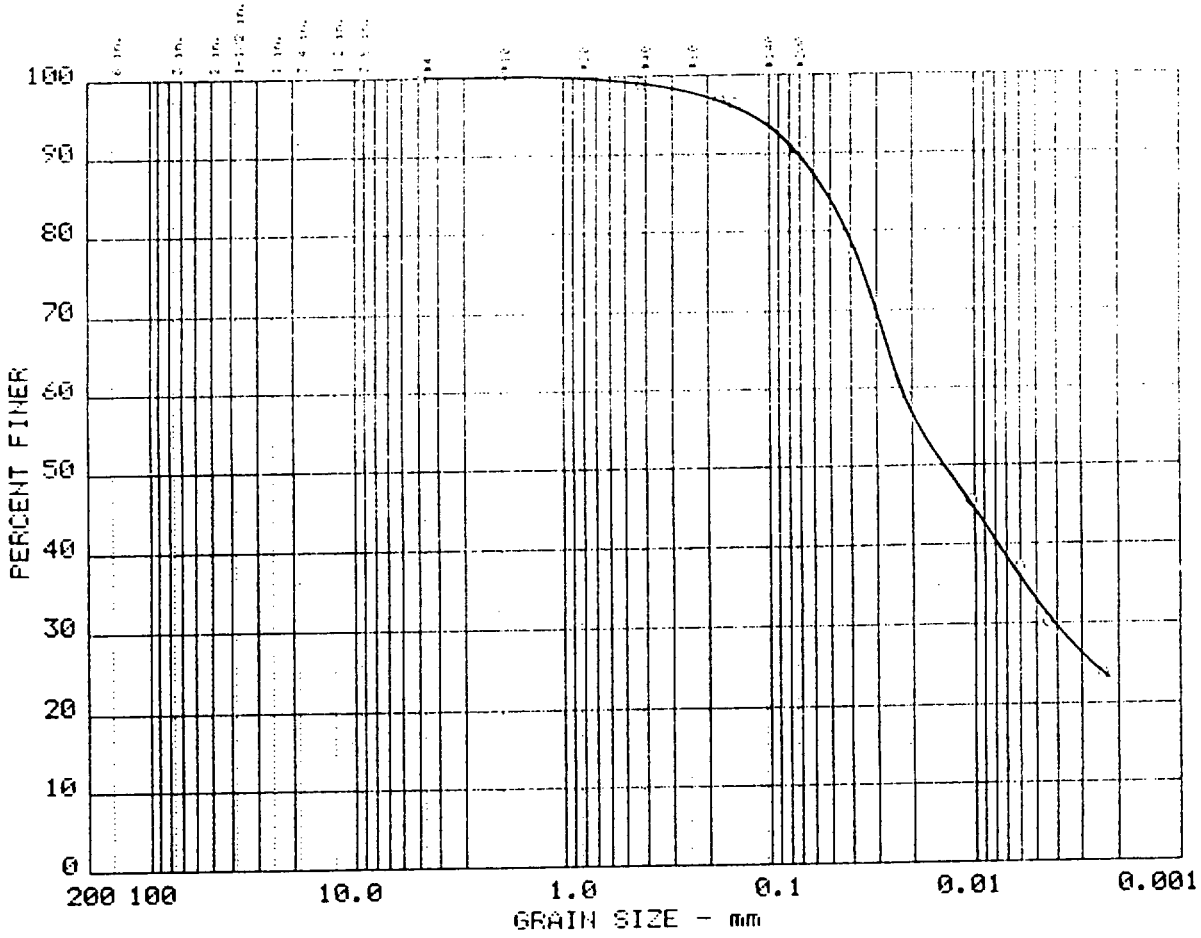
Mechanical Analysis Data

Initial
ry sample and tare= 903.60
are = 0.00
ry sample weight = 903.60
ample split on number 4 sieve
plit sample data:
Sample and tare = 250 Tare = 0 Sample weight = 250

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
1.5 inches	0.00	0.00	100.0
0.75 inches	17.50	0.00	98.1
0.375 inches	16.00	0.00	96.3
# 4	7.00	0.00	95.5
# 10	4.20	0.00	93.9
# 40	21.50	0.00	85.7
# 80	159.20	0.00	24.9
# 100	36.80	0.00	10.8
# 200	22.40	0.00	2.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

	MATERIAL DESCRIPTION	USCS	AASHTO
○			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: BENEFICIAL USE #1

Date: 11-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 2

Date: 11-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BENEFICIAL USE #1
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	60.00
Tare =	0.00
Dry sample weight =	60.00

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.00	0.00	100.0
# 40	0.65	0.00	98.9
# 80	1.30	0.00	96.8
# 100	0.36	0.00	96.2
# 200	3.25	0.00	90.7

Hydrometer Analysis Data

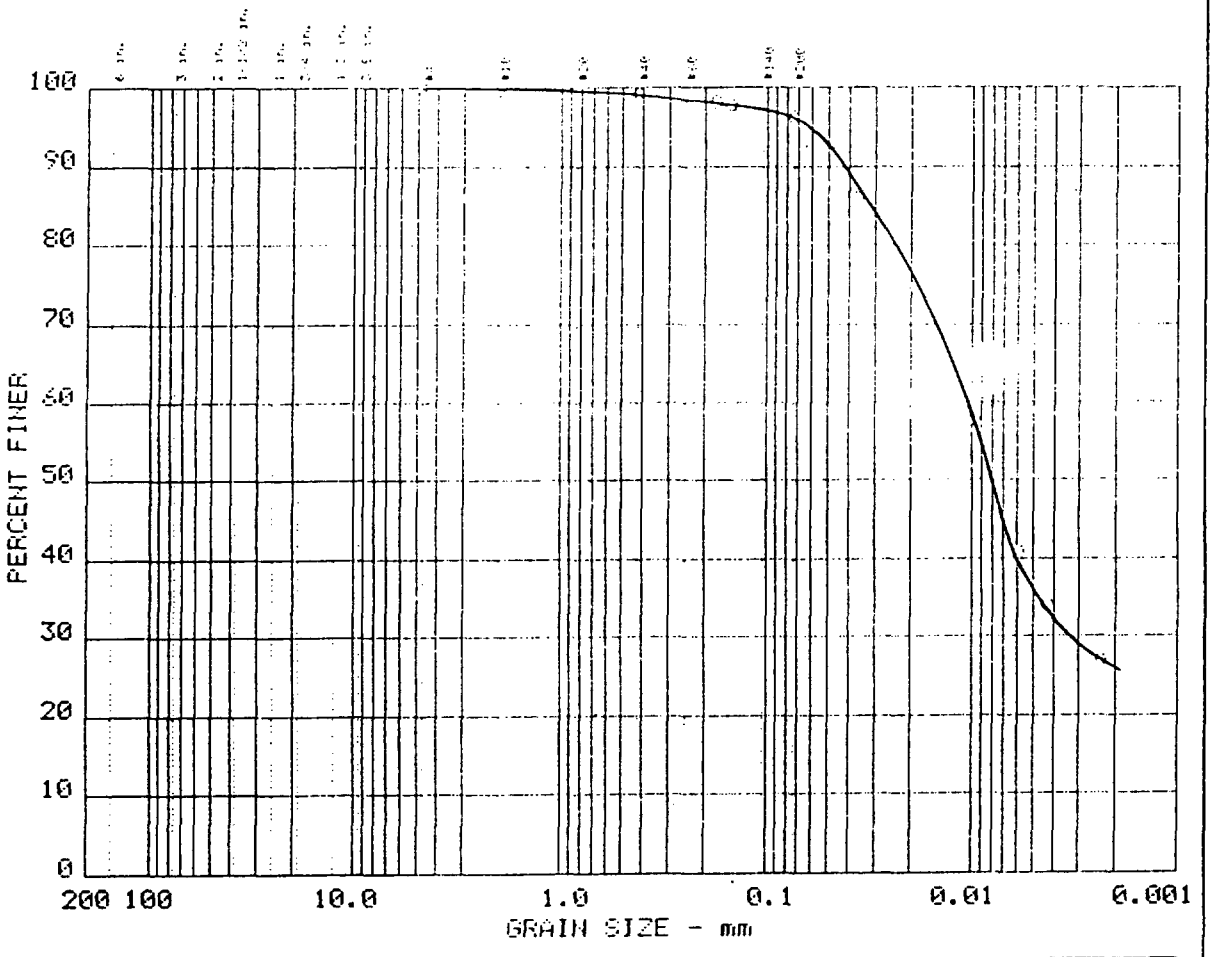
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	20.0	20.5
Comp. corr:	- 4.8	- 4.7

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.5	51.0	46.3	0.0136	51.0	7.9	0.0382	77.2
4.0	20.5	40.0	35.3	0.0136	40.0	9.7	0.0212	58.8
19.0	20.5	32.0	27.3	0.0136	32.0	11.0	0.0103	45.5
60.0	20.0	27.0	22.2	0.0136	27.0	11.9	0.0061	37.0
120.0	20.0	23.0	18.2	0.0136	23.0	12.5	0.0044	30.3
435.0	20.0	19.0	14.2	0.0136	19.0	13.2	0.0024	23.7

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BENEFICIAL USE #2

Date: 11-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 3

Date: 11-18-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BENEFICIAL USE #2
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.15	0.00	99.8
# 40	0.34	0.00	99.2
# 80	0.64	0.00	98.1
# 100	0.25	0.00	97.7
# 200	0.95	0.00	96.1

Hydrometer Analysis Data

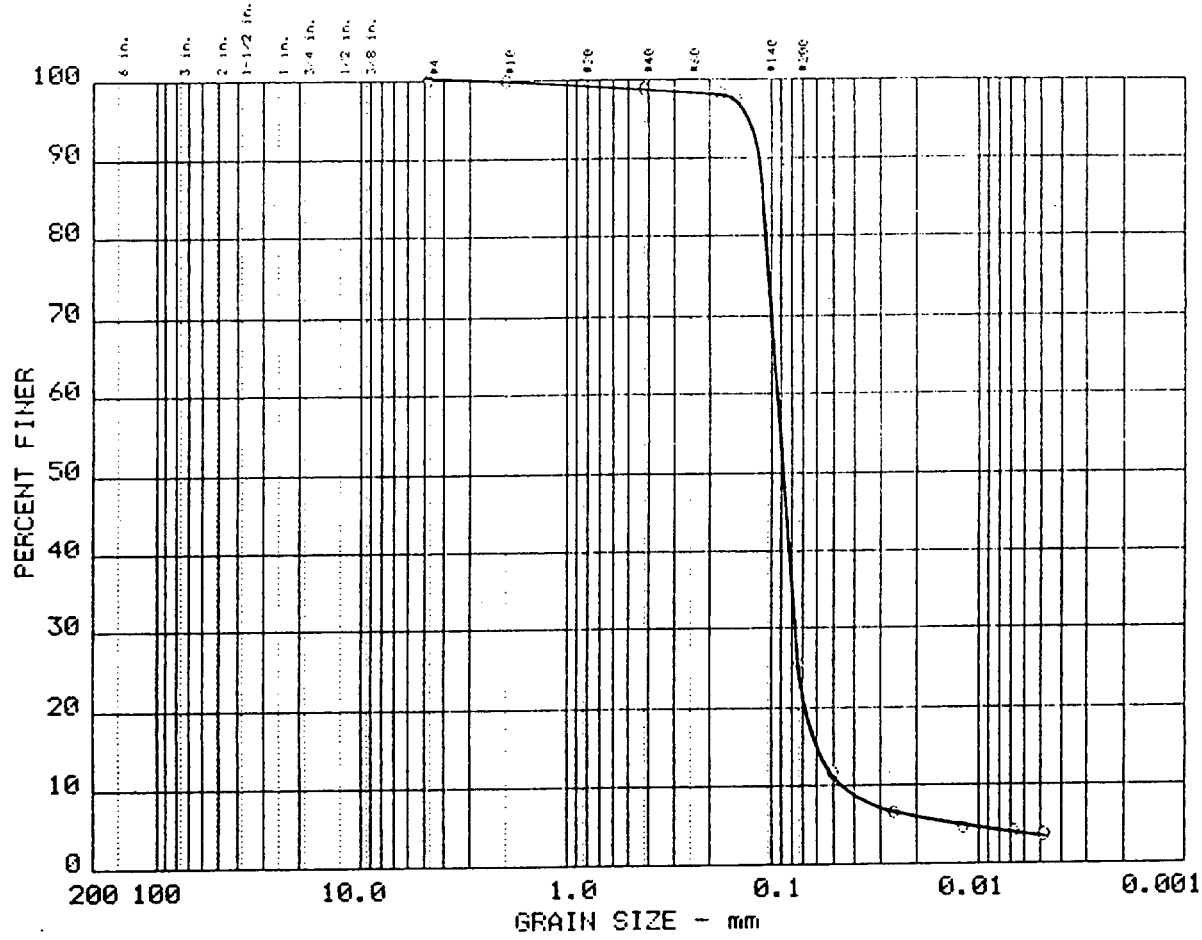
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	20.0	21.0	21.5	22.0
Comp. corr:	- 4.8	- 4.5	- 4.3	- 4.2

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	56.0	51.8	0.0133	56.0	7.1	0.0355	86.3
4.0	22.0	49.0	44.8	0.0133	49.0	8.3	0.0191	74.7
19.0	21.5	39.0	34.7	0.0134	39.0	9.9	0.0097	57.8
60.0	21.0	29.0	24.5	0.0135	29.0	11.5	0.0059	40.8
120.0	21.0	25.0	20.5	0.0135	25.0	12.2	0.0043	34.2
435.0	20.0	21.0	16.2	0.0136	21.0	12.9	0.0023	27.0

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: BENEFICIAL USE #3, BS-3, FR-28

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 11

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: BENEFICIAL USE #3, BS-3, FR-28
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 60.00
Tare = 0.00
Dry sample weight = 60.00
Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.05	0.00	99.9
# 40	0.66	0.00	98.8
# 80	0.38	0.00	98.2
# 100	0.36	0.00	97.6
# 200	43.24	0.00	25.5

Hydrometer Analysis Data

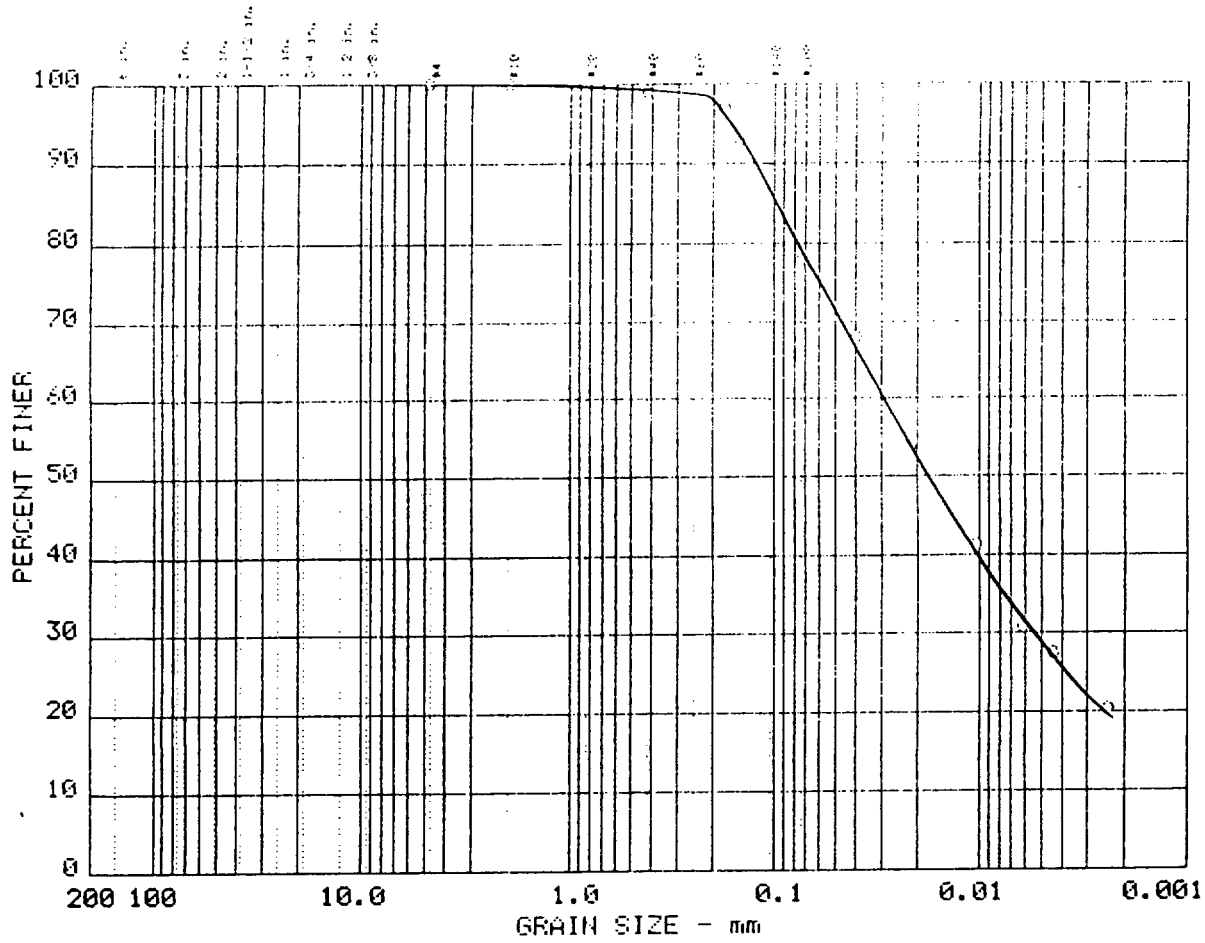
Separation sieve is number 4
Percent -# 4 based on complete sample= 100.0
Weight of hydrometer sample: 60
Calculated biased weight= 60.00
Table of composite correction values:

Temp, deg C:	20.0	21.0	22.0	22.5
Comp. corr:	- 4.8	- 4.5	- 4.2	- 4.0

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	11.0	7.0	0.0132	11.0	14.5	0.0504	11.7
4.0	22.5	8.0	4.0	0.0132	8.0	15.0	0.0256	6.7
19.0	22.0	7.0	2.8	0.0133	7.0	15.1	0.0119	4.7
60.0	21.0	7.0	2.5	0.0135	7.0	15.1	0.0068	4.2
120.0	20.0	7.0	2.2	0.0136	7.0	15.1	0.0048	3.7

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

	MATERIAL DESCRIPTION	USCS	AASHTO
○			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: BENEFICIAL USE #4

Date: 11-18-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 1

ate: 11-18-1993
roject No.: 1153
roject: DELAWARE BAY SEDIMENT

Sample Data

ocation of Sample: BENEFICIAL USE #4
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

ig. No.:

Mechanical Analysis Data

	Initial
ry sample and tare=	60.00
are =	0.00
ry sample weight =	60.00

ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.07	0.00	99.9
# 40	0.60	0.00	98.9
# 80	1.26	0.00	96.8
# 100	2.36	0.00	92.9
# 200	9.02	0.00	77.8

Hydrometer Analysis Data

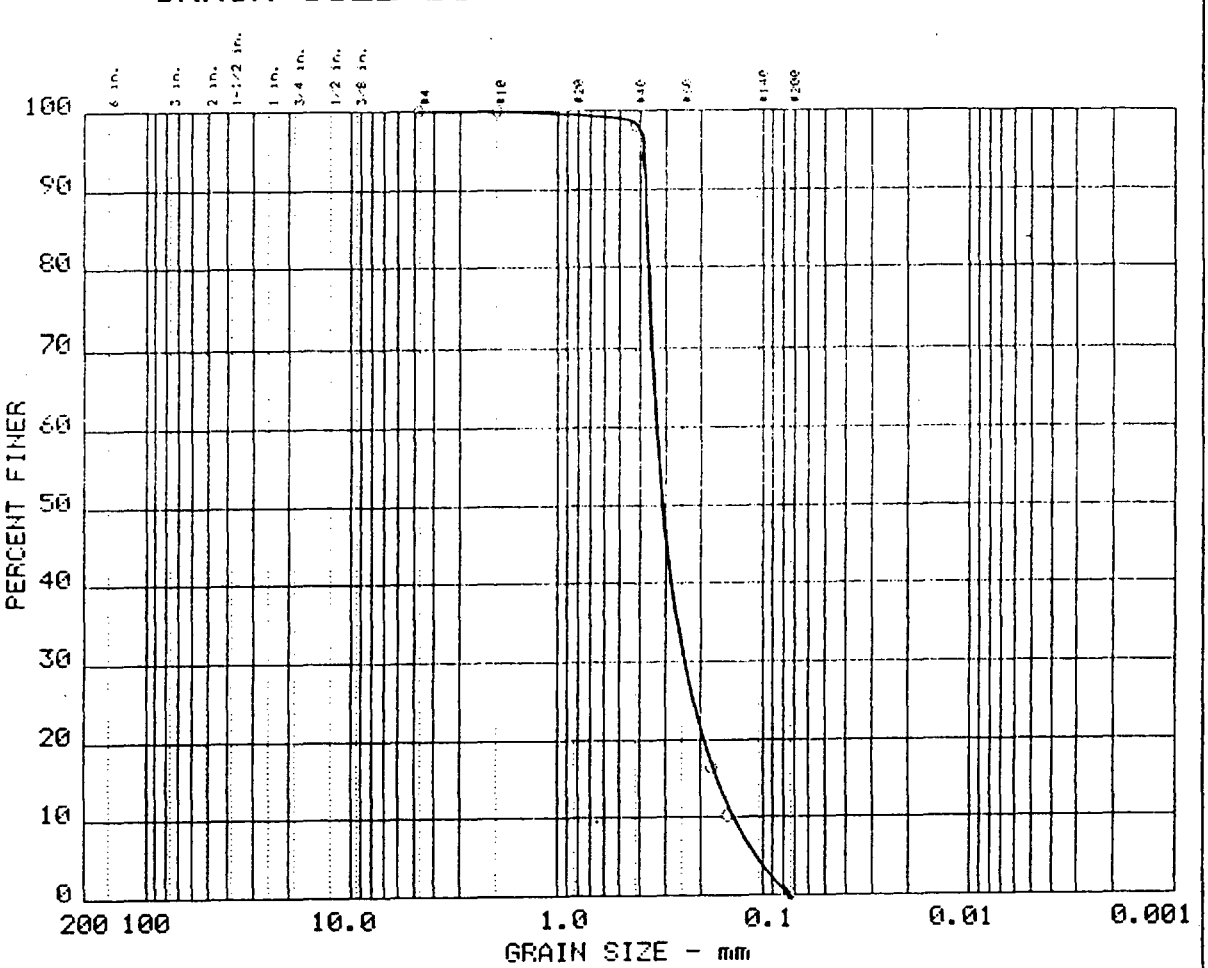
eparation sieve is number 4
ercent -# 4 based on complete sample= 100.0
eight of hydrometer sample: 60
alculated biased weight= 60.00
able of composite correction values:

Temp, deg C:	20.0	21.0	22.0
Comp. corr:	- 4.8	- 4.5	- 4.2

eniscus correction only= 0
pecific gravity of solids= 2.65
pecific gravity correction factor= 1.000
ydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	45.0	40.8	0.0133	45.0	8.9	0.0398	68.0
4.0	22.0	36.5	32.3	0.0133	36.5	10.3	0.0214	53.8
19.0	22.0	29.0	24.8	0.0133	29.0	11.5	0.0104	41.3
60.0	21.0	23.0	18.5	0.0135	23.0	12.5	0.0062	30.8
120.0	21.0	21.0	16.5	0.0135	21.0	12.9	0.0044	27.5
435.0	20.0	17.0	12.2	0.0136	17.0	13.5	0.0024	20.3

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
○					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										

MATERIAL DESCRIPTION	USCS	AASHTO
○		

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
○ Location: BENEFICIAL USE #5, BS-5

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA Test No.: 12

ate: 10-29-1993
roject No.: 1153
roject: DELAWARE BAY SEDIMENT

Sample Data

ocation of Sample: BENEFICIAL USE #5, BS-5
ample Description:
SCS Class: Liquid limit:
ASHTO Class: Plasticity index:

Notes

emarks:

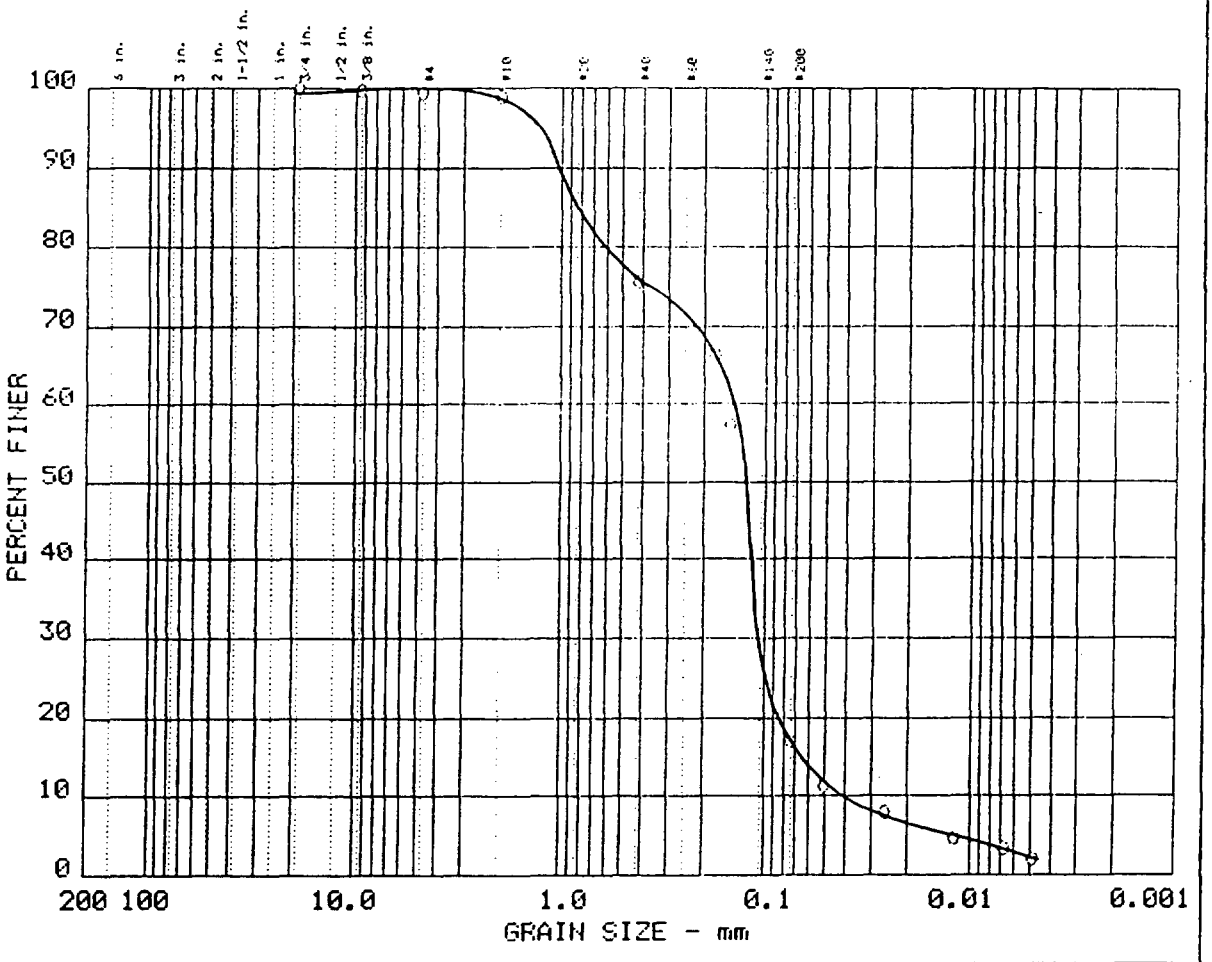
ig. No.:

Mechanical Analysis Data

Initial
ry sample and tare= 250.00
are = 0.00
ry sample weight = 250.00
ieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
# 4	0.00	0.00	100.0
# 10	0.00	0.00	100.0
# 40	4.90	0.00	98.0
# 80	204.30	0.00	16.3
# 100	15.10	0.00	10.3
# 200	25.20	0.00	0.2

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
O					

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O										

	MATERIAL DESCRIPTION	USCS	AASHTO
O			

Project No.: 1153
Project: DELAWARE BAY SEDIMENT
O Location: MS-19, BS-6

Date: 10-29-1993

LESNY & KITLINSKI ASSOCIATES

Remarks:

Figure No.

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 13

Date: 10-29-1993
Project No.: 1153
Project: DELAWARE BAY SEDIMENT

Sample Data

Location of Sample: MS-19, BS-6
Sample Description:
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 1587.00
Tare = 0.00
Dry sample weight = 1587.00
Sample split on number 4 sieve
Split sample data:
Sample and tare = 60 Tare = 0 Sample weight = 60

Sieve tare method

Sieve	Weight retained	Sieve tare	Percent finer
0.75 inches	0.00	0.00	100.0
0.375 inches	5.00	0.00	99.7
# 4	5.30	0.00	99.4
# 10	0.31	0.00	98.8
# 40	14.05	0.00	75.6
# 80	5.57	0.00	66.3
# 100	5.47	0.00	57.3
# 200	24.40	0.00	16.9

Hydrometer Analysis Data

Separation sieve is number 4
Percent -# 4 based on complete sample= 99.4
Weight of hydrometer sample: 60
Calculated biased weight= 60.39
Table of composite correction values:

Temp, deg C:	20.0	21.0	22.0
Comp. corr:	- 4.8	- 4.5	- 4.2

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000

Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	11.0	6.8	0.0133	11.0	14.5	0.0507	11.3
4.0	22.0	9.0	4.8	0.0133	9.0	14.8	0.0256	7.9
19.0	22.0	7.0	2.8	0.0133	7.0	15.1	0.0119	4.6
60.0	21.0	6.5	2.0	0.0135	6.5	15.2	0.0068	3.3
120.0	20.0	6.0	1.2	0.0136	6.0	15.3	0.0049	2.0

CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/20/93 at 12:30
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12693
Sample Description: BECKETT ST. TERMINAL

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	7000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	54 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

Twila E. Dixon
Laboratory Manager

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RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/20/93 at 13:27
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12694
Sample Description: RANGE M

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	7000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	45 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/20/93 at 14:19
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12695
Sample Description: BEND AF

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	4000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	56 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/20/93 at 15:53
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12696
Sample Description: W. HORSESHOE RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	580 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	78 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/21/93 at 14:40
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12700
Sample Description: BEND G

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	3100 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	56 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:
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Twila E. Dixon
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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/21/93 at 13:48
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12699
Sample Description: MIFFLIN RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	2000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	67 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/21/93 at 13:03
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12698
Sample Description: BEND H

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	8000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	55 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 09/21/93 at 12:15
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12697
Sample Description: BILLINGSPORT RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	5000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	81 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/26/93 at 15:15
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12691
Sample Description: BEND I

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	650 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	73 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/26/93 at 16:13
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12692
Sample Description: TINICUM

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	3800 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	59 %	10/15/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/26/93 at 13:16
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12690
Sample Description: BEND J

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	5000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	56 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/26/93 at 11:22
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12689
Sample Description: EDYYSTONE RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	540 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	93 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

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CERTIFICATE OF ANALYSIS

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Army Corps of Engineers
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/26/93 at 08:40
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12688
Sample Description: BEND K

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	3000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	60 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/25/93 at 13:30
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12687
Sample Description: BEND L

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	3000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	65 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/24/93 at 11:50
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12683
Sample Description: MARCUS HOOK

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	5000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	27 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/24/93 at 13:35
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12684
Sample Description: BEND M

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	4000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	41 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/25/93 at 10:10
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12686
Sample Description: BELLVUE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	5000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	56 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

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REPORT DESCRIPTION : 4710-11

Report No. : 933790
Sample Date: 08/25/93 at 09:02
Sampled By : RMK
Received : 10/08/93
Reported : 11/17/93
P.O. Number: N/A

RMC Number : 12685
Sample Description: BEND N

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	4000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	49 %	10/14/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
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REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/05/93 at 17:00
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15058
Sample Description: CHERRY IS. RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	2100 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	35 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

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REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/05/93 at 14:58
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15059
Sample Description: BEND O

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	4500 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	53 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

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REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/06/93 at 13:30
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15050
Sample Description: DEEPWATER RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	4800 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	35 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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Laboratory Manager

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CERTIFICATE OF ANALYSIS

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REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/06/93 at 11:29
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15053
Sample Description: BEND PQ

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	900 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	75 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/06/93 at 12:13
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15054
Sample Description: NEW CASTLE RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	3000 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	43 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:
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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/06/93 at 14:40
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15051
Sample Description: BEND R

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	5000 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	45 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
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REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/06/93 at 17:10
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15057
Sample Description: REEDY IS. RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	1200 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	70 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/06/93 at 16:10
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15055
Sample Description: BEND S

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	1400 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	67 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/07/93 at 11:40
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15056
Sample Description: BAKER RANGE

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	2600 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	48 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934524
Sample Date: 10/07/93 at 10:50
Sampled By : RMK
Received : 11/23/93
Reported : 12/06/93
P.O. Number: N/A

RMC Number : 15052
Sample Description: BEND T

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	1500 MG/KG	12/06/93	*	EPA 415.1
1	% SOLIDS (NO CHARGE-DRY WT CALC)	87 %	11/24/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/22/93 at 10:45
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13474
Sample Description: DEL BAY #1

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	4000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	42 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/22/93 at 12:45
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13475
Sample Description: DEL BAY #2

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	400 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	77 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/22/93 at 15:30
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13476
Sample Description: DEL BAY #3

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	230 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	79 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934189
Sample Date: 10/29/93 at 15:42
Sampled By : RMK
Received : 11/02/93
Reported : 11/18/93
P.O. Number: N/A

RMC Number : 13997
Sample Description: DEL BAY #4

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	900 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	74 %	11/15/93	*	EPA 160.3

* This analysis was subcontracted

Approved By:

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Army Corps of Engineers
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REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/19/93 at 13:00
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13477
Sample Description: DEL BAY #5

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	4000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	63 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/19/93 at 15:05
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13478
Sample Description: DEL BAY #6

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	1500 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	67 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934189
Sample Date: 10/29/93 at 12:28
Sampled By : RMK
Received : 11/02/93
Reported : 11/18/93
P.O. Number: N/A

RMC Number : 13998
Sample Description: DEL BAY #7

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	500 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	83 %	11/15/93	*	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934189
Sample Date: 10/29/93 at 10:45
Sampled By : RMK
Received : 11/02/93
Reported : 11/18/93
P.O. Number: N/A

RMC Number : 13999
Sample Description: DEL BAY #8

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	200 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	82 %	11/15/93	*	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/18/93 at 16:00
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13479
Sample Description: DEL BAY #9

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	330 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	79 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

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CERTIFICATE OF ANALYSIS

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REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/18/93 at 17:50
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13480
Sample Description: DEL BAY #10

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	1400 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	76 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934347
Sample Date: 11/08/93 at 11:10
Sampled By : RMK
Received : 11/11/93
Reported : 11/30/93
P.O. Number: N/A

RMC Number : 14524
Sample Description: BEN-USE #1

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	8000 MG/KG	11/22/93	*	EPA 9060

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-11

Report No. : 934347
Sample Date: 11/08/93 at 12:30
Sampled By : RMK
Received : 11/11/93
Reported : 11/30/93
P.O. Number: N/A

RMC Number : 14525
Sample Description: BEN-USE #2 (LC9)

Repl	Parameter	Result	Date Anl Completed	Analyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	8000 MG/KG	11/22/93	*	EPA 9060

* This analysis was subcontracted

Approved By:

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Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/20/93 at 13:52
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13481
Sample Description: BEN. SITE #3

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	3000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	66 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

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REPORT DESCRIPTION : 04710-11

Report No. : 934347
Sample Date: 11/09/93 at 12:10
Sampled By : RMK
Received : 11/11/93
Reported : 11/30/93
P.O. Number: N/A

RMC Number : 14526
Sample Description: BEN-USE #4

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	8000 MG/KG	11/22/93	*	EPA 9060

* This analysis was subcontracted

Approved By:
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Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/20/93 at 11:20
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13482
Sample Description: BEN. SITE #5

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	300 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	76 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CERTIFICATE OF ANALYSIS

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Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 4710-11

Report No. : 934031
Sample Date: 10/18/93 at 13:28
Sampled By : RMK
Received : 10/25/93
Reported : 11/17/93
P.O. Number: SPRING CITY

RMC Number : 13483
Sample Description: BEN. SITE #6

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	CARBON, TOTAL ORGANIC (SOLID)	3000 MG/KG	11/15/93	*	EPA 9060
1	% SOLIDS (NO CHARGE-DRY WT CALC)	56 %	10/28/93	LAC	EPA 160.3

* This analysis was subcontracted

Approved By:

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CHAIN OF CUSTODY

RMC Analytics
A Division of RMC Environmental Services, Inc.
88 Robinson Street
Pottstown, Pa. 19464
(215) 327-4850

Client: ACOE VIP #:
Address:
Phone: 215 948 - 4700 (133)
Samplers: RMC
Job No.: 04710/11

Lab Contact:
Sales Order No.:
P.O. Number:

Turnaround Time	Normal [ ]	Rush [ ]
Sample	Return to Client	[ ]
Disposal	Disposal by Lab	[ ]

RMC USE ONLY

No. Container/Size						3-liter							
Analysis Requested	**ORGANICS**							**INORGANICS**					

RMC only Lab ID	Sample Identification	Matrix Code *	Sample Date	Sample Time	VOA	BNA	Pest/ PCB	Herb		TOC		Metals	Cn	NH3	Wet Chem		
	BECKETT ST. TERMINAL	SE	9/20/93	1230						X							
	RANGE M	SE	9/20/93	1327						X							
	BEND AF	SE	9/20/93	1419						X							
	W. HORSE RANGE	SE	9/20/93	1553						X							
	BILLINGSPORT RANGE	SE	9/21/93	1215						X							
	BEND H	SE	9/21/93	1303						X							
	MIFFLIN RANGE	SE	9/21/93	1348						X							
	BEND G	SE	9/21/93	1440						X							

Potential Hazard Identification:
Non-Hazard [ ] Flammable [ ] Unknown [ ]
Skin-irritant [ ] Poison [ ]

QA/QC Reporting Requirements (Circle one)
None Standard Tier II CLP
Other (specify):

* Matrix Codes:

S - soil	WW - waste water
SE - sediment	PW - potable water
SO - solid	SW - surface water
WS - solid waste	GW - ground water
DS - drum solids	DL - drum liquids
SL - sludge	ST - stormwater
O - oil	A - air
WI - wipe	F - fish
BI - biological	X - other

Relinquished By:	Received By:	Time:	Date:	Relinquished By:	Received By:	Time:	Date:
Daniel Jopp	L. Ulrich	1420	10/6/93				

Special Instructions: SAVE SAMPLES FOR FUTURE ANALYSIS
CALL - R. KING

RMC Use Only

Samples were:
1. Shipped or Hand-delivered
Notes:
2. Chilled or Ambient
Notes:
3. Received broken/leaking: Yes (No)
4. Properly preserved: Yes N/P No
5. Received within holding times: Yes No

COC Tape Was:
1. Present on outer package: Yes (No)
2. Unbroken on outer package: Yes No
3. Present on sample: Yes (No)
4. Unbroken on sample: Yes No
5. Discrepancies between sample labels and COC record? Yes No

CHAIN OF CUSTODY

RMC Analytics

A Division of RMC Environmental Services, Inc.
88 Robinson Street
Pottstown, Pa. 19464
(215) 327-4850

CHAIN OF CUSTODY

Client: ACOE VIP #:
Address:
Phone: 215 948-4700 (133)
Samplers: RMK
Job No.: 4710/11

Lab Contact:
Sales Order No.:
P.O. Number:

Turnaround Time	Normal [X]	Rush [ ]
Sample Disposal	Return to Client [ ]	Disposal by Lab [ ]

RMC USE ONLY

No. Container/Size: 1/2 gal or liters

RMC only Lab ID	Sample Identification	Matrix Code *	Sample Date	Sample Time	VOA	BNA	Pest/PCB	Herb		TOC		Metals	Cn	NH3	Wet Chem		
	MARCUS HOOK	SE	8/24/93	1150						X							
	BEND M	SE	8/24/93	1335						X							
	BEND N	SE	8/25/93	0902						X							
	BELLVUE	SE	8/25/93	1010						X							
	BEND L	SE	8/25/93	1330						X							
	BEND K	SE	8/26/93	0840						X							
	EDDYSTONE RANGE	SE	8/26/93	1122						X							
	BEND J	SE	8/26/93	1316						X							
	BEND I	SE	8/26/93	1515						X							
	TINICUM	SE	8/26/93	1613						X							

(Analysis Requested: ORGANICS — VOA, BNA, Pest/PCB, Herb, TOC; INORGANICS — Metals, Cn, NH3, Wet Chem)

Potential Hazard Identification:
Non-Hazard [ ] Flammable [ ] Unknown [ ]
Skin-irritant [ ] Poison [ ]

QA/QC Reporting Requirements (Circle one)
None Standard Tier II CLP
Other (specify):

Relinquished By:	Received By:	Time:	Date:	Relinquished By:	Received By:	Time:	Date:
Daniel [illegible]	L. Dietrich	1420	10/8/93				

Special Instructions: SAVE SAMPLES FOR FUTURE ANALYSIS — CALL RMK/CLING

* Matrix Codes:
S - soil; WW - waste water
SE - sediment; PW - potable water
SO - solid; SW - surface water
WS - solid waste; GW - ground water
DS - drum solids; DL - drum liquids
SL - sludge; ST - stormwater
O - oil; A - air
WI - wipe; F - fish
BI - biological; X - other

RMC Use Only

Samples were:
1. Shipped or Hand-delivered (circled: Hand-delivered) Notes:
2. Chilled or Ambient (circled: Chilled) Notes:
3. Received broken/leaking Yes No (circled: No)
4. Properly preserved Yes N/A No
5. Received within holding times Yes (marked) No

COC Tape Was:
1. Present on outer package Yes No (circled: No)
2. Unbroken on outer package Yes No
3. Present on sample Yes No (circled: No)
4. Unbroken on sample Yes No
5. Discrepancies between sample labels and COC record? Yes No (circled: No)

CHAIN OF CUSTODY

CHAIN OF CUSTODY

RMC Analytics
A Division of RMC Environmental Services, Inc.
88 Robinson Street
Pottstown, Pa. 19464
(215) 327-4850

Client: ACOE/RMC RICH KLING
VIP #:
Address:
Phone: 215-948-4700 (133)
Samplers: RMK
Job No.: 4710/11

Lab Contact:
Sales Order No.:
P.O. Number:

RMC USE ONLY

Turnaround Time	Normal [X]	Rush [ ]
Sample	Return to Client [ ]	
Disposal	Disposal by Lab [ ]	

No. Container/Size: 1/2 GAL OR 2 LITERS

RMC only Lab ID	Sample Identification	Matrix Code *	Sample Date	Sample Time	ORGANICS: VOA	BNA	Pest/PCB	Herb		TOC		INORGANICS: Metals	Cn	NH3	Wet Chem			
	DEEPWATER RANGE	SE	10-6-93	13:30						X								
	BEND R	SE	10-6-93	14:40						X								
	BEND T	SE	10-7-93	10:50						X								
	BEND PQ	SE	10-6-93	11:29						X								
	NEW CASTLE RANGE	SE	10-6-93	12:13						X								
	BEND S	SE	10-6-93	16:10						X								
	BAKER RANGE	SE	10-7-93	11:40						X								
	REEDY IS. RANGE	SE	10-6-93	17:10						X								
	CHERRY IS RANGE	SE	10/5/93	17:00						X								
	BEND O	SE	10/5/93	14:58						X								

Potential Hazard Identification:
Non-Hazard [X] Flammable [ ] Unknown [ ]
Skin-irritant [ ] Poison [ ]

QA/QC Reporting Requirements (Circle one)
None Standard Tier II CLP
Other (specify):

* Matrix Codes:

S - soil	WW - waste water
SE - sediment	PW - potable water
SO - solid	SW - surface water
WS - solid waste	GW - ground water
DS - drum solids	DL - drum liquids
SL - sludge	ST - stormwater
O - oil	A - air
WI - wipe	F - fish
BI - biological	X - other

Relinquished By:	Received By:	Time:	Date:	Relinquished By:	Received By:	Time:	Date:
[signature]	[signature]	1015	11/23/93				

Special Instructions: SAVE SAMPLES FOR POSSIBLE KE ANALYSIS

RMC Use Only

Samples were:
1. Shipped or Hand-delivered (circled: Hand-delivered)
Notes:
2. Chilled or Ambient (circled: Chilled)
Notes:
3. Received broken/leaking Yes No (circled: No)
4. Properly preserved Yes No — NP
5. Received within holding times Yes No

COC Tape Was:
1. Present on outer package Yes No
2. Unbroken on outer package Yes No
3. Present on sample Yes No
4. Unbroken on sample Yes No
5. Discrepancies between sample labels and COC record? Yes No

CHAIN OF CUSTODY

CHAIN OF CUSTODY

RMC Analytics
A Division of RMC Environmental Services, Inc.
88 Robinson Street
Pottstown, Pa. 19464
(215) 327-4850

Client: ACOE VIP #:
Address:
Phone: 948-4700
Samplers: RMK DRJ
Job No.: 04710/11

Lab Contact:
Sales Order No.:
P.O. Number:

Turnaround Time	Normal [ ]	Rush [ ]
Sample	Return to Client	[ ]
Disposal	Disposal by Lab	[ ]

RMC USE ONLY

No. Container/Size: (2) 1 L

RMC only Lab ID	Sample Identification	Matrix Code *	Sample Date	Sample Time	ORGANICS: VOA	BNA	Pest/PCB	Herb		TOC		INORGANICS: Metals	Cn	NH3	Wet Chem			
	BEN-USE #1	SE	11-5-93	11:10						X								
	BEN-USE #2 (LC9)	SE	11-5-93	12:30						X								
	BEN-USE #4	SE	11-5-93	12:10						X								
		~~SE~~								X								
		~~SE~~								X								
		~~SE~~								X								

Potential Hazard Identification:
Non-Hazard [X] Flammable [ ] Unknown [ ]
Skin-irritant [ ] Poison [ ]

QA/QC Reporting Requirements (Circle one)
None Standard Tier II CLP
Other (specify):

Relinquished By:	Received By:	Time:	Date:	Relinquished By:	Received By:	Time:	Date:
Daniel Jopp	T Ustrich	1126	11/11/93				

Special Instructions:

* Matrix Codes:

S - soil	WW - waste water
SE - sediment	PW - potable water
SO - solid	SW - surface water
WS - solid waste	GW - ground water
DS - drum solids	DL - drum liquids
SL - sludge	ST - stormwater
O - oil	A - air
WI - wipe	F - fish
BI - biological	X - other

RMC Use Only

Samples were:
1. Shipped or Hand-delivered — Notes:
2. Chilled or Ambient — Notes:
3. Received broken/leaking: Yes / No
4. Properly preserved: Yes / No
5. Received within holding times: Yes / No

COC Tape Was:
1. Present on outer package: Yes / No
2. Unbroken on outer package: Yes / No
3. Present on sample: Yes / No
4. Unbroken on sample: Yes / No
5. Discrepancies between sample labels and COC record? Yes / No

CHAIN OF CUSTODY

CHAIN OF CUSTODY

RMC Analytics
A Division of RMC Environmental Services, Inc.
88 Robinson Street
Pottstown, Pa. 19464
(215) 327-4850

ACOC

Client: RMC - Rich Kling VIP #:
Address: SPRING CITY PA
Phone: 948-4700 (133)
Samplers: RMK, DRJ
Job No.: 04710/11

Lab Contact:
Sales Order No.:
P.O. Number:

Turnaround Time	Normal [✓]	Rush [ ]
Sample	Return to Client	[ ]
Disposal	Disposal by Lab	[x]

RMC USE ONLY

No. Container/Size: (2) 1 liter JARS

RMC only Lab ID	Sample Identification	Matrix Code *	Sample Date	Sample Time	ORGANICS: VOA	BNA	Pest/PCB	Herb		TOC		INORGANICS: Metals	Cn	NH3	Wet Chem			
	DEL BAY #4	SE	10/29/93	1542						✓								
	[illegible]	SE	[illegible]							✓								
	DEL BAY #7	SE	10/29/93	1228						✓								
	[illegible]	SE	[illegible]							✓								
	DEL BAY #8	SE	10/29/93	1045						✓								
	[illegible]	SE	[illegible]							✓								

Potential Hazard Identification:
Non-Hazard [ ] Flammable [ ] Unknown [ ]
Skin-irritant [ ] Poison [ ]

QA/QC Reporting Requirements (Circle one)
None Standard Tier II CLP
Other (specify):

Relinquished By:	Received By:	Time:	Date:	Relinquished By:	Received By:	Time:	Date:
Daniel Jopp	[illegible]	1522	11/2/93				

Special Instructions: SAVE EXCESS FOR POSSIBLE FUTURE ANALYSIS

* Matrix Codes:

S - soil	WW- waste water
SE - sediment	PW - potable water
SO - solid	SW - surface water
WS - solid waste	GW - ground water
DS - drum solids	DL - drum liquids
SL - sludge	ST - stormwater
O - oil	A - air
WI - wipe	F - fish
BI - biological	X - other

RMC Use Only

Samples were:
1. Shipped or Hand-delivered Notes:
2. Chilled or Ambient Notes:
3. Received broken/leaking Yes No
4. Properly preserved Yes No
5. Received within holding times Yes No

COC Tape Was:
1. Present on outer package Yes No
2. Unbroken on outer package Yes No
3. Present on sample Yes No
4. Unbroken on sample Yes No
5. Discrepancies between sample labels and COC record? Yes No

CHAIN OF CUSTODY

CHAIN OF CUSTODY

RMC Analytics
A Division of RMC Environmental Services, Inc.
88 Robinson Street
Pottstown, Pa. 19464
(215) 327-4850

Client: ACOE VIP #:
Address:
Phone: 215 - 948 - 4700 (133)
Samplers: RMK
Job No.: 4710 / 11

Lab Contact: Rich Kling
Sales Order No.:
P.O. Number:

Turnaround Time	Normal [X]	Rush [ ]
Sample	Return to Client	[ ]
Disposal	Disposal by Lab	[ ]

RMC USE ONLY

No. Container/Size: (2) 1 liter jars
Analysis Requested: ORGANICS / INORGANICS

RMC only Lab ID	Sample Identification	Matrix Code*	Sample Date	Sample Time	VOA	BNA	Pest/PCB	Herb		TOC		Metals	Cn	NH3	Wet Chem		
	DEL BAY #1	SE	10/22/93	10:45						X							
	DEL BAY #2	SE	10/22/93	12:45						X							
	DEL BAY #3	SE	10/22/93	15:30						X							
	DEL BAY #5	SE	10/19/93	13:00						X							
	DEL BAY #6	SE	10/19/93	15:05						X							
	DEL BAY #9	SE	10/18/93	16:00						X							
	DEL BAY #10	SE	10/18/93	17:50						X							
	BEN. SITE #3	SE	10/20/93	13:52						X							
	BEN. SITE #5	SE	10/20/93	11:20						X							
	BEN SITE #6	SE	10/18/93	13:28						X							

Potential Hazard Identification:
Non-Hazard [X] Flammable [ ] Unknown [ ]
Skin-irritant [ ] Poison [ ]

QA/QC Reporting Requirements (Circle one)
None Standard Tier II CLP
Other (specify):

Relinquished By:	Received By:	Time:	Date:	Relinquished By:	Received By:	Time:	Date:
[signature]	[signature]	1355	10/26/93				

Special Instructions:

* Matrix Codes:

S - soil	WW - waste water
SE - sediment	PW - potable water
SO - solid	SW - surface water
WS - solid waste	GW - ground water
DS - drum solids	DL - drum liquids
SL - sludge	ST - stormwater
O - oil	A - air
WI - wipe	F - fish
BI - biological	X - other

RMC Use Only

Samples were:
1. Shipped or Hand-delivered (circled) — Notes:
2. Chilled or Ambient (circled) — Notes:
3. Received broken/leaking — Yes No (circled)
4. Properly preserved — Yes (marked) No
5. Received within holding times — Yes No

COC Tape Was:
1. Present on outer package — Yes No (circled)
2. Unbroken on outer package — Yes No (circled)
3. Present on sample — Yes No (circled)
4. Unbroken on sample — Yes No (circled)
5. Discrepancies between sample labels and COC record? — Yes No (circled)

CHAIN OF CUSTODY

SUMMARY OF BIOASSAY RESULTS

WATER COLUMN BIOASSAY RESULTS - FRESHWATER SAMPLE LOCATIONS

Sample: Beckett Street Terminal

Delaware River — Date whole sediment sample taken: 9/20/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Range M

Delaware River — Date whole sediment sample taken: 9/20/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend AF

Delaware River — Date whole sediment sample taken: 9/20/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: West Horseshoe Range

Delaware River — Date whole sediment sample taken: 9/20/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend G

Delaware River — Date whole sediment sample taken: 9/21/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Mifflin Range

Delaware River — Date whole sediment sample taken: 9/21/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend H

Delaware River — Date whole sediment sample taken: 9/21/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Billingsport Range

Delaware River — Date whole sediment sample taken: 9/21/93
Date Mifflin Range water sample taken: 9/20/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend I

Delaware River — Date whole sediment sample taken: 8/26/93
Date Chester Range water sample taken: 8/26/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Tinicum Range

Delaware River — Date whole sediment sample taken: 8/26/93
Date Chester Range water sample taken: 8/26/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend J

Delaware River — Date whole sediment sample taken: 8/26/93
Date Chester Range water sample taken: 8/26/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Eddystone Range

Delaware River — Date whole sediment sample taken: 8/26/93
Date Chester Range water sample taken: 8/26/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend K

Delaware River — Date whole sediment sample taken: 8/26/93
Date Chester Range water sample taken: 8/26/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Chester Range

Delaware River — Date whole sediment sample taken: No sample
Date Chester Range water sample taken: 8/26/93

Sample: Bend L

Delaware River — Date whole sediment sample taken: 8/25/93
Date Chester Range water sample taken: 8/26/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Marcus Hook Range

Delaware River — Date whole sediment sample taken: 8/24/93
Date Bellevue Range water sample taken: 8/25/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend M

Delaware River — Date whole sediment sample taken: 8/24/93
Date Bellevue Range water sample taken: 8/25/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bellevue Range

Delaware River — Date whole sediment sample taken: 8/25/93
Date Bellevue Range water sample taken: 8/25/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend N

Delaware River — Date whole sediment sample taken: 8/25/93
Date Bellevue Range water sample taken: 8/25/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Cherry Island Range

Delaware River — Date whole sediment sample taken: 10/05/93
Date Deepwater Range water sample taken: 10/05/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend O

Delaware River — Date whole sediment sample taken: 10/05/93
Date Deepwater Range water sample taken: 10/05/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Deepwater Point Range

Delaware River — Date whole sediment sample taken: 10/06/93
Date Deepwater Range water sample taken: 10/05/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend PQ

Delaware River — Date whole sediment sample taken: 10/06/93
Date Deepwater Range water sample taken: 10/05/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: New Castle Range

Delaware River — Date whole sediment sample taken: 10/06/93
Date Deepwater Range water sample taken: 10/05/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend R

Delaware River — Date whole sediment sample taken: 10/06/93
Date Deepwater Range water sample taken: 10/05/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Reedy Island Range

Delaware River — Date whole sediment sample taken: 10/06/93
Date Baker Range water sample taken: 10/07/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend S

Delaware River — Date whole sediment sample taken: 10/06/93
Date Baker Range water sample taken: 10/07/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Baker Range

Delaware River — Date whole sediment sample taken: 10/07/93
Date Baker Range water sample taken: 10/07/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Bend T

Delaware River — Date whole sediment sample taken: 10/07/93
Date Baker Range water sample taken: 10/07/93

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

REFERENCE TOXICANT

1) Fathead Minnow (Pimephales promelas)

48 hr LC_{50} = 1,237 mg/L KCl

2) Water flea (Ceriodaphnia sp.)

48 hr LC_{50} = 273.2 mg/L $CuSO_4$

3) Amphipod (Hyalella azteca)

48 hr LC_{50} = 223.7 mg/L Kcl

WATER COLUMN BIOASSAY RESULTS - ESTUARINE SAMPLE LOCATIONS

Sample: Delaware Bay #1

Delaware Bay — Date whole sediment sample taken: 10/22/93
Date Baker Range water sample taken: 10/07/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in river water control = 100%

Sample: Delaware Bay #2

Delaware Bay — Date whole sediment sample taken: 10/22/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #3

Delaware Bay — Date whole sediment sample taken: 10/22/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #4

Delaware Bay — Date whole sediment sample taken: 10/29/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #5

Delaware Bay — Date whole sediment sample taken: 10/19/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #6

Delaware Bay — Date whole sediment sample taken: 10/19/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #7

Delaware Bay — Date whole sediment sample taken: 10/29/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #8

Delaware Bay — Date whole sediment sample taken: 10/29/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #9

Delaware Bay — Date whole sediment sample taken: 10/18/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

Sample: Delaware Bay #10

Delaware Bay — Date whole sediment sample taken: 10/18/93
Date Miah Maull Range water sample taken: 10/19/93

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = >100%
% survival in lab water control = 100%
% survival in bay water control = 100%

REFERENCE TOXICANT

1) Sheepshead Minnow (Cyprinodon variegatus)

48 hr LC_{50} = 1,175 mg/L Kcl

2) American Oyster (Crassostrea virginica)

48 hr LC_{50} = 138.9 mg/L $CuSO_4$

3) Mysid Shrimp (Mysidopsis sp.)

48 hr LC_{50} = 425.3 mg/L Kcl

WHOLE SEDIMENT BIOASSAY RESULTS - ESTUARINE SAMPLE LOCATIONS

Sample: Delaware Bay #1

Delaware Bay

Date whole sediment sample taken: 10/22/93
Date Baker Range water sample taken: 10/07/93
Date Beneficial Use Site #2 sample taken: 11/08/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #2

Delaware Bay

Date whole sediment sample taken: 10/22/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #1 sample taken: 11/08/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #3

Delaware Bay

Date whole sediment sample taken: 10/22/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #2 sample taken: 11/08/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #4

Delaware Bay

Date whole sediment sample taken: 10/29/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #3 sample taken: 10/20/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #5

Delaware Bay

Date whole sediment sample taken: 10/19/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #3 sample taken: 10/20/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #6

Delaware Bay

Date whole sediment sample taken: 10/19/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #5 sample taken: 10/20/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #7

Delaware Bay

Date whole sediment sample taken: 10/29/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #4 sample taken: 11/09/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #8

Delaware Bay

Date whole sediment sample taken: 10/29/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #5 sample taken: 10/20/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #9

Delaware Bay — Date whole sediment sample taken: 10/18/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #6 sample taken: 10/18/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

Sample: Delaware Bay #10

Delaware Bay — Date whole sediment sample taken: 10/18/93
Date Miah Maull Range water sample taken: 10/19/93
Date Beneficial Use Site #6 sample taken: 10/18/93

1) Ampelisca sp.

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

2) Nereis virens

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

3) Mercenaria mercenaria

10 day % survival = 100%
% survival in control sediment = 100%
% survival in reference sediment = 100%

REFERENCE TOXICANT

Ampelisca sp.	-	48 hr LC_{50} = 654.4 mg/L KCl
Nereis virens	-	48 hr LC_{50} = 1,073.5 mg/L KCl
Mercenaria mercenaria	-	48 hr LC_{50} = 827.8 mg/L KCl

BIOACCUMULATION TEST RESULTS

Sample: Delaware Bay #1

Date whole sediment sample taken: 10/22/93
Date Beneficial Use Site #2 sample taken: 11/08/93
Percent silt and clay: 97.2%
Analytical results summarized in Table 18.

Sample: Delaware Bay #4

Date whole sediment sample taken: 10/29/93
Date Beneficial Use Site #3 sample taken: 10/20/93
Percent silt and clay: 8.9%
Analytical results summarized in Table 18.

Sample: Delaware Bay #5

Date whole sediment sample taken: 10/19/93
Date Beneficial Use Site #3 sample taken: 10/20/93
Percent silt and clay: 59.9%
Analytical results summarized in Table 18.

Sample: Delaware Bay #6

Date whole sediment sample taken: 10/19/93
Date Beneficial Use Site #5 sample taken: 10/20/93
Percent silt and clay: 5.1%
Analytical results summarized in Table 18.

Sample: Delaware Bay #10

Date whole sediment sample taken: 10/18/93
Date Beneficial Use Site #6 sample taken: 10/18/93
Percent silt and clay: 2.3%
Analytical results summarized in Table 18.

REFERENCE TOXICANT

(1) Mercenaria mercenaria

48 hr LC_{50} = 827.8 mg/L KCl

APPENDIX G:

CHEMICAL ANALYSES OF M. MERCENARIA TISSUE

CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16490
Sample Description: CONTROL

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	0.5 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	2.34 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	0.454 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	13.2 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/10/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	18 %	01/04/94	LAC	EPA 160.3

Approved By:

Imila E. Dixon
Laboratory Manager

TRI-COUNTY BUSINESS CAMPUS • 88 ROBINSON STREET • POTTSTOWN, PA 19464 • 215-327-4850 • FAX 215-327-4852
CO: NA • CT: PH-0667 • DE: REC-PA • MD: 150 • MA: PA060 • MI: REC-PA • NH: 25391-A • NJ: 77434 • PA: 46-253 • VA: 00298 • WI: 999902530

CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: CONTROL
RMC ID: 16490

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : CONTROL
RMC I.D. : 935013-16490

Date Analyzed : 01/10/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	74 %
2-Fluorobiphenyl	94 %
Terphenyl-d14	71 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

TRI-COUNTY BUSINESS CAMPUS • 88 ROBINSON STREET • POTTSTOWN, PA 19464 • 215-327-4850 • FAX 215-327-4852

CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16491
Sample Description: DELAWARE BAY 1

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.39 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	0.342 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	10.5 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/10/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	14 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: DELAWARE BAY 1
RMC ID: 16491

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : DELAWARE BAY 1
RMC I.D. : 935013-16491

Date Analyzed : 01/10/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	81 %
2-Fluorobiphenyl	91 %
Terphenyl-d14	78 %

Percent Solid of 100. is used for all Target compounds.

QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By John C. Gallagher

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16492
Sample Description: DELAWARE BAY 4

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.85 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	<0.200 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	11.8 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/10/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	17 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: DELAWARE BAY 4
RMC ID: 16492

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

		ug/kg			ug/kg
a-BHC	<	16.00	4,4'-DDD	<	32.0
g-BHC (lindane)	<	16.00	endrin aldehyde	<	32.0
b-BHC	<	16.00	methoxychlor	<	160.0
d-BHC	<	16.00	4,4'-DDT	<	32.0
heptachlor	<	16.00	chlordane	<	160.0
aldrin	<	16.00	toxaphene	<	320.0
heptachlor epoxide	<	16.00	PCB-1016	<	160.0
endosulfan I	<	16.00	PCB-1221	<	160.0
4,4'-DDE	<	32.0	PCB-1232	<	160.0
dieldrin	<	32.0	PCB-1242	<	160.0
endrin	<	32.0	PCB-1248	<	160.0
endosulfan II	<	32.0	PCB-1254	<	320.0
			PCB-1260	<	320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: [signature]

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : DELAWARE BAY 4
RMC I.D. : 935013-16492
Date Analyzed : 01/10/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	84 %
2-Fluorobiphenyl	99 %
Terphenyl-d14	76 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16493
Sample Description: DELAWARE BAY 5

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.73 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	0.256 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	10.3 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/10/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	14 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

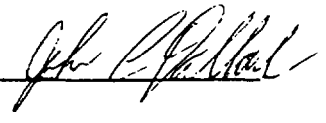
CLIENT ID: DELAWARE BAY 5
RMC ID: 16493

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: 

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : DELAWARE BAY 5
RMC I.D. : 935013-16493

Date Analyzed : 01/10/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	88 %
2-Fluorobiphenyl	103 %
Terphenyl-d14	80 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16494
Sample Description: DELAWARE BAY 6

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.91 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	<0.200 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	11.2 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/10/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	15 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: DELAWARE BAY 6
RMC ID: 16494

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: John C. Gilbert

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : DELAWARE BAY 6
RMC I.D. : 935013-16494
Date Analyzed : 01/10/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	85 %
2-Fluorobiphenyl	105 %
Terphenyl-d14	73 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16495
Sample Description: DELAWARE BAY 10

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.82 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	<0.200 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	11.8 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/11/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	17 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: DELAWARE BAY 10
RMC ID: 16495

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : DELAWARE BAY 10
RMC I.D. : 935013-16495

Date Analyzed : 01/11/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	80 %
2-Fluorobiphenyl	102 %
Terphenyl-d14	77 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16496
Sample Description: BENEFICIAL USE SITE 2

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	1.04 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.76 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	0.47 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	<0.200 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	12.7 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/11/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	18 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: BENEFICIAL USE SITE 2
RMC ID: 16496

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By:

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : BENEFICIAL USE SITE 2
RMC I.D. : 935013-16496

Date Analyzed : 01/11/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	74 %
2-Fluorobiphenyl	95 %
Terphenyl-d14	67 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16497
Sample Description: BENEFICIAL USE SITE 3

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.95 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	<0.200 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	15.5 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAJ	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/11/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	18 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: BENEFICIAL USE SITE 3
RMC ID: 16497

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : BENEFICIAL USE SITE 3
RMC I.D. : 935013-16497

Date Analyzed : 01/11/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	78 %
2-Fluorobiphenyl	108 %
Terphenyl-d14	74 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P.O. Number: SPRING CITY

RMC Number : 16498
Sample Description: BENEFICIAL USE SITE 5

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	0.4 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	1.16 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	1.64 MG/KG	01/07/94	BAK	EPA 7210, 7211
1	LEAD, TOTAL	<2.00 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 7471
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	<0.200 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	12.1 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/11/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	14 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: BENEFICIAL USE SITE 5 | DATE ANALYZED: 01-11-94
RMC ID: 16498 | ANALYZED BY: JAI

Pesticides

		ug/kg			ug/kg
a-BHC	<	16.00	4,4'-DDD	<	32.0
g-BHC (lindane)	<	16.00	endrin aldehyde	<	32.0
b-BHC	<	16.00	methoxychlor	<	160.0
d-BHC	<	16.00	4,4'-DDT	<	32.0
heptachlor	<	16.00	chlordane	<	160.0
aldrin	<	16.00	toxaphene	<	320.0
heptachlor epoxide	<	16.00	PCB-1016	<	160.0
endosulfan I	<	16.00	PCB-1221	<	160.0
4,4'-DDE	<	32.0	PCB-1232	<	160.0
dieldrin	<	32.0	PCB-1242	<	160.0
endrin	<	32.0	PCB-1248	<	160.0
endosulfan II	<	32.0	PCB-1254	<	320.0
			PCB-1260	<	320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: ____________

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : BENEFICIAL USE SITE 5
RMC I.D. : 935013-16498

Date Analyzed : 01/11/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	85 %
2-Fluorobiphenyl	92 %
Terphenyl-d14	96 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By John C. Gallucci

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CERTIFICATE OF ANALYSIS

RMC Analytics

Army Corps of Engineers
Custom House, 2nd and Chestnut St.
Philadelphia, PA 19106-2991

REPORT DESCRIPTION : 04710-09

Report No. : 935013
Sample Date: 12/04/93
Sampled By : MEM
Received : 12/29/93
Reported : 01/13/94
P O Number: SPRING CITY

RMC Number : 16499
Sample Description: BENEFICIAL USE SITE G

Repl	Parameter	Result	Date Anl Completed	Ana-lyst	Method
1	ANTIMONY, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7040
1	ARSENIC, TOTAL	<0.2 MG/KG	01/10/94	LMS	EPA 7060
1	BERYLLIUM, TOTAL	<0.050 MG/KG	01/07/94	BAK	EPA 7091
1	CADMIUM, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7131
1	CHROMIUM, TOTAL	1.02 MG/KG	01/07/94	BAK	EPA 7191
1	COPPER, TOTAL	2.31 MG/KG	01/07/94	BAK	EPA 7210, 721
1	LEAD, TOTAL	2.42 MG/KG	01/07/94	BAK	EPA 7421
1	MERCURY, TOTAL	<0.07 MG/KG	01/03/94	JNO	EPA 7470, 747
1	NICKEL, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 249.2
1	SELENIUM, TOTAL	<0.200 MG/KG	01/05/94	LMS	EPA 7740
1	SILVER, TOTAL	<1.00 MG/KG	01/07/94	BAK	EPA 7760
1	THALLIUM, TOTAL	<5.00 MG/KG	01/07/94	BAK	EPA 7841
1	ZINC, TOTAL	16.0 MG/KG	01/07/94	BAK	EPA 7950
1	SELECTED PESTICIDES & PCBS (SOLID)	SEE PEST. ATTACHMENT	01/11/94	JAI	EPA 8080
1	SELECTED SEMI-VOLATILES (SOLID)	SEE SEMI-VOL. ATTACHMENT	01/11/94	JVG	EPA 8270
1	SAMPLE PREP (COMPOSITING, ETC)	COMPLETED	12/30/93	JNO	
1	% SOLIDS (NO CHARGE-DRY WT CALC)	16 %	01/04/94	LAC	EPA 160.3

Approved By:

Twila E. Dixon
Laboratory Manager

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CERTIFICATE OF ANALYSIS

RMC Analytics

CLIENT ID: BENEFICIAL USE SITE 6
RMC ID: 16499

DATE ANALYZED: 01-11-94
ANALYZED BY: JAI

Pesticides

	ug/kg		ug/kg
a-BHC	< 16.00	4,4'-DDD	< 32.0
g-BHC (lindane)	< 16.00	endrin aldehyde	< 32.0
b-BHC	< 16.00	methoxychlor	< 160.0
d-BHC	< 16.00	4,4'-DDT	< 32.0
heptachlor	< 16.00	chlordane	< 160.0
aldrin	< 16.00	toxaphene	< 320.0
heptachlor epoxide	< 16.00	PCB-1016	< 160.0
endosulfan I	< 16.00	PCB-1221	< 160.0
4,4'-DDE	< 32.0	PCB-1232	< 160.0
dieldrin	< 32.0	PCB-1242	< 160.0
endrin	< 32.0	PCB-1248	< 160.0
endosulfan II	< 32.0	PCB-1254	< 320.0
		PCB-1260	< 320.0

<X = Not detected; value indicates minimum quantifiable limit.

Approved By: John C. Caldwell

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CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : BENEFICIAL USE SITE 6
RMC I.D. : 935013-16499

Date Analyzed : 01/11/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	89 %
2-Fluorobiphenyl	96 %
Terphenyl-d14	114 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

TRI-COUNTY BUSINESS CAMPUS • 88 ROBINSON STREET • POTTSTOWN, PA 19464 • 215-327-4850 • FAX 215-327-4852

CERTIFICATE OF ANALYSIS

RMC Analytics

Semivolatile Analysis Data

CLIENT I.D. : >C1332 METHOD BLANK
RMC I.D. : METHOD BLANK
Date Analyzed : 01/10/94
Analyzed By : JVG

COMPOUND	UG/KG	QL	COMPOUND	UG/KG	QL
Naphthalene	U	330	Benzo(k)fluoranthene	U	330
Acenaphthylene	U	330	Benzo(a)pyrene	U	330
Acenaphthene	U	330	Indeno(1,2,3-cd)pyrene	U	330
Fluorene	U	330	Dibenzo(a,h)anthracene	U	330
Phenanthrene	U	330	Benzo(g,h,i)perylene	U	330
Anthracene	U	330	Mirex	U	330
Fluoranthene	U	330	Parathion	U	330
Pyrene	U	330	Malathion	U	330
Benzo(a)anthracene	U	330	Guthion	U	1700
Chrysene	U	330	Demeton	U	330
Benzo(b)fluoranthene	U	330			

SURROGATE COMPOUNDS	RECOVERY
Nitrobenzene-d5	74 %
2-Fluorobiphenyl	84 %
Terphenyl-d14	103 %

Percent Solid of 100. is used for all Target compounds.
QL = Sample specific quantitation limit

Qualifiers

(J) Indicates an estimated value
(U) Indicates compound not detected
(B) Indicates compound found in blank
(D) Indicates surrogates have been diluted out

Approved By _____

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CHAIN OF CUSTODY

RMC Analytics

A Division of RMC Environmental Services, Inc.
88 Robinson Street
Pottstown, Pa. 19464
(215) 327-4850

Client: ACoE VIP #:
Address:

Phone:
Samplers: MEM/JAM
Job No.: 04710-09

Lab Contact: M. Messersmith
Sales Order No.:
P.O. Number:

Turnaround Time	Normal [ ]	Rush [X] 10-days
Sample Disposal	Return to Client [ ]	Disposal by Lab [X]

RMC USE ONLY
935013

No. Container/Size
Analysis Requested — ORGANICS / INORGANICS

RMC only Lab ID	Sample Identification	Matrix Code *	Sample Date	Sample Time	VOA	BNA	Pest/PCB	Herb		Seed	Sc Acf (BABO)	Metals	Cn	NH3	Wet Chem			
16490	Control	BI	12/4/93	N/A							1							
16491	Delaware Bay 1	BI	↓	↓							1							
16492	" 4	BI	↓	↓							1							
16493	" 5	BI	↓	↓							1							
16494	" 6	BI	↓	↓							1							
16495	" 10	BI	↓	↓							1							
16496	Beneficial use site 2	BI	↓	↓							1							
16497	" 3	BI	↓	↓							1							
16498	" 5	BI	↓	↓							1							
16499	" 6	BI	↓	↓							1							

Potential Hazard Identification:
Non-Hazard [X] Flammable [ ] Unknown [ ]
Skin-irritant [ ] Poison [ ]

QA/QC Reporting Requirements (Circle one)
None (Standard) Tier II CLP
Other (specify):

Relinquished By:	Received By:	Time:	Date:	Relinquished By:	Received By:	Time:	Date:
Cory Araias	N. Smith	0830	12/29/93				

Special Instructions:

* Matrix Codes:

S - soil	WW - waste water
SE - sediment	PW - potable water
SO - solid	SW - surface water
WS - solid waste	GW - ground water
DS - drum solids	DL - drum liquids
SL - sludge	ST - stormwater
O - oil	A - air
WI - wipe	F - fish
BI - biological	X - other

RMC Use Only

Samples were:
1. Shipped or (Hand-delivered) Notes:
2. (Chilled) or Ambient Notes:
3. Received broken/leaking Yes (No)
4. Properly preserved Yes N/A No [initials] 12/29/93
5. Received within holding times (Yes) No

COC Tape Was:
1. Present on outer package Yes (No)
2. Unbroken on outer package Yes No
3. Present on sample Yes (No)
4. Unbroken on sample Yes No
5. Discrepancies between sample labels and COC record? Yes (No)

CHAIN OF CUSTODY