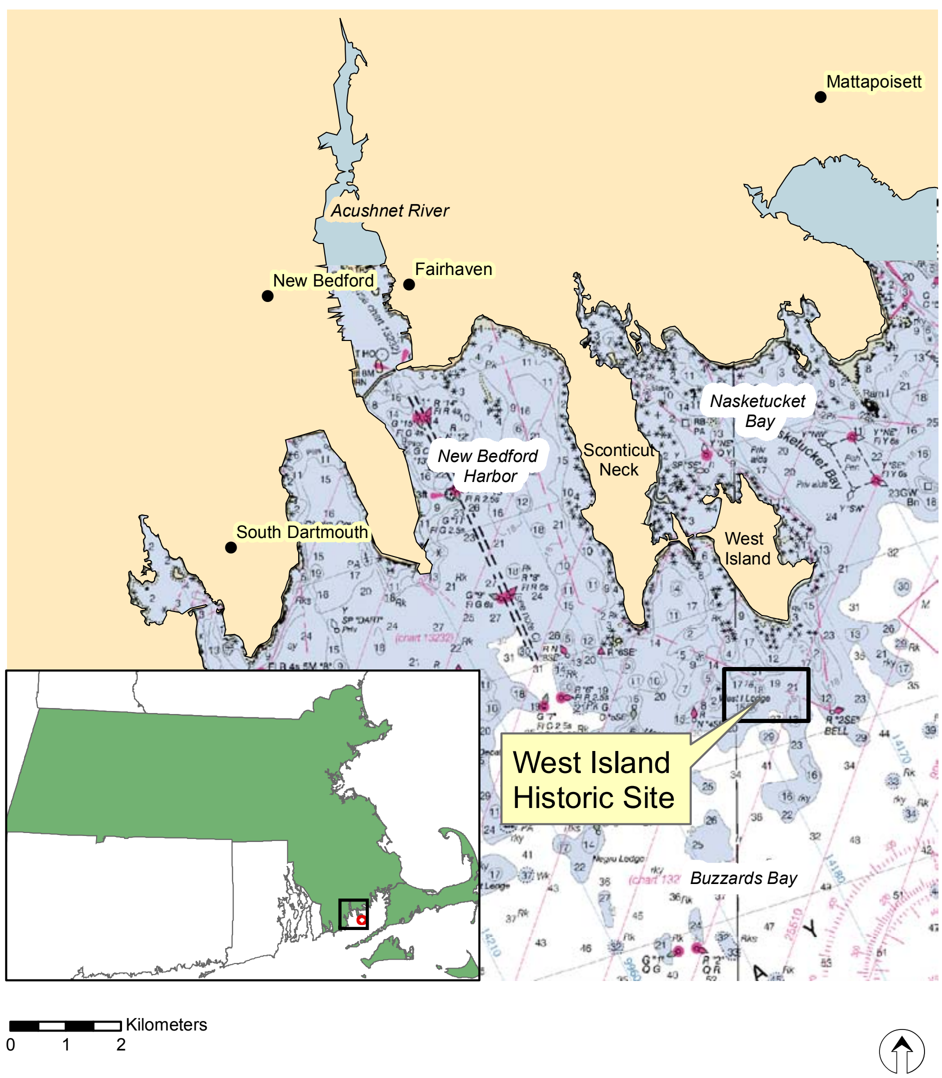
Monitoring Survey at the West Island Historic Site
Fall 2003

Disposal Area Monitoring System DAMOS

D A M O S

DISPOSAL AREA MONITORING SYSTEM

Contribution 164
September 2005



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13. ABSTRACT

The West Island Historic Site (WHIS) was monitored as part of the Disposal Area Monitoring System (DAMOS) in fall 2003. The 2003 field effort consisted of bathymetric and side-scan sonar surveys and sediment grab sampling. The 2003 monitoring survey was designed to provide a physical characterization of the site and a screening-level assessment of potential PCB distribution in surficial sediments at WIHS, which could have been deposited with dredged material from New Bedford Harbor accepted at the site until the 1970s. The monitoring was performed in three phases from August to December 2003, allowing the grab sample station placement to target potential deposition areas identified by the physical characterization. The use of the video-assisted grab allowed for further refinement of sampling locations during the survey. Sediment samples were analyzed using a biomarker-based assay for dioxin toxic equivalents (TEQs) as a screening-level test for the presence of PCBs

The bathymetry and side-scan surveys and the video performed as part of the sampling all identified the presence of historical disposal at WIHS, with individual rings and mounds as well as clusters of features distributed across and to the south of the site. The survey results also indicated that the disposal features consisted of coarse-grained material or large stone/debris and that much of the site was exposed rock outcrop. As contaminants such as PCBs are typically associated with fine-grained sediments, the physical characteristics of WIHS limit the potential for extensive PCB contamination. The assay technique that was used appeared to have a relatively low sensitivity for New Bedford Harbor PCBs. However, the results of the screening level testing supported the physical assessment of limited potential for PCB contamination at WIHS.

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EXECUTIVE SUMMARY

A monitoring survey was conducted in 2003 at the West Island Historic Site (WIHS) as part of the Disposal Area Monitoring System (DAMOS). WIHS is located in Buzzards Bay just outside of New Bedford Harbor, Massachusetts and historically accepted dredged material from New Bedford Harbor up until the 1970s. Given the polychlorinated biphenyl (PCB) contamination that exists in New Bedford Harbor, some PCB contaminated sediments were likely disposed at WIHS. The 2003 monitoring survey was designed to provide a physical characterization of the site and a screening-level assessment of potential PCB distribution in surficial sediments at WIHS.

The 2003 monitoring survey included bathymetry, side-scan sonar, and video-assisted grab sampling. The bathymetric survey was performed over a 3 km^2 area that encompassed the boundary of WIHS. The side-scan sonar survey included WIHS and extended to the south, covering a 6.3 km^2 area. Grab samples were collected from 41 locations, focusing on WIHS, but also including reference areas to the west and south of WIHS and within New Bedford Harbor. The monitoring was performed in three phases from August to December 2003, allowing the grab sample station placement to target potential deposition areas identified by the physical characterization. The use of the video-assisted grab allowed for further refinement of sampling locations during the survey. Sediment samples were analyzed using a biomarker-based assay for dioxin toxic equivalents (TEQs) as a screening-level test for the presence of PCBs.

The bathymetry and side-scan surveys and the video performed as part of the sampling all identified the presence of historical disposal at WIHS, with individual rings and mounds as well as clusters of features distributed across and to the south of the site. The survey results also indicated that the disposal features consisted of coarse-grained material or large stone/debris and that much of the site was exposed rock outcrop. Sampling that targeted deeper, apparently finer grained areas of WIHS revealed sediments composed primarily of sand. Hence, any fine-grained material that was historically disposed at WIHS was likely resuspended and transported away from the site by wave and current action. As contaminants such as PCBs are typically associated with fine-grained sediments, the physical characteristics of WIHS limit the potential for extensive PCB contamination. The assay technique that was used appeared to have a relatively low sensitivity for New Bedford Harbor PCBs. However, the results of the screening level testing supported the physical assessment of limited potential for PCB contamination at WIHS.

1.0 INTRODUCTION

A monitoring survey was conducted at the West Island Historic Site in the late summer and fall of 2003 as part of the U.S. Army Corps of Engineers (USACE) New England District (NAE) Disposal Area Monitoring System (DAMOS). The West Island Historic Site (WIHS) is located in the western portion of Buzzards Bay just outside of New Bedford Harbor, Massachusetts (Figure 1-1) and historically accepted dredged sediment from New Bedford Harbor. Given the polychlorinated biphenyl (PCB) contamination that exists in New Bedford Harbor (USEPA 1996), some PCB contaminated sediments were likely disposed at WIHS. If elevated levels of PCB contamination reside in the surficial sediments at WIHS, placement of cleaner sediments over exposed contaminated sediments could benefit this site. The monitoring survey described in this report was designed as a screening-level investigation to assess potential PCB distribution at WIHS.

1.1 Overview of the DAMOS Program

DAMOS is a comprehensive monitoring and management program designed and conducted to address environmental concerns associated with use of open-water disposal sites throughout the New England region (Fredette and French 2004). For over 25 years, the USACE NAE has collected and evaluated disposal site data throughout New England. Patterns of physical, chemical, and biological responses of seafloor environments to dredged material disposal activity have been documented based on these data. The DAMOS program features a tiered management protocol designed to ensure that any potential adverse environmental impacts associated with dredged material disposal activities are promptly identified and addressed (Germano et al. 1994).

Disposal site monitoring surveys are designed to collect data that support evaluation of the environmental status of each disposal site. Sites are evaluated relative to historic conditions and to conditions in nearby reference areas unaffected by disposal activities. The results of each monitoring survey are evaluated to determine the next step in the process of managing each specific disposal site. The DAMOS Program periodically undertakes focused studies to evaluate inactive/historic disposal sites. This investigation was designed to provide an initial evaluation of WIHS and included identifying physical remnants of historical disposal and performing a screening-level characterization of PCB distribution.

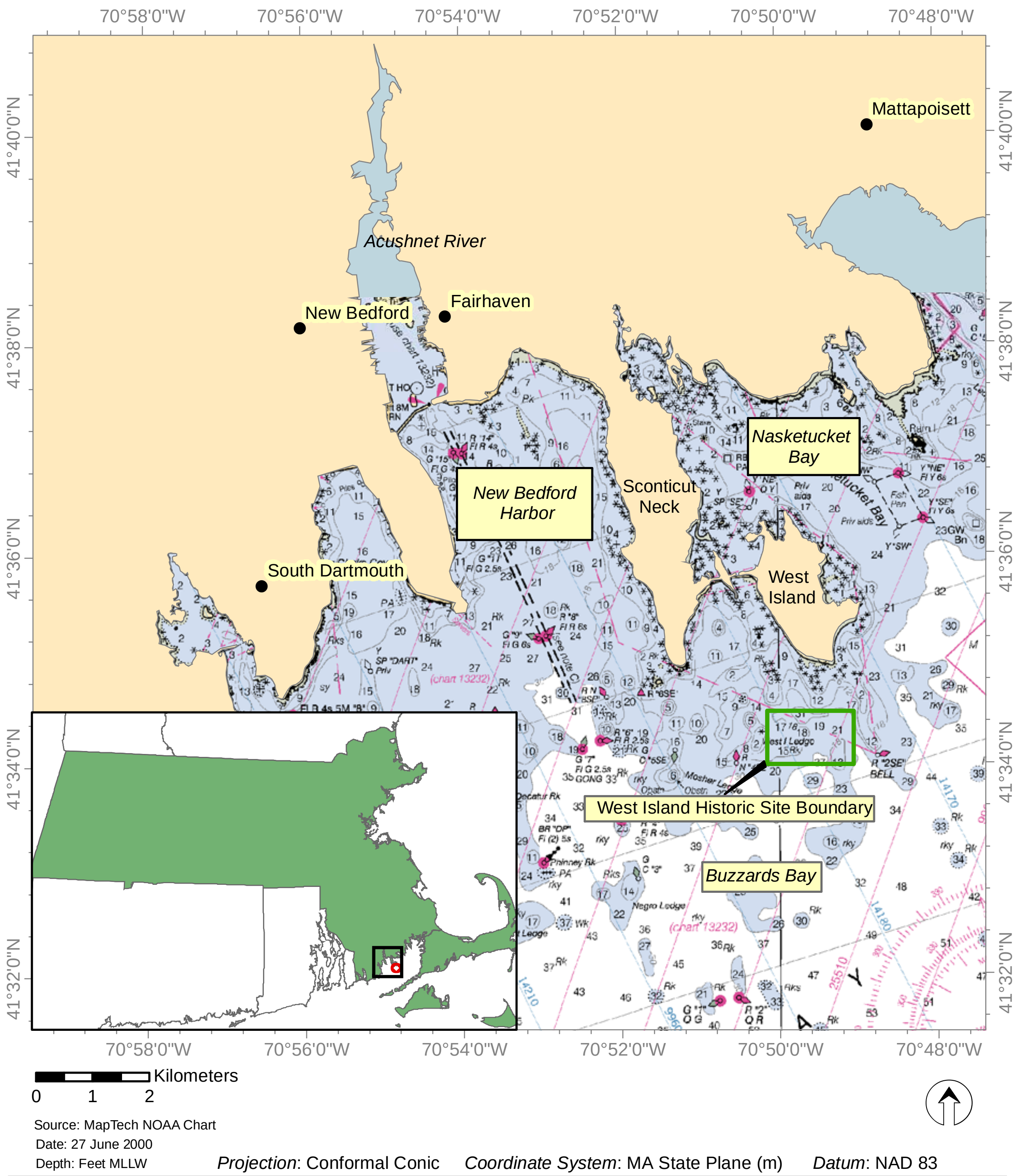

Figure 1-1. Location of the West Island Historic Site

1.2 Background on the West Island Historic Site

WIHS is located in the western waters of Buzzards Bay, Massachusetts approximately 3 km east of the entrance channel to New Bedford Harbor (Figure 1-1). WIHS is delineated on older charts as a 1.5 x 1.0 km area on the seafloor centered at 41°34.18' N, 70°49.55' W (NAD 83) just south of West Island (Figure 1-2). WIHS is characterized by water depths ranging from 4.5 to 11 m (15 to 37 ft in Figure 1-2) Mean Lower Low Water (MLLW) with noted rocky areas. WIHS is bounded by shallow waters on three sides with exposed rocks to the north and west and 2 to 4 m water depth along much of the eastern boundary. To the south, waters deepen into Buzzards Bay.

Screening for potential aquatic disposal sites for dredged material from New Bedford Harbor was performed in the late 1990s as part of the Massachusetts Coastal Zone Management Office's (MCZM) Dredged Material Management Plan (MCZM 2000). An extensive literature search performed as part of the MCZM study did not find information on when WIHS was used or the nature of the dredged material disposed at the site. The limited descriptions of the site that exist note two specific disposal locations, "Fairhaven" and "16 West Island" (Figure 1-2). It is assumed that dredged material from New Bedford, Fairhaven, and other surrounding harbors was periodically disposed at the site until the mid 1970s when regulations governing the disposal of dredged material became more restrictive.

Although there is no record of a focused study on WIHS, the area has been investigated as part of larger studies. In a study of bottom sediments in Buzzards Bay, Moore (1963) found that the deeper areas of the bay and near-shore depressions were covered with fine-grained sediments, while sands and gravels were found in the shallower, nearshore areas. Sediments in the vicinity of WIHS consisted of a mixture of gravel and fine to medium sand (Moore 1963, Summerhayes et al. 1977). Based on the presence of hard rock ledges and the predominance of coarse-grained sediments, WIHS was characterized as an erosional rather than depositional area (MCZM 2000). Relatively shallow depth and high energy environment with exposure to the open waters of Buzzards Bay deemed WIHS infeasible as a potential aquatic disposal site (MCZM 2000).

1.3 Survey Objectives

Given the widespread PCB contamination of New Bedford Harbor sediments, it is likely that some historical disposal of contaminated sediments occurred at WIHS (USEPA 1996). The potential for highly contaminated sediment to exist at the site coupled with the possibility of available capping material in the form of uncontaminated, glacially placed sediments from future projects, warranted an investigation into the need for

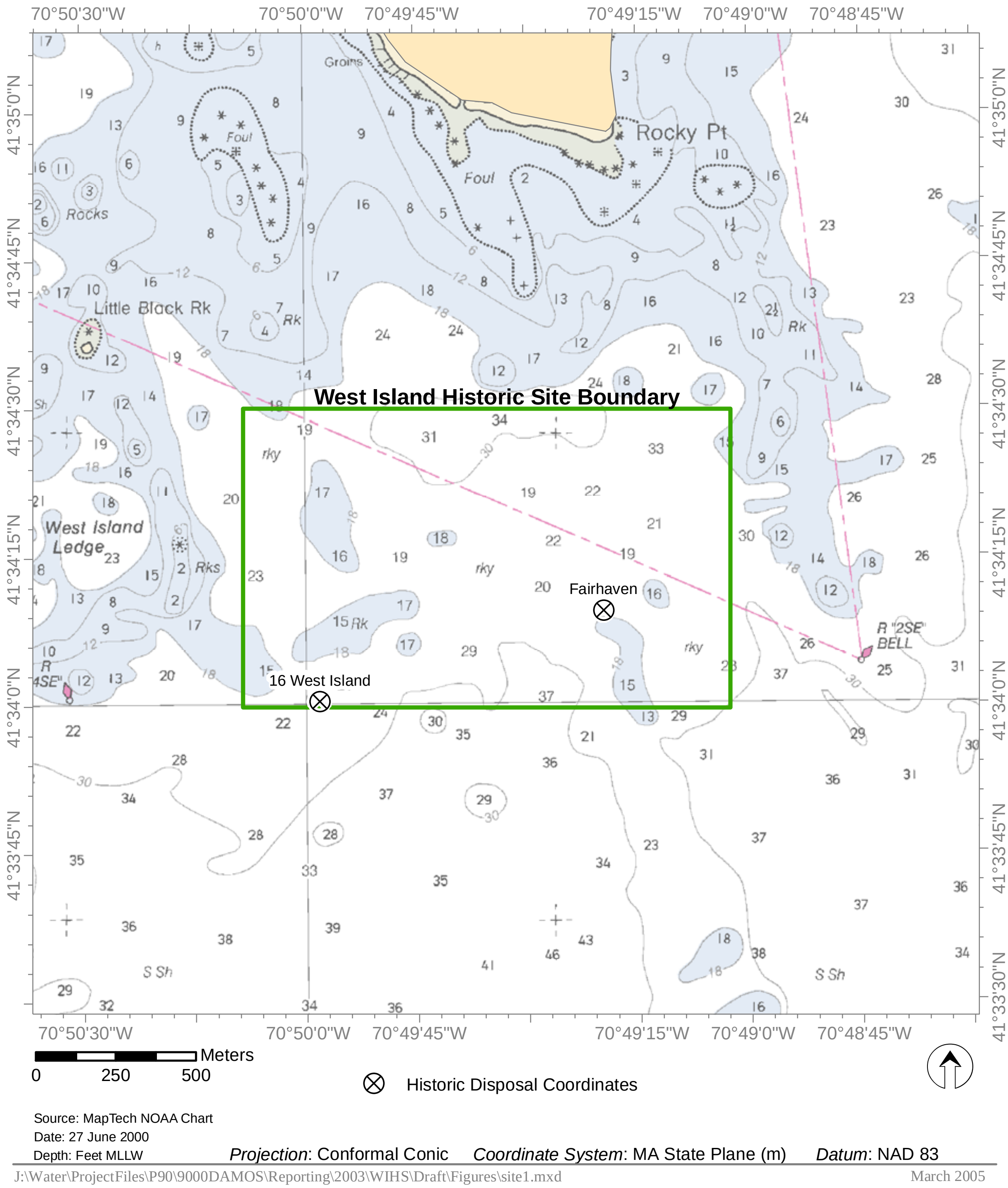

Figure 1-2. WIHS with historic disposal locations indicated

remediation at WIHS. The 2003 survey at WIHS was designed to provide a physical characterization of the site, including identification of potentially depositional areas, and a screening-level assessment of PCB concentrations and distributions in surficial sediments.

2.0 METHODS

The 2003 survey at WIHS was performed by ENSR International and CR Environmental. The survey included bathymetry, side-scan, and video-assisted sediment grabs and was performed in three phases (Table 2-1). An initial bathymetry and side-scan sonar survey was performed 26 August 2003 to identify areas with the greatest potential to be depositional. Based on the results of the first phase, side-scan coverage was extended to the south, and video-assisted grab samples focused on the depositional areas were collected on 1 October 2003. Additional video-assisted grab samples were collected 9 December 2003, and a more focused single-beam bathymetry survey was conducted within the original survey boundary. An overview of the methods used to collect the survey data and process and analyze the data is provided below.

2.1 Navigation and On-Board Data Acquisition

Positional data, comprised of horizontal positioning (x- and y-dimensional data) and time (t-dimensional data), were collected using a Trimble AG 132 Differential Global Positioning System (DGPS). This system received and processed satellite and land-based beacon data and provided real-time vessel position, typically to sub-meter accuracy. Coastal Oceanographics, Inc.'s HYPACK® hydrographic survey software was used to acquire, integrate, and store all positional data from the DGPS as well as bathymetric and station data. The HYPACK® software also displayed real-time vessel position and survey data over an electronic chart of the study area, thus enabling survey scientists to review and evaluate survey data on a real-time basis.

2.2 Bathymetry

2.2.1 Bathymetric Data Acquisition

The initial 2003 single-beam bathymetric survey was conducted 26 August 2003 aboard the R/V *Cyprinodon*. A total of 60 east-west survey lines spaced 25 meters apart were occupied over the 2000 m x 1500 m survey area (Figure 2-1). A secondary bathymetric survey was conducted 9 December 2003 aboard the R/V *Cyprinodon*. A focused single-beam bathymetric survey, using 15 m line spacing over a 600 x 600 m area, was conducted to refine the resolution of certain topographic features within WIHS.

The bathymetric surveys were conducted using an Ocean Data Equipment Corporation (ODEC) MF500 precision echo sounder outfitted with a narrow beam (3°), 200-kHz transducer with an accuracy of approximately 0.1% of the water depth. The system was calibrated at the dock daily prior to each survey. In addition, local

Table 2-1.

Summary of Field Activities at WIHS, 2003

Survey Type	Date	Summary
Bathymetry	26 August 2003	Area: 2000 x 1500 m Line Spacing: 25 m
	9 December 2003	Area: 600 x 600 m Line Spacing: 15 m
Side-Scan Sonar	26 August 2003	Area: 2000 x 1500 m Line Spacing: 150 m
	1 October 2003	Area: 2750 x 1200 m Line Spacing: 150 m
Sediment Grab	1 October 2003	Stations: 20
	9 December 2003	Stations: 21

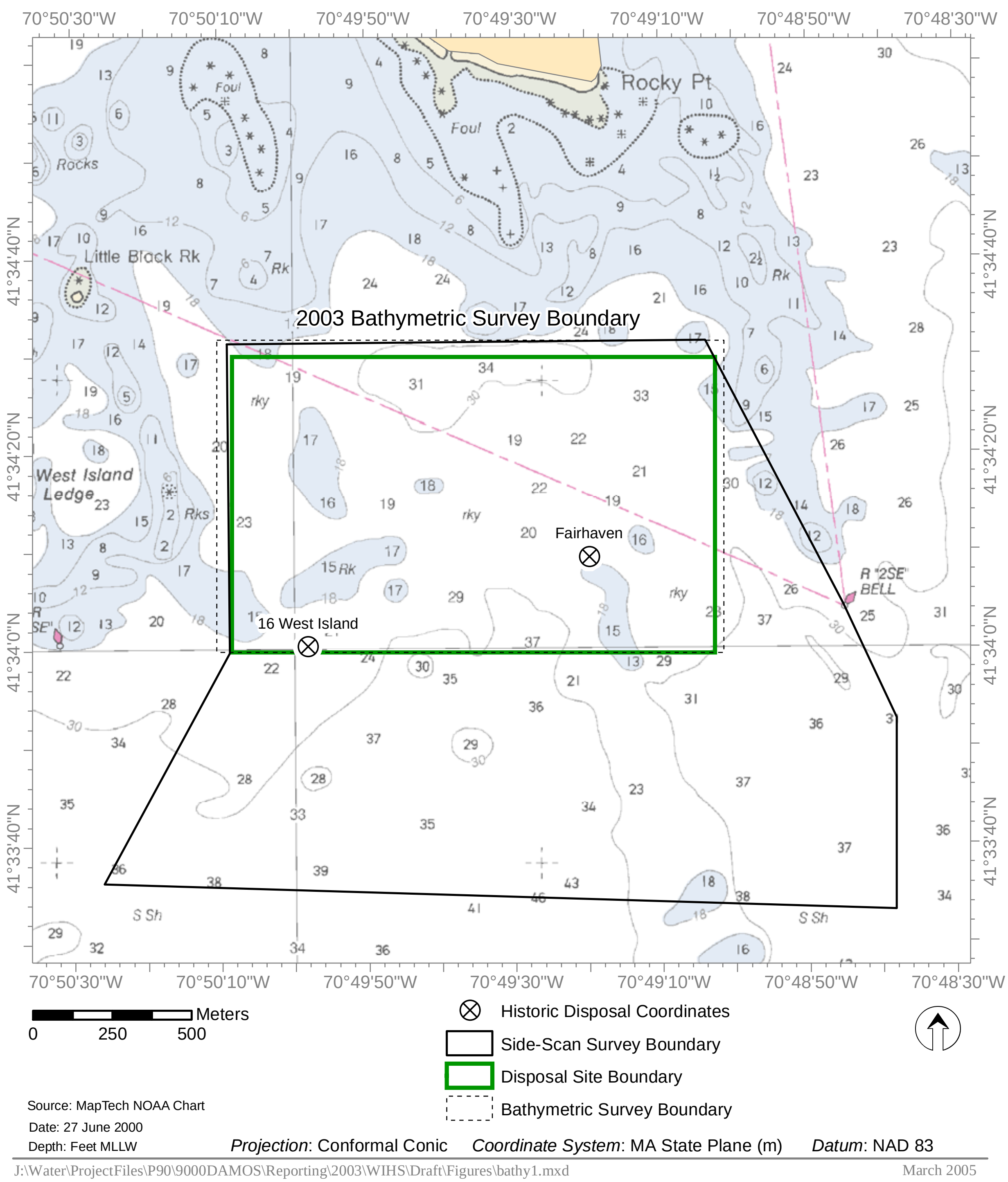

Figure 2-1. Bathymetric and side-scan survey boundaries at WIHS, 2003

measurements of salinity and temperature for determining speed of sound in water calibrations were taken *in-situ* using a Seabird SEACAT-19 CTD. Local tidal water level data were recorded at the New Bedford State Pier using a pressure transducer (InSitu, Inc. Mini-Troll®). These ancillary measurements were used to process the bathymetric data.

2.2.2 Bathymetric Data Processing

The bathymetric data were processed using the HYPACK® software program and included corrections for tidal conditions, local speed of sound, acquisition system latency, and spurious data points. Tidal correction consisted of transforming the raw measurements of depth below the transducer to seafloor elevation measurements relative to Mean Lower Low Water (MLLW) using the locally collected tidal elevation data. The speed of sound during the survey was calculated from local temperature and salinity measurements and used to correct the bathymetric data. Corrections were applied for acquisition system latency to account for positional errors related to small time delays between the actual DGPS and echo sounder measurements and the digital recording. The bathymetric data were also reviewed for spurious data points (clearly unrealistic measurements resulting from signal interference), and these points were removed.

2.2.3 Bathymetric Data Analysis

Bathymetric data were analyzed to gain a better understanding of the existing conditions at the site. For this survey, the corrected bathymetric data were analyzed using a combination of the surface modeling software program, Surfer® 8.0 and the GIS-based software package ArcMap® 9.0. Using Surfer®, the processed WIHS 2003 data were gridded to a cell size of 25 m^2 consistent with the line spacing of the initial survey. Once gridded, bathymetric contour lines were developed and the layers were displayed using ArcMap®.

2.3 Side-Scan Sonar

Side-scan sonar measurements characterize the reflective properties of the seafloor beneath and to each side of the transiting survey vessel. Following processing, a map of seafloor reflectivity can be generated to help infer seafloor topography and surficial sediment characteristics. This technique is used in the DAMOS Program to provide reconnaissance-level characterization of surficial seafloor materials and identification of seafloor features associated with disposal activities.

2.3.1 Side-Scan Sonar Data Acquisition

The initial 2003 side-scan sonar survey was conducted concurrently with the bathymetry survey on 26 August 2003, aboard the R/V *Cyprinodon*. The area covered was 2000 m x 1500 m and encompassed the entire site (Figure 2-1). A second side-scan sonar survey was conducted on 1 October 2003, also aboard the R/V *Cyprinodon*. The second side-scan sonar survey focused on two additional areas adjacent to WIHS. One 2750 m x 1200 m area was surveyed to the south of the site boundary and a second wedge-shaped area was surveyed to the east of the site (Figure 2-1). The side-scan sonar range was set to ensure sufficient overlap between survey lanes.

Side-scan sonar measurements were collected using an Edgetech, Inc. TD272 dual-frequency transducer array. The transducer was deployed using a hydraulic oceanographic winch and towed at an altitude of approximately 5 m off the bottom. A sonar frequency of 100-kHz was used with a range of 100 m, resulting in a total swath width of 200 m. The incoming analog sonar signals received from the tow fish were converted to digital data and displayed in real-time with the on-board data acquisition package SonarWiz provided by Chesapeake Technology, Inc.

2.3.2 Side-Scan Sonar Data Processing

Raw side-scan sonar data were processed using Chesapeake Technology, Inc.'s SonarWeb software to correct for layback and signal attenuation (related to swath width), and to georeference sonar imagery. Data processing also included corrections for variations of the sonar beam angle of incidence relative to the seafloor (beam angle corrections) and signal attenuation with distance (time varied gain corrections). These corrections were made through an iterative review of survey lane data. Once corrected, data from each survey lane were merged to create a single georeferenced mosaic of the survey area with a resolution of approximately 0.25-meters per pixel.

Side-scan images are typically depicted in a range of shades or colors that correspond to the strength of the returning signal and are used to infer bottom type and topography. The 2003 WIHS side-scan images were depicted in the traditional gray scale.

2.3.3 Side-Scan Sonar Data Analysis

Side-scan sonar data were analyzed to identify seafloor features (e.g., rock outcrops and historic disposal artifacts) and to assess the potential extent of the dredged material distribution. Analysis was performed on the georeferenced mosaic. In general, weak signal returns corresponded to smooth seafloor substrates (e.g., fine sediments with little micro-topography), soft materials that absorb the signal, or seabed sloping away from the signal source. These features appeared lighter gray in the conventional scale. Strong signal returns corresponded to rough seabed substrates (e.g., gravel, cobble), highly reflective materials, or to a seabed sloping towards the signal source. These features appeared as dark gray to black in the conventional scale. Features that rose above the seabed (e.g., boulders) reflected more of the sonar energy than the surrounding substrate resulting in strong signal returns due to decreased angle of incidence. These features often prevented insonification of the area opposite the signal source, resulting in a sonar "shadow" (white in the conventional scale).

2.4 Video-Assisted Sediment Grab Sampling

Video-assisted sediment grab samples were collected for laboratory screening of PCBs. The video-assisted grab method provided visual characterization of bottom type and enabled placement of the grab sampler for sediment collection in locations where soft sediment, rather than rock and cobble, was observed (Figure 2-2). The 2003 video-assisted sediment grab survey was conducted in two phases. The first phase of sediment grabs were collected from soft bottom areas, identified from the initial bathymetric and side-scan survey within the WIHS boundary. Samples were also collected from selected reference stations to the south of the site and from within New Bedford Harbor. A total of 20 sediment samples were collected during the first phase on 1 October 2003 (Figure 2-3).

Locations for the second phase of sediment grabs were based on review of the additional side-scan data and the results of the first video grab sampling effort. Samples were collected from potential depositional areas within WIHS and from selected stations to the south and west of the site. A total of 21 stations were sampled during the second phase on 9 December 2003. Video footage was also collected in December from an area suspected to have received historic disposal activity as determined from the side-scan survey. All sediment collection work was performed aboard the R/V *Cyprinodon.*

Sediment grabs were collected using a Ted-Young grab sampler equipped with a Deep Sea Power and Light Multi-SeaCam 2050 color underwater video camera (Figure 2-2). The sampler was lowered to a height just above the bottom to allow clear visual imaging of bottom conditions so that targeted sampling could be conducted to acquire sediments from the soft-bottom areas. Approximately 30 grams of sediment were collected for PCB assay analysis.

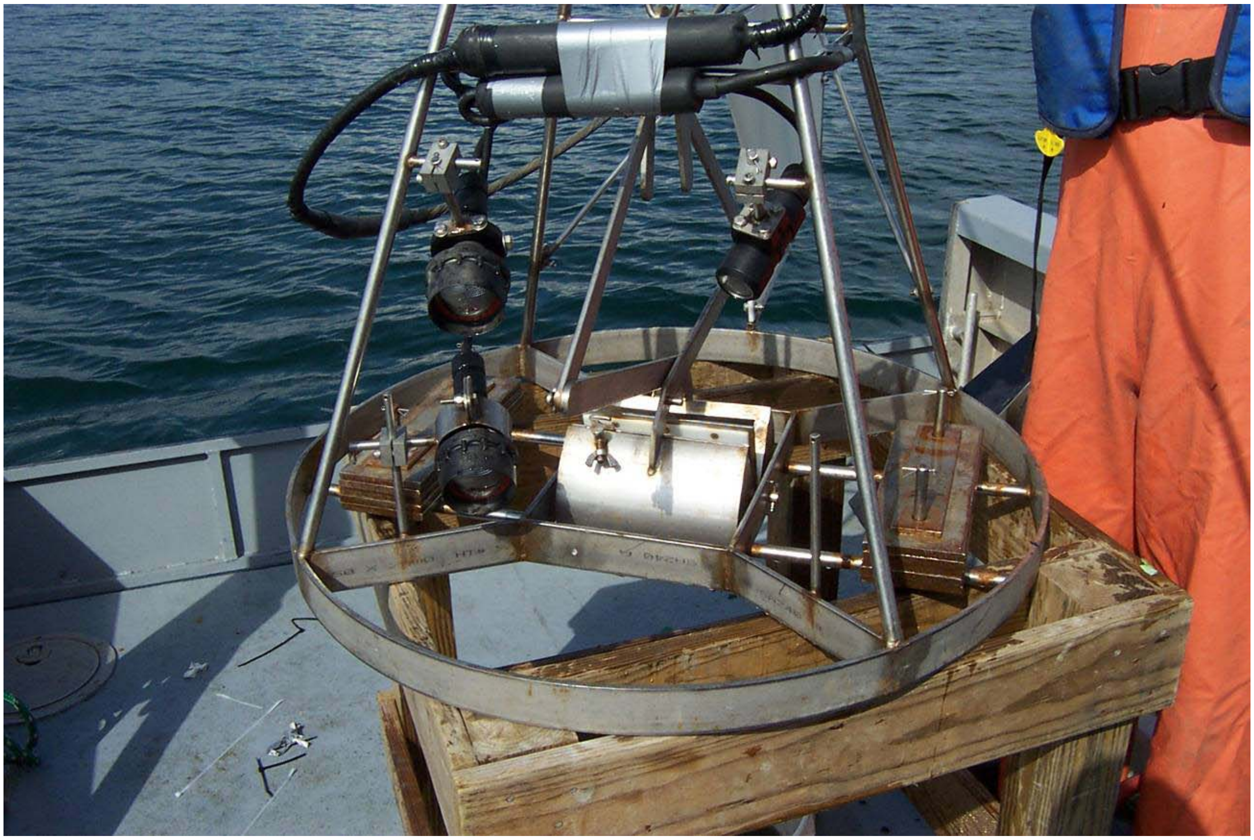

Figure 2-2. Video-assisted sediment grab sampler used at WIHS, 2003

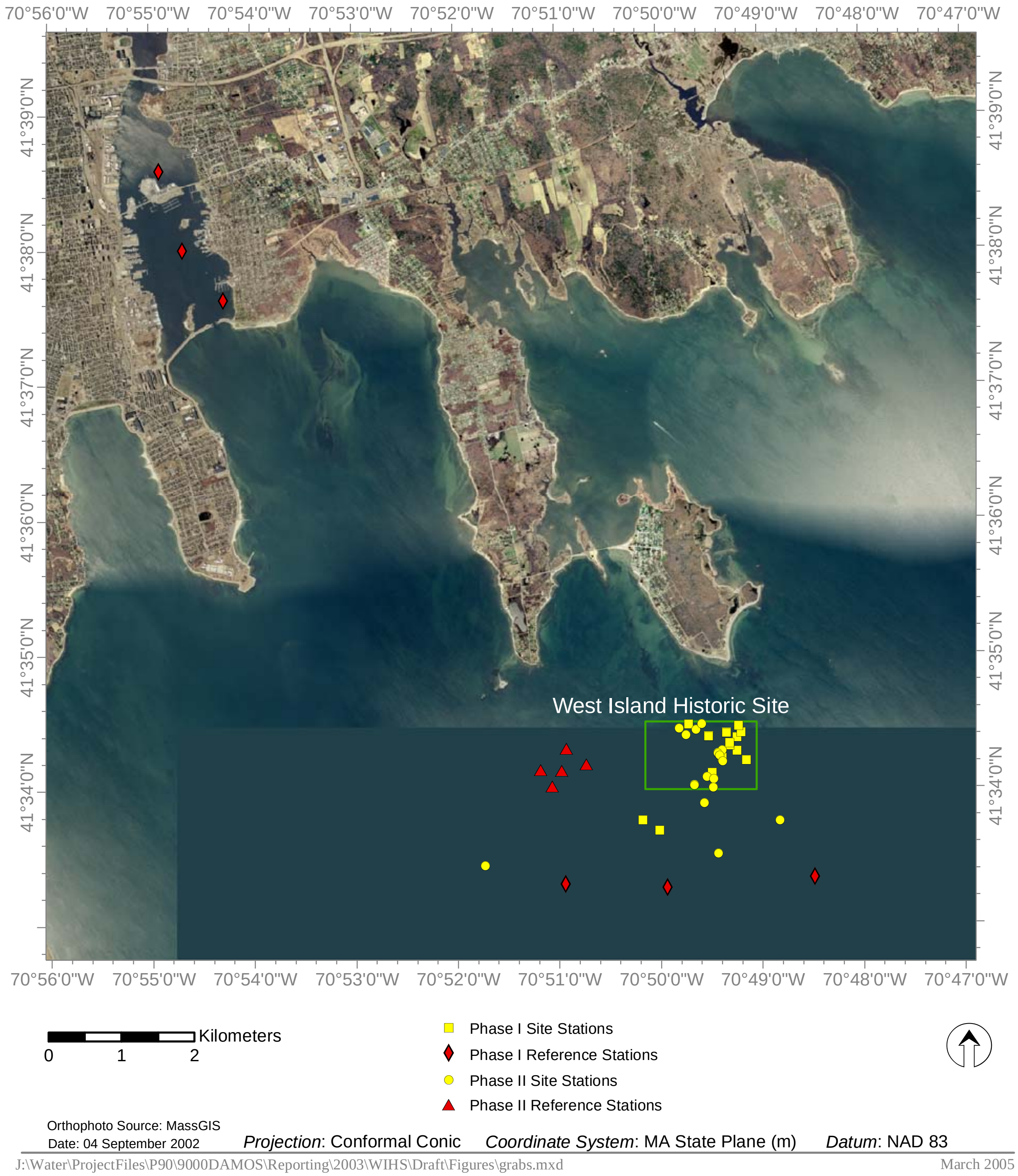

Figure 2-3. Sediment grab sample locations at WIHS, 2003

2.5 PCB Screening Assay for Sediments

The PCB assay analysis was performed at the USACE Waterways Experiment Station (WES). The analytical method used was a biomarker-based screening assay for dioxin toxic equivalents (TCDD TEQs). This technique uses cultured mammalian cells as the basis of the assay, providing a cost-effective screening alternative to prioritize which samples should receive more definitive congener analysis. Cell-based assays detect and measure the activity of dioxin and dioxin-like chemicals, including PCBs and polyaromatic hydrocarbons (PAHs), using the same cellular machinery responsible for the toxicity of these chemicals in whole organisms.

A variety of cells lines have been used in biomarker tests for exposure to chemicals and in identifying toxic substances in environmental samples according to the primary physiological effect they produce. Recently, cell-based assays have been used to test contaminated sediments. The P450 Reporter Gene System (P450RGS) is based on human HepG2 cells and uses the luciferase gene as a reporter and has proven effective in identifying and measuring PCBs and PAHs in sediment extracts (McFarland et al. 1999).

The sediment samples from WIHS were received at WES and freeze-dried prior to processing. Triplicate aliquots of 5 g were extracted and cleaned with sulfuric-acid silica gel (SASG). Extracts were concentrated to 0.2 mL and assayed for 2,3,7,8-TCDD Toxic Equivalents (TEQs) in compliance with USEPA Method 4425. Assays were performed in triplicate using 101L cells (a transgenic human cell line) in the 96-well plate format with simultaneous 2,3,7,8-TCDD standardization according to protocol USACE ERDC-DOER-C10 (Ang et al. 2000).

Quality control (QC) samples were also analyzed with each set of WIHS samples. The QC samples consisted of a pure sand blank and a sediment standard from New York-New Jersey Harbor with an accurately determined TEQ.

3.0 RESULTS

3.1 Bathymetry

The 2003 bathymetric survey was conducted in two parts. The first survey was conducted in August and covered a 2000 x 1500 m area using 25-meter line spacing. Based on the results of the first survey, a second survey was conducted in December, focusing on a 600 x 600 m area within the original survey boundary, but with a tighter, 15-meter line spacing for greater resolution of bottom features. A composite bathymetric map was developed with data from these two surveys (Figure 3-1).

The seafloor topography of WIHS was varied with water depths ranging from 5 to 12 meters MLLW (Figure 3-1). Several depressed areas were apparent as well as shallower ridge and mounded areas. There were also numerous small elevated features, rising 1 to 2 m off the bottom with a footprint often falling within the survey lines. There were no obvious mounds at the noted historic disposal target coordinates. The character of the bathymetric signal return indicated that the shallower areas of the site consisted of hard bottom.

3.2 Side-Scan Sonar

The mosaic image of the WIHS seafloor created from the two 2003 side-scan sonar surveys was consistent with the results of the bathymetric survey (Figure 3-2). Areas of high reflectance (dark gray/black), typically characteristic of rough seabed structures including rock outcrops and ledges that rise above the surrounding seafloor, matched well with the shallower, hard bottom areas delineated by the bathymetric survey. Areas of low reflectance (white/light gray), indicative of a smooth seafloor composed of finer sediments, matched well with the depressions along the northern and southern WIHS boundaries delineated by the bathymetric survey.

The side-scan data also allowed for further characterization of the small-scale targets identified in the bathymetric survey. A detailed inspection of the side-scan image revealed numerous small mounds or rings, indicative of individual disposal events as well as clusters of mounds and rings (Figure 3-3). These were distributed over the entire surveyed area. Many of these targets appeared to be very rough, indicative of boulders or demolition debris.

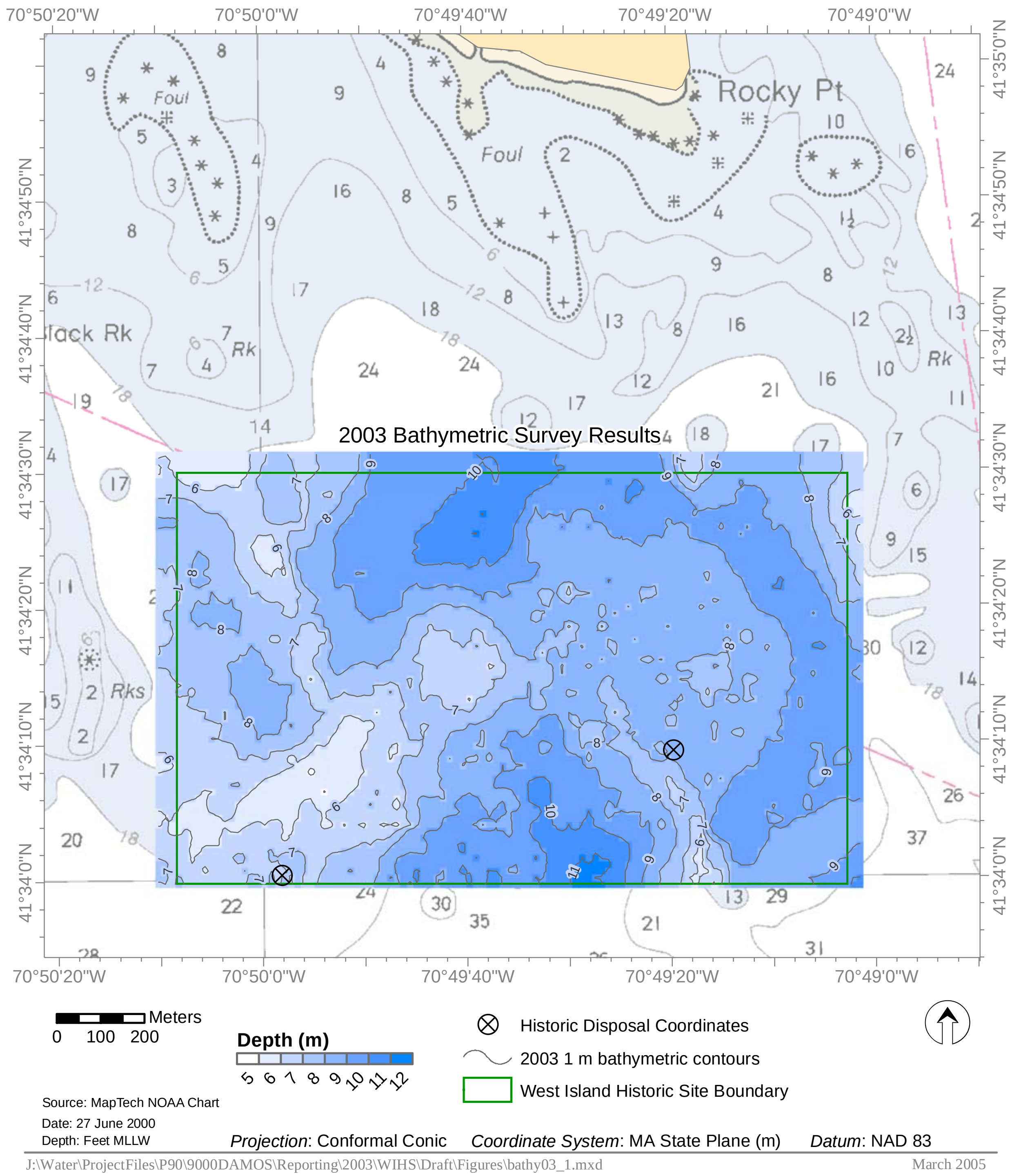

Figure 3-1. Bathymetric contour map of WIHS, 2003 (1-meter contour interval)

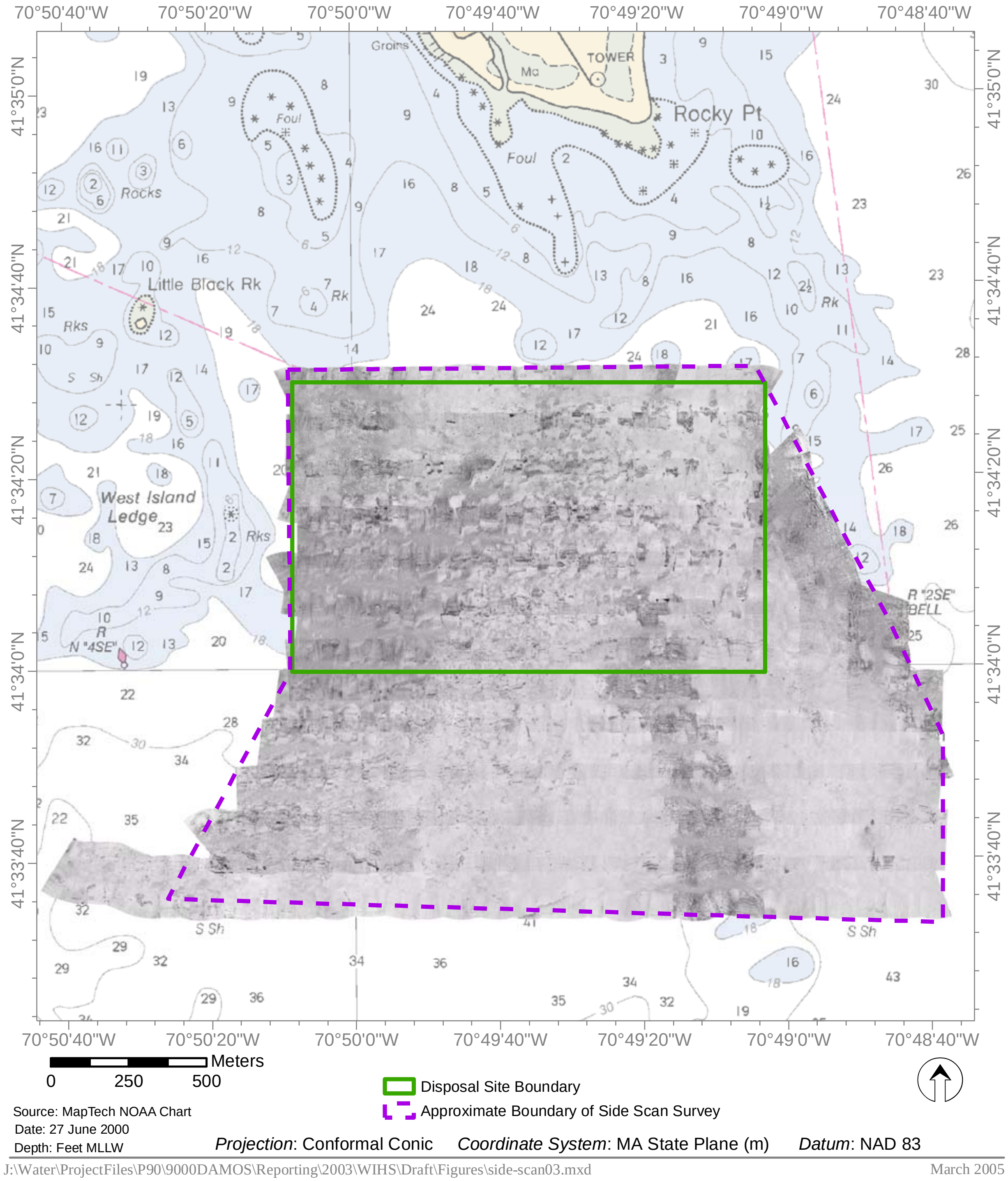

Figure 3-2. Side-scan sonar mosaic image of WIHS, 2003

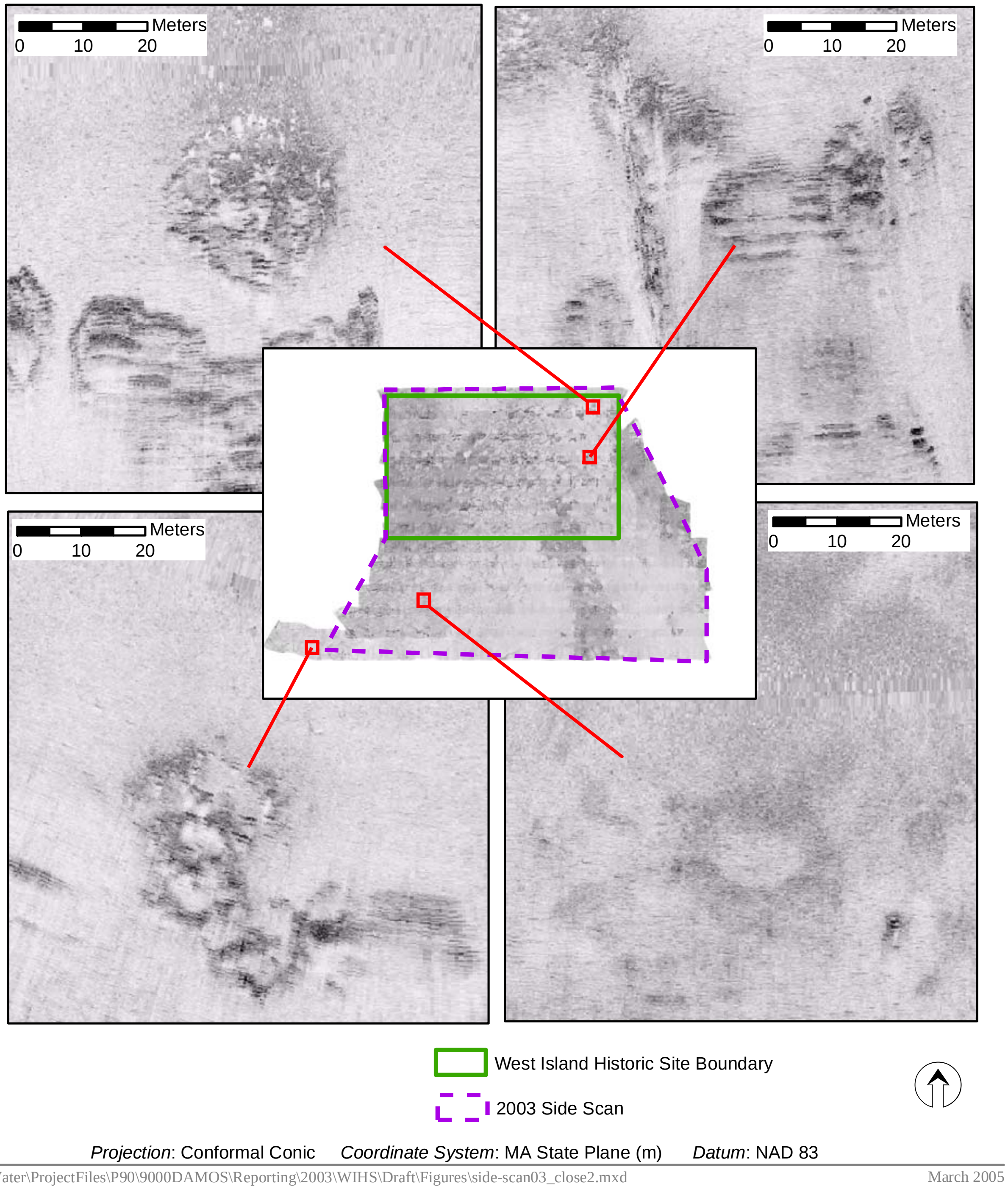

Figure 3-3. Side-scan sonar image of selected WIHS area targets, 2003

3.3 Video Grab Samples

Sediment samples were collected from a total of 41 locations using the video-assisted Ted-Young grab sampler during two site visits in October and December 2003. General positioning of stations within WIHS was based on the results of the bathymetry and side-scan surveys, focusing on depressions with finer grained material or areas with apparent disposal features. The live video was useful for targeting specific areas with finer-grained sediments and avoiding rocks and debris. The video also helped to ground truth the side-scan sonar results.

During the October 2003 survey, 20 locations were sampled; 3 stations were located within New Bedford Harbor as a PCB source reference area, 3 stations were located well south of WIHS as a site reference area, and 14 stations were located within or near WIHS. During the December survey 21 locations were sampled; 5 stations were located to the west of WIHS as an alternative site reference area; 1 station was positioned at a New Bedford Harbor Long Term Monitoring Program station southwest of WIHS (ENSR 2001), and 15 stations were located within or near WIHS. Station coordinates and sample descriptions are provided in Table 3-1.

Sediments within the boundaries of WIHS generally consisted of fine to medium sands with traces of silt and some imbedded shells (Figure 3-4). Algae were noted at the sediment surface of many stations, and a hydrogen sulfide odor was common. At one station (WI-11), the sand contained embedded pockets of a dark silt-clay material. Traces of the silt-clay material were found at one other station (WI-08). Evidence of an established benthic community (tubes, burrows, and actual organisms) was apparent at most stations.

The reference stations in the comparable water depths to the west of WIHS also consisted primarily of sand, but with an increased silt content and an abundance of slipper snails *(Crepidula fornicata)*, both live and remnant shells, at the surface (Figure 3-5). The stations in the deeper water to the south of WIHS consisted of primarily of silt. The PCB reference stations within New Bedford Harbor also consisted primarily of silt with an abundance of quahogs *(Mercenaria mercenaria)* and slipper snails.

3.4 PCB Screening Assay

Composite samples from all of the 41 stations sampled in the 2003 survey were subjected to the screening assay. In addition, the fine-grained nodules that were found embedded within the sample from WI-11 were composited and assayed. The screening assay used to assess PCB contamination in WIHS sediments was a biomarker-based

Table 3-1.

Sediment Grab Sample Location and Description for WIHS, 2003

Phase	Station	Date	Latitude (N)	Longitude (W)	Description
I	WI-01	10/1/2003	41°34.281'	70°49.239'	Medium silty sand. Olive-brown coloration at surface, darker gray with slight odor at depth. Scattered empty shells at surface.
I	WI-02	10/1/2003	41°34.320'	70°49.311'	Sand with shell fragments, nearby cobble & sponge. Olive-brown coloration at surface, darker gray with embedded shells and small stones at depth. Mild sulfide odor. Active amphipod/worm tubes present.
I	WI-03	10/1/2003	41°34.389'	70°49.514'	Sand with shell fragments, abundant patches of algae, some cobbles. Olive-brown fine sand at surface, darker gray at depth. Active amphipod/worm tubes, scattered shells.
I	WI-04	10/1/2003	41°34.383'	70°49.236'	Flat sandy bottom with scattered clumps of algae. Some sediment lofted on impact. Active amphipod/worm tubes. Olive/brown hard packed sand with trace silt at surface, dark charcoal gray to black at depth. Sulfide odor present.
I	WI-05	10/1/2003	41°34.415'	70°49.197'	Flat sandy bottom located about 10-meters from historic disposal remnants. Olive fine sand at surface, dark gray at depth. No detectable odor. Active amphipod/worm tubes.
I	WI-06	10/1/2003	41°34.466'	70°49.220'	Sandy bottom with scattered large cobbles. Olive fine sand with trace silt at surface, gray hard packed sand below. Trace sulfide odor.
I	WI-07	10/1/2003	41°34.415'	70°49.339'	Sandy bottom, abundant patches of algae. Olive hard packed fine sand with shell hash at surface, charcoal gray at depth. Mild sulfide odor. Active amphipod/worm tubes. Razor clams present.
I	WI-08	10/1/2003	41°34.338'	70°49.310'	Sandy bottom, abundant patches of algae. Olive colored fine sand at surface, light gray at depth. Active amphipod/worm tubes. Isolated black patches of embedded silty material and small stones at depth. Mild sulfide odor.
I	WI-09	10/1/2003	41°34.231'	70°49.384'	Sandy bottom, abundant patches of algae. Olive-gray silty sand at surface, dark gray/black hard packed sand at depth. Prominent sulfide odor present.

Table 3-1 (continued).

Sediment Grab Sample Location and Description for WIHS, 2003

Phase	Station	Date	Latitude (N)	Longitude (W)	Description
I	WI-10	10/1/2003	41°34.210'	70°49.146'	Sandy bottom, patches of algae. Brown sand with shell hash at surface, gray hard packed with small gravel at depth. No detectable odor.
I	WI-11	10/1/2003	41°34.120'	70°49.480'	Olive-brown colored fine sand with silt, some shell hash and red algae fibers at surface. Worm tubes present. Material at depth is dark gray to black with embedded pockets of black silt-clay. A discrete sample of the embedded black material was collected. Consistency of homogenized sample "sticky" with trace sulfide odor.
I	WI-12	10/1/2003	41°34.479'	70°49.709'	Brown silty material at surface. Material at depth is dark gray silty sand with bands of darker black material and small gravel. Mild sulfide odor. Worm tubes present.
I	WI-13	10/1/2003	41°33.769'	70°50.166'	Brown silty sand and traces of shell fragments at surface, darker gray at depth with small gravel. No detectable odor.
I	WI-14	10/1/2003	41°33.694'	70°50.004'	Soft, gray clayey silt. Large cloud of sediment lofted on impact. Prominent sulfide odor. Small brittle star observed.
I	WIREF-01	10/1/2003	41°33.299'	70°50.932'	Large cloud of sediment lofted on impact. Olive gray silt at surface over darker gray clay/silt at depth. Worm tubes present.
I	WIREF-02	10/1/2003	41°33.271'	70°49.928'	Olive clay/silt at surface, gray colored with striations of darker black material at depth. Very "sticky" homogenate. Larger worm tubes observed (parchment worms).
I	WIREF-03	10/1/2003	41°33.346'	70°48.477'	Olive clay/silt at surface, gray to black colored material at depth. Worm tubes present.
I	WINBHREF-02	10/1/2003	41°38.006'	70°54.669'	Brown silt at surface, black silt at depth. Abundant Quahog and limpet (*Crepidula fornicata*) shell hash. Strong sulfide / petroleum odor.
I	WINBHREF-03	10/1/2003	41°37.632'	70°54.271'	Olive silt with shell fragments at surface, black silt at depth. Initial station repositioned towards edge of channel to avoid bed of dense Quahog and *Crepidula fornicata* shell hash. Strong sulfide odor.
I	WINBHREF-01	10/1/2003	41°38.594'	70°54.897'	Black sandy silt with embedded shells. Strong sulfide odor.

Table 3-1 (continued).

Sediment Grab Sample Location and Description for WIHS, 2003

Phase	Station	Date	Latitude (N)	Longitude (W)	Description
II	WI2-1	12/9/2003	41°34.448'	70°49.804'	Tan/brown silt at top with charcoal silty sand below. Amphipods present. No odor.
II	WI2-2	12/9/2003	41°34.400'	70°49.738'	Thin layer of silt at surface tan/brown in color, followed by charcoal colored silty sand. Some shell hash and a large scallop shell remnant present.
II	WI2-3	12/9/2003	41°34.438'	70°49.637'	Tan silt, followed by tan colored silty sand below transitioning to charcoal colored silty sand below. Shell hash apparent.
II	WI2-4	12/9/2003	41°34.480'	70°49.582'	Silty sand underlain by tan colored medium-fine silty sand transitioning to charcoal colored sediment below. Amphipods, shell hash present.
II	WI2-5	12/9/2003	41°34.286'	70°49.383'	Olive colored fine sand at surface and fine to medium charcoal sand at depth. Algae at surface and shell hash. Spine crab, worms and amphipods present.
II	WI2-6	12/9/2003	41°34.262'	70°49.422'	Tan colored fine-medium sand at surface transitioning to charcoal color below. Some amphipods present.
II	WI2-7	12/9/2003	41°34.247'	70°49.406'	Light medium sand with grass present at surface followed by charcoal colored sand below. Worms and some shell material present.
II	WI2-8	12/9/2003	41°34.205'	70°49.375'	Olive colored medium silty sand. Small shells and numerous amphipods present.
II	WI2-9	12/9/2003	41°34.026'	70°49.657'	Olive colored material at surface and charcoal colored material below.
II	WI2-10	12/9/2003	41°34.088'	70°49.533'	Silty sand, algae fragments transitioning to charcoal below. Some sulfide odor noted.
II	WI2-11	12/9/2003	41°34.071'	70°49.469'	Olive colored fine material at surface with much darker silty sand below. Worm tubes and shell fragments present.
II	WI2-12	12/9/2003	41°34.011'	70°49.475'	Olive colored fine material at surface with charcoal colored silty sand below, possible clay content also. Some sulfide odor.
II	WI2-13	12/9/2003	41°33.894'	70°49.562'	Tan/brown silty sand at surface to charcoal gray silty sand at depth. Some amphipods present.

Table 3-1 (continued).

Sediment Grab Sample Location and Description for WIHS, 2003

Phase	Station	Date	Latitude (N)	Longitude (W)	Description
II	WI2-14	12/9/2003	41°33.522'	70°49.425'	Light tan colored fine material at surface followed by charcoal colored sandy silt below. Very sticky with very small amount of shell hash.
II	WI2-15	12/9/2003	41°33.762'	70°48.817'	Tan/brown silty sand at surface with red algae and amphipods. Charcoal gray silty sand below.
II	WI2-16	12/9/2003	41° 33.440'	70° 51.723'	Tan/brown colored fine silty sand with gray/charcoal colored silty sand below. Sticky consistency.
II	REF-1	12/9/2003	41° 34.143'	70° 51.172'	*Crepidula fornicata* shell material scattered at surface, underlain with dark silt and shell hash.
II	REF-2	12/9/2003	41° 34.301'	70° 50.917'	Olive colored fine material at surface with *Crepidula fornicata* shells, underlain by black silt with sulfide odor.
II	REF-3	12/9/2003	41° 34.141'	70° 50.966'	*Crepidula fornicata* shell material at surface above olive silt layer, red algae and sea grass fragments. Dark charcoal colored silty sand below.
II	REF-4	12/9/2003	41° 34.025'	70° 51.059'	Tan/brown colored silty sand at surface underlain by charcoal colored sand. Worm tube and shell hash present. Sulfide odor also present.
II	REF-5	12/9/2003	41° 34.185'	70° 50.723'	*Crepidula fornicata* shells covering a thin layer of brown silty ooze underlain by black silty sand.

Notes: All coordinates NAD 83

Figure 3-4. Photographs of WIHS sediment samples WI-03 (top) and WI-11 (bottom)

Figure 3-5. Photographs of sediment sample collected west of WIHS (WI2-REF4)

screening assay for dioxin toxic equivalents (TCDD TEQs) as described in Section 2. The assay was run in triplicate, and the mean and standard deviation were calculated (Tables 3-2 and 3-3). Because selected replicates appeared to be inconsistent with the mean results, an outlier test was performed. The outlier test was applied in cases where the relative standard deviation was greater than 20%. Selected outliers were removed from the dataset with 80% confidence, and the station mean was adjusted (Tables 3-2 and 3-3). The mean values were used in describing the data below and presenting the data in Figures 3-6 and 3-7.

Overall mean sediment TEQ concentrations ranged from 9 to 41 pg/g for samples collected during the two phases of the survey (Tables 3-2 and 3-3). The majority of the samples collected within the bounds of WIHS had concentrations below 15 pg/g (Figure 3-7). One sample (WI2-9) was above 30 pg/g, and the embedded nodule found at WI-11 had a concentration of 28 pg/g. The three samples collected at the source reference area in New Bedford Harbor (Figure 3-6) were at the upper end of the concentrations range found in the study (36-41 pg/g). Three stations west of the WIHS boundary (WI2-16, WI2-REF1, and WI2-REF2 in Figure 3-7) had concentrations at the upper end of the range found in the study (26-39 pg/g).

Five of the stations sampled coincided with sampling locations in the Long Term Monitoring Program that is part of the remediation effort for the New Bedford Harbor Superfund Site (ENSR 2001). These included the three stations within New Bedford Harbor (Figure 3-6) and the two westernmost stations in the study area (WI2-16 and WI2-REF1 in Figure 3-7). The 2003 assay data were compared with the most recent round of sediment PCB data (1999) for these stations, and the results are presented in Table 3-4. The PCB concentrations for these stations (reported as total PCBs) ranged from 0.1 ug/g for the outer harbor stations to 29 ug/g within New Bedford Harbor (Table 3-4).

Table 3-2.

Sediment Assay Results for WIHS, October 2003

Sample ID	Rep 1	Rep 2	Rep 3	Mean	Adjusted Mean[1]
October Survey			pg TEQ / g		
WI-01	12.1	20.3	13.7	15.4	12.9
WI-02	8.8	8.7	11.4	9.6	
WI-03	9.7	9.4	8.3	9.1	
WI-04	9.1	10.3	10.4	9.9	
WI-05	9.3	9.1	11.3	9.9	
WI-06	10.5	10.1	9.4	10.0	
WI-07	9.0	10.0	10.5	9.8	
WI-08	17.5	12.4	14.2	14.7	
WI-09	17.5	17.5	13.5	16.2	
WI-10	10.2	<8.1	9.7	9.3	
WI-11	10.0	8.4	8.6	9.0	
WI-12	10.6	10.0	9.9	10.2	
WI-13	9.6	<8.1	10.0	9.3	
WI-14	20.4	15.4	18.8	18.2	
WIREF-01	19.1	16.6	16.6	17.4	
WIREF-02	25.2	19.1	17.7	20.7	
WIREF-03	17.2	19.1	17.5	17.9	
WINBHREF-01	33.1	36.1	37.6	35.6	
WINBHREF-02	35.3	78.7	41.0	51.6	38.1
WINBHREF-03	27.5	41.9	39.7	36.4	40.8
WI-11-Nodule	25.3	23.2	35.5	28.0	24.2
Quality Control					
NY/NJ SRM 1944[2]	202.7	175.4	194.4	190.8	
NY/NJ SRM 1944	170.7	165.0	157.5	164.4	
Sand Blank[3]	6.4	4.9	5.5	5.6	

Notes:
[1] Adjusted average based on results of outlier test
[2] NY/NJ SRM 1944 contains approximately 250 pg TEQ/g (true value)
[3] Sand blank is Ottawa sand standard

Table 3-3.

Sediment Assay Results for WIHS, December 2003

Sample ID	Rep 1	Rep 2	Rep 3	Average	Adjusted Mean[1]
December Survey					
WI2-1	21.8	19.9	25.1	22.3	
WI2-2	13.7	12.6	20.0	15.4	13.1
WI2-3	12.8	13.5	13.8	13.4	
WI2-4	12.7	13.6	15.1	13.8	
WI2-5	9.4	11.1	17.4	12.6	10.2
WI2-6	14.1	10.9	14.4	13.1	
WI2-7	14.4	14.4	19.9	16.2	
WI2-8	18.2	16.7	17.1	17.3	
WI2-9	45.0	40.8	31.1	39.0	
WI2-10	24.4	13.5	16.0	17.9	
WI2-11	16.7	11.2	9.4	12.4	
WI2-12	25.7	16.7	15.4	19.2	16.0
WI2-13	14.9	9.8	<9.4	11.4	
WI2-14	36.5	16.6	19.7	24.2	18.1
WI2-15	19.1	12.2	18.6	16.6	18.8
WI2-16	29.1	21.8	27.5	26.1	
WI2-REF1	36.0	34.1	28.7	32.9	
WI2-REF2	35.7	43.6	37.9	39.0	
WI2-REF3	13.3	12.2	15.5	13.7	
WI2-REF4	<9.4	10.7	23.1	14.4	
WI2-REF5	17.3	15.8	27.7	20.3	16.6
Quality Control					
NY/NJ SRM 1944[2]	216.5	182.3	197.5	198.8	
Sand Blank[3]	8.7	8.9	11.6	9.7	

Notes:
[1] Adjusted average based on results of outlier test
[2] NY/NJ SRM 1944 contains approximately 250 pg TEQ/g (true value)
[3] Sand blank is Ottawa sand standard

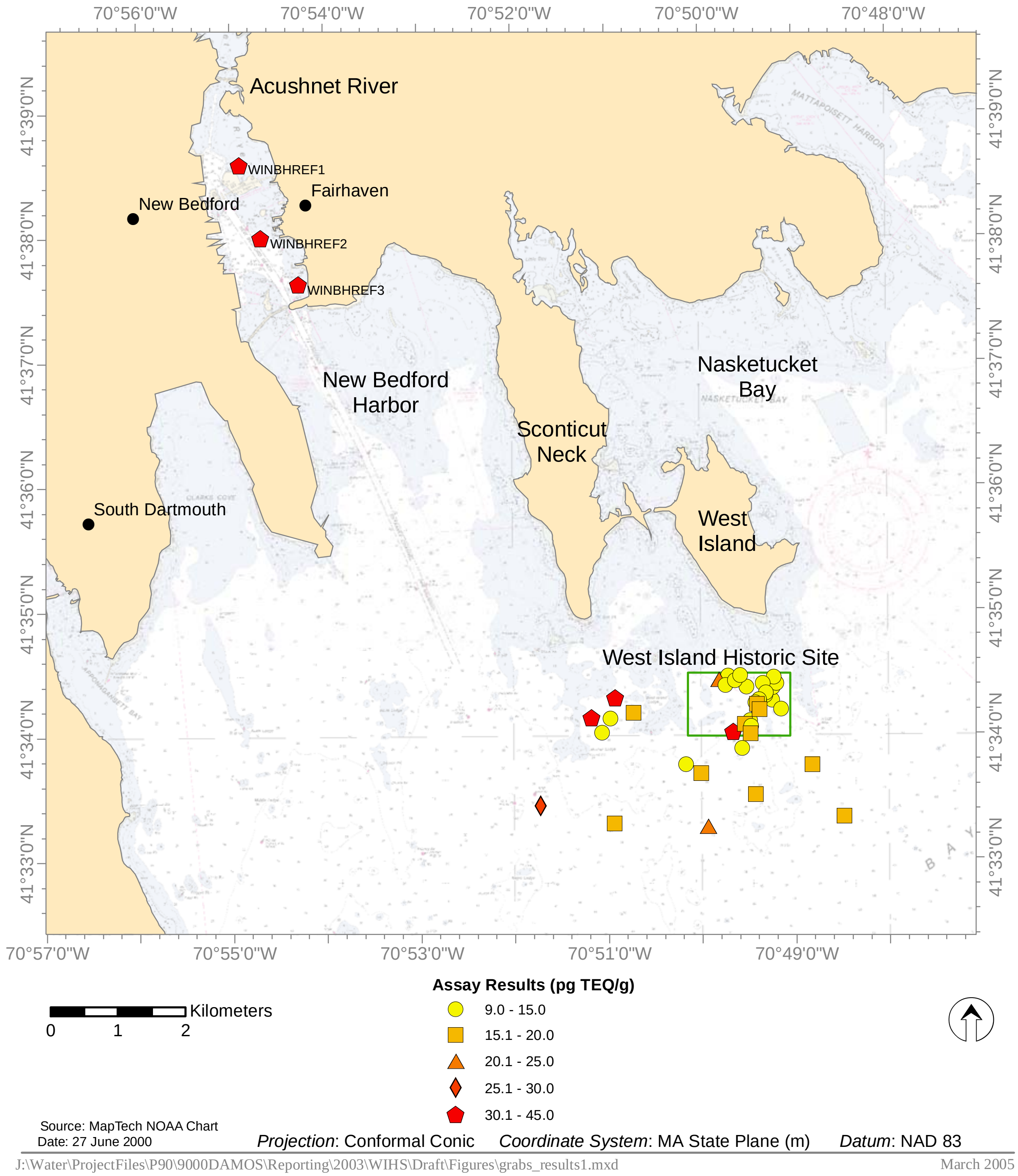

Figure 3-6. Sediment assay results for all 2003 sampling locations

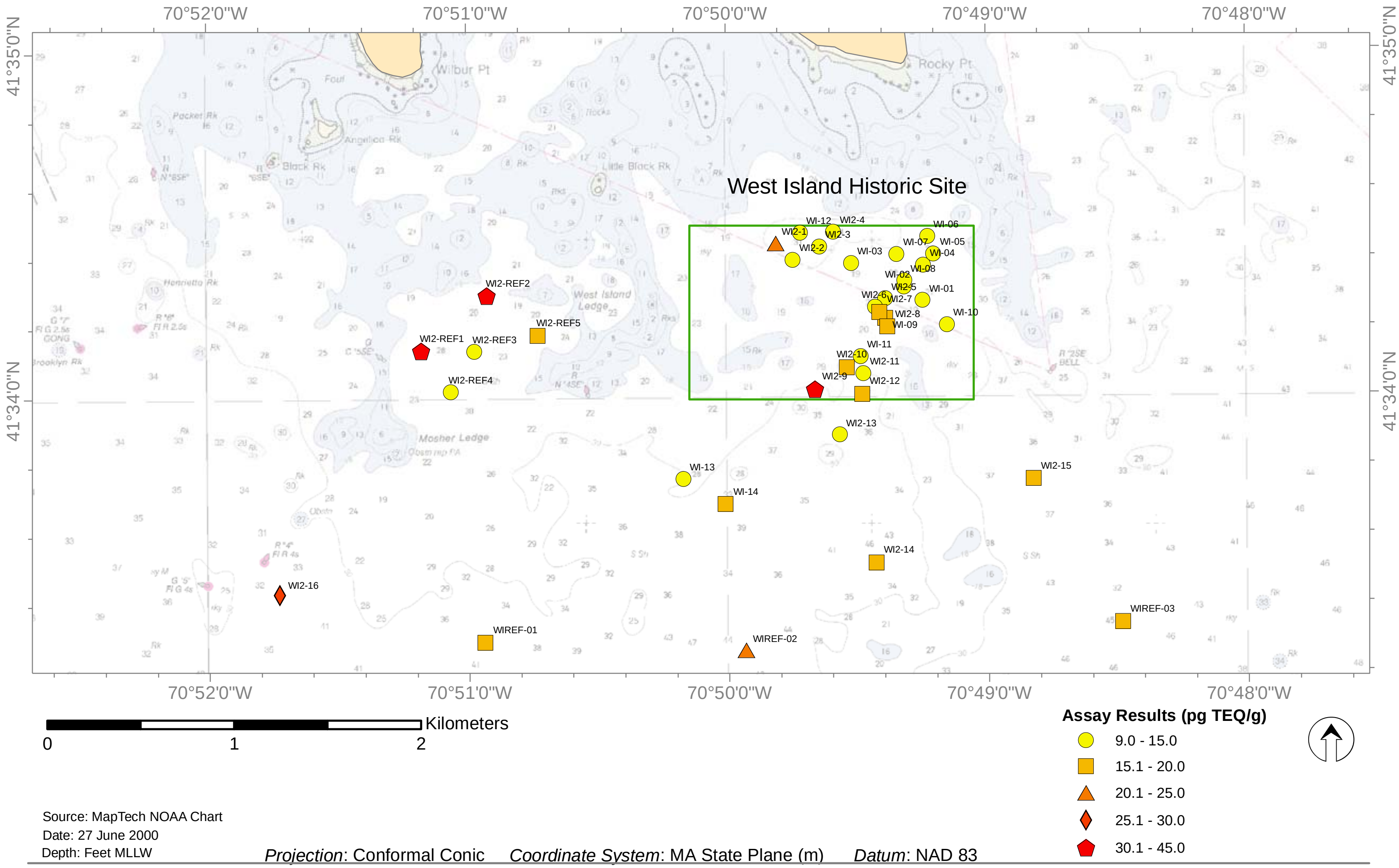

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Figure 3-7. Sediment assay results for WIHS area 2003 sampling locations

Table 3-4.

Co-Located Chemistry Results from the West Island and Long Term Monitoring (III) Surveys

Location	Sample ID	% TOC[1]	TEQ (pg/g)[2]	Total PCBs (ug/g)[3]
New Bedford Harbor Stations	WINBHREF01 (2003)	-	35.6	-
	LTM-221 (1999)	8.2	-	29
	WINBHREF02 (2003)	-	38.1	-
	LTM-236 (1999)	4.2	-	15
	WINBHREF03 (2003)	-	40.8	-
	LTM-247 (1999)	3.3	-	10
Buzzards Bay Stations	WI2-REF1 (2003)	-	32.9	-
	LTM-335 (1999)	0.58	-	0.1
	WI2-16 (2003)	-	26.1	-
	LTM-341 (1999)	1.3	-	0.2

[1]Total Organic Carbon, from the Long Term Monitoring (LTM) Survey III (ENSR, 2001).
[2]2,3,7,8-TCDD Toxic Equivalents (TEQs)
[3]Total PCB results from the Long Term Monitoring (LTM) based the sum of 18 NOAA Congeners x 2.6 (Foster Wheeler Environmental Corp. 2001)

4.0 DISCUSSION

The area around WIHS has been characterized as an erosional zone based on its general location, exposed to Buzzards Bay with an extended fetch to the south and southwest, and the coarse nature of the sediments (MCZM 2000). The 2003 survey supported this finding with the bathymetry, side-scan, and video all identifying multiple areas of exposed rock. Sediments that were found in the deeper areas between the rock outcrops were generally uniform and consisted of sand, gravel, and shells; sand waves were visible on the bottom in some locations. These characteristics were indicative of a high energy environment, and any fine-grained material placed at WIHS would likely have been resuspended and transported away from the site over time.

Although no records exist detailing historic disposal at WIHS, it is generally accepted that dredged material from New Bedford, Fairhaven, and other nearby harbors was placed at the site up until the mid 1970s. The 2003 survey found remnants of that historic disposal. The bathymetric survey identified numerous small features rising 1 to 2 m off the bottom. The side scan survey further characterized these features as mounds or rings of coarse-grained or large-scale material. The video captured during the sampling effort identified some of these features as piles of heavily encrusted rock and/or demolition debris. These disposal remnants were distributed across WIHS and extended well beyond its southern boundary. This distribution was consistent with the layout of the site, with the only deeper water approach for vessels from the south (Figure 1-1).

The biomarker-based assay that was used in this study screened for dioxin toxic equivalents (TCDD TEQs). The assay did not specifically test for PCBs, rather it measured the activity of dioxin and dioxin-like chemicals, including PCBs and PAHs. As such the assay was intended as a screening level test to assess the potential for elevated concentrations of PCBs in the surficial sediments at WIHS. Samples were collected at three stations within New Bedford Harbor as a source reference area (Figure 3-6). TEQ concentrations ranged from 36 to 41 pg/g for these reference samples. Previous laboratory analysis of samples collected from the same stations as part of the USEPA's Long Term Monitoring Program for the New Bedford Superfund Site identified total PCB concentrations of 10 to 29 ug/g (ENSR 2001). These concentrations are typical for Lower New Bedford Harbor where historic dredging was likely to have occurred and fall below the 50 ug/g cleanup standard set for the more contaminated subtidal areas of the Lower Harbor (USEPA 1998).

Twenty-four grab samples were collected for analysis within the boundaries of WIHS, targeting areas identified by the bathymetry and side scan that had the greatest potential to be depositional. These samples consisted primarily of sand with a limited amount of silt near the surface. Consolidated nodules of fine-grained material were found in only one of the samples. The majority of the samples collected at WIHS had TEQ concentrations less than 15 pg/g, approximately one-half to one-third that of the samples collected within New Bedford Harbor. A TEQ concentration similar to those at the New Bedford Harbor stations was only reported at one station within WIHS.

Additional samples were also collected outside of the WIHS boundary. Three stations to the west of WHIS had TEQ concentrations similar to those of samples from New Bedford Harbor (Figure 3-7). Two of these stations were also part of the Long Term Monitoring Program, and previous sampling reported total PCB concentrations of 0.1-0.2 ug/g for these stations (ENSR 2001). As the assay technique is not specific for PCBs, the elevated TEQ concentration at these station may have been due to the activity of other chemicals.

TEQ concentrations for the standards used as quality control for the assay test ranged from 5 to 12 pg/g for the sand blank to 160 to 220 pg/g for the New York/New Jersey Harbor reference sample. This reference sample had a documented TEQ concentration of 250 pg/g and a total PCB concentration of approximately 2 ug/g. Compared to the quality control standards, TEQ concentrations for this study displayed a much more narrow range, from 9 to 41 pg/g. For the five stations that overlapped with previous sampling and PCB analysis as part of the New Bedford Harbor Superfund Site Long Term Monitoring Program, assay results ranged over about a factor of two (26 to 41 pg/g) while the previously reported total PCB concentrations ranged over more than two orders of magnitude (0.1 to 29 ug/g) (Table 3-4), indicating that the assay test had a lower sensitivity for the PCBs present in the New Bedford Harbor area. Nevertheless, a consistent difference was noted between the assay results for samples from WIHS and from New Bedford Harbor indicating, at a screening level, a reduced likelihood for significant PCB contamination in WIHS sediments.

5.0 CONCLUSIONS

The 2003 survey at WIHS included the collection of bathymetry and side-scan data as well as the collection of sediment samples using a video-assisted grab sampler. The survey was designed to provide physical characterization of WIHS and a screening-level assessment of the potential magnitude and distribution of PCBs residing in surficial sediments

The bathymetry and side-scan surveys and the video performed as part of the sampling all identified the presence of historical disposal at WIHS; individual rings and mounds as well as clusters of features rising 1 to 2 m above the bottom were distributed across and to the south of WIHS. However, the survey results also indicated that the disposal features consisted of coarse-grained material or large stone/debris and that much of the site was exposed rock outcrop. Sampling that targeted deeper, apparently finer grained areas of WIHS revealed sediments composed primarily of sand. This information supports the previous classification of WIHS as an erosional area (MCZM 2000). Hence, any fine-grained material that was historically disposed at WIHS was likely resuspended and transported away from the site by wave and current action. As contaminants such as PCBs are typically associated with fine-grained sediments, the physical characteristics of WIHS limit the potential for extensive PCB contamination. Although the assay technique that was used appeared to have a relatively low sensitivity for New Bedford Harbor PCBs, the results of the screening level testing supported the physical assessment of limited potential for PCB contamination at WIHS.

Given the results of the 2003 survey, no additional investigations at WIHS are recommended at this time.

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