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AMBIENT AIR MONITORING OF DREDGING AND DISPOSAL OF PCB CONTAMINATED SEDIMENT AT A MARINE SUPERFUND SITE: NEW BEDFORD HARBOR, MASSACHUSETTS.

Alan S. Fowler
Ebasco Services Incorporated
Boston, Massachusetts

Mark R. Hanson
Ebasco Services Incorporated
Boston, Massachusetts

INTRODUCTION

Site Location And History

The New Bedford Harbor Superfund site is located approximately 55 miles south of Boston along the northwestern shore of Buzzard's Bay. The site consists of 18,000 acres of estuary, harbor and bay contaminated with polychlorinated biphenyl (PCB) and heavy metals. Studies conducted by EPA during the late 1970s discovered PCB contamination in the sediment over a widespread area and in several species of marine biota. The biota concentrations were in excess of the U.S. Food and Drug Administration (FDA) edible tissue tolerance limit of 2 parts per million (ppm). In addition to PCBs, other contaminants including lead, cadmium, chromium, copper, and polycyclic aromatic hydrocarbons (PAHs) have also been found in the sediment.

As a result of the widespread PCB contamination and the accumulation of PCB in marine biota, the Massachusetts Department of Public Health established three fishing closure areas in New Bedford Harbor in September 1979. Closure of the New Bedford Harbor and upper Buzzards Bay areas to lobstering has resulted in the loss of approximately 18,000 acres of productive lobstering ground. In July 1982, the site was added to the EPA Superfund National Priorities List (NPL) making it eligible for federal funds to further investigate the nature and extent of contamination and evaluate potential clean-up alternatives for the site.

For the purpose of conducting site studies, the site was divided into three geographical areas: the Hot Spot area, the Acushnet River Estuary and the Lower Harbor/Upper Buzzards Bay (Figure 1). The Hot Spot is an approximate 5-acre area located along the western bank of the Acushnet River Estuary. PCB concentrations in the Hot Spot Area range from 4,000 ppm to over 200,000 ppm. In 1989, the Hot Spot was designated as a separate operable unit. A Record of Decision (ROD) was signed on April 6, 1990 by the EPA Region I Regional Administrator documenting the rationale and selection of the preferred remedial measures for the Hot Spot area. The remedial measures included the dredging and treatment of approximately 10,000 cubic yards of PCB contaminated sediment from this 5-acre area.

The remainder of the site, the Estuary and Lower Harbor/Bay areas, are being addressed as a second operable unit. The Acushnet River Estuary is an area of approximately 230 acres (excluding the Hot Spot area), extending from the Wood Street Bridge to the north, to the Coggeshall Street Bridge to the south. Sediment PCB concentrations in this area (excluding the Hot Spot area) range from below detection to approximately 4,000 ppm. The Lower Harbor area consists of approximately 750 acres extending from the Hurricane Barrier, north to the Coggeshall Street Bridge. Sediment PCB concentrations range from below detection to over 100 ppm. The Upper Buzzards Bay portion of the site area extends from the Hurricane Barrier to the southern boundary of Fishing Closure Area III, an area of approximately 17,000 acres. Sediment PCB concentrations in this area range from below detection up to 100 ppm in localized areas along the New Bedford shoreline near combined sewer and stormwater outfalls. Additional information on site history and the nature and extent of contamination can be found in the Hot Spot Feasibility Study (Ebasco, 1989).

In 1984, a Feasibility Study (FS) was conducted for EPA by the NUS Corporation. This FS presented five remedial clean-up alternatives for the Estuary portion of the site, four of these alternatives involved some form dredging activity to remove or isolate the contaminated sediments. During the public comment period, comments from the general public, the Potentially Responsible Parties (PRPs) and other governmental agencies raised concerns regarding the adequacy of available dredging techniques. These concerns included sediment/contaminant migration and the potential release of leachate from unlined shoreline disposal facilities. To address these questions, EPA sought assistance from the Corps of Engineers. This assistance included performing a number of pre-design studies to address the concerns and to develop a conceptual dredging and disposal alternative for the Estuary portion of the site. This Engineering Feasibility Study (EFS) was later expanded to a pilot-scale demonstration of dredging and dredge material disposal.

Pilot Study Description

The Pilot Study was conducted to evaluate dredging and disposal of contaminated sediment at the New Bedford site under actual conditions. The major factors evaluated were effectiveness in contaminant removal and contaminant release migration. The Pilot Study was conducted in a cove area along the western shore of the Acushnet River Estuary, just north of the Coggeshall Street bridge (Figure 1). The PCB levels for the top 2 feet of the cove sediment generally ranged from 100 to 200 ppm, with higher concentrations measured in the 0 to 6 inch horizon. The PCB measurements for this surficial layer ranged from 149 to 585 ppm. Three dredge types and two disposal techniques were evaluated during the course of the study. A total of 10,000 cubic yards of sediment, including 2,900 cubic yards of contaminated sediment were removed using a cutterhead, horizontal auger and Matchbox dredges. The dredged sediment was then transported via hydraulic pipeline and placed in a sediment disposal facility. The first sediment disposal facility used was a Confined Disposal Facility (CDF) constructed on the New Bedford shoreline (Figure 2). The contaminated dredge material was placed in the CDF in two layers, first the contaminated sediment, and then a layer of clean sediment as a cap. The second disposal method employed was an innovative application of a subaqueous disposal technique called a Contained Aquatic Disposal (CAD). The entire CAD disposal process is conducted underwater and results in a layer of clean sediment covering the contaminated sediment while maintaining the original bathymetry.

A major component of the Pilot Study was an environmental monitoring program designed to assist in the evaluation of the dredging and disposal operations and to ensure protection of public health and the environment over existing conditions. Both air and water quality monitoring were conducted during the Pilot Study with the water quality monitoring conducted by EPA and the Corps. The results of the water quality monitoring and an overall presentation of the Pilot Study are presented in a report prepared by the Corps (USACE, 1990).

PILOT STUDY AIR MONITORING PROGRAM

Background

The general findings of several site specific monitoring programs have indicated an ambient presence of PCB in New Bedford. (GCA, 1984 and NUS, 1987). In addition, the results of bench scale testing and modeling highlighted the role of exposed wet sediment in PCB volatilization (Brannon, 1989 and Thibodeaux, 1989). Although the PCB concentrations within the Pilot Study cove were relatively low, and the surface area of the CDF was relatively small, EPA and the Corps believed it was important to determine whether or not dredging and disposal activities would adversely impact air quality. In addition, the Pilot Study provided a unique opportunity to obtain site specific air quality data during actual field conditions that could be useful in the design process if dredging was selected as part of a remedial action for the New Bedford site.

During the initial scoping of the program, concerns were raised that contaminant releases during the Pilot Study could potentially impact worker safety and the surrounding residential community. To address these concerns, the program was designed to obtain monitoring results in a mode that was as close to real-time as possible. In addition, risk-based Decision Criteria were developed to assist in evaluating the daily operations. The risk-based approach was used to develop criteria because the ambient PCB levels in New Bedford posed a potential risk under existing conditions. In addition, the ambient levels also exceeded a proposed Commonwealth of Massachusetts Allowable Ambient Limit (AAL) for an annual average of 0.5 ng/m^3. The concept of developing criteria to indicate increased risk over existing conditions was similar to the approach used in developing Decision Criteria for the water quality monitoring program.

In an attempt to develop a background PCB level for the New Bedford site, results from previous monitoring studies (GCA, 1984 and NUS, 1987) were evaluated. These studies reported a wide range of values for a number of sites and consequently, the spatial and temporal variabilities were not resolved. However, the background concentration of 10 ng/m^3 suggested by the NUS report appeared to be reasonable. Although a limited monitoring effort was conducted during the pre-dredging phase in an attempt to refine site-specific background levels, the value of 10 ng/m^3 was selected for the development of Decision Criteria.

Under assumed background condition of 10 ng/m^3, the excess lifetime cancer risk is approximately 10^{-5} (Ebasco, 1989). This risk estimate was calculated using a conservative exposure scenario of 24 hours per day for 70 years. The intent of the Decision Criteria was to develop an ambient PCB concentration that would not significantly increase the risk above existing conditions during the dredging and disposal portion of the study. To be conservative, a risk level of 10^{-6} was selected to calculate the criteria value. The corresponding PCB concentration was 64 ng/m^3 as an average value for the three month period of dredging and disposal activities. This value reflected the acceptable daily average PCB concentrations above background conditions (10 $\mu g/m^3$) for this period. The maximum daily value for any individual day was 10 $\mu g/m^3$ based on the 10-day Health Advisory (HA) developed by EPA for protection against the non-carcinogenic effects of PCB.

Program Objectives

The primary objectives of the air monitoring program were twofold. The first objective was to ensure that the activities were not causing significant releases above background conditions that could impact work safety or the surrounding residential areas. The second objective was to monitor ambient contaminant levels prior to, during and after the dredging and disposal portions of the Pilot Study. This information was gathered to assist EPA and the Corps in directing daily operations of the Pilot Study to minimize airborne contaminant releases. A secondary objective was to gather pre-design data to assist in the design process if a similar remedial action was selected for the New Bedford site.

MONITORING PROGRAM COMPONENTS

The air monitoring program consisted of ambient monitoring conducted at five sites within the Pilot Study area. The contaminants measured during the monitoring program included: PCBs (aroclors 1016, 1242, 1248, and 1254), trace metals (Cd, Cr, and Pb), odor (hydrogen-sulfide, H_2S), and volatile organic contaminants (VOCs). While H_2S and VOC measurements were conducted in a real-time mode, PCB and metals measurements were available on a verbal basis within 24 hours after the laboratory received the samples. This resulted in a turn-around time of approximately 48 hours for the PCB samples and 7 days for the trace metals samples. In support of the air sampling effort, a meteorological station, including a 10-meter tower equipped to monitor, wind speed, wind direction, temperature, precipitation, solar radiation, and soil temperature was employed at the site to assess localized meteorological conditions.

Monitoring Site Descriptions

In order to assess PCB and heavy metal emissions, six Polyurethane Foam Samplers (PUF) and two High Volume (HI-VOL) samplers were located at five sites. These components include the dredging and disposal areas along with the air monitoring and meteorological stations. The monitoring station located on the southwest corner of the CDF included collocated PUF and HI-VOL samplers to collect data simultaneously in order to demonstrate data precision. A single PUF sampler was installed at each of the other four sites (Figure 2).

Though local climatology of the area indicated winds with predominant northwest through southwest components, there were a number of other climatological and geographical variables which made the monitoring site selection process difficult based on historical meteorological data. Since the study was performed from November 1988, through April 1989, three seasonal weather patterns influenced wind conditions during the sampling period. Additionally, the influence of varied wind conditions due to "sea-breeze" effects further complicated siting the samplers. Therefore, the emphasis was placed on locating the sites upwind and downwind of the expected sources of contamination for virtually any wind direction. In addition, consideration was given to the requirements for AC power, security, and site access (Ebasco, 1988).

To effectively assess contaminant releases under all meteorological conditions, four monitoring sites were located on each corner of the CDF. This configuration located PCB sampling units southwest, southeast, northeast, and northwest of the CDF. The southeast and northeast sampling sites bordered the Acushnet River. Each site was within 20 feet of the CDF and no more than 20 feet above the surface of the CDF. The southwest corner site was also designated as the only heavy metal sampling location. Since this was the only one to be collecting both PCB and heavy metal data, it was further designated as the collocated sampler site. The sites were also configured to effectively assess PCB impacts on the residential areas in the vicinity of the study area.

A northern cove area site was located on the northern side of the cove opposite of the CDF area. This location was selected to assess potential PCB emissions from the dredging and CAD disposal activities within the cove. Additionally, this site was used to obtain data during non-dredging periods where PCB emissions could be attributed to sources not associated with pilot study activities. These potential sources adjacent include mudflat and surface water areas.

Odor and Volatile Organic Contaminant (VOC)

Real-time odor measured as (H_2S) and VOC screening were completed on days when particulate and PCB sampling was scheduled. During the daily setups of the HI-VOL and PUF samplers, and at least five more times during the ensuing 24-hour sampling period, odor and VOC levels were measured at each of the five sampling locations. If instantaneous non-methane organic vapor levels in excess of 10 ppm over the background were measured, a more intensive Volatile Organic Priority Pollutant (VOPP) sampling program would have been implemented to quantify the pollutants.

Meteorological Monitoring Site

An on-site meteorological station was installed in the area between the cove and the CDF. The station was established to evaluate potential contaminant transport and conditions conducive to particulate release. By installing the site directly at the CDF, it was possible to measure conditions as they existed in the area of concern, thereby enhancing the accuracy of the database. A 10-meter meteorological tower was installed and equipped with instrumentation to monitor wind speed, wind direction, sigma theta, temperature, solar radiation, soil temperature, and precipitation.

Monitoring Program Schedule

The air quality monitoring program was segmented into three distinct phases as presented in Table 1. Each phase was conducted concurrent to the Pilot Study activities, to identify conditions prior to dredging, during the dredging period, and after dredging and site activities had been completed.

Quality Assurance Program

A quality assurance program was implemented to ensure that collected data was accurate and precise, in order to effectively characterize both magnitude and variations in ambient conditions at the site. Key elements of the field QA program included:

- Routine site visits to each sampling site over a sample day to check sampler flow rates, operation and sample conditions, noting any ambient conditions which could affect the accuracy or representativeness of the sample.
- Routine checks of the meteorological system and database, in order to verify that the measured database reflect observed weather conditions.
- Daily flow checks of the PUF and HI-VOL samplers against current calibration results and flow controller set points.
- Daily collocated samples collected from the PUF and HI-VOL sampling systems.
- Weekly electronic calibration of all meteorological parameters and the incorporated strip chart recorder.
- Monthly multipoint flow calibrations of the PUF and HI-VOL samplers, the results of which were used to calculate flow curves used for determining set points for maintaining sampler flow conditions.
- Primary calibration and/or recertification of all calibration, electronic test, and laboratory equipment used on the program.
- Daily field blanks of the PUF and HI-VOL sampling media.
- Laboratory blanks and spikes submitted to the laboratory after every 10 filters analyzed.

The data was subjected to a series of data consistency and validation checks during the final data processing phase. This included review of the strip chart output records for the meteorological parameters, program crosschecks between strip chart and Data Acquisition System (DAS) readings for 10 percent of all hours, review of all instrument performance, daily data sheets, calibration records, and computed data concentrations. During the course of the program, no data was deleted from the database on the basis of quality assurance program results or acceptance criteria.

The analytical data were subject to a data validation review to assess the overall validity of the data from a laboratory QA/Quality Control (QC) perspective. No data were rejected as a result of the validation process. Some data were considered qualified, or approximated. However, these qualifications did not eliminate any of the data from consideration.

MONITORING RESULTS

The PCB results were evaluated as total PCB based on the summation of the four aroclors that were quantified. In general, aroclors 1016 and 1242 were the most frequently detected. This was consistent with the higher volatility of the less chlorinated isomers generally associated with these two mixtures. To facilitate comparison, results from the monitoring sites surrounding the CDF were grouped together. Although there was some variability between the four locations, the PCB levels were generally consistent. This variably was often attributed to the location of the dredge pipe relative to a CDF monitoring site. This condition was most pronounced during the earliest phases of CDF filling when the dredge discharge pipe was above the waterline.

The average PCB results for all of the monitoring sites are compared with the operational phases of the pilot study in Figure 3. The observed values were relatively low compared with the generally accepted site background concentration of 0.0010 $\mu g/m^3$. This precluded the comparison between the three phases difficult and during the study period suggests that general climatic conditions influenced ambient PCB levels. This is demonstrated by the general upward trend in PCB levels as the project moved into the warmer months.

In further reviewing the potential for meteorological effects, the PCB data was compared against wind speed and direction. Wind direction did not appear to greatly influence the results as the wind direction was fairly consistent from the north-northwest to south-southwest. However, wind speed did have a pronounced effect on ambient levels. Figure 4 demonstrates the increased PCB levels as the wind speed decreased for both the CDF area sites and the north cove area site.

The average PCB results for the dredging and disposal phases of the study were generally an order of magnitude below the health-based Decision Criteria value of 0.064 $\mu g/m^3$. In fact, the highest PCB measurement was a factor of 3 below the daily average criterion. In summary, the criteria values were never approached and therefore, no corrective measures were required. Results of the VOC, H_2S and heavy metals monitoring, indicated that the observed levels for all three study phases were consistent with typical urban background levels.

CONCLUSIONS

Emissions modeling initially conducted for the Pilot Study suggested a potential problem associated with shoreline disposal of PCB contaminated sediment. However, results of the ambient monitoring conducted prior to, during, and following the dredging and disposal activities demonstrated that the PCB levels did not rise above background levels. While the data does suggest that sediment disposal promotes PCB volatilization. The associated impacts to air quality appear to be confined to nearfield areas in vicinity of the sediment discharge.

Given that the quantity of, or potential for PCB release is a function of sediment PCB concentration, the size of the sediment disposal facility and the operational procedures used

during disposal. The degree to which engineering controls would be needed for future dredging and disposal applications should be determined on a site specific basis. However, based on the data presented herein, sediment with PCB concentrations below 200 ppm would not appear to pose a problem provided similar operating procedures were followed.

These findings are significant to engineers and scientists evaluating the potential adverse of dredging and disposal of contaminated sediment. Many projects have yet to evaluate the volatilization pathway, as the focus has been previously placed on water column impacts. However, the positive results of the Corps of Engineers Dredging Pilot Study and EPA's selection of dredging to remove the New Bedford Harbor Hot Spot will likely increase the interest in using dredging techniques to remove toxins from the nations's rivers and harbors.

Although the data did not support their presence during the Pilot Study, VOC and H_2S monitoring should be conducted in support of shoreline sediment ambient disposal as the potential always exists and the corresponding cost is relatively low. Monitoring for heavy metals would not be recommended unless the potential for fugitive dust emissions was high.

REFERENCES

Brannon, 1989. Laboratory Assessment of Volatilization from New Bedford Harbor Sediment. Memorandum for record prepared for U.S. Environmental Protection Agency.

Ebasco Services Inc., 1988. New Bedford Harbor Pilot Dredging and Disposal Study, Task 26, Air Monitoring Plan. Prepared for U.S. Environmental Protection Agency.

Ebasco Services Inc., 1989. New Bedford Harbor Hot Spot Feasibility Study. Prepared for U.S. Environmental Protection Agency.

GCA, 1984. New Bedford Environmental Investigation - Ambient Monitoring Program, Final Report. Prepared for U.S. Environmental Protection Agency.

NUS, 1987. Ambient Air Monitoring Program, Acushnet River Estuary. New Bedford Draft Report, Volume I. Prepared for U.S. Environmental Protection Agency.

Thibodeaux, 1989. Theoretical Models for Evaluation of Volatile Emissions to Air During Dredged Material Disposal with Applications to New Bedford Harbor, Massachusetts. *Miscellaneous paper El-89-3. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.*

U.S. Army Corps of Engineers, 1990. New Bedford Harbor Superfund Pilot Study: Evaluation of Dredging and Dredged Material Disposal. USACE New England Division.

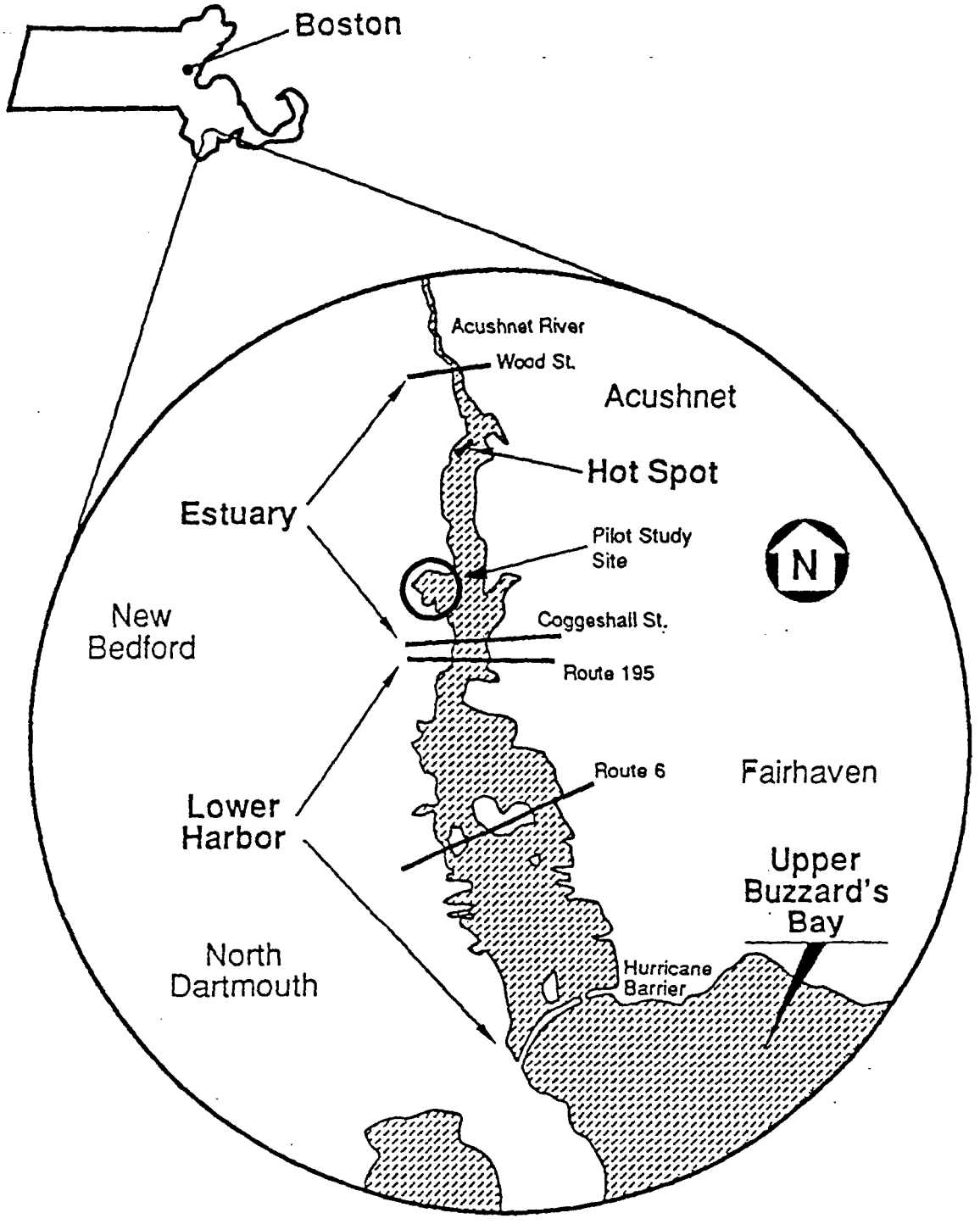
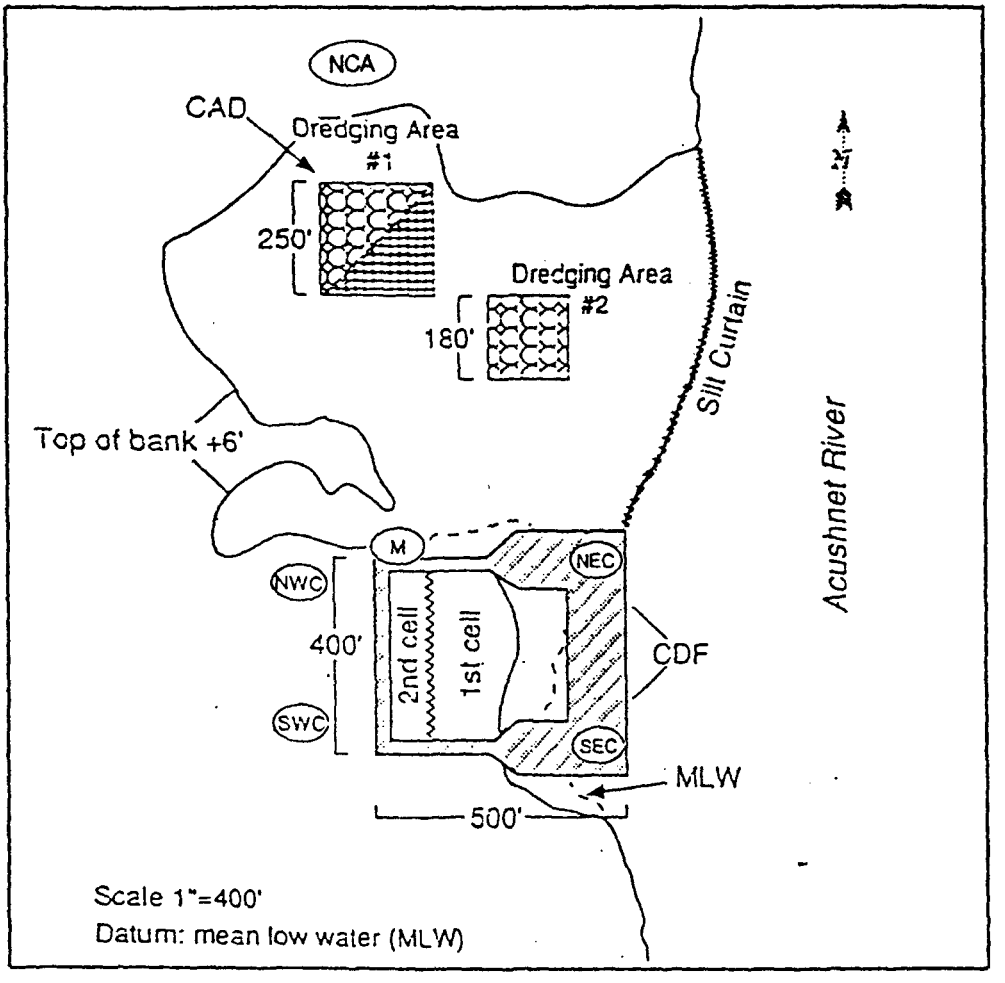


FIGURE 1 Site location map.



SWC - Southwest corner

NWC - Northwest corner

NEC - Southeast corner

NCA - North Cove Area

M - Meteorological Tower

FIGURE 2 Pilot study layout.

TABLE 1

DREDGING/AIR MONITORING SCHEDULE

Dates	Dredging Activity	No. of Sample Days
November 7 - November 19	Pre-Dredging Sampling	12
November 19 - December 19	CDF Contaminated Material	24
December 20 - January 4	CDF Clean Material	4
January 7 - January 20	CAD Contaminated Material	9
January 25 - February 11	CAD Clean Material	0
April 3 - April 28	Post-Dredging Sampling	16

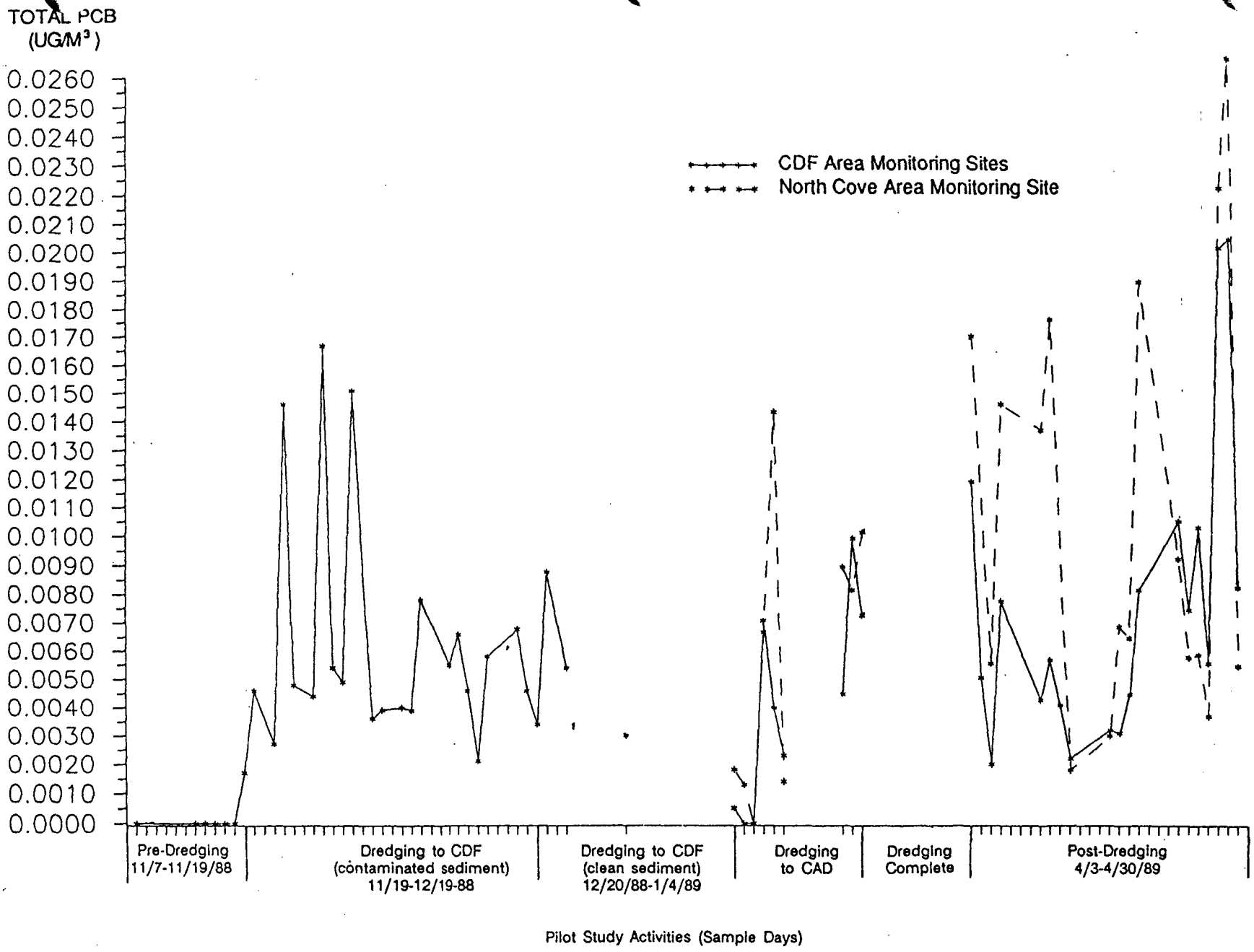


FIGURE 3 **Average PCB concentrations for all sites during pilot dredging study.**

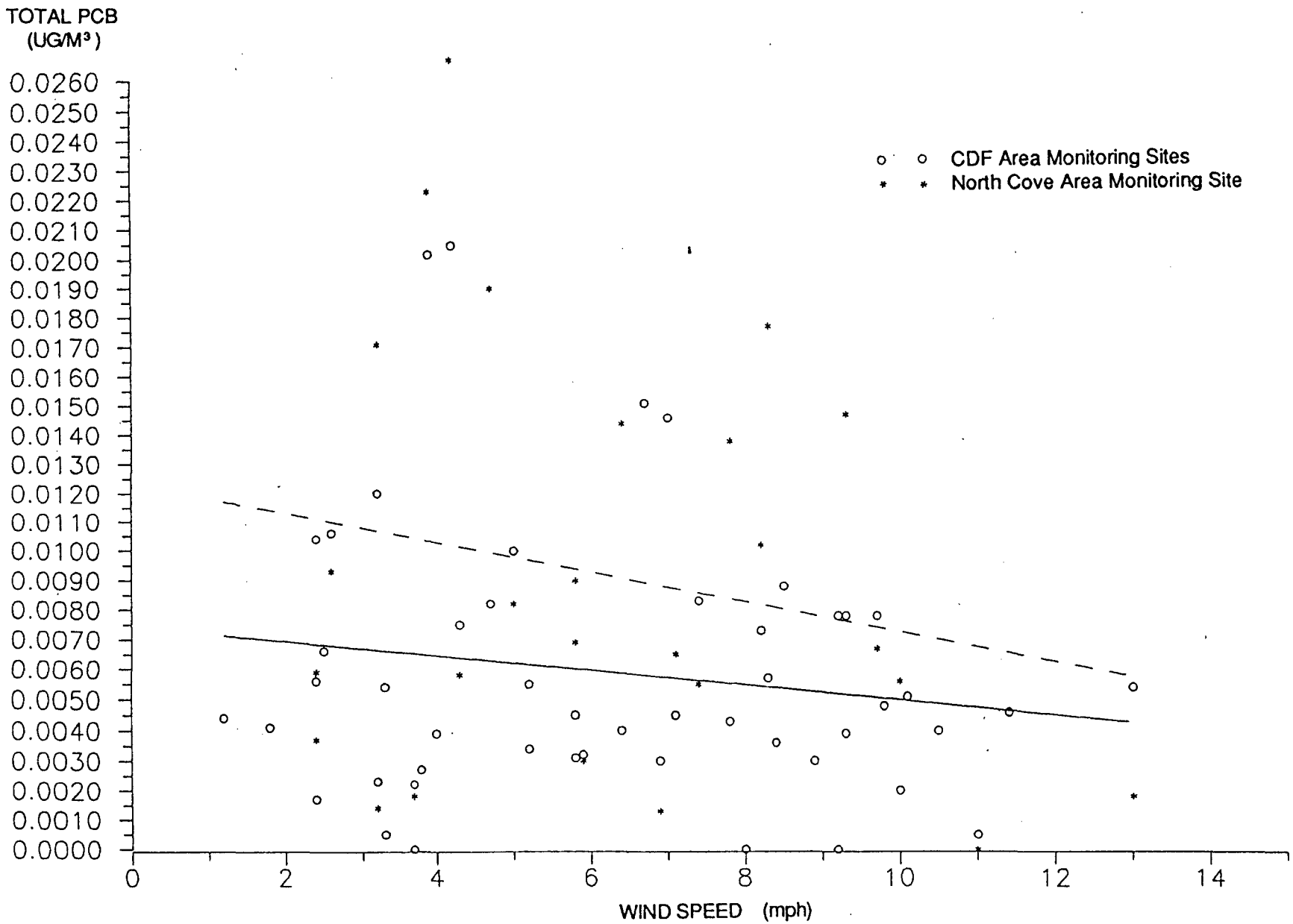


FIGURE 4 Average PCB concentrations for all sites versus wind speed.