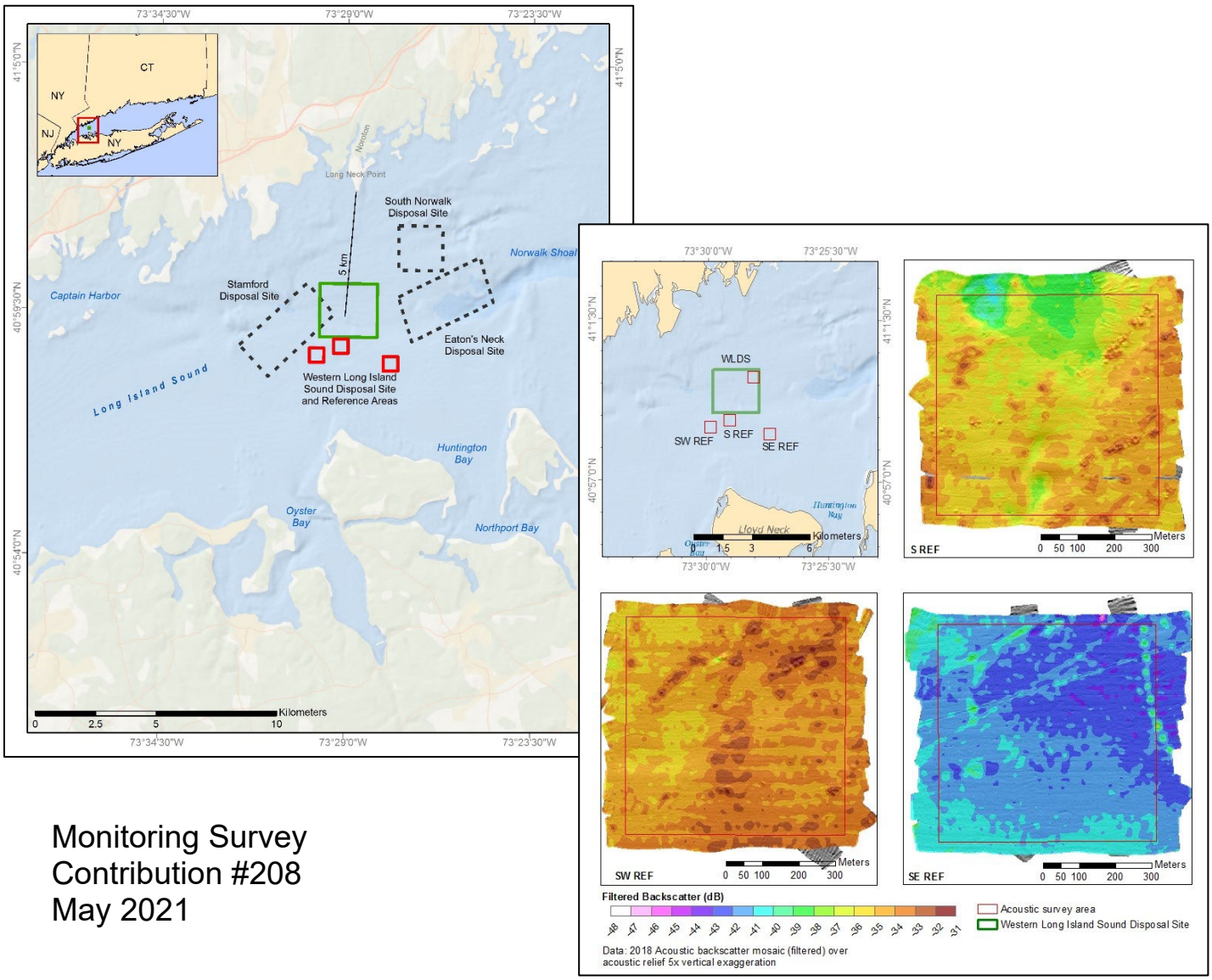
Monitoring Survey of the Western Long Island Sound Disposal Site - October 2018

Disposal Area Monitoring System DAMOS



Monitoring Survey
Contribution #208
May 2021

D A M O S
DISPOSAL AREA MONITORING SYSTEM

US Army Corps of Engineers ®
New England District

MONITORING SURVEY OF THE WESTERN LONG ISLAND SOUND DISPOSAL SITE OCTOBER 2018

CONTRIBUTION # 208
May 2021

Contract No. W912WJ-17-D-0003
Report No.

Submitted to:

Environmental Branch, Planning Division
New England District
U.S. Army Corps of Engineers
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US Army Corps of Engineers ®
New England District

REPORT DOCUMENTATION PAGE

form approved
OMB No.

1. AGENCY USE ONLY (LEAVE BLANK)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	May 2021	FINAL REPORT

4. TITLE AND SUBTITLE
Monitoring Survey of the Western Long Island Sound Disposal Site, October 2018

5. FUNDING NUMBERS

6. AUTHOR(S)
AECOM and CR Environmental, Inc.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER
AECOM- 60589083.8

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Corps of Engineers-New England District
696 Virginia Rd
Concord, MA 01742-2751

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Contribution No. 208

11. SUPPLEMENTARY NOTES
Available from DAMOS Program Manager, Evaluation Branch
USACE-NAE, 696 Virginia Rd, Concord, MA 01742-2751

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT

A confirmatory survey was conducted in October 2018 at the Western Long Island Sound Disposal Site (WLDS) as part of the Disposal Area Monitoring System (DAMOS) Program. The 2018 survey consisted of an acoustic (multibeam bathymetry, side scan sonar, and backscatter) survey to provide physical information about a selected area of the seafloor within the site and associated reference areas. Sediment grab samples were also collected within three areas of the current WLDS. These areas were selected based on visible markers from the 2014 multibeam echo sounder data, collected under the DAMOS Program, and were designated as follows for the purposes of this survey; active mound area (where dredged material has been disposed over the past 10 years), inactive mound area (where dredged material disposal was targeted from the beginning of the formal use of WLDS), and the historic area (with no formal record of disposal). Based on the 2014 survey, there was evidence of historical disposal (prior to formal record keeping or testing) over all three sampling areas. Sediment chemistry values were used to provide information about the chemical concentrations within the three areas of the site and the reference areas.

The results of the 2018 acoustic survey were used to delineate dredged material distribution and mound formation over the northeast corner of the site, which has been actively receiving dredged material since this area was last surveyed in 2014. Between 2014 and 2018 approximately 82,000 m^3 (107,000 yd^3) of dredged material was placed within the northeast corner of the site. Results of the sediment grab sampling survey were used to measure sediment chemistry at the site and to compare site concentrations to regional sediment quality guidelines (SQGs), represented as the Effects Range Low and Effects Range Median (ER-L and ER-M, respectively) and provided comparison to the reference area chemical concentrations. Sediment nutrient results were used to provide a general comparison of nutrients at the site and reference areas using the upper confidence limit model.

The multibeam bathymetric survey was conducted over a 600 m x 600 m square polygon within the northeast corner of WLDS, and 600 m x 600 m square polygons over each of the three reference areas. Two mounds were documented within the WLDS survey area; the previously formed Mound N and newly formed Mound O. Mounds N and O both rise approximately 5 m from the ambient seafloor, Mound N spans approximately 150 m in diameter and Mound O is approximately 250 m in diameter.

Sediment grab samples were collected from nine locations within WLDS and from nine locations within the reference areas. Results of the sediment grab sampling survey indicated that areas within WLDS contained levels of certain chemicals above ER-Ls and exhibited concentrations above the ER-M value for the sum of the alpha and gamma chlordane isomers in one sample near Mound N. However, there is a high level of uncertainty in the SQGs for total chlordane, in both the screening value itself and the chlordane isomers included within the calculation; results of this screening exercise should be viewed with caution considering these inconsistencies. The ER-M value for high molecular weight polycyclic aromatic hydrocarbons (HMW PAHs) was also exceeded at a station within the historic area of the site where there were no recorded disposals of dredged material. In addition, the SE REF area contained higher levels of chemicals relative to ER-Ls and in comparison to the other two reference areas.

Historical chemistry data were analyzed and compared to the 2018 chemistry data to assess overall trends in sediment health within WLDS and associated reference areas. In general, sediments within both the site and reference areas are displaying downward trends in chemical concentrations, most notably for metals and hydrocarbons.

14. SUBJECT TERMS	15. NUMBER OF TEXT PAGES:
DAMOS, Disposal Site, Dredged Material, Long Island Sound	101
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified			

Note on units of this report: As a scientific contribution, information and data are presented in the metric system. However, given the prevalence of English units in the dredging industry of the United States, conversions to English units are provided for the general information in Section 1. A table of common conversions can be found in Appendix C.

Citation:

United States Army Corps of Engineers, New England District. 2021. Monitoring Survey of the Western Long Island Sound Disposal Site, October 2018. *Prepared by:* AECOM Technical Services, Inc. and CR Environmental.

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EXECUTIVE SUMMARY

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The multibeam bathymetric survey was conducted over a 600 m x 600 m square polygon within the northeast corner of WLDS, and 600 m x 600 m square polygons over each of the three reference areas. Two mounds were documented within the WLDS survey area; the previously formed Mound N and newly formed Mound O. Mounds N and O both rise approximately 5 m from the ambient seafloor, Mound N spans approximately 150 m in diameter and Mound O is approximately 250 m in diameter.

Sediment grab samples were collected from nine locations within WLDS and from nine locations within the reference areas. Results of the sediment grab sampling survey indicated that areas within WLDS contained levels of certain chemicals above ER-Ls and exhibited concentrations above the ER-M value for the sum of the alpha and gamma chlordane isomers in one sample near Mound N. However, there is a high level of uncertainty in the SQGs for total chlordane, in both the screening value itself and the chlordane isomers included within the calculation; results of this screening exercise should

be viewed with caution considering these inconsistencies. The ER-M value for high molecular weight polycyclic aromatic hydrocarbons (HMW PAHs) was also exceeded at a station within the historic area of the site where there were no recorded disposals of dredged material. In addition, the SE REF area contained higher levels of chemicals relative to ER-Ls and in comparison to the other two reference areas.

Historical chemistry data were analyzed and compared to the 2018 chemistry data to assess overall trends in sediment health within WLDS and associated reference areas. In general, sediments within both the site and reference areas are displaying downward trends in chemical concentrations, most notably for metals and hydrocarbons.

The 2018 monitoring survey of WLDS confirmed the continued stability of dredged material disposal mounds at the site and identified varying concentrations of some chemicals in surficial sediments at areas with dredged material deposits, areas with no documented dredged material disposal activity, and at the WLDS reference areas. This is consistent with the understanding that historical disposal of dredged material (and potentially other debris/wastes) occurred within the footprint of the existing WLDS and surrounding area long before there were requirements for sampling, testing, or disposal tracking. Additionally, all three WLDS reference areas exhibited evidence of anthropogenic impacts including historical dredged material disposal and trawling scars. Future monitoring work at WLDS should continue regularly to track the placement of newly placed dredged material and assess benthic recovery following the DAMOS Program tiered assessment protocol. Sediment grab samples should be collected periodically to monitor sediment quality within the site compared to the data collected during this study, at reference areas, and with appropriate sediment quality guidelines.

LIST OF ACRONYMS

aRPD	Apparent Redox Potential Discontinuity
As	arsenic
ASCII	American Standard Code for Information Interchange
CAS	Chemical Abstracts Service
Cd	cadmium
CI	confidence interval
CLDS	Central Long Island Sound
cm	centimeters
Cu	copper
Cr	chromium
CTD	Conductivity, Temperature, and Depth
CVAA	Cold Vapor Atomic Absorption
DAMOS	Disposal Area Monitoring System
dB	decibel
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DGPS	differential GPS
ER-L	effects range low
ER-M	effects range median
FNP	Federal Navigation Project
ft	foot/feet
F/V	Fishing Vessel
GC-ECD	Gas Chromatography/Electron Capture Detector
GC-MS	Gas Chromatography/Mass Spectrometry
GIS	geographic information system
GPS	Global Positioning System
GRD	gridded file format
Hg	mercury

HMW	high molecular weight
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
kHz	kilohertz
km	kilometer
km^2	square kilometer
LCS	laboratory control sample
Pb	lead
LIIS	Long Island Sound Study
LMW	low molecular weight
m	meter
m^3	cubic meter
MB	method blank
MBES	multibeam echosounder
MDL	method detection limit
mg/kg	milligrams per kilogram
mi^2	square mile
MLLW	Mean Lower Low Water
MRU	motion reference unit
msec	millisecond
µg/kg	micrograms per kilogram
N	nitrogen
NAD 83	North American Datum of 1983
NAE	USACE, New England District
Ni	nickel
nmi	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NTRIP	Networked Transport of Radio Technical Commission for Maritime Services (RTCM) via Internet Protocol
P	phosphorus
PAHs	polycyclic aromatic hydrocarbons

PCBs	polychlorinated biphenyls
PPS	pulse per second
PV	plan-view
QAPP	Quality Assurance Project Plan
QC	quality control
RIM	Regional Implementation Manual
ROV	Remotely Operated Vehicle
RTCM	Radio Technical Commission for Maritime Services
RTK GPS	Real Time Kinematic Global Positioning System
R/V	Research Vessel
SMMP	Site Management and Monitoring Plan
SOP	Standard Operating Procedure
SPARROW	Spatially Referenced Regression on Watershed Attributes
SPI	sediment-profile imaging
SQGs	Sediment Quality Guidelines
SVP	sound velocity profile
TIF	tagged image file
TKN	Total Kjeldahl nitrogen
TOC	total organic carbon
UNH/NOAA CCOM	University of New Hampshire's NOAA Center for Coastal and Ocean Mapping
UCL	Upper Confidence Limit
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WLDS	Western Long Island Sound Disposal Site
yd	yard
yd^3	cubic yard
Zn	zinc

1.0 INTRODUCTION

A monitoring survey was conducted at the Western Long Island Sound Disposal Site (WLDS) (the site) in October 2018 as part of the United States Army Corps of Engineers (USACE) New England District (NAE) Disposal Area Monitoring System (DAMOS) Program. DAMOS is a comprehensive monitoring and management program designed and conducted to address environmental concerns surrounding the placement of dredged material at aquatic disposal sites throughout the New England region. An introduction to the DAMOS Program and WLDS, including a brief description of previous dredged material disposal and site monitoring activities, is provided below.

1.1 Overview of the DAMOS Program

The DAMOS Program features a tiered management protocol designed to ensure that any potential adverse environmental impacts associated with dredged material disposal are promptly identified and addressed (Germano et al., 1994). For over 40 years, the DAMOS Program has collected and evaluated dredged material disposal site data throughout New England. Based on these data, patterns of physical, chemical, and biological responses of seafloor environments to dredged material placement activity have been documented along with evaluation of impacts to water quality (Fredette and French, 2004).

DAMOS monitoring surveys fall into two general categories: confirmatory studies and focused studies. The data collected and evaluated during these studies provide answers to strategic questions in determining next steps in the disposal site management process. DAMOS monitoring results guide the management of disposal activities at existing sites, support planning for use of future sites, and evaluate the long-term status of historical sites (Wolf et al. 2012).

Confirmatory studies are designed to test hypotheses related to expected physical and ecological response patterns following placement of dredged material on the seafloor at established, active disposal sites. Several survey techniques are employed in order to characterize dredged material placement. Sequential acoustic monitoring surveys (including bathymetric and acoustic backscatter measurements and side-scan sonar) are made to characterize the height and extent of discrete dredged material deposits or mounds created at open water sites as well as the accumulation/consolidation of dredged material into confined aquatic disposal cells. Sediment-profile imaging (SPI) and plan-view (PV) imaging surveys are often included in confirmatory surveys to provide further physical characterization of the material and to support evaluation of seafloor (benthic) habitat and recovery over time.

Focused studies are periodically undertaken within the DAMOS Program to evaluate candidate sites, as baseline surveys at new sites, to evaluate inactive/historical disposal sites, and to contribute to the development of dredged material placement and capping techniques. Focused DAMOS monitoring surveys often feature additional types of data collection

activities as deemed appropriate to achieve specific survey objectives, such as grab sampling of sediment for physical and biological analysis, sub-bottom profiling, sediment coring, towed video, or video collection via a remotely operated vehicle (ROV).

The survey discussed herein included elements of both a confirmatory survey and a focused study which employed the use of acoustic survey techniques to monitor the buildup and stability of recently placed dredged material and a focused sediment grab sampling survey to gain information on the concentration of specific chemical components of newly placed materials as well as historical dredged materials and reference areas.

1.2 WLDS Background

WLDS is located approximately 5 kilometers (km) (2.7 nautical miles [nmi]) south of Long Neck Point, Noroton, Connecticut and covers a square area approximately 5.3 square kilometers (km^2) (2 square miles [mi^2]) in size, centered at 40° 59.50' N, 73° 28.95' W in the North American Datum of 1983 (NAD 83) (Figure 1-1). WLDS is surrounded by three historical disposal sites (Stamford, South Norwalk, and Eaton's Neck) (Figure 1-1). This entire area of western Long Island Sound was likely the site of historical dredged material disposal (potentially with other debris and wastes) long before there were any restrictions on disposal or requirements for sampling and testing.

WLDS has been officially used as a disposal site since 1982 receiving formal designation by the United States Environmental Protection Agency (USEPA) in 1995. In general, WLDS has accepted small to moderate volumes of dredged material from projects along the Connecticut and New York coasts of Long Island Sound. WLDS is jointly managed by the USEPA and USACE. The historical disposal management strategy at the site featured controlled placement of dredged material to form a ring/containment cell on the seafloor in the south-central portion of the site. Most recently, the disposal strategy within WLDS has shifted to focus on the northeast corner of the site.

Water depths at WLDS slope from their shallowest point along the northern portion of the site to their deepest in the central portion of the site, ranging from 23 to 35 meters (m) (75 to 115 feet [ft]), respectively. Water depths again decrease in the southern portion of the site (26 m [85 ft] minimum depth), and mounds are present in the central and deepest portion of the site forming a ringed structure on the seafloor (Figure 1-2).

1.3 Historical Disposal Activity at WLDS

WLDS regularly received sediment from regional dredging projects from 1982 through 2005. During this time, an estimated 875,000 cubic meters (m^3) (1.14 million cubic yards [yd]^3) of dredged material was placed in a directed manner on the seafloor. The early management strategy for WLDS focused on forming a ringed structure in the south-central portion of the site. Mounds A through M in this ring are identifiable in bathymetric surveys and rise up to 3 m (9.8 ft) above the ambient seafloor (Figure 1-2).

In the early 1980's, Mounds A and B were formed prior to the management decision to form a ring of mounds. The placement of dredged material at WLDS between 1986 and 1999 resulted in the formation of six disposal mounds (C, D, E, F, G, and I) forming a ring partially enclosing a containment cell that covers an area of approximately 0.3 km² (0.1 mi²) in the south-central region of WLDS (SAIC, 2002) (Figure 1-3). Between 1997 and 2004, Mounds J, K, and L were formed in an effort to refine and complete the structure of the containment cell. During the 2004-2005 season, Mound M was formed to further enhance the ring-shaped containment formation. Between 2005 and 2010, additional dredged materials were placed at Mounds M, F, J, and K. Beginning in 2010, dredged materials were placed in the northeast corner of the site, forming Mound N in the 2010-2011 dredging season.

1.4 Previous Surveys at WLDS

A summary of all WLDS monitoring events from 1990 through 2014 is presented in Table 1-1. Most recently, in 2014, a confirmatory study was conducted at the site that included performance of an acoustic survey that documented a well-formed ring structure in the central region of the site and a mound in the northeast corner which was in the early stages of formation. Bathymetric survey data collected during the 2014 survey depicted the central portion of the site as relatively smooth, ranging in depth from 30 to 38.5 m (98.4 to 126.3 ft). The signature of isolated disposals were visible on the 2014 side scan sonar within the site as circular features (pits with raised rims approximately 20 m [65.6 ft] in diameter). The 12 circular mounds in the southern central portion of the site (A through M) were visible and two mounds in the northeast corner of the site (N and "unnamed" at the time of the survey) were also visible. Within the northeast corner, Mound N rose approximately 6 m (19.7 ft) above the surrounding seafloor, and the unnamed mound was visible to the south of Mound N, rising approximately 2 m (6.6 ft) above the seafloor (Guarinello and Carey, 2017).

In 2014, a SPI survey was conducted to assess the physical and biological conditions of WLDS as well as the associated reference areas (SW REF, S REF, SE REF). Statistical results in 2014 showed disposal mound aRPD (apparent Redox Potential Discontinuity) values to be significantly less than reference area values. Successional stage results from 2014 were statistically equivalent to reference area results.

Sediment grain size data from grab samples collected during the 2014 survey were dominated by silt, clay, and fine sand with some areas of medium to coarse sand and gravel. Total Organic Carbon (TOC) values at the site and reference areas ranged from 0.9 to 2.4%, with TOC increasing as the percentage of fines increased.

Grab samples were also collected for benthic community analysis in 2014, and a total of 55 species were found within both the site and the reference areas. The mean species richness was 14 per station. The overall species abundance was 963 with a mean of 80 individuals per station (Guarinello and Carey, 2017).

1.5 Recent Disposal Activity

Since the previous DAMOS survey in 2014, approximately 82,000 m^3 (107,000 yd^3) of material have been placed at WLDS, all targeted within the northeast corner of the site. A summary of recent disposal activities is presented in Table 1-2 and depicted in Figures 1-3 and 1-4. A detailed record of scow disposal activity at WLDS for the period from 2014 to 2018, including the origins of dredged material, the volumes deposited, and the disposal locations, is provided in Appendix A.

1.6 Study Objectives

The 2018 survey was designed with both confirmatory and focused DAMOS survey elements to address the following objectives:

- Characterize the seafloor topography and surficial features over the active portion of WLDS and three associated reference areas by completing a high-resolution acoustic survey, including the use of bathymetry, backscatter, and side-scan sonar;
- Characterize the surficial sediment quality across the site and the associated reference areas through the collection of sediment samples for laboratory analysis of sediment chemistry and the screening of analytical results against sediment quality guidelines, and
- Collect surface sediments and conduct analytical laboratory analysis to determine the nutrient content of site and reference area sediments; results are intended to further inform stakeholders about the nutrient content of dredged materials compared to nutrient loads from watershed sources within western Long Island Sound.

Table 1-1.

Previous Surveys at WLDS

Year	Survey Type	Bathymetric Survey Area (m x m)	No. SPI Stations	Other	Citation	DAMOS Contribution No.
1990	Monitoring	800 x 800 3000 x 2500	77	CTD, DO, Chemical Sediment Chemistry Grab, Grain Size	Germano et al.,1993	85
1991	Monitoring	1200 x 800	77	CTD, DO, Grain Size, TOC, Metals, PAH	Williams, 1995	99
1992	Monitoring, reference area investigation	1200 x 1000	64	CTD, DO, Toxicity, Grain Size, TOC, Metals, PAH, Pesticides, PCBs	Eller and Williams, 1996	102
1996	Monitoring, reference area investigation	1400 x 1000	41		Morris, 1998	119
1997	Monitoring	800 x 800	39	Side-scan	Murray and Saffert, 1999	125
1998	Reference area investigation	1500 x 4000	60	Side-scan, Grain Size, TOC, Metals, PAH, Pesticides, PCBs	Murray and Saffert, 1999	125
2001	Monitoring	1000 x 1000	47		SAIC, 2002	138
2004	Monitoring	1200 x 1200	60		ENSR, 2005	161
2005	Monitoring	2600 x 2800			ENSR, 2007	177
2014	Monitoring	2700 x 2900	45	Grain Size, TOC, Benthic Community Structure	Guarinello and Carey, 2017	199

Notes: CTD - Conductivity, Temperature, and Depth; DO - Dissolved Oxygen; TOC - Total Organic Carbon; PAH - polycyclic aromatic hydrocarbons; PCB - polychlorinated biphenyls

Table 1-2.

Summary of Recent Disposals at WLDS

Project	Disposal Year	Mound	Volume (m^3)	Volume (yd^3)
Five Mile River	2014	O	153	200
Sheree Frank	2014	O	306	400
Miltco	2015	O	238	312
American Yacht Club	2015	O	16,065	21,000
Brewer Yacht Haven Marina	2016	O	8,185	10,700
Riverside Landing Association	2016	O	883	1,154
Mianus Harbor Federal Navigation Project (FNP)	2017	O	37,868	49,500
Noroton Yacht Club	2017	O	1,124	1,470
Riverside Yacht Club	2017	O	230	301
Soundwaters, Inc.	2017	O	2,171	2,839
Beacon Point Marina	2017	O	3,320	4,341
Norwalk Cove Marina	2017/2018	O	11,411	14,916
Total			**81,954**	**107,133**

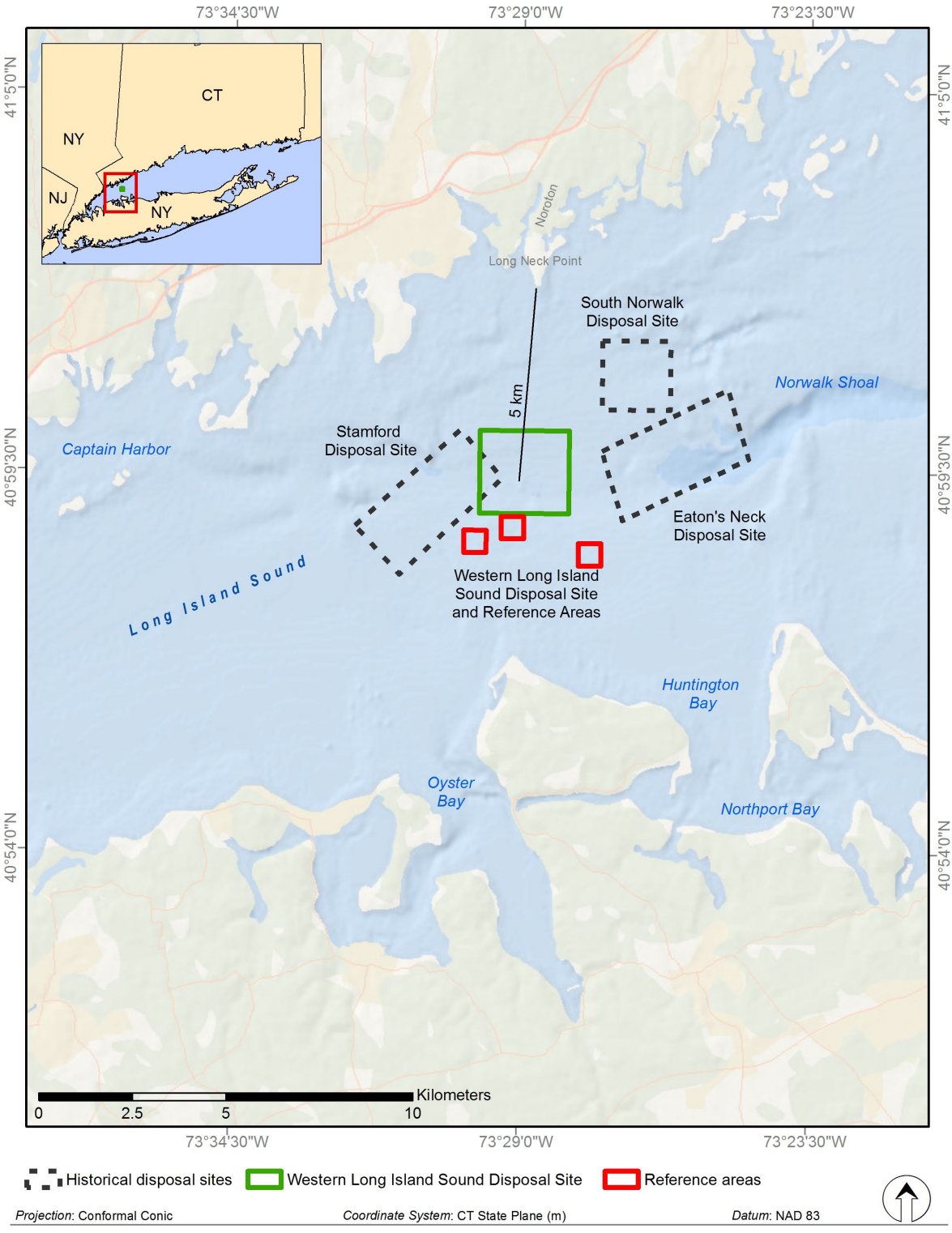

Figure 1-1. Location of WLDS in Long Island Sound and nearby Disposal Sites and features.

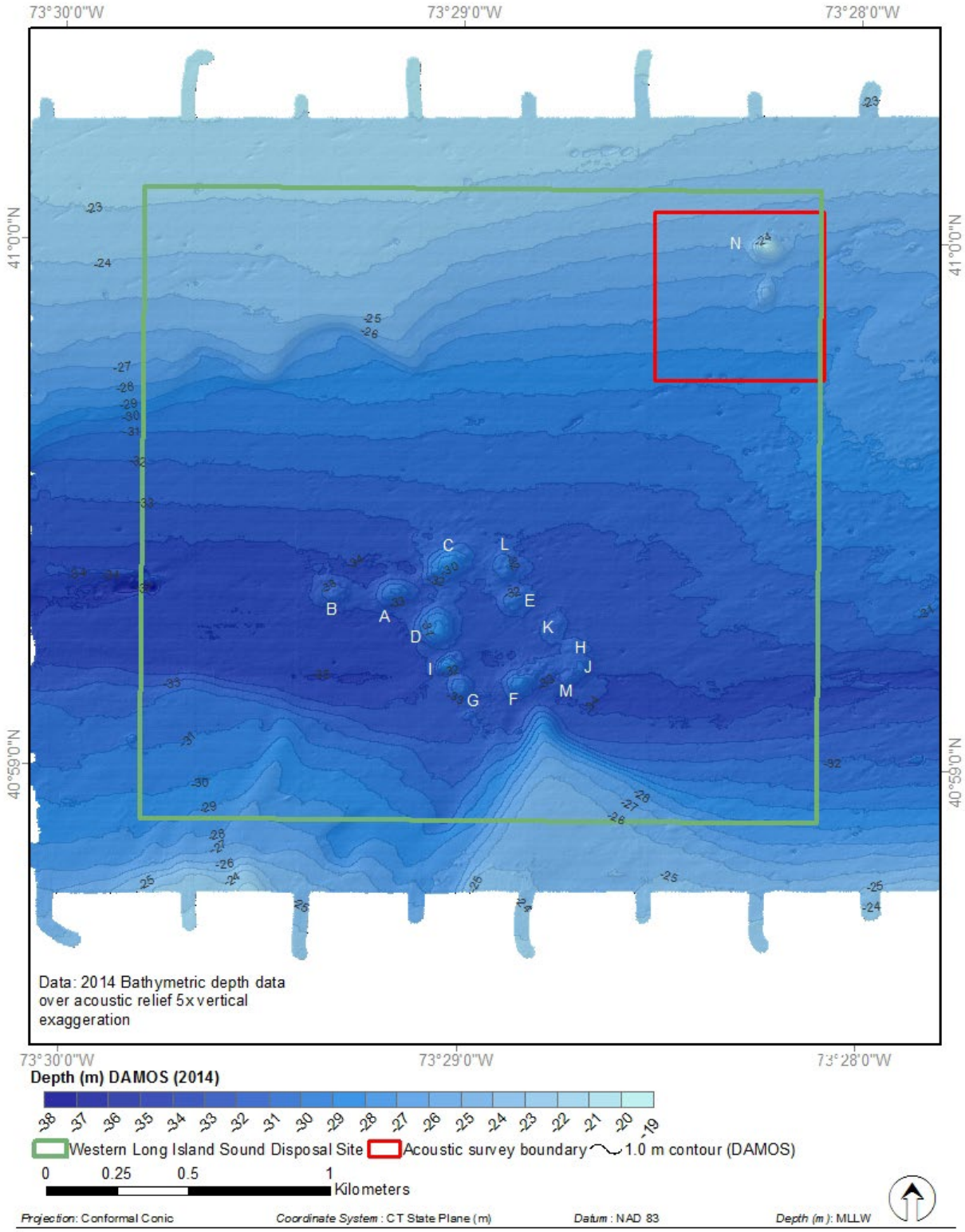

Figure 1-2. Bathymetric contour map of WLDS, August 2014.

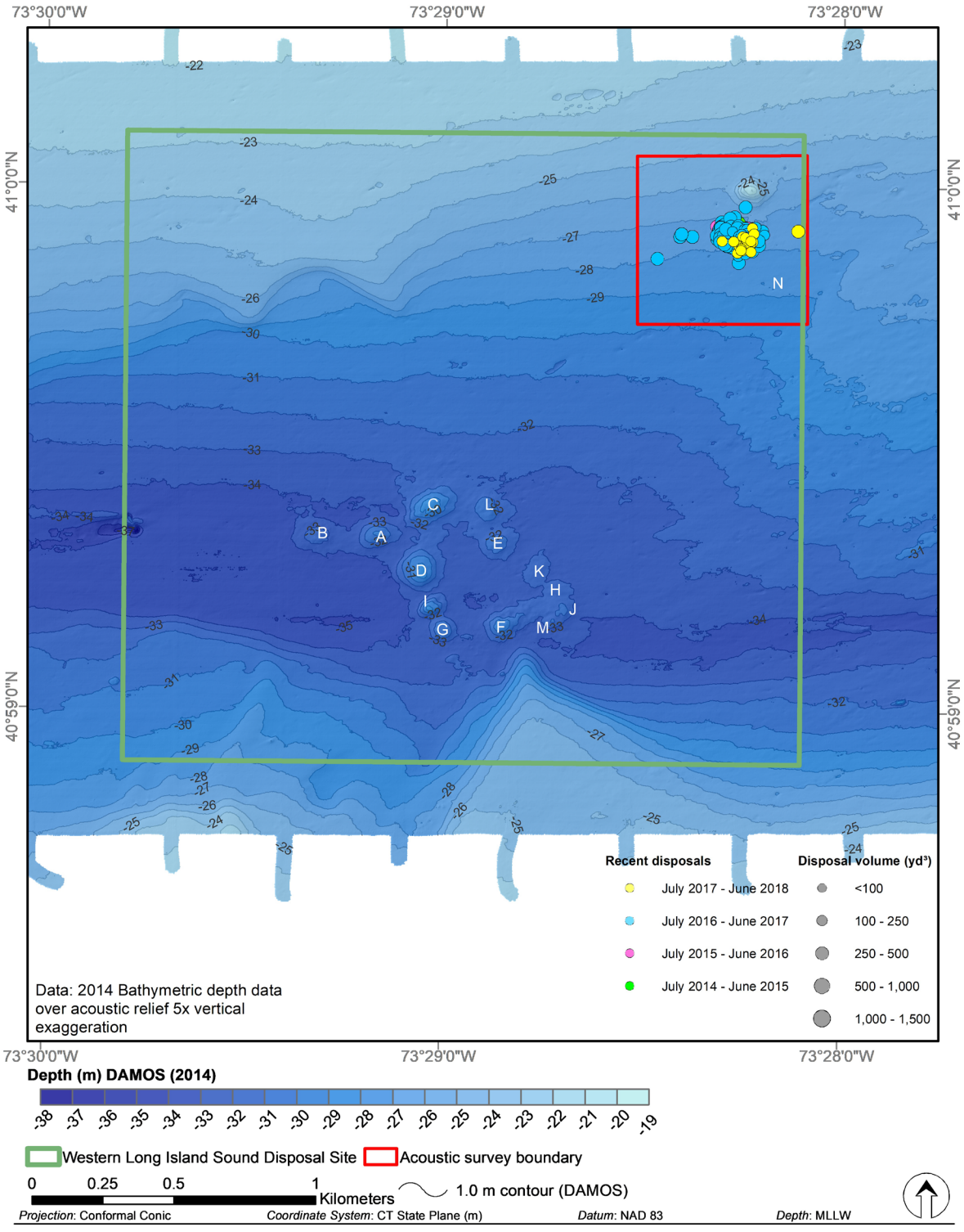

Figure 1-3. Recent disposal history at WLDS (2014 – 2018).

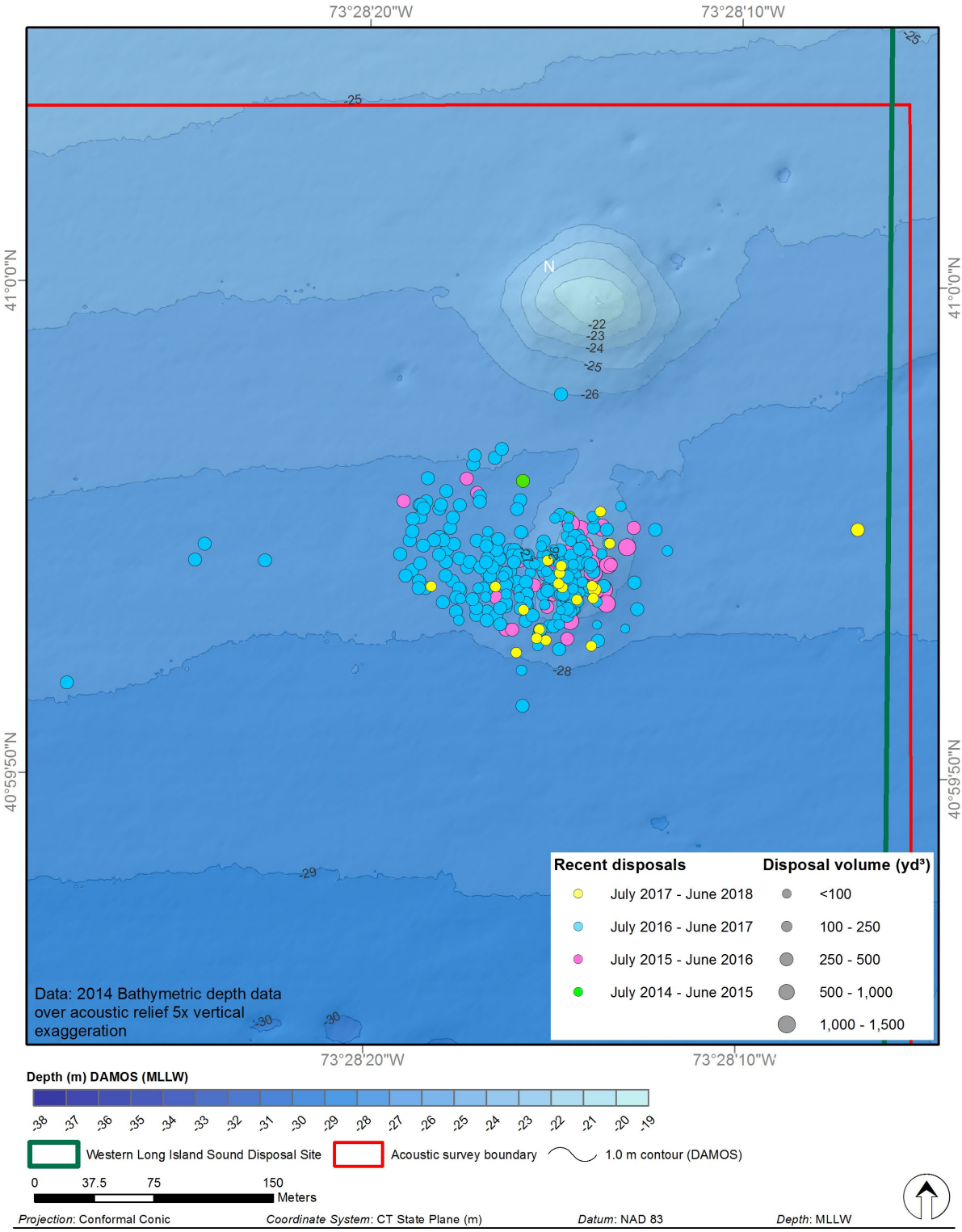

Figure 1-4. Recent disposal history at WLDS (2014 – 2018), survey area.

2.0 METHODS

The October 2018 surveys conducted at WLDS were performed by a scientific team from AECOM and CR Environmental, Inc.; laboratory analysis was conducted by Katahdin Analytical Services (Scarborough, Maine). The acoustic survey was conducted on 20 and 22 October 2018 to document recent disposals in the northeast corner of the disposal site. Sediment grab samples were collected from 18 unique locations within the disposal site and reference areas on 23 October 2018. A fishing gear assessment was performed during the acoustic survey. The surveys were conducted aboard the 55-foot Research Vessel (R/V) *Jamie Hannah* and the 40-foot Fishing Vessel (F/V) *Jeanette T*. Field activities are summarized in Table 2-1, and an overview of the methods used to collect and analyze the survey data is provided below. Detailed Standard Operating Procedures (SOPs) for data collection and processing are presented in the program Quality Assurance Project Plan (QAPP) (AECOM, 2018).

2.1 Navigation and On-Board Data Acquisition

Navigation for the acoustic survey was accomplished using a Hemisphere VS-330 Real Time Kinematic Global Positioning System (RTK GPS) which received base station correction through the Keynet Networked Transport of Radio Technical Commission for Maritime Services (RTCM) via Internet Protocol (NTRIP) broadcast. Horizontal position accuracy in fixed RTK mode was approximately 2 centimeters (cm). A dual-antennae Hemisphere VS110 differential GPS (DGPS) was available, if necessary, as a backup. The GPS system was interfaced to a desktop computer running HYPACK hydrographic survey software. HYPACK continually recorded vessel position and GPS satellite quality and provided a steering display for the vessel captain to accurately maintain the position of the vessel along pre-established survey transects and targets. Vessel heading measurements were provided by an IxBlue Octans III fiber optic gyrocompass.

2.2 Acoustic Surveys

Bathymetric surveys provide measurements of water depth that, when processed, can be used to map the seafloor topography. The processed data can also be compared with previous surveys to track changes in the size and location of seafloor features. This technique is the primary tool in the DAMOS Program for mapping the distribution of dredged material at disposal sites. Backscatter intensity is a measure of acoustic return from the seafloor from the multibeam system, which can be exploited for bottom classification purposes (USACE, 2002). Examples of seafloor properties that these data are able to estimate remotely include the grain size and roughness of the near-surface sediments (Fonseca and Mayer, 2007). Side-scan sonar data allows for interpretation of surficial features like rocks, shipwrecks, or other seafloor anomalies.

2.2.1 Bathymetry, Backscatter, and Side-Scan Data Collection

The 2018 acoustic survey of WLDS was conducted on 20 and 22 October 2018 aboard the R/V *Jamie Hannah.* The bathymetric survey was conducted within a 600 x 600 m area focusing on the northeastern corner of WLDS and three 600 x 600 m squares covering the associated reference areas for WLDS (Figure 2-1). Acoustic backscatter data (beam time-series) and side-scan sonar imagery were collected in conjunction with the bathymetric survey. The acoustic survey included a total of 54 survey lines over the four survey areas, spaced approximately 50 m apart and oriented in an east-west direction. Eight cross-tie lines were collected perpendicular to the survey lines to assess data quality and the accuracy of tidal corrections (Figure 2-1).

Data layers generated by the survey included bathymetric, acoustic backscatter, and side-scan sonar and were collected using an R2Sonic 2022 broadband multibeam echo sounder (MBES). This 200-400 kilohertz (kHz) system forms up to 256 1- to 2-degree beams (frequency dependent) distributed equiangularly or equidistantly across a 10- to 160-degree swath. For this survey, a frequency of 200 kHz and pulse length of 0.070 millisecond (msec) were selected to maximize the resolution of bathymetric data without compromising the quality of acoustic backscatter data. The MBES transducer was mounted amidships to the port rail of the survey vessel using a high-strength adjustable boom. The primary GPS antenna was mounted atop the transducer boom. The transducer depth below the water surface (draft) and antenna height were checked and recorded at the beginning and end of data acquisition, and draft was confirmed using the "bar check" method.

An IxBlue Octans III motion reference unit (MRU) was interfaced to the MBES topside processor and to the acquisition computer. Precise linear offsets between the MRU and MBES were recorded and applied during acquisition. Depth and backscatter data were synchronized using pulse per second (PPS) timing and transmitted to the HYPACK MAX® acquisition computer via Ethernet communications. Patch calibration tests were conducted before and during the survey to allow computation of angular offsets between the MBES system components.

The system was calibrated for local water mass speed of sound by performing sound velocity profile (SVP) casts at frequent intervals throughout the survey day using an AML, Inc. MinosX sound velocity profiler.

2.2.2 Bathymetric Data Processing

Bathymetric data were processed using HYPACK HYSWEEP® software. Processing components are described below and included:

- Adjustment of data for tidal elevation fluctuations;
- Correction of ray bending (refraction) due to density variations in the water column;

- Removal of spurious points associated with water column interference or system errors;
- Development of a grid surface representing depth solutions;
- Statistical estimation of sounding solution uncertainty; and
- Generation of data visualization products.

Tidal adjustments were accomplished using RTK GPS verified against tide data using records obtained from the National Oceanic and Atmospheric Association's (NOAA) Bridgeport Tide Station (#8467150). The mean difference between RTK and NOAA Tide Station data was 0.07 m, though deviations were as great as 0.2 m. Water surface elevations derived using the NOAA Tide Zoning Model were used to adjust soundings to Mean Lower Low Water (MLLW) elevations. Correction of sounding depth and position (range and azimuth) for refraction due to water column stratification was conducted using a series of nine sound-velocity profiles acquired by the survey team. Data artifacts associated with refraction remain in the bathymetric surface model at a relatively fine scale (generally less than 5 to 10 cm) relative to the survey depth.

Bathymetric data were filtered to accept only beams falling within an angular limit of 60° to minimize refraction artifacts. Spurious sounding solutions were rejected based on the careful examination of data on a sweep-specific basis.

The R2Sonics 2022 MBES system was operated at 200 kHz. At this frequency, the system has a published beam width of 2.0°. Assuming an average survey area depth of 23.9 m and a maximum beam angle of 60°, the average dimensions of the beam footprint mid-swath was 1.7 m × 1.2 m resulting in an approximately 2.0 m^2 footprint. Data were reduced to a cell (grid) size of 2.0 m × 2.0 m, acknowledging finer resolution in shallow portions of the survey area and the system's fine range resolution while accommodating beam position uncertainty. This data reduction was accomplished by calculating and exporting the average elevation for each cell in accordance with USACE recommendations (USACE, 2013).

Statistical analysis of 2018 bathymetric data, as summarized on Table 2-2, displays negligible tide bias (<0.01 m) and a mean vertical uncertainty of 0.12 m, substantially lower than the values recommended by USACE (2013) or NOAA (2015). Note that the most stringent National Ocean Service (NOS) standard for this project depth (Special Order 1A) would call for a 95th percentile interval (95% confidence interval [CI]) uncertainty of 0.33 m at the maximum survey depth (30.2 m MLLW) and 0.28 m uncertainty at the mean survey depth (17.7 m MLLW).

Reduced data were exported in American Standard Code for Information Interchange (ASCII) text format with fields for Easting, Northing, and MLLW elevation in meters. All data were projected to the Connecticut State Plane, NAD 83 (metric). A variety of data

visualizations were generated using a combination of ESRI ArcMap and Golden Software Surfer programs. Visualizations and data products included:

- ASCII data files of all processed soundings including MLLW depths and elevations;
- Contours of seabed elevation (20-cm, 50-cm and 1.0-m intervals) in a geospatial data file format suitable for plotting using geographic information system (GIS) and computer-aided design software;
- 3-Dimensional surface maps of the seabed created using 2× vertical exaggeration and artificial illumination to highlight fine-scale features not visible on contour layers delivered in grid and tagged image file (TIF) formats, and
- An acoustic relief map of the survey area created using 5× vertical exaggeration, delivered in georeferenced TIF format.

2.2.3 Backscatter Data Processing

Backscatter data were extracted from cleaned MBES TruePix formatted files and then used to provide an estimation of surface sediment texture based on seabed surface roughness. Mosaics of backscatter data were created using HYPACK's implementation of GeoCoder software developed by scientists at the University of New Hampshire's NOAA Center for Coastal and Ocean Mapping (UNH/NOAA CCOM). A seamless mosaic of unfiltered backscatter data was developed and exported in grayscale TIF format using a 0.5 m x 0.5 m pixel resolution. Backscatter data were also exported in ASCII format with fields for Easting, Northing, and backscatter decibel (dB). These data were converted to a grid format and a Gaussian filter was applied to the grid to minimize nadir artifacts, and the filtered data were used to map backscatter values on a 1 m x 1 m grid. The grid was exported in ESRI binary gridded file format (GRD) to facilitate comparison with other data layers.

2.2.4 Side-Scan Sonar Data Processing

Side-scan sonar data were processed using Chesapeake Technology, Inc. Sonar Wiz software to generate a database of images that maximized both textural information and structural detail. Data were processed using gain adjustment methods to minimize nadir artifacts and facilitate visualization of fine seabed structures. Seamless mosaics of side-scan sonar data were developed using SonarWiz and exported in grayscale TIF format using a resolution of 0.20 m per pixel. Data for each sonar file were exported as individual TIF images to allow detailed inspection using GIS software.

2.2.5 Acoustic Data Analysis

Bathymetric data were analyzed to document the distribution of dredged material at WLDS and to evaluate changes in seafloor topography in comparison with previous surveys.

The processed bathymetric grids were converted to rasters, and bathymetric contour lines were generated and displayed using GIS.

GIS was also used to calculate depth difference grids between the previous 2014 survey and the 2018 bathymetric dataset. The depth difference grid was calculated by subtracting the 2014 survey depth estimates from the 2018 survey depth estimates at each point throughout the grid. The resulting depth differences were contoured and displayed using GIS.

The backscatter mosaics and filtered backscatter grids were combined with acoustic relief models in GIS to facilitate visualization of relationships between acoustic datasets. This was done by rendering images and color-coded grids with sufficient transparency to allow the three-dimensional acoustic relief model to be visible underneath.

2.3 Sediment Grab Sampling

2.3.1 Sediment Chemistry Data Collection

Sediment grab samples were collected for physical grain size and chemical analysis on 23 October 2018 aboard the F/V *Jeanette T*. Sediment grab samples were collected using a 0.04 m² Ted Young grab sampler. Target sampling locations were selected prior to the survey and pre-programmed into the on-board navigation system. The survey vessel navigated within 10 m of the selected target sampling locations prior to deployment of the sediment grab sampling equipment over the side of the vessel. Sediment grab sampling locations are depicted on Figure 2-2, and sample collection coordinates are presented in Table 2-3. Upon collection, sediment was brought aboard the vessel to be visually inspected and generally described in the dedicated project field notebook.

Subsamples for grain size, TOC, total nitrogen and phosphorus, metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) analyses were collected from the grab sampler using stainless steel utensils and were homogenized in a decontaminated, stainless steel bowl. The samples were placed in the appropriate glassware for analysis, and the glass containers were wiped clean and labeled. Sample container sizes, preservation requirements, and holding times are detailed in the program QAPP (AECOM, 2018). Between samples, the grab sampler, spoons, and bowl were thoroughly cleaned with a non-phosphate detergent and then rinsed with de-ionized water. Analytical chemistry samples were stored on ice and shipped via courier to Katahdin Analytical Services.

2.3.2 Sediment Chemistry Data Analysis

The sediment samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc), TOC, total nitrogen, total phosphorus, grain size, pesticides, PAHs (high molecular weight [HMW] and low molecular weight [LMW]) and PCBs (NOAA 18 congeners) (Table 2-4). A routine set of quality control (QC) samples was

collected, including one field duplicate and one matrix spike duplicate. A rinsate blank was collected from the sediment grab sampling and processing equipment and analyzed. Samples were extracted and analyzed within the holding times for the various analytes.

For the metals, total nitrogen, total phosphorus, pesticides, PAH, and PCB analyses, standard QC included a method blank (MB) and a laboratory control sample (LCS) in order to evaluate the accuracy of the dataset. For TOC, all samples were analyzed in duplicate per the method requirements, and the QC samples included a MB and a LCS.

2.3.3 Sediment Sample Comparison Groups

Grab sampling stations were separated into four areas for the comparison of analytical chemistry results. These four areas include; the active mounds; an area that is currently receiving dredged materials, the inactive mounds; an area that previously received dredged materials, the historic site; an area without disposal records, but acoustic markings displaying disturbance in the area, and the three reference areas. The three areas within the WLDS are displayed on Figure 2-3 over the Side Scan Sonar data collected during the 2014 DAMOS survey, acoustic data were not available for the Reference Areas.

2.3.4 Regional Implementation Manual

The analytical methods used in this study are consistent with those prescribed in the Regional Implementation Manual (RIM) that provides guidance for testing dredged material (USEPA and USACE, 2004) with the exception of the methods described herein. A deviation from the RIM occurred for the analysis of total chlordane. The RIM prescribes five isomers of chlordane (cis-and trans-chlordane, cis- and trans- nonachlor, and oxychlordane) to be included for analysis; however, during this study, only two of the primary isomers were analyzed (cis- and trans- chlordane). For the purposes of this study, the two analyzed chlordane isomers were used to generate total chlordane values and may under-represent the total concentration (versus if all five isomers were included).

2.3.5 Sediment Quality Guidelines

Chemistry results from the survey are compared to national sediment quality guidelines (SQGs). These SQGs were derived using a database which compiles data from multiple studies and investigators and contains paired sediment chemistry and bioassay data (Long and Morgan, 1991, Long et al. 1995). From this data, the 10^{th} and 50^{th} percentile of the effect values were identified for each chemical of interest (Sturdivant et al, 2021). The two guidance values used for comparative purposes herein (ER-L and ER-M) are intended to delineate three concentration ranges for a specific chemical. The concentrations below the ER-L (10^{th} percentile) value represent a minimal effects range, or rare to cause adverse effects. Concentrations above the ER-L but below the ER-M (between 10^{th} and 50^{th} percentile) represent a possible adverse effects range, and concentrations above the ER-M (>50^{th} percentile) represent a probable effects range (Long et al., 1995). The screening

values used within this report are intended to provide a general context for sediment contamination levels.

2.3.6 Nutrient Data Analysis

In addition, nitrogen (nitrate+nitrite as N), total Kjeldahl nitrogen (TKN), and phosphorus (P) were collected. These analytes are not prescribed within the RIM, but were collected to provide information on the nutrient composition of WLDS and reference areas. USEPA's ProUCL was used to calculate the 95% Upper Confidence Limits (UCLs) on the arithmetic mean for nutrients within the three site areas (active, inactive, and historic) to concentrations within the reference sites. It should be noted, due to the low sample size of the site areas (3 samples within each site area), calculated UCLs exceeded maximum concentrations. Although it is not recommended, ProUCL will compute decision statistics for as low as 3 samples and will provide warnings about the potential deficiencies associated with the dataset. Decision statistics are not considered reliable with a small dataset (i.e., less than 8 samples) (USEPA, 2011).

Table 2-1.

2018 Field Activities at WLDS

Survey	Date	Summary
Bathymetry	20 and 22 October 2018	Four square areas with sides of: 600 x 600 m Lines: 14 per area Spacing: 50 m
Sediment Grab Sampling	23 October 2018	Stations: 18 WLDS: 9 Reference Areas: 9

Table 2-2.

Acoustic Cross-Line Comparison Results

+/- Beam Angle Limit	Max Outlier	Mean Diff	Std Dev	95% Confidence
0 (vertical)	0.5	0.0	0.06	0.11
5	0.5	-0.01	0.06	0.11
10	0.67	0.0	0.06	0.11
15	0.76	-0.01	0.06	0.13
20	0.76	-0.03	0.07	0.13
25	0.76	-0.01	0.06	0.12
30	0.76	-0.01	0.06	0.12
35	0.9	0.01	0.06	0.12
40	0.9	0.01	0.06	0.11
45	0.9	0.03	0.06	0.11
50	0.9	0.03	0.06	0.12
55	0.54	0.01	0.07	0.14
60	0.48	0.02	0.07	0.15
65	0.45	0.02	0.07	0.13
Mean	0.70	0.004	0.06	0.12

Notes:

1. Data from October 20 and 22, 2018 survey represented in meters.

2. Comparisons made between cross-line swaths and a reference surface created using mainstay data to +/- 65 degrees from nadir using 2m x 2m cell average elevations.

3. 95th percentile uncertainty calculated as 2x root mean square per Army Corps of Engineers recommendations.

Table 2-3.

Sediment Grab Sampling Stations (Actual)

Station	Latitude (N)	Longitude (W)	Station	Latitude (N)	Longitude (W)
WLDS			**Reference Areas**		
WLDS-1	40° 59.948'	-73° 28.240'	S REF-1	40° 58.814'	-73° 29.329'
WLDS-2	40° 59.766'	-73° 28.240'	S REF-2	40° 58.787'	-73° 29.144'
WLDS-3	40° 59.525'	-73° 28.195'	S REF-3	40° 58.643'	-73° 29.004'
WLDS-4	40° 59.479'	-73° 28.622'	SE REF-1	40° 58.383'	-73° 27.696'
WLDS-5	40° 59.513'	-73° 28.994'	SE REF-2	40° 58.324'	-73° 27.580'
ACD	40° 59.335'	-73° 29.105'	SE REF-3	40° 58.424'	-73° 27.863'
MOUND C	40° 59.411'	-73° 29.008'	SW REF-1	40° 58.609'	-73° 30.048'
MOUND D	40° 59.275'	-73° 29.050'	SW REF-2	40° 58.462'	-73° 29.728'
MOUND N	40° 59.993'	-73° 28.228'	SW REF-3	40° 58.487'	-73° 30.029'

Table 2-4.

Summary of Laboratory Analytical Work

	Test Method EPA Test Method No.		
	Sample Prep	**Analytical**	**Instrumentation**
Arsenic (As)	3050B	6020B	ICP-MS
Cadmium (Cd)	3050B	6020B	ICP-MS
Chromium (Cr)	3050B	6020B	ICP-MS
Copper (Cu)	3050B	6020B	ICP-MS
Lead (Pb)	3050B	6020B	ICP-MS
Mercury (Hg)	7471B	7471B	CVAA
Nickel (Ni)	3050B	6020B	ICP-MS
Zinc (Zn)	3050B	6020B	ICP-MS
Polycyclic Aromatic Hydrocarbons (PAHs)	SW 846*/3550C	8270D SIM	GC-MS
Polychlorinated Biphenyls	3550C	8082A	GC-ECD
Pesticides	3550C	8081B	GC-ECD
Total Nitrogen**		351.2/353.2	
Total Phosphorous		365.4	
Total Organic Carbon (TOC)	-	9060A	Carbonaceous analyzer
Grain Size	ASTM D422-63		

Notes:

ICP-MS - Inductively Coupled Plasma Mass Spectrometry

CVAA – Cold Vapor Atomic Absorption

GC-MS - Gas Chromatography/Mass Spectrometry

GC-ECD - Gas Chromatography/Electron Capture Detector

*Ultrasonic Extraction Method – semi volatile and nonvolatile organics

** Total Nitrogen is the sum of total Kjeldahl nitrogen (TKN) and nitrate-nitrite

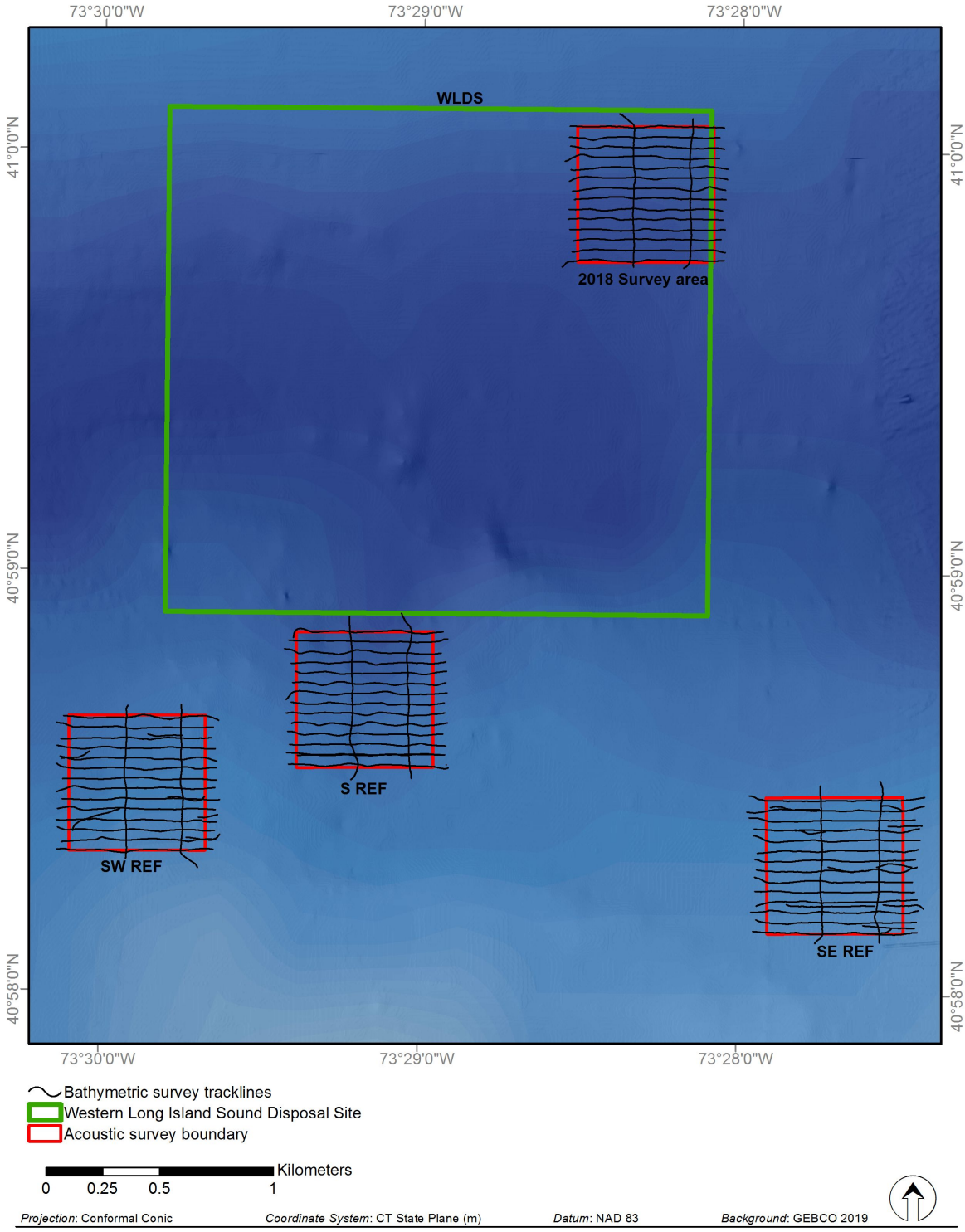

Figure 2-1. WLDS and reference areas bathymetric survey boundaries and tracklines, October 2018.

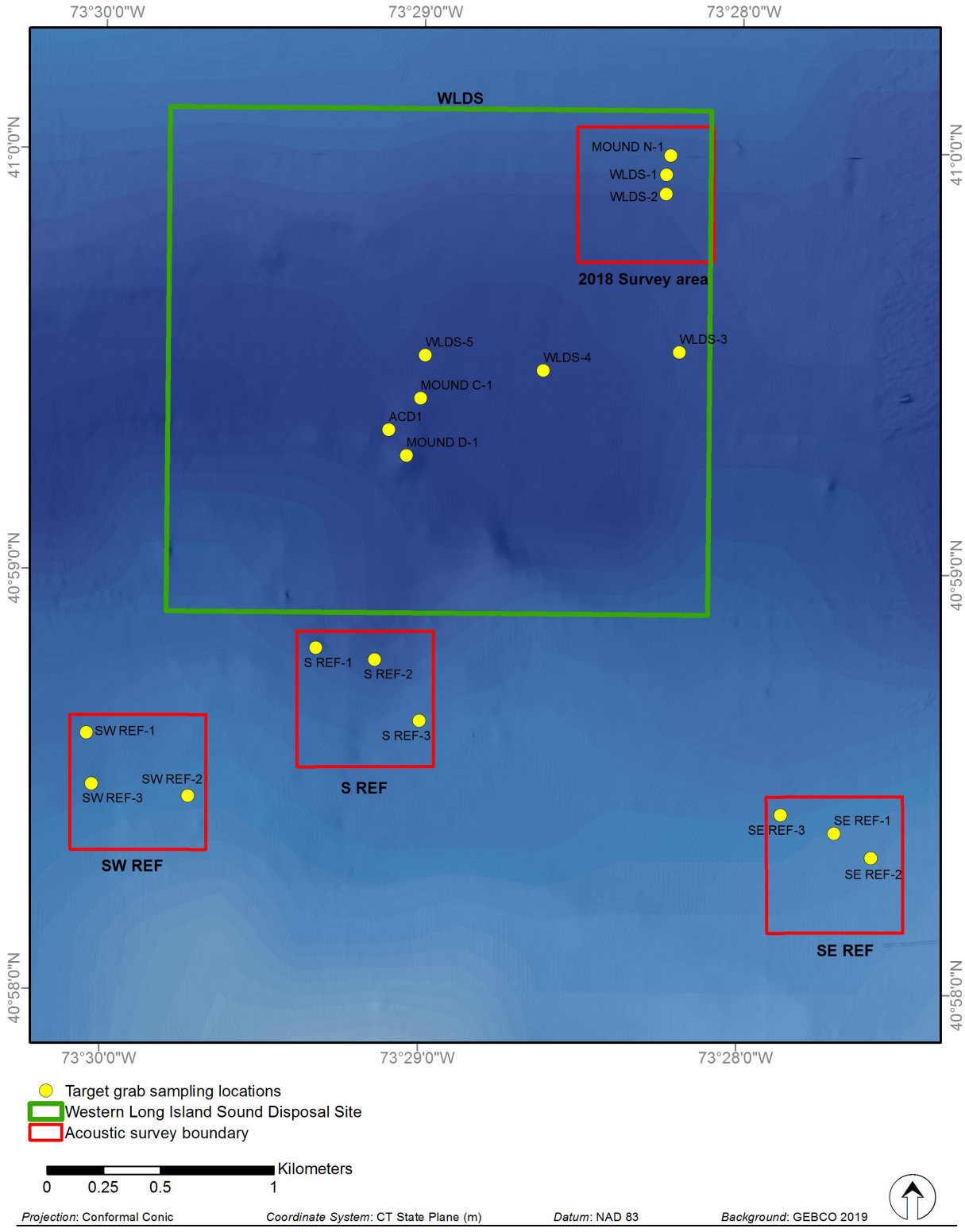

Figure 2-2. Sediment grab sampling locations WLDS and reference areas, October 2018.

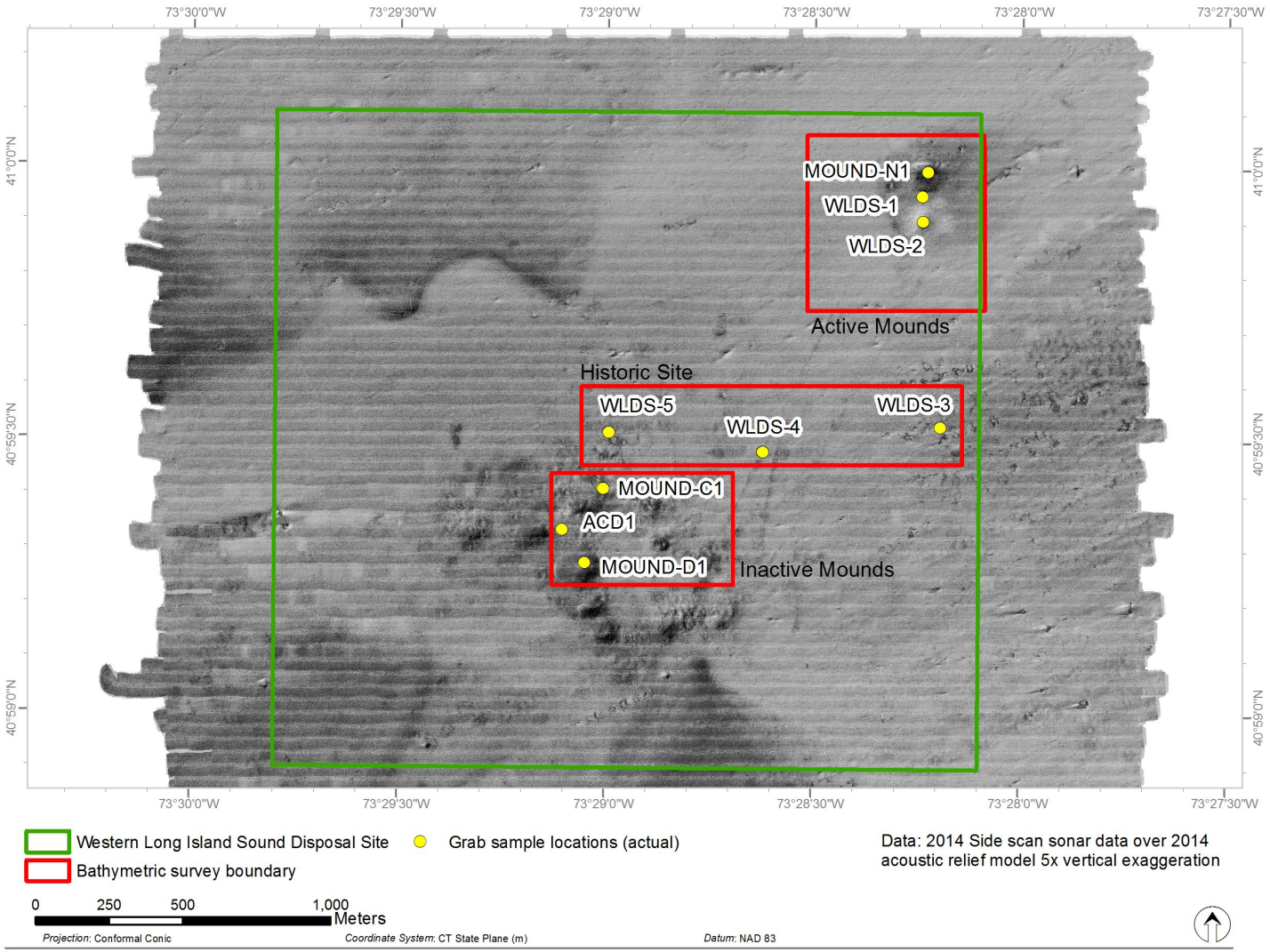

Figure 2-3. Sediment chemistry groupings for comparison over 2014 Side Scan Sonar.

3.0 RESULTS

The 2018 acoustic surveys of WLDS covered an area of 600 x 600 m over the active portion of the site, and 600 x 600 m areas over each of the three reference areas (SW REF, S REF, and SE REF). The acoustic surveys were completed on 20 and 22 October 2018 and a fishing gear assessment was performed during the same time frame. On 23 October 2018, sediment grab samples were collected for chemical analysis at WLDS and the three reference areas. As previously mentioned within the methods section, chemistry data/results have been grouped based on four spatial categories for discussion and comparison purposes; Active Mounds, Inactive Mounds, Historic Site, and Reference Areas. Data from these investigations are presented below and in the subsequent tables and figures.

3.1 Bathymetry, Backscatter, and Side-Scan

3.1.1 Bathymetric Results

The 2018 survey area in the northeast corner of WLDS gradually slopes from north to south, with depths increasing from approximately 25 m MLLW on the northern boundary, to approximately 30 m MLLW at the southern survey boundary. The seafloor within this active area of WLDS was relatively uniform, with small disposal craters apparent throughout. Two disposal mounds were identifiable in the central portion of the survey area; the water depth over the peak of both the northern and southern disposal mounds was approximately 22 m MLLW (Figure 3-1). The southern-most disposal mound (Mound O), was slightly larger in circumference than the mound to the north (Mound N); however, both appeared as circular mounds rising from the active disposal site. Mound O spanned approximately 250 m in diameter at its widest point and rose approximately 5 m above the surrounding seafloor. Mound N spanned approximately 150 m in diameter at its widest point and was also approximately 5 m above the ambient seafloor.

Acoustic surveys were conducted over the three reference areas (SW REF, S REF and SE REF) (Figure 3-2). Water depths within SW REF ranged from approximately 20 to 26 m, with the site gaining depth from the southeast corner to the northwest corner. Water depths within S REF ranged from 22 to 30 m, with the deepest depths occurring in the northern area and the shallowest depths in the southwest and southeast areas. The SE REF area had the least depth variation of the three reference areas; it gradually slopes from the southeast to the northwest, with depths ranging from 17 to 21 m.

Depth difference calculations were performed using the 2014 and 2018 bathymetric datasets. A range of -0.3 to 0.3 m was assumed to capture the estimated uncertainty between the 2014 and 2018 surveys. Depth difference results clearly highlight Mound O which was primarily formed after the 2014 bathymetry survey and rises approximately 5 m above the ambient seafloor. The results of the depth difference comparison support the bathymetric signature of Mound O with a footprint covering approximately 15% of the survey area

(Figure 3-3). The previously surveyed Mound N is also present on the depth difference figure, represented as an area that increased in depth by approximately 0.9 m at the mound peak since 2014. This initial loss of mound height is typical in the first few years following cessation of disposal at a given target as the placed dredged material self-consolidates.

3.1.2 Backscatter and Side-Scan Results

Backscatter and side-scan sonar data provide images that display changes in seafloor sediment texture and roughness. These tools also aid in the analysis of topographic changes between the ambient seafloor and areas that have received dredged material. Typically, high backscatter intensity is related to the presence of rock or coarse-grained sediment (e.g., gravel, coarse sand), and low backscatter intensity is indicative of fine-grained sediments (e.g., silt, clay). Side-scan sonar also provides a high-resolution image of seafloor texture and bottom features.

The WLDS backscatter survey results (measured in dB) highlight the difference in sediment type over the previously formed Mound N and newly formed disposal Mound O, in the central portion of the survey area (Figures 3-4 and 3-5). In general, backscatter signals over the disposal mounds ranged from to -31 to -44 dB. Ambient sediments in the areas surrounding the disposal mounds emitted weaker backscatter signals ranging from -45 to -48 dB.

A side-scan sonar mosaic of the survey area provided a similar depiction of features, with the two clearly identifiable disposal mounds and some individual disposal features present in the surrounding area within the survey area (Figure 3-6).

Backscatter signals over the three reference areas were varied within each reference site and bracket the variation observed across the WLDS survey area. Backscatter signals over the SW REF area ranged from -32 to -38 dB; the S REF area signals ranged from -32 to -41 dB; and, within SE REF, signals ranged from -38 to -44 dB (Figures 3-7 and 3-8). Side-scan sonar results displayed variations of sediment types, as well as surficial features that were present on each reference area mosaic. Within SW REF, survey artifacts were present within the dataset due to rough seas at the time of data collection. Within S REF, disposals were apparent on the western edge of the survey area and within SE REF, trawl scars from a fishing vessel, and a string of uniform, circular seafloor anomalies were visible (Figure 3-9).

3.2 Sediment Survey

3.2.1 Sediment Physical and Chemical Analyses

Sediment grab samples were collected from 18 stations on 23 October 2019 and were analyzed for grain size, TOC, total PCBs, total PAHs, total metals, and total nitrogen and phosphorus. Results are summarized below in the text, tables, and figures, and sediment data

are also presented using standard box plots by sampling area. Chemistry data tables are presented in Appendix B.

3.2.2 Grain Size and Total Organic Carbon

Surficial samples analyzed for grain size varied across WLDS and the reference areas from predominantly silt and clay to fine and medium sand with minimal amounts of gravel. Stations located within the active portion of the site (Mound N-1, WLDS-1, and WLDS-2) had a relatively even mix of sand and silt/clay, with trace amounts of gravel at the WLDS-2 station. Sediment grain size within the inactive mound area (ACD-1, Mound C-1, and Mound D-1) also yielded a relatively even mix of sand and silt/clay. Samples collected over the historic portion of the site (WLDS-3, WLDS-4, and WLDS-5) were varied. WLDS-3 displayed similar grain size characteristics to the samples that were collected within the active and inactive areas, WLDS-4 had the highest percentage of gravel of the samples collected, and WLDS-5 had the highest silt/clay content of the samples collected at the site (Table 3-1, Figures 3-10 and 3-11).

Sediment grain sizes within the reference areas were similar within the S REF and SW REF areas and samples were composed mostly of sand, with smaller amounts of silt/clay. Samples within the SE REF area were dominated by silt/clay (Table 3-1, Figures 3-10 and 3-11).

TOC values ranged from 0.9 to 3.0% within WLDS (Table 3-2). Both the minimum and maximum TOC values were recorded within the active portion of the site, at WLDS-2 and Mound N-1, respectively. Reference area TOC values ranged from 0.09 to 2.4%. The SE REF area had the highest TOC values, paired with the highest percentage of silt/clay. Generally, TOC values are greater in silt-dominated environments and are lower in areas with coarser-grained materials. This trend was visible within the S REF and SW REF areas which were dominated by sand (coarser-grained material) (Table 3-1, Figure 3-11).

3.2.3 PCBs

Total PCB concentrations (estimated as the sum of the NOAA 18 congeners multiplied by two) within WLDS ranged from 10.2 to 45.4 micrograms per kilogram (µg/kg). Five samples within WLDS exceeded the ER-L of 22.7 µg/kg. Two samples collected within the active portion of the site exceeded the ER-L value, as well as two samples in the inactive area and one sample in the historical portion of the site (Table 3-3, Figures 3-12 and 3-13). Total PCB concentrations within the reference areas ranged from 7.9 to 26.8 µg/kg (Table 3-4). At two locations within SE REF, values exceeded the ER-L for total PCBs (Table 3-3, Figures 3-12 and 3-13). There were no concentrations approaching the ER-M for total PCBs within the site or within the reference areas (Figure 3-13).

3.2.4 PAHs

Total PAH values within WLDS ranged from 532 to 14,403 µg/kg; one sample within the historic area (WLDS-3) had a concentration greater than the ER-L screening value of 4,022 µg/kg for total PAHs (Table 3-2). Reference area PAH values ranged from 238 to 1,075 µg/kg (Table 3-5, Figures 3-14 and 3-15). Concentrations of total LMW PAHs ranged from 51.4 to 753 µg/kg within WLDS and from 26.1 to 211 µg/kg within the reference areas. Concentrations of total HMW PAHs ranged from 481 to 13,650 µg/kg within WLDS and from 212 to 962 µg/kg within the reference areas (Table 3-5).

At sample location WLDS-3, within the historic area, the concentration of HMW PAHs was greater than the corresponding ER-M screening value, yielding a concentration of 13,650 µg/kg (ER-M = 9,600 µg/kg) (Table 3-2). The concentrations of three HMW PAHs were greater than their respective ER-M screening values at WLDS-3 (Appendix B), benzo(g,h,i)perylene (650 µg/kg, ER-M = 260 µg/kg), indeno(1,2,3-cd)pyrene (1,200 µg/kg, ER-M = 260 µg/kg), and pyrene (2,700 µg/kg, ER-M = 2,600 µg/kg). Concentrations for Total HMW PAHs exceeded the ER-L screening value at Mound N-1, Mound D-1, WLDS-3, and WLDS-4; benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene were detected at concentrations greater than their respective ER-L screening values at all four locations. At locations WLDS-3 and WLDS-4 concentrations were greater than the ER-L screening values for anthracene and fluorene. The concentrations of acenaphthylene and acenaphthene exceeded the ER-L screening values in WLDS-3 and WLDS-4, respectively. There were no other concentrations approaching the ER-M for HMW PAHs or LMW PAHs (Table 3-2).

3.2.5 Metals

Sediment within WLDS and the reference areas were analyzed for the following metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn). Metals were detected at all locations within WLDS and the reference areas (Table 3-2). Metals concentrations are summarized in Table 3-6 and presented on Figures 3-16 through 3-31. All metals concentrations were less than the associated ER-M values. Concentrations at all locations within WLDS and the reference areas were less than the ER-L for cadmium and chromium. The arsenic concentration exceeded the ER-L at one location within the historic area of the site. The ER-L was exceeded at one location within the site for zinc and at one location within the SE REF area. Lead concentrations exceeded the ER-L at four locations - two locations within the inactive area, and two locations within the historic area, with concentrations approaching the ER-M at one location. The ER-L was exceeded at five locations for nickel - two locations within the inactive area, and all three sampling locations within the historic area. Mercury concentrations exceeded the ER-L at all locations within the inactive and historic areas and at one location within the active mound area. The mercury concentration approached the ER-M at one inactive mound location. For the reference areas, all locations within SE REF also exceeded the ER-L for mercury. Copper

concentrations exceeded the ER-L at two of the locations within the active mound area, and at all locations within the inactive mound, historic, and SE REF areas.

3.2.6 Pesticides

Pesticides detected in sediments within WLDS and the reference areas are presented in Table 3-2 and summarized in Table 3-7. Summary results include total DDx, which is the sum of 4,4'- dichlorodiphenyldichloroethane (DDD), 4,4' dichlorodiphenyldichloroethylene (DDE), and 4,4' dichlorodiphenyltrichloroethane (DDT). Results for total DDx and chlordane (presented as the sum of the cis and trans chlordane isomers) are presented on Figures 3-32 through 3-35. The detected pesticides within WLDS and the reference areas are as follows: 4,4'-DDD, 4, 4'-DDE, 4,4'-DDT, alpha (cis) chlordane, and gamma (trans) chlordane. Total DDx exceeded the ER-L at every location within WLDS, except for one location in the active mound area; concentrations ranged from 0.56 to 19.7 µg/kg across the site. Total DDx within the reference areas was less than the ER-L within S REF and SW REF; however, the ER-L was exceeded at all sampling locations within SE REF. As noted in Section 2.3.4, chlordane in this study is presented as the sum of cis- and trans-chlordane and is compared to the ER-L and ER-M values for total chlordane (typically the sum of five isomers). The values for the sum of cis- and trans-chlordane were non-detect at all locations within the reference areas and at six locations within WLDS. The ER-L for total chlordane was exceeded at two locations (ACD-1 and Mound D-1) within the inactive mound area and the ER-M for total chlordane was exceeded at one location within the active mound area, near Mound N. It should be noted that the degree of confidence in the screening values for chlordane should be considered low. The determination of the ER-L and ER-M screening values is biased due to low-equilibrium partitioning derived chronic thresholds compared to co-occurrence and site data, a lack of sensitive infaunal organisms within the sample group, and an abundance of data collected from an area where chlordane concentrations were low (Long and Morgan, 1991).

3.2.7 Nitrogen and Phosphorous

Nitrogen (nitrate+nitrite as N), TKN, and P were detected at all locations within the active mounds, inactive mounds, and the historic site (Table 3-8). Values for N ranged from 0.14 to 0.91 milligrams per kilogram (mg/kg) within WLDS, and from 0.71 to 6.1 mg/kg within the reference areas. TKN values ranged from 770 to 2,400 mg/kg within WLDS and from 550 to 2,400 mg/kg within the reference areas. Values for P ranged from 340 to 780 mg/kg within WLDS and from 210 to 640 mg/kg within the reference areas.

Results for phosphorus UCLs for all three areas within WLDS were greater than the reference areas' UCL. Maximum concentrations of phosphorus in the active mounds and historic area were greater than the maximum concentration of the reference areas. The maximum concentration of phosphorus within the inactive mound area was less than the reference areas' maximum. The total kjeldahl nitrogen UCLs were greater than the reference areas' UCL for the active and inactive mounds; the historic area UCL was less than the

reference areas' UCL. Maximum concentrations of TKN were less than the reference area maximums for the inactive and active mounds, and the historic site maximum was equal to the reference area maximum. For nitrate+nitrite as N, all UCLs for the site areas were less than the reference areas' UCL. Similarly, all the maximum concentrations of nitrate+nitrite as N were less than the maximum in the reference areas.

3.3 Fishing Gear Assessment

During the surveys, no fishing-related gear was observed at the site or within any of the reference areas.

Table 3-1.

Grain Size Data for WLDS and Reference Area Sediment

Sample ID	Clay	Silt	Coarse Sand	Medium Sand	Fine Sand	Gravel
Active Mounds			**Percent (%)**			
MOUND N-1	6.8	33.7	0.0	31.9	27.6	0.0
WLDS-1	6.7	52.5	0.0	8.3	32.5	0.0
WLDS-2	9.0	29.6	6.0	10.2	40.3	4.9
Historic Site						
WLDS-3	13.0	52.5	0.0	7.5	27.1	0.0
WLDS-4	12.3	35.9	1.7	3.4	12.6	34.1
WLDS-5	11.4	80.3	0.0	2.5	5.7	0.0
Inactive Mounds						
ACD-1	9.5	43.7	0.0	9.5	37.3	0.0
MOUND C-1	12.3	47.0	0.0	15.4	25.3	0.0
MOUND D-1	8.0	44.5	0.0	21.7	25.8	0.0
Reference Areas						
SE REF-1	13.1	76.7	0.0	1.6	8.7	0.0
SE REF-2	13.6	72.3	0.0	3.0	11.1	0.0
SE REF-3	12.6	68.8	0.0	5.3	13.4	0.0
S REF-1	9.2	29.3	0.0	23.2	38.3	0.0
S REF-2	9.7	24.5	0.0	17.7	48.1	0.0
S REF-2-DUP	9.6	32.0	0.0	14.7	43.7	0.0
S REF-3	8.8	29.9	0.0	13.2	48.1	0.0
SW REF-1	7.3	13.6	0.0	25.5	53.6	0.0
SW REF-2	6.3	20.7	0.0	10.2	62.7	0.0
SW REF-3	7.9	16.3	0.0	22.9	52.9	0.0

Table 3-2.

Total Organic Carbon in WLDS and Reference Area Sediment

		Total Organic Carbon %			
Area	**n**	**MIN**	**MAX**	**Mean**	**StdDev**
Active Mounds	3	0.90	3.0	2.0	1.1
Inactive Mounds	3	1.5	1.9	1.6	0.22
Historic Site	3	1.9	2.5	2.2	0.31
Reference	9	0.092	2.4	1.3	0.85

Notes:
1 - Duplicates are averaged.
2 - Active Mound Samples = Mound -N1, WLDS-1, WLDS-2.
3 - Inactive Mound Samples = Mound C-1, ACD1, Mound D-1.
4 - Historic Site Samples = WLDS-3, WLDS-4, WLDS-5.
5 - Reference Area Samples = S REF-1, S REF-2, S REF-3, SW REF-1, SW REF-2, SW REF-3, SE REF-1, SE REF-2, SE REF-3.

Table 3-3.

Sediment Chemistry Results Summary

Sample ID	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Total PCBs	Total DDXs	Chlordane (α+γ)[a]	Total LMW PAHs	Total HMW PAHs	Total PAHs
	(mg/kg)								(µg/kg)					
Active Mounds														
MOUND N-1	3.3	0.3	36.3	**47.2**	46.4	19.3	111.0	0.12	**38.0**	**19.7**	**17.3**	266.5	**3,480**	3,746.5
WLDS-1	5.4	0.4	50.9	**65.1**	35.5	20.6	124.0	**0.16**	**45.1**	**3.37**	0.53 U	69.2	937	1,006.2
WLDS-2	4.8	0.06 J	26.8	22.0	12.6	13.8	58.7	0.06	10.2	0.6 U	0.35 U	51.4	481	532.4
Inactive Mounds														
ACD-1	5.2	0.6	49.2	**58.8**	**58.3**	**21.1**	121.0	**0.35**	**45.4**	**19.7**	**1.17**	201.4	1,505	1,706.4
MOUND C-1	6.4	0.3	41.3	**47.5**	**48.1**	**21.4**	96.2	**0.22**	18.2	**11**	0.42 U	70.0	716	786.0
MOUND D-1	3.6	0.7	37.7	**55.0**	31.0	14.9	90.6	**0.66**	**23.2**	**8.3**	**2.2**	287.9	**1,996**	2,283.9
Historic Site														
WLDS-3	7.6	0.2	53.4	**59.8**	**151.0**	**23.4**	135.0	**0.34**	17.7	**2.9**	0.46 U	**753.0**	**13,650**	**14,402.5**
WLDS-4	**8.4**	0.4	69.5	**65.8**	**56.1**	**26.6**	**162.0**	**0.21**	**33.1**	**2.9**	0.53 U	**703.0**	**2,002**	2,705.0
WLDS-5	6.8	0.2	59.5	**63.4**	41.9	**23.3**	137.0	**0.31**	15.7	**2.9**	0.64 U	133.6	1,284	1,417.6
Reference Areas														
SE REF-1	7.4	0.1 J	66.2	**63.2**	43.8	**27.7**	**154.0**	**0.20**	**24.3**	**2.5**	0.60 U	113.3	962	1,075.3
SE REF-2	7.3	0.2 J	63.3	**62.9**	43.4	**27.0**	**150.0**	**0.19**	**26.8**	**2.4**	0.55 U	60.5	751	811.5
SE REF-3	6.7	0.1 J	58.8	**57.7**	39.9	**25.2**	138.0	**0.19**	18.5	**2.1**	0.51 U	54.0	584	638.0
S REF-1	4.0	0.1	32.1	25.9	18.7	13.2	67.2	0.10	9.7	1.3	0.36 U	48.2	383	431.4
S REF-2	3.7	0.07 J	26.4	24.8	17.8	13.0	63.5	0.10	12.0	0.6 U	0.38 U	96.7	992	1,088.7
S REF-2-DUP	5.4	0.09 J	44.3	**42.8**	29.7	19.5	107.0	0.12	18.4	0.6 U	0.37 U	70.6	647	717.6
S REF-3	3.9	0.09 J	28.8	29.5	23.9	13.4	75.0	0.09	16.1	0.6 U	0.36 U	27.3	339	366.7
SW REF-1	3.4	0.08 J	21.0	20.0	13.9	10.5	53.1	0.07	7.9	0.4 U	0.28 U	33.0	363	396.0
SW REF-2	4.3	0.05 J	22.1	20.6	14.6	10.0	58.8	0.06	10.8	0.5 U	0.32 U	34.4	272	306.7
SW REF-3	3.6	0.08 J	24.9	25.9	17.2	12.4	62.3	0.08	14.1	0.5 U	0.30 U	26.1	212	237.9
Sediment Screening Values [b]														
ER-L	**8.2**	**1.2**	**81**	**34**	**46.7**	**20.9**	**150**	**0.15**	**22.7**	**1.58**	**0.50**	**552**	**1,700**	**4022**
ER-M	**70.0**	**9.6**	**370**	**270**	**218**	**51.6**	**410**	**0.71**	**180**	**46.1**	**6**	**3160**	**9,600**	**44792**

Notes:
ERL - Effects Range Low
ERM - Effects Range Median
HMW - High Molecular Weight
LMW - Low Molecular Weight
mg/kg – milligrams per kilogram
µg/kg – micrograms per kilogram

PAHs - Polycyclic Aromatic Hydrocarbons
PCBs - Polychlorinated biphenyls
J – Estimated
U - Not Detected (reported at 1/2 method detection limit)
Totals for non-detects were calculated using 1/2 the method detection limit for non-detects
Total PCBs calculated as the sum of the 18 NOAA congeners multiplied by 2

Concentration exceeds ERL screening value
Concentration exceeds the ERM screening value
([a]) Screening value for chlordane references Chemical Abstracts Services (CAS) number 57-74-9 (5 isomers), Site/Reference data consist of the sum of alpha and gamma chlordane isomers (CAS numbers 5103-71-9 and 5103-74-2, respectively)
([b]) Marine sediment screening values obtained from Long, et al. (1995) and Buchman (2008)

Table 3-4.

Total PCBs in WLDS and Reference Area Sediment

		Total PCBs[6] µg/kg			
Area	**n**	**MIN**	**MAX**	**Mean**	**StdDev**
Active Mounds	3	10.2	45.1	31.1	18.4
Inactive Mounds	3	18.2	45.4	28.9	14.5
Historic Site	3	15.7	33.1	22.2	9.5
Reference	9	7.9	26.8	15.9	6.4

Notes:
1 - Duplicates are averaged.
2 - Active Mound Samples = Mound -N1, WLDS-1, WLDS-2.
3 - Inactive Mound Samples = Mound C-1, ACD1, Mound D-1.
4 - Historic Site Samples = WLDS-3, WLDS-4, WLDS-5.
5 - Reference Area Samples = S REF-1, S REF-2, S REF-3, SW REF-1, SW REF-2, SW REF-3, SE REF-1, SE REF-2, SE REF-3.
6 - Total PCB is the sum of the NOAA 18 congeners multiplied by 2. Non-detected congeners were summed using ½ the method detection limit (MDL).

Table 3-5.

Total PAHs and High and Low Molecular Weight PAHs in WLDS and Reference Area Sediment

	Total PAHs[1] µg/kg					Total LMW PAHs[2] µg/kg					Total HMW PAHs[3] µg/kg				
Area	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**
Active Mounds	3	532	3746	1762	1735	3	51.4	266	129	119	3	481	3480	1633	1616
Inactive Mounds	3	786	2284	1592	755	3	70.0	288	186	110	3	716	1996	1406	646
Historic Site	3	1418	14403	6175	7154	3	134	753	530	344	3	1284	13650	5645	6942
Reference	9	238	1075	574	296	9	26.1	113	53	29	9	212	962	521	268

Notes:

1 - Total PAHs is the sum of the 18 PAH compounds analyzed (naphthalene, 2-methylnaphthalene, 1-methylnaphthalene, acenaphthylene, acenaphthene, fluorene, anthracene, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene). Non-detected compounds were summed using ½ the MDL.

2 - Total LMW PAHs is the sum of 8 PAH compounds analyzed (1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene). Non-detected compounds were summed using ½ the MDL.

3 - Total HMW PAHs is the sum of 10 PAH compounds analyzed (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene), benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene. Non-detected compounds were summed using ½ the MDL.

4 - Duplicates are averaged.

5 - Active Mound Samples = Mound -N1, WLDS-1, WLDS-2.

6 – Historic Site Samples = WLDS-3, WLDS-4, WLDS-5.

7 - Inactive Mound Samples = Mound C-1, ACD1, Mound D-1.

8 - Reference Area Samples = S REF-1, S REF-2, S REF-3, SW REF-1, SW REF-2, SW REF-3, SE REF-1, SE REF-2, SE REF-3.

Table 3-6.

Metals in WLDS and Reference Area Sediment

		Arsenic mg/kg					Cadmium mg/kg					Chromium mg/kg					Copper mg/kg			
Area	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**
Active Mounds	3	3.3	5.4	4.5	1.1	3	0.060	0.37	0.25	0.17	3	26.8	50.9	38.0	12.1	3	22.0	65.1	44.8	21.7
Inactive Mounds	3	3.6	6.4	5.1	1.4	3	0.30	0.67	0.52	0.20	3	37.7	49.2	42.7	5.9	3	47.5	58.8	53.8	5.8
Historic Site	3	6.8	8.4	7.6	0.80	3	0.23	0.38	0.28	0.083	3	53.4	69.5	60.8	8.1	3	59.8	65.8	63.0	3.0
Reference	9	3.4	7.4	5.0	1.6	9	0.052	0.15	0.095	0.029	9	21.0	66.2	39.2	18.4	9	20.0	63.2	37.7	18.2

		Lead mg/kg					Mercury mg/kg					Nickel mg/kg					Zinc mg/kg			
Area	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**
Active Mounds	3	12.6	46.4	31.5	17.3	3	0.056	0.16	0.11	0.051	3	13.8	20.6	17.9	3.6	3	58.7	124	97.9	34.6
Inactive Mounds	3	31.0	58.3	45.8	13.8	3	0.22	0.66	0.41	0.22	3	14.9	21.4	19.1	3.7	3	90.6	121	103	16.2
Historic Site	3	41.9	151	83.0	59.3	3	0.21	0.34	0.29	0.071	3	23.3	26.6	24.4	1.9	3	135	162	145	15.0
Reference	9	13.9	43.8	26.6	12.4	9	0.059	0.20	0.12	0.06	9	10.0	27.7	17.3	7.3	9	53.1	154	93.7	41.4

Notes:
1 - Duplicates are averaged.
2 - Active Mound Samples = Mound -N1, WLDS-1, WLDS-2.
3 - Inactive Mound Samples = Mound C-1, ACD1, Mound D-1.
4 - Historic Site Samples = WLDS-3, WLDS-4, WLDS-5.
5 - Reference Area Samples = S REF-1, S REF-2, S REF-3, SW REF-1, SW REF-2, SW REF-3, SE REF-1, SE REF-2, SE REF-3.

Table 3-7.

Pesticides in WLDS and Reference Area Sediment

		Total DDx[1] µg/kg					Cis+Trans Chlordane[2] µg/kg			
Area	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**
Active Mounds	3	0.56	19.7	7.9	10.3	3	0.35	17.3	6.1	9.7
Inactive Mounds	3	8.3	19.7	13.0	6.0	3	0.42	2.20	0.90	0.69
Historic Site	3	2.9	2.9	2.9	0.0	3	0.46	0.64	0.54	0.091
Reference	9	0.4	2.5	1.2	0.9	9	0.28	0.60	0.40	0.12

1 - Total DDx is the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'DDT.
2 - Cis + Trans Chlordane is the sum of the two isomers.
3 - Non-detected compounds were summed using ½ the MDL.
4 - All other pesticides analyzed were not detected within site or reference area samples and are not presented within the above table.
5 - Duplicates are averaged.
6 - Active Mound Samples = Mound -N1, WLDS-1, WLDS-2.
7 - Inactive Mound Samples = Mound C-1, ACD1, Mound D-1.
8 – Historic Site Samples = WLDS-3, WLDS-4, WLDS-5.
9 - Reference Area Samples = S REF-1, S REF-2, S REF-3, SW REF-1, SW REF-2, SW REF-3, SE REF-1, SE REF-2, SE REF-3.

Table 3-8.

Nitrogen and Phosphorous in WLDS and Reference Area Sediment

	Nitrate+Nitrite as N mg/kg					Total Kjeldahl Nitrogen mg/kg					Phosphorus, Total as P mg/kg				
Area	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**	**n**	**MIN**	**MAX**	**Mean**	**StdDev**
Active Mounds	3	0.19	0.72	0.48	0.3	3	770	2100	1490	671.8	3	340	610	500	141.8
Inactive Mounds	3	0.42	0.91	0.73	0.3	3	1100	1600	1300	264.6	3	340	560	463.3	112.4
Historic Site	3	0.14	0.84	0.477	0.4	3	1900	2400	2133	251.7	3	500	780	606.7	151.4
Reference	9	0.71	6.1	3.342	1.9	9	550	2400	1327	756.9	9	210	640	376.1	158.3

Notes:
1 - Duplicates are averaged
2 - Active Mound Samples = Mound -N1, WLDS-1, WLDS-2
3 - Inactive Site = WLDS-3, WLDS-4, WLDS-5
4 - Historic Mounds Samples = Mound C-1, ACD1, Mound D-1
5 - Reference Area Samples = S REF-1, S REF-2, S REF-3, SW REF-1, SW REF-2, SW REF-3, SE REF-1, SE REF-2, SE REF-3

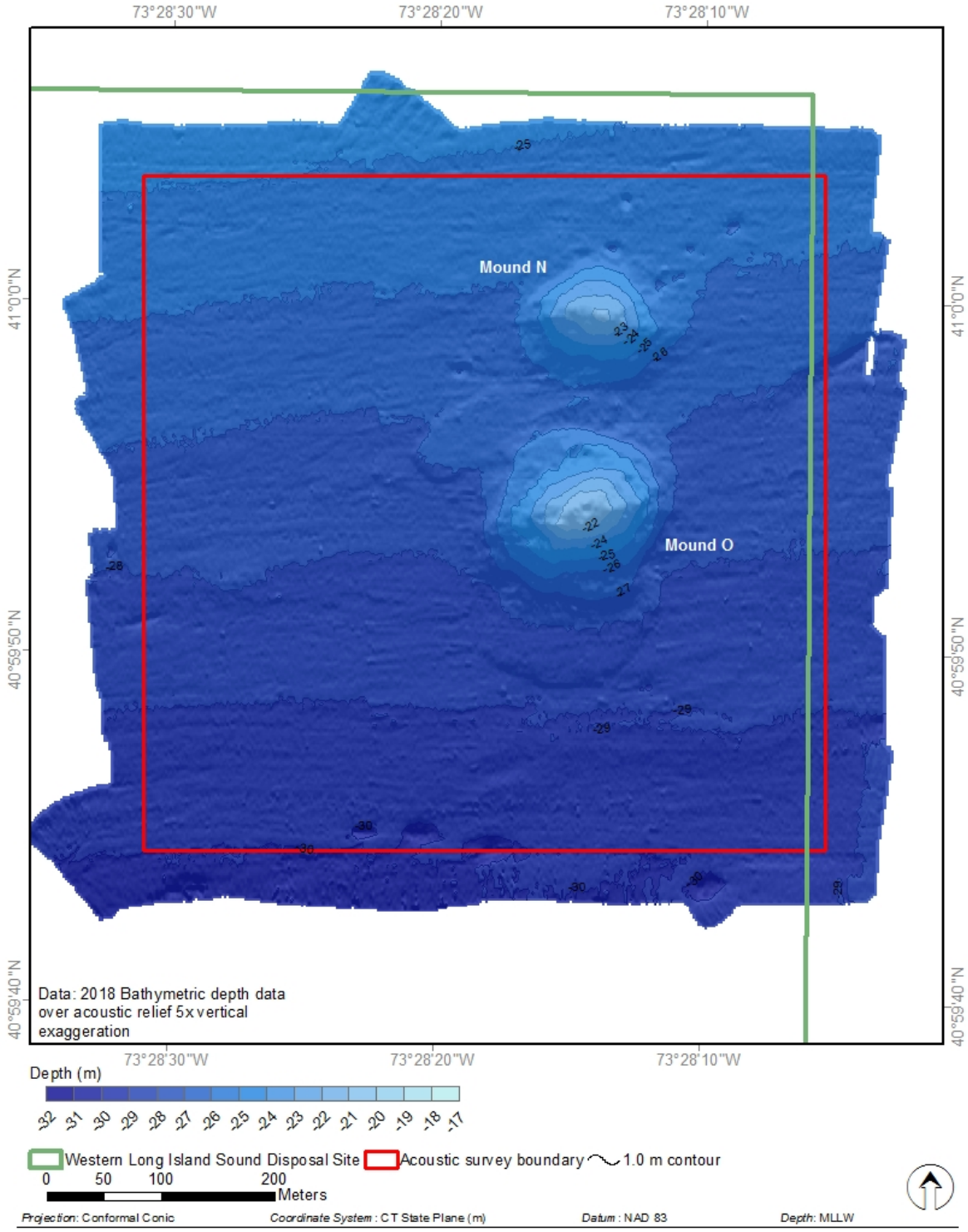

Figure 3-1. Bathymetry of the survey area over the northeast portion of WLDS presented over 5x vertical relief model, October 2018.

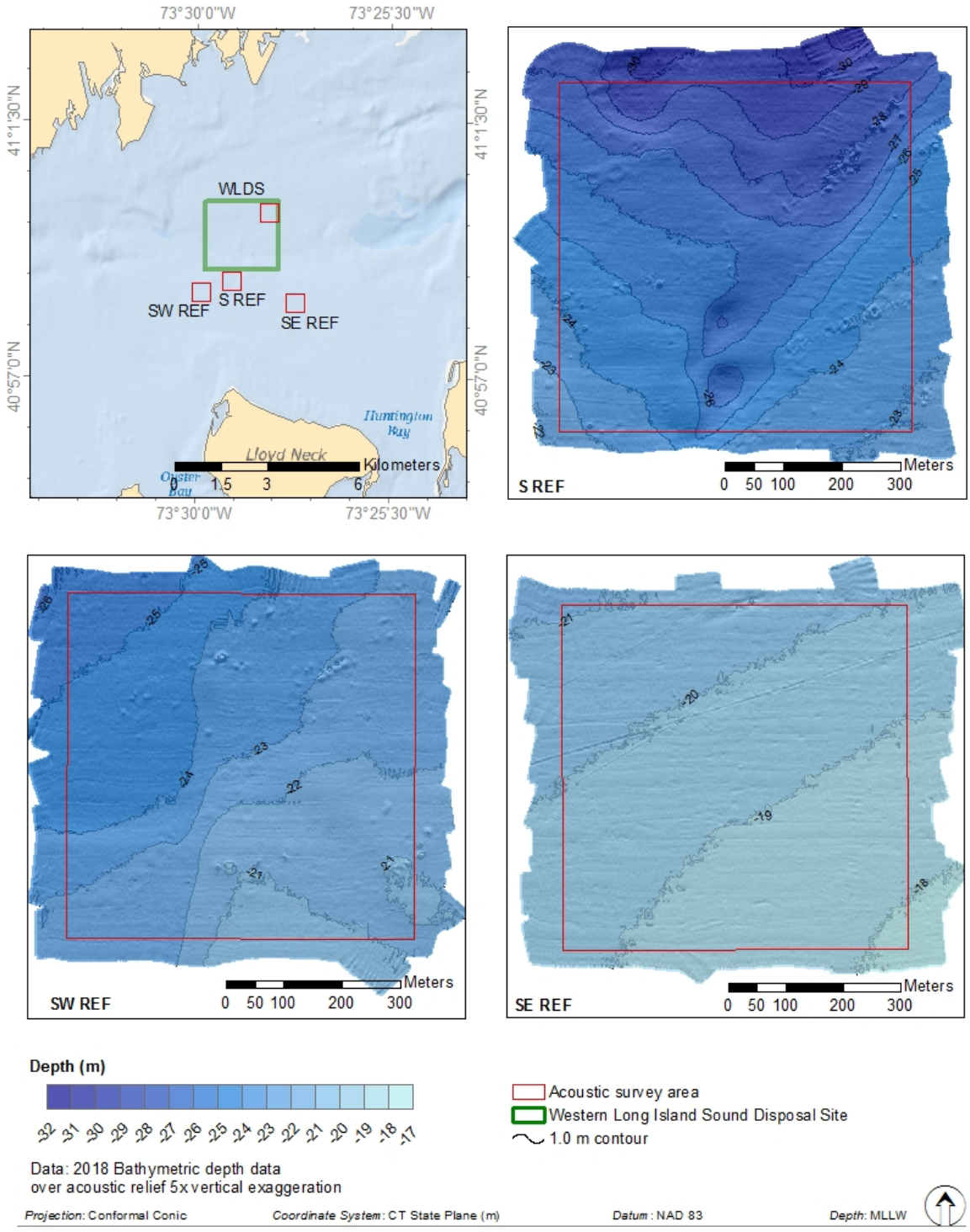

Figure 3-2. Bathymetry of S REF, SW REF, and SE REF over 5x vertical relief model, October 2018.

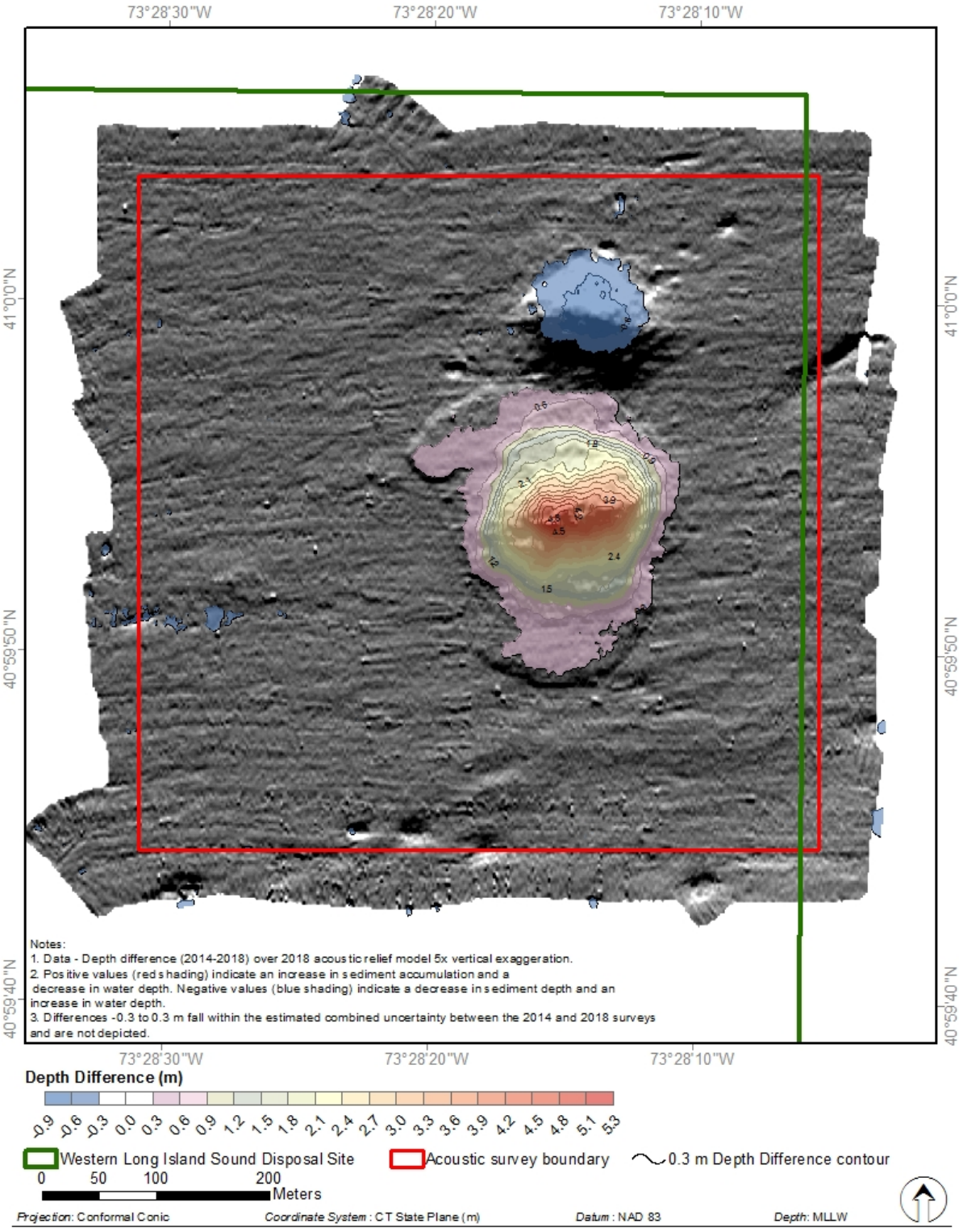

Figure 3-3. Depth differencing (2014 – 2018) of WLDS over 5x vertical relief model, 2018.

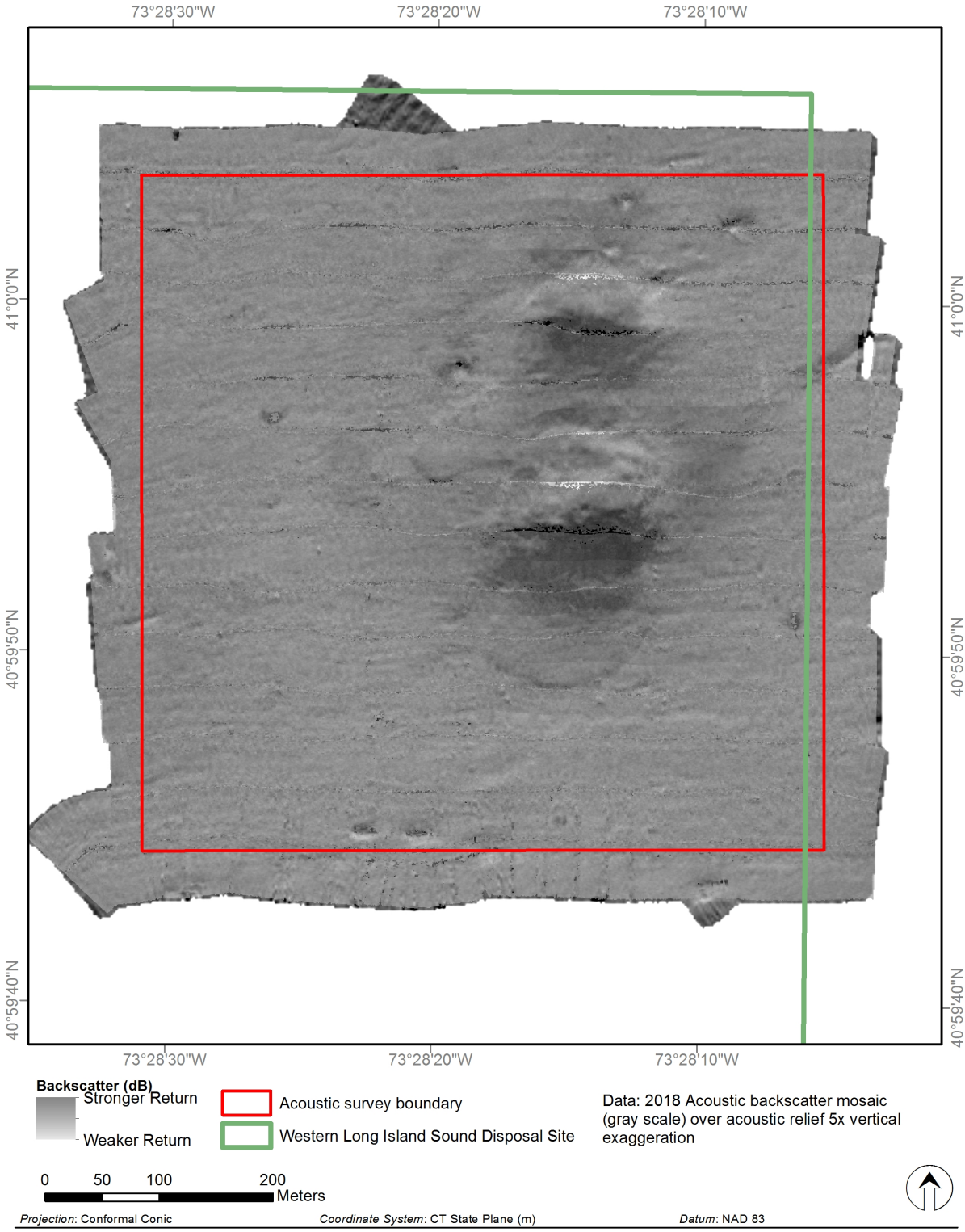

Figure 3-4. Backscatter intensity (dB) at WLDS over 5x vertical relief model, 2018.

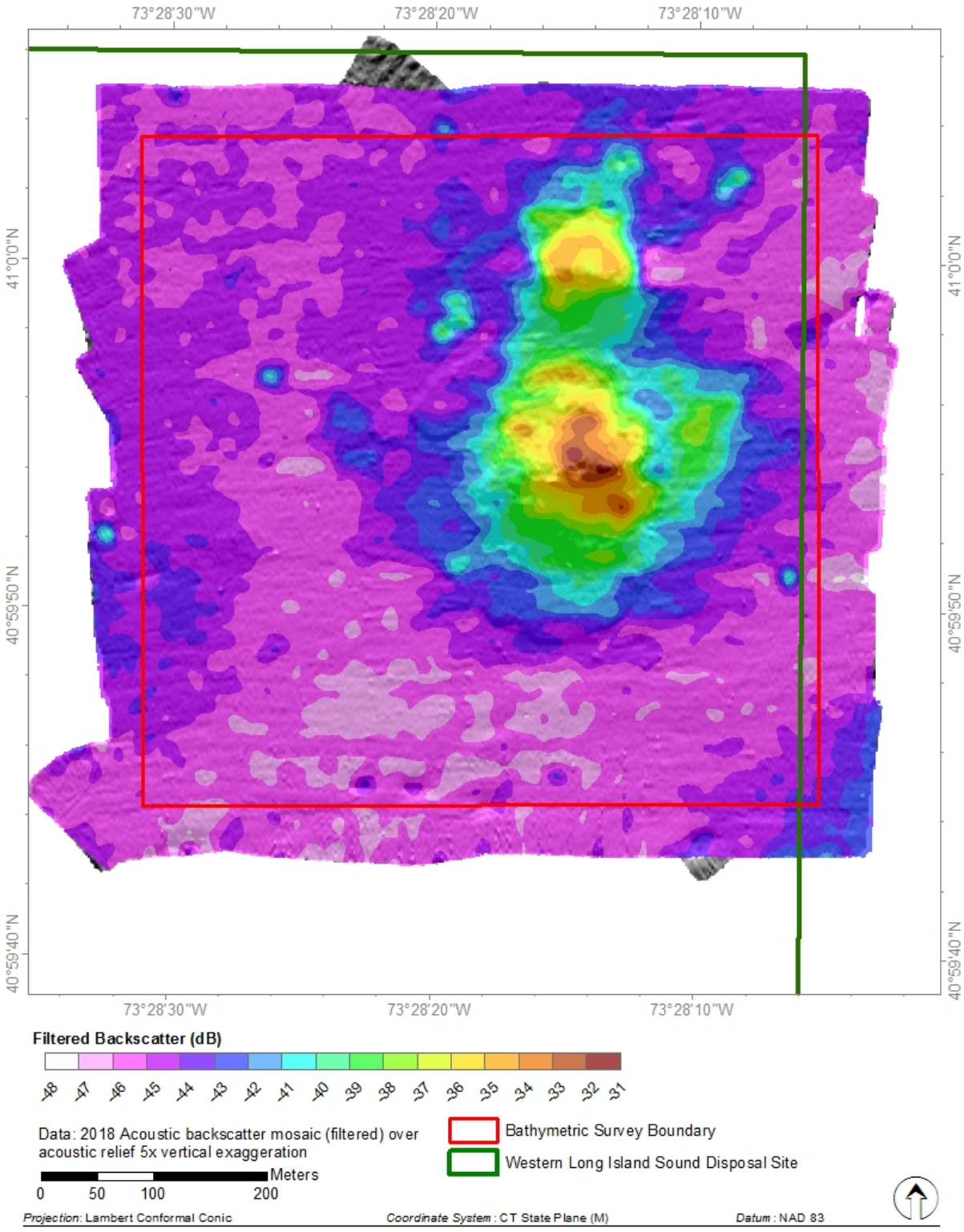

Figure 3-5. Filtered backscatter intensity (dB) at WLDS over 5x vertical relief model, 2018.

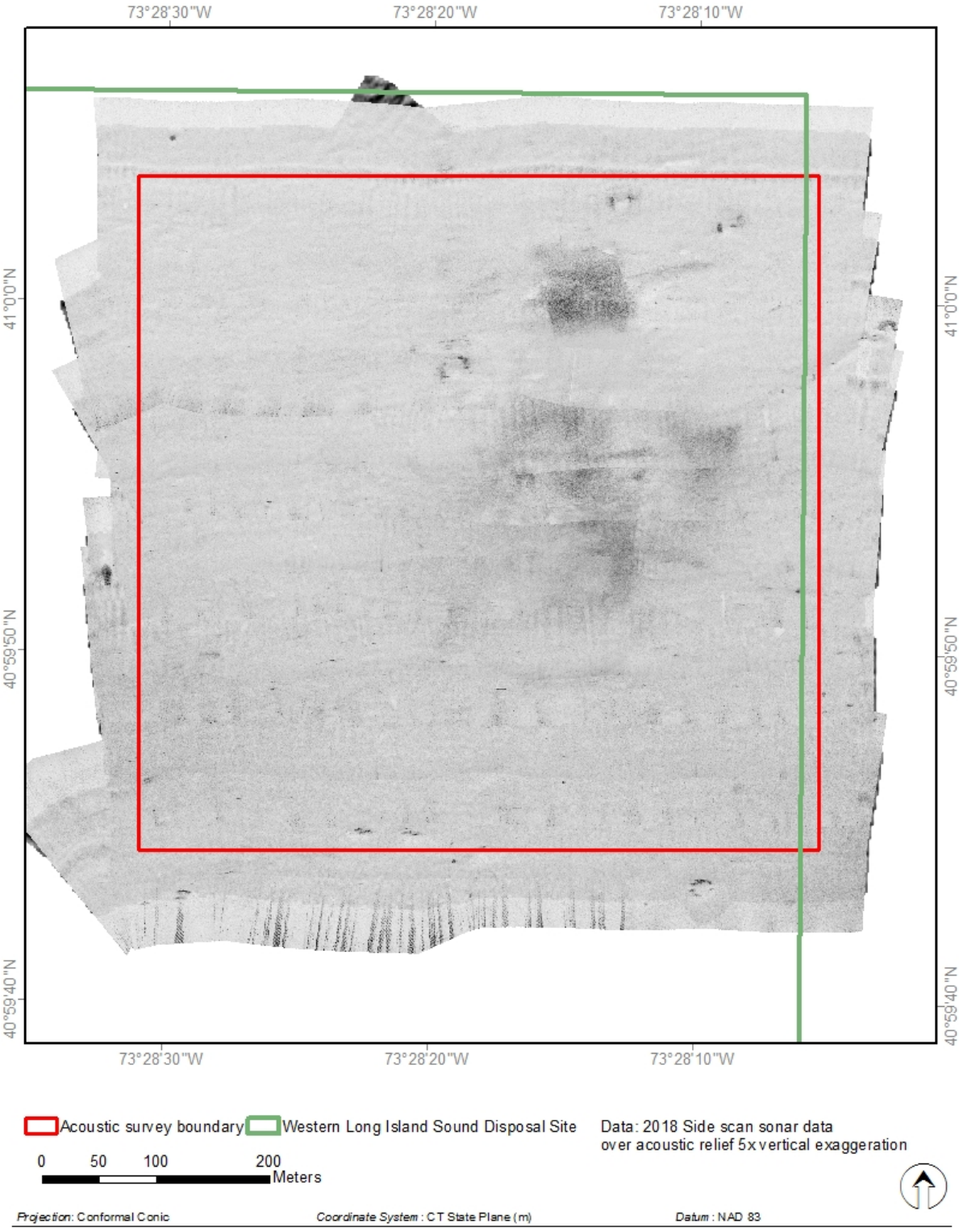

Figure 3-6. Side-scan sonar at WLDS over 5x vertical relief model, 2018.

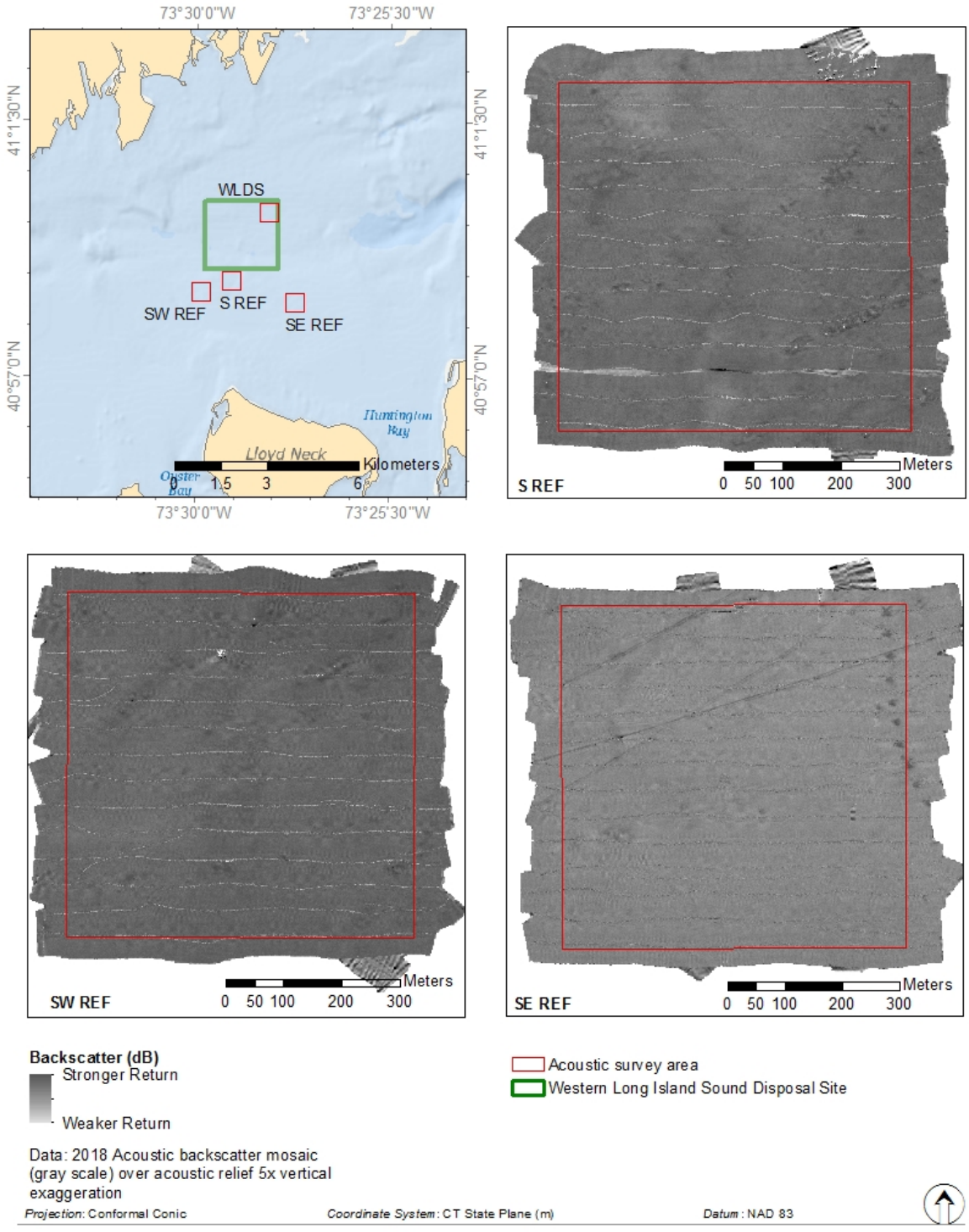

Figure 3-7. Backscatter intensity (dB) at SW REF, S REF, and SE REF over 5x vertical relief model, October 2018.

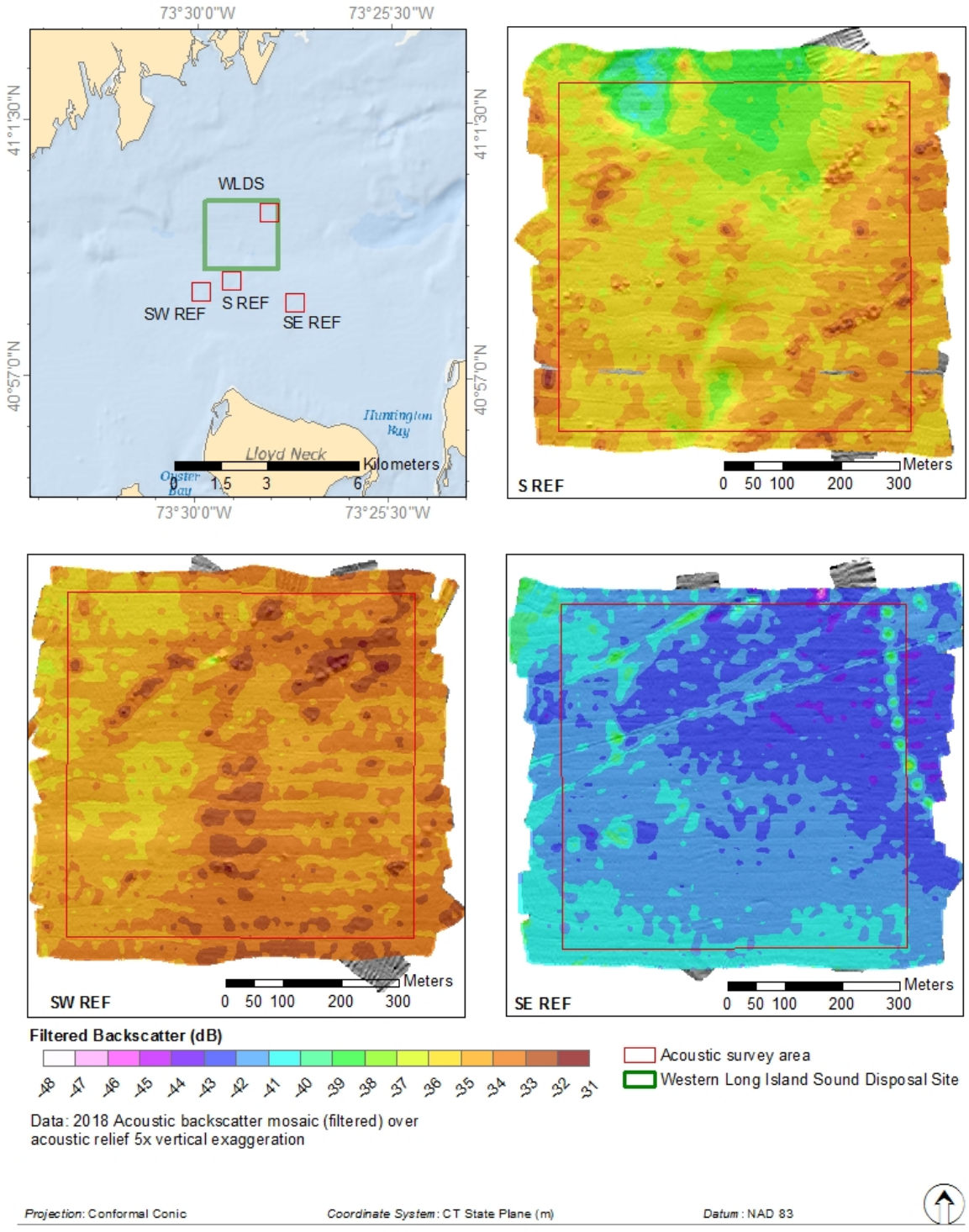

Figure 3-8. Filtered backscatter intensity (dB) at SW REF, S REF, and SE REF over 5x vertical relief model, October 2018.

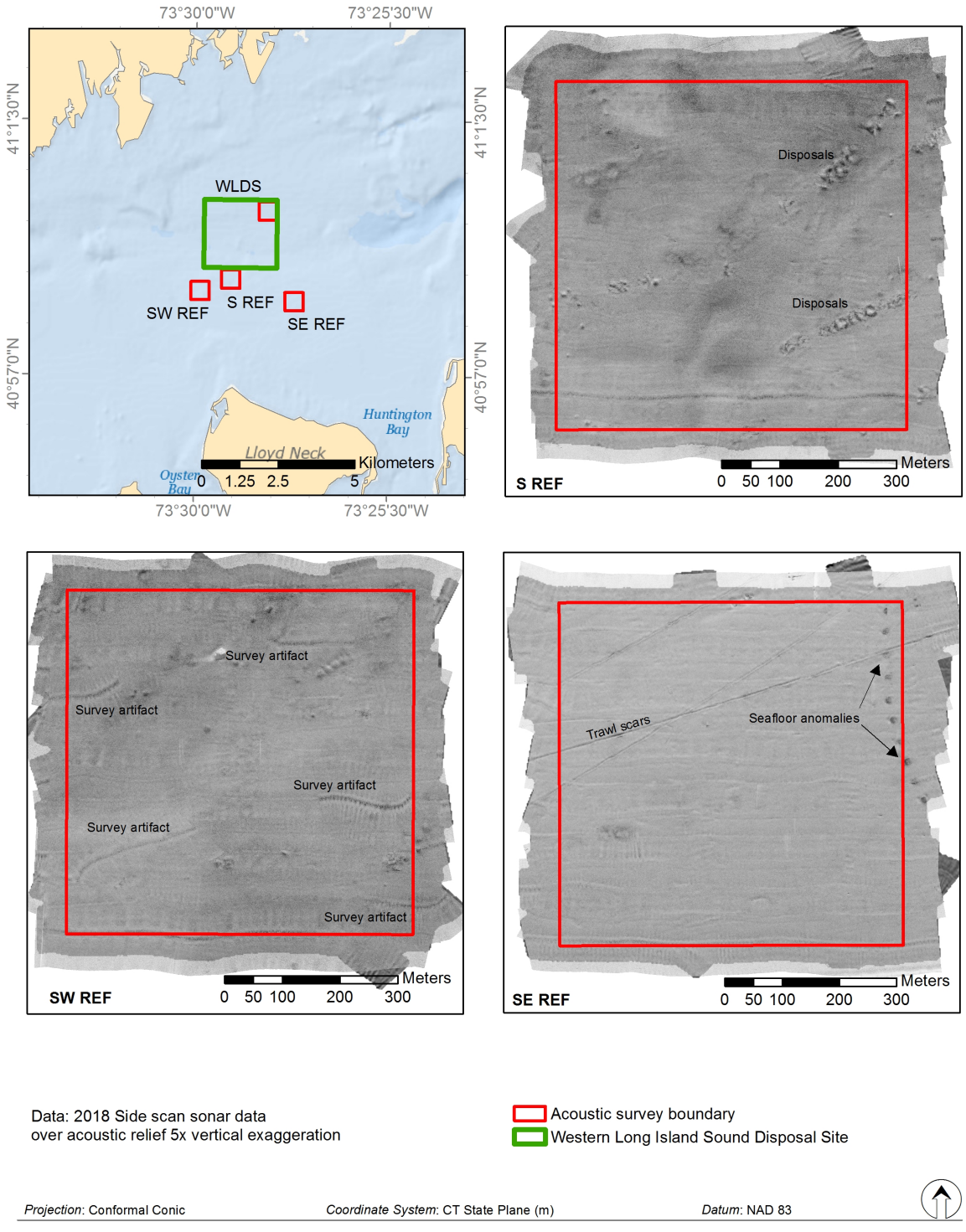

Figure 3-9. Side-scan sonar at SW REF, S REF, and SE REF over 5x vertical relief model, October 2018.

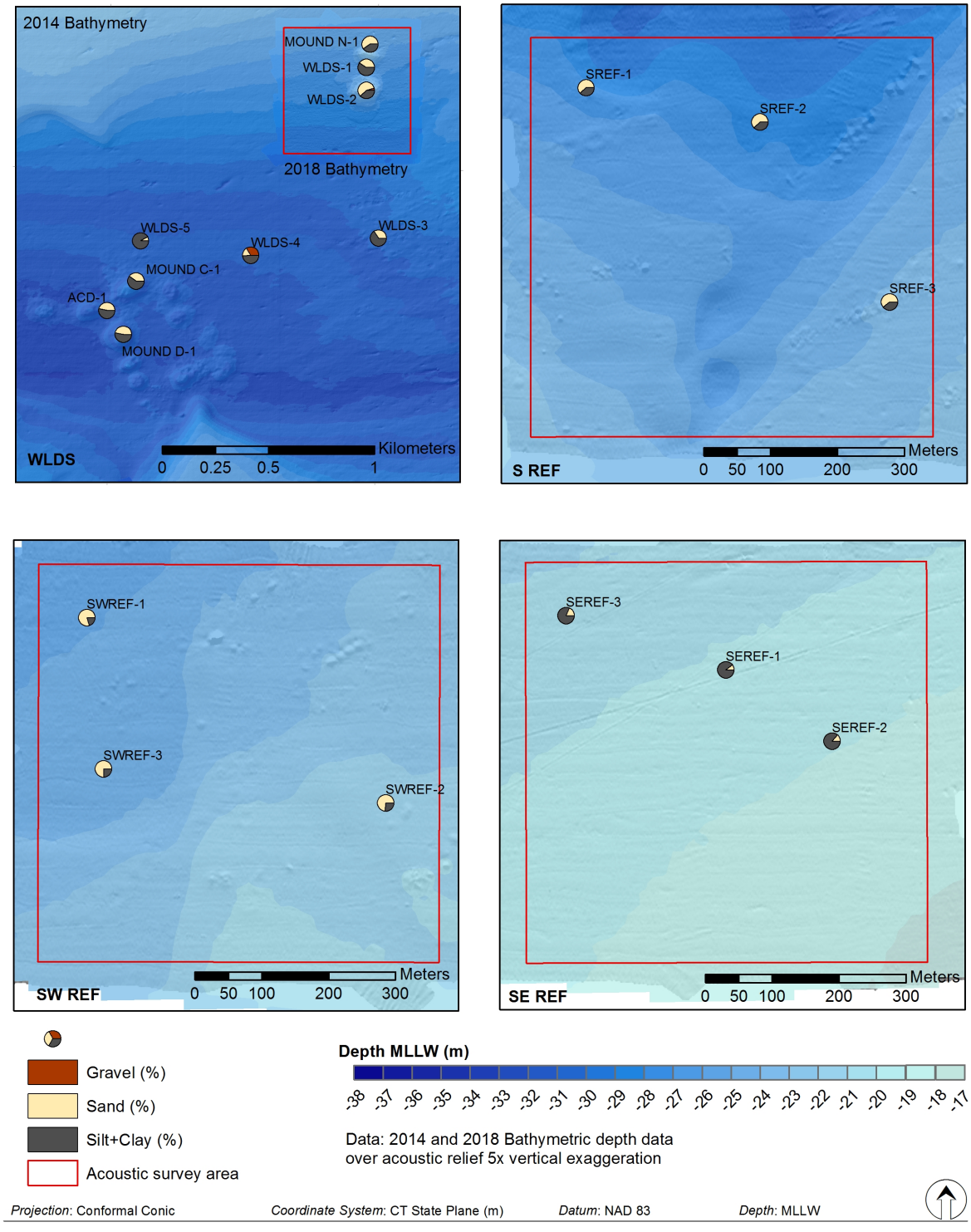

Figure 3-10. Sediment grain size at WLDS and reference areas, October 2018.

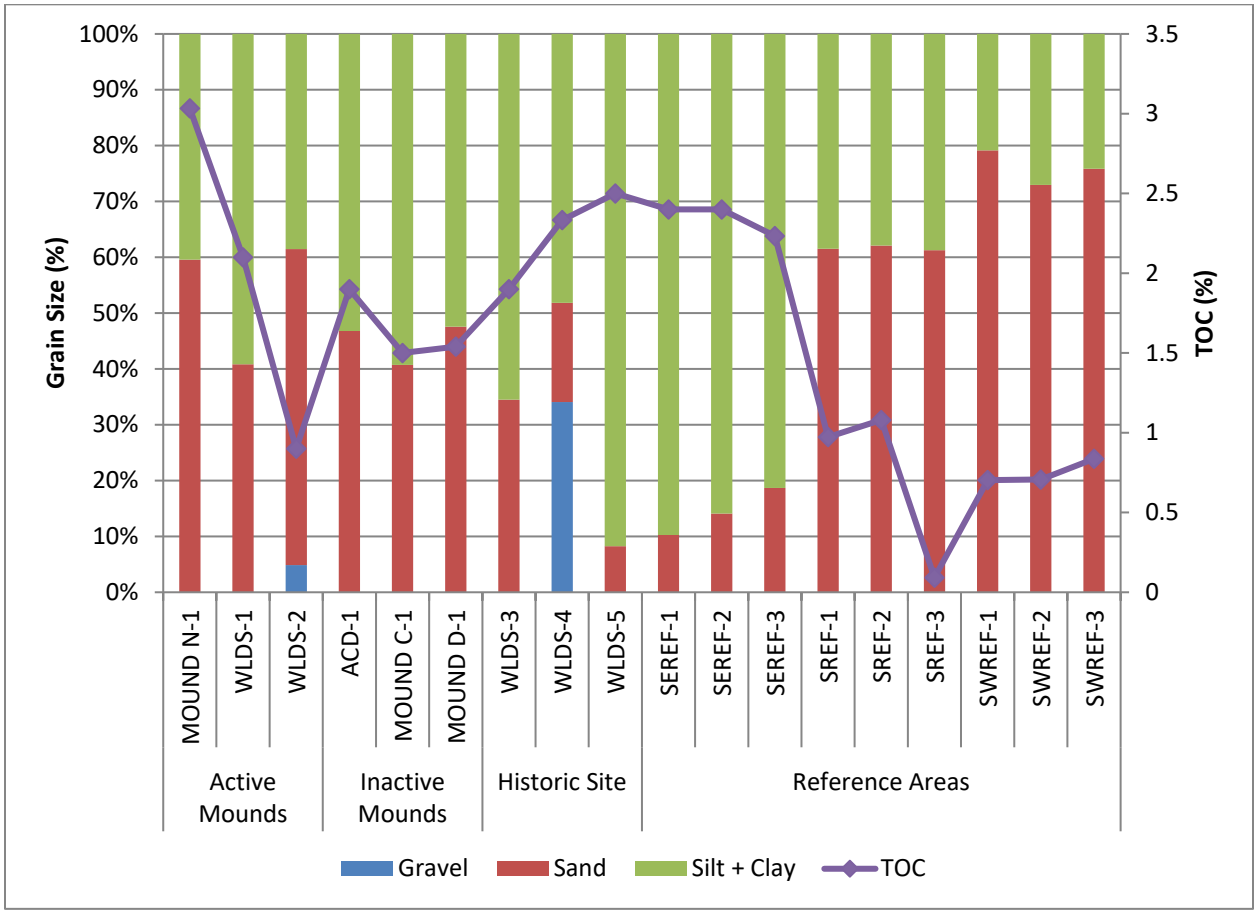

Figure 3-11. Total organic carbon and grain size, WLDS and reference areas, October 2018.

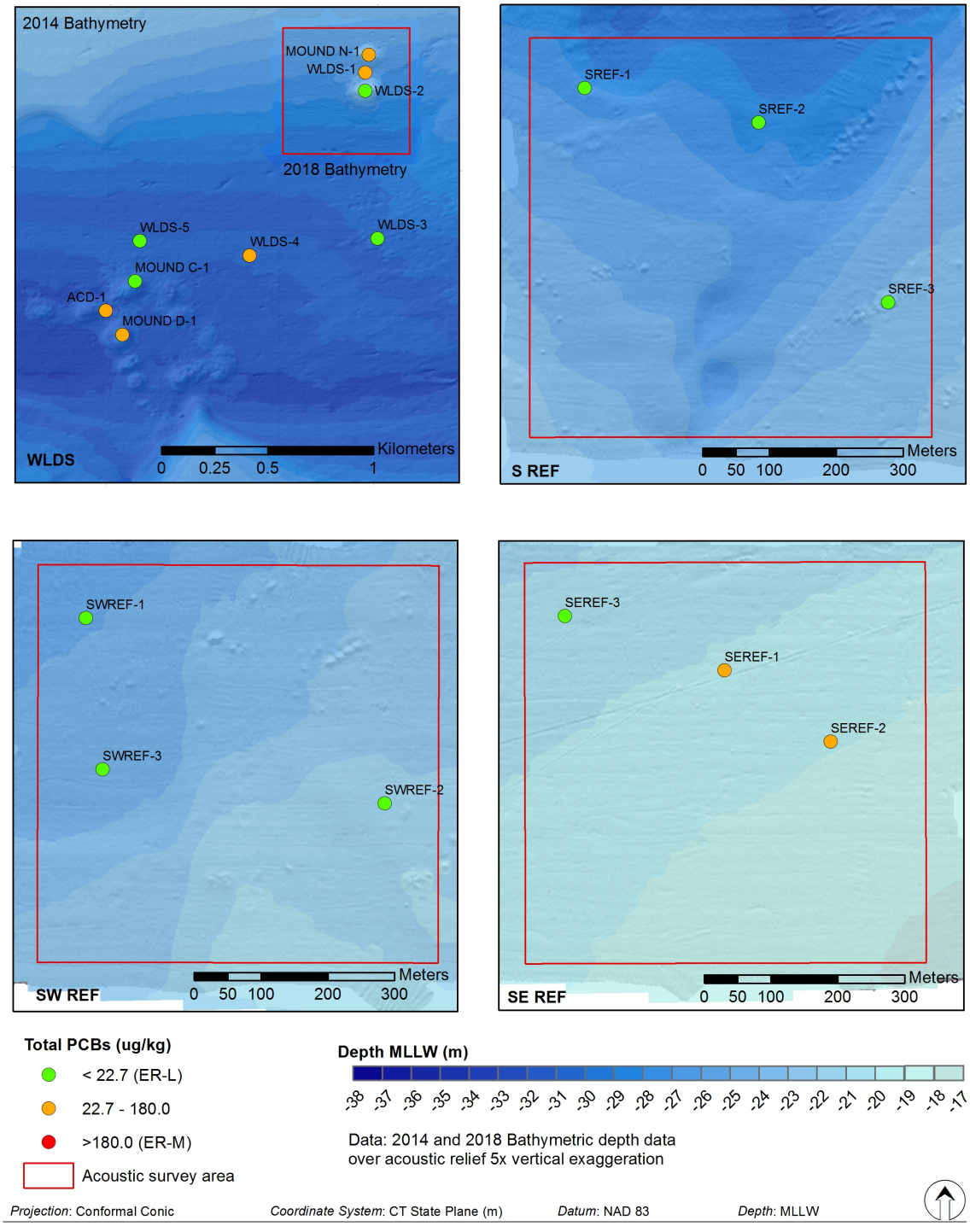

Figure 3-12. Total PCB concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

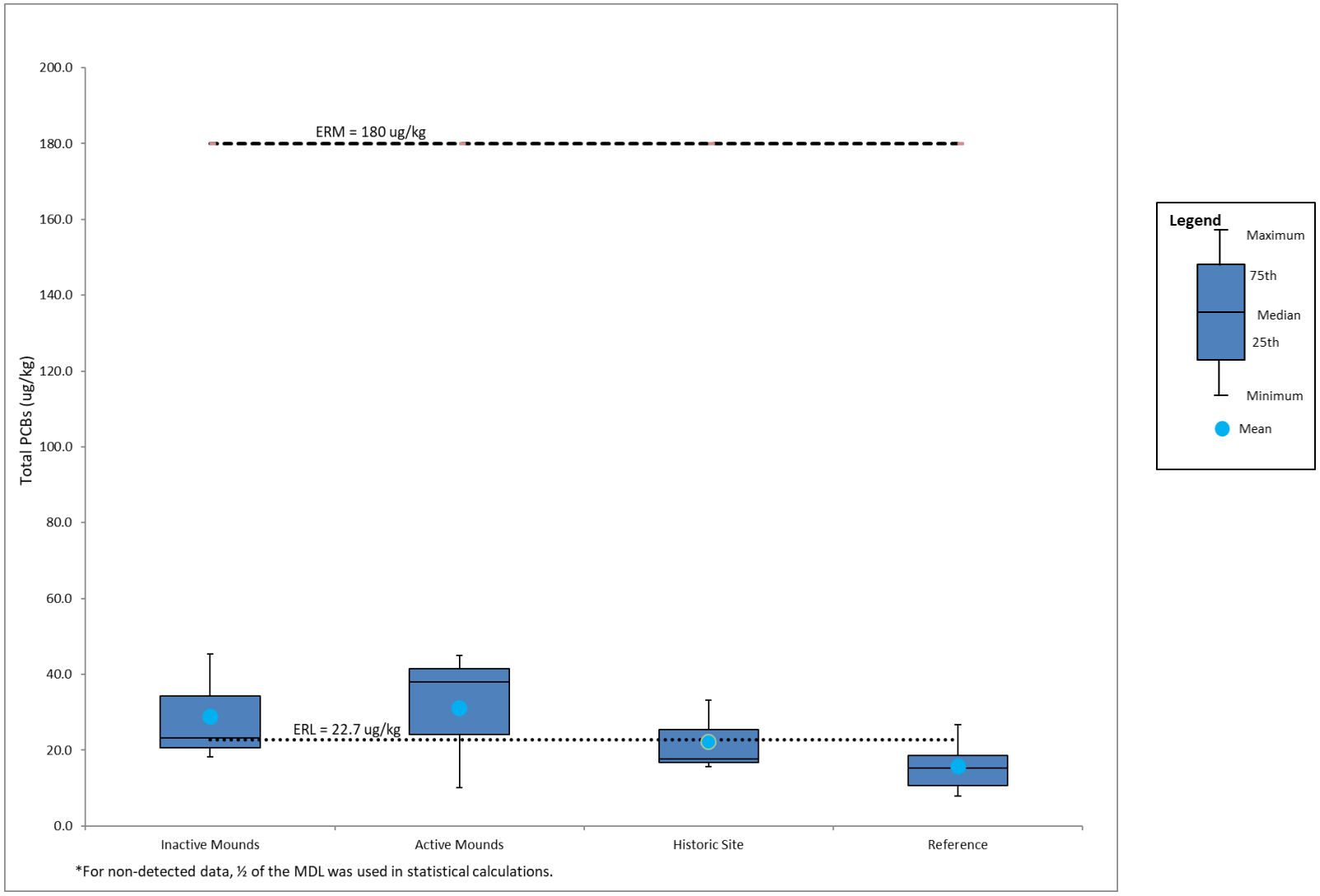

Figure 3-13. Box plots displaying total PCB concentrations in WLDS and reference areas, October 2018.

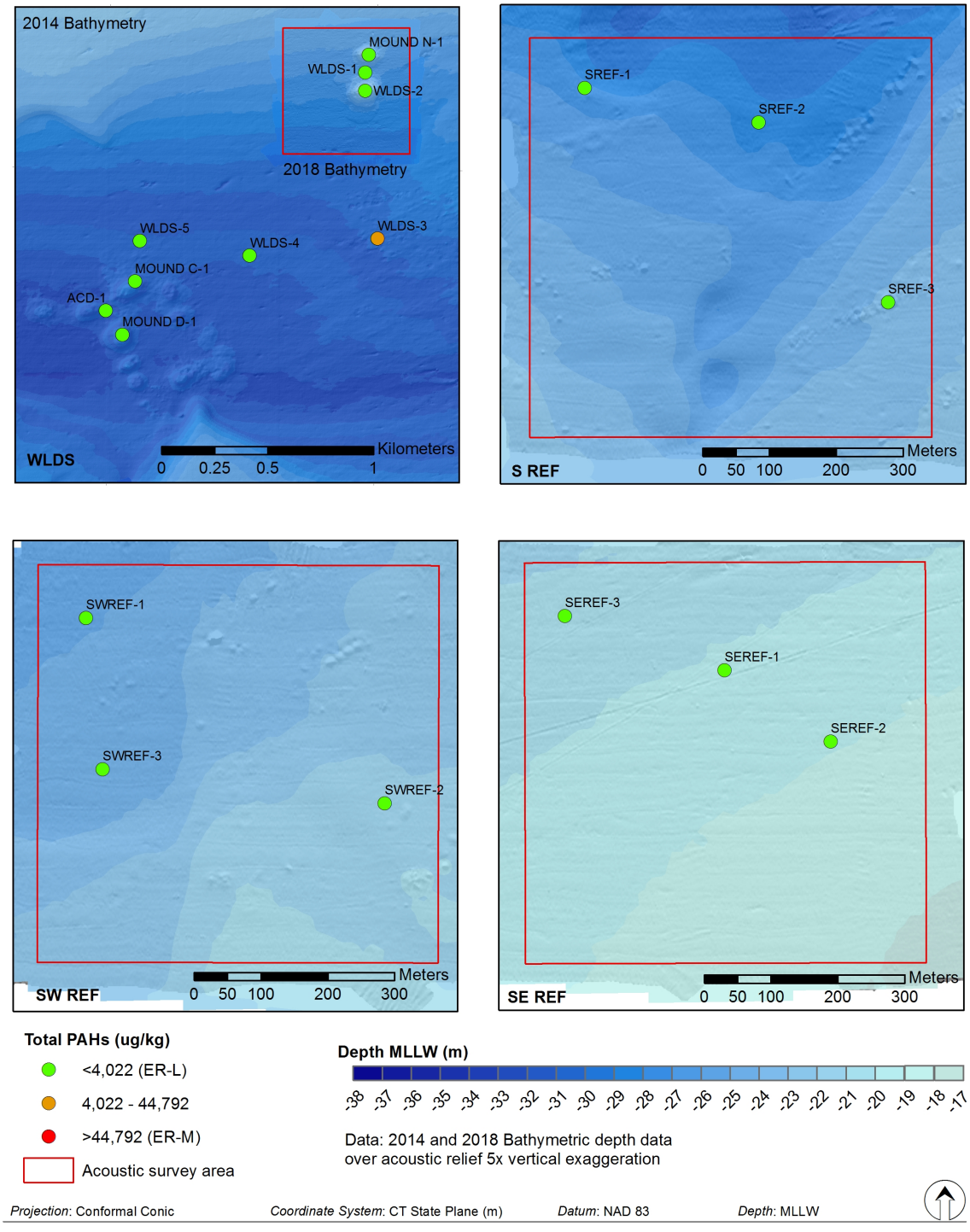

Figure 3-14. Total PAH concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

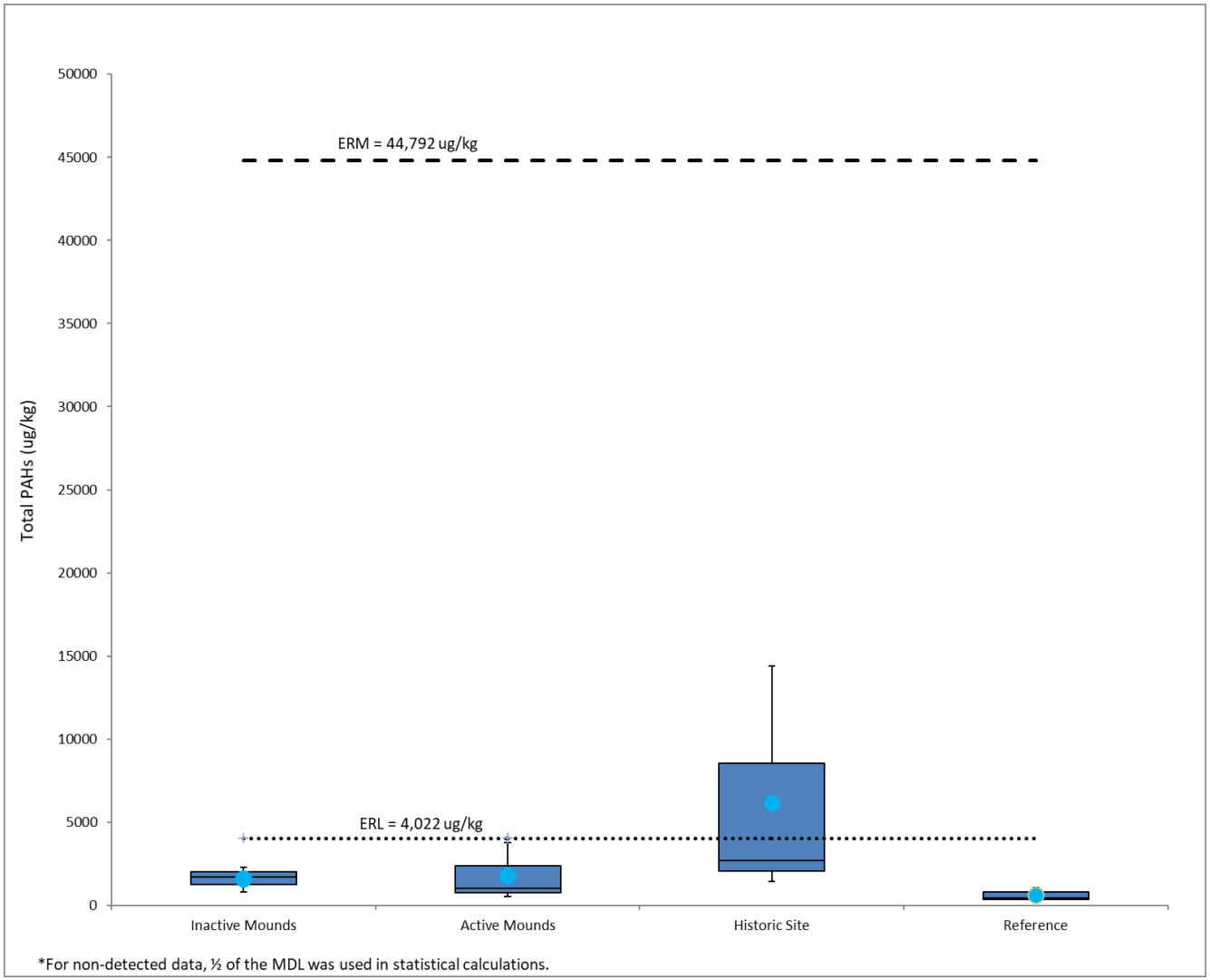

Figure 3-15. Box plots displaying total PAH concentrations in WLDS and reference areas, October 2018.

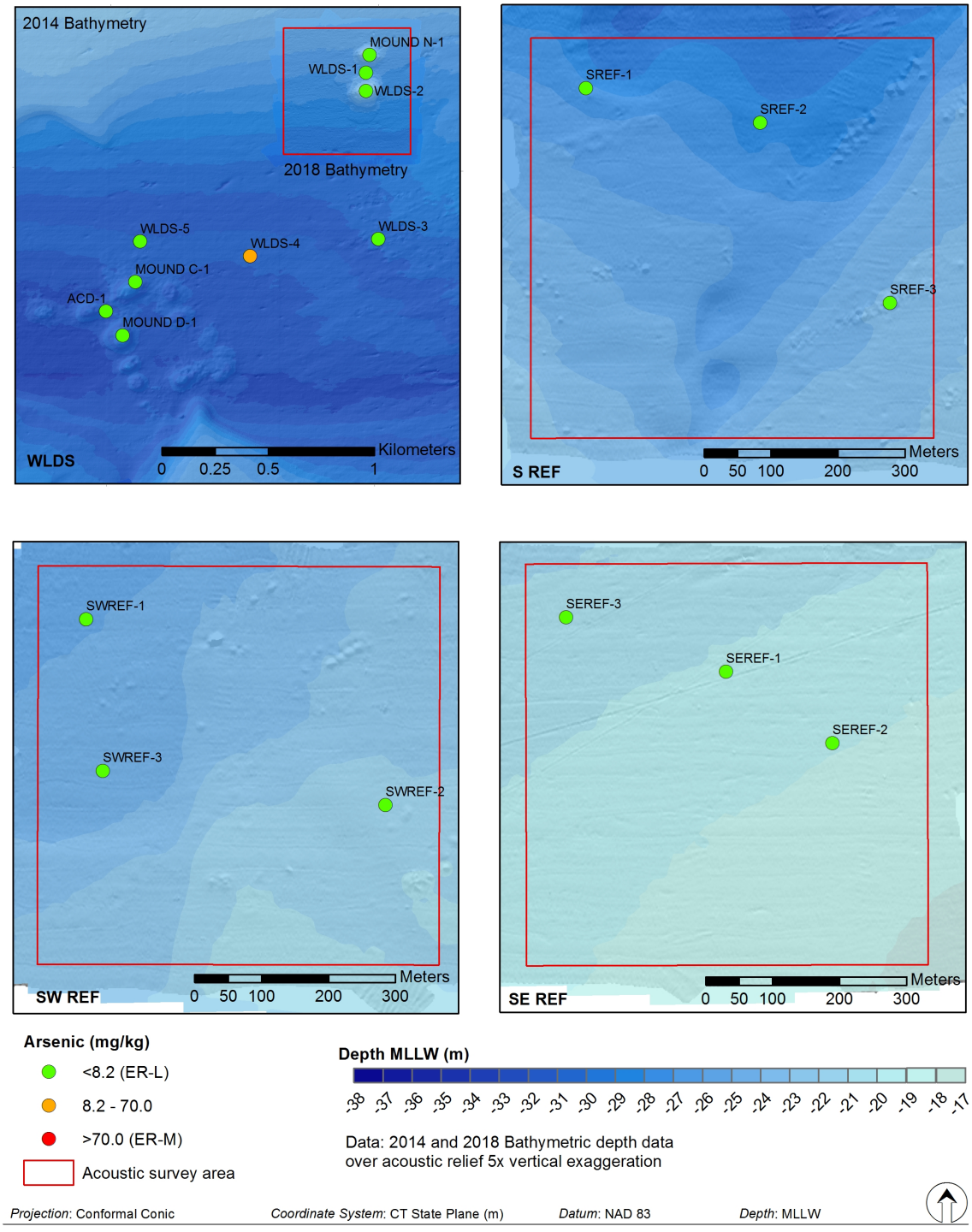

Figure 3-16. Arsenic concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

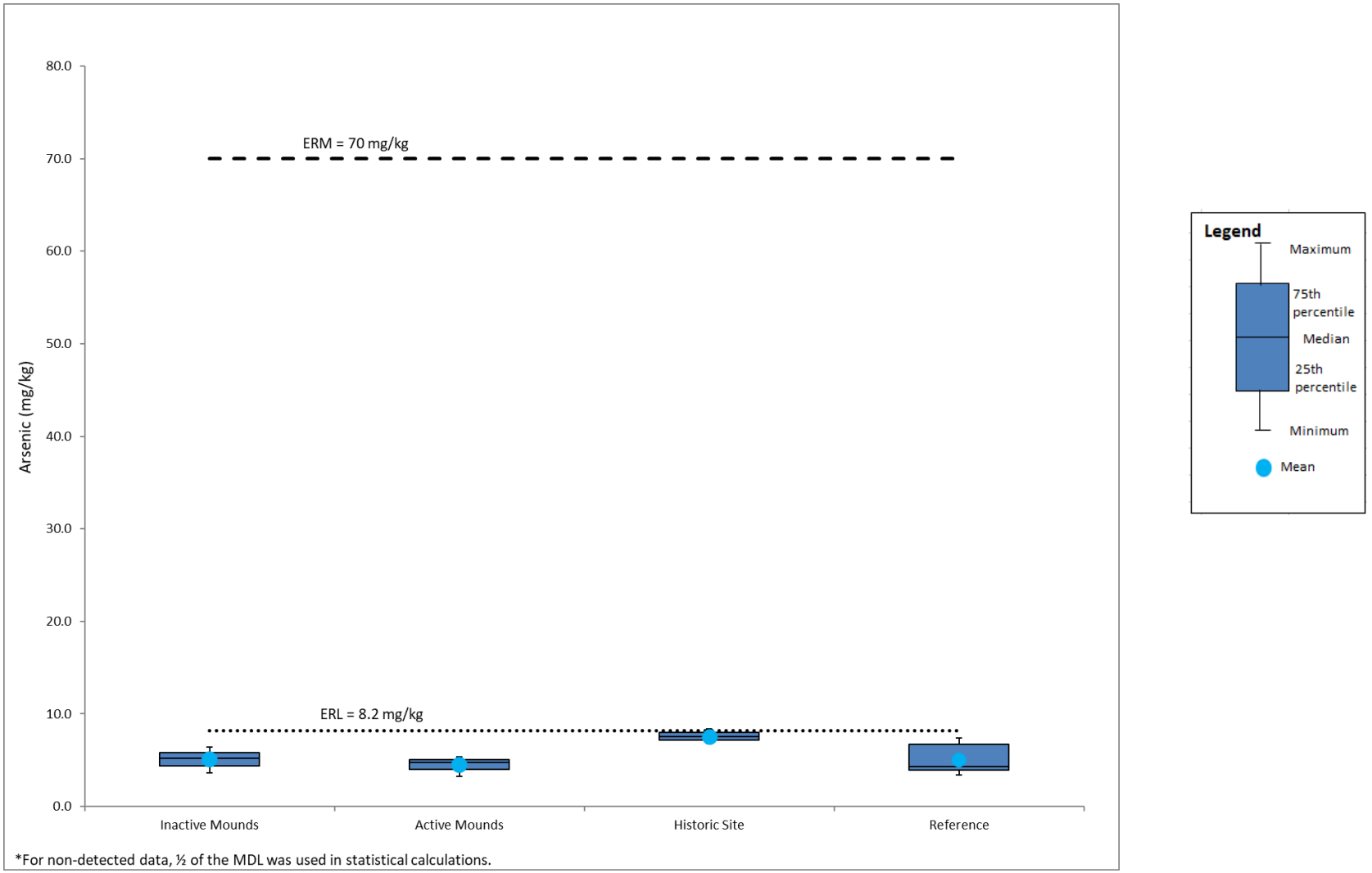

Figure 3-17. Box plots displaying arsenic concentrations in WLDS and reference areas, October 2018.

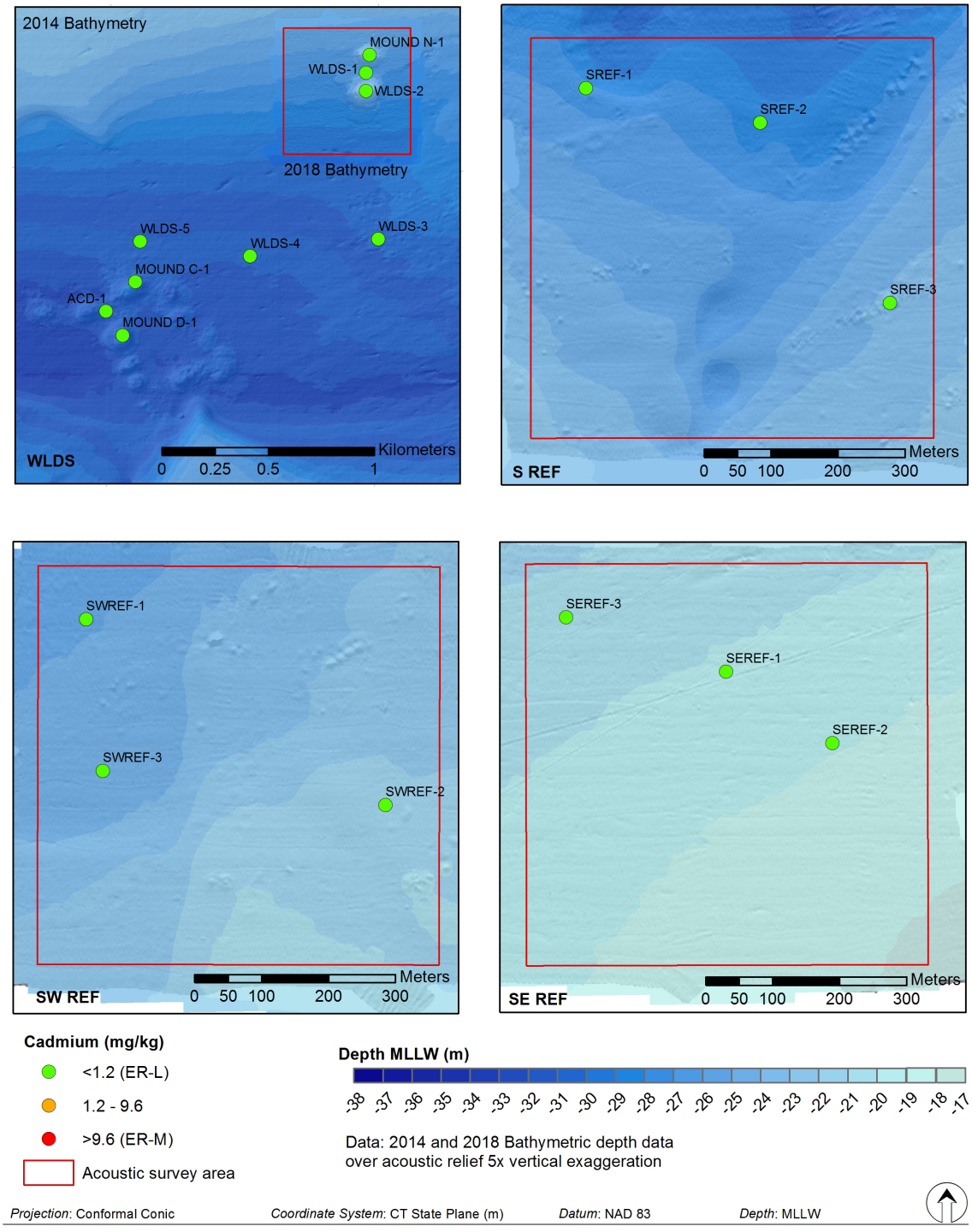

Figure 3-18. Cadmium concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

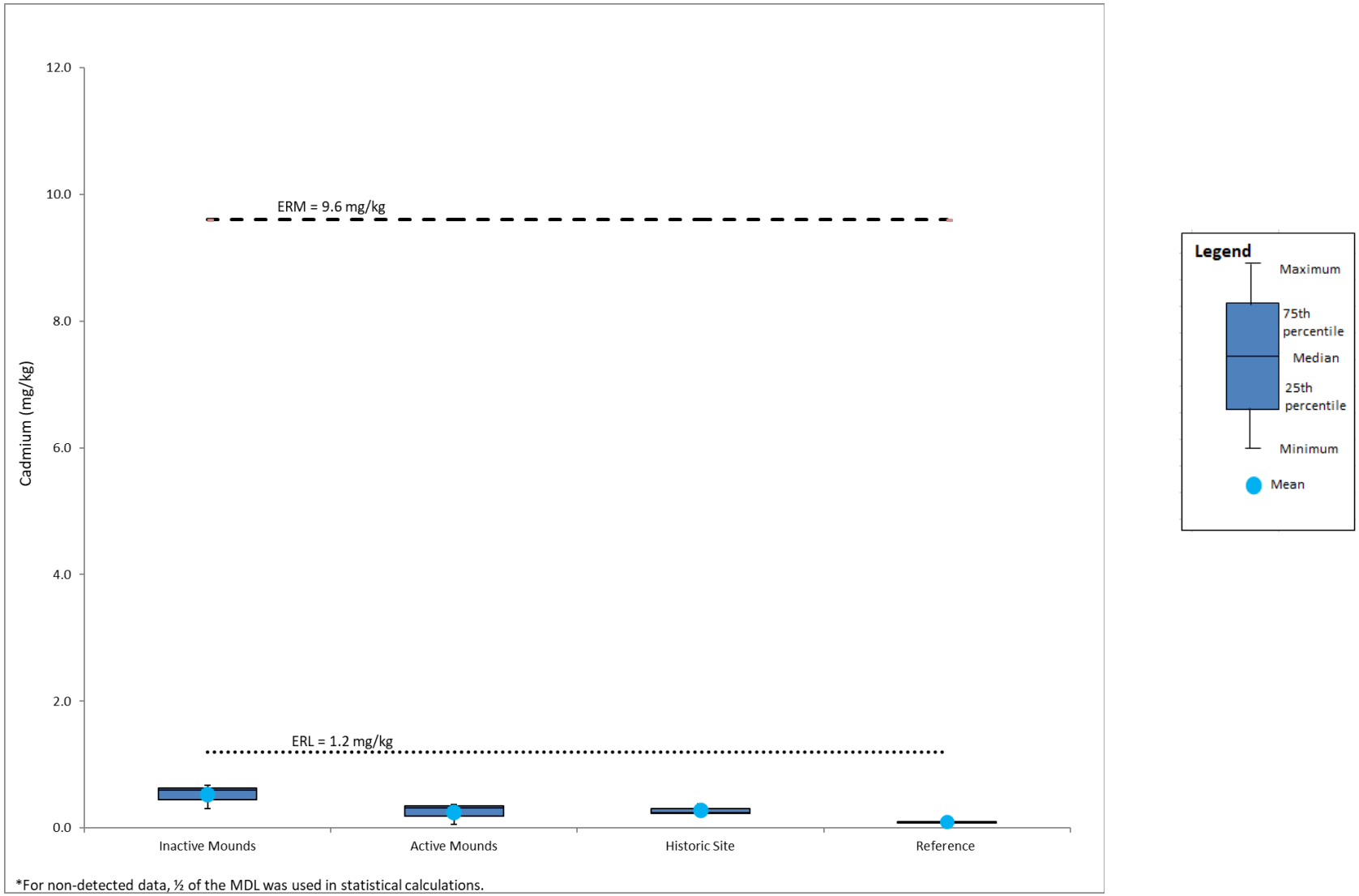

Figure 3-19. Box plots displaying cadmium concentrations in WLDS and reference areas, October 2018.

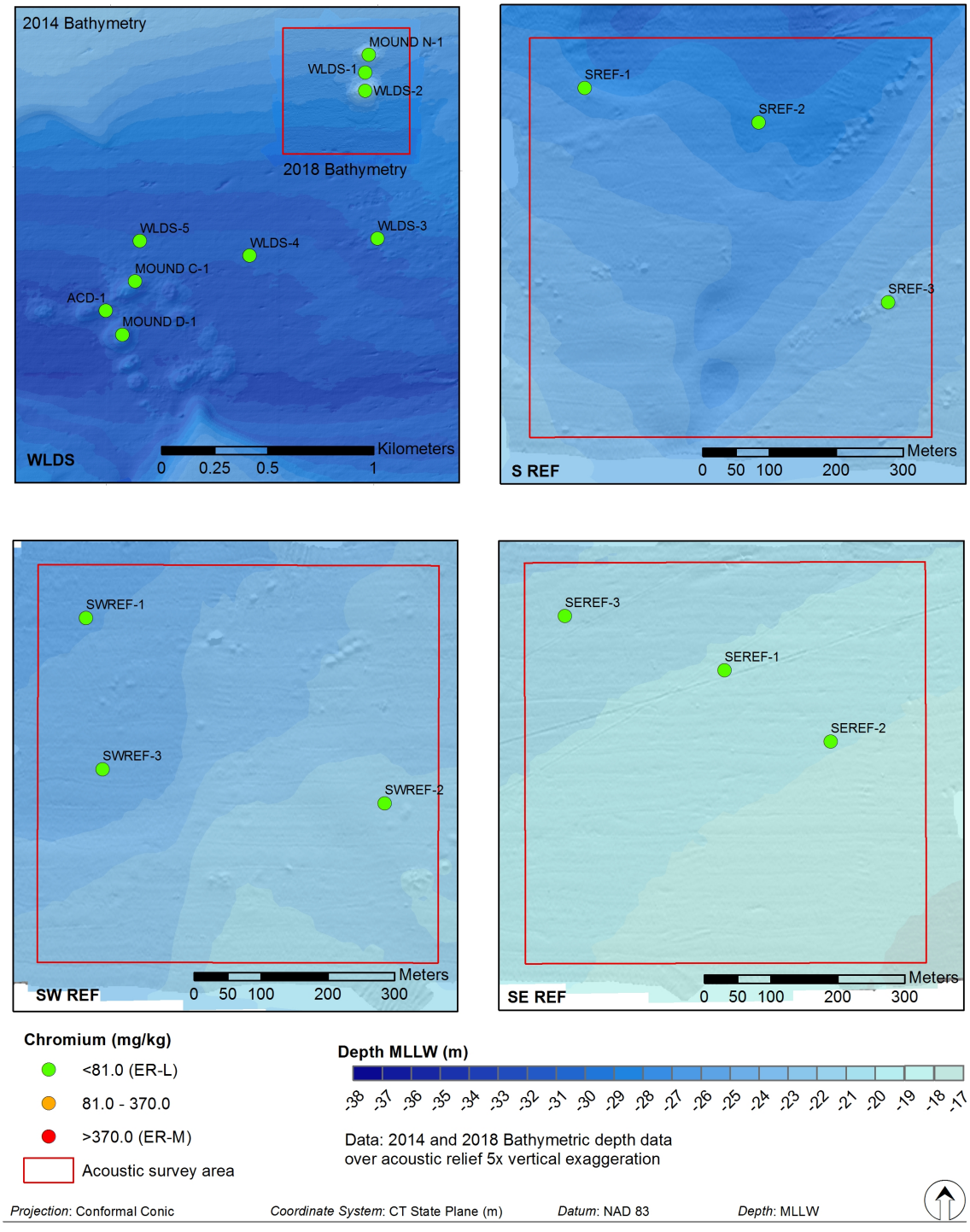

Figure 3-20. Chromium concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

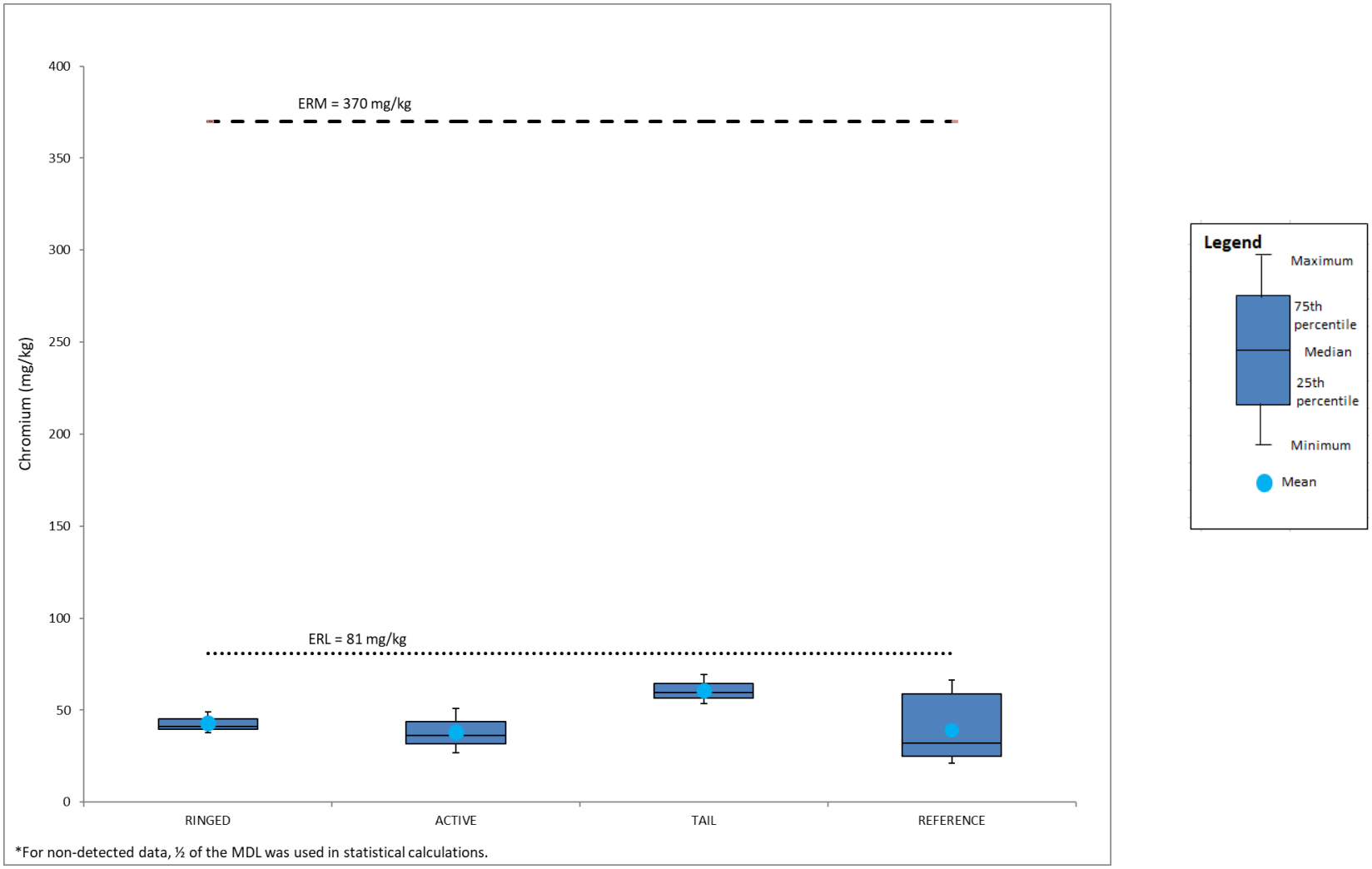

Figure 3-21. Box plots displaying chromium concentrations in WLDS and reference areas, October 2018.

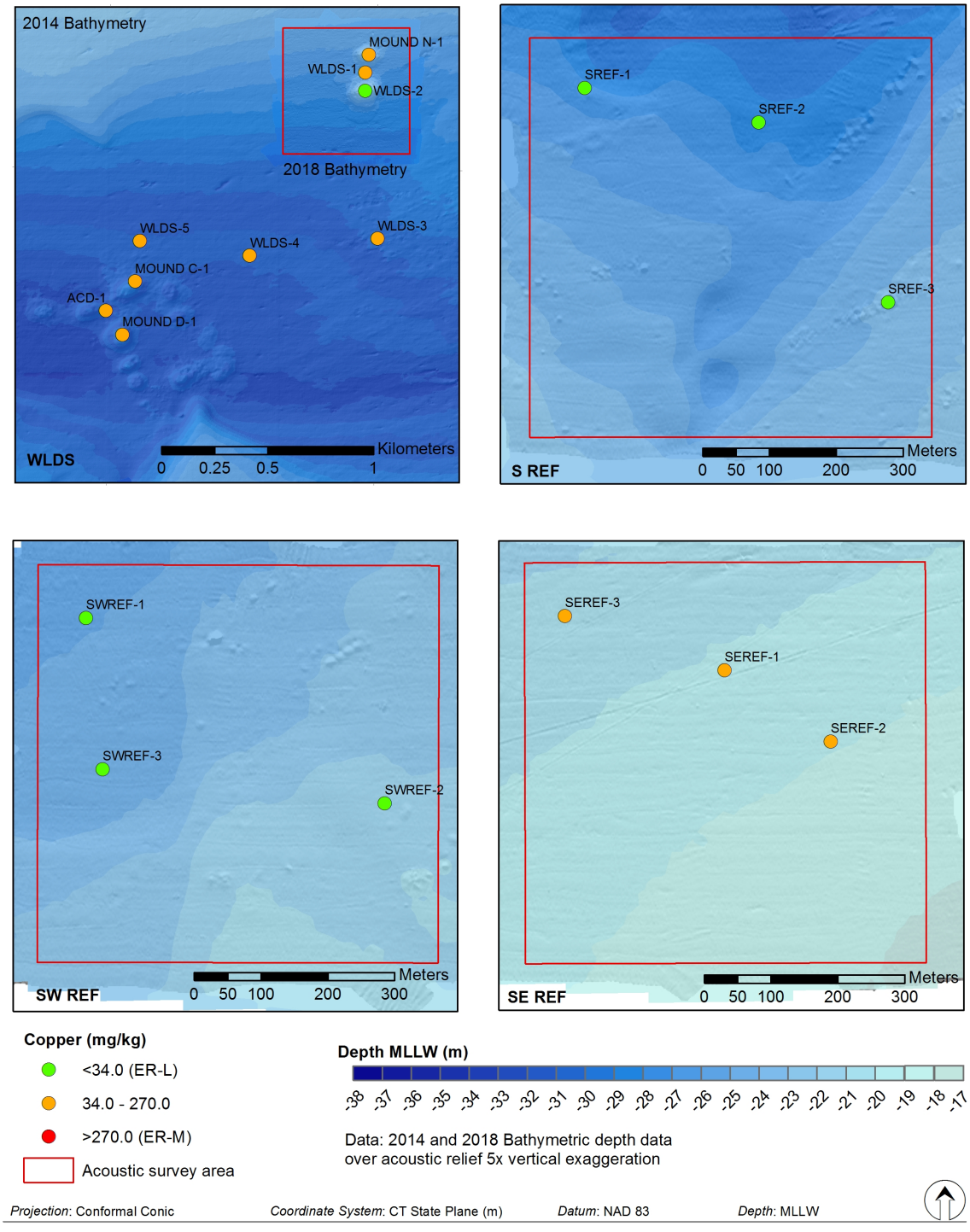

Figure 3-22. Copper concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

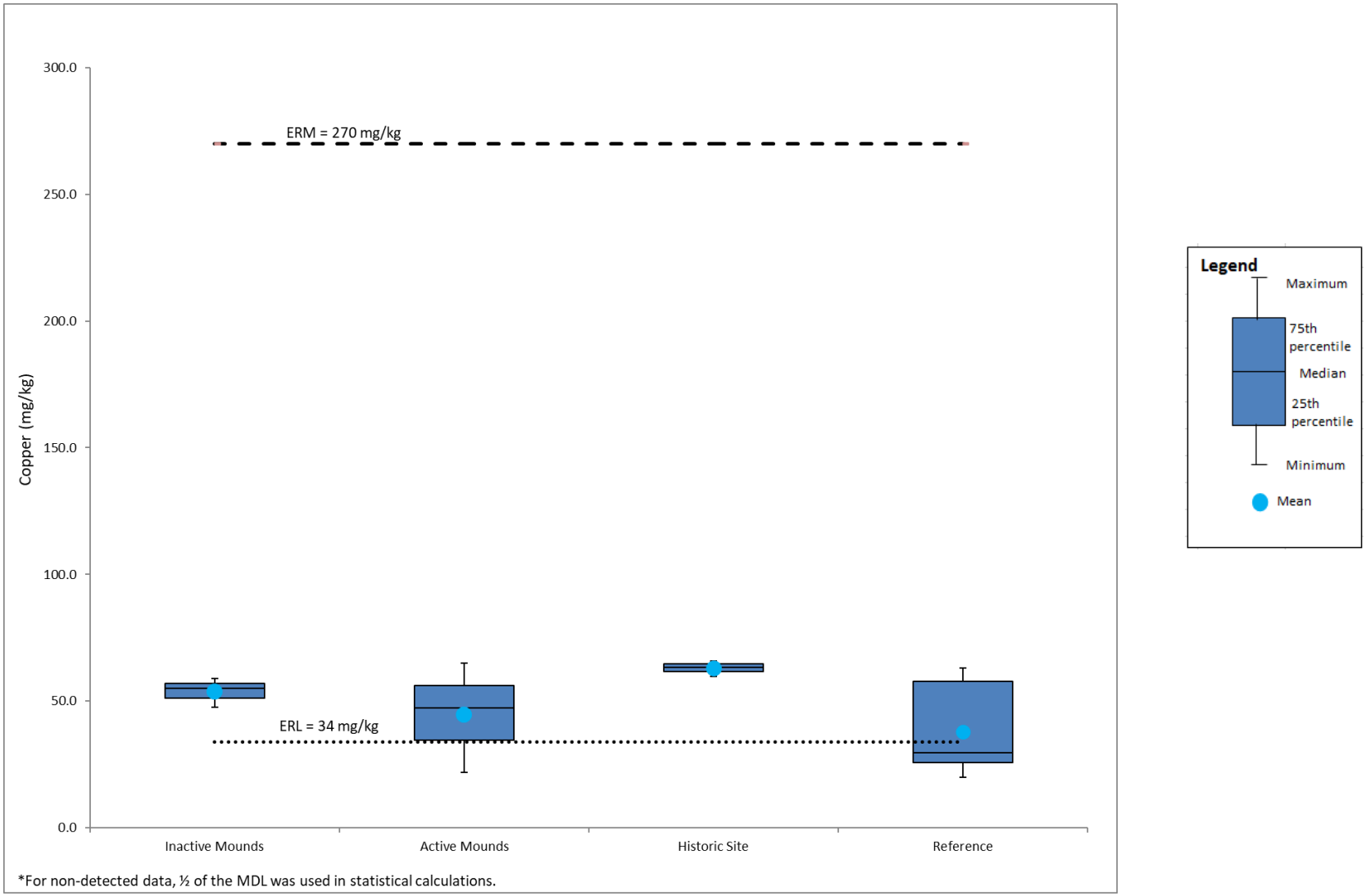

Figure 3-23. Box plots displaying copper concentrations in WLDS and reference areas, October 2018.

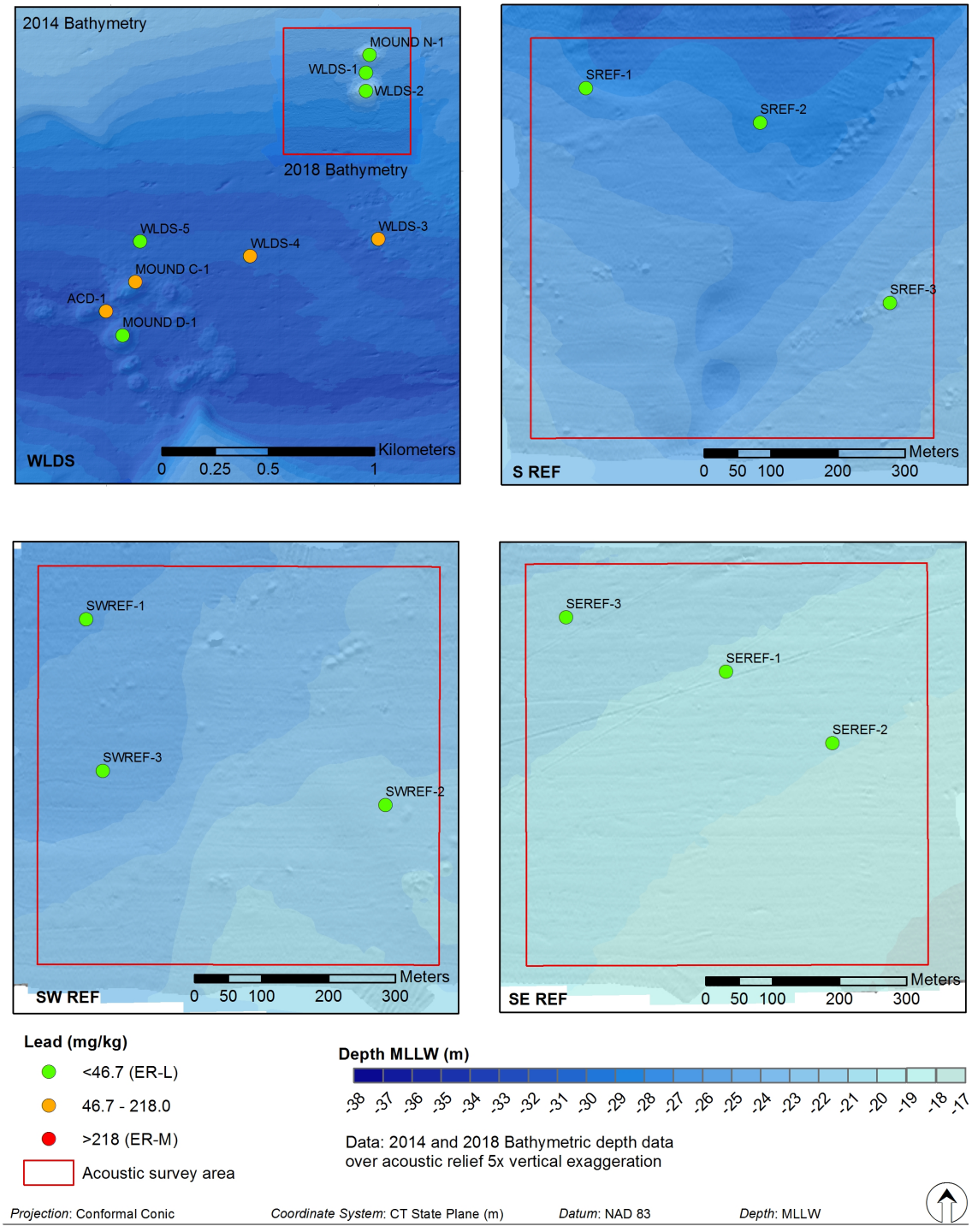

Figure 3-24. Lead concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

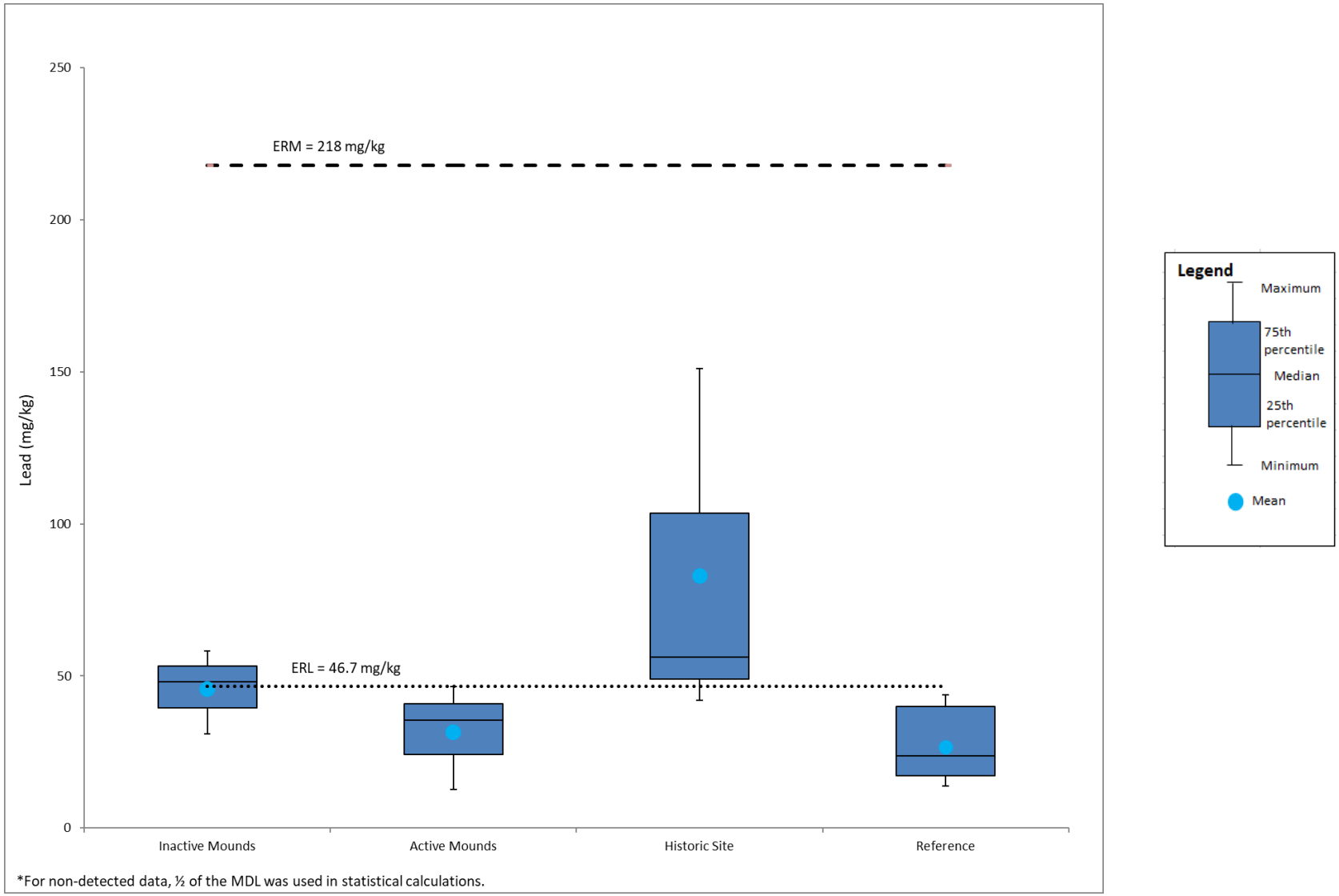

Figure 3-25. Box plots displaying lead concentrations in WLDS and reference areas, October 2018.

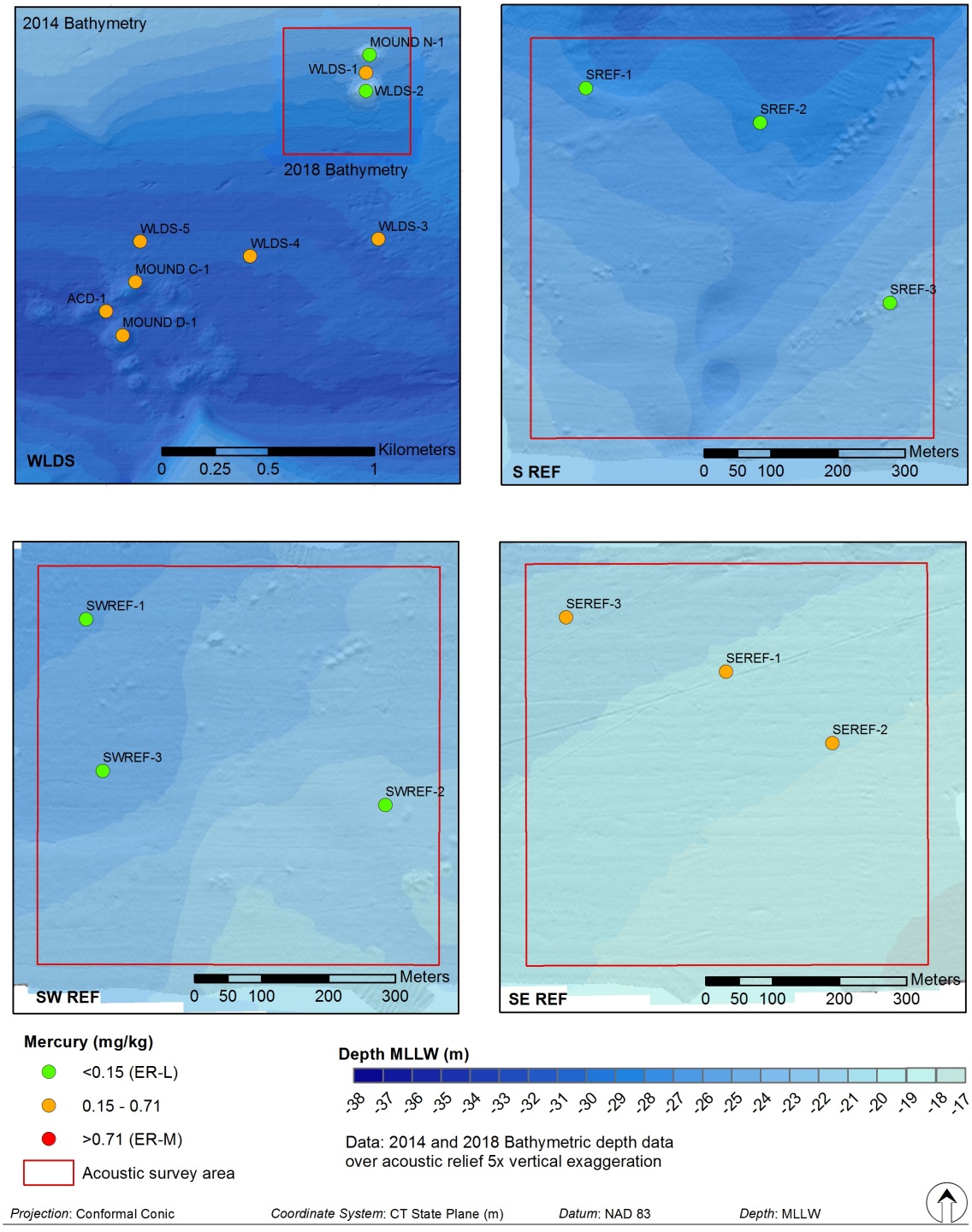

Figure 3-26. Mercury concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

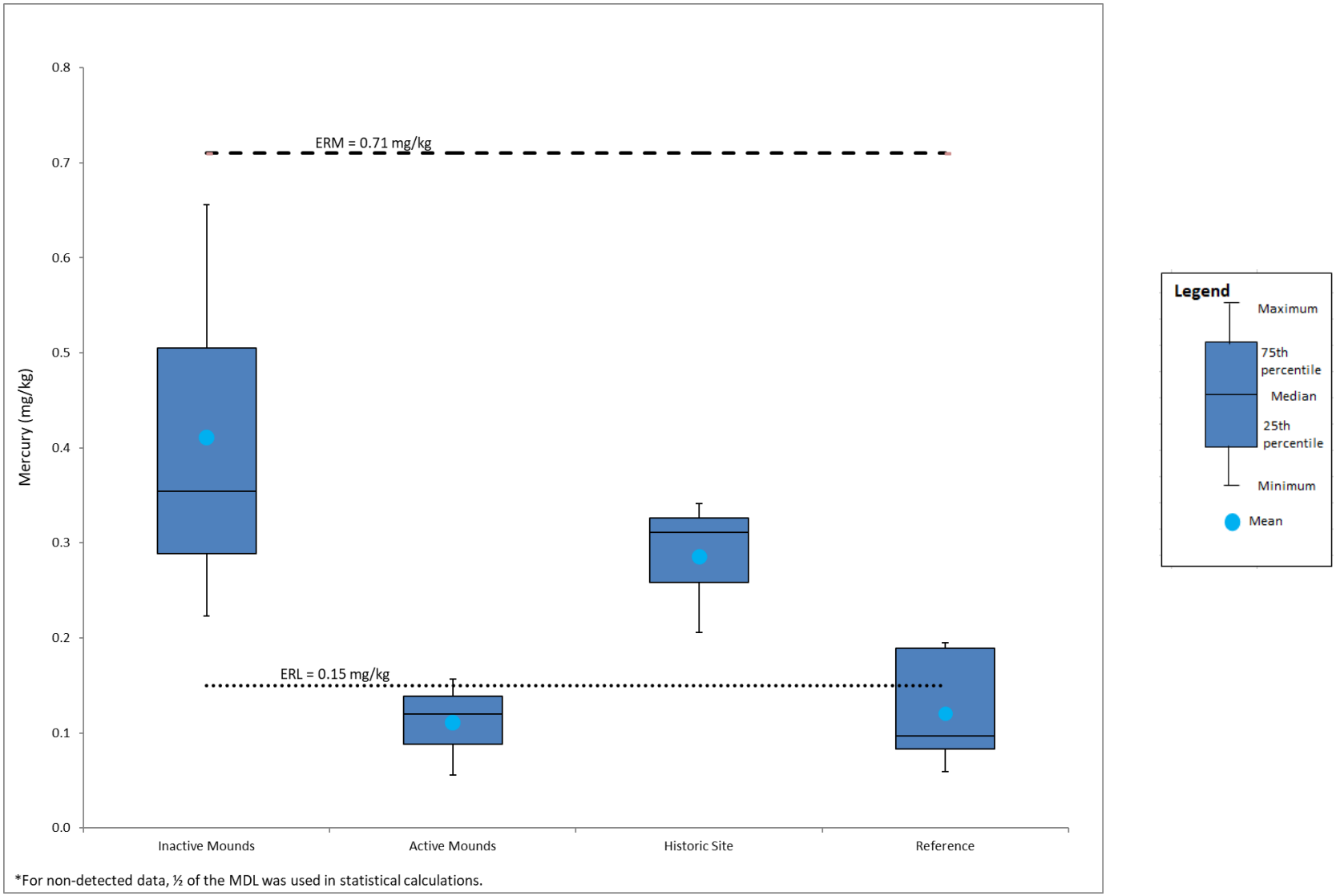

Figure 3-27. Box plots displaying mercury concentrations in WLDS and reference areas, October 2018.

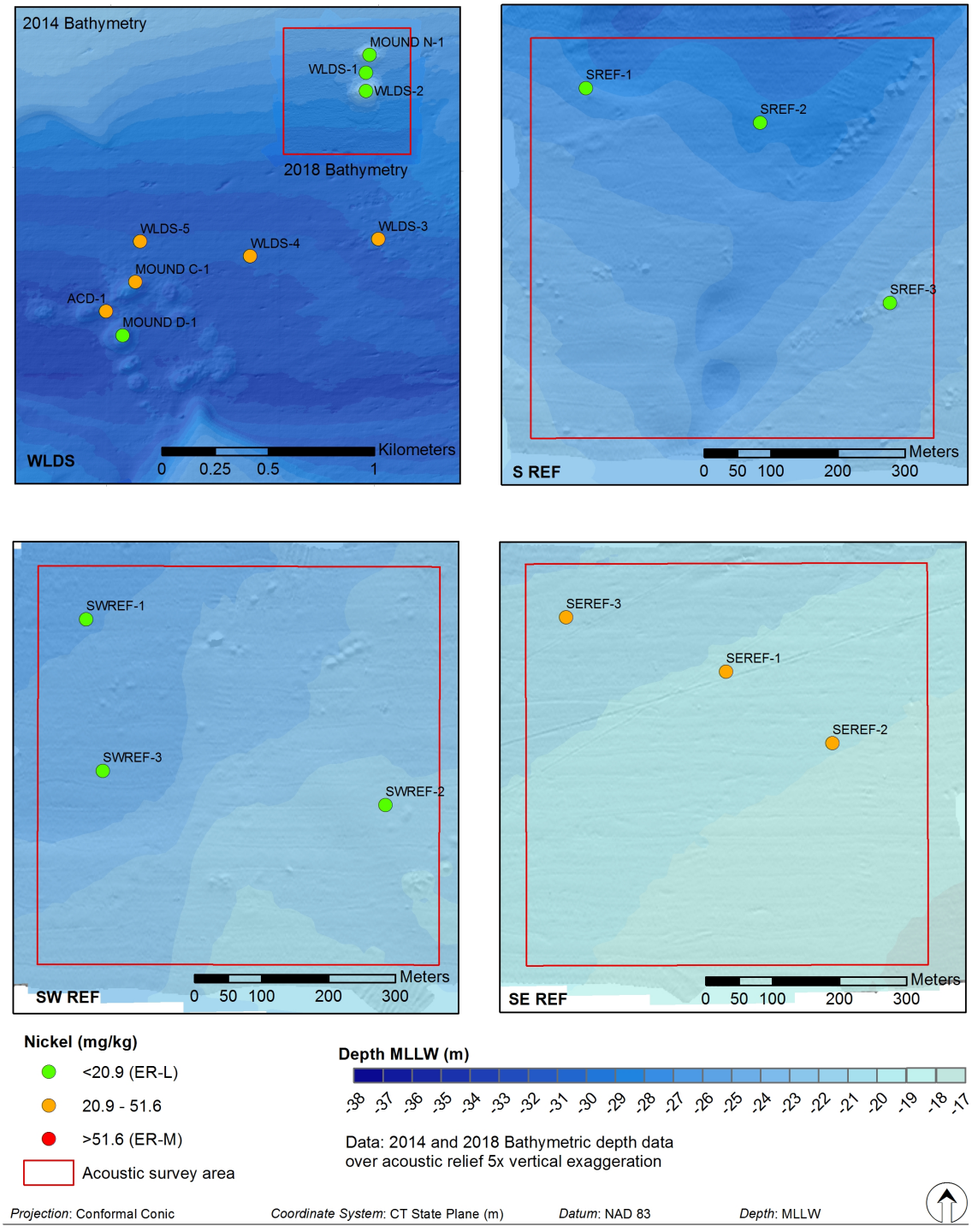

Figure 3-28. Nickel concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

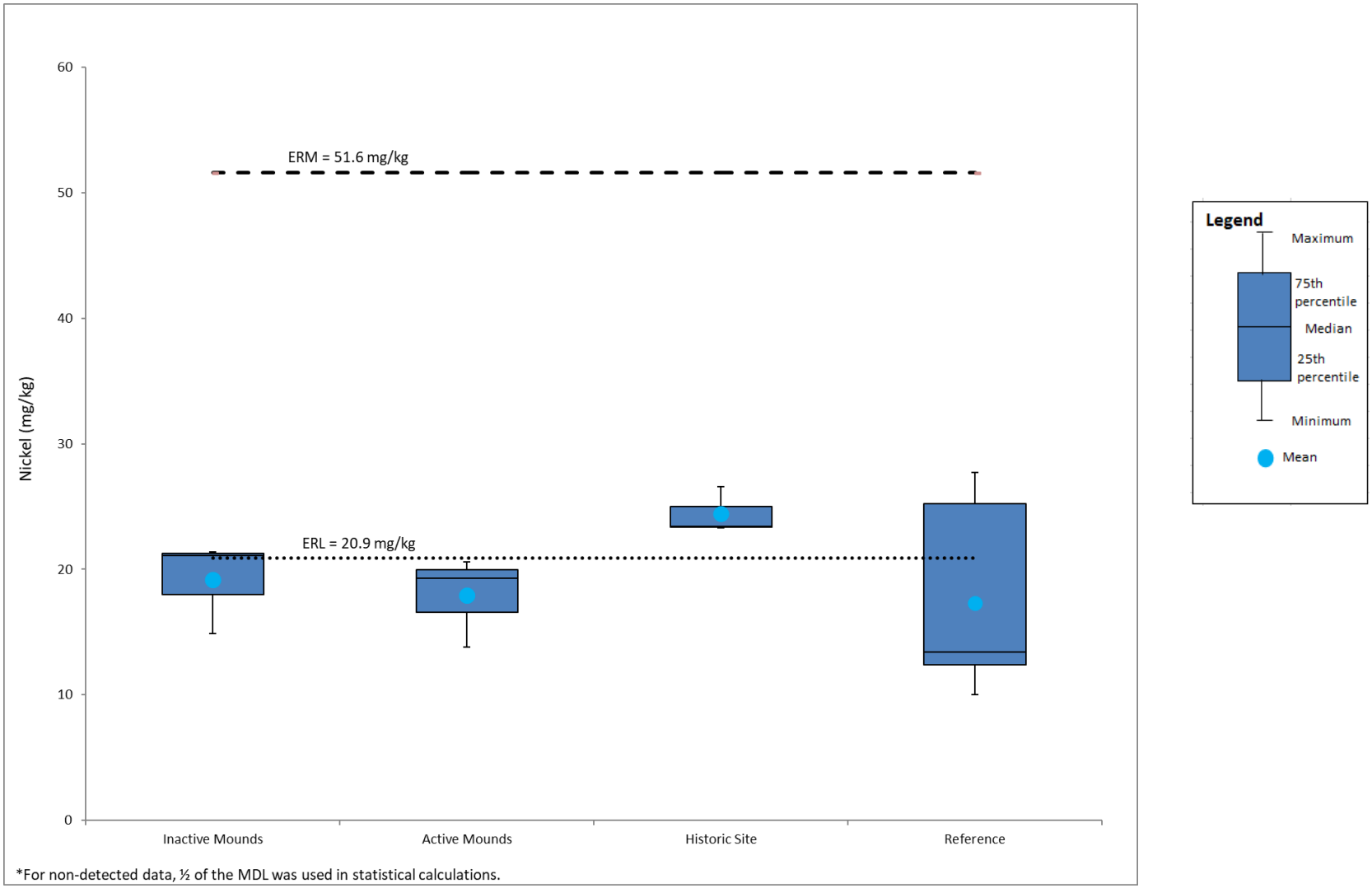

Figure 3-29. Box plots displaying nickel concentrations in WLDS and reference areas, October 2018.

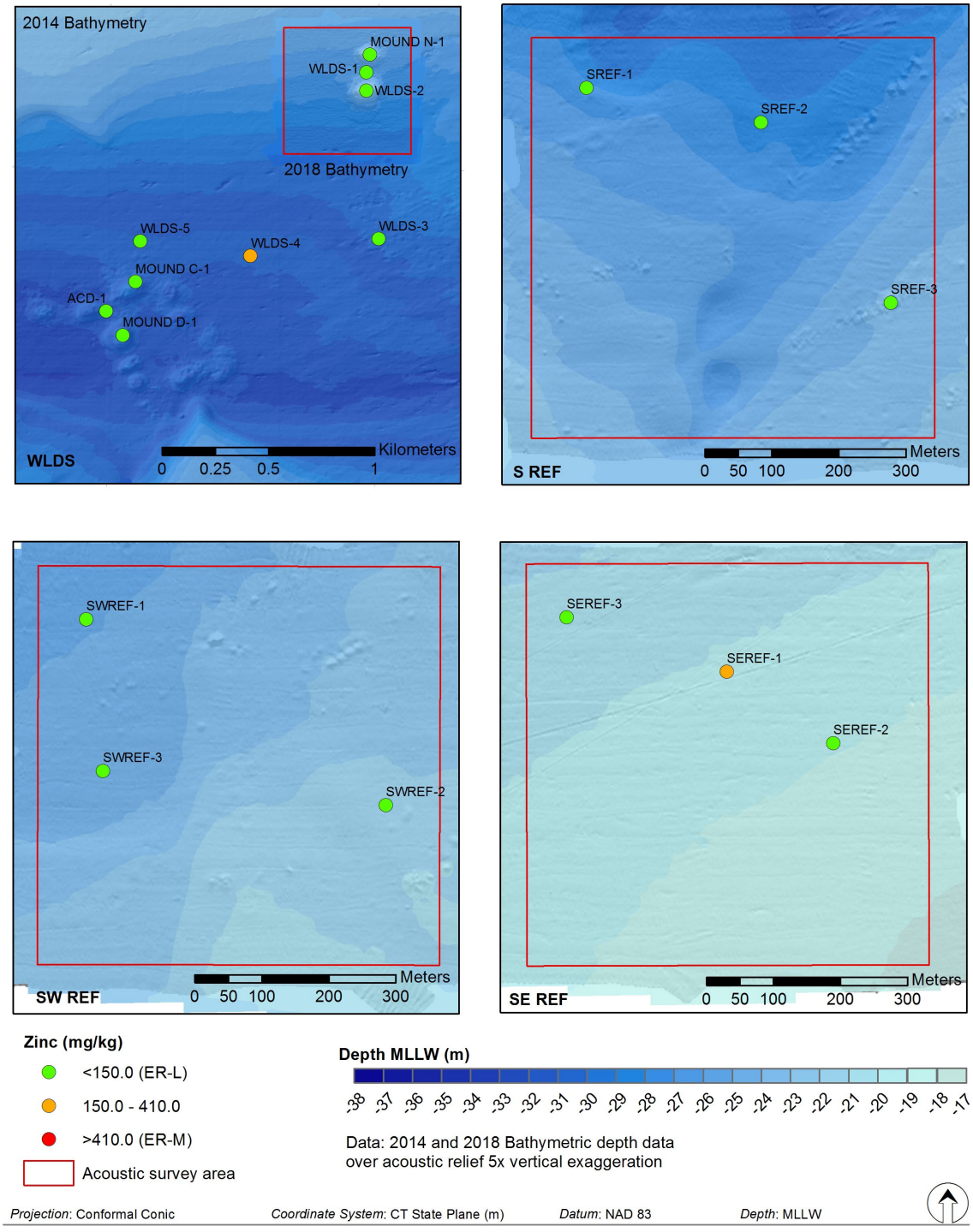

Figure 3-30. Zinc concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

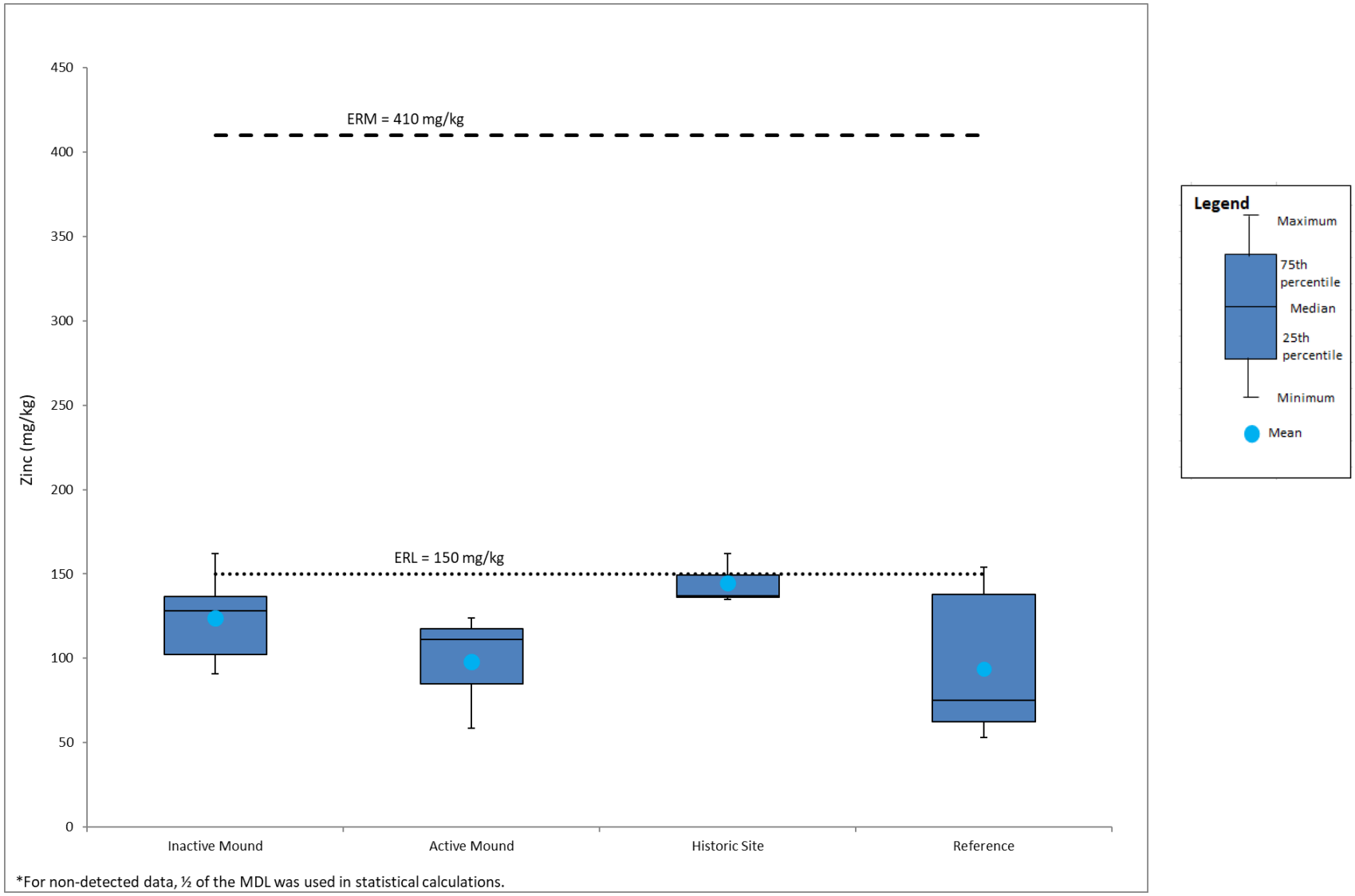

Figure 3-31. Box plots displaying zinc concentrations in WLDS and reference areas, October 2018.

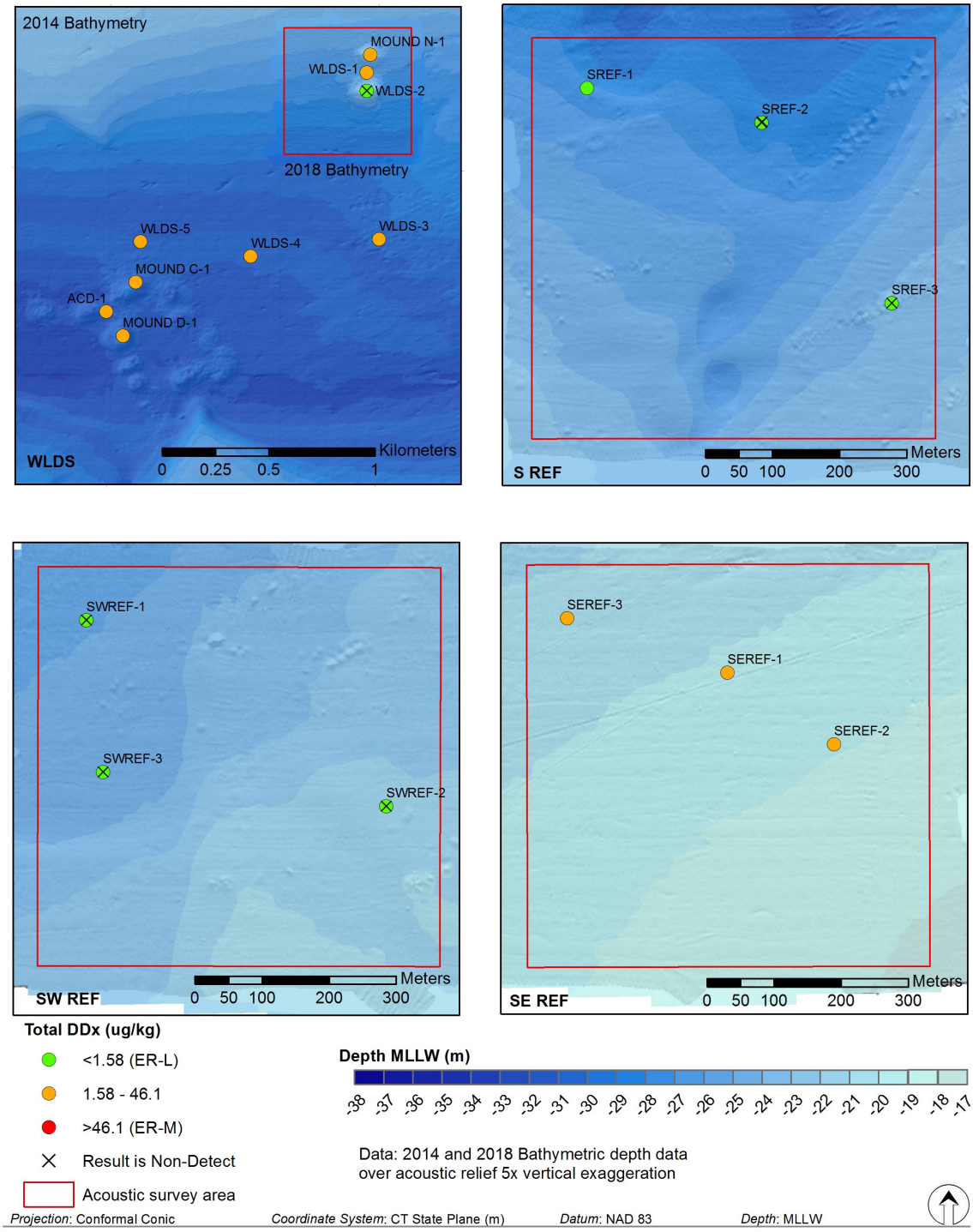

Figure 3-32. Total DDx concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

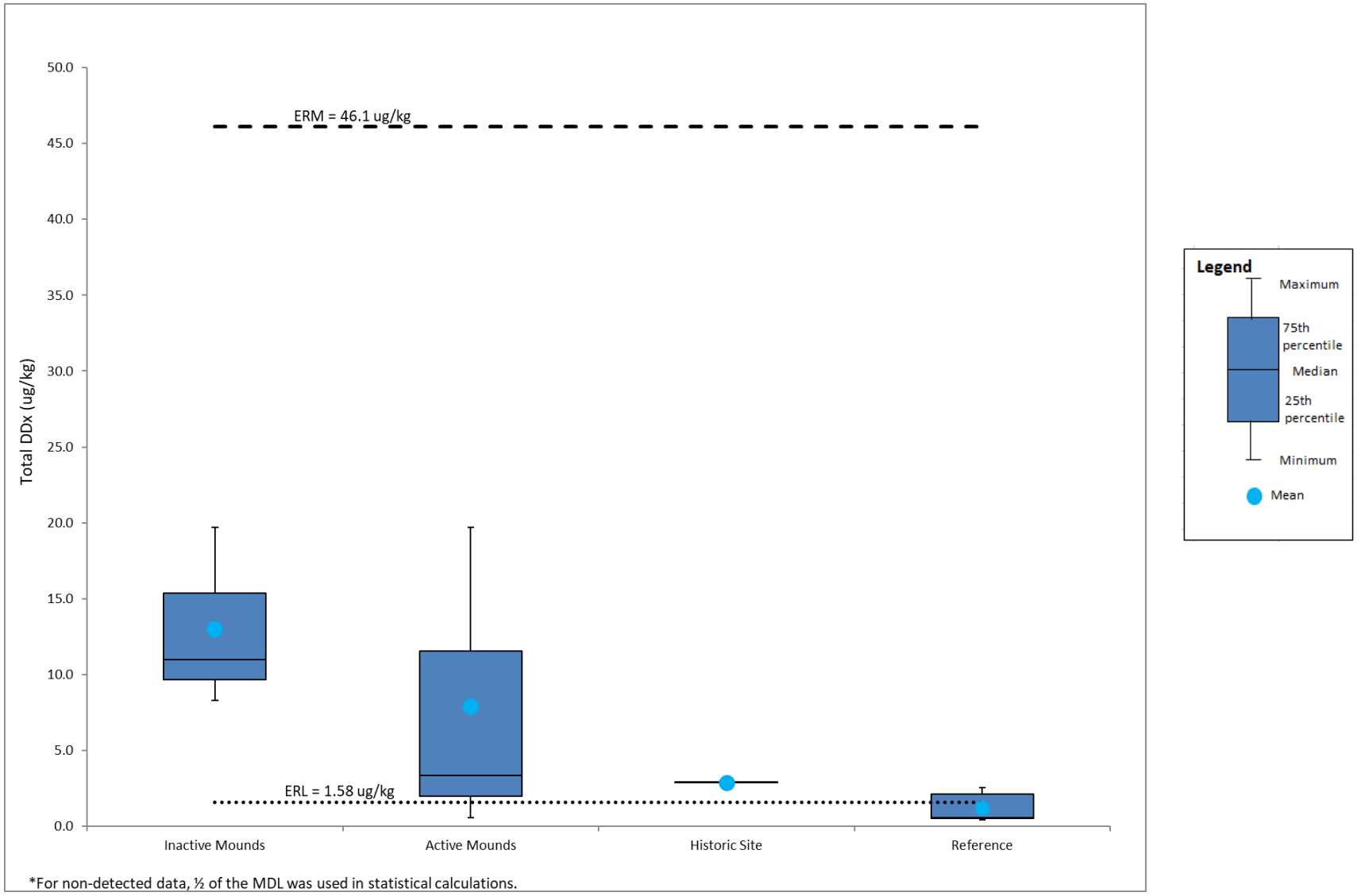

Figure 3-33. Box plots displaying total DDX concentrations in WLDS and reference areas, October 2018.

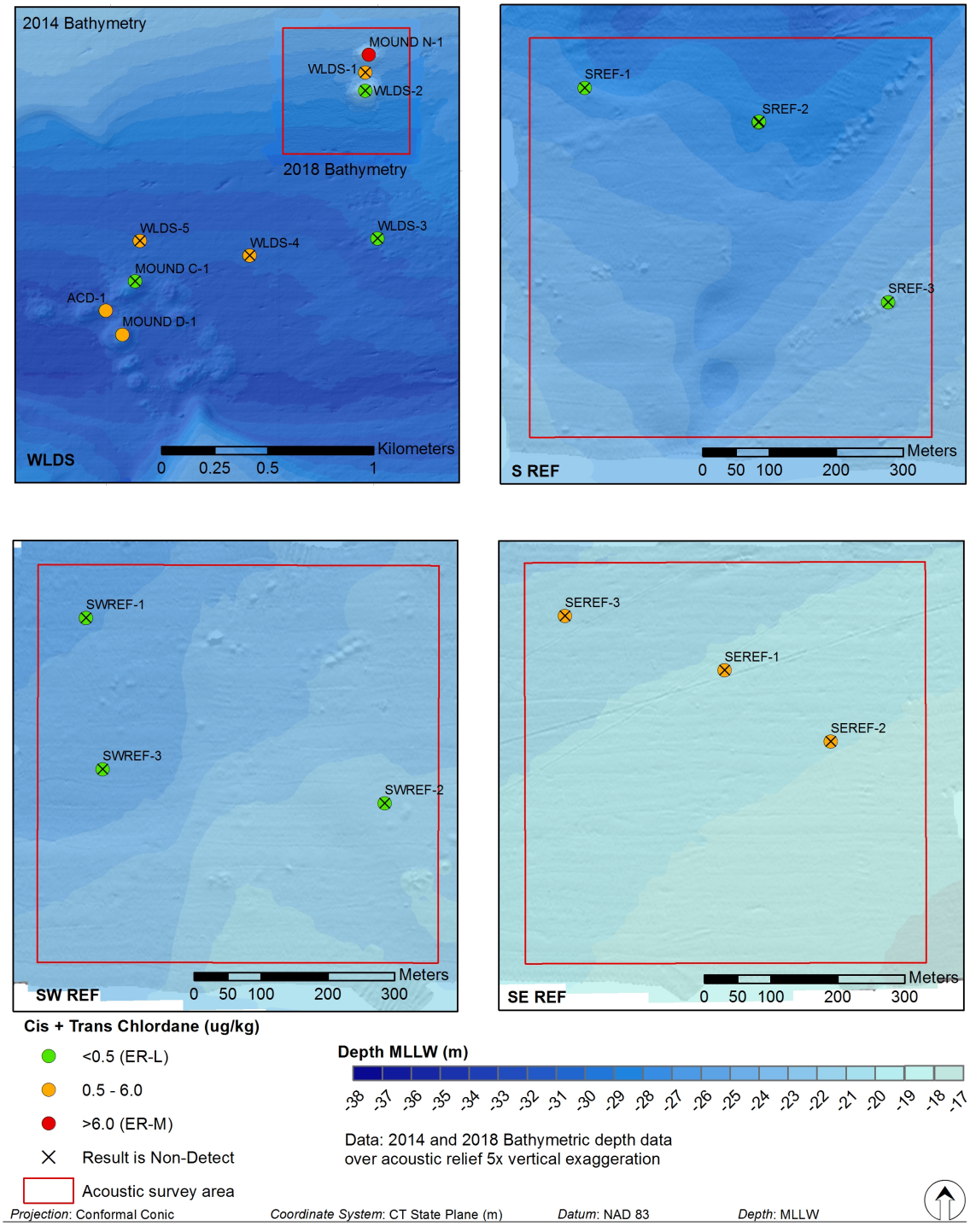

Figure 3-34. Sum of cis and trans chlordane concentrations compared to ER-L and ER-M values, WLDS and reference areas, October 2018.

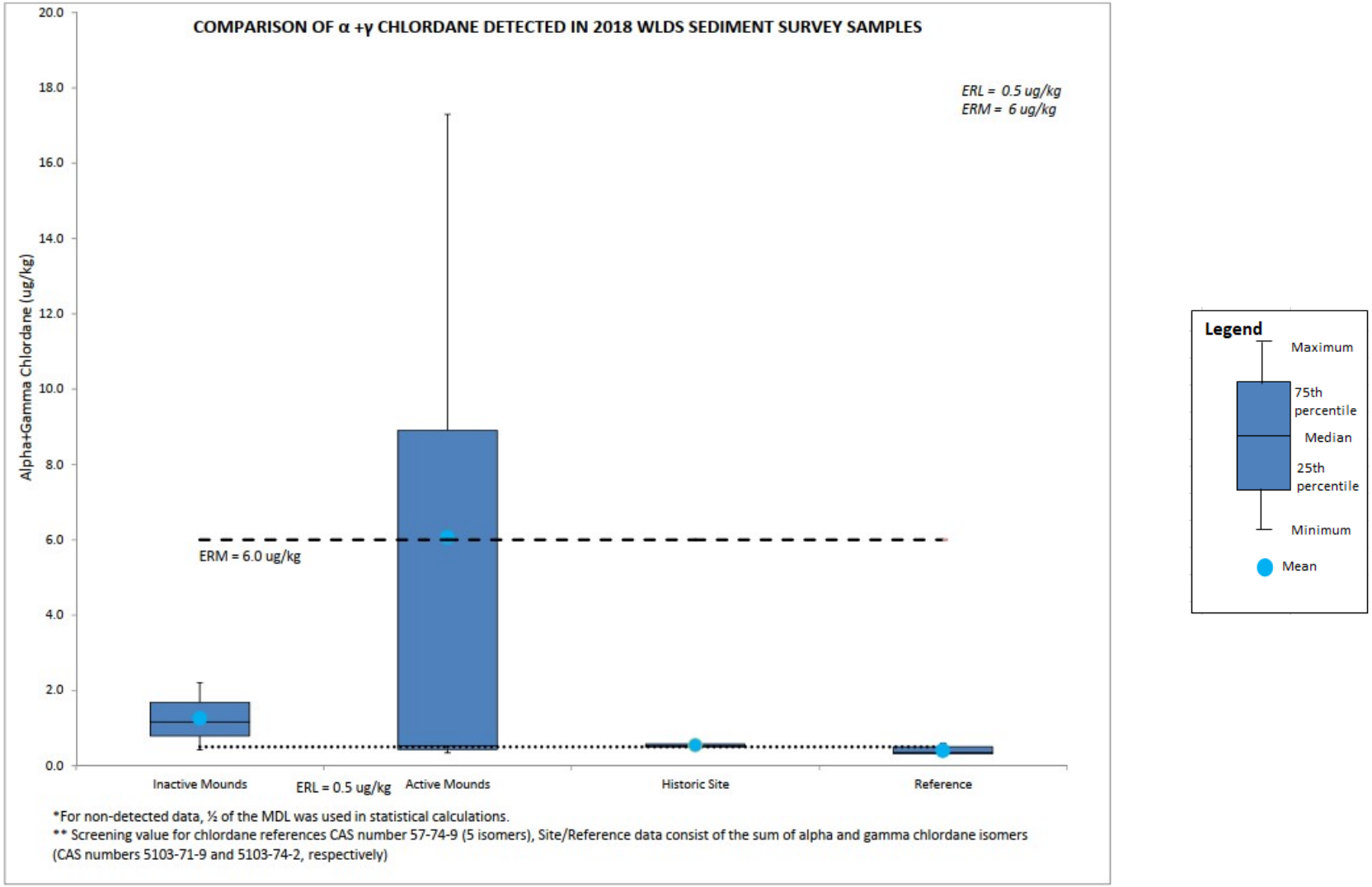

Figure 3-35. Box plots displaying the sum of cis and trans chlordane concentrations in WLDS and Reference Areas, October 2018.

4.0 DISCUSSION

As specified in the Site Management and Monitoring Plan (SMMP) for WLDS, monitoring activities are conducted periodically at the site to determine compliance with disposal conditions, to evaluate the short-term and long-term fate of dredged material placed at the site, and to assess potential adverse environmental impacts from the use of WLDS for disposal of dredged material (USEPA and USACE 2016). The monitoring activities performed in 2018 represent a combination of a standard confirmatory survey with elements of a more comprehensive survey. A multibeam bathymetry survey was performed over the active portion of WLDS to map the buildup of material at a new target location and the stability of a previously used target. The bathymetric survey also included the three reference areas associated with WLDS; this represents the first time all three areas have been mapped with a multibeam system as part of the DAMOS Program. Sediment grab samples were collected to characterize surficial sediment quality across active and inactive portions of WLDS, as well as across the reference areas.

4.1 Dredged Material Distribution and Seafloor Topography

The acoustic survey identified two well-formed mounds, Mound N and Mound O, located in the northeastern corner of WLDS. During the previous 2014 acoustic survey, Mound N was visible as a defined mound complex and the Mound O target was visible as an area that had received minimal disposals and was not yet classified as a mound feature. The buildup of material at Mound O is consistent with the record of recent disposal locations as shown in Figure 4-1. The slight decrease in height of the older Mound N is consistent with the consolidation of the dredged material that is expected to occur in the first several years following cessation of disposal at a given target location (Figure 4-1).

Although none of the three reference areas fall within the defined boundaries of historic dredged material disposal sites in Long Island Sound (Figure 1-2), the acoustic imagery for all three areas showed some indicators of past dredged material disposal and other anthropogenic disturbances. Weathered dredged material was tentatively identified within the SE-REF area during a 1998 side scan sonar survey that may have been disposed of many years prior to the acoustic survey (SAIC, 1999). Considering the proximity of western Long Island Sound to areas that have been highly developed for centuries, these influences are considered ubiquitous in the area and must be considered when evaluating reference site conditions.

4.2 Surficial Sediment Characterization

Sediment sampling data presented in Section 4.2 was combined into the following four groups to aid in interpretation (Figure 2-3):

– Reference Sites – Data from the three reference sites were evaluated individually and were also grouped for comparison with WLDS.

– Active Mounds – Samples collected in the northeast corner of WLDS were representative of areas with ongoing placement of dredged material (Mound O) and recently active placement (Mound N).

– Inactive Mounds – There is a ringed group of 13 mounds in the south-central portion of WLDS formed from the placement of dredged material based on the earliest disposal records for the site in the 1980's through 2010 (Figure 1-3). Samples were collected from the older mounds on the western side of this ring.

– Historic Site – Samples were collected across the central portion of WLDS where there is no formal record of disposal, however, seafloor disturbances are visible on the 2014 side scan sonar data.

The interpretation of sediment quality within these groupings has been made with the understanding that the entire survey area (all of WLDS and to a lesser degree the reference areas) received historical disposals before there were controls on the types of material disposed or any requirements for sampling, testing, or tracking.

4.2.1 Reference Sites

Although the reference area analytical results have been grouped in the box plot figures referenced in Section 3.2, the corresponding figures presenting mapped concentrations provide more insight into the variability of the data. For the predominantly coarse-grained sediment of the S REF and SW REF reference areas, all chemical concentrations were less than their respective ER-L's. The predominantly fine-grained sediment of SE REF had consistently higher chemical concentrations with multiple inorganic and organic constituents with concentrations that were between ER-L and ER-M levels.

In addition, surficial sediment grab samples were collected in 1993 within the current S REF and SW REF boundaries (Eller and Williams, 1996), and in 1998 within the current SE REF boundary (Murray and Saffert, 1999). Historical values within each reference area were averaged to provide a general overview of chemical concentrations over time for added context (Table 4-1). Although there are acute differences between the laboratory analytical methods in the historic datasets and the current laboratory analytical methods, general conclusions about trends are appropriate.

Within the S REF, SW REF, and SE REF areas, metal concentrations were consistent between the historic and 2018 datasets with the exceptions of cadmium; which decreased by an order of magnitude in both S REF and SW REF, and zinc which decreased by an order of magnitude in S REF. Total HMW and LMW PAHs displayed downward trends, all decreasing by an order of magnitude within the three reference areas. Where historic PAH

data were available the analytes used to generate totals were matched to the same analytes used to generate totals within the 2018 dataset. In the 1993 dataset, acenaphthylene was not included within the total calculation and within the 1998 dataset 1-methylnaphthalene was not included. The most notable decrease in PAHs was observed within S REF, followed by SE REF, and SW REF, respectively.

Trend assessments of other organic contaminants were less meaningful between the datasets. Total DDXs and total PCBs were not-detected in the historic studies, however, it should be noted that apparent reporting limits within the older datasets were higher than current standards, which presents uncertainty in comparing the non-detect values to the current data. Also worth noting is the analysis of aroclors in the historic PCB datasets, which groups ~5 peaks per aroclor to produce PCB analysis results. The current analysis methods for PCBs analyzes ~160 individual congeners which typically generates higher total PCB values; therefore, these datasets are not directly comparable.

During a DAMOS study conducted at the nearby Central Long Island Sound Disposal Site (CLDS), it was noted that surface sediments (<10 cm) are the result of ambient sediment deposition from within Long Island Sound (Myre, et al., 2007). It is assumed that surface sediments at the reference areas are largely comprised of depositional sediment that has accumulated over time and mixed and/or buried historic sediments. Downward trends in chemical concentrations at the reference areas over the last 20 – 25 years reflects the positive impacts of environmental regulations and efforts by conservation organizations within the Long Island Sound watershed.

4.2.2 Active Mounds

The three sediment samples collected within the active mounds area were comprised of a relatively even mix of silt and sand. Samples collected and analyzed for grain size within this area during the 2014 survey were comprised generally of silt/fines (Guarinello and Carey, 2017). Variations in the physical composition of exposed sediment is expected over the active areas of disposal given the expected variation in material from different dredging projects.

There were also variations in the chemical signatures of the surficial sediment in this area for some constituents as shown in the box plots in Section 3. Mean sediment concentrations were greater than ER-Ls for copper, total PCBs, and total DDx.

Concentrations of total chlordane were highly variable within the active mound area with the chlordane isomers not detected at two stations but detected above the ER-M level at the third station. It should also be noted that using ½ the MDL for non-detect values produced concentrations greater than the ER-L of 0.5 mg/kg resulting in non-detect values reporting above the screening value. As previously mentioned in Section 3.2.6, chlordane screening values do not directly correlate to data collected during this survey due to the

difference in isomers used to calculate the total value. In addition, the screening values for chlordane were generated with a low degree of confidence (Long et al. 1991).

4.2.3 Inactive Mounds

Sediment samples within the inactive mounds area were comprised of an even mix of sand and silt. Samples within this area were located on, near, or between Mounds A, C, and D. This area received dredged material between 1982 and 1990 and has remained unused for the past two-plus decades. Bathymetric data collected over this area during the 2014 DAMOS survey provided evidence of stable mounds and side-scan sonar data collected over this area displayed coarser materials within the ringed disposal area (Guarinello and Carey 2017).

Chemical concentrations in the three samples from this area paralleled those of the active mounds with concentrations of copper, total PCBs, and total DDx above the respective ER-Ls. However, mercury was also elevated above the ER-L for these samples. Total chlordane was above the ER-L at two locations, however the considerations for total chlordane mentioned in the previous section also apply to these samples.

Bulk sediment chemistry analysis for metals was conducted during the 1982 site baseline survey (SAIC, 1982) near the current ACD-1 sample location. Comparing the 2018 data to the 1982 baseline data shows current metals concentrations lower than baseline concentrations for all analyzed metals with the exception of mercury (Table 4-1). However, as previously mentioned, there are variations in the methods between the historic and current datasets.

4.2.4 Historic Site Area

The three sediment samples within the historic site area (within the site boundary but with no record of dredged material disposal) varied in their physical grain size composition from almost entirely fine-grained to more than 50% sand and gravel. Sediment concentrations in these samples differed from those of the active and inactive mounds, with higher concentrations of chromium, copper, lead, nickel, and total PAHs (some above their respective ER-L) and lower concentrations of total PCBs, total DDx, and total chlordane.

Historic surficial sediment samples from 1982 (SAIC, 1982) were compared to the current WLDS-3, WLDS-4, and WLDS-5 locations. The historic locations do not spatially overlap but neighbor the current sampling locations. The historic samples neighboring the 2018 samples were averaged and compared to the current (2018) site samples to provide an overview of the data trends within this area. It is again worth noting that there are differences between the laboratory analytical methods in the datasets.

In general, metals concentrations within the historic site area are trending downward, and cadmium was notably reduced by an order of magnitude similar to the reduction

observed in the reference areas (Table 4-1). Lead and mercury displayed slight increases since the 1982 sampling event. As previously mentioned, it is assumed that sediments sampled over this portion of the site are largely comprised of depositional sediment that has accumulated over time and mixed and/or buried historic sediments.

It is worth noting that in 1972 the Marine Protection, Research and Sanctuaries Act (MPRSA) and the Clean Water Act (CWA) regulated the disposal of certain chemicals, such as cadmium, into aquatic environments. The order of magnitude reduction of cadmium concentrations within WLDS over the last 35 years is an indication that regulations such as the MPRSA and CWA are having a positive impact at reducing contaminants in the ocean and supports an overall trend of increasing sediment and water quality within the larger Long Island Sound watershed.

4.2.5 Nutrients in Sediment

Sediment samples have not typically been analyzed for nutrients as part of DAMOS surveys; however, given the seasonal hypoxic conditions that occur in western Long Island Sound, this analysis was included for the 2018 survey to provide additional information beyond the typical regulatory framework. Tracking and monitoring nutrients in dredged sediments also provides information to support efforts by organizations such as the Long Island Sound Study (LISS), which has conducted studies highlighting the benefits of nitrogen loading permit limits for contributors into Long Island Sound. In a study conducted by the LISS using the Spatially Referenced Regression on Watershed Attributes (SPARROW) model, it was determined that over the course of one year (2002) the Housatonic River, which is the closet major river input to the WLDS, contributed approximately 3.3 million kg of N/year (USEPA, 2020). In comparison, an average of approximately 34 million kg/year of dredged sediment has been deposited at WLDS over the last five to ten years. Multiplying this input by the maximum total nitrogen concentration measured over the active mound area (0.72 mg/kg), generated an estimated yearly load of approximately 25 kg of N/year from dredged material placed at WLDS. This estimated nitrogen load is a fraction of the input from the Housatonic River alone, suggesting that the placement of dredged material at WLDS has little impact on the total nitrogen load for western Long Island Sound.

4.2.6 Management Considerations

Management considerations resulting from the 2018 survey fall into three separate categories:

Management of Material Placement – The 2018 acoustic data support the continued successful use of WLDS as a containment site for dredged material disposal. The release points of dredged material logged in the Dredging Quality Management system are consistent with the recorded buildup of material in the northeast portion of WLDS (Figure 4-1). Depth differencing indicates the disposed material remains as a stable deposit on the seafloor. In 2004 the site capacity of WLDS was estimated at 20 million yd^3 (15.3 million

m³) with a site controlling depth of 14 m (46 ft) MLLW (USEPA and USACE, 2004). Based on the current disposal records and height of mound buildup, there is additional capacity for material placement in the active portion of the site.

Appropriateness of Existing Reference Sites – The 2018 acoustic data is the first comprehensive DAMOS survey that covered all three of the WLDS reference areas using a multibeam system and revealed acoustic markers indicative of dredged material disposals within the S REF area and presumably within the SE REF area (Figure 3-9). Markers within the SE REF area were also identified previously in side-scan sonar data collected in 1998 and are assumed to be the result of historical dredged material disposal (Saffert and Murray, 1999). The 2018 sediment chemistry data provides further support of this conclusion for the SE REF area. Additional survey efforts are warranted to further characterize the general area where the reference sites are located with the goal of refining reference site boundaries to target areas with minimal anthropogenic disturbance.

Management of Surficial Sediment Quality within WLDS – The 2018 sediment sampling effort revealed limited elevated chemical concentrations relative to the reference areas and ER-L/ER-M screening level values. Additional sediment characterization as well as a biological assessment, such as a SPI survey over the newly formed mound, is warranted within the site to assess the health of the benthic community.

Table 4-1.

Historical Data Comparison

Sample Area	S REF		SW REF		SE REF		Historic Site		Inactive Mounds	
Year	**1993**	**2018**	**1993**	**2018**	**1998**	**2018**	**1982**	**2018**	**1982**	**2018**
Sample Size for Average (n)	3	3	1	3	10	3	9	3	7	1
	mg/kg									
Arsenic	4.6	4.3	2.7	3.8	8.3	7.1	14	7.6	10.7	5.2
Cadmium	1.4	0.09	0.84	0.07	0.7	0.13J	4.2	0.3	6.3	0.6
Chromium	37.7	32.9	18	22.7	63.9	62.8	83.5	60.8	79	49.2
Copper	47.3B	30.8	23B	22.2	78.2	61.3	97.5	63	120.7	58.8
Lead	29	22.5	14	15.2	52	42.4	68.6	83	70	58.3
Nickel	15.3	14.8	9.3	11	24.9	26.6	46.8	24.4	56.8	21.1
Zinc	105	78.2	52B	58.1	166	147.3	185.5	144.7	230	121
Mercury	0.12J	0.1	0.048J	0.07	0.34	0.19	0.14	0.29	0.02	0.36
	ug/kg									
Total LMW PAHs	359	60.7	127J	31.2	203	75.9	No Data	530	No Data	201
Total HMW PAHs	2902	590	834J	282	1173	766	No Data	5645	No Data	1505
Total PAHs	3,261	651	961J	314	1376	842	No Data	6175	No Data	1706

Notes:
1. 1993 metals analyzed using EPA method 3051/6010
2. 1993 PAHs analyzed using 3540/8270
3. 1993 Mercury analyzed using 7471B
4. 1998 metals analyzed using EPA methods 6010 (Ni, Zn, Pb, Cu, Cr, Al), 7060 (Ar), 7131 (Cd), and 7471 (Hg)
5. 1998 PAHs analyzed using EPA method 8270
6. 1982 metals data analyzed using bulk sediment chemistry analysis
7. 1982 Hg was consistently low, drawing the assumption that problems with the analysis may have occurred
8. 2018 data analysis specified in Table 2-4
9. Where available, PAH data for historic totals used the same analytes as 2018 totals for sums. In 1993 Acenaphthylene was not included in the analysis, and in 1998 1-Methylnaphthalene was not included in the analysis
10. Data are results of surface sediment collection

No Data - Data not analyzed during specified study
B - Blank contamination
J – Estimated

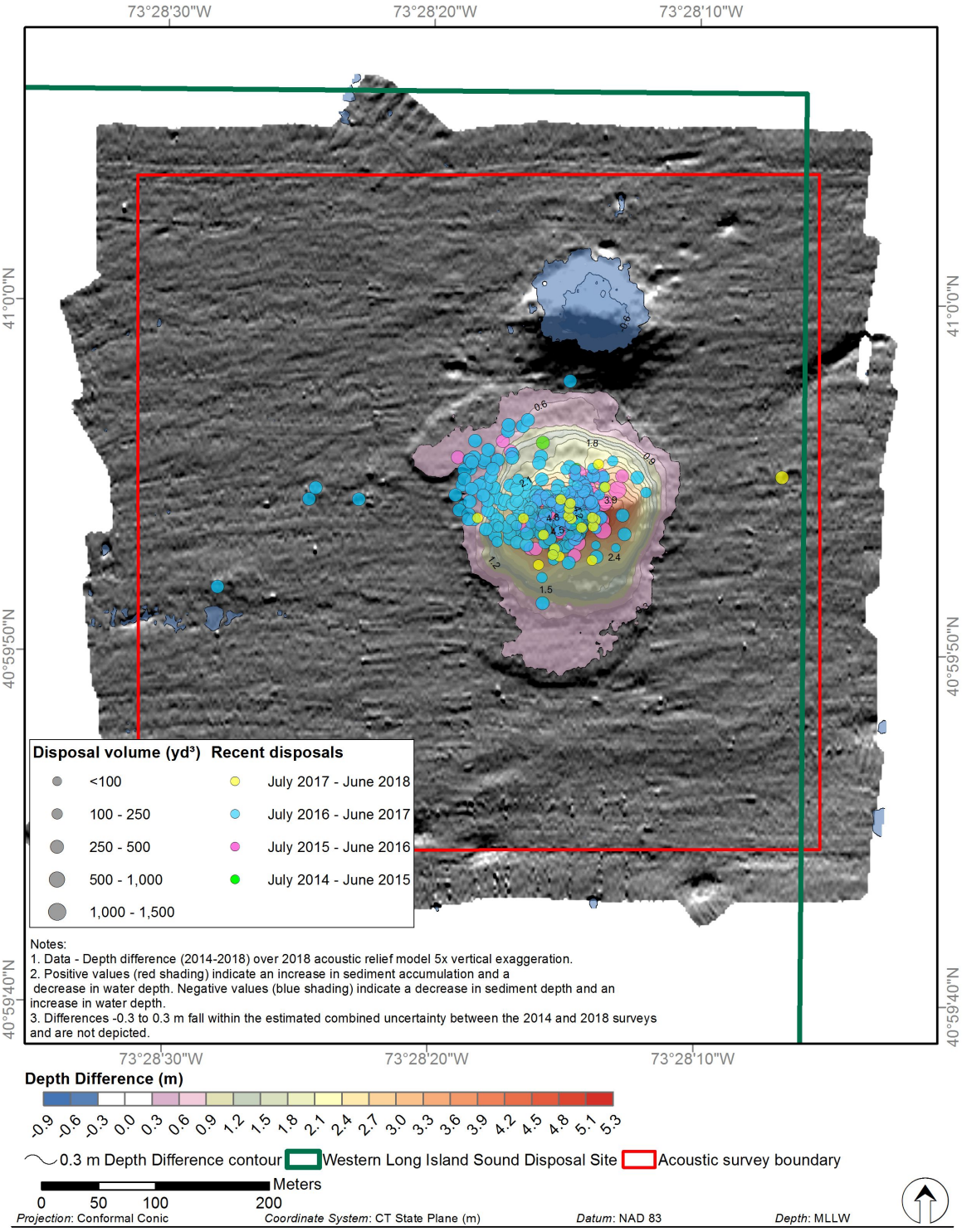

Figure 4-1. Recent disposals at WLDS presented over depth differencing model (2014 – 2018) and 5x vertical relief model, 2018.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The October 2018 survey at WLDS was designed with elements of a confirmatory survey to document the recent disposal of dredged material at the site as well as a focused survey to characterize surficial sediment quality across. The representativeness of the three reference areas associated with the site were also evaluated as part of this survey. Survey elements included collection of multibeam acoustic data within the active portion of the site and the three reference areas, and collection of sediment chemistry samples over a broad area within WLDS (both active and inactive areas) and reference areas. All survey elements and data analyses were successfully performed with the following conclusions:

- The recent disposal of 82,000 m^3 (107,000 yd^3) of dredged material in the northeast corner of the site created a new disposal mound (Mound O) which was visible in the acoustic survey data. The acoustic survey data also displayed the previously formed Mound N, situated to the north of Mound O. Depth difference comparisons to the previous (2014) bathymetric data as well as mapping of side-scan and backscatter imagery confirmed that dredged material disposal was confined within the WLDS boundaries and that the disposal mounds were stable features, with expected settling (mound height reduction) at Mound N.
- The acoustic data for the three reference areas showed indications of past dredged material disposal or other seafloor disturbances and the SE REF area had a consistent signature of elevated concentrations of chemicals relative to ER-Ls.
- The surficial sediment chemistry was variable across WLDS with slight to moderate exceedances of ER-L levels noted for chemicals across the site. Chemical patterns were variable within the site and reference areas sometimes yielding elevated chemical concentrations for areas of the site for which there is no record of dredged material disposal. The chlordane concentration was above the ER-M at one station in the active mound area, but chlordane results should be evaluated with caution due to inconsistencies with the analyzed isomers and low confidence in the applied screening values.

5.2 Recommendations

Based on the results of the 2018 survey, the recommendations for future site use and monitoring are as follows:

- Based on the identified elevation and distribution of disposed dredged material in the northeast corner of WLDS, disposal of material can continue in this area with subsequent confirmatory monitoring surveys.

- Based on the identified relic disposal features in all three reference areas, and elevated surficial sediment concentrations for some chemicals in the SE REF reference area, future surveys should expand the acoustic mapping (inclusive of side scan sonar and backscatter) and sediment characterization along the southern boundary of WLDS with the goal of refining reference site boundaries to minimize the potential inclusion of historic deposits of dredged material.
- Based on the varied surficial sediment concentrations for some chemicals in the areas sampled within WLDS, continued mapping of sediment quality, as well as an assessment of the benthic community following the DAMOS Program tiered monitoring protocol, is warranted within the site.

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Appendix A

Disposal Barge Logs for WLDS

Appendix A
Disposal Barge Logs

Project Name	Target Site	Load Volume (yd^3)	Load Volume (m^3)	Placement Date	Latitude	Longitude
Five Mile River	WLDS13	200	153	10/28/2014	40.99869	-73.47071
Sheree Frank	WLDS13	400	306	10/29/2014	40.99889	-73.47106
Miltco	WLDS13	312	239	5/5/2015	40.99828	-73.47072
American Yacht Club	WLDS13	1235	944	12/4/2015	40.99838	-73.47075
American Yacht Club	WLDS13	1235	944	12/5/2015	40.99828	-73.47045
American Yacht Club	WLDS13	1235	944	12/5/2015	40.99837	-73.47053
American Yacht Club	WLDS13	1235	944	12/6/2015	40.99853	-73.4706
American Yacht Club	WLDS13	1235	944	12/7/2015	40.99837	-73.47088
American Yacht Club	WLDS13	1235	944	12/7/2015	40.99863	-73.47047
American Yacht Club	WLDS13	1235	944	12/8/2015	40.99848	-73.47055
American Yacht Club	WLDS13	1235	944	12/9/2015	40.99852	-73.47028
American Yacht Club	WLDS13	1235	944	12/10/2015	40.99862	-73.47063
American Yacht Club	WLDS13	1235	944	12/10/2015	40.99848	-73.47073
American Yacht Club	WLDS13	1235	944	12/11/2015	40.99865	-73.4707
American Yacht Club	WLDS13	1235	944	12/11/2015	40.9982	-73.47043
American Yacht Club	WLDS13	1235	944	12/12/2015	40.99843	-73.47055
American Yacht Club	WLDS13	1235	944	12/13/2015	40.99842	-73.47042
American Yacht Club	WLDS13	1235	944	12/16/2015	40.9981	-73.4707
American Yacht Club	WLDS13	1235	944	12/16/2015	40.99845	-73.47108
American Yacht Club	WLDS13	1240	948	12/19/2015	40.99842	-73.47092
Brewer Yacht Haven Marina	WLDS13	382	292	12/29/2015	40.99882	-73.4714
Brewer Yacht Haven Marina	WLDS13	382	292	12/30/2015	40.9983	-73.47097
Brewer Yacht Haven Marina	WLDS13	382	292	12/30/2015	40.99828	-73.47088
Brewer Yacht Haven Marina	WLDS13	382	292	12/31/2015	40.99833	-73.47077
Brewer Yacht Haven Marina	WLDS13	382	292	12/31/2015	40.9983	-73.47078
Brewer Yacht Haven Marina	WLDS13	382	292	1/1/2016	40.99818	-73.47087
Brewer Yacht Haven Marina	WLDS13	382	292	1/2/2016	40.99827	-73.47108
Brewer Yacht Haven Marina	WLDS13	382	292	1/2/2016	40.9983	-73.47085
Brewer Yacht Haven Marina	WLDS13	382	292	1/3/2016	40.99835	-73.47077
Brewer Yacht Haven Marina	WLDS13	382	292	1/4/2016	40.99842	-73.4704
Brewer Yacht Haven Marina	WLDS13	382	292	1/5/2016	40.99845	-73.47072
Brewer Yacht Haven Marina	WLDS13	382	292	1/6/2016	40.9983	-73.47075
Brewer Yacht Haven Marina	WLDS13	382	292	1/7/2016	40.99863	-73.47023
Brewer Yacht Haven Marina	WLDS13	382	292	1/11/2016	40.99823	-73.47125
Brewer Yacht Haven Marina	WLDS13	382	292	1/12/2016	40.99842	-73.47063
Brewer Yacht Haven Marina	WLDS13	382	292	1/14/2016	40.99827	-73.4705
Brewer Yacht Haven Marina	WLDS13	382	292	1/15/2016	40.99832	-73.47082
Brewer Yacht Haven Marina	WLDS13	386	295	1/16/2016	40.99835	-73.47078
Brewer Yacht Haven Marina	WLDS13	382	292	1/18/2016	40.99843	-73.4708
Brewer Yacht Haven Marina	WLDS13	382	292	1/19/2016	40.99805	-73.47118
Brewer Yacht Haven Marina	WLDS13	382	292	1/20/2016	40.99847	-73.47063
Brewer Yacht Haven Marina	WLDS13	382	292	1/21/2016	40.998	-73.47072
Brewer Yacht Haven Marina	WLDS13	382	292	1/22/2016	40.99837	-73.47055
Brewer Yacht Haven Marina	WLDS13	382	292	1/22/2016	40.99843	-73.47058
Brewer Yacht Haven Marina	WLDS13	382	292	1/25/2016	40.99825	-73.47083
Brewer Yacht Haven Marina	WLDS13	382	292	1/26/2016	40.99877	-73.47195
Brewer Yacht Haven Marina	WLDS13	382	292	3/5/2016	40.9989	-73.47148
Brewer Yacht Haven Marina	WLDS13	382	292	3/15/2016	40.99805	-73.47113
Riverside Landing Associates	WLDS 14/15	345	264	10/6/2016	40.99847	-73.4709
Riverside Landing Associates	WLDS 14/15	384	294	10/10/2016	40.9985	-73.47162
Riverside Landing Associates	WLDS 14/15	97	74	10/11/2016	40.99808	-73.4705
Mianus Harbor FNP	WLDS13	356	272	10/23/2016	40.99815	-73.47132
Mianus Harbor FNP	WLDS13	356	272	10/24/2016	40.9985	-73.47115
Mianus Harbor FNP	WLDS13	356	272	10/25/2016	40.99855	-73.4714
Mianus Harbor FNP	WLDS13	356	272	10/25/2016	40.9984	-73.47147
Mianus Harbor FNP	WLDS13	356	272	10/26/2016	40.99813	-73.4714
Riverside Landing Associates	WLDS 14/15	328	251	10/26/2016	40.99818	-73.47102
Mianus Harbor FNP	WLDS13	356	272	10/27/2016	40.99873	-73.47168
Mianus Harbor FNP	WLDS13	356	272	10/27/2016	40.99838	-73.47053
Mianus Harbor FNP	WLDS13	356	272	10/29/2016	40.99938	-73.47078
Mianus Harbor FNP	WLDS13	356	272	10/30/2016	40.9984	-73.47067
Mianus Harbor FNP	WLDS13	356	272	10/30/2016	40.99845	-73.47153
Mianus Harbor FNP	WLDS13	356	272	10/31/2016	40.99815	-73.47155
Mianus Harbor FNP	WLDS13	356	272	10/31/2016	40.99827	-73.47133

Appendix A
Disposal Barge Logs

Project Name	Target Site	Load Volume (yd^3)	Load Volume (m^3)	Placement Date	Latitude	Longitude
Mianus Harbor FNP	WLDS13	356	272	11/1/2016	40.99827	-73.47152
Mianus Harbor FNP	WLDS13	356	272	11/1/2016	40.99847	-73.47102
Mianus Harbor FNP	WLDS13	356	272	11/2/2016	40.99838	-73.47115
Mianus Harbor FNP	WLDS13	356	272	11/2/2016	40.99845	-73.47123
Mianus Harbor FNP	WLDS13	356	272	11/3/2016	40.99837	-73.47132
Mianus Harbor FNP	WLDS13	356	272	11/4/2016	40.99843	-73.47145
Mianus Harbor FNP	WLDS13	356	272	11/4/2016	40.9985	-73.47112
Mianus Harbor FNP	WLDS13	356	272	11/5/2016	40.99845	-73.47132
Mianus Harbor FNP	WLDS13	356	272	11/5/2016	40.99837	-73.47123
Mianus Harbor FNP	WLDS13	356	272	11/6/2016	40.99837	-73.4713
Mianus Harbor FNP	WLDS13	356	272	11/6/2016	40.99832	-73.4713
Mianus Harbor FNP	WLDS13	356	272	11/7/2016	40.99835	-73.4713
Mianus Harbor FNP	WLDS13	356	272	11/10/2016	40.99817	-73.4714
Mianus Harbor FNP	WLDS13	356	272	11/10/2016	40.99838	-73.47053
Mianus Harbor FNP	WLDS13	356	272	11/11/2016	40.9984	-73.47128
Mianus Harbor FNP	WLDS13	356	272	11/11/2016	40.99862	-73.47043
Mianus Harbor FNP	WLDS13	356	272	11/11/2016	40.99828	-73.47135
Mianus Harbor FNP	WLDS13	356	272	11/13/2016	40.99845	-73.47103
Mianus Harbor FNP	WLDS13	356	272	11/13/2016	40.9984	-73.47137
Norwalk Cove Marina	WLDS 14/15	134	102	11/13/2016	40.99855	-73.47133
Mianus Harbor FNP	WLDS13	356	272	11/14/2016	40.9985	-73.47125
Norwalk Cove Marina	WLDS 14/15	258	197	11/14/2016	40.99856	-73.47124
Mianus Harbor FNP	WLDS13	356	272	11/14/2016	40.9986	-73.47107
Mianus Harbor FNP	WLDS13	356	272	11/14/2016	40.99838	-73.47188
Mianus Harbor FNP	WLDS13	356	272	11/15/2016	40.99832	-73.47158
Norwalk Cove Marina	WLDS 14/15	224	171	11/15/2016	40.99847	-73.47059
Mianus Harbor FNP	WLDS13	356	272	11/15/2016	40.99827	-73.47103
Mianus Harbor FNP	WLDS13	356	272	11/15/2016	40.99835	-73.47193
Norwalk Cove Marina	WLDS 14/15	120	92	11/16/2016	40.99851	-73.47059
Mianus Harbor FNP	WLDS13	356	272	11/16/2016	40.99863	-73.47053
Norwalk Cove Marina	WLDS 14/15	67	51	11/16/2016	40.99848	-73.47057
Mianus Harbor FNP	WLDS13	356	272	11/16/2016	40.99835	-73.47083
Mianus Harbor FNP	WLDS13	356	272	11/17/2016	40.99807	-73.47085
Mianus Harbor FNP	WLDS13	356	272	11/17/2016	40.99832	-73.47085
Norwalk Cove Marina	WLDS 14/15	242	185	11/17/2016	40.99868	-73.47053
Mianus Harbor FNP	WLDS13	356	272	11/17/2016	40.9983	-73.4711
Mianus Harbor FNP	WLDS13	356	272	11/18/2016	40.99813	-73.47125
Norwalk Cove Marina	WLDS 14/15	252	193	11/18/2016	40.99826	-73.4708
Mianus Harbor FNP	WLDS13	356	272	11/18/2016	40.99835	-73.47163
Mianus Harbor FNP	WLDS13	356	272	11/18/2016	40.99818	-73.47118
Mianus Harbor FNP	WLDS13	356	272	11/18/2016	40.99875	-73.47183
Mianus Harbor FNP	WLDS13	356	272	11/19/2016	40.99832	-73.4711
Mianus Harbor FNP	WLDS13	356	272	11/19/2016	40.9989	-73.47177
Mianus Harbor FNP	WLDS13	356	272	11/19/2016	40.99842	-73.47072
Mianus Harbor FNP	WLDS13	356	272	11/20/2016	40.99828	-73.47087
Mianus Harbor FNP	WLDS13	356	272	11/26/2016	40.9982	-73.47075
Mianus Harbor FNP	WLDS13	356	272	11/26/2016	40.99875	-73.47167
Mianus Harbor FNP	WLDS13	356	272	11/26/2016	40.99868	-73.47182
Mianus Harbor FNP	WLDS13	356	272	11/26/2016	40.99823	-73.47073
Norwalk Cove Marina	WLDS 14/15	207	158	11/26/2016	40.99836	-73.47066
Mianus Harbor FNP	WLDS13	356	272	11/27/2016	40.99843	-73.47063
Mianus Harbor FNP	WLDS13	356	272	11/27/2016	40.99857	-73.47168
Norwalk Cove Marina	WLDS 14/15	239	183	11/27/2016	40.99845	-73.47072
Mianus Harbor FNP	WLDS13	356	272	11/27/2016	40.99827	-73.47055
Mianus Harbor FNP	WLDS13	356	272	11/27/2016	40.99875	-73.47153
Norwalk Cove Marina	WLDS 14/15	209	160	11/28/2016	40.99854	-73.47042
Mianus Harbor FNP	WLDS13	356	272	11/28/2016	40.99832	-73.47077
Mianus Harbor FNP	WLDS13	356	272	11/28/2016	40.99862	-73.47007
Mianus Harbor FNP	WLDS13	356	272	11/28/2016	40.99902	-73.47127
Norwalk Cove Marina	WLDS 14/15	289	221	11/29/2016	40.99829	-73.47055
Mianus Harbor FNP	WLDS13	356	272	11/29/2016	40.99858	-73.47072
Mianus Harbor FNP	WLDS13	356	272	11/29/2016	40.99898	-73.47143
Mianus Harbor FNP	WLDS13	356	272	11/30/2016	40.9981	-73.47132
Mianus Harbor FNP	WLDS13	356	272	11/30/2016	40.99867	-73.47188

Appendix A
Disposal Barge Logs

Project Name	Target Site	Load Volume (yd^3)	Load Volume (m^3)	Placement Date	Latitude	Longitude
Norwalk Cove Marina	WLDS 14/15	200	153	11/30/2016	40.99859	-73.47064
Mianus Harbor FNP	WLDS13	356	272	12/1/2016	40.99847	-73.47113
Mianus Harbor FNP	WLDS13	356	272	12/1/2016	40.99877	-73.47178
Mianus Harbor FNP	WLDS13	356	272	12/1/2016	40.99847	-73.47108
Mianus Harbor FNP	WLDS13	356	272	12/1/2016	40.99855	-73.4719
Mianus Harbor FNP	WLDS13	356	272	12/2/2016	40.99822	-73.47143
Mianus Harbor FNP	WLDS13	356	272	12/2/2016	40.99843	-73.4735
Mianus Harbor FNP	WLDS13	356	272	12/2/2016	40.99843	-73.47133
Mianus Harbor FNP	WLDS13	356	272	12/2/2016	40.99843	-73.47298
Mianus Harbor FNP	WLDS13	356	272	12/3/2016	40.99828	-73.47153
Mianus Harbor FNP	WLDS13	356	272	12/3/2016	40.9986	-73.47188
Mianus Harbor FNP	WLDS13	356	272	12/3/2016	40.99762	-73.47105
Norwalk Cove Marina	WLDS 14/15	275	210	12/4/2016	40.99799	-73.47049
Mianus Harbor FNP	WLDS13	356	272	12/5/2016	40.99883	-73.47163
Norwalk Cove Marina	WLDS 14/15	232	177	12/5/2016	40.99796	-73.47094
Mianus Harbor FNP	WLDS13	356	272	12/5/2016	40.9988	-73.47138
Mianus Harbor FNP	WLDS13	356	272	12/5/2016	40.99875	-73.47182
Mianus Harbor FNP	WLDS13	356	272	12/5/2016	40.99823	-73.47103
Norwalk Cove Marina	WLDS 14/15	259	198	12/5/2016	40.99847	-73.47076
Mianus Harbor FNP	WLDS13	356	272	12/6/2016	40.99843	-73.47163
Mianus Harbor FNP	WLDS13	356	272	12/6/2016	40.99823	-73.47155
Mianus Harbor FNP	WLDS13	356	272	12/6/2016	40.99847	-73.47197
Norwalk Cove Marina	WLDS 14/15	236	180	12/6/2016	40.99842	-73.47071
Mianus Harbor FNP	WLDS13	356	272	12/7/2016	40.99802	-73.47093
Norwalk Cove Marina	WLDS 14/15	175	134	12/7/2016	40.99826	-73.47063
Mianus Harbor FNP	WLDS13	356	272	12/8/2016	40.99852	-73.47133
Norwalk Cove Marina	WLDS 14/15	161	123	12/8/2016	40.99845	-73.47078
Mianus Harbor FNP	WLDS13	356	272	12/8/2016	40.99907	-73.47122
Norwalk Cove Marina	WLDS 14/15	231	177	12/12/2016	40.99869	-73.47054
Mianus Harbor FNP	WLDS13	356	272	12/14/2016	40.99827	-73.47107
Norwalk Cove Marina	WLDS 14/15	246	188	12/14/2016	40.9985	-73.46998
Norwalk Cove Marina	WLDS 14/15	100	76	12/14/2016	40.99806	-73.47029
Mianus Harbor FNP	WLDS13	356	272	12/14/2016	40.99817	-73.47067
Norwalk Cove Marina	WLDS 14/15	295	226	12/16/2016	40.99812	-73.47078
Mianus Harbor FNP	WLDS13	356	272	12/16/2016	40.99843	-73.47057
Mianus Harbor FNP	WLDS13	356	272	12/17/2016	40.99828	-73.47083
Mianus Harbor FNP	WLDS13	356	272	12/17/2016	40.9983	-73.47045
Norwalk Cove Marina	WLDS 14/15	248	190	12/17/2016	40.99837	-73.471
Mianus Harbor FNP	WLDS13	356	272	12/18/2016	40.9981	-73.47103
Mianus Harbor FNP	WLDS13	356	272	12/18/2016	40.99822	-73.4707
Norwalk Cove Marina	WLDS 14/15	140	107	12/19/2016	40.99782	-73.47106
Mianus Harbor FNP	WLDS13	356	272	12/19/2016	40.99817	-73.47103
Mianus Harbor FNP	WLDS13	356	272	12/19/2016	40.99817	-73.47068
Mianus Harbor FNP	WLDS13	356	272	12/20/2016	40.99807	-73.47082
Norwalk Cove Marina	WLDS 14/15	254	194	12/20/2016	40.99794	-73.47078
Mianus Harbor FNP	WLDS13	356	272	12/20/2016	40.99835	-73.47082
Mianus Harbor FNP	WLDS13	356	272	12/21/2016	40.99825	-73.4709
Norwalk Cove Marina	WLDS 14/15	228	174	12/21/2016	41.00257	-73.46704
Mianus Harbor FNP	WLDS13	356	272	12/21/2016	40.99825	-73.47077
Norwalk Cove Marina	WLDS 14/15	229	175	12/22/2016	40.99833	-73.47083
Mianus Harbor FNP	WLDS13	356	272	12/22/2016	40.9983	-73.47075
Mianus Harbor FNP	WLDS13	356	272	12/22/2016	40.99903	-73.47142
Norwalk Cove Marina	WLDS 14/15	289	221	12/23/2016	40.99823	-73.47066
Mianus Harbor FNP	WLDS13	356	272	12/27/2016	40.99858	-73.47067
Mianus Harbor FNP	WLDS13	356	272	12/27/2016	40.99853	-73.47157
Mianus Harbor FNP	WLDS13	356	272	12/27/2016	40.99847	-73.4707
Mianus Harbor FNP	WLDS13	356	272	12/28/2016	40.99832	-73.47117
Norwalk Cove Marina	WLDS 14/15	146	112	12/28/2016	40.99824	-73.47073
Mianus Harbor FNP	WLDS13	356	272	12/28/2016	40.99808	-73.47122
Norwalk Cove Marina	WLDS 14/15	78	60	12/28/2016	40.99839	-73.47068
Mianus Harbor FNP	WLDS13	356	272	12/28/2016	40.99877	-73.47138
Mianus Harbor FNP	WLDS13	356	272	12/29/2016	40.99878	-73.47108
Mianus Harbor FNP	WLDS13	356	272	12/29/2016	40.99832	-73.47103
Norwalk Cove Marina	WLDS 14/15	196	150	12/29/2016	40.99856	-73.47062

Appendix A
Disposal Barge Logs

Project Name	Target Site	Load Volume (yd^3)	Load Volume (m^3)	Placement Date	Latitude	Longitude
Mianus Harbor FNP	WLDS13	356	272	1/2/2017	40.99843	-73.47112
Mianus Harbor FNP	WLDS13	356	272	1/2/2017	40.99855	-73.47165
Mianus Harbor FNP	WLDS13	356	272	1/2/2017	40.99823	-73.47105
Norwalk Cove Marina	WLDS 14/15	202	154	1/2/2017	40.99828	-73.47139
Mianus Harbor FNP	WLDS13	356	272	1/2/2017	40.99852	-73.47343
Mianus Harbor FNP	WLDS13	356	272	1/3/2017	40.99855	-73.47172
Mianus Harbor FNP	WLDS13	356	272	1/3/2017	40.99773	-73.47445
Mianus Harbor FNP	WLDS13	356	272	1/5/2017	40.9987	-73.47078
Mianus Harbor FNP	WLDS13	356	272	1/6/2017	40.99862	-73.4716
Norwalk Cove Marina	WLDS 14/15	225	172	1/6/2017	40.99824	-73.47069
Mianus Harbor FNP	WLDS13	356	272	1/6/2017	40.99827	-73.47087
Mianus Harbor FNP	WLDS13	356	272	1/6/2017	40.99873	-73.4718
Mianus Harbor FNP	WLDS13	356	272	1/7/2017	40.99843	-73.47078
Norwalk Cove Marina	WLDS 14/15	220	168	1/7/2017	40.99819	-73.47089
Mianus Harbor FNP	WLDS13	356	272	1/7/2017	40.99818	-73.4707
Mianus Harbor FNP	WLDS13	356	272	1/7/2017	40.99828	-73.47178
Noroton Yacht Club	WLDS	133	102	1/7/2017	40.9985	-73.47083
Norwalk Cove Marina	WLDS 14/15	234	179	1/8/2017	40.99819	-73.4707
Mianus Harbor FNP	WLDS13	356	272	1/8/2017	40.99825	-73.47102
Mianus Harbor FNP	WLDS13	356	272	1/8/2017	40.99852	-73.4718
Mianus Harbor FNP	WLDS13	356	272	1/9/2017	40.99837	-73.47118
Norwalk Cove Marina	WLDS 14/15	150	115	1/9/2017	40.99853	-73.4706
Mianus Harbor FNP	WLDS13	356	272	1/9/2017	40.99832	-73.47183
Noroton Yacht Club	WLDS	129	99	1/9/2017	40.99863	-73.47072
Noroton Yacht Club	WLDS	113	86	1/9/2017	40.99847	-73.47103
Mianus Harbor FNP	WLDS13	356	272	1/10/2017	40.99855	-73.4709
Mianus Harbor FNP	WLDS13	356	272	1/10/2017	40.99842	-73.47182
Norwalk Cove Marina	WLDS 14/15	228	174	1/10/2017	40.99832	-73.47068
Mianus Harbor FNP	WLDS13	356	272	1/10/2017	40.99845	-73.47083
Mianus Harbor FNP	WLDS13	356	272	1/10/2017	40.99847	-73.47168
Noroton Yacht Club	WLDS	118	90	1/10/2017	40.99868	-73.47072
Noroton Yacht Club	WLDS	115	88	1/10/2017	40.99855	-73.4707
Mianus Harbor FNP	WLDS13	356	272	1/11/2017	40.99838	-73.4709
Norwalk Cove Marina	WLDS 14/15	227	174	1/11/2017	40.9984	-73.47056
Mianus Harbor FNP	WLDS13	356	272	1/11/2017	40.99828	-73.47183
Mianus Harbor FNP	WLDS13	356	272	1/12/2017	40.99868	-73.47158
Norwalk Cove Marina	WLDS 14/15	206	157	1/13/2017	40.99848	-73.47047
Mianus Harbor FNP	WLDS13	356	272	1/13/2017	40.99848	-73.47083
Mianus Harbor FNP	WLDS13	356	272	1/13/2017	40.9982	-73.47118
Norwalk Cove Marina	WLDS 14/15	122	93	1/13/2017	40.99821	-73.4705
Noroton Yacht Club	WLDS	127	97	1/13/2017	40.99842	-73.47097
Mianus Harbor FNP	WLDS13	356	272	1/14/2017	40.99805	-73.47092
Noroton Yacht Club	WLDS	24	18	1/14/2017	40.99847	-73.47088
Noroton Yacht Club	WLDS	124	95	1/14/2017	40.99823	-73.47108
Noroton Yacht Club	WLDS	109	83	1/14/2017	40.99875	-73.47033
Mianus Harbor FNP	WLDS13	356	272	1/15/2017	40.99842	-73.47092
Noroton Yacht Club	WLDS	125	96	1/15/2017	40.99842	-73.47075
Noroton Yacht Club	WLDS	101	77	1/15/2017	40.99838	-73.47088
Noroton Yacht Club	WLDS	131	100	1/15/2017	40.99852	-73.47092
Norwalk Cove Marina	WLDS 14/15	203	155	1/16/2017	40.99808	-73.47078
Mianus Harbor FNP	WLDS13	372	284	1/16/2017	40.99873	-73.4711
Riverside Yacht Club	WLDS 14/15	301	230	1/16/2017	40.9983	-73.47118
Noroton Yacht Club	WLDS	120	92	1/16/2017	40.99842	-73.47068
Norwalk Cove Marina	WLDS 14/15	269	206	1/17/2017	40.99831	-73.47069
Beacon Point Marina	WLDS 14/15	464	355	1/17/2017	40.99813	-73.47072
Soundwaters, Inc.	WLDS 14/15	233	178	1/17/2017	40.99823	-73.47133
Norwalk Cove Marina	WLDS 14/15	208	159	1/17/2017	40.99821	-73.47064
Beacon Point Marina	WLDS 14/15	375	287	1/18/2017	40.99828	-73.47075
Soundwaters, Inc.	WLDS 14/15	259	198	1/18/2017	40.99817	-73.47122
Norwalk Cove Marina	WLDS 14/15	190	145	1/18/2017	40.99829	-73.47075
Norwalk Cove Marina	WLDS 14/15	225	172	1/19/2017	40.99815	-73.47069
Beacon Point Marina	WLDS 14/15	433	331	1/19/2017	40.99825	-73.47075
Soundwaters, Inc.	WLDS 14/15	331	253	1/19/2017	40.99813	-73.47098
Soundwaters, Inc.	WLDS 14/15	232	177	1/19/2017	40.99825	-73.47118

Appendix A
Disposal Barge Logs

Project Name	Target Site	Load Volume (yd^3)	Load Volume (m^3)	Placement Date	Latitude	Longitude
Beacon Point Marina	WLDS 14/15	408	312	1/19/2017	40.99835	-73.47085
Soundwaters, Inc.	WLDS 14/15	257	196	1/20/2017	40.9982	-73.47103
Beacon Point Marina	WLDS 14/15	370	283	1/20/2017	40.99835	-73.47072
Soundwaters, Inc.	WLDS 14/15	218	167	1/21/2017	40.99822	-73.47152
Soundwaters, Inc.	WLDS 14/15	289	221	1/21/2017	40.99817	-73.47107
Beacon Point Marina	WLDS 14/15	405	310	1/21/2017	40.99817	-73.47072
Beacon Point Marina	WLDS 14/15	441	337	1/22/2017	40.9985	-73.47078
Soundwaters, Inc.	WLDS 14/15	213	163	1/22/2017	40.99835	-73.4712
Norwalk Cove Marina	WLDS 14/15	265	203	1/22/2017	40.99851	-73.47063
Soundwaters, Inc.	WLDS 14/15	241	184	1/23/2017	40.9981	-73.47153
Soundwaters, Inc.	WLDS 14/15	333	255	1/24/2017	40.99817	-73.4702
Beacon Point Marina	WLDS 14/15	347	265	1/25/2017	40.99825	-73.47075
Mianus Harbor FNP	WLDS13	356	272	1/25/2017	40.9982	-73.47165
Norwalk Cove Marina	WLDS 14/15	218	167	1/25/2017	40.99828	-73.47068
Soundwaters, Inc.	WLDS 14/15	233	178	1/26/2017	40.9986	-73.47132
Norwalk Cove Marina	WLDS 14/15	99	76	1/26/2017	40.99816	-73.47077
Beacon Point Marina	WLDS 14/15	325	248	1/26/2017	40.99843	-73.471
Beacon Point Marina	WLDS 14/15	389	297	1/28/2017	40.99832	-73.47022
Beacon Point Marina	WLDS 14/15	384	294	1/28/2017	40.99842	-73.47055
Norwalk Cove Marina	WLDS 14/15	162	124	1/29/2017	40.99838	-73.47079
Norwalk Cove Marina	WLDS 14/15	196	150	2/4/2017	40.99832	-73.47061
Norwalk Cove Marina	WLDS 14/15	229	175	2/8/2017	40.99868	-73.47082
Norwalk Cove Marina	WLDS	287	219	12/15/2017	40.99863	-73.46856
Norwalk Cove Marina	WLDS	227	174	12/17/2017	40.99799	-73.47088
Norwalk Cove Marina	WLDS	246	188	12/18/2017	40.99792	-73.4711
Norwalk Cove Marina	WLDS	227	173	12/19/2017	40.99829	-73.47076
Norwalk Cove Marina	WLDS	261	200	12/21/2017	40.99828	-73.47052
Norwalk Cove Marina	WLDS	249	191	12/22/2017	40.99872	-73.47048
Norwalk Cove Marina	WLDS	160	122	12/30/2017	40.99816	-73.47105
Norwalk Cove Marina	WLDS	104	80	12/30/2017	40.99823	-73.47053
Norwalk Cove Marina	WLDS	224	171	1/10/2018	40.99829	-73.47126
Norwalk Cove Marina	WLDS	214	164	1/10/2018	40.99831	-73.47079
Norwalk Cove Marina	WLDS	210	161	1/12/2018	40.99837	-73.47078
Norwalk Cove Marina	WLDS	225	172	1/14/2018	40.99822	-73.47065
Norwalk Cove Marina	WLDS	201	154	1/15/2018	40.99805	-73.47093
Norwalk Cove Marina	WLDS	237	181	1/16/2018	40.99844	-73.47087
Norwalk Cove Marina	WLDS	246	188	1/16/2018	40.99796	-73.47054
Norwalk Cove Marina	WLDS	234	179	1/17/2018	40.99829	-73.47174
Norwalk Cove Marina	WLDS	155	118	1/18/2018	40.99841	-73.47077
Norwalk Cove Marina	WLDS	217	166	1/21/2018	40.99854	-73.47041
Norwalk Cove Marina	WLDS	206	158	1/22/2018	40.9983	-73.47054
Norwalk Cove Marina	WLDS	250	191	1/26/2018	40.998	-73.47095

Appendix B

Chemistry Data Tables

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Sediment Results

Analyte	CAS Number	ACTIVE						INACTIVE					
		MOUND N-1		WLDS-1		WLDS-2		ACD-1		MOUND C-1		MOUND D-1	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
GRAIN SIZE AND SOLIDS (%)													
% Clay	20	6.78		6.67		8.98		9.48		12.27		7.99	
% Silt	19	33.66		52.51		29.56		43.72		47.01		44.45	
Sieve #10 Coarse Sand (2.0-4.75mm) %Retained	27	0		0		6.02		0		0		0	
Sieve #200 Fine Sand (0.075-.425mm) %Retained	28	27.63		32.48		40.32		37.33		25.33		25.81	
Sieve #4 Gravel (>4.75mm) %Retained	26	0		0		4.88		0		0		0	
Sieve #40 Medium Sand (0.425-2.0mm) %Retained	29	31.94		8.34		10.24		9.47		15.4		21.74	
% Solids	17	41		41		60		49		49		56	
NUTRIENTS (MG/KG)													
Phosphorus	7723140	550		610		340		490		560		340	
Total Kjeldahl Nitrogen		1600		2100		770		1600		1200		1100	
Nitrate+Nitrite as N		0.72	J	0.19	J	0.54	J	0.87	J	0.91	J	0.42	J
TOTAL ORGANIC CARBON (UG/G)													
TOC In Soil (Avg)	14762744	30333		21000		9000		19000		15000		15400	

Analyte	CAS Number	HISTORIC						REFERENCE					
		WLDS-3		WLDS-4		WLDS-5		SEREF-1		SEREF-2		SEREF-3		SREF-1	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
GRAIN SIZE AND SOLIDS (%)															
% Clay	20	13.02		12.25		11.42		13.07		13.64		12.58		9.17	
% Silt	19	52.47		35.93		80.33		76.68		72.27		68.75		29.32	
Sieve #10 Coarse Sand (2.0-4.75mm) %Retained	27	0		1.72		0		0		0		0		0	
Sieve #200 Fine Sand (0.075-.425mm) %Retained	28	27.05		12.6		5.71		8.65		11.09		13.39		38.29	
Sieve #4 Gravel (>4.75mm) %Retained	26	0		34.07		0		0		0		0		0	
Sieve #40 Medium Sand (0.425-2.0mm) %Retained	29	7.45		3.44		2.54		1.6		3		5.29		23.22	
% Solids	17	44		37		33		36		37		37		58	
NUTRIENTS (MG/KG)															
Phosphorus	7723140	500		540		780		640		540		540		300	
Total Kjeldahl Nitrogen		1900		2100		2400		2300		2400		2200		970	
Nitrate+Nitrite as N		0.84	J	0.45	J	0.14	J	5.4		0.71	J	1.5		6.1	
TOTAL ORGANIC CARBON (UG/G)															
TOC In Soil (Avg)	14762744	19000		23333		25000		24000		24000		22333		9733	

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Analyte	CAS Number	REFERENCE											
		SREF-2		SREF-2-DUP		SREF-3		SWREF-1		SWREF-2		SWREF-3	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
GRAIN SIZE AND SOLIDS (%)													
% Clay	20	9.7		9.6		8.79		7.25		6.32		7.91	
% Silt	19	24.49		32.02		29.93		13.6		20.73		16.25	
Sieve #10 Coarse Sand (2.0-4.75mm) %Retained	27	0		0		0		0		0		0	
Sieve #200 Fine Sand (0.075-.425mm) %Retained	28	48.12		43.66		48.08		53.61		62.73		52.94	
Sieve #4 Gravel (>4.75mm) %Retained	26	0		0		0		0		0		0	
Sieve #40 Medium Sand (0.425-2.0mm) %Retained	29	17.69		14.72		13.2		25.54		10.23		22.9	
% Solids	17	57		52		58		65		67		63	
NUTRIENTS (MG/KG)													
Phosphorus	7723140	430		320		300		210		220		260	
Total Kjeldahl Nitrogen		960		1200		1100		550		580		760	
Nitrate+Nitrite as N		4.7		0.028	U	3.9		1.3		4.6		4.2	
TOTAL ORGANIC CARBON (UG/G)													
TOC In Soil (Avg)	14762744	9600		12000		917		7033		7067		8367	

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Analyte	CAS Number	ACTIVE						INACTIVE					
		MOUND N-1		WLDS-1		WLDS-2		ACD-1		MOUND C-1		MOUND D-1	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
METALS (MG/KG)													
Arsenic	7440382	3.28		5.38		4.78		5.22		6.44		3.6	
Cadmium	7440439	0.32		0.37		0.06	J	0.592		0.3		0.672	
Chromium	7440473	36.3		50.9		26.8		49.2	E	41.3		37.7	
Copper	7440508	47.2		65.1		22		58.8	EA	47.5		55	
Lead	7439921	46.4		35.5		12.6		58.3	NA	48.1		31	
Nickel	7440020	19.3		20.6		13.8		21.1		21.4		14.9	
Zinc	7440666	111		124		58.7		121	EA	96.2		90.6	
Mercury	7439976	0.12		0.157		0.056		0.354	A	0.223		0.656	

Analyte	CAS Number	HISTORIC						REFERENCE							
		WLDS-3		WLDS-4		WLDS-5		SEREF-1		SEREF-2		SEREF-3		SREF-1	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
METALS (MG/KG)															
Arsenic	7440382	7.58		8.36		6.76		7.42		7.32		6.72		4	
Cadmium	7440439	0.23		0.378		0.238		0.095	J	0.15	J	0.1	J	0.126	
Chromium	7440473	53.4		69.5		59.5		66.2		63.3		58.8		32.1	
Copper	7440508	59.8		65.8		63.4		63.2		62.9		57.7		25.9	
Lead	7439921	151		56.1		41.9		43.8		43.4		39.9		18.7	
Nickel	7440020	23.4		26.6		23.3		27.7		27		25.2		13.2	
Zinc	7440666	135		162		137		154		150		138		67.2	
Mercury	7439976	0.341		0.206		0.311		0.195		0.193		0.189		0.0969	

Analyte	CAS Number	REFERENCE											
		SREF-2		SREF-2-DUP		SREF-3		SWREF-1		SWREF-2		SWREF-3	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
METALS (MG/KG)													
Arsenic	7440382	3.71		5.4		3.9		3.42		4.27		3.55	
Cadmium	7440439	0.069	J	0.085	J	0.0938	J	0.0803	J	0.052	J	0.078	J
Chromium	7440473	26.4		44.3		28.8		21		22.1		24.9	
Copper	7440508	24.8		42.8		29.5		20		20.6		25.9	
Lead	7439921	17.8		29.7		23.9		13.9		14.6		17.2	
Nickel	7440020	13		19.5		13.4		10.5		10		12.4	
Zinc	7440666	63.5		107		75		53.1		58.8		62.3	
Mercury	7439976	0.0968		0.12		0.0905		0.0694		0.059		0.0831	

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Analyte	CAS Number	ACTIVE						INACTIVE					
		MOUND N-1		WLDS-1		WLDS-2		ACD-1		MOUND C-1		MOUND D-1	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PESTICIDES (UG/KG)													
4,4`-DDD	72548	6.9	J	1.8	J	0.16	U	6	J	9		2.6	J
4,4`-DDE	72559	7.1	J	1.2	J	0.15	U	4.5	J	1.7	J	2.8	J
4,4`-DDT	50293	5.7	J	0.37	U	0.245	U	9.2	J	0.295	U	2.9	J
Total DDTs		*19.7*		*3.37*		*0.555*	*U*	*19.7*		*10.995*		*8.3*	
Aldrin	309002	0.315	U	0.335	U	0.22	U	0.27	U	0.265	U	0.22	U
Alpha-BHC	319846	0.38	U	0.41	U	0.27	U	0.33	U	0.32	U	0.27	U
Alpha-Chlordane (cis)	5103719	8.7		0.25	U	0.165	U	0.94	J	0.2	U	0.7	J
Beta-BHC	319857	0.37	U	0.395	U	0.26	U	0.32	U	0.31	U	0.26	U
Delta-BHC	319868	0.36	U	0.385	U	0.255	U	0.31	U	0.305	U	0.255	U
Dieldrin	60571	0.245	U	0.265	U	0.175	U	0.215	U	0.21	U	0.175	U
Endosulfan I	959988	0.27	U	0.29	U	0.19	U	0.23	U	0.23	U	0.19	U
Endosulfan II	33213659	0.38	U	0.41	U	0.27	U	0.33	U	0.32	U	0.27	U
Endosulfan sulfate	1031078	0.65	U	0.7	U	0.46	U	0.55	U	0.55	U	0.46	U
Endrin	72208	0.95	U	1	U	0.65	U	0.8	U	0.8	U	0.65	U
Gamma-Chlordane	5566347	8.6		0.275	U	0.18	U	0.225	U	0.22	U	1.5	U
Heptachlor	76448	0.325	U	0.35	U	0.23	U	0.28	U	0.275	U	0.23	U
Heptachlor epoxide	1024573	0.245	U	0.265	U	0.175	U	0.215	U	0.21	U	0.175	U
Lindane	58899	0.3	U	0.325	U	0.215	U	0.26	U	0.255	U	0.215	U
Methoxychlor	72435	0.55	U	0.6	U	0.395	U	0.485	U	0.475	U	0.395	U
Technical Chlordane	12789036	67		4.3	U	2.85	U	67	J	3.4	U	18	J
Toxaphene	8001352	8	U	8.5	U	5.5	U	7	U	6.5	U	5.5	U

US Army Corps of Engineers®
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Analyte	CAS Number	HISTORIC						REFERENCE							
		WLDS-3		WLDS-4		WLDS-5		SEREF-1		SEREF-2		SEREF-3		SREF-1	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PESTICIDES (UG/KG)															
4,4`-DDD	72548	1.6	J	1.7	J	1.3	J	1.2	J	1.1	J	0.94	J	0.55	J
4,4`-DDE	72559	1	J	0.82	J	1.1	J	0.91	J	0.88	J	0.8	J	0.47	J
4,4`-DDT	50293	0.325	U	0.37	U	0.45	U	0.42	U	0.385	U	0.36	U	0.25	U
Total DDTs		*2.925*		*2.89*		*2.85*		*2.53*		*2.365*		*2.1*		*1.27*	
Aldrin	309002	0.295	U	0.335	U	0.405	U	0.375	U	0.35	U	0.325	U	0.225	U
Alpha-BHC	319846	0.355	U	0.41	U	0.49	U	0.46	U	0.425	U	0.395	U	0.275	U
Alpha-Chlordane (cis)	5103719	0.22	U	0.25	U	0.305	U	0.285	U	0.26	U	0.245	U	0.17	U
Beta-BHC	319857	0.345	U	0.395	U	0.48	U	0.445	U	0.41	U	0.38	U	0.265	U
Delta-BHC	319868	0.335	U	0.385	U	0.465	U	0.43	U	0.4	U	0.37	U	0.26	U
Dieldrin	60571	0.23	U	0.265	U	0.32	U	0.295	U	0.275	U	0.255	U	0.18	U
Endosulfan I	959988	0.25	U	0.29	U	0.35	U	0.325	U	0.3	U	0.28	U	0.195	U
Endosulfan II	33213659	0.355	U	0.41	U	0.49	U	0.46	U	0.425	U	0.395	U	0.275	U
Endosulfan sulfate	1031078	0.6	U	0.7	U	0.85	U	0.8	U	0.7	U	0.65	U	0.47	U
Endrin	72208	0.9	U	1	U	1.25	U	1.15	U	1.05	U	1	U	0.7	U
Gamma-Chlordane	5566347	0.24	U	0.275	U	0.335	U	0.31	U	0.285	U	0.265	U	0.185	U
Heptachlor	76448	0.305	U	0.35	U	0.42	U	0.39	U	0.36	U	0.335	U	0.235	U
Heptachlor epoxide	1024573	0.23	U	0.265	U	0.32	U	0.295	U	0.275	U	0.255	U	0.18	U
Lindane	58899	0.28	U	0.325	U	0.39	U	0.365	U	0.335	U	0.31	U	0.22	U
Methoxychlor	72435	0.5	U	0.6	U	0.7	U	0.65	U	0.6	U	0.6	U	0.405	U
Technical Chlordane	12789036	3.75	U	4.3	U	5	U	4.85	U	4.5	U	4.15	U	2.9	U
Toxaphene	8001352	7.5	U	8.5	U	10	U	9.5	U	8.5	U	8	U	5.5	U

US Army Corps of Engineers®
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Analyte	CAS Number	REFERENCE											
		SREF-2		SREF-2-DUP		SREF-3		SWREF-1		SWREF-2		SWREF-3	
		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PESTICIDES (UG/KG)													
4,4`-DDD	72548	0.17	U	0.165	U	0.16	U	0.125	U	0.145	U	0.135	U
4,4`-DDE	72559	0.16	U	0.16	U	0.155	U	0.12	U	0.14	U	0.13	U
4,4`-DDT	50293	0.265	U	0.255	U	0.25	U	0.195	U	0.225	U	0.21	U
Total DDTs		*0.595*	*U*	*0.58*	*U*	*0.565*	*U*	*0.44*	*U*	*0.51*	*U*	*0.475*	*U*
Aldrin	309002	0.24	U	0.23	U	0.225	U	0.18	U	0.205	U	0.19	U
Alpha-BHC	319846	0.29	U	0.28	U	0.275	U	0.215	U	0.245	U	0.23	U
Alpha-Chlordane (cis)	5103719	0.18	U	0.175	U	0.17	U	0.135	U	0.15	U	0.14	U
Beta-BHC	319857	0.28	U	0.275	U	0.265	U	0.21	U	0.24	U	0.225	U
Delta-BHC	319868	0.27	U	0.265	U	0.26	U	0.205	U	0.23	U	0.215	U
Dieldrin	60571	0.185	U	0.18	U	0.18	U	0.14	U	0.16	U	0.15	U
Endosulfan I	959988	0.205	U	0.2	U	0.195	U	0.15	U	0.175	U	0.16	U
Endosulfan II	33213659	0.29	U	0.28	U	0.275	U	0.215	U	0.245	U	0.23	U
Endosulfan sulfate	1031078	0.495	U	0.48	U	0.47	U	0.37	U	0.42	U	0.395	U
Endrin	72208	0.7	U	0.7	U	0.7	U	0.55	U	0.6	U	0.6	U
Gamma-Chlordane	5566347	0.195	U	0.19	U	0.185	U	0.145	U	0.165	U	0.155	U
Heptachlor	76448	0.245	U	0.24	U	0.235	U	0.185	U	0.21	U	0.195	U
Heptachlor epoxide	1024573	0.185	U	0.18	U	0.18	U	0.14	U	0.16	U	0.15	U
Lindane	58899	0.23	U	0.225	U	0.22	U	0.17	U	0.195	U	0.185	U
Methoxychlor	72435	0.425	U	0.415	U	0.405	U	0.32	U	0.365	U	0.34	U
Technical Chlordane	12789036	3.05	U	3	U	2.9	U	2.3	U	2.6	U	2.45	U
Toxaphene	8001352	6	U	6	U	5.5	U	4.45	U	5	U	4.75	U

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Analyte		CAS Number	ACTIVE						INACTIVE					
			MOUND N-1		WLDS-1		WLDS-2		ACD-1		MOUND C-1		MOUND D-1	
			Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PCBs (UG/KG)														
PCB 101		37680732	1.4	J	4.6	J	0.29	U	2.2		1.1	J	2	J
PCB 105		32598144	0.85	U	0.9	U	0.55	U	0.7	U	0.7	U	0.6	U
PCB 118		31508006	1.3	J	1.3	J	0.55	J	2		0.98	J	0.74	J
PCB 126	x	57465288	0.74	J	0.18	U	0.49	J	0.14	U	0.135	U	0.12	U
PCB 128		38380073	0.83	J	1	J	0.075	U	0.56	J	0.34	J	0.085	U
PCB 138		35065282	1.6	J	1.5	J	0.065	U	1.8		1	J	1.3	J
PCB 153		35065271	2.5		2.2	J	0.39	J	2.4		1.1	J	1.1	J
PCB 156	x	38380084	0.11	U	0.125	U	0.075	U	0.095	U	0.095	U	0.085	U
PCB 169	x	32774166	0.13	U	0.145	U	0.09	U	0.11	U	0.11	U	0.1	U
PCB 170		35065306	0.1	U	0.76	J	0.07	U	0.085	U	0.085	U	0.075	U
PCB 18		37680652	1.85	U	2	U	1.25	U	1.55	U	1.55	U	1.35	U
PCB 180		35065293	0.16	U	0.84	J	0.11	U	1.1	J	0.135	U	0.43	J
PCB 183	x	52663691	0.049	U	0.055	U	0.0335	U	0.0415	U	0.041	U	0.0365	U
PCB 184	x	74472483	0.095	U	0.105	U	0.065	U	0.08	U	0.08	U	0.07	U
PCB 187		52663680	0.11	U	0.75	J	0.46	J	0.87	J	0.23	J	0.44	J
PCB 195		52663782	0.15	J	0.17	J	0.038	U	0.11	J	0.047	U	0.0415	U
PCB 206		40186729	0.07	U	0.45	J	0.048	U	0.44	J	0.06	U	0.37	J
PCB 209		2051243	0.065	U	0.07	U	0.0445	U	1.4	J	0.055	U	0.049	U
PCB 28		7012375	0.16	U	1.9	J	0.11	U	0.88	J	0.35	J	0.12	U
PCB 44		41464395	2.4	J	0.68	J	0.045	U	1.6	J	0.28	J	0.52	J
PCB 49	x	41464408	0.255	U	4.1	J	0.175	U	1.6	J	0.21	U	0.19	U
PCB 52		35693993	3.6	J	1.6	J	0.69	J	2.7		0.69	J	1.1	J
PCB 66		32598100	1.5	J	1.4	J	0.06	U	2	J	0.07	U	0.98	J
PCB 77	x	32598133	0.205	U	1.4	J	0.14	U	0.17	U	0.17	U	0.15	U
PCB 8		34883437	0.365	U	0.405	U	0.25	U	0.31	U	0.305	U	0.275	U
PCB 87	x	38380028	0.15	U	0.17	U	0.105	U	0.6	J	1.2	J	0.115	U
Total PCBs			*38*		*45*		*10*		*45*		*18*		*23*	

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Analyte		CAS Number	HISTORIC						REFERENCE									
			WLDS-3		WLDS-4		WLDS-5		SEREF-1		SEREF-2		SEREF-3		SREF-1		SREF-2	
			Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PCBs (UG/KG)																		
PCB 101		37680732	0.46	U	1.4	J	0.5	U	0.6	U	0.55	U	0.55	U	0.31	U	0.355	U
PCB 105		32598144	0.9	U	1.05	U	1	U	1.15	U	1.1	U	1.05	U	0.6	U	0.7	U
PCB 118		31508006	0.075	U	1.2	J	0.46	J	0.9	J	0.89	J	0.72	J	0.36	J	0.44	J
PCB 126	x	57465288	2.5	J	0.2	U	0.19	U	0.225	U	0.21	U	0.205	U	0.115	U	0.135	U
PCB 128		38380073	0.12	U	0.14	U	0.13	U	0.155	U	0.145	U	0.14	U	0.08	U	0.095	U
PCB 138		35065282	0.97	J	1.2	J	0.35	J	0.65	J	0.78	J	0.53	J	0.28	J	0.32	J
PCB 153		35065271	1.2	J	2	J	0.64	J	1.2	J	1.3	J	0.81	J	0.45	J	0.58	J
PCB 156	x	38380084	0.12	U	0.14	U	0.13	U	0.155	U	0.145	U	0.14	U	0.08	U	0.095	U
PCB 169	x	32774166	0.145	U	0.165	U	0.155	U	0.18	U	0.17	U	0.165	U	0.095	U	0.11	U
PCB 170		35065306	0.11	U	0.125	U	0.12	U	0.14	U	0.13	U	0.13	U	0.075	U	0.085	U
PCB 18		37680652	2	U	2.3	U	2.15	U	2.55	U	2.35	U	2.3	U	1.3	U	1.5	U
PCB 180		35065293	0.175	U	1.4	J	0.19	U	0.225	U	0.21	U	0.205	U	0.115	U	0.135	U
PCB 183	x	52663691	0.05	U	0.06	U	0.06	U	0.07	U	0.065	U	0.06	U	0.035	U	0.0405	U
PCB 184	x	74472483	0.105	U	0.12	U	0.115	U	0.13	U	0.125	U	0.12	U	0.07	U	0.08	U
PCB 187		52663680	0.12	U	0.82	J	0.26	J	0.66	J	0.71	J	0.35	J	0.08	U	0.095	U
PCB 195		52663782	0.06	U	0.07	U	0.065	U	0.075	U	0.07	U	0.07	U	0.04	U	0.0465	U
PCB 206		40186729	0.075	U	0.085	U	0.085	U	0.51	J	0.26	J	0.09	U	0.05	U	0.06	U
PCB 209		2051243	0.075	U	0.08	U	0.075	U	0.81	J	0.93	J	0.08	U	0.047	U	0.055	U
PCB 28		7012375	0.175	U	1.7	J	0.19	U	0.225	U	1.9	J	0.65	J	0.115	U	0.42	J
PCB 44		41464395	0.45	J	0.45	J	0.08	U	0.09	U	0.085	U	0.085	U	0.0475	U	0.055	U
PCB 49	x	41464408	0.275	U	0.63	J	0.3	U	1.2	J	0.33	U	0.32	U	0.185	U	0.21	U
PCB 52		35693993	1	J	0.88	J	1	J	1.6	J	0.73	J	0.63	J	0.055	U	0.7	J
PCB 66		32598100	0.51	J	1.2	J	0.1	U	0.12	U	0.78	J	0.41	J	0.56	J	0.07	U
PCB 77	x	32598133	0.22	U	0.255	U	0.24	U	0.28	U	0.265	U	0.26	U	0.145	U	0.17	U
PCB 8		34883437	0.395	U	0.455	U	0.435	U	0.5	U	0.475	U	0.465	U	0.265	U	0.305	U
PCB 87	x	38380028	0.165	U	0.19	U	0.18	U	0.21	U	0.195	U	0.195	U	0.11	U	0.125	U
Total PCBs			*18*		*33*		*16*		*24*		*27*		*19*		*10*		*12*	

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Analyte		CAS Number	REFERENCE											
			SREF-2		SREF-2-DUP		SREF-3		SWREF-1		SWREF-2		SWREF-3	
			Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PCBs (UG/KG)														
PCB 101		37680732	0.355	U	0.375	U	0.345	U	0.25	U	0.25	U	0.26	U
PCB 105		32598144	0.7	U	0.7	U	0.65	U	0.49	U	0.485	U	0.5	U
PCB 118		31508006	0.44	J	1.5	J	0.75	J	0.2	J	0.32	J	0.38	J
PCB 126	x	57465288	0.135	U	0.14	U	0.13	U	0.095	U	0.095	U	0.1	U
PCB 128		38380073	0.095	U	0.1	U	0.09	U	0.065	U	0.065	U	0.07	U
PCB 138		35065282	0.32	J	0.44	J	0.41	J	0.17	J	0.27	J	0.42	J
PCB 153		35065271	0.58	J	1.4	J	0.69	J	0.26	J	0.42	J	0.66	J
PCB 156	x	38380084	0.095	U	0.1	U	0.09	U	0.065	U	0.065	U	0.07	U
PCB 169	x	32774166	0.11	U	0.115	U	0.105	U	0.075	U	0.075	U	0.08	U
PCB 170		35065306	0.085	U	0.37	J	0.08	U	0.06	U	0.06	U	0.06	U
PCB 18		37680652	1.5	U	1.6	U	1.5	U	1.05	U	1.05	U	1.1	U
PCB 180		35065293	0.135	U	0.53	J	0.13	U	0.095	U	0.095	U	0.27	J
PCB 183	x	52663691	0.0405	U	0.0425	U	0.0395	U	0.0285	U	0.0285	U	0.0295	U
PCB 184	x	74472483	0.08	U	0.085	U	0.075	U	0.055	U	0.055	U	0.06	U
PCB 187		52663680	0.095	U	0.72	J	0.34	J	0.065	U	0.19	J	0.28	J
PCB 195		52663782	0.0465	U	0.049	U	0.045	U	0.0325	U	0.0325	U	0.034	U
PCB 206		40186729	0.06	U	0.16	J	0.055	U	0.041	U	0.041	U	0.0425	U
PCB 209		2051243	0.055	U	0.055	U	0.05	U	0.038	U	0.038	U	0.0395	U
PCB 28		7012375	0.42	J	0.14	U	1.1	J	0.22	J	0.54	J	0.73	J
PCB 44		41464395	0.055	U	0.06	U	0.24	J	0.0385	U	0.18	J	0.26	J
PCB 49	x	41464408	0.21	U	0.22	U	0.75	J	0.15	U	0.34	J	0.68	J
PCB 52		35693993	0.7	J	0.3	J	1.2	J	0.6	J	0.73	J	1.2	J
PCB 66		32598100	0.07	U	0.4	J	0.07	U	0.05	U	0.4	J	0.52	J
PCB 77	x	32598133	0.17	U	0.18	U	0.165	U	0.12	U	0.12	U	0.12	U
PCB 8		34883437	0.305	U	0.32	U	0.295	U	0.215	U	0.215	U	0.22	U
PCB 87	x	38380028	0.125	U	0.135	U	0.125	U	0.09	U	0.09	U	0.09	U
Total PCBs			*12*		*18*		*16*		*8*		*11*		*14*	

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Analyte		CAS Number	ACTIVE						INACTIVE					
			MOUND N-1		WLDS-1		WLDS-2		ACD-1		MOUND C-1		MOUND D-1	
			Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PAHs (UG/KG)														
1-Methylnaphthalene	L	90120	1.8	U	1.95	U	1.3	U	4.1	J	1.7	U	1.35	U
2-Methylnaphthalene	L	91576	2.3	U	2.5	U	1.7	U	4	J	2.15	U	1.75	U
Acenaphthene	L	83329	14		1.7	U	1.15	U	10	J	3.6	J	13	
Acenaphthylene	L	208968	4.6	J	1.4	U	0.9	U	10	J	5.8	J	6.7	J
Anthracene	L	120127	44		15		4.8	J	27		12	J	64	
Benzo(a)anthracene	H	56553	310		73		34		140	M	60		210	
Benzo(a)pyrene	H	50328	290		80		41	B	140	M	73		160	
Benzo(b)fluoranthene	H	205992	510		120		58		220	M	100		240	
Benzo(g,h,i)perylene	H	191242	180		46		22		100		39		70	
Benzo(k)fluoranthene	H	207089	160		42		21		57		36		87	
Chrysene	H	218019	380		93		46		160	M	72		210	
Dibenz(a,h)anthracene	H	53703	60		22	B	11	B	28	B	18	B	29	B
Fluoranthene	H	206440	640		200		110		280	M	110		470	
Fluorene	L	86737	17		3.65	U	2.5	U	14		3.15	U	19	
Indeno(1,2,3-cd)pyrene	H	193395	250		71		39	B	200	M	58	B	100	
Naphthalene	L	91203	2.75	U	3	U	2	U	2.3	U	2.55	U	2.1	U
Phenanthrene	L	85018	180		40		37		130	M	39		180	
Pyrene	H	129000	700		190		99		180	M	150		420	
Total LMW PAHs	*L*		*266*		*69*		*51*		*201*		*70*		*288*	
Total HMW PAHs	*H*		*3480*		*937*		*481*		*1505*		*716*		*1996*	
Total PAHs			*3746*		*1006*		*532*		*1706*		*786*		*2284*	

US Army Corps of Engineers®
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Analyte		CAS Number	HISTORIC						REFERENCE							
			WLDS-3		WLDS-4		WLDS-5		SEREF-1		SEREF-2		SEREF-3		SREF-1	
			Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PAHs (UG/KG)																
1-Methylnaphthalene	L	90120	5.5	U	16	J	4.5	J	4.7	J	2.1	U	2.15	U	1.4	U
2-Methylnaphthalene	L	91576	24	J	17	J	7.1	J	6.9	J	2.75	U	2.8	U	1.85	U
Acenaphthene	L	83329	16	J	55		5.1	J	1.95	U	1.9	U	1.9	U	2.8	J
Acenaphthylene	L	208968	90		24		16	J	1.6	U	1.5	U	1.5	U	4.9	J
Anthracene	L	120127	410		120		28		18		10	J	8.3	J	8.4	J
Benzo(a)anthracene	H	56553	1400		220		120		79		58		44		37	
Benzo(a)pyrene	H	50328	1300		200		140		110		86		67		46	B
Benzo(b)fluoranthene	H	205992	1600		220		180		120		100		77		46	
Benzo(g,h,i)perylene	H	191242	650		81		72		77		64		50		31	
Benzo(k)fluoranthene	H	207089	720		87		70		47		40		32		20	
Chrysene	H	218019	1500		230		140		100		79		62		46	
Dibenz(a,h)anthracene	H	53703	180		34	B	32	B	19	B	15	JB	12	JB	7.2	JB
Fluoranthene	H	206440	2400		360		190		150		110		85		54	
Fluorene	L	86737	25	J	78		8.5	J	8.7	J	4	U	4.05	U	2.65	U
Indeno(1,2,3-cd)pyrene	H	193395	1200		120		100		140		110		88		48	B
Naphthalene	L	91203	42	J	13	J	3.35	U	3.4	U	3.25	U	3.3	U	2.15	U
Phenanthrene	L	85018	140		380		61		68		35		30		24	
Pyrene	H	129000	2700		450		240		120		89		67		48	
Total LMW PAHs	*L*		*753*		*703*		*134*		*113*		*61*		*54*		*48*	
Total HMW PAHs	*H*		*13650*		*2002*		*1284*		*962*		*751*		*584*		*383*	
Total PAHs			*14403*		*2705*		*1418*		*1075*		*812*		*638*		*431*	

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Analyte		CAS Number	REFERENCE									
			SREF-2		SREF-2-DUP		SREF-3		SWREF-1		SWREF-2		SWREF-3	
			Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
PAHs (UG/KG)														
1-Methylnaphthalene	L	90120	1.5	U	1.6	U	1.4	U	1.25	U	1.15	U	1.3	U
2-Methylnaphthalene	L	91576	1.9	U	2.1	U	1.8	U	1.6	U	1.5	U	1.7	U
Acenaphthene	L	83329	4.2	J	1.4	U	1.2	U	1.1	U	1	U	1.15	U
Acenaphthylene	L	208968	13		11	J	1	U	4.2	J	2.7	J	3.3	J
Anthracene	L	120127	24		9	J	6.2	J	6.6	J	5	J	4.1	J
Benzo(a)anthracene	H	56553	98		51		37		40		23		21	
Benzo(a)pyrene	H	50328	120		75		43	B	46	B	33	B	25	B
Benzo(b)fluoranthene	H	205992	130		81		39		53		38		33	B
Benzo(g,h,i)perylene	H	191242	72		50		25		19		16		18	
Benzo(k)fluoranthene	H	207089	44		36		17		16		16		11	
Chrysene	H	218019	110		70		44		45		29		20	
Dibenz(a,h)anthracene	H	53703	18	B	14	B	5.4	JB	11	B	8.3	JB	4.8	JB
Fluoranthene	H	206440	140		92		44		48		42		29	
Fluorene	L	86737	2.8	U	3	U	2.6	U	2.35	U	2.2	U	2.5	U
Indeno(1,2,3-cd)pyrene	H	193395	120		97		43	B	33	B	26	B	24	B
Naphthalene	L	91203	2.25	U	2.45	U	2.1	U	1.9	U	1.8	U	2	U
Phenanthrene	L	85018	47		40		11		14		19		10	
Pyrene	H	129000	140		81		42		52		41		26	
Total LMW PAHs	*L*		*97*		*71*		*27*		*33*		*34*		*26*	
Total HMW PAHs	*H*		*992*		*647*		*339*		*363*		*272*		*212*	
Total PAHs			*1089*		*718*		*367*		*396*		*307*		*238*	

Notes:
x - Not a NOAA18 congener.
B - Detected in equipment blank.
H/HMW - High Molecular Weight.
J - Estimated.
L/LMW - Low Molecular Weight.
M – Indicates that the flagged compound did not meet DoD criteria in the Matrix Spike and/or Matrix Spike Duplicate prepared and/or analyzed concurrently with the native sample.
NA - Not Analyzed.
PAHs - Polycyclic Aromatic Hydrocarbons.
PCBs - Polychlorinated Biphenyls.
TOC - Total Organic Carbon.
U - Not Detected (reported at 1/2 method detection limit).
Totals calculated using 1/2 the method detection limit for non-detects.
Total PCBs calculated as the sum of the 18 NOAA congeners multiplied by 2.

Appendix C

Common Conversions

APPENDIX C

Common Conversions

Metric	English
Area	
1 Square Kilometer (km^2)	247.12 Acres
Length	
1 Kilometer (km)	0.62 Miles (mi)
1 Kilometer (km)	0.54 Nautical Miles (nmi)
1 Meter (m)	3.28 Feet (ft)
1 Centimeter (cm)	0.39 Inches (in)
Volume	
1 Cubic Meter (m^3)	35.31 Cubic Feet (ft^3)
1 Cubic Meter (m^3)	1.31 Cubic Yards (yd^3)