FHWA-NJ-2015-001

State Channel Maintenance Capacity

FINAL REPORT
January 2015

Submitted by

B. Steven Howard
Senior Geospatial Analyst
Stockton College

Daniel A. Barone
Director of Research
Stockton College

Kimberly K. McKenna
Coastal Geologist
Stockton College

NJDOT Research Project Manager
Paul Thomas

In cooperation with

New Jersey
Department of Transportation
Bureau of Research
And
U.S. Department of Transportation
Federal Highway Administration

DISCLAIMER STATEMENT

The contents of this report reflect the views of the author(s) who is (are) responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the New Jersey Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

TECHNICAL REPORT
STANDARD TITLE PAGE

1. Report No.	2.Government Accession No.	3. Recipient's Catalog No.
FHWA NJ-2015-001		

4. Title and Subtitle	5. Report Date
State Channel Maintenance Capacity	January 2015
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
B. Steven Howard, Daniel A Barone, and Kimberly McKenna	

9. Performing Organization Name and Address	10. Work Unit No.
Richard Stockton College Coastal Research Center 30 Wilson Ave. Port Republic NJ 08241	11. Contract or Grant No.

12. Sponsoring Agency Name and Address		13. Type of Report and Period Covered
New Jersey Department of Transportation PO 600 Trenton, NJ 08625	Federal Highway Administration U.S. Department of Transportation Washington, D.C.	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The New Jersey Department of Transportation/Office of Maritime Resources (NJDOT-OMR), Richard Stockton College of New Jersey Coastal Research Center (CRC), and Ocean and Coastal Consultants (OCC) investigated the utilization of dredged holes in New Jersey's coastal bays for the dual benefit of restoring degraded habitat and alleviating shoaling of nearby navigation channels through the beneficial use of dredged material.

This study created a geodatabase containing a total number of 122 dredged hole features that were identified and delineated from aerial photography, navigation charts, and previous investigations. Of the 46 features visited during field reconnaissance, three were previously investigated as part of a pilot study (Bass River and both Drag Island sites [Barone et al., 2013]), 28 received a basic site visit, 10 were surveyed as candidate sites and 5 were identified and surveyed as priority sites. Candidate sites were deep enough to warrant a bathymetric survey, benthic grab sample and bottom water quality reading at the deepest location within the dredged hole during the reconnaissance field survey. Priority dredged holes were identified from the candidate dataset as those that provide the greatest opportunities for the placement of dredged material to improve degraded marine habitat while continuing to maintain navigation channels to support commercial and recreational economies. Field visits of the priority sites consisted of more extensive water quality, sediment, submerged aquatic vegetation, and benthic analyses.

The project team recommends five priority dredged holes for potential habitat restoration (18 [USACE 18], 25, 78, 86 [USACE 34], and 93). Water quality surveys and benthic grab samples confirm that hypoxia (dissolved oxygen content of less than 2mg/l) is occurring in these dredged holes and that the benthic habitat is azoic. Through the placement of dredged material the bottom elevation of these dredged holes can be increased to shallower depths that do not facilitate the stratification of the water column and subsequent stagnation and hypoxia of the waters in these features. An engineering feasibility analysis was completed by OCC for each priority site to identify appropriate dredged material placement methodologies and the need for any pre-placement dredging or engineering.

17. Key Words	18. Distribution Statement
Dredged Holes, Subaqueous Borrow Pits, Habitat Restoration, Dredged Material, Channel Maintenance	

19. Security Classif (of this report)	20. Security Classif. (of this page)	21. No of Pages	22. Price
Unclassified	Unclassified	94	

Form DOT F 1700.7 (8-69)

ACKNOWLEDGMENTS

The authors wish to thank staff members from the New Jersey Deparmtent of Transportation Ofiice of Maritime Resources, Scott Douglas and Genevieive Clifton; staff from the Stockton College Coastal Reseach Center, Alex Ferencz, Marcus Gruver and Mat Suran; Mathew Dalon from Ocean and Coastal Consultants, and Mark Davis from the Office of Dredging & Sediment Technology, without whom this rewrite would not have been possible.

Executive Summary

Subaqueous borrow pits, or dredged holes, are common submerged features within the bays and estuaries of New Jersey's Ocean, Atlantic, and Cape May counties. Based on aerial photography investigation and findings by Murawski (1969), the features are former sediment borrow pits that were excavated in the early to mid-1900's as sources for construction of upland areas, roads and bridges, former railroad beds, or for beach replenishment following the 1962 Ash Wednesday storm. Depths of these features are well below the surrounding bayfloor and many have limited water circulation that has negatively affected benthic habitat.

The New Jersey Department of Transportation/Office of Maritime Resources (NJDOT-OMR), Richard Stockton College of New Jersey Coastal Research Center (CRC), and Ocean and Coastal Consultants (OCC) investigated the utilization of dredged holes in New Jersey's coastal bays for the dual benefit of restoring degraded habitat and alleviating shoaling of nearby navigation channels through the beneficial use of dredged material. This study created a geodatabase containing a total number of 122 dredged hole features that were identified and delineated from aerial photography, navigation charts, and previous investigations. Field reconnaissance was performed on varying levels for 46 of these features. Of the 46 visited, three were previously investigated as part of a pilot study (Bass River and both Drag Island sites [Barone et al., 2013]), 28 received a basic site visit, 10 were surveyed as candidate sites and 5 were identified and surveyed as priority sites. Candidate sites were identified during the reconnaissance field surveys and are defined as deeper than 18 feet measured by the on-board depth sounder. Candidate sites were deep enough to warrant a bathymetric survey, benthic grab sample and bottom water quality reading at the deepest location within the dredged hole during the reconnaissance field survey. After consultation with the study partners, Priority dredged holes were identified from the candidate dataset as those that provide the greatest opportunities for the placement of dredged material to improve degraded marine habitat while continuing to maintain navigation channels to support commercial and recreational economies. Field visits of the priority sites consisted of more extensive water quality, sediment, submerged aquatic vegetation, and benthic analyses.

Based on the dredged material capacity analysis for the 10 candidate and five priority dredged holes, the sum of the capacity volumes below -12ft MLW, -16ft MLW, and -18ft MLW are 2,258,609 cubic yards, 1,183,655 cubic yards, and 808,929 cubic yards, respectively. The deepest dredged hole reached depths of -57.4ft mean low water (MLW).

The project team recommends five priority dredged holes for potential habitat restoration (18 [USACE #18], 25, 78, 86 [USACE #34], and 93). These dredged holes provide opportunities for the dual benefit of restoring habitat and alleviating shoaling of nearby navigation channels. Water quality surveys and benthic grab samples confirm that hypoxia (dissolved oxygen content of less than 2mg/l) is occurring in these dredged holes and that the benthic habitat is azoic. Through the placement of dredged material the bottom elevation of these dredged holes can be increased to shallower depths that do not facilitate the stratification of the water column and subsequent stagnation and hypoxia of the waters in these features. An engineering feasibility analysis was completed by OCC for each priority site to identify appropriate dredged material placement methodologies and the need for any pre-placement dredging or engineering.

Though priority sites have been identified, many non-priority sites may offer opportunities for dredged material placement and habitat restoration, particularly if permit requirements are established to allow restoration of dredged holes to shallower depths than previous restoration efforts. Nearly all candidate sites have the potential to be classified as priority sites as field reconnaissance surveys have reported azoic benthic conditions. The discriminating factors in classifying these sites as priority were largely based on the reconnaissance surveys not documenting hypoxic dissolved oxygen levels during the reconnaissance survey and limited available capacities calculated from bathymetric survey data (if filled to -18ft MLW). Continuous or more frequent water quality monitoring is recommended to document hypoxia in many of these features as benthic grab samples indicate that these dredged holes are experiencing hypoxia for extended periods of time.

Contents

LIST OF FIGURES

LIST OF TABLES

Introduction

Federal, state, and private channels within New Jersey's bay waters provide sheltered travel for smaller vessels and pleasure craft in the relative safety of bays that lie landward of the barrier coastline. These channels include a network of two upland canals, 11 tidal inlets, and over 110 miles of shore-parallel bay water passages. The New Jersey Intracoastal Waterway (NJIWW) that is part of this bay-wide network is managed by the US Army Corps of Engineers (USACE). State channels are managed by the New Jersey Department of Transportation/Office of Maritime Resources (NJDOT-OMR). Currently, conventional placement areas for sediments dredged from New Jersey's waterways are in upland placement sites known as Confined Disposal Facilities (CDF). Both agencies share a great need for dredged material placement sites as their designated CDFs are nearing capacity. This need grows as private marine facilities, local channels, and residential lagoons require dredging; especially in the aftermath of Hurricane Sandy where it is estimated that shoaling increased across all State channels by an average of 20%, for a total of over 3.3 million cubic yards (Parsons Brinckerhoff, 2013).

One solution for addressing the need for dredged material placement is to utilize the former subaqueous borrow pits or "dredged holes" that are found throughout the New Jersey bay-wide system. These holes were excavated in the early to mid-1900's as sediment borrow sites for construction of upland areas, roads and bridges, former railroad beds, or for beach replenishment following the 1962 Ash Wednesday storm (which was the storm of record for New Jersey until the passage of Hurricane Sandy). Some of the holes exceed 40-feet in water depth and have been found to contain an inadequate oxygen supply for local fisheries to thrive (Barone et al., 2013; Murawski, 1969). Murawski (1969) revealed that these areas are notoriously hypoxic environments (low dissolved oxygen levels) which to do not support healthy marine habitats due to stagnation and stratification of water within them.

Utilizing dredged holes for the placement of dredged material presents a dual benefit of improving degraded marine habitat while maintaining navigation channels to support commercial and recreational economies. This report Identifies potential dredged holes throughout New Jersey's coastal bays and classifies ten dredged holes as candidate and five as priority sites. For these sites, additional information was collected on water quality, sediment composition, and invertebrate and submerged aquatic vegetation (SAV) and the results support the placement of dredged material to improve habitat.

Research Objectives

Research objectives included:

- Identify dredged holes and develop a dredged hole database.
- Complete a literature review and collection of existing information related to location, history, current status, and any other required data and identify candidate sites (approximately 20) for further evaluation in collaboration with the NJDEP and NJDOT-OMR.
- Survey candidate dredged holes utilizing a single-beam echosounder and real time kinematic (RTK) global positioning system (GPS).
- Complete candidate site analysis (maximum depth, capacity, and access).
- Perform biological and water quality surveys for approximately five identified dredged hole sites:
    - Using a YSI 6600 multipart water quality sampler to determine dissolved oxygen content, temperature, pH, and salinity in each feature.
    - Take a benthic grab sample at each water quality sampling location and visually assess the sample for benthic community structure as well as sediment composition.

Previous Work and Literature Review

Table 1 includes a list of previous studies that pertain to dredged holes located within New Jersey's coastal bays and estuaries. The table provides a compilation of the major data sources and includes studies of, water quality, suitability for habitat and environmental restoration at several locations. The findings from some of the former studies are discussed in the appropriate sections of this report.

The earliest study of dredged holes in New Jersey was by Murawski (1969) who evaluated water quality parameters and invertebrate captures from 38 dredged holes to determine appropriateness for finfish habitat. The study found that 21 of the 38 dredged holes could not sustain healthy fish life and the reasons provided were that many of the dredged holes were too deep, were exposed to poor quality ground water, or contained abnormally high amounts of detritus. These findings were the first indications that the bottoms of the dredged holes were considered degraded habitat. Two of the Murawski (1969) sites, Dredged Holes #5 and #6 were resurveyed in 1992 and selected for a pilot study by the New Jersey Department of Environmental Protection (NJDEP) for habitat restoration in Barnegat Bay (USACE and NJDEP, 2003). Water and sediment quality, fisheries, and benthic studies showed that Dredged Hole #6 contained degraded habitat and that partial filling could increase productivity and not adversely affect fish populations (Versar, 2000). Using dredged sands from nearby Double Creek Channel, the US Army Corps of Engineers Philadelphia District raised the bottom elevation of Dredged Hole #6 from -38ft (-11.6m) MLW to a depth of -18ft (-5.5m) MLW with the placement of approximately 125,000 cubic yards of sand. The project was completed in February 2005 (Reine et al., 2012). After completion, Dredged Holes #5 and #6 were monitored for impacts to sediment and water quality, and benthic and fishery resources (Reine et al., 2012). Results from the monitoring found similar fishery resource assemblages in both the filled (Dredged Hole #6) and non-filled (Dredged Hole #5) sites and no summertime water column stratification that would induce hypoxic or anoxic water quality conditions. Reine and others (2012) concluded that the partial filling of former dredged holes could benefit fishery resources.

The USACE and NJDEP also identified deep dredged holes along the NJ Intracoastal Waterway (NJIWW) for potential habitat restoration (USACE, 2009). Murawski-numbered Dredged Holes #34 and #35 (in the bays of Atlantic and Ocean Cape May counties) were found to contain degraded habitat and it was recommended to fill the holes to a depth that would support aquatic life. An environmental assessment of existing habitat conditions comprised a significant component in permitting for the restoration of these dredged holes. Versar (2002) applied several methods to assess habitat in Dredged Hole #35 to facilitate permitting of its use by the NJDEP and USACE. These methods included: (1) assessing water quality (dissolved oxygen, temperature, pH, salinity and turbidity), (2) sampling for hydrogen sulfide, (3) sieving of grab samples to classify benthic organisms, (4) 48 hours of continuous water quality monitoring to assess diel changes, (5) finfish surveys, and (6) chemical and grain size analysis of sediment within the dredged hole. As a result of these analyses, Dredged Hole #35 was found to display degraded habitat (Versar, 2002) and was selected for the placement of dredged sediments from the NJIWW near Ocean City and filled to depth of -19ft (USACE, 2010). For Dredged Hole #34, the restoration plan with the greatest benefit to habitat was filling to a depth of -19 feet from the water surface. A project management plan is under development for the site. It is feasible for the site to be filled using sands dredged from the NJIWW near Atlantic City (USACE, 2014), but no action is planned or has been taken.

In 2013, the Richard Stockton College of NJ, Coastal Research Center (CRC) completed a pilot study for the NJDOT-OMR and NJDEP of two dredge holes: the Bass River dredged hole near New Gretna in Burlington County and the Drag Island dredged hole near Somers Point in Cape May County. The purpose of the project was to provide a reconnaissance survey of the submerged extent of the feature, bathymetry, water quality at varying depths, and an estimate of the capacity of the feature if it were to be filled to a depth that would be favorable for fishery habitat (Barone et al., 2013). Unfortunately, deed restrictions and potential habitat concerns excluded the Bass River site for dredged material placement and the habitat within the Drag Island dredged hole was not considered degraded (Table 1).

Table 1, Previous studies that pertain to dredged holes located within the submerged sections of New Jersey's coastal bays and estuaries.

REFERENCE	GEOGRAPHIC AREA	DATA TYPE
Murawski, 1969	Manasquan River to Ludlam Bay	depth, water quality, benthic invertebrates
Farrar & Burton, 1999 (in USACE&NJDEP, 2009)	bays and NJIWW in Atlantic and Cape May counties	water & sediment quality
Versar, 2000	Barnegat Bay, Great Thorofare, Crook Horn Creek	water quality, winter fish & crab surveys
Bruce, Slacum, & Scott, 2002 (in USACE, 2010b)	Little Egg Inlet to Cape May Canal	vibracores, sediment & water quality, benthic invertebrates
Cox, 2003	bays and NJIWW in Atlantic and Cape May counties	reconnaissance study of cultural resources
USACE & NJDEP, 2003	Barnegat Bay (dredged holes #5 & #6)	summary of results from water quality, fisheries & benthic surveys; project alternatives
USACE, 2005	Barnegat Bay (dredged hole #6)	project fact sheet
USACE & NJDEP, 2009	bays and NJIWW in Atlantic and Cape May counties	integrated environmental assessment; presentation of management alternatives; appendices contain info from former environmental & dredging studies
USACE, 2010	dredged hole #35 Cape May county	review of previous testing results, existing conditions, and project alternatives
USACE, 2011	dredged hole #35 Cape May county	project fact sheet
Reine et al, 2012	Barnegat Bay (dredged holes #5 & #6)	post-fill monitoring results
Barone and others, 2013	bays in Burlington and Cape May counties	depth, water quality
USACE, 2014	dredged hole #34 Atlantic county	project fact sheet

Methods

Dredged Hole Identification and Delineations

The CRC completed a literature review and collection of existing information related to dredged hole location, history, current status, and any other available data. The majority of the pre-existing detailed information for dredged holes within New Jersey's coastal waterways was provided by the USACE and NJDEP.

All of the existing data from the referenced reports were combined with dredged hole delineations identified by the CRC staff in ESRI's geographic information system (GIS) software, ArcGIS, through the use of aerial photography and navigation charts. ArcGIS was used to populate a geodatabase with the dredged hole information provided by the USACE and those identified by the CRC. Digital and paper maps were produced that showed the locations of the dredged holes, coastal channels, and thorofares and were used to support discussions and decisions by the project working group that was comprised of staff from NJDOT-OMR, NJDOT-Bureau of Research, Ocean and Coastal Consultants, and the CRC.

Dredged hole identification numbers, classifications, and index map are provided in the Dredged Hole Index in Appendix A.

Field Visited Selection, Candidate and Priority Site Selection

Criteria for a dredged hole to be considered for a field visit included:

- Clearly defined in vertical and oblique aerial photography
- Previously identified by USACE & NJDEP
- Proximity to state navigation channel
- Sufficient acreage (qualitative assessment)
- Dredging need in vicinity of suspected dredged hole

Candidate sites were identified during the reconnaissance field surveys and are defined as deeper than 18 feet measured by the on-board depth sounder. Candidate sites were deep enough to warrant a bathymetric survey, benthic grab sample and bottom water quality reading at the deepest location within the dredged hole during the reconnaissance field survey. The -18ft (-5.5m) water depth threshold was chosen from discussions with the project working group regarding sufficient space for potential fill placement and previous studies that recommend dredged holes be filled to an elevation of -18ft MLW (USACE 2003; USACE, 2009; USACE 2010).

After the *candidate sites* were identified, *priority sites* were chosen from discussions of findings from field reconnaissance and bathymetric surveys with the project working group. The *priority sites* were determined to be the most suitable for dredged material placement considering the following criteria:

- Capacity of dredged hole to receive dredged material for proximal state channels.
- Dissolved oxygen levels displaying degraded conditions at the bottom (hypoxic levels - less than 2 mg/l – measured in the field).
- Degraded benthic environment conditions based on field grab samples.
- State navigation channel dredging needs proximal to a dredged hole.

Field Data Collection

Field visits of the *candidate* dredged hole locations were completed to gain a general understanding of the depth and extent of the hole, water quality, and biological features. Data collection for candidate sites included a bathymetric survey and single water quality and benthic grab sample within the feature. *Priority* dredged holes were selected from candidate sites and had additional data datasets which include in-depth water quality surveys and benthic grab sampling and mapping of SAVs in the area if previous data did not exist.

Bathymetric Surveys

Bathymetric surveys were conducted along approximately 80ft (25m) transect lines extending across each GIS-delineated candidate dredged hole and overlapped the feature by a minimum of 325ft (100m) where possible. Data were collected in Hypack hydrographic survey software using an Odom single-beam echosounder combined with an Odom Hydrotrac and a Leica Geosystems RTK-GPS System 1200. An ESRI shapefile and accompanying geodatabase were created to house this information. All surveying

techniques and processes were overseen and monitored by the CRC licensed surveyor for quality assessment and quality control.

Water Quality Surveys

Dissolved oxygen (mg/l & percent), temperature (degrees Celsius), pH, salinity (ppt), and turbidity Nephelometric Turbidity Units (NTU) were recorded using a Yellow Springs Instrument (YSI) 6600 multi-parameter data logger. Following initial reconnaissance field visits to determine if a site warranted a bathymetric survey (based on initial depth readings from an on-board depth sounder), a single water quality reading from the deepest location within the dredged hole was collected at holes with sufficient depth. Initial field visits were conducted in fall 2013 and winter 2014. Bathymetric surveys and single water quality readings were completed at all candidate sites. For the five chosen priority dredged holes, more in-depth water quality readings were collected. For each priority site, water quality data were collected at one-meter intervals at three locations along the long axis of each site, with one of the locations being in the deepest portion of the feature and the other two locations representing different depths. In order to collect information at varying depths within the dredged hole, data sampling locations were determined using GIS and bathymetric survey data. Bathymetric and water quality data were also recorded at an additional location outside of the feature and used as a reference. If water quality readings at the time of data collection showed that the dredged hole was not experiencing anoxic (total depletion of oxygen) or hypoxic (defined as < 2 mg/l dissolved oxygen) conditions, additional field visits were conducted in in the summer and fall of 2014 to evaluate water quality.

Benthic Grab Samples

Benthic samples were obtained using a hand-deployed Ponar grab sampler. Visual determinations of the grain size and presence of benthic fauna and/or flora were completed during the field survey. Photographs were taken of each sample.

SAV Mapping

Presence of submerged aquatic vegetation (SAV) within 100 meters was assessed for only the five priority sites and are discussed in the Results section of Dredged Holes 78, 86, and 93 in this report (page 31). Previous studies have mapped the extent of SAV in Barnegat Bay and the datasets were used by CRC staff to evaluate SAV presence for specific dredged hole locations (CRSSA, 2009). However, SAV have not been mapped for other areas in the state of New Jersey and CRC staff were required to map SAV in the vicinity of priority dredged holes outside of Barnegat Bay using the Submersed Aquatic Vegetation Early Warning System Jr. (SAVEWS Jr.) mapping methodology (Sabol et al., 2014).

CRRSA 2009 SAV Mapping - Dredged Holes 18 and 25

The areal extent and density of SAV in Barnegat Bay was mapped by the Rutgers University Center for Remote Sensing and Spatial Analysis (CRRSA) in 2009, providing GIS layers of the extent of SAV separated into three classes based on density of coverage (CRSSA, 2009). The CRRSA 2009 datasets were analyzed in GIS to determine the presence of SAV within 100m of the priority dredged holes in Barnegat Bay: Dredged Holes 18 and 25.

SAVEWS Jr.

Automated processing of digital echo sounder data is an effective means in determining the presence of SAV as well as depth and canopy characterization SAV (Sabol et al., 2014). The original methodology and system components that comprised the digital echo sounder system for detection and characterization is known as SAVEWS, developed by the US Army Engineer Research and Development Center (ERDC) and released in 2001 (Sabol et al., 2002). Since the original development of SAVEWS advances in marine electronics have allowed consumer grade electronics to replace many of the specialized components of SAVEWS. A second generation of SAVEWS was released in 2012, SAVEWS Jr., utilizing consumer grade marine electronics and a new signal processing code adapted to calibrate and interpret dual frequencies simultaneously broadcasted by newer consumer grade echo sounders (Sabol et al., 2014).

SAVEWS Jr. was operated by CRC field staff conducting parallel transects with a vertically-aimed echosounder integrated with a Wide Area Augmentation System (WAAS) enabled GPS and coordinated with tide level observations. The recorded data stream is post processed to generate position referenced attributes including depth, canopy height, and percent cover, to a selected horizontal coordinate system and vertically corrected for tides and transducer depth (Molly et al., 2012) (Sabol et al., 2014).

Species discrimination is possible with SAVEWS Jr. when large differences in canopy characteristics are measured and species present in a water body are known (Sabol et al., 2014). Sabol and others (2005, 2008) demonstrated the ability of SAVEWS to differentiate between eelgrass (*Zostra marina*) from macroalgae based on canopy height. More buoyant species of SAV (i.e. *Zostra marina*) have a greater acoustic reflectivity then less buoyant species of SAV or macroalgae (i.e. *Ulva lactuca*) (Sabol et al., 2002).

SAVEWS Jr. Survey Methodology – Dredged Holes 78, 86, and 93

Current extents of SAV have not been recently mapped or characterized in the vicinity of priority dredged holes 78, 86, and 93 which are located in Atlantic County near Steelman Bay , Turtle Gut , and Patcong Creek , respectively. SAVEWS Jr. was used to determine the presence of SAV within 325ft (100m) of each of these priority sites and if present characterize canopy height and percent coverage. Surveys were conducted from September 9 through September 12, 2014 with a control survey of a known SAV bed near Barrel Island (in Barnegat Bay Ocean County) on September 23, 2014 during high tide to allow for greater access to shallow areas (Figure 1). Survey transects were spaced approximately 75ft (23m) apart and a drop camera was deployed at 9 to 15 locations, depending on the size of the area being surveyed, for quality assurance and to determine species present. Tidal observations were obtained by taking observations of the water level with an RTK GPS approximately every 15 minutes.

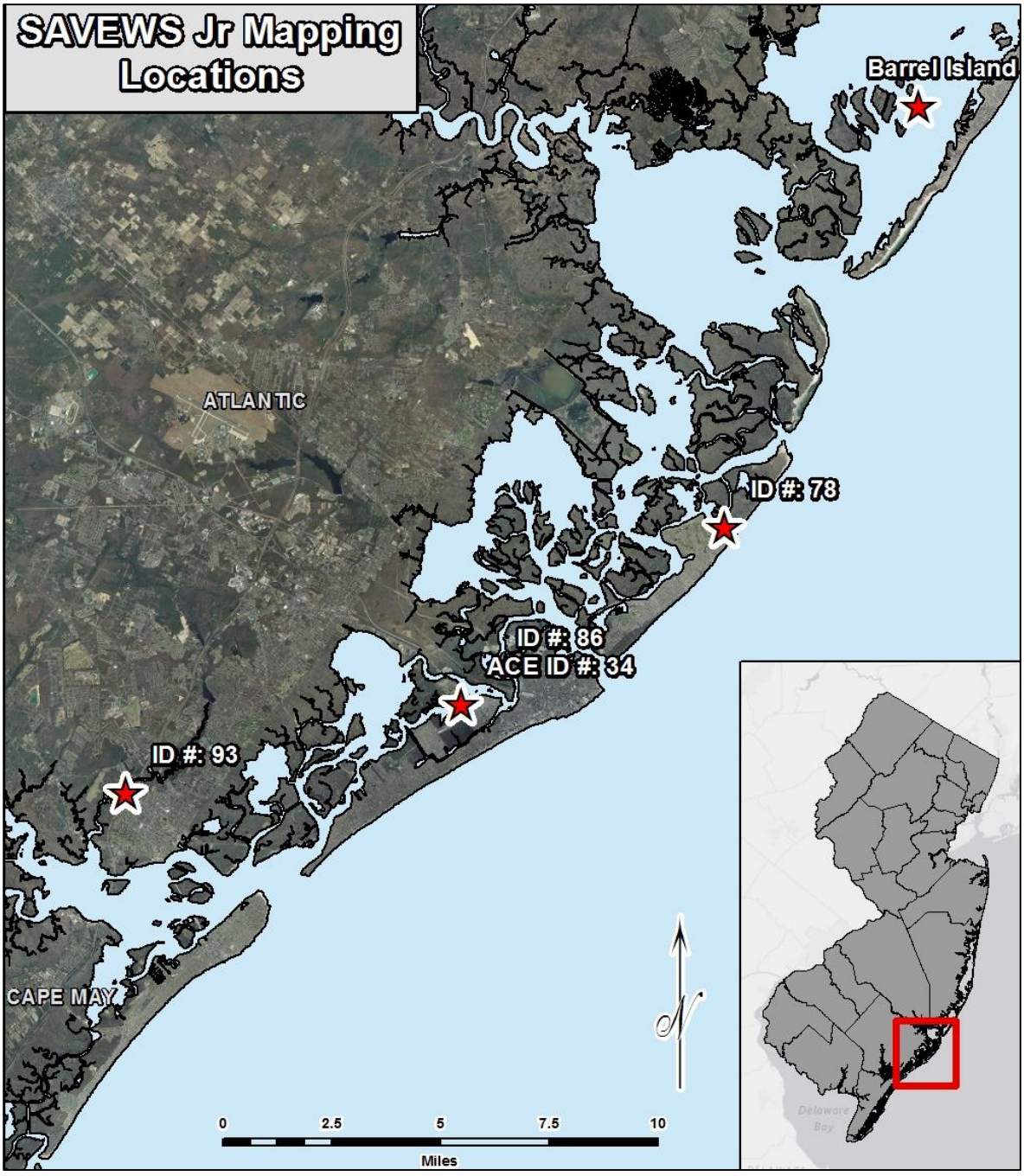


Figure 1, SAVEWS Jr. methodology was used to map SAV in the vicinity of Dredged Holes 78, 86, and 93. Known SAV beds were mapped at Barrel Island as a control site.

SAVEWS Jr. Data Analysis

Acoustic data was processed to obtain SAV canopy height, and density, along surveyed transects horizontally referenced to New Jersey State Plane (US feet) and vertically referenced to the 1988 North American Vertical Datum (NAVD88). Canopy height was primarily used to distinguish occurrences of SAV with the aid of visual inspection of the echogram. Sabol and others (2005) found a canopy height threshold of 1ft (0.3m) greatly reduced false occurrences of SAV detection caused by macroalgae. The

canopy height threshold for detection of SAV presence was set to greater than 0.5ft (0.15m) as a conservative threshold for SAV detection, despite the higher probability for false detections of SAV due to macroalgae and significant elevation relief which were later identified by visual inspection of echograms. Acoustically detected canopy heights are not considered a true canopy height due to currents and water levels altering measured heights. However, surveys were generally performed within an hour of high tide when are currents are were slack or reduced and SAV canopies are were near their greatest height, adding to the conservative canopy height threshold. When visually inspecting colorized echograms produced by SAVEWS, SAV was identified by a contiguous vertical echo return immediately above the bottom, which is weaker than the bottom return but stronger than ambient water column noise as indicated by Sabol (2002)and interpreted in the control survey.

Outputs of this processing stage included cross sections of bottom depth and canopy superimposed over a colorized echogram (Figure 2 and Figure 3) aligned with plots of canopy height and percent coverage for each transect and a comma delimited file containing records for each processed observation containing northing and easting as well as SAV attributes.

Data generated from SAVEWS Jr. were analyzed in a geographic information system (GIS) to assess spatial distribution of SAV within the vicinity of dredged holes 78, 86, and 93. Comma delimited files containing canopy height and density at specific locations were converted to GIS feature classes and used to generate grids to interpolate canopy height. The statistical interpolation method of kriging using the exponential model and a search radius of 96 points was used as the most effective way to interpolate canopy height in a GIS in accordance with findings by Guan (1999). Echograms were checked to verify the processed outputs and identify false occurrences due to improper bottom tracking, potential for macroalgae canopy greater than 0.5ft (0.15m), and other factors. Video from drop cameras provided a means for verifying visual interpretations of echograms.

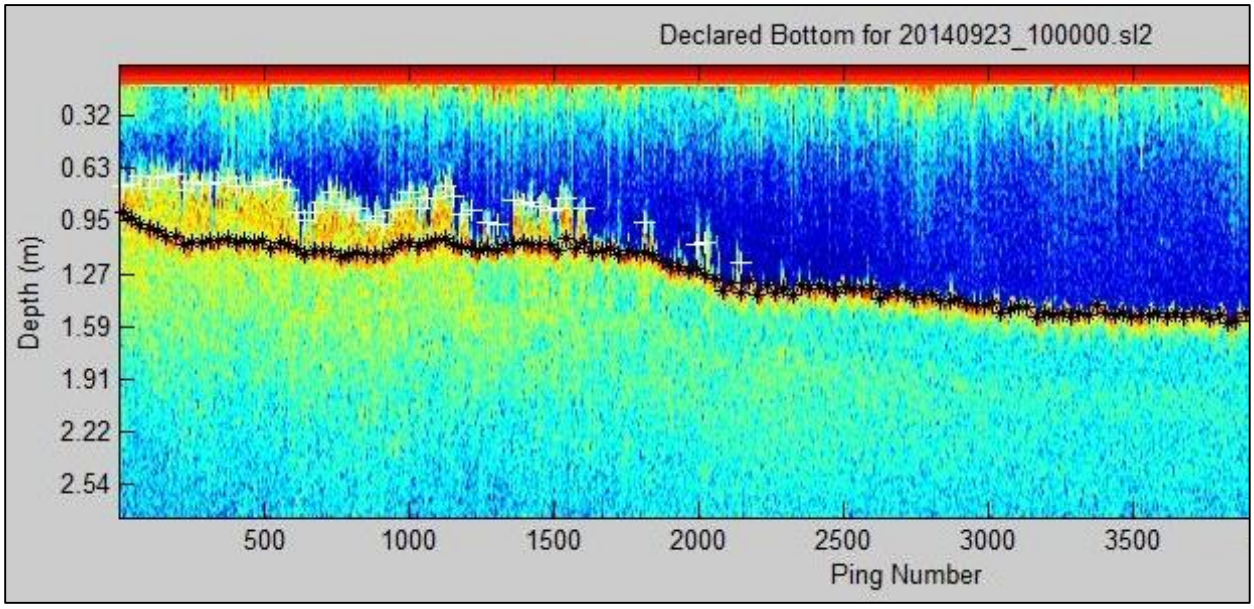


Figure 2, Colorized echogram of known SAV bed near Barrel Island, Beach Haven, NJ (see Figure 1 for location). Bottom detection is symbolized by black stars and the SAV detection is symbolized by white crosses at the top of the canopy. High reflectivity is symbolized by warmer red and yellow colors while lower reflectivity is symbolized by cooler blue colors. Zostra marina is present from ping number 0 through approximately ping 1200 where it becomes sparse through ping 2000 where it no longer becomes present. High acoustic reflectivity of Zostra marina is evident in the red and yellow colors where it is detected.

SAV is also evident in this echogram due to the contiguous vertical echo return immediately above the bottom, which is weaker than the bottom return (partially covered by black stars) but stronger than ambient water column noise.

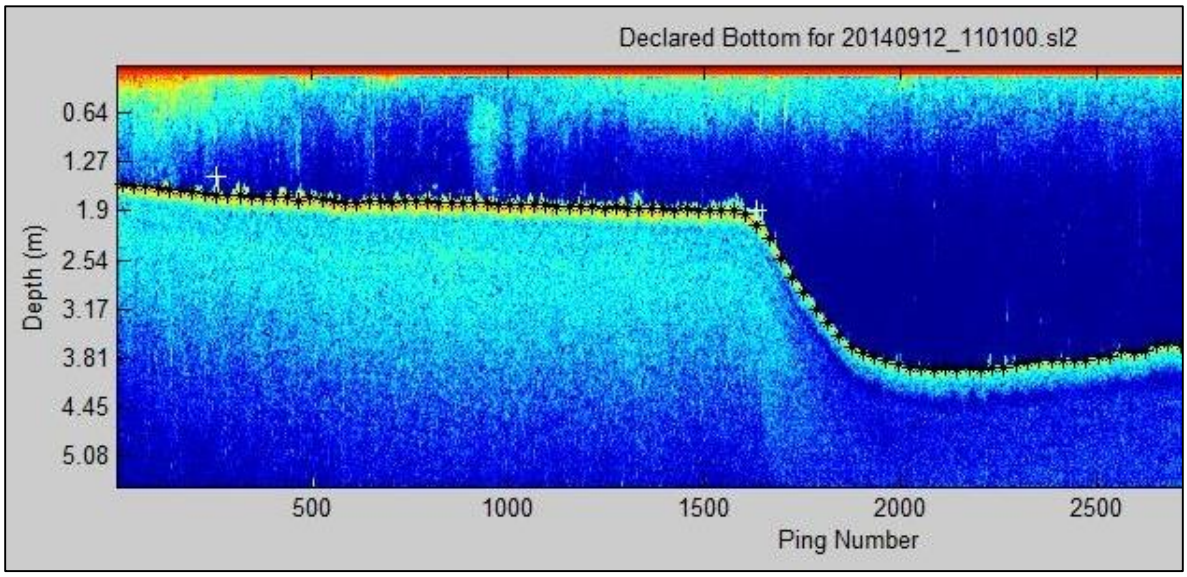


Figure 3, Colorized echogram from SAVEWS Jr. Bottom detection is symbolized by black stars and the SAV detection is symbolized by white crosses at the top of the canopy. High reflectivity is symbolized by warmer red and yellow colors while lower reflectivity is symbolized by cooler blue colors. False occurrences using canopy height to detect SAV occurrences tend to occur in areas of steep drop offs as seen near ping 1600 with a single detection of SAV indicated by a white cross. Macroalgae can be seen as low areas of weak reflectivity just above the bottom. In some instances macroalgae canopies are above the canopy height threshold and a false occurrence of SAV is present as seen near ping 300. When visually compared to the characteristics of known SAV occurrences as seen in the echogram in Figure 2 and drop camera video used to verify similar instances and echograms from other transects, it is evident the location near ping 300 is a false occurrence of SAV.

Candidate Site Analysis

Capacity for Dredged Material

To determine the dredged material capacity for each candidate site, one-foot Digital Elevation Model (DEM) rasters were created in ArcGIS by interpolating bathymetric data collected during field research activities using Triangulated Irregular Network (TIN) surfaces. Using the 3-D Analyst extension in ArcGIS software, the "Surface Volume" tool was implemented to calculate the volume of material needed to fill a dredged hole below a specified elevation plane. Several sediment volumes were calculated at various elevation planes to understand the range of capacity at each candidate site at various depths. The elevation planes used to calculate capacity at each candidate site were:

- -12ft MLW
- -16ft MLW
- -18ft MLW

All volume calculations for each candidate site were exported to the attribute table within the dredged hole geodatabase.

Boat/Barge Access Depth

Using Quick Terrain (QT) Modeler software, DEMs for each candidate site were examined to determine what depth a boat/barge could access a given dredged hole. The flood analysis tool in QT Modeler was used to incrementally raise the water surface elevation (in 3-D) from the dredged hole's maximum depth until the DEM of the dredged hole and surrounding area displayed a "channel" (below the water surface elevation) of the shortest distance and deepest access to each site from an exterior channel. Access depths for each candidate site were exported to the attribute table within the dredged hole geodatabase.

Maximum Depth

The maximum depth for each candidate site was calculated in ArcGIS from bathymetric data using the "Zonal Statistics" tool in the Spatial Analyst extension. Dredged hole delineation polygons and corresponding DEMs representing bathymetry were used as input in the zonal statistics tool to calculate the minimum raster cell values (or maximum depth) within each dredged hole polygon, or "zone." Maximum depth values were exported to the attribute table within the dredged hole geodatabase.

Candidate Dredged Hole Service Area

For this project, a dredged hole's service area is defined as the mileage of state navigation channels (whole or partial channels) that fall within three miles of a dredged hole polygon's center point (or centroid). The three-mile range is a basic "rule of thumb" distance limit for pumping dredged material from a project area to a placement site. This basic analysis was performed in ArcGIS using the built-in Geoprocessing Tools to create three-mile buffers around dredged hole centroids. Then using the state navigation channel polyline feature class provided by the NJDOT, the buffers were used to clip the channel polylines within three-miles of the dredged holes and exported to a new polyline feature class. Using the "calculate geometry" function within the clipped polyline feature class's attribute table, the length (in miles) of each clipped channel polyline was calculated. The sum of all polyline mileage within each three-mile dredged hole buffer was calculated using the "Summary Statistics" tool. The candidate dredged hole service area mileages were exported to the attribute table within the dredged hole geodatabase.

Results

A total number of 122 features were delineated in GIS for this project. Of those 122 features, 46 were visited and 76 were not visited. Of the 46 visited features, three were previously investigated as part of a pilot study (Bass River and both Drag Island sites (Barone et al., 2013)), 28 received a basic site visit, 10 were surveyed as candidate sites and 5 were identified and surveyed as priority sites (more extensive water quality testing).

Based on the dredged material capacity analysis for the 10 candidate and five priority dredged holes, the sum of the capacity volumes below -12ft MLW, -16ft MLW, and -18ft MLW are 2,258,609 cubic yards, 1,183,655 cubic yards, and 808,929 cubic yards, respectively (
Table 2).

Table 2. Individual and summary results for the capacity for dredged material analysis within candidate and priority sites below -12 MLW, -16 MLW, and -18 MLW.

USACE ID	Dredged Hole ID	Capacity Below -12 MLW (yds^3)	Capacity Below -16 MLW (yds^3)	Capacity Below -18 MLW (yds^3)
18	*18*	69,930	28,703	11,852
37	*61*	282,456	131,054	78,250
34	*86*	494,928	399,418	357,091
24	*83*	18,311	7,751	4,506
NA	*25*	104,638	27,067	4,328
NA	*118*	47,022	3,948	160
NA	*90*	154,497	53,962	25,022
NA	*85*	151,118	67,612	35,259
NA	*89*	347,742	158,330	92,547
NA	*78*	136,733	68,066	42,806
NA	*54*	317,123	187,615	132,818
NA	*59*	95,930	39,161	19,477
NA	*55*	21,423	5,926	2,334
NA	*95*	5,354	545	4
NA	*93*	11,404	4,497	2,475
	Total (yds^3)	**2,258,609**	**1,183,655**	**808,929**

The total serviceable area provided within three miles of the candidate and priority dredged holes includes approximately 113 miles of 111 state navigation channels (Table 3).

Table 3. Individual and summary results for the serviceable area analysis.

USACE ID	Dredged Hole ID	No. of Channels within 3 miles	Serviceable Channel Length (miles)
18	*18*	16	12
37	*61*	12	9
34	*86*	4	5
24	*83*	5	7
NA	*25*	17	16
NA	*118*	7	4
NA	*90*	4	6
NA	*85*	4	7
NA	*89*	4	5
NA	*78*	2	4
NA	*54*	6	4
NA	*59*	11	9
NA	*55*	11	7
NA	*95*	4	10
NA	*93*	4	9
	Total	**111**	**113**

The individual results for the five priority and 10 candidate dredged holes can be found below.

The results for the *priority sites* include:

- Maximum depth (MLW)
- Area (Acres)
- Minimum draft of vessel (MLW)
- Capacity at -12ft MLW, -16ft MLW, and -18ft MLW
- Digital Elevation Model (DEM) representing bathymetry
- Water quality survey results
- Benthic grab sample results
- SAV analysis results
- Serviceable channel analysis

The results for the *candidate sites* include:

- Maximum depth (MLW)
- Area (Acres)
- Minimum draft of vessel (MLW)
- Capacity at -12ft MLW, -16ft MLW, and -18ft MLW
- Digital Elevation Model (DEM) representing bathymetry
- Benthic grab/bottom water quality sample results
- Serviceable channel analysis

Priority Dredged Holes

Dredged Hole 18 (USACE 18)

Description

Max Depth	-22.6ft MLW
Area	9.0 Acres
Minimum Draft	-6.1ft MLW

Capacity Below -12ft MLW	69,930 yds^3
Capacity Below -16ft MLW	28,703 yds^3
Capacity Below -18ft MLW	11,852 yds^3

Dredged Hole 18 is located in Brick Township, Ocean County. It is evident this feature is a former subaqueous borrow site due to the atypical depths (-22.6ft MLW [-6.8m]) and steep slopes, the presence of a small saltmarsh island encroaching on the dredged hole in the 1920 aerial photographs, and mild cuspate boundary of the feature created by a dredge cutter head. The habitat within this dredged hole is considered degraded. Water quality and benthic grab samples taken during the 2013 and 2014 site visits indicate that the benthic habitat within this feature is azoic due to extended periods of hypoxic conditions.

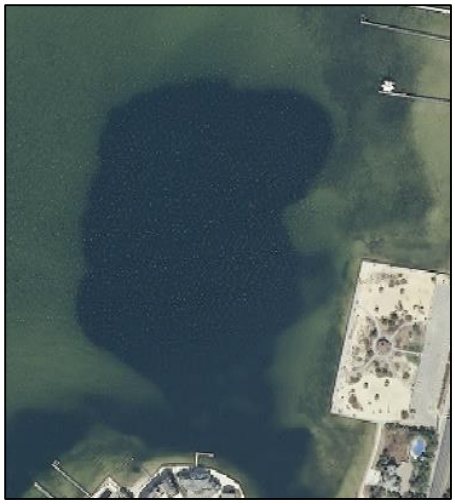


Figure 4, Dredged Hole 18 is evident in 2012 aerial photography as a dark blue area surrounded mainly by shallow sand flats.

Digital Elevation Model

Bathymetric data collected by the CRC on October 24th, 2013 was used to create the DEM for Dredged Hole 18 and the surrounding area (Figure 5). The deepest portion of the dredged hole is located in the northern portion of the feature with depths reaching -22.6ft (-6.8m) MLW. Steep banks surround the dredged hole where depths rapidly rise from -22ft (-6.7m) MLW to depths of the surrounding bay floor near -4ft (1.2m) MLW.

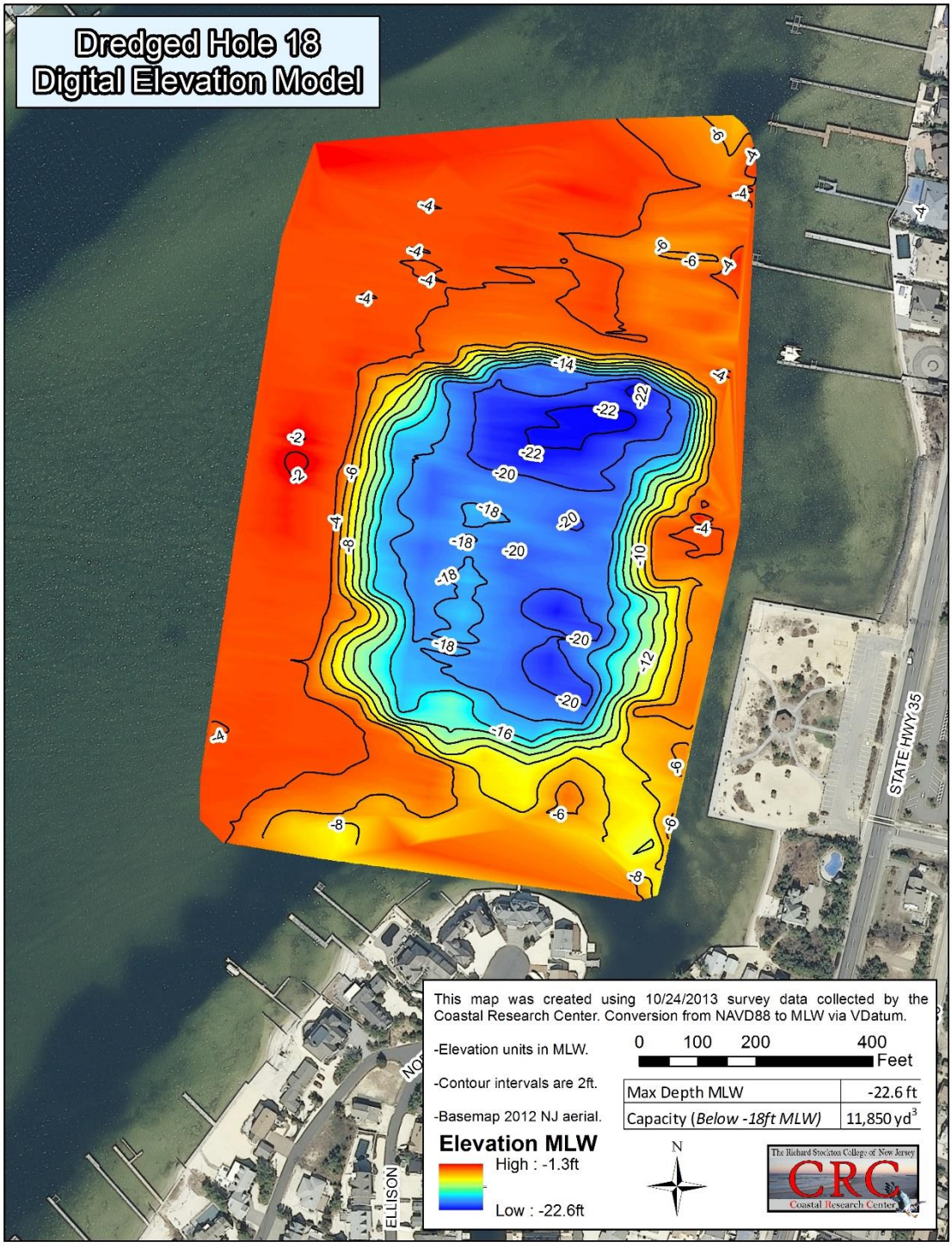
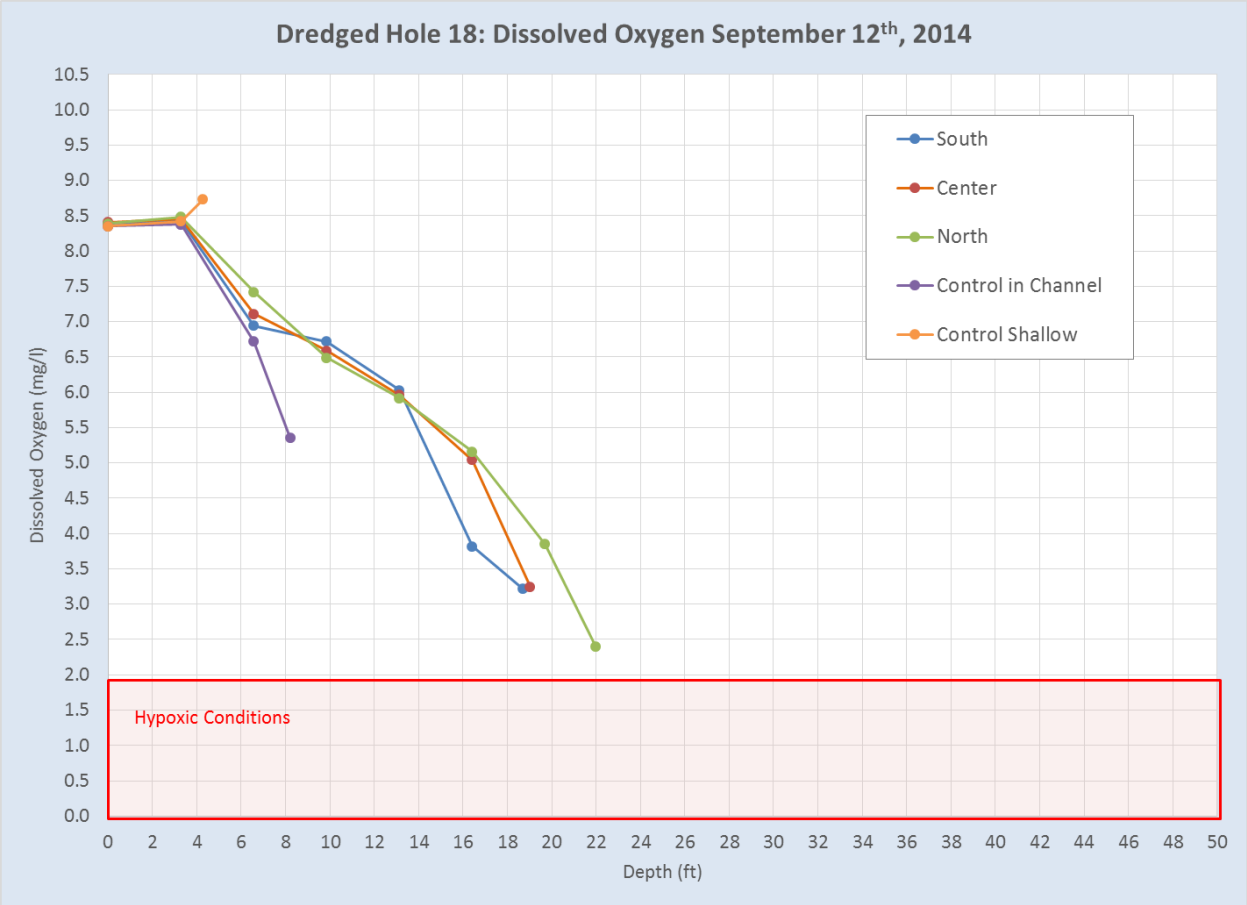

Dredged Hole 18
Digital Elevation Model
STATE HWY 35
ELLISON
This map was created using 10/24/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.
-Elevation units in MLW.
-Contour intervals are 2ft.
-Basemap 2012 NJ aerial.
0 100 200 400
Feet
Max Depth MLW -22.6 ft
Capacity (Below -18ft MLW) 11,850 yd3
Elevation MLW
High : -1.3ft
Low : -22.6ft
N
The Richard Stockton College of New Jersey
CRC
Coastal Research Center

Figure 5

Water Quality Survey

Three separate water quality surveys were performed on Dredged Hole 18 (August 7, 2014, September 12, 2014 and October 28, 2014) and a single observation of dissolved oxygen content at the deepest section of the feature during the bathymetric survey on October 24, 2013. During the September and October (2014) surveys, the dissolved oxygen content was significantly less than the control sites and decreased rapidly with water depth to near hypoxic conditions. The lowest observed dissolved oxygen content at this site was near hypoxic with a reading of 2.4 mg/l during the September survey. Additionally, surveys displayed a distinct increase in salinity of ~3.5 ppt that occurred between 3 and 9ft (1 and 3 meters) and ~4.5ppt between 6.5 and 13ft (2m and 4m), respectively, during the September and October (2014) surveys. Additionally, Murawski (1969) found anoxic conditions at the bottom of this dredged hole during his 1969 investigation.



Benthic Grab Sampling

At each of the five water quality sampling locations in Dredged Hole 18 (three in the interior of the feature and two controls outside) benthic grab samples were taken using a hand-deployed Ponar grab sampler and visually inspected for the presence of SAV and benthic organisms during the August 7, 2014 water quality survey. All three interior benthic grab samples taken within the dredged hole were azoic and smelled of hydrogen sulfide. The samples were mainly comprised of black mud with some plant debris present in two of the samples. The shallow control sample (depth of 1m) contained grey sand with plant debris and the control in the channel contained black sandy mud with black stained plant debris and few pebbles. No SAV or macroalgae were present in any samples.

Figure 6. The grab sample from the deepest (north) sampling location. Grab samples within Dredged Hole 18 were mainly comprised of black mud with some plant debris present in two of the samples.

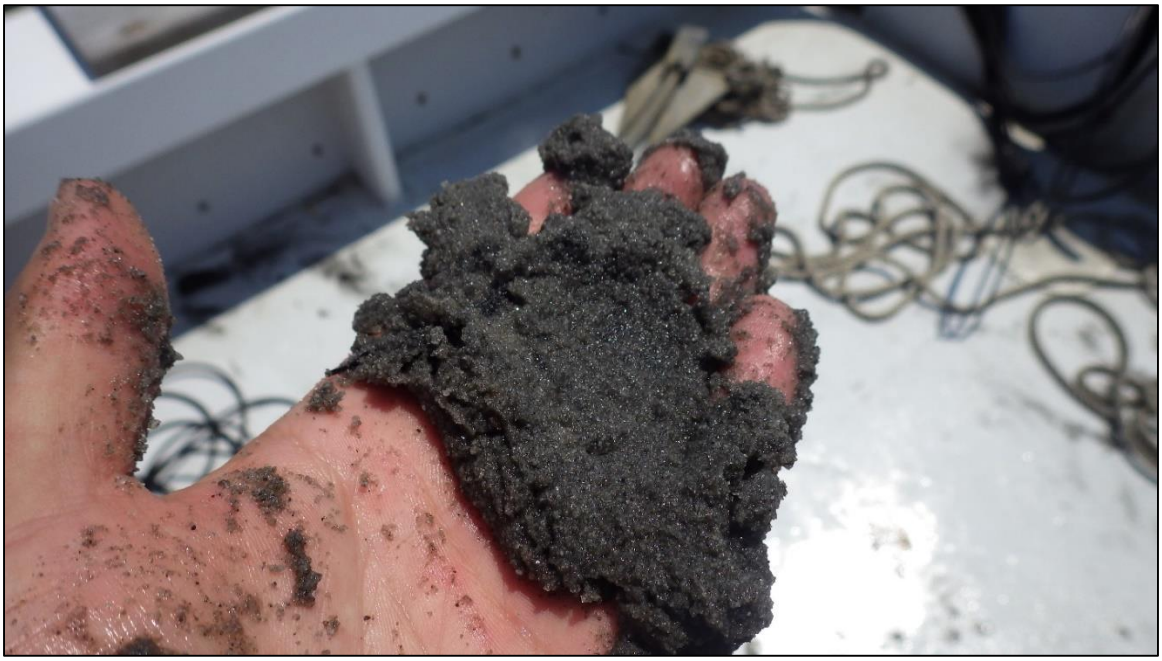


Figure 7, The shallow control sample (depth of 1m) for Dredged Hole 18 contained grey sand with plant debris.

SAV Presence

Dredged Hole 18 falls within the coverage area of the 2009 SAV areal extent and density mapping efforts by Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA, 2009). The nearest mapped SAV to Dredged Hole 18, occurred over 1,500 ft (457m) to the southwest.

Serviceable Channels

Dredged Hole 18 can service 13.07 miles (21km) of state channels within a three-mile (4.8km) radius from a total of 18 different state channels. There are 12 state channels that lie completely within the three mile radius of Dredged Hole 18 (Table 4), and six additional state channels are partially within the three mile radius (Table). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 4

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
56	*Gunners Ditch*	*1.15*
61	*Winter Yacht Basin*	*0.13*
62	*Havens Cove*	*0.87*
63	*Seaweed Cove Entry*	*0.43*
64	*Seaweed Cove*	*0.08*
65	*Mantoloking - Curtis Point Le*	*0.12*
66	*Mantoloking 2 - Dutchmans*	*0.49*
67	*Mantoloking 3*	*0.26*
68	*Mantoloking - Curtis Point*	*0.23*
69	*Mantoloking 4*	*0.48*
72	*Andrews Point*	*0.80*
75	*Chadwick Beach Channel*	*0.32*
	Total Mileage	***5.36***

Table 5

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
55	*Beaver Dam Buoy Channel*	*0.06*
60	*Metedeconk River*	*0.56*
71	*Kettle Creek*	*1.85*
74	*Silver Bay Entrance*	*0.89*
76	*Lavallette Beach Channel*	*2.55*
77	*Ocean Beach Channel*	*1.80*
	Total Mileage	***7.71***

Dredged Hole 25

Description

Max Depth	-20.5ft MLW
Area	18.7 Acres
Minimum Draft	-7.5ft MLW

Capacity Below -12ft MLW	104,638 yds^3
Capacity Below -16ft MLW	27,067 yds^3
Capacity Below -18ft MLW	4,328 yds^3

Dredged Hole 25 is located west of the Borough of Lavallette, Ocean County. Lavallette Beach Channel defines the southern and eastern extents of this feature. Clearly defined cusps created by a dredge can be seen on the boundary in the 2012 aerial photograph (Figure 8). These cusps and the atypical depths -20.5ft (-6.2m) MLW and steep banks are evidence that Dredged Hole 25 is a former subaqueous borrow pit. Water quality and benthic grab samples indicate benthic habitat in Dredged Hole 25 is azoic and hypoxic for long periods of time.

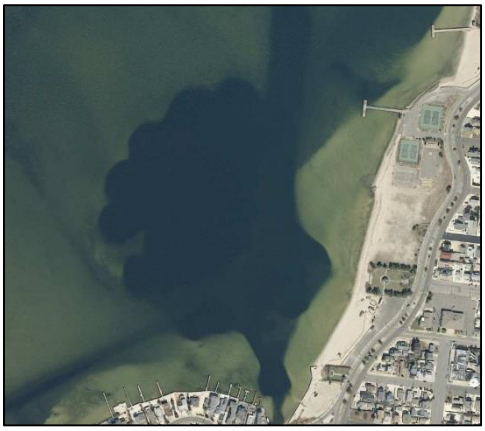


Figure 8, A cuspate boundary created by a dredge can be seen on the northern and eastern limits of Dredged Hole 25 in 2012 aerial photograph. Lavallette Beach Channel can be seen on the bottom left of the image running along the south and east border of the dredged hole and out to the center of the image.

Digital Elevation Model

Bathymetric data collected by the CRC on October 22nd, 2013 was used to create the DEM for Dredged Hole 25 and the surrounding area (Figure 9). The deepest portion of the dredged hole is located in the southern section of the feature with depths reaching -20.5ft (-6.2m) MLW. Lavallette Beach Channel is located to the north and south and is currently at a depth of -6ft to -8ft (-

1.8 to -2.4m) MLW adjacent to the dredged hole. With the exception of Lavallette Channel, steep banks encircle the dredged hole where depths rapidly rise from -20ft (6m) MLW to depths of the surrounding bay floor near -4ft (1.2m) MLW.

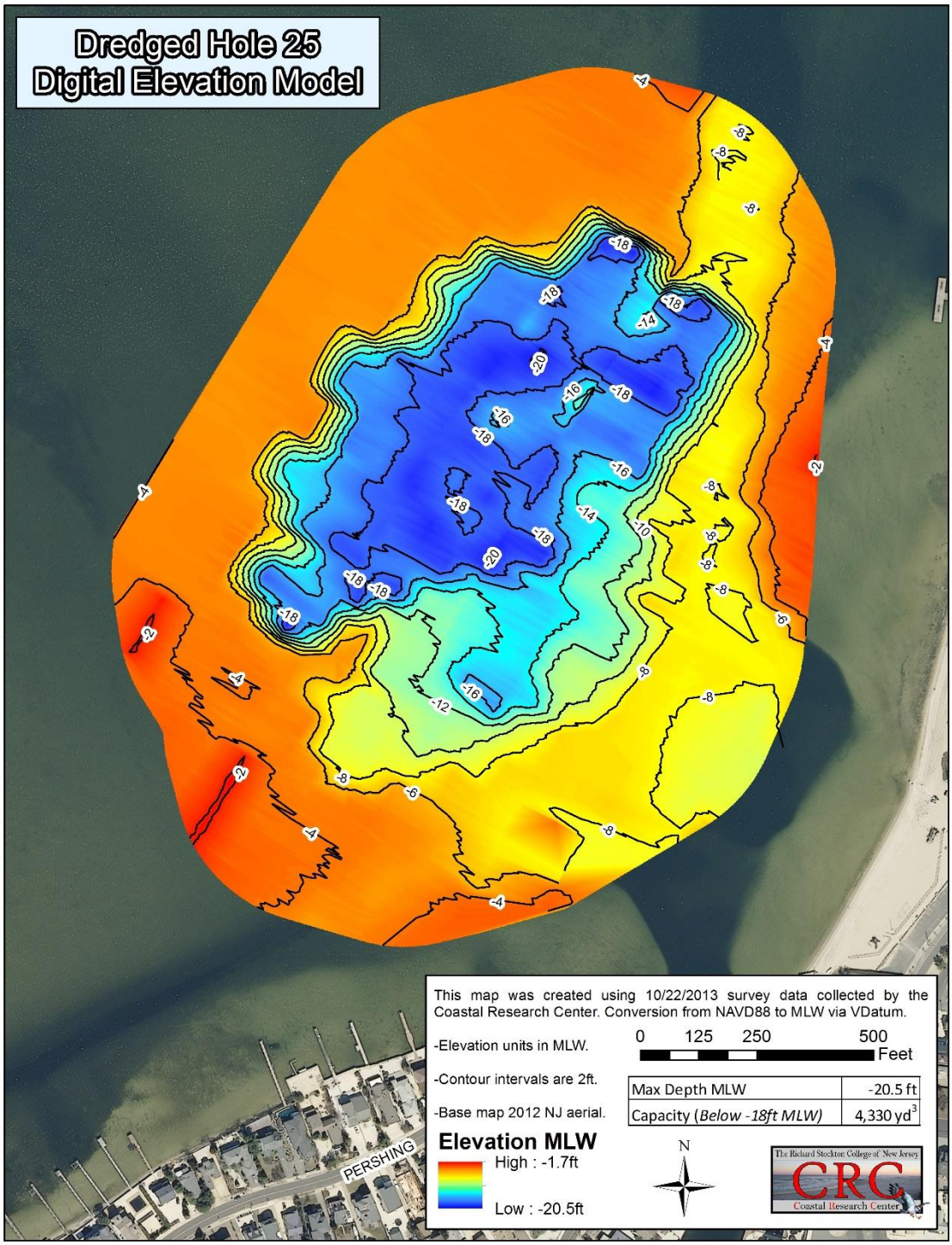
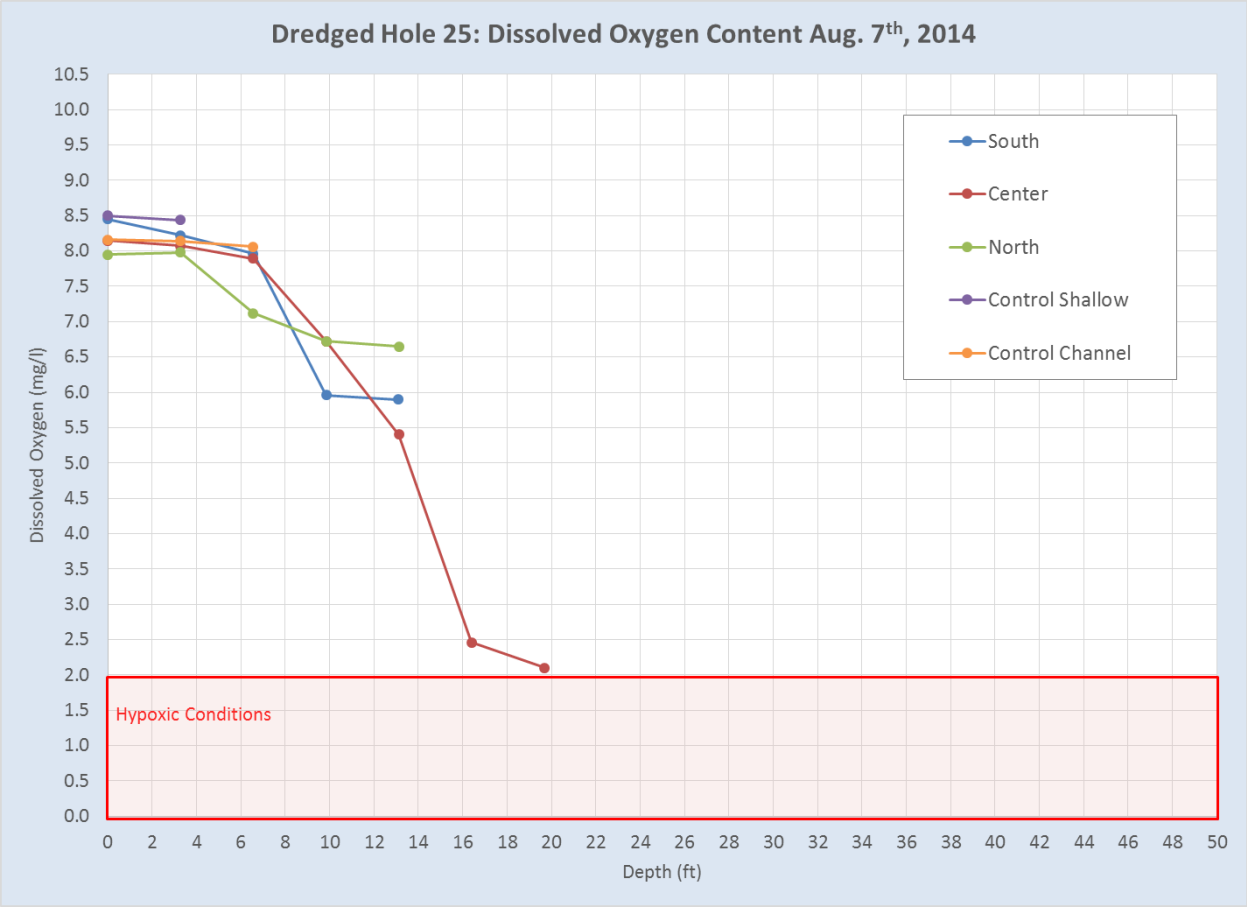


Figure 9

Water Quality Surveys

Three separate water quality surveys were performed on Dredged Hole 25 (August 7, 2014, September 12, 2014 and October 28, 2014) and a single observation of dissolved oxygen content at the deepest section of the feature during the bathymetric survey on October 22, 2013. This series of water quality surveys indicate that Dredged Hole 25 is hypoxic for periods of time and dissolved oxygen content throughout the water column is dynamic. During the October 2013 spot check, Dredged Hole 25 was hypoxic with dissolved oxygen observed at its lowest level of 1.13mg/l. The water column in the dredged hole was stratified during the August 2014 survey and dissolved oxygen content was near hypoxic dropping from 8.15mg/l at the surface to 2.10mg/l at the deepest location. A sharp decline in pH correlated with the decrease of oxygen content during this survey, ranging from 8.1 at the surface to 7.25 at the bottom. However, during the September and October 2014 surveys dissolved oxygen content ranged from 8.1mg/l to 7.4mg/l and 9.5mg/l to 9.1mg/l, respectively, and the water column was not clearly stratified.



Benthic Grab Sampling

During the August 7, 2014 water quality survey of Dredged Hole 25, a benthic grab sample was taken at each of the five sampling locations and visually inspected. The three samples from within the dredged hole contained black mud and black stained plant debris and were found to be azoic. At a depth of one meter, the shallow control sample consisted of grey fine sand, plant and shell debris, a few small pebbles, and a live snail. A control was also taken in the Lavallette Channel near Dredged Hole 25 which was comprised of black/grey sandy mud.

Figure 10, The grab sample from the deepest sampling location in the center of Dredged Hole 25 consisted of black mud and plant debris.

Figure 11, Fine grey sand with plant debris, shell fragments, and a few small pebbles were found at the shallow control sample near Dredged Hole 25.

SAV Presence

Dredged Hole 25 falls within the coverage area of the 2009 SAV areal extent and density mapping efforts by Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA, 2011). A small area of sparse (10% to 40% coverage) SAV is found within 100 meters of the delineation of Dredged Hole 25 (Figure 12).

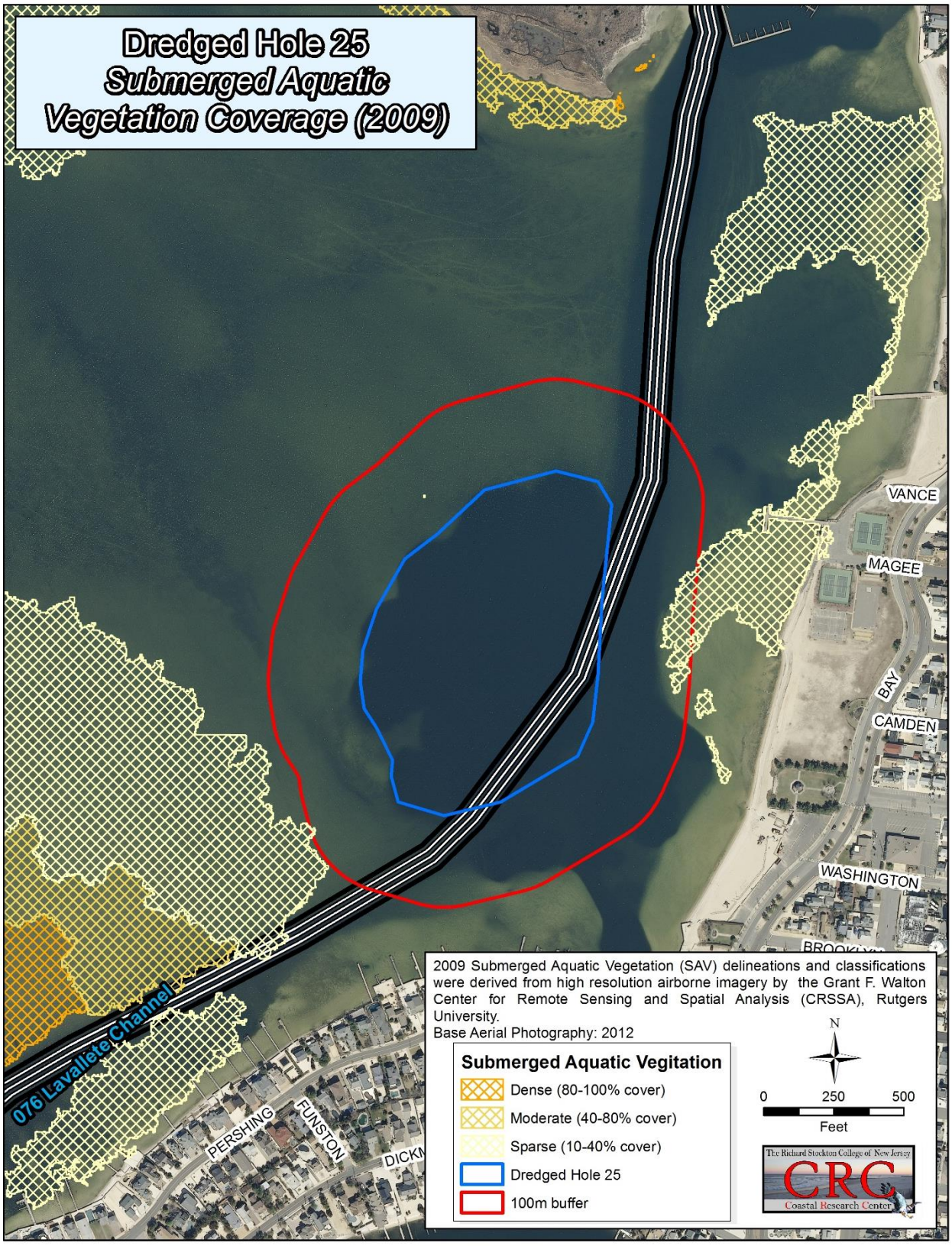

Dredged Hole 25
Submerged Aquatic
Vegetation Coverage (2009)
VANCE
MAGEE
BAY
CAMDEN
WASHINGTON
076 Lavallette Channel
PERSHING
FUNSTON
2009 Submerged Aquatic Vegetation (SAV) delineations and classifications were derived from high resolution airborne imagery by the Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University.
Base Aerial Photography: 2012
Submerged Aquatic Vegitation
Dense (80-100% cover)
Moderate (40-80% cover)
Sparse (10-40% cover)
Dredged Hole 25
100m buffer
N
0
250
500
Feet
The Richard Stockton College of New Jersey
CRC
Coastal Research Center

Figure 12

Serviceable Channels

Dredged Hole 25 can service 16.86 miles (27km) of state channels within a three mile (4.8km) radius from a total of 18 different state channels. There are 13 state channels that lie completely within a three mile radius of Dredged Hole 25 (Table), and five additional state channels are partially within the three mile radius (Table). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 6

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
63	*Seaweed Cove Entry*	*0.43*
64	*Seaweed Cove*	*0.08*
67	*Mantoloking 3*	*0.26*
69	*Mantoloking 4*	*0.48*
75	*Chadwick Beach Channel*	*0.32*
76	*Lavallette Beach Channel*	*5.49*
77	*Ocean Beach Channel*	*2.29*
78	*Lavallette Buoy Channel*	*1.01*
79	*Lavallette Spur - 2*	*0.24*
80	*Lavallette Spur*	*0.10*
81	*Goose Creek*	*1.09*
82	*Pier 1 Channel*	*0.75*
83	*Bay Shore Bridge Channel*	*0.64*
	Total Mileage	***13.18***

Table 7

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
71	*Kettle Creek*	*0.87*
72	*Andrews Point*	*0.71*
74	*Silver Bay Entrance*	*1.34*
84	*Toms River*	*0.56*
89	*Bay Shore Toms river*	*0.20*
	Total Mileage	***3.68***

Dredged Hole 78

Description

Max Depth	-26.4ft MLW
Area	15.0 Acres
Minimum Draft	-7.3ft MLW

Capacity Below -12ft MLW	136,733 yds^3
Capacity Below -16ft MLW	68,066 yds^3
Capacity Below -18ft MLW	42,806 yds^3

Dredged Hole 78 is located northeast of Brigantine, and south of Weakfish Thorofare in Atlantic County. The northern half of the feature borders salt marsh while the southern half is surrounded by shallow flats with the exception of a deeper channel (~-6ft MLW) to the south. In the 1930 aerial photographs, the area where Dredged Hole 78 is located is comprised of saltmarsh, shallow sand/mud flats, and shallow channels. An irregular boundary created by a dredge is evident in 2012 aerial photography (Figure 13). Atypical depths and steep slopes indicate that this feature is a former subaqueous borrow site. Water quality and benthic grab samples indicate that the habitat within this feature is azoic and hypoxic for long periods of time.

Figure 13, Dredged Hole 78 is evident in 2012 imagery by dark blue-green indicating a deep area surrounded by salt marsh and shallow areas.

Digital Elevation Model

Bathymetric data collected by the CRC on October 25, 2013 was used to create the DEM for Dredged Hole 78 and the surrounding area (Figure 14). A moderate rise in elevation to -16ft (4.8m) MLW in the center of Dredged Hole 78 divides the feature into two cells that each reach to depths near -26ft (-7.9m). The steep banks of this feature rise abruptly to -2ft (0.6m) MLW in the southern portion of the hole and rise even higher to the elevation of the saltmarsh in the northern portion of the hole.

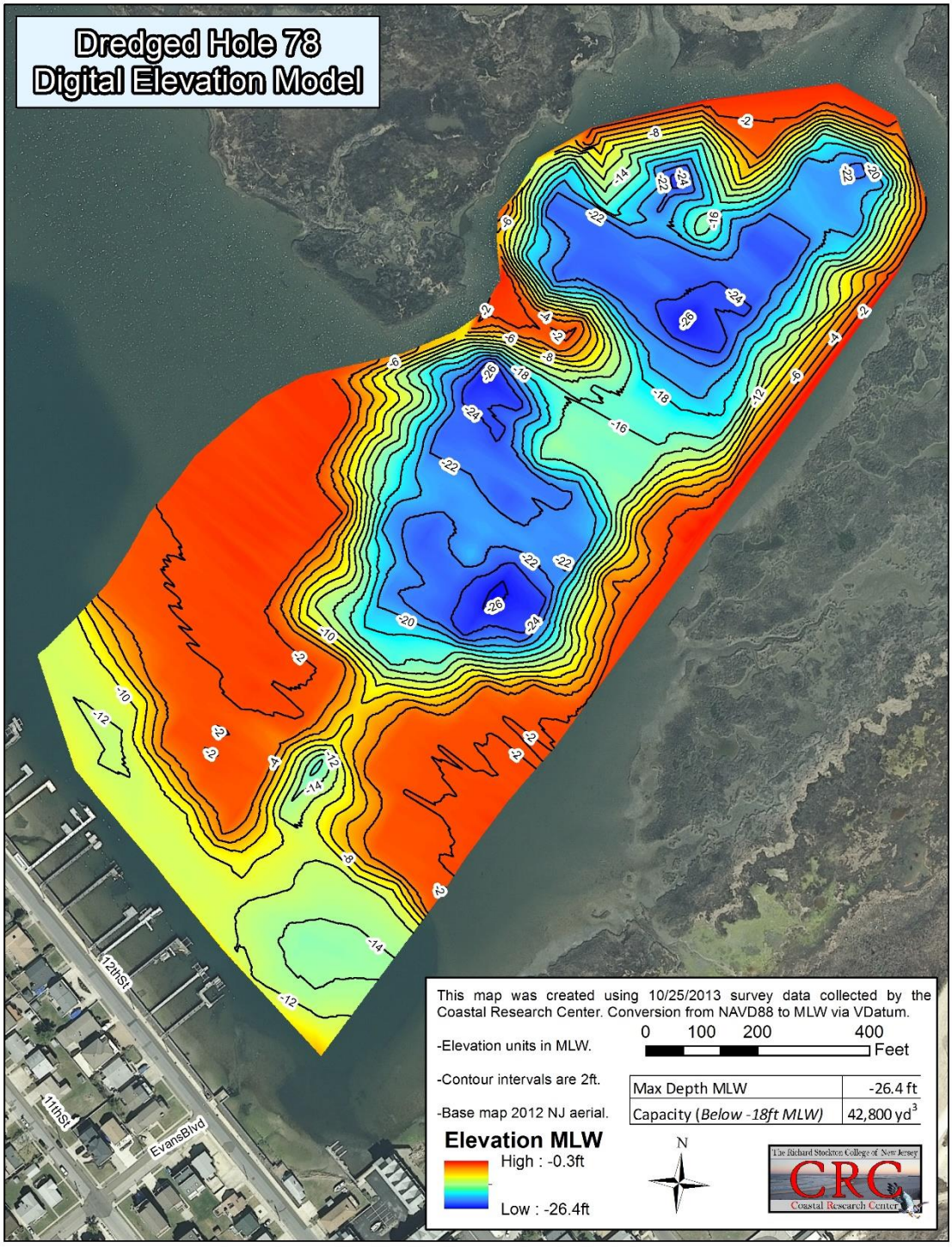
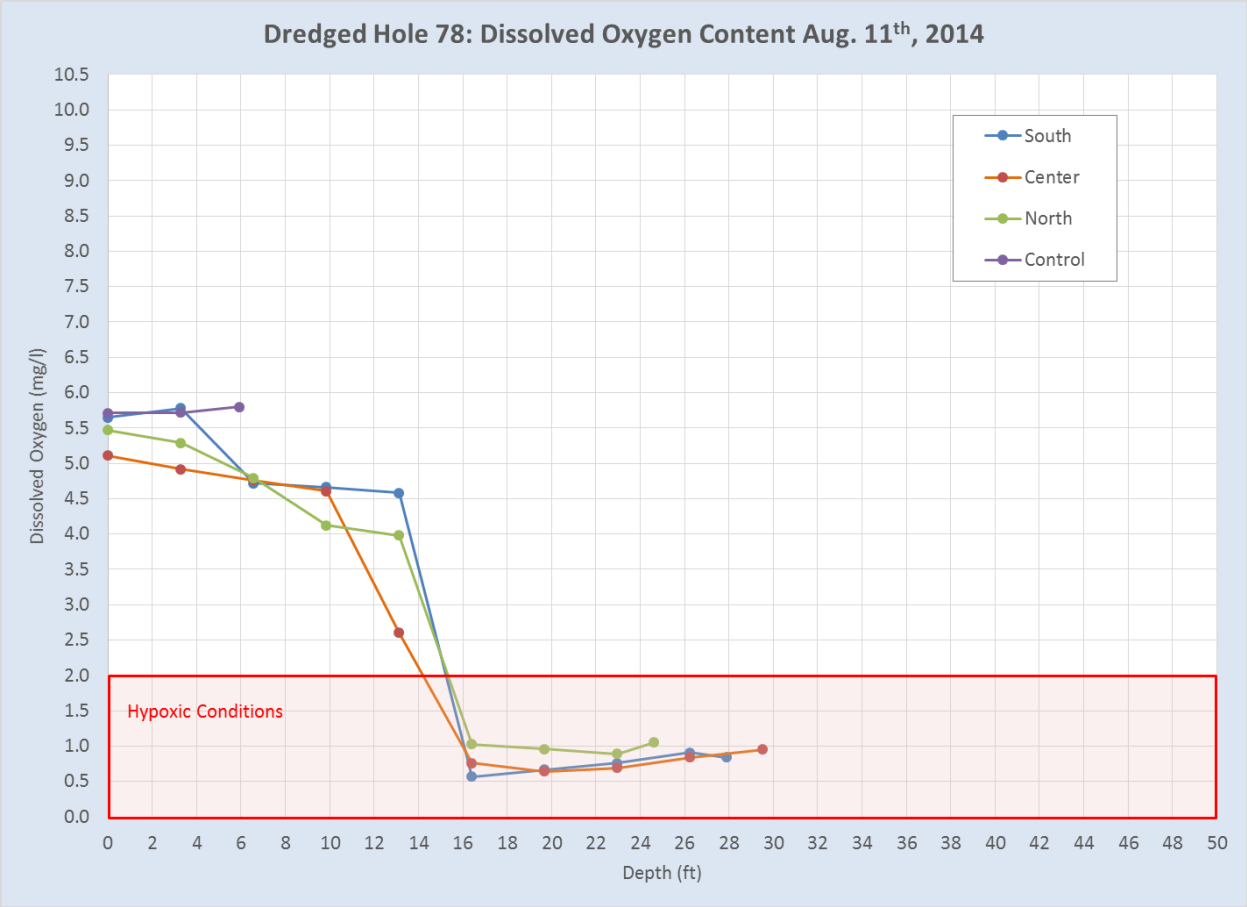

Dredged Hole 78
Digital Elevation Model
This map was created using 10/25/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.
-Elevation units in MLW.
0 100 200 400
Feet
-Contour intervals are 2ft.
-Base map 2012 NJ aerial.
Max Depth MLW -26.4 ft
Capacity (Below -18ft MLW) 42,800 yd3
Elevation MLW
High : -0.3ft
Low : -26.4ft
N
The Richard Stockton College of New Jersey
CRC
Coastal Research Center
12thSt
11thSt
EvansBlvd

Figure 14,

Water Quality Survey

Hypoxic conditions were documented at Dredged Hole 78 during a water quality survey on August 11, 2014. All three sample locations within the feature displayed uniform results, and the control location exhibited contrasting conditions. While dissolved oxygen began to decline at a depth of 3 feet in the three sample locations within the dredged hole, dissolved oxygen at the control location slightly increased. The water column in Dredged Hole 78 was markedly stratified, which was evident as dissolved oxygen, pH, and temperature decreasing sharply at a depth of ~13ft. Conversely, salinity began to rise at the 13ft depth mark by 1ppt from ~29.9ppt to ~31ppt. Hypoxia occurred between depths of ~15ft to the bottom of the feature (~30ft) with the lowest recorded dissolved oxygen content nearing anoxia (0.84 mg/l). Temperature decreased from near 77°F (25°C) at the surface to near 64°F (18°C) at the bottom of the hole. Additionally, pH decreased from 7.7 at the surface to 6.8 at the bottom of the feature.



Benthic Grab Sampling

All three benthic grab samples from Dredged Hole 78 had consistent findings during an August 11, 2014 field visit. Samples within the feature were azoic and consisted of dark grey silt with some black stained detritus and had a distinct sulfur odor. The grab sample at the control location differed from samples within the dredged hole. The control sample contained grey sandy silt with some shell fragments and contained the macroalgae, (*false agardhiella)*.

Figure 15, The northern grab sample within Dredged Hole 78 consisted of dark grey silt and detritus which can be seen in the bottom left of the image.

Figure 16, The control sample for Dredged Hole 78 consisted of dark grey sandy silt and shell fragments, and contained macroalgae.

SAV Presence

A survey to map SAV was conducted using SAVEWS Jr. on September 12, 2014 which found an absence of SAV within 328ft (100m) of Dredged Hole 78. Large areas were covered by macroalgae which were below the 0.5ft (0.15m) canopy height threshold set for the detection of SAV. There were several instances where SAV were falsely detected due to canopy heights of macroalgae greater than 0.5ft (0.15cm). These occurrences of SAV we deemed false by visual inspection of the echogram and analysis of drop camera video in the vicinity of the readings. Analyzing the echogram, the false SAV occurrences exhibited weaker acoustic reflectivity (indicated by light blue) and in most instances lacked a continuous vertical echo return between the bottom and canopy (Figure 17 and Figure 18). When compared to echograms of known SAV at the control site

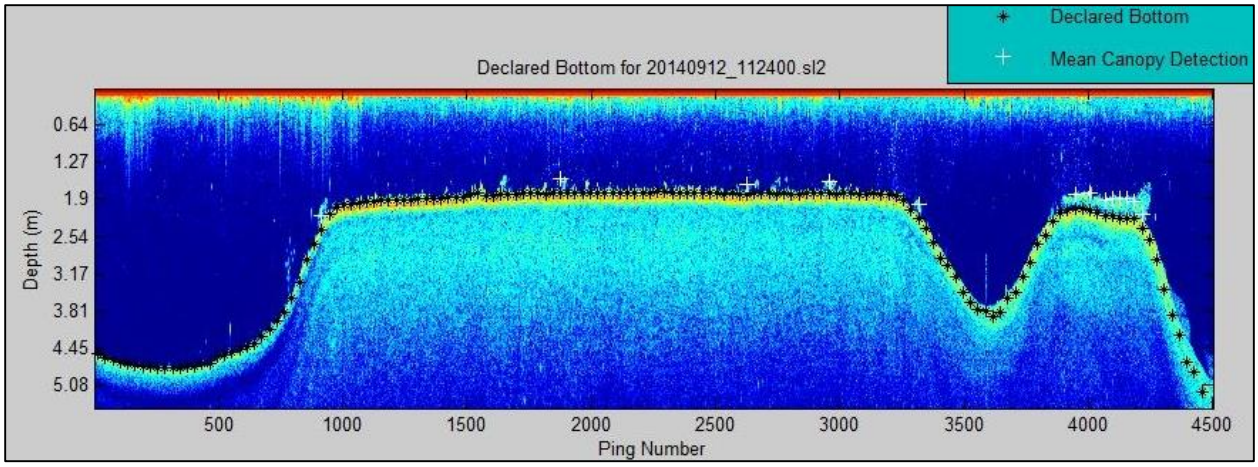


Figure 17, In the above echogram in vicinity of Dredged Hole 78 acoustic reflectivity symbolized with the warmer red and yellow colors indicating stronger acoustic reflectivity and cooler blue colors indicating weaker acoustic reflectivity. Bottom declarations

are symbolized by black asterisk and canopy detections are indicated by white crosses. There are a few false SAV canopy detections between pings 1800 and 3200 and several additional false SAV canopy declarations between pings 3800 and 4500 (Figure 18).

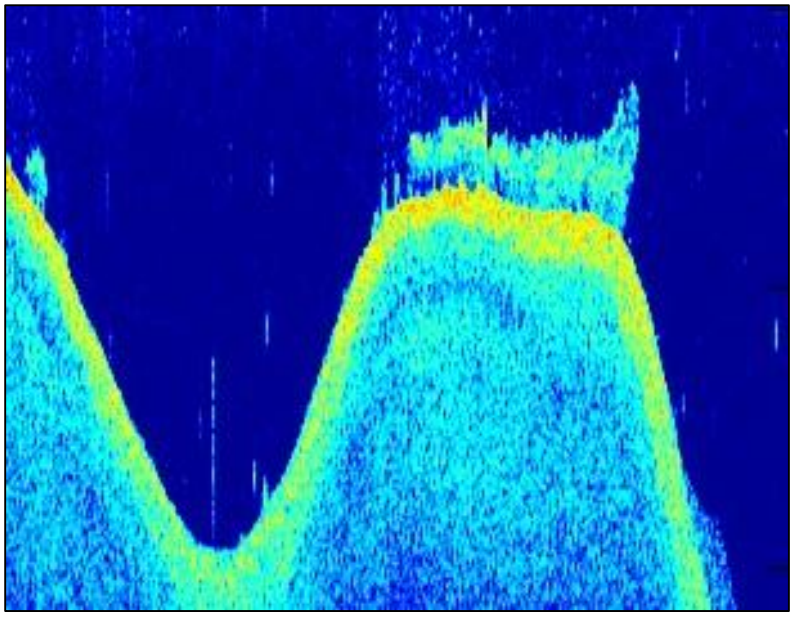


Figure 18, A closer view of ping numbers 3300 through 4500 from the echogram in Figure 17 without canopy and bottom symbolized. In the area on top of the hump had several false SAV canopy detections. These detections were deemed false due to the echo return (non-continuous from the top of the canopy to the bottom as it would be if SAV were present). Video from a drop camera near this area confirms the interpretation of the echogram.

Figure 19, Macroalgae and a blue claw crab can be seen in an image from drop camera video within 100m of Dredged Hole 78.

Figure 20, Dense macroalgae can be seen in an image from drop camera video within 100m of Dredged Hole 78.

Serviceable Channels

Dredged Hole 78 can service 7.22 miles (11.6km) of state channels within a three mile radius (4.8km) from a total of two different state channels. There are no state channels completely within a three mile radius of Dredged Hole 78, however two state channels are partially within the three mile radius (Table 4). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 4

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
-	-	-

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
170	*Brigantine Channel*	*6.04*
171	*St Georges Thorofare*	*1.18*
	Total Mileage	***7.22***

Dredged Hole 86 (USACE ID 34)

Description

Max Depth	-57.4ft MLW
Area	14.4 Acres
Minimum Draft	-5.0ft MLW

Capacity Below -12ft MLW	494,928 yds³
Capacity Below -16ft MLW	399,418 yds³
Capacity Below -18ft MLW	357,091 yds³

Dredged Hole 86, identified by Murawski (1969) as Dredged Hole 34, is located west of Atlantic City, Atlantic County in Turtle Gut Thorofare. This feature was previously identified in earlier investigations by Murawski (1969) and the US Army Corps of Engineers and found to have significant potential for habitat restoration and capacity for dredged material (USACE, 2009). The extraordinary depths (-57ft MLW) and steep banks indicate this feature is a former subaqueous borrow site. The benthic habitat in this dredged hole was found to be severely degraded by Murawski (1969) and Versar (2002), and confirmed by an August 11, 2014 water quality survey performed by the CRC.

Figure 21, Dredged Hole 86 can be seen in 2007 aerial photography as a darker green indicating deep water depths bordered by lighter green indicating shallow water ways.

Digital Elevation Model

Bathymetric data collected by the CRC on January 20, 2014 was used to create the DEM for Dredged Hole 86 and the surrounding area (Figure 22). Dredged hole 86 reaches extreme depths of -57.4ft MLW and is surrounded by depths less then -5ft MLW with the exception of a channel to the east.

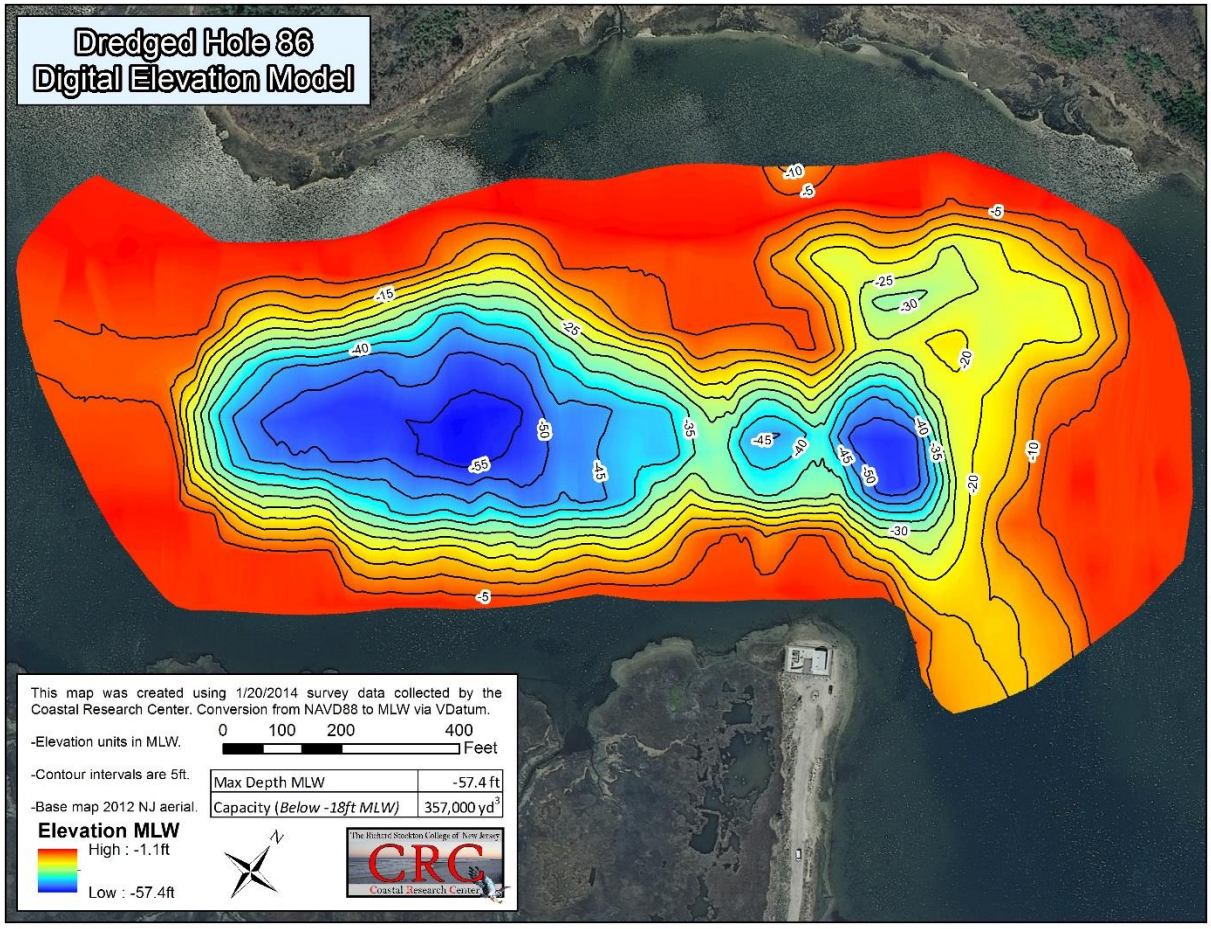
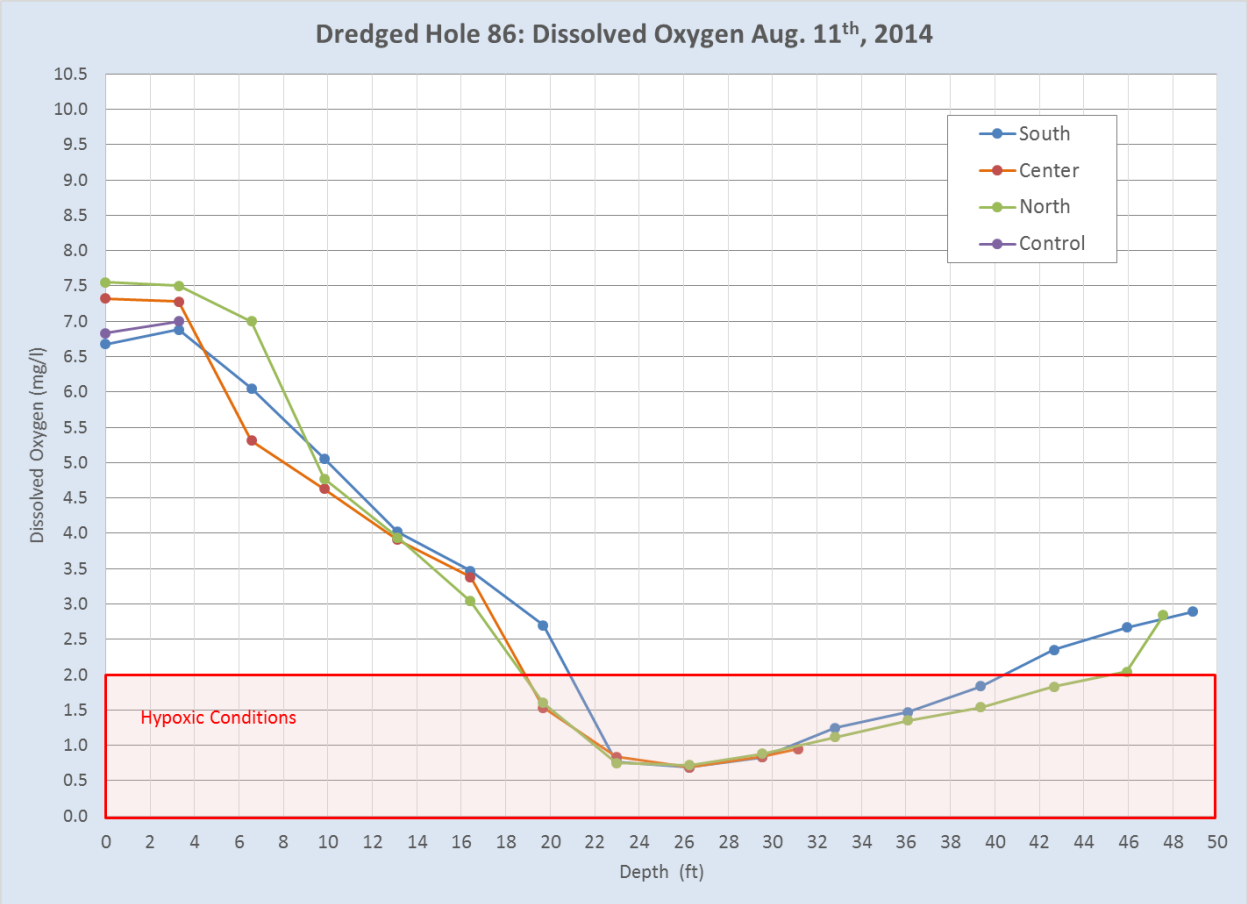


Figure 22

Water Quality Survey

During an August 11, 2014 water quality survey Dredged Hole 86 was found to have degraded water quality with hypoxia beginning at depths of 19ft (5m). Dissolved oxygen content, pH, and water temperature began to decline below water depths of 3ft (0.9m). Dissolved oxygen content fell sharply to depths of 26ft (8m) where the lowest oxygen content (0.69mg/l) was recorded and began to gradually increase to 2.89mg/l at the bottom of the hole. This gradual increase of dissolved oxygen coincided with a drastic decrease of water temperature, the surface water temperate steadily decreased from 80°F to 72°F (27°C to 22°C) at 26ft (8m) where it then sharply fell to 52°F (11°C) at the bottom of the dredged hole. Additionally, pH progressively dropped from 7.8 at the surface to 6.8 at the bottom. Salinity increased by 1ppt from a surface reading of 29.1 to a bottom reading 30.1 with the sharpest gain seen between depths of 19ft and 26ft (5.8m and 8m).



Benthic Grab Sampling

All three benthic grab samples from Dredged Hole 86 had consistent findings during an August 11, 2014 field visit. Samples within the feature were azoic and consisted of black silt and had a distinct sulfur odor. The grab sample at the control location differed from samples within the dredged hole. The control sample contained grey silt and sand.

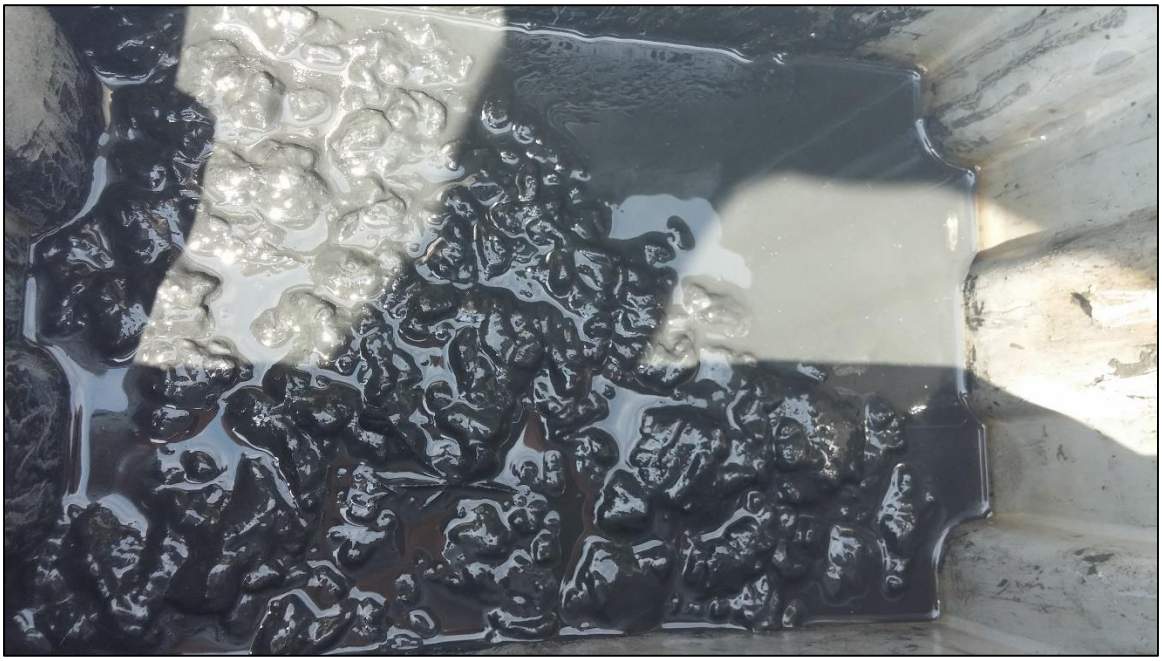


Figure 23, Grab sample taken in the southwest portion of Dredged Hole 86 at a depth of 55ft.

Figure 24, Grab sample taken at the control location in the vicinity of Dredged Hole 86.

SAV Presence

A September 11, 2014 survey using SAVEWS Jr. found no SAV present in the vicinity of Dredged Hole 86. The bay floor in the vicinity of Dredged Hole 86 was mostly bare or covered by macroalgae. The automated processing of SAVEWS Jr. did produce some false occurrences of SAV that were predominantly due to false bottom tracking near relief in bathymetry or due to dense macroalgae (Figure 25).

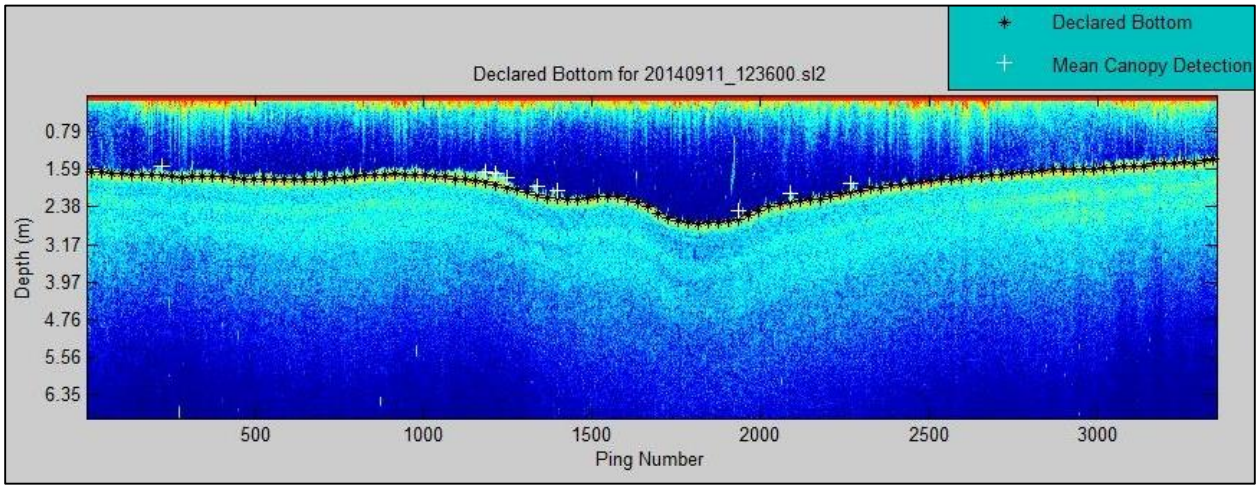


Figure 25, In the above echogram in the vicinity of Dredged Hole 86, acoustic reflectivity symbolized by the warmer red and yellow colors indicating stronger acoustic reflectivity and cooler blue colors indicating weaker acoustic reflectivity. Bottom surface declarations are symbolized by black asterisks and canopy detections are indicated by white crosses. There are a few false SAV canopy detections due to dense macroalgae.

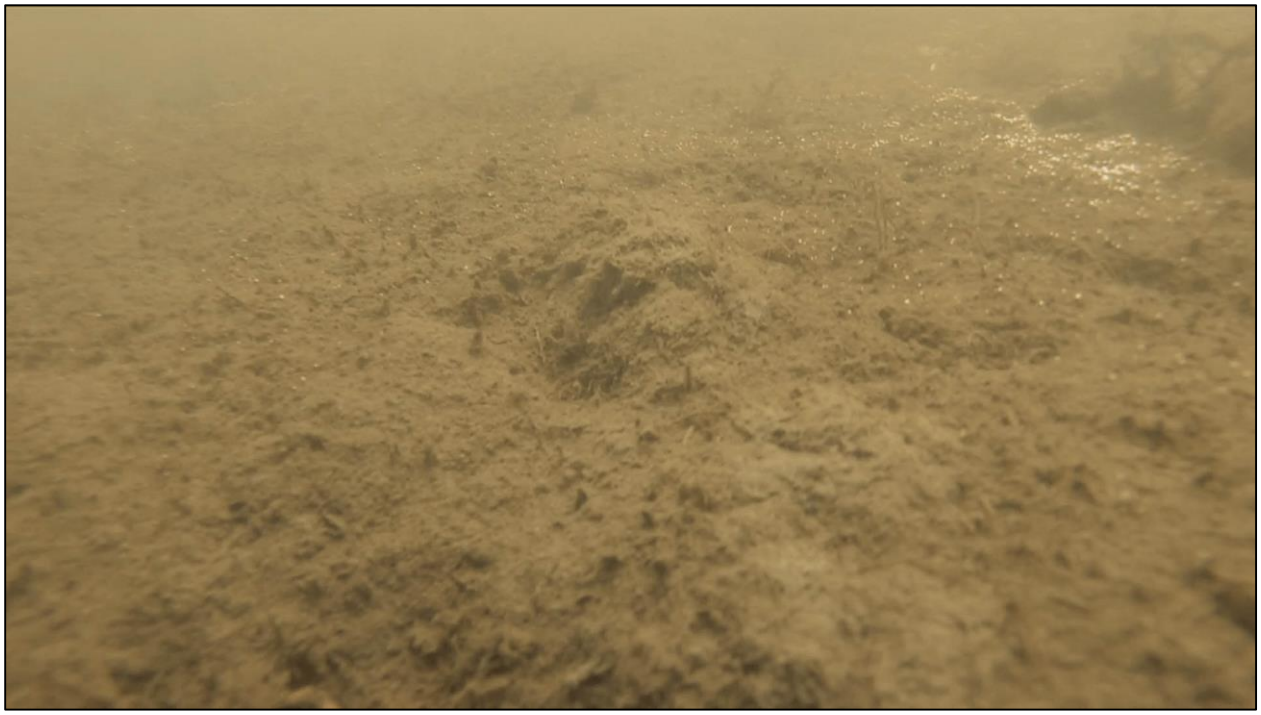


Figure 26, Barren bay floor within 328ft (100m) of Dredged Hole 86.

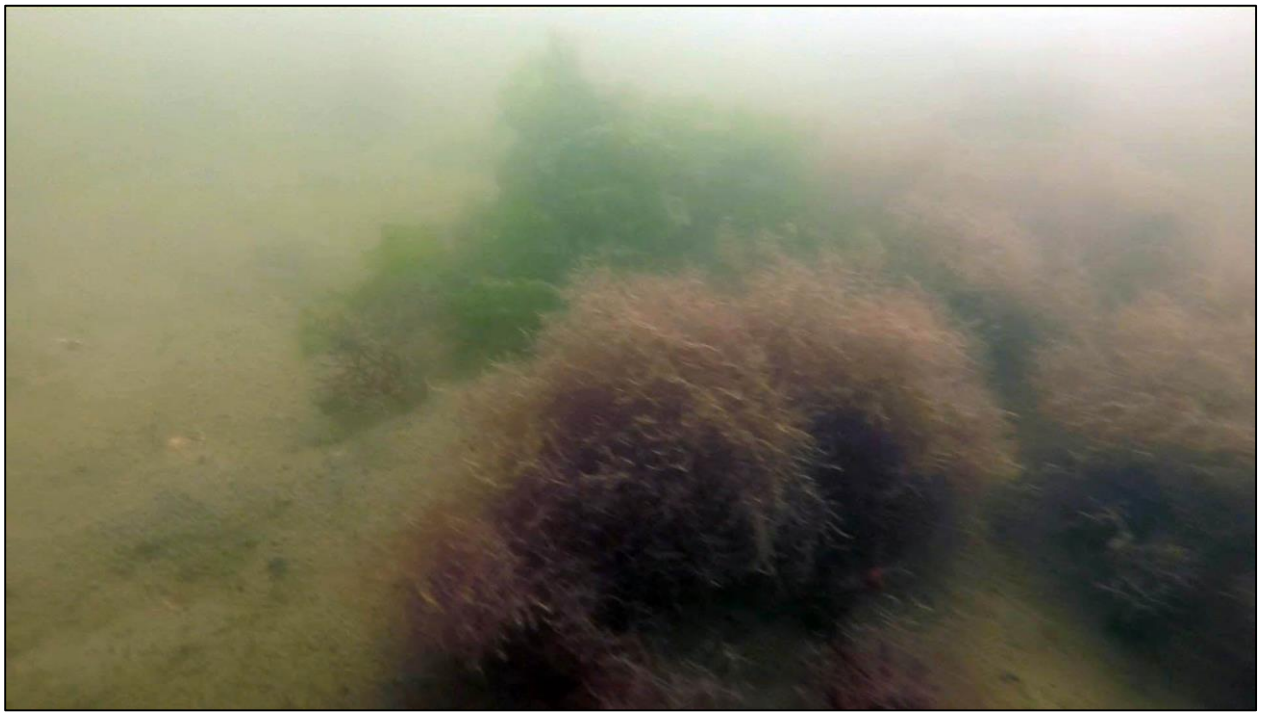


Figure 27, An image from a drop camera shows macroalgae within 328ft (100m) of Dredged Hole 86.

Serviceable Channels

Dredged Hole 86 can service 8.18 miles (13km) of state channels within a three mile (4.8km) radius from a total of four different state channels. There are two state channels that lie completely within a three mile radius of Dredged Hole 78 (Table), and two additional state channels that are partially within the three mile radius (Table 105). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 9

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
174	*Lakes Bay*	*3.89*
175	*Lakes Bay Spur*	*0.05*
	Total Mileage	***3.94***

Table 105

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
172	*Absecon Creek*	*3.90*
173	*Tunis Basin*	*0.34*
	Total Mileage	***4.24***

Dredged Hole 93

Description

Max Depth	-23.9ft MLW
Area	16.5 Acres
Minimum Draft	-1.6ft MLW

Capacity Below -12ft MLW	11,404 yds^3
Capacity Below -16ft MLW	4,497 yds^3
Capacity Below -18ft MLW	2,475 yds^3

Dredged Hole 93 is located in Atlantic County west of Somers Point and east of Egg Harbor Township along Patcong Creek. This dredged hole is completely surrounded by saltmarsh with the exception of one channel allowing tidal exchange with Patcong Creek. This feature is undoubtedly a dredged hole because the 1930 aerial photographs depict upland and saltmarsh at the current site of Dredged Hole 93. The benthic habitat of this feature was determined to be azoic from the benthic grab samples and a water quality survey in August of 2014.

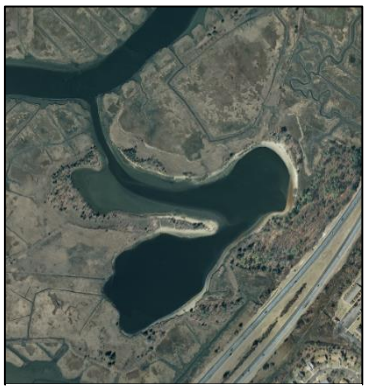


Figure 28, Dredged Hole 93 is surrounded by the saltmarsh and uplands it was cut out of decades earlier. The Garden State Parkway is shown near the bottom right of the photograph.

Digital Elevation Model

Bathymetric data collected by the CRC on August 14, 2014 was used to create the DEM for Dredged Hole 93 and the surrounding area (Figure 29). Dredged Hole 93 reaches depths of -23.9ft (-7.2m) MLW, however only the northern portion of the feature reaches depths greater than -18ft (-5.4m) MLW while the southern portion averages near -8ft (-2.4m) MLW. This feature is completely surrounded by saltmarsh with only a single channel connecting to Patcong Creek.

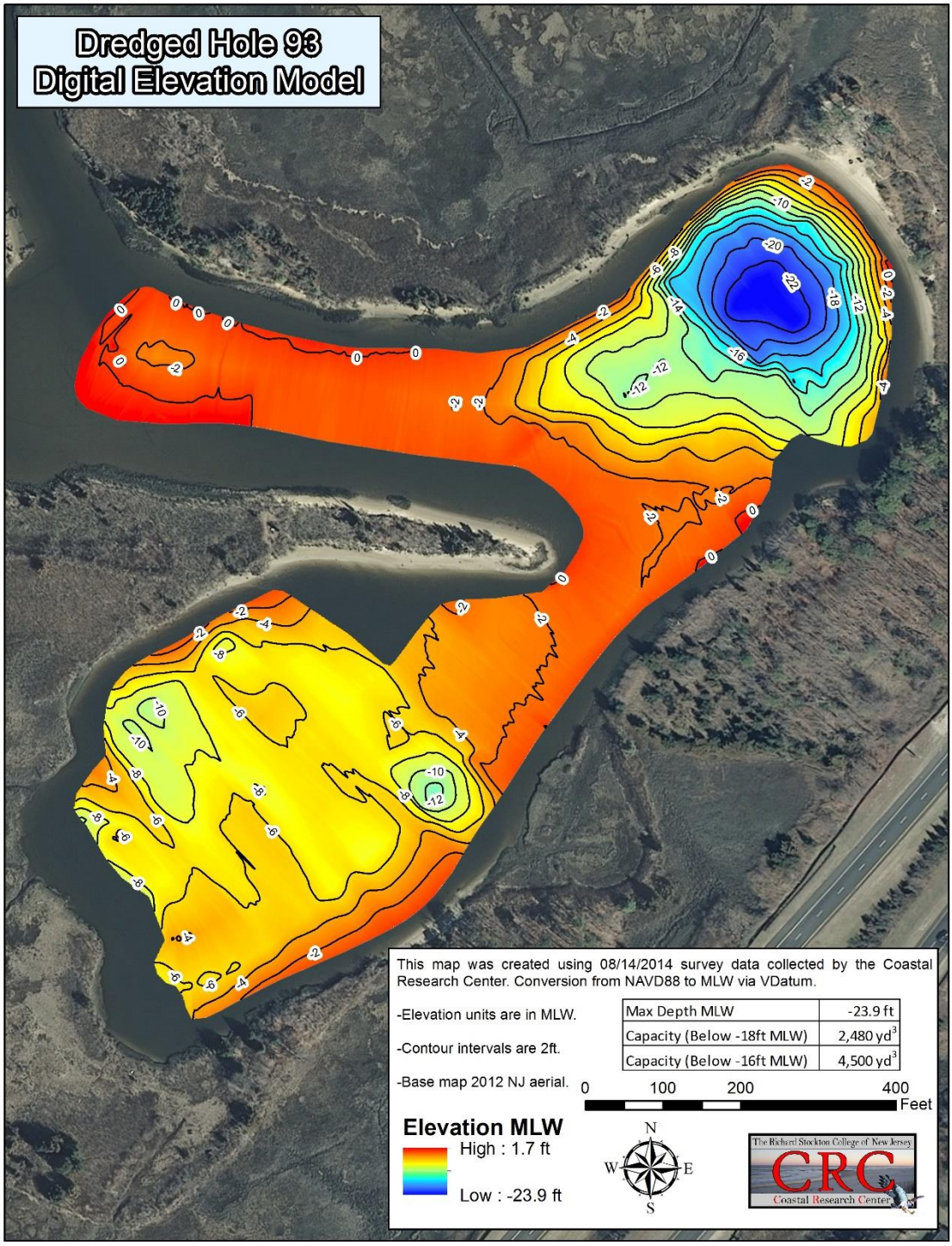
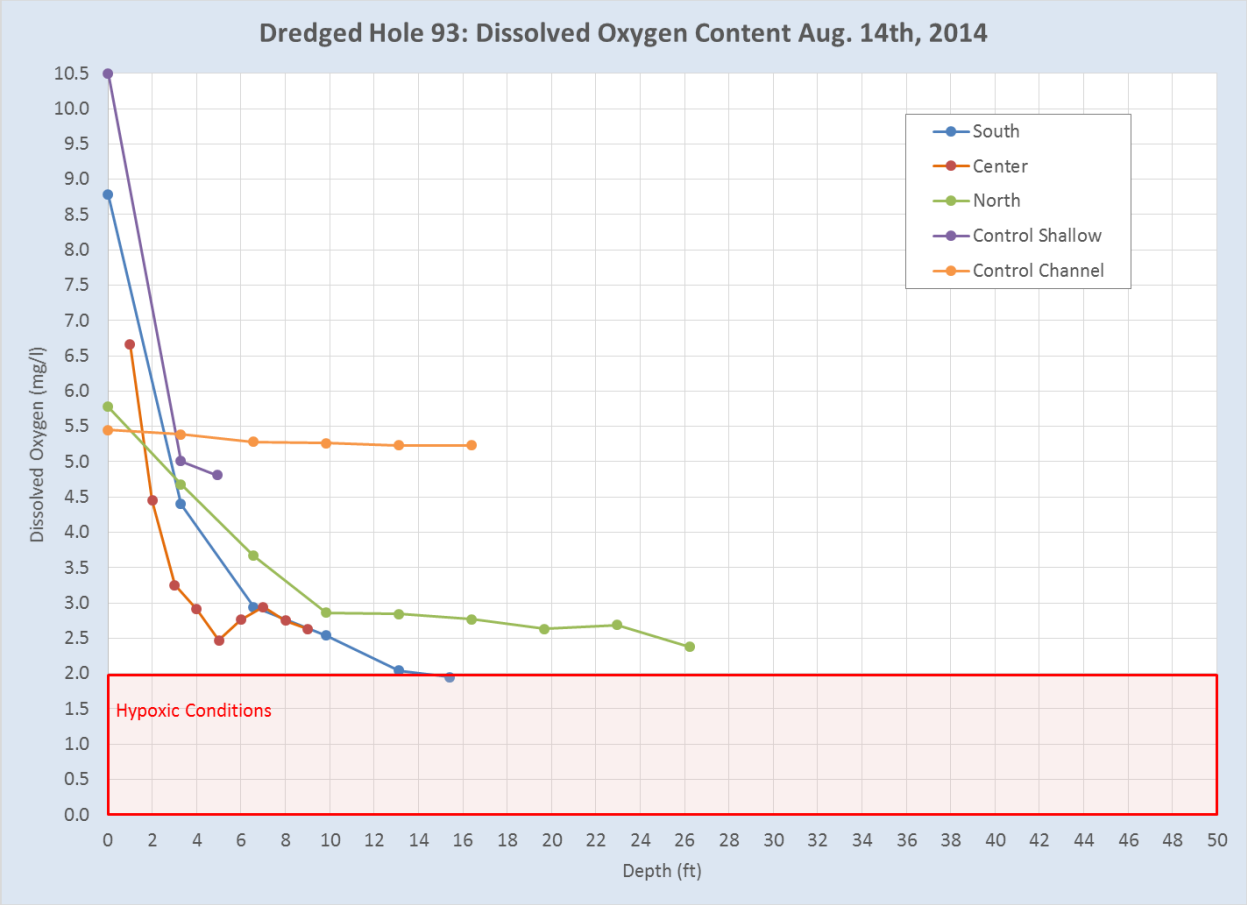

Dredged Hole 93
Digital Elevation Model
This map was created using 08/14/2014 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.
-Elevation units are in MLW.
-Contour intervals are 2ft.
-Base map 2012 NJ aerial.
Max Depth MLW -23.9 ft
Capacity (Below -18ft MLW) 2,480 yd3
Capacity (Below -16ft MLW) 4,500 yd3
0 100 200 400
Feet
Elevation MLW
High : 1.7 ft
Low : -23.9 ft
N
W
E
S
The Richard Stockton College of New Jersey
CRC
Coastal Research Center

Figure 29

Water Quality Surveys

Hypoxic conditions were documented at Dredged Hole 93 during a water quality survey on August 14, 2014 at one of the three sampling locations within the feature. All three sampling locations within the feature indicated the water column was stratified by the rapid decline in dissolved oxygen content from the surface to a depth of six to eight feet (1.8m to 2.4m) where it became stable. A rapid increase in salinity was associated with a decrease in dissolved oxygen, rising from 13.5ppt at the surface to 25ppt at a depth of 10ft then gradually increasing to 26ppt at the bottom of each sampling location.



Benthic Grab Sampling

During an August 11, 2014 field visit of Dredged Hole 93 all three benthic grab samples within the feature were azoic and had a distinct sulfur odor. Samples from within the feature consisted of black or dark grey silt and only the northern sample contained some detritus. The grab sample at the control location differed from the samples within the dredged hole. The control sample contained dark brown silt with some shells and detritus.

Figure 30, The grab sample from the center of Dredged Hole 93 consisted of dark grey silt with some detritus, and black or dark grey silt.

Figure 31, The benthic grab sample from the shallow control location consisted of dark brown silt with some shells and detritus.

SAV Presence

The area around Dredged Hole 93 was nearly completely barren and lacking of SAV, as well as macroalgae during a September 10, 2014 survey utilizing SAVEWS Jr. There were only two instances where SAVEWS falsely identified SAV due to improper bottom tracking where the bay floor was highly irregular. These occurrences of SAV were clearly false when visually inspecting the echograms (Figure 32).

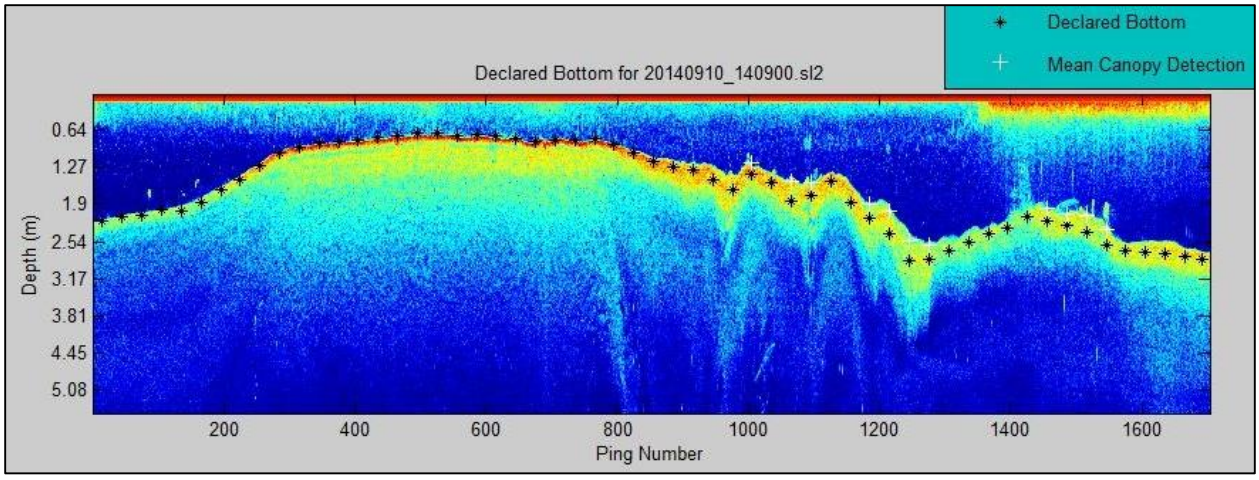


Figure 32, Transect 27 from SAV mapping efforts on Sept. 10, 2014. False identification of SAV occurred in several instances between pings 1000 and 1500 due to poor bottom tracing of irregular bay floor resulting in SAVEWS incorrectly detecting canopy heights greater than 15cm. The barren area between pings 0 through 1000 represent the typical bay floor in the vicinity of Dredged Hole 93.

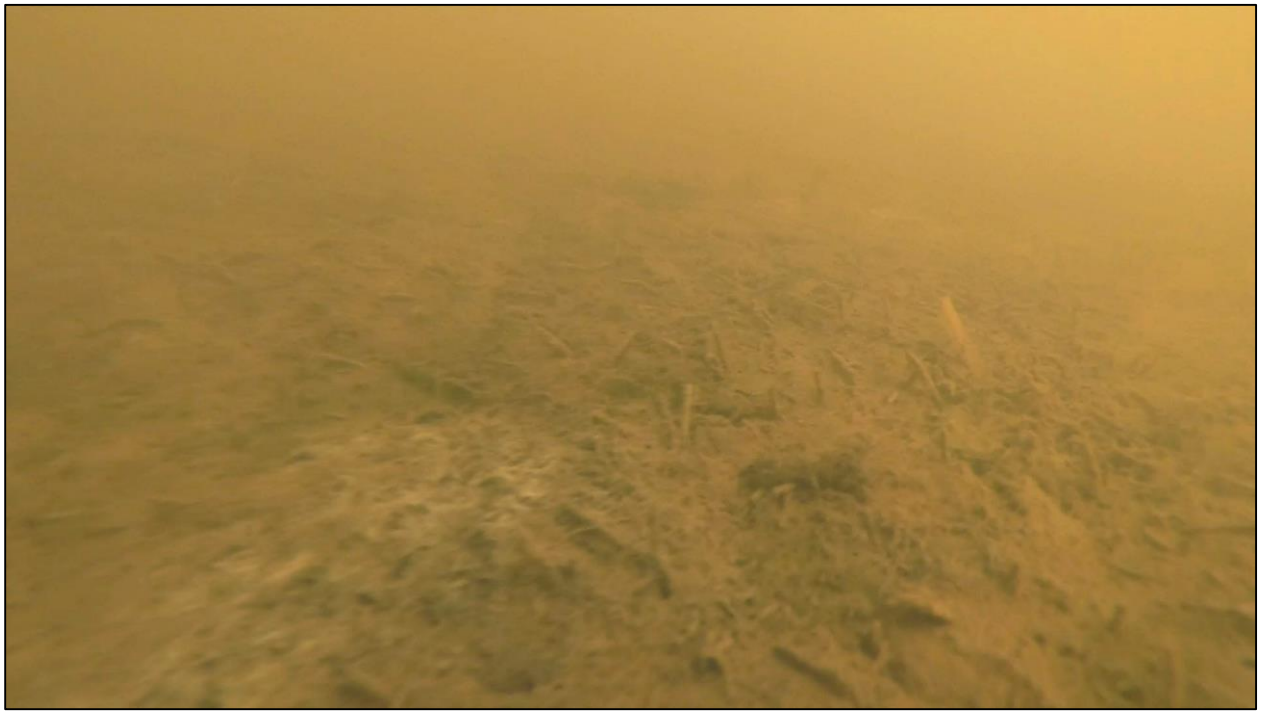


Figure 33, An image from video taken during the SAV survey representing the typical bay floor within 328ft (100m) of Dredged Hole 93. SAV and macroalgae are absent and detritus litters the bay floor.

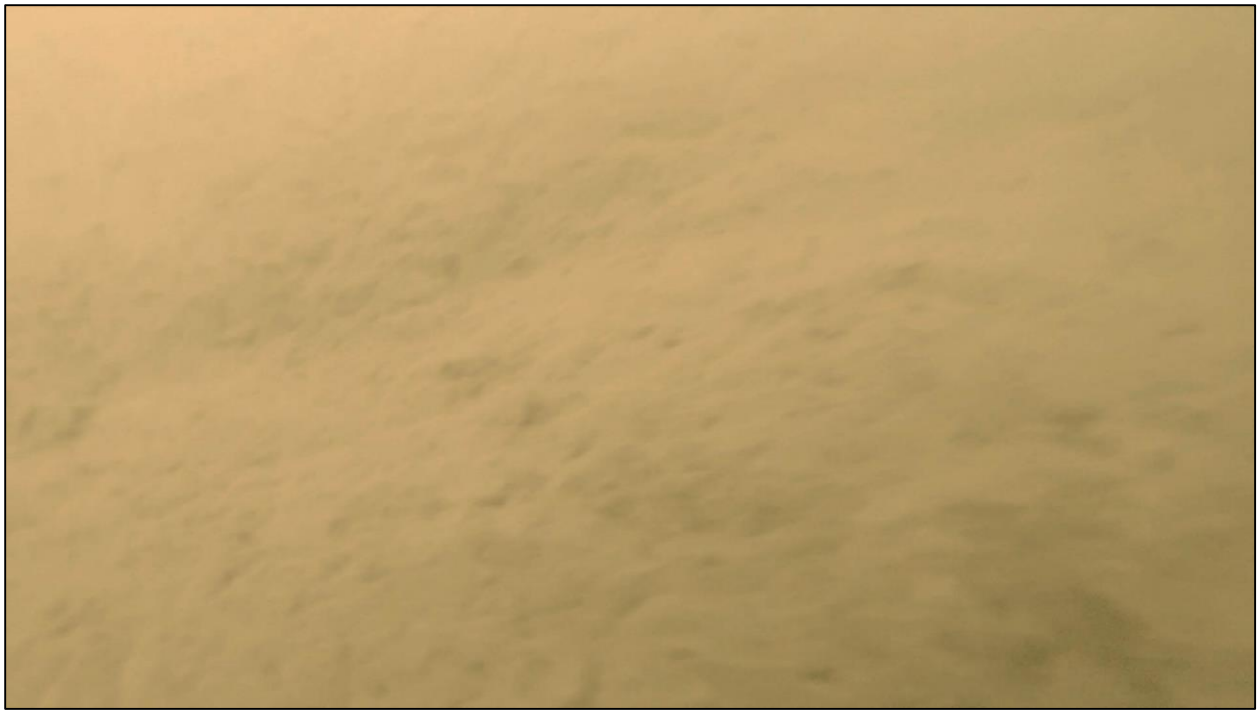


Figure 34, Only barren bay floor can be seen in an image from drop camera video within 328ft (100m) of Dredged Hole 93.

Serviceable Channels

Dredged Hole 93 can service 29.48 miles (47.4km) of state channels within a three mile radius (4.8km) from a total of four different state channels. There is one state channel that lies completely within a three mile radius of Dredged Hole 93 (Table 6), and three additional state channels are partially within the three mile radius (Table 7). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 6

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
179	*Patcong Creek*	*1.42*
	Total Mileage	***1.42***

Table 7

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
177	*Great Egg Harbor River*	*15.24*
178	*Tuckahoe River*	*9.17*
180	*Ship Channel*	*3.65*
	Total Mileage	***28.06***

Candidate Dredged Holes

Dredged Hole 54

Description

Max Depth	-30.8ft MLW	*Capacity Below -12ft MLW*	317,123 yds³
Area	24 Acres	*Capacity Below -16ft MLW*	187,615 yds³
Minimum Draft	-12.0ft MLW	*Capacity Below -18ft MLW*	132,818 yds³

Dredged Hole 54 is located in Barnegat Bay west of Harvey Cedars in Ocean County. Shallow flats border this large dredged hole to the north, west and south with the borough of Harvey Cedars along the east border. This feature has a highly irregular border with multiple cusps created by a dredge (Figure 35). Due to the extraordinary depths of this feature and shallow surrounding areas it is likely this feature is hypoxic for long periods of time.

Figure 35, Dredged Hole 54 is clearly depicted in 2012 aerial photography by an irregular delineation with several cusps. A channel connecting the feature to Barnegat Bay is located at the left of the image and a smaller second channel is visible at the top of the image.

Digital Elevation Model

Bathymetric data collected by the CRC on February 6, 2014 was used to create the DEM for Dredged Hole 54 and the surrounding area (Figure 36). Dredged Hole 54 reaches depths of -30.8ft (-9.3m) MLW in the center of the feature.

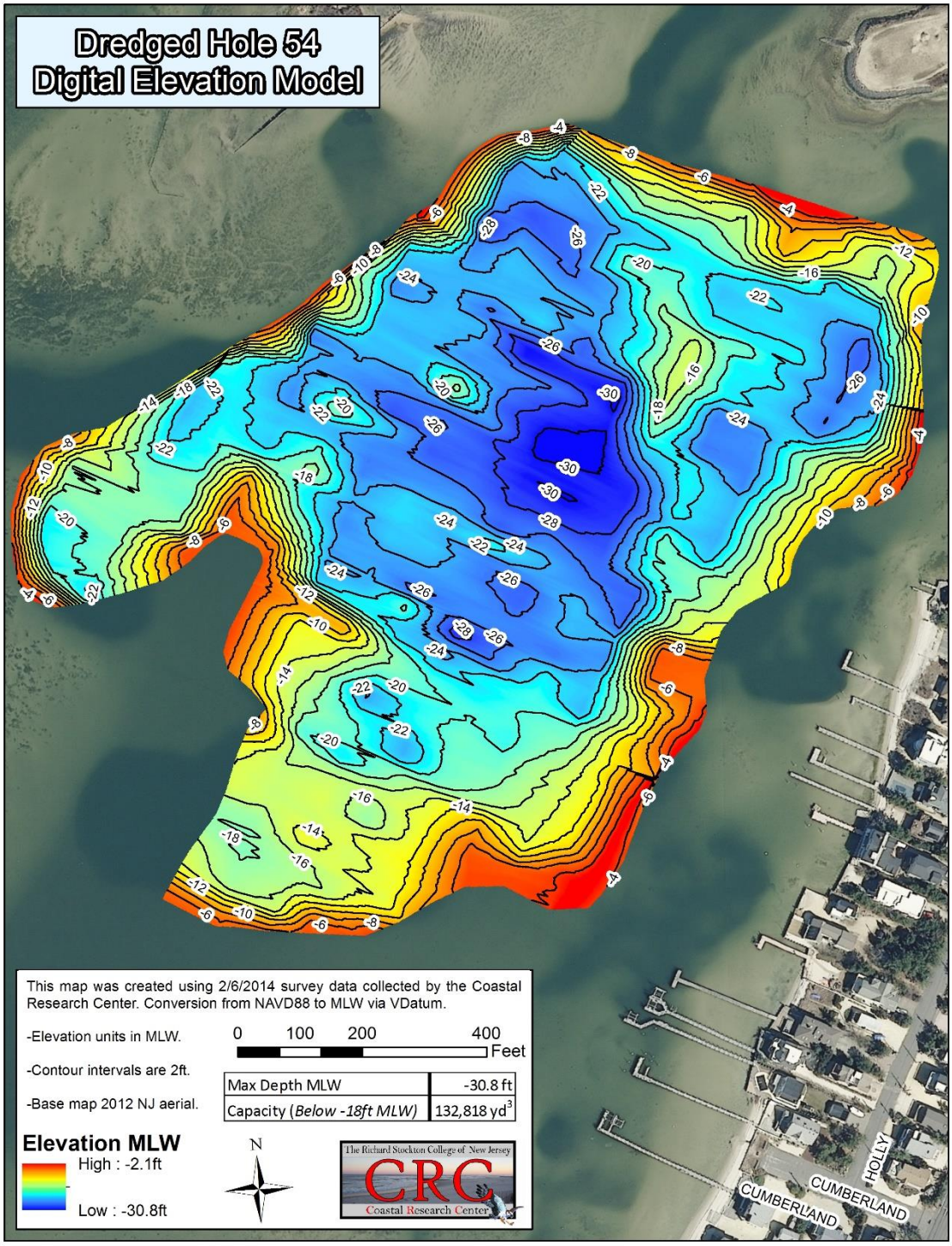


Figure 36

Water Quality/Benthic Habitat

Two spot checks for water quality were performed at the bottom of Dredged Hole 54 during the winter (2014) and summer (2014) and a benthic grab sample was taken concurrently with the summer water quality test. On February 6, 2014 dissolved oxygen content measured 6.3mg/l and on July 1, 2014

dissolved oxygen measured 5.08 mg/l at the bottom of the hole. A benthic grab sample taken along with the July water quality reading revealed sediment in the dredged hole contained black silt and black stained plant debris without any living organisms.

Figure 37, A benthic grab sample from Dredged Hole 54 contained black silt and black stained plant debris without any living organisms.

Serviceable Channels

Dredged Hole 54 can service 4.06 miles (6.5km) of state channels within a three mile (4.8km) radius from a total of six different state channels. There are five state channels that lie completely within a three mile radius of Dredged Hole 54 (Figure 15), and one additional state channel partially within the three mile radius (Table 9). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 8

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
131	*Loveladies North Spur*	*0.57*
132	*Loveladies*	*0.59*
133	*Harvey Cedars 2*	*0.43*
134	*Harvey Cedars 1*	*0.35*
135	*Harvey Cedars*	*0.70*
	Total Mileage	***2.64***

Table 9

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
136	*Surf City*	*1.42*
	Total Mileage	***1.42***

Dredged Hole 55

Description

Max Depth	-24.4ft MLW
Area	2.9 Acres
Minimum Draft	-7.3ft MLW

Capacity Below -12ft MLW	21,423 yds^3
Capacity Below -16ft MLW	5,926 yds^3
Capacity Below -18ft MLW	2,334 yds^3

Dredged Hole 55 is located west of the Loveladies section of Long Beach Township in Barnegat Bay, Ocean County. This dredged hole is bordered by shallow flats on all its sides and a single channel to the north.

Figure 38, Dredged Hole 55 is viewed in 2012 aerial imagery as a dark green, elongated feature.

Digital Elevation Model

Bathymetric data collected by the CRC on February 6, 2014 was used to create the DEM for Dredged Hole 55 and the surrounding area (Figure 39). Dredged Hole 55 is an elongated feature that reaches depths of -24.4ft (-7.4m) MLW towards the center of the feature. The banks rise steeply to the elevation of the shallow areas that surround it.

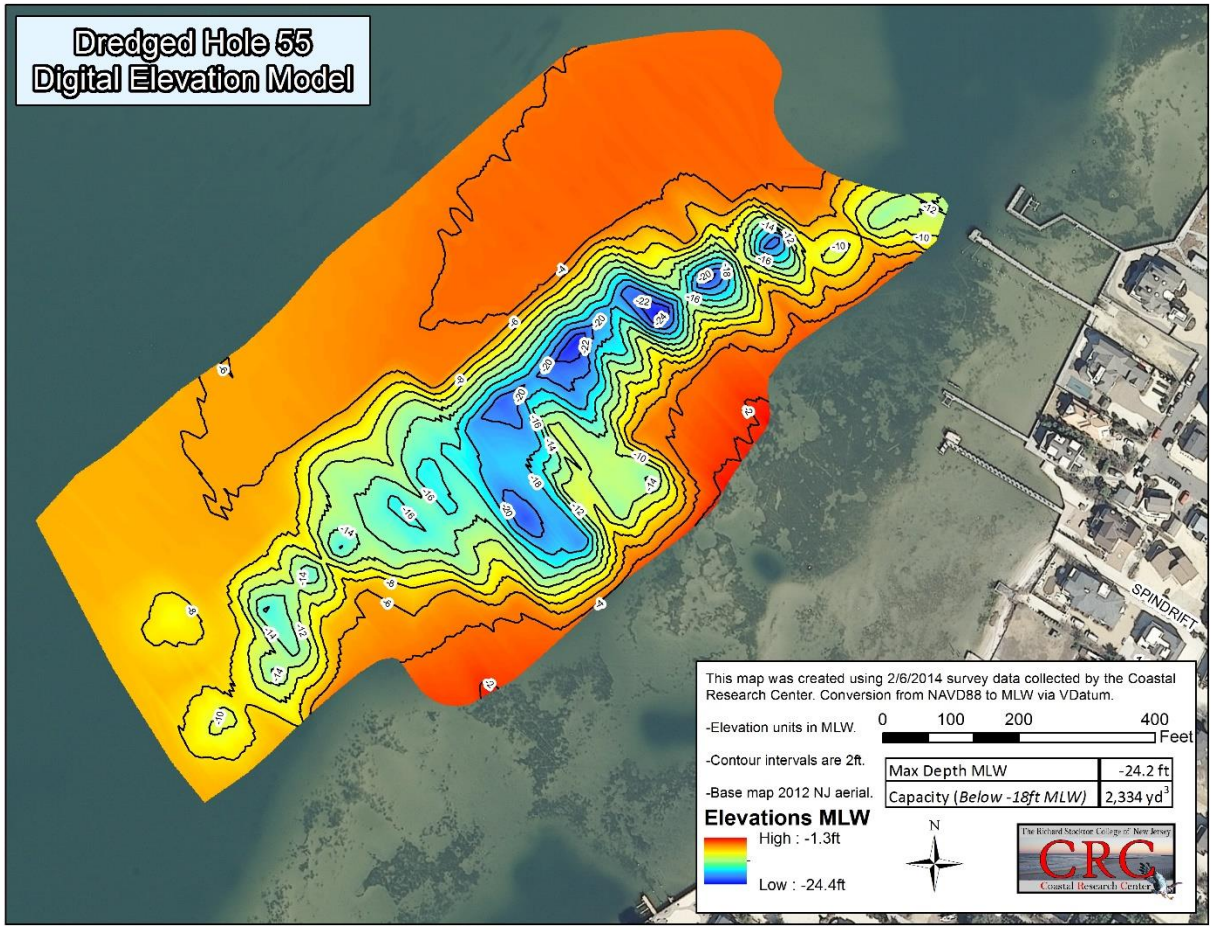


Figure 39

Water Quality/Benthic Habitat

Water quality was sampled in Dredged Hole 55 on February 2014 and July 2014 and a benthic grab sample was taken along with the July water quality sample. Dissolved oxygen content was measured at 13.4mg/l and 5.08mg/l on February 6, 2014 and July 1, 2014, respectively. The benthic grab sample revealed black silt and plant debris with no living organisms.

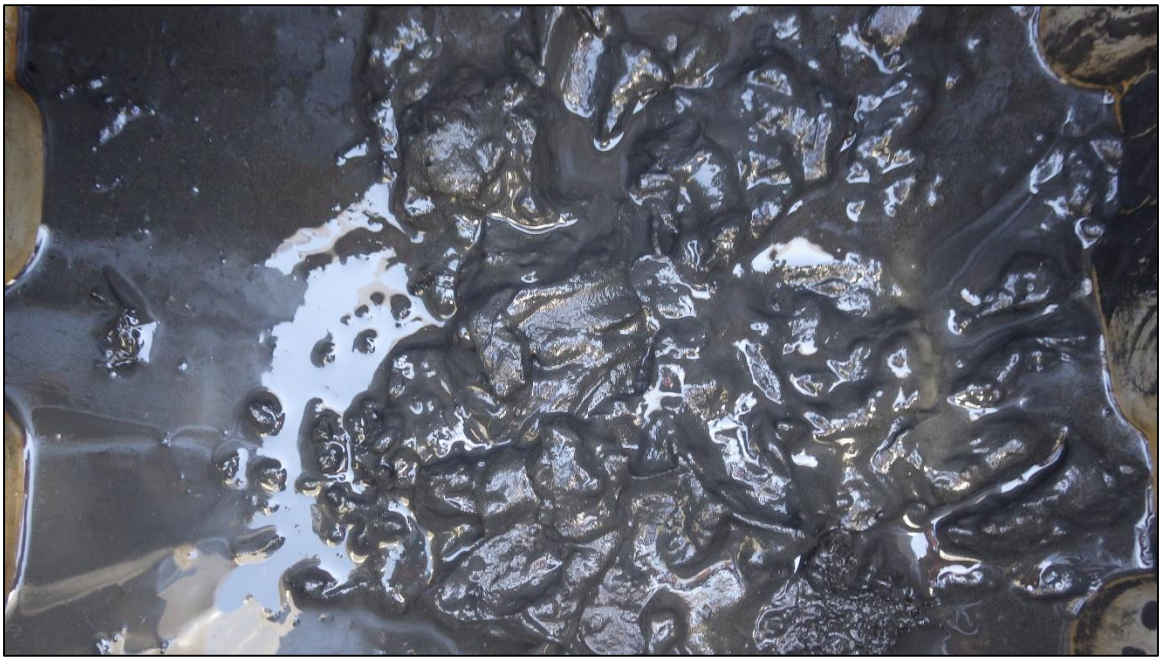


Figure 40, A benthic grab sample from Dredged Hole 55 consisted of black silt and plant debris with no living organisms.

Serviceable Channels

Dredged Hole 55 can service 7.72 miles (12.4km) of state channels within a three mile (4.8km) radius from a total of 11 different state channels. There are seven state channels that lie completely within a three mile radius of Dredged Hole 55 (Table 11), and four additional state channels partially within the three mile radius (Table 10). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 11

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
133	*Harvey Cedars 2*	*0.43*
134	*Harvey Cedars 1*	*0.35*
135	*Harvey Cedars*	*0.70*
137	*Dutchman Surf City*	*0.83*
139	*Ship Bottom*	*0.24*
140	*Flat Island East*	*0.09*
143	*Margos*	*0.75*
	Total Mileage	***3.39***

Table 10

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
136	*Surf City*	*2.91*
138	*Crossover - Surf City*	*0.62*
144	*Beach Haven West*	*0.39*
145	*Mill Creek*	*0.41*
	Total Mileage	***4.33***

Dredged Hole 59

Description

Max Depth	-26.5ft MLW
Area	4.4 Acres
Minimum Draft	-7.5ft MLW

Capacity Below -12ft MLW	95,930 yds^3
Capacity Below -16ft MLW	39,161 yds^3
Capacity Below -18ft MLW	19,477 yds^3

Dredged Hole 59 is located in southern Barnegat Bay west of Ship Bottom in Ocean County. This feature is bound by shallow flats to the north, Surf City Channel to the west, Ship Bottom Channel to the south, and Ship Bottom to the east.

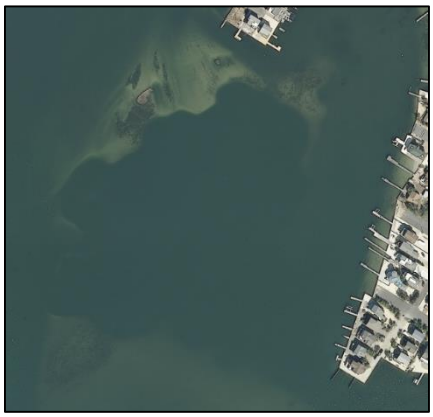


Figure 41, The northwest border of Dredged Hole 59 is shown in 2012 aerial photography.

Digital Elevation Model

Bathymetric data collected by the CRC on December 17, 2013 was used to create the DEM for Dredged Hole 59 and the surrounding area (Figure 42Figure 36). Dredged Hole 59 reached depths of -26.5ft (-8m) MLW in the western portion of the feature.

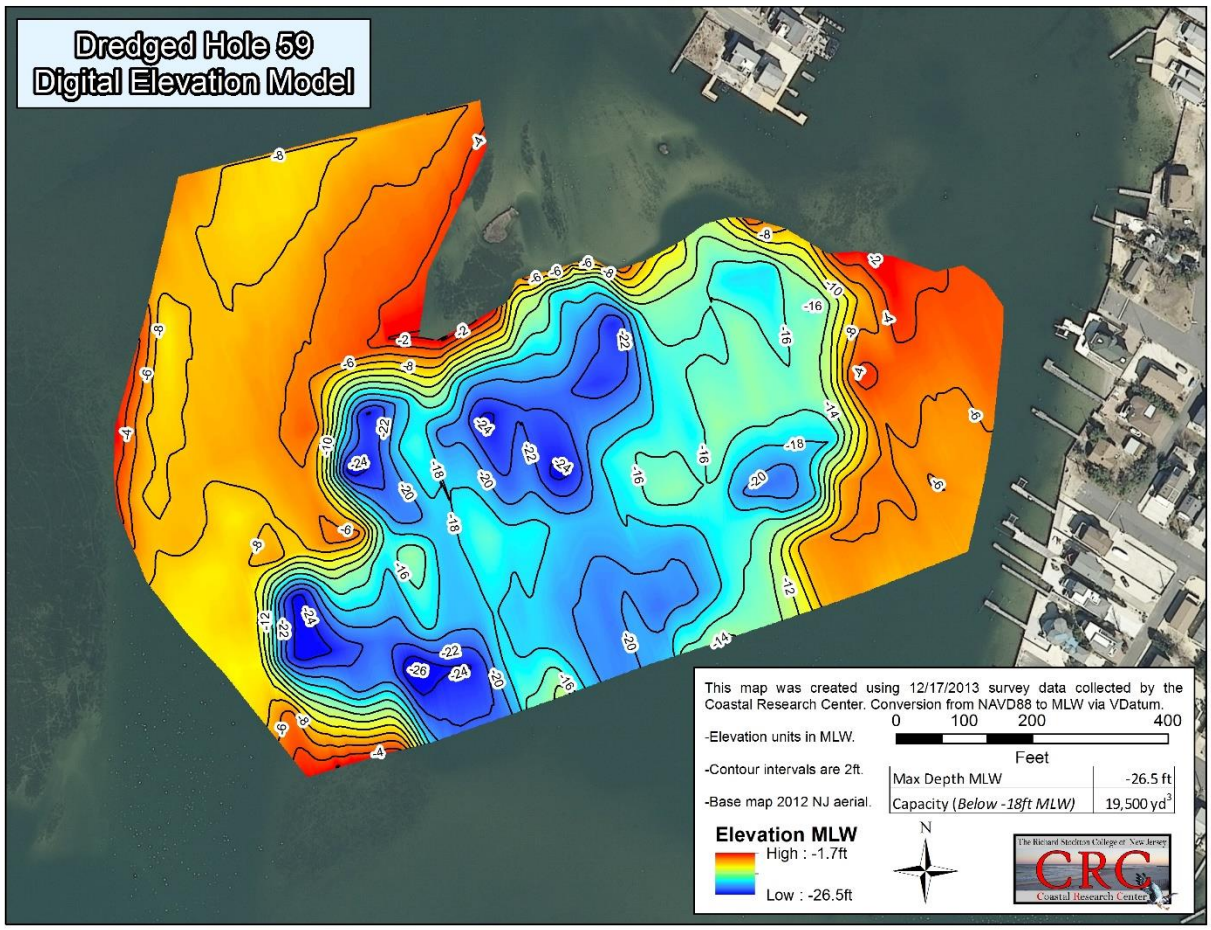


Figure 42

Water Quality/Benthic Habitat

A water quality sample was taken in Dredged Hole 59 in December 2013 and July 2014 and a benthic grab sample taken along with the July water quality sample. Dissolved oxygen content was measured at 13.03mg/l and 5.75mg/l on December 17, 2013 and July 1, 2014, respectively. The benthic grab sample revealed black/grey silt with some fine sand and plant debris with no living organisms.

Figure 43, A benthic grab sample from Dredged Hole 59 consisted of black/grey silt with some fine sand and plant debris with no living organisms.

Serviceable Channels

Dredged Hole 59 can service 8.66 miles (13.9km) of state channels within a three mile (4.8km) radius from a total of 11 different state channels. There are 10 state channels that lie completely within a three mile radius of Dredged Hole 59 (Table 127), and one additional state channel partially within the three mile radius (Table 13). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 12

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
136	*Surf City*	*3.85*
137	*Dutchman Surf City*	*0.83*
138	*Crossover - Surf City*	*0.86*
139	*Ship Bottom*	*0.24*
140	*Flat Island East*	*0.09*
141	*Lower Flat Island East*	*0.08*
142	*Brant Beach*	*0.19*
143	*Margos*	*0.75*
144	*Beach Haven West*	*0.50*
145	*Mill Creek*	*1.17*
	Total Mileage	***8.56***

Table 13

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
146	*Cedar Run*	*0.10*
	Total Mileage	***0.10***

Dredged Hole 61 (USACE ID 37)

Description

Max Depth	-32.8ft MLW
Area	34.1 Acres
Minimum Draft	-10.0ft MLW

Capacity Below -12ft MLW	282,456 yds³
Capacity Below -16ft MLW	131,054 yds³
Capacity Below -18ft MLW	78,250 yds³

Dredged Hole 61 is situated in southern Barnegat Bay west of the Brant Beach Section of Long Beach Township in Ocean County. Shallow flats border this feature to the north and west and urban areas comprise the south and east borders. Surf City Channel runs through the western portion of the dredged hole.

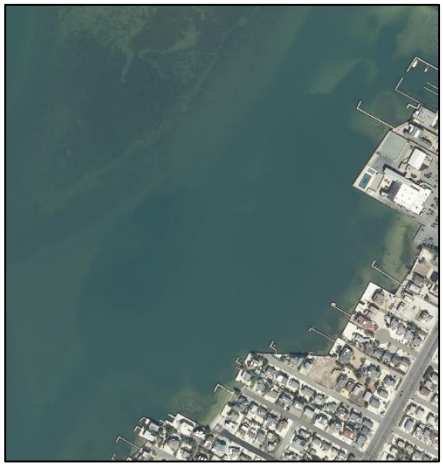


Figure 44, Dredged Hole 61 is shown in 2012 aerial photography as a dark green color bordered by lighter green shallow areas to the north and west and Brant beach to the west and south.

Digital Elevation Model

Bathymetric data collected by the CRC on January 13, 2014 was used to create the DEM for Dredged Hole 61 and the surrounding area (Figure 45). Dredged Hole 61 reaches depths of –32.8ft (-10m) MLW in a small area near the center of the feature and separate areas to the east and west that reach depths of -30ft (-9.1m) MLW. Surf City channel runs through the northern portion of the dredged hole and is defined by the -10ft contour (Figure 45).

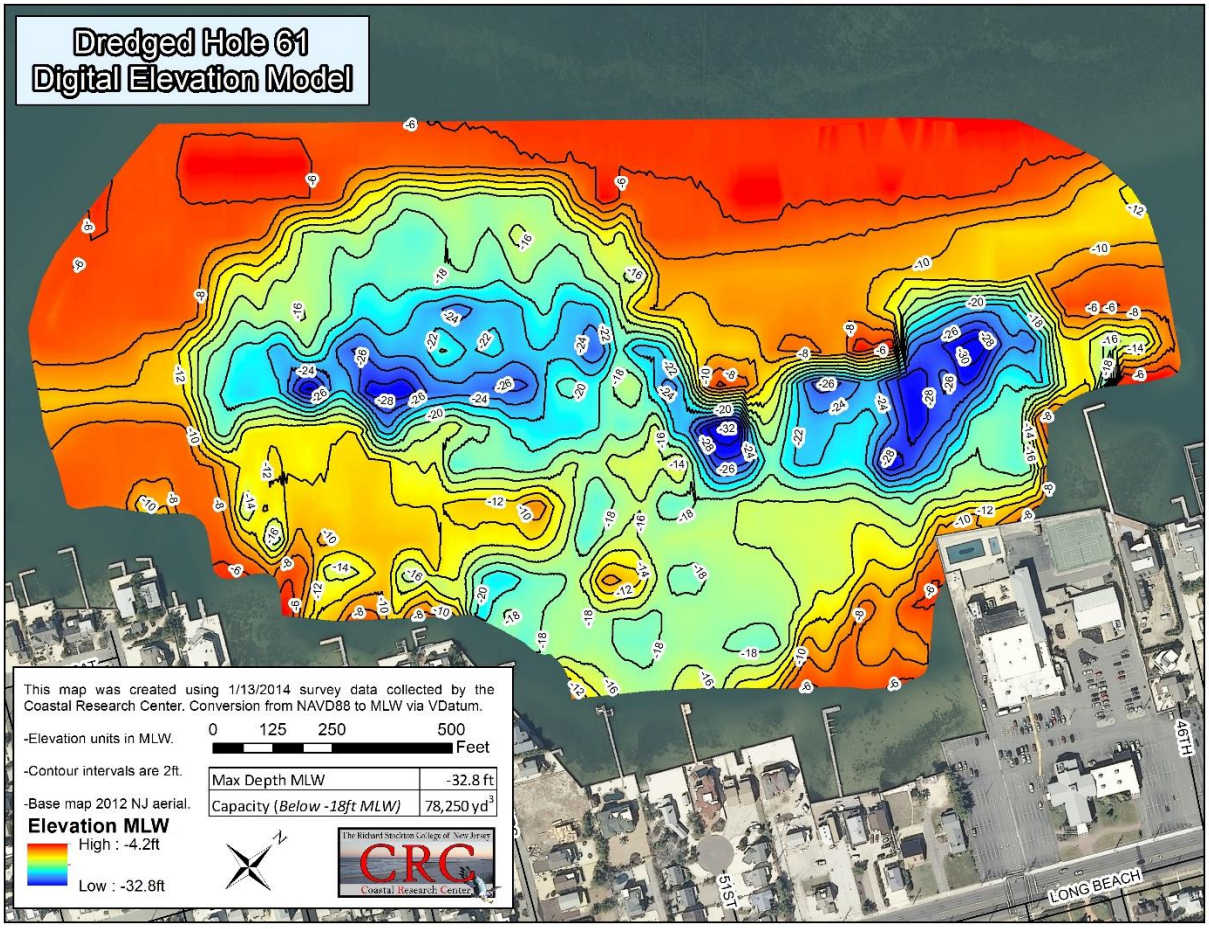


Figure 45

Water Quality/Benthic Habitat

A water quality sample was taken in Dredged Hole 61 in January 2014 and in July 2014 and a benthic grab sample taken along with the July water quality sample. Dissolved oxygen content was measured at 13.5mg/l and 6.05mg/l on January 13, 2014 and July 1, 2014, respectively. The benthic grab sample revealed black silt with no living organisms.

Figure 46, A benthic grab sample from Dredged Hole 61 consisted of black silt with no living organisms.

Serviceable Channels

Dredged Hole 61 can service 9.03 miles (14.5km) of state channels within a three mile radius (4.8km) from a total of 12 different state channels. There are 10 state channels that lie completely within a three mile radius of Dredged Hole 61 (Table 14), and two additional state channels partially within the three mile radius (Table 20). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 14

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
137	*Dutchman Surf City*	*0.83*
138	*Crossover - Surf City*	*0.86*
139	*Ship Bottom*	*0.24*
140	*Flat Island East*	*0.09*
141	*Lower Flat Island East*	*0.08*
142	*Brant Beach*	*0.19*
143	*Margos*	*0.75*
144	*Beach Haven West*	*0.50*
145	*Mill Creek*	*1.17*
149	*Peahala Park*	*0.11*
	Total Mileage	***4.82***

Table 20

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
136	*Surf City*	*3.71*
146	Cedar Run	0.5
	Total Mileage	***4.21***

Dredged Hole 83 (USACE ID 24)

Description

Max Depth	-27.4ft MLW
Area	15.2 Acres
Minimum Draft	-6.9ft MLW

Capacity Below -12ft MLW	18,311 yds³
Capacity Below -16ft MLW	7,751 yds³
Capacity Below -18ft MLW	4,506 yds³

Dredged Hole 83 is located in Lakes Bay east of Pleasantville and West of Atlantic City in Atlantic County. This dredged hole has been previously identified by Murawski (1969) and the US Army Corps of Engineers. This feature is within Lakes Bay Channel bordered by to the east and shallow areas to the north, south, and west.

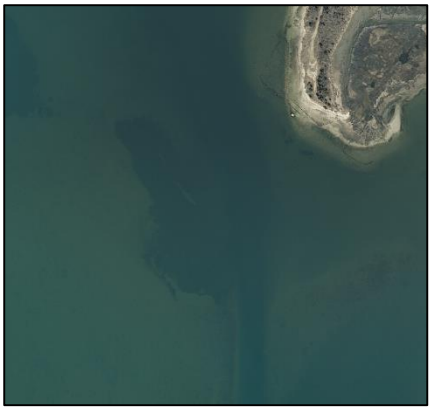


Figure 47, A faint outline of Dredged Hole 83 is visible in 2012 aerial imagery.

Digital Elevation Model

Bathymetric data collected by the CRC on January 20, 2014 was used to create the DEM for Dredged Hole 83 and the surrounding area (Figure 48). Dredged Hole 83 reached depths of -27.4ft (-8.3m) MLW. Lakes Bay Channel passes through the dredged hole and can be seen in the DEM as a linear feature defined by -12ft (-3.6m) depths south of the dredged hole and -6ft (-1.8m) contour north of the feature.

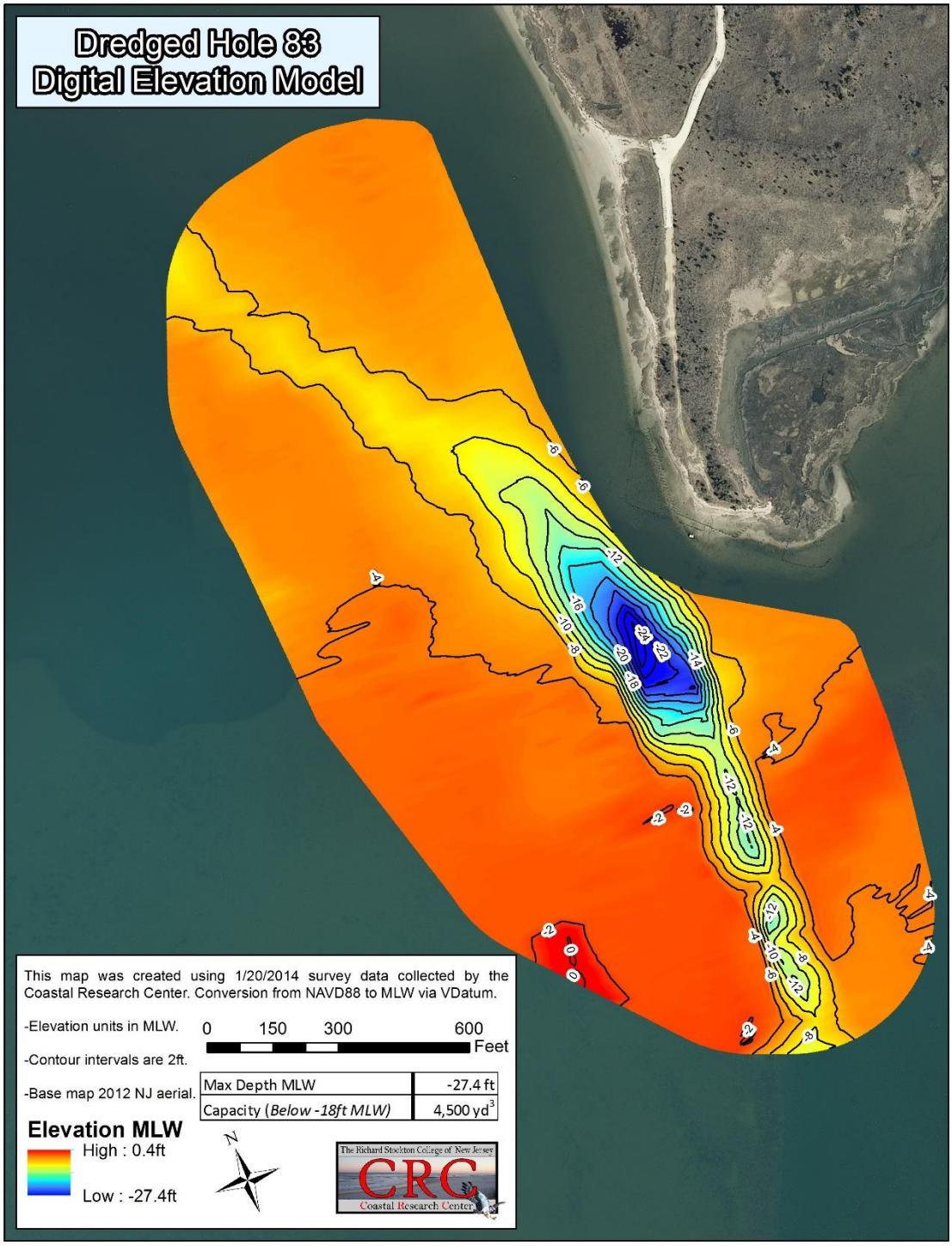

Dredged Hole 83
Digital Elevation Model
This map was created using 1/20/2014 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.
-Elevation units in MLW.
-Contour intervals are 2ft.
-Base map 2012 NJ aerial.
0 150 300 600
Feet
Max Depth MLW -27.4 ft
Capacity (Below -18ft MLW) 4,500 yd3
Elevation MLW
High : 0.4ft
Low : -27.4ft
N
The Richard Stockton College of New Jersey
CRC
Coastal Research Center

Figure 48

Water Quality/Benthic Habitat

A water quality was sample was taken in Dredged Hole 83 in October 2013 and in June 2014 and a benthic grab sample was taken along with the June water quality sample. Dissolved oxygen content was measured at 11.7mg/l and 6.3mg/l on a January 20, 2014 and June 30, 2014, respectively. The benthic grab sample consisted of black silt with small amounts of sand and no living organisms.

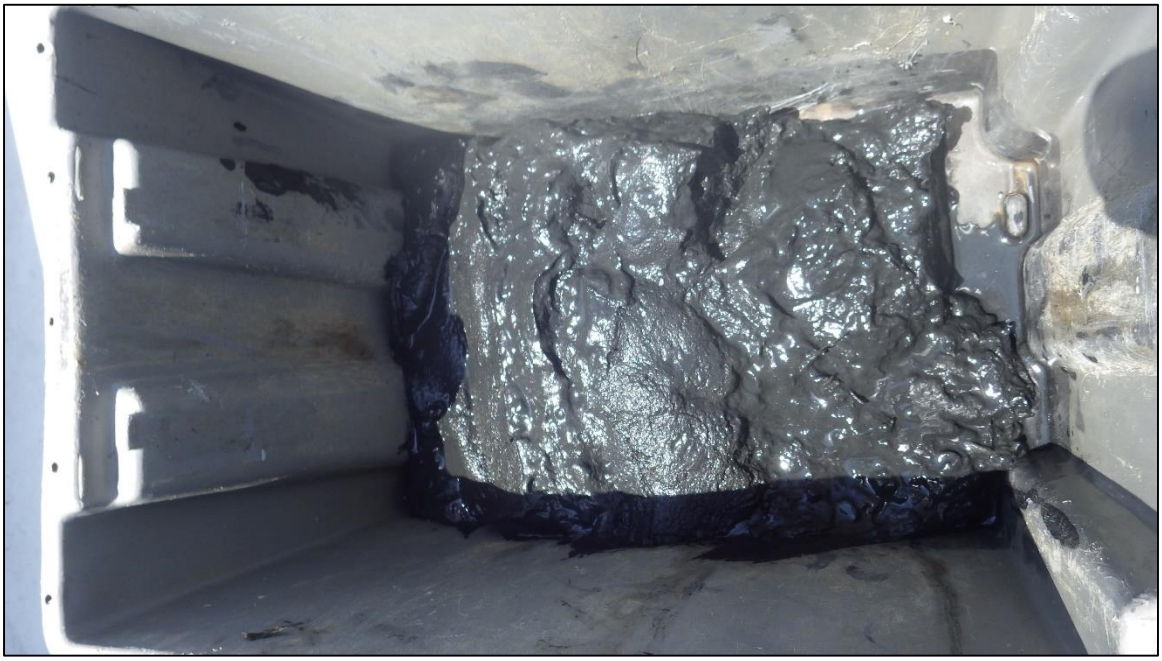


Figure 49, A benthic grab sample from Dredged Hole 83 consisted of black silt with small amounts of sand and no living organisms.

Serviceable Channels

Dredged Hole 83 can service 7.19 miles (11.5km) of state channels within a three mile (4.8km) radius from a total of five different state channels. There are three state channels that lie completely within a three mile radius of Dredged Hole 83 (Table 15), and two additional state channels partially within the three mile radius (Table 16). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 15

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
174	*Lakes Bay*	*3.89*
175	*Lakes Bay Spur*	*0.05*
176	*Risleys Channel*	*0.34*
	Total Mileage	***4.28***

Table 16

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
172	*Absecon Creek*	*2.01*
173	*Tunis Basin*	*0.90*
	Total Mileage	***2.91***

Dredged Hole 85

Description

Max Depth	-23.9ft MLW
Area	22.0 Acres
Minimum Draft	-4.7ft MLW

Capacity Below -12ft MLW	151,118 yds^3
Capacity Below -16ft MLW	67,612 yds^3
Capacity Below -18ft MLW	35,259 yds^3

Dredged Hole 85 is situated west of Atlantic City and South of the Atlantic City Expressway in Atlantic County. This feature is surrounded by shallow flats with the exception of its northern border along the Atlantic City Expressway and without any channels connecting it to adjacent bay waters. It is evident in 1930 aerial photography that this feature is a dredged hole due to the existence of a large saltmarsh island through a large portion of the current extent of the hole.

Figure 50, A mosaic of oblique aerial photography created a variation in color scale, but Dredged Hole 85 can be viewed as a dark green feature bordered by shallow, tan areas and the Atlantic City Expressway to the North.

Digital Elevation Model

Bathymetric data collected by the CRC on October 25, 2013 was used to create the DEM for Dredged Hole 85 and the surrounding area (Figure 51). The majority of Dredged Hole 85 is below -20ft (-6m) MLW but an area in the center and western portion of the feature is below -22ft (-6.7m) MLW. The feature is separated from the main channel and bordered by the Atlantic City Expressway to the north and shallow areas to the east, south, and west.

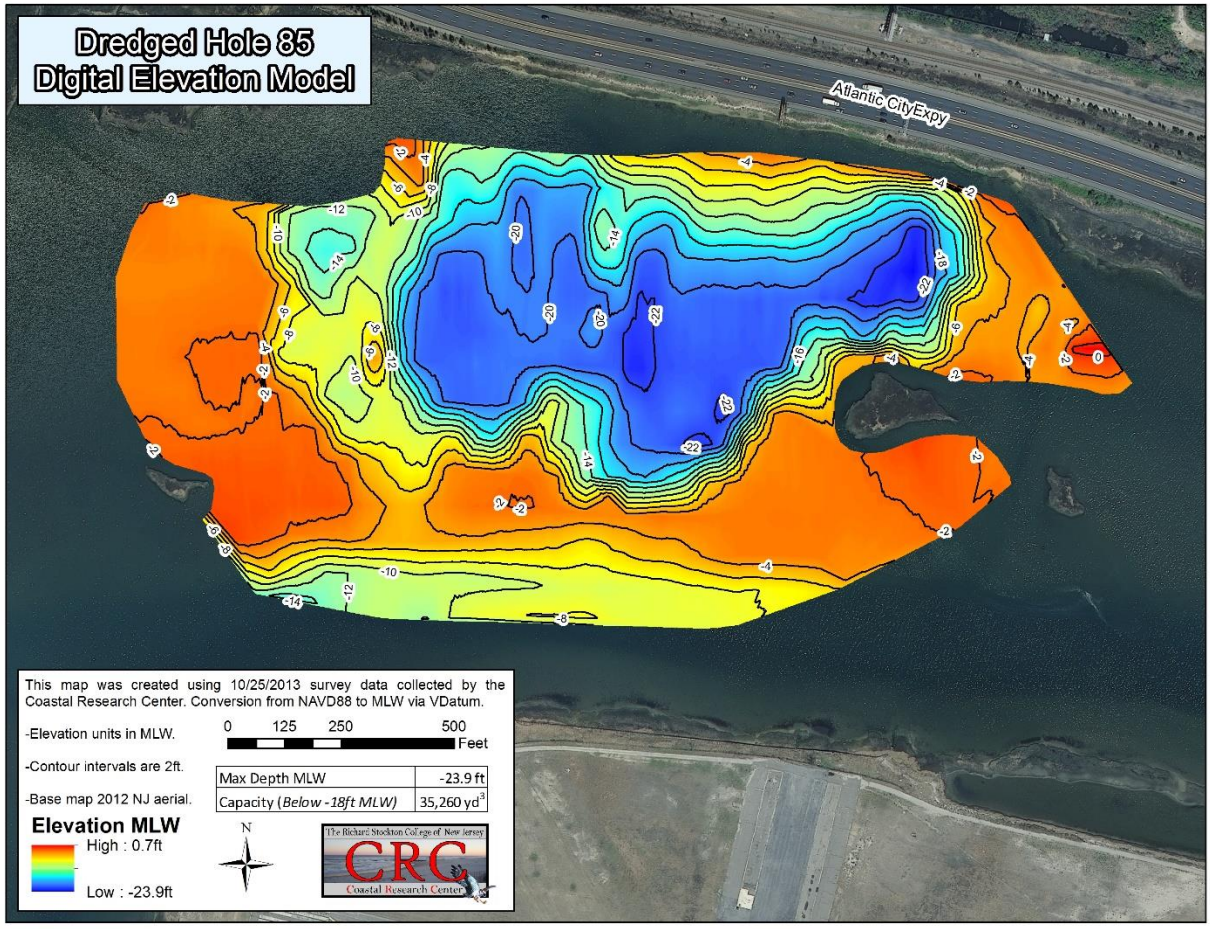


Figure 51

Water Quality/Benthic Habitat

A water quality was sample was taken in Dredged Hole 85 in October 2013 and in June 2014 and a benthic grab sample taken along with the June water quality sample. Dissolved oxygen content was measured at 8.5mg/l and 4.8mg/l on October 26, 2013 and June 30, 2014, respectively. The benthic grab sample consisted of black/grey silt with small amounts of sand and no living organisms.

Figure 52, A benthic grab sample from Dredged Hole 85 consisted of black/grey silt with small amounts of sand and no living organisms.

Serviceable Channels

Dredged Hole 85 can service 7.22 miles (11.6km) of state channels within a three mile (4.8km) radius from a total of four different state channels. There are no state channels completely within a three mile radius of Dredged Hole 85, however four state channels are partially within the three mile radius (Table 17). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 17

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
-	-	-

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
170	*Brigantine Channel*	*0.74*
171	*St Georges Thorofare*	*0.59*
172	*Absecon Creek*	*2.26*
174	*Lakes Bay*	*3.63*
	Total Mileage	***7.22***

Dredged Hole 89

Description

Max Depth	-41.1ft MLW
Area	34.0 Acres
Minimum Draft	-8.3ft MLW

Capacity Below -12ft MLW	347,742 yds³
Capacity Below -16ft MLW	158,330 yds³
Capacity Below -18ft MLW	92,547 yds³

Dredged Hole 89 is located in Turtle Gut Thorofare northwest of Ventnor City in Atlantic County. This feature is bound by saltmarsh to the north, urban development to the south, shallow areas to the east, and a channel to the west.

Figure 53, Dredged Hole 89 is located in the center of the above 2012 aerial imagery bordered by saltmarsh to the north and urban development of Ventnor City to the south.

Digital Elevation Model

Bathymetric data collected by the CRC on February 19, 2014 was used to create the DEM for Dredged Hole 89 and the surrounding area (Figure 54). Dredged Hole 89 reached depths of -41ft (-12.5m) MLW in an isolated area to the southwest of the feature while the rest of the feature is a considerably higher elevation -25ft (-7.6m) MLW or greater.

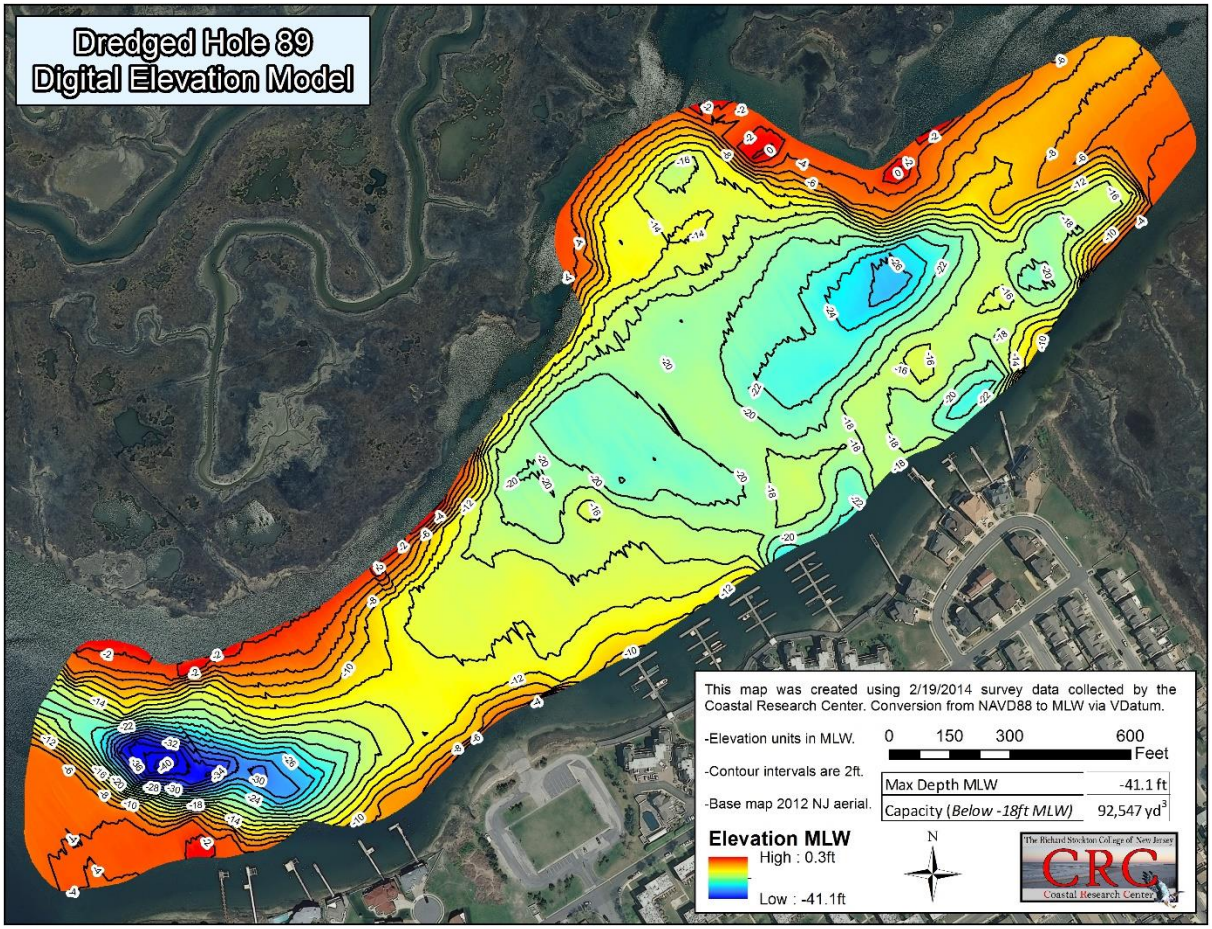


Figure 54

Water Quality/Benthic Habitat

A water quality was sample was taken in Dredged Hole 89 in February 2014 and in June 2014 and a benthic grab sample taken along with the June water quality sample. Dissolved oxygen content was measured at 11.6mg/l and 6.4mg/l on February 19, 2014 and June 30, 2014, respectively. The benthic grab sample consisted of black silt with plant debris and no living organisms.

Figure 55, A benthic grab sample from Dredged Hole 89 consisted of black silt with plant debris and no living organisms.

Serviceable Channels

Dredged Hole 89 can service 5.97 miles (9.6km) of state channels within a three mile (4.8km) radius from a total of four different state channels. There are three state channels that lie completely within a three mile radius of Dredged Hole 89 (Table 18), and one additional state channel partially within the three mile radius (Table 19). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 18

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
173	*Tunis Basin*	*0.34*
174	*Lakes Bay*	*3.89*
175	*Lakes Bay Spur*	*0.05*
	Total Mileage	***4.28***

Table 19

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
176	*Risleys Channel*	*1.69*
	Total Mileage	***1.69***

Dredged Hole 90

Description

Max Depth	-25.1ft MLW
Area	10.6 Acres
Minimum Draft	-4.4ft MLW

Capacity Below -12ft MLW	154,497 yds^3
Capacity Below -16ft MLW	53,962 yds^3
Capacity Below -18ft MLW	25,022 yds^3

Dredged Hole 90 is located in near Beach Thorofare west of Ventnor City in Atlantic County. This feature is bound by saltmarsh with the exception of three channels connecting the feature to adjacent baywaters.

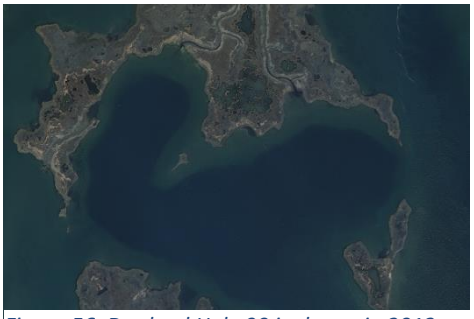


Figure 56, Dredged Hole 90 is shown in 2012 aerial photography as a dark blue feature almost completely surrounded by saltmarsh.

Digital Elevation Model

Bathymetric data collected by the CRC on February 19, 2014 was used to create the DEM for Dredged Hole 90 and the surrounding area (Figure 57). Dredged Hole 90 reaches depths of -25.1ft (-7.6m) MLW. The banks of this feature rise sharply to the elevation of the saltmarsh that surrounds it.

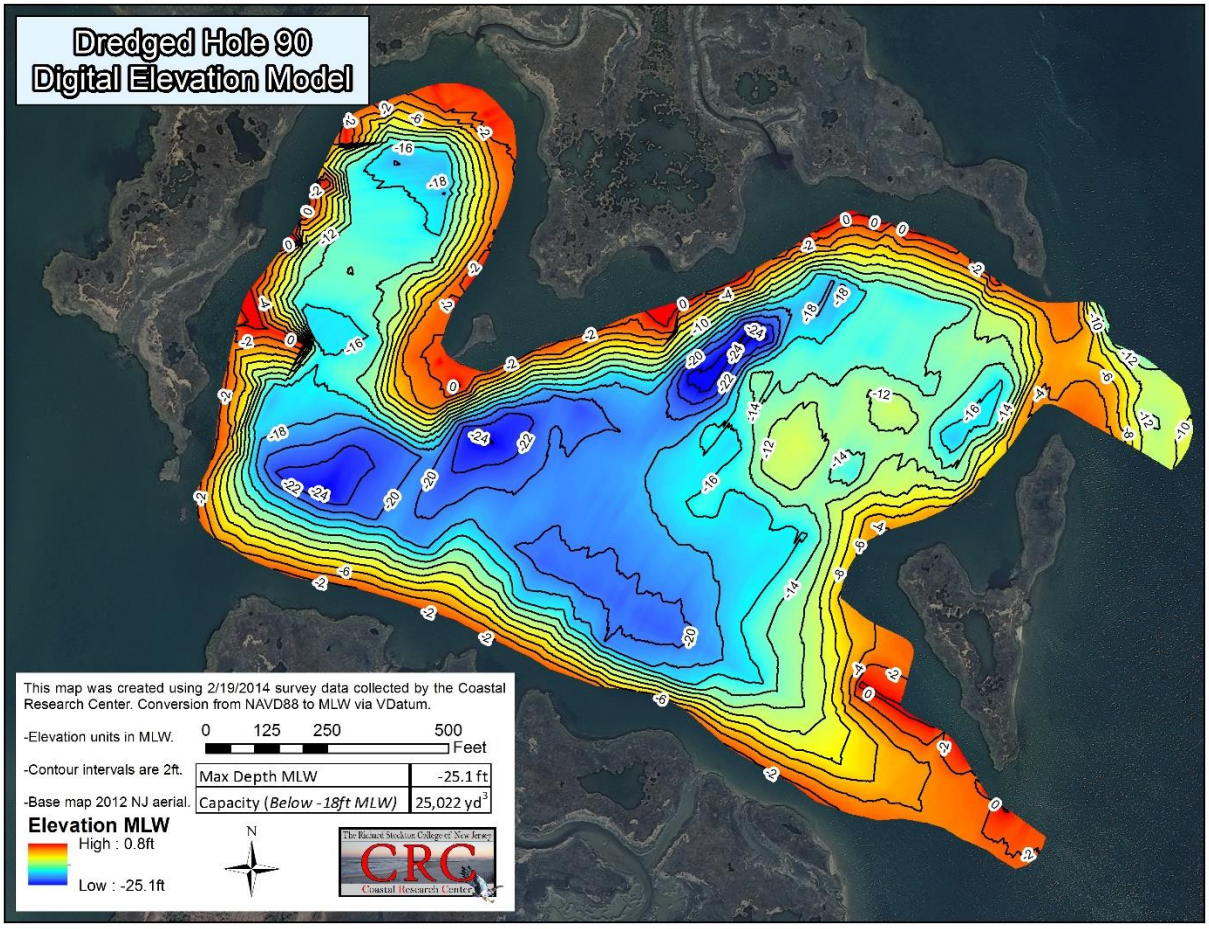


Figure 57

Water Quality/Benthic Habitat

A water quality sample was taken in Dredged Hole 90 in February 2014 and in June 2014 and a benthic grab sample taken along with the June water quality sample. Dissolved oxygen content was measured at 11.5mg/l and 5.37mg/l on February 19, 2014 and June 30, 2014, respectively. The benthic grab sample consisted of black/grey silt with few shell fragments and no living organisms.

Figure 58, a benthic grab sample from Dredged Hole 90 consisted of black/grey silt with few shell fragments and no living organisms.

Serviceable Channels

Dredged Hole 90 can service 6.12 miles (9.8km) of state channels within a three mile (4.8km) radius from a total of four different state channels. There are four state channels that lie completely within a three mile radius of Dredged Hole 90 (Table 20), with no state channels partially within the three mile radius. Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 20

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
173	*Tunis Basin*	*0.34*
174	*Lakes Bay*	*3.89*
175	*Lakes Bay Spur*	*0.05*
176	*Risleys Channel*	*1.84*
	Total Mileage	***6.12***

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
-	-	-

Dredged Hole 95

Description

Max Depth	-18.3ft MLW
Area	10.6 Acres
Minimum Draft	0.8ft MLW

Capacity Below -12ft MLW	5,354 yds³
Capacity Below -16ft MLW	545 yds³
Capacity Below -18ft MLW	4 yds³

Dredged Hole 95 is located adjacent to Patcong Creek, east of Egg Harbor Township and west of Somers Point in Atlantic County. The 1930 aerial photography shows Dredged Hole 95 had not yet been created and the area the feature currently occupies consisted of saltmarsh.

Figure 59, Dredged Hole 95 is shown in 2012 aerial photography surrounded by saltmarsh and a narrow channel connecting to Patcong Creek in the upper left of the photograph,

Digital Elevation Model

Bathymetric data collected by the CRC on November 5, 2013 was used to create the DEM for Dredged Hole 95 and the surrounding area (Figure 60). Dredged Hole 95 reached depths of -18.3ft (-5.6m) MLW in the western part of the feature. The area to the east of this dredged hole is extremely shallow and nearly all above 0ft MLW.

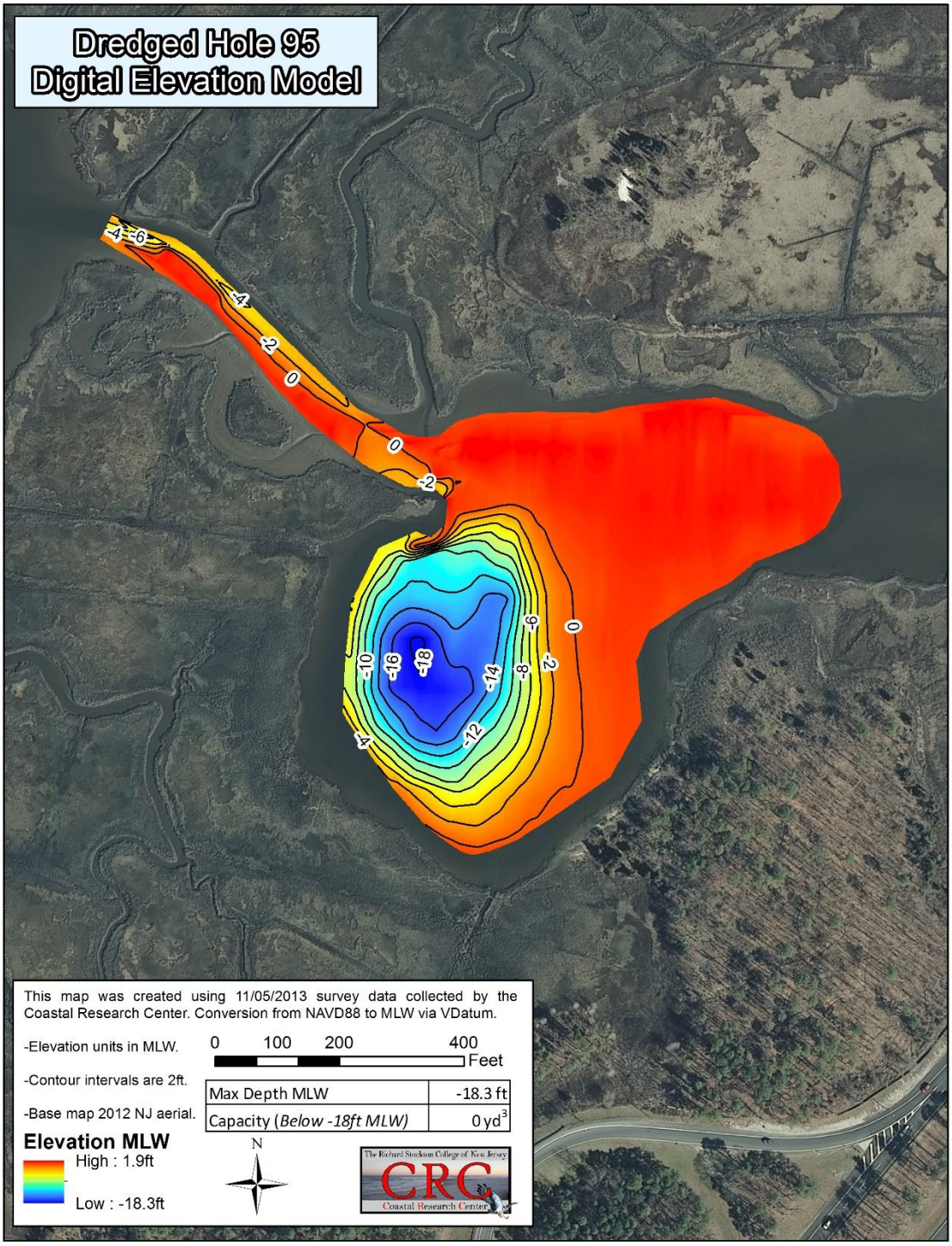

Dredged Hole 95
Digital Elevation Model
-4
-6
-4
-2
0
0
-2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
This map was created using 11/05/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.
-Elevation units in MLW.
-Contour intervals are 2ft.
-Base map 2012 NJ aerial.
0 100 200 400
Feet
Max Depth MLW -18.3 ft
Capacity (Below -18ft MLW) 0 yd3
Elevation MLW
High : 1.9ft
Low : -18.3ft
N
The Richard Stockton College of New Jersey
CRC
Coastal Research Center

Figure 60

Water Quality/Benthic Habitat

A water quality was sample was taken in Dredged Hole 95 in November 2013 and in June 2014 and a benthic grab sample taken along with the June water quality sample. Dissolved oxygen content was measured at 7.4mg/l and 0.49mg/l on November 5, 2014 and June 30, 2014, respectively. The benthic grab sample consisted of black silt and no living organisms.

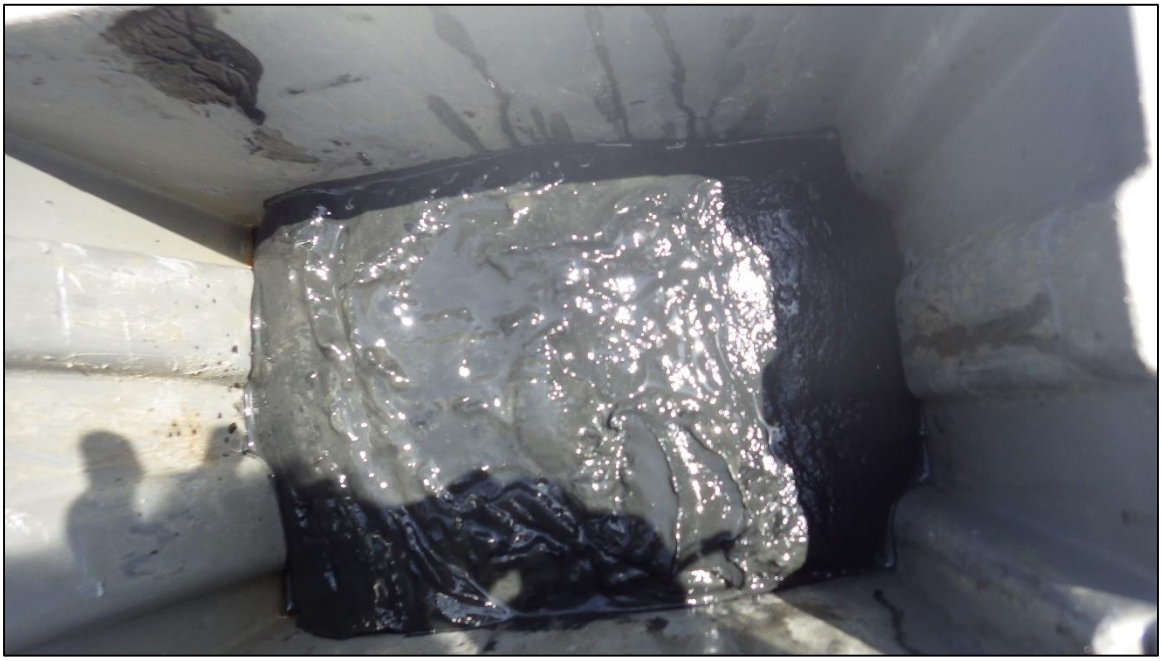


Figure 61, A benthic grab sample from Dredged Hole 95 consisted of black silt and no living organisms.

Serviceable Channels

Dredged Hole 95 can service 10.29 miles (16.5km) of state channels within a three mile (4.8km) radius from a total of four different state channels. There is one state channel that lies completely within the three mile radius of Dredged Hole 95 (Table 22), and three additional state channels are partially within the three mile radius (Table 21). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 22

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
179	*Patcong Creek*	*1.42*
	Total Mileage	***1.42***

Table 21

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
177	*Great Egg Harbor River*	*4.51*
178	*Tuckahoe River*	*0.92*
180	*Ship Channel*	*3.44*
	Total Mileage	***8.87***

Dredged Hole 118

Description

Max Depth	-18.3ft MLW
Area	18.5 Acres
Minimum Draft	-12.6ft MLW

Capacity Below -12ft MLW	47,022 yds^3
Capacity Below -16ft MLW	3,948 yds^3
Capacity Below -18ft MLW	160 yds^3

Dredged Hole 118 is located west of Wildwood Crest in Cape May County. This feature is bordered by saltmarsh to the west and urban development to the south.

Figure 62, Dredged Hole 118 is located in the center of the above 2012 aerial imagery bordered by saltmarsh to the west and open bay waters to the north.

Digital Elevation Model

Bathymetric data collected by the CRC on December 4, 2014 was used to create the DEM for Dredged Hole 118 and the surrounding area (Figure 63). Dredged Hole 118 reached depths of -18.3ft (-5.5m) MLW. Deep bay waters (-14ft [-4.2m] MLW) border the feature to the north while the steep banks on the east side rise dramatically to the elevation of the saltmarsh.

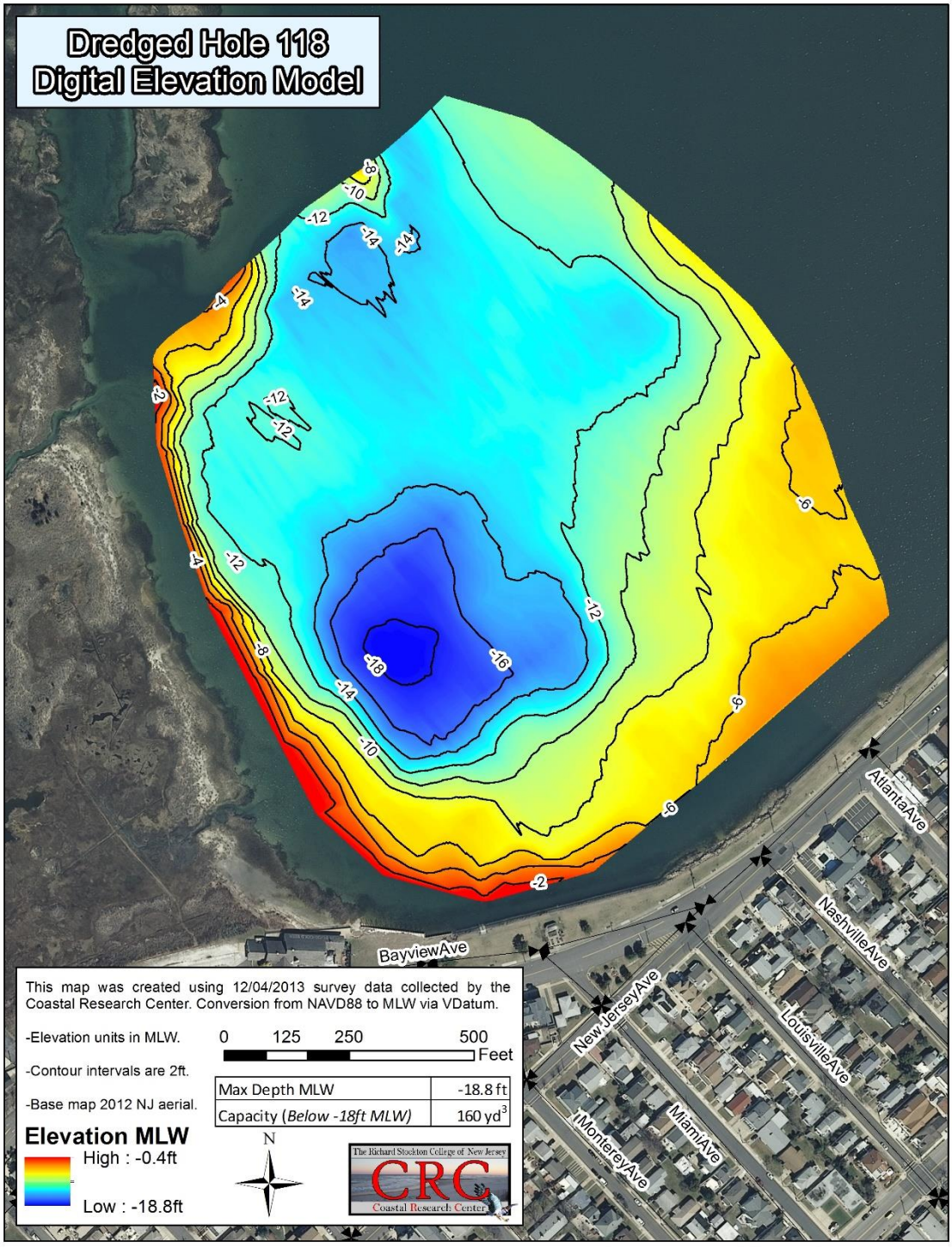

Dredged Hole 118
Digital Elevation Model
This map was created using 12/04/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.
-Elevation units in MLW.
-Contour intervals are 2ft.
-Base map 2012 NJ aerial.
0 125 250 500
Feet
Max Depth MLW -18.8 ft
Capacity (Below -18ft MLW) 160 yd3
Elevation MLW
High : -0.4ft
Low : -18.8ft
N
The Richard Stockton College of New Jersey
CRC
Coastal Research Center
BayviewAve
AtlantaAve
NashvilleAve
LouisvilleAve
MiamiAve
MontereyAve
New JerseyAve

Figure 63

Water Quality/Benthic Habitat

A water quality sample was taken in Dredged Hole 118 in December 2013. Dissolved oxygen content was measured at 10.57mg/l and 0.49mg/l on December 4, 2014. No benthic grab samples were taken at this location.

Serviceable Channels

Dredged Hole 118 can service 3.69 miles (5.9km) of state channels within a three mile (4.8km) radius from a total of seven different state channels. There are six state channels that lie completely within a three mile radius of Dredged Hole 118 (Table 23), and one additional state channel partially within the three mile radius (Table 24). Mileage of channels partially within the three mile buffer is calculated only from the portion of the channel that falls within the buffer.

Table 23

Channels Completely Within 3 Miles		
Channel ID	*Channel Name*	*Length (miles)*
200	*Ottens Harbor*	*0.69*
201	*Ottens Canal (Lagoon)*	*0.10*
202	*West Wildwood Channel*	*0.29*
203	*Ottens Canal*	*0.61*
204	*Sunset Lake Channel*	*1.33*
205	*Middle Thorofare Lagoon*	*0.29*
	Total Mileage	***3.31***

Table 24

Channels Partially Within 3 Mile Buffer		
Channel ID	*Channel Name*	*Length (miles)*
199	*Beach Creek 2*	*0.38*
	Total Mileage	***0.38***

Discussion

Restoring habitat within former dredged holes using dredged material from nearby channels provides a unique opportunity for ecological enhancement within New Jersey's coastal waterways while assisting the NJDOT in its state navigation maintenance efforts. These types of restoration projects have the potential to become commonplace as more attempts are made to return human altered systems to a more natural state. While the goal of this activity is to restore degraded benthic habitat within New Jersey's coastal waterways, it will be imperative for future projects that proper data collection methods are established to effectively document degraded habitat within a dredged hole. This study classified five priority dredged holes that were based on degraded benthic habitat and individual capacity for receiving dredged material. Additionally, ten dredged holes were identified as candidate sites and were not upgraded to priority sites largely due to hypoxic conditions not being observed during field reconnaissance. Field sampling results from candidate sites indicate that benthic habitats are azoic (based on low DO readings and benthic grab samples), which suggests that hypoxia occurs in these features for extended periods of time even though dissolved oxygen below 2 mg/l was not observed on the day of the field survey.

Priority Site Selection

Data gathered for selecting priority sites to be used for the dual benefit of habitat restoration and receiving dredged material must identify degraded habitat that will benefit from the placement of dredged material. Criteria for identifying potential placement sites should include measures that satisfy permitting requirements and adequate dredged hole capacity that could alleviate shoaling of navigable waterways. These criteria may change as we learn from additional studies, alteration of restorations methods, and the establishment of permitting requirements. Under this current assessment, priority sites were determined from the presence of hypoxic conditions during field reconnaissance surveys as well as available dredged hole capacity and the need for dredging in the area. Measures of these criteria may vary from current standards due to the environmental conditions that affect water quality and future investigations into different restoration designs. Elimination of any dredged hole from consideration of future restoration based on the available data is premature. The majority of dredged holes identified in this report could be reconsidered for restoration with additional data or if new restoration methods become available.

Hypoxia & Degraded Habitat

Hypoxia within these features is dynamic state that changes with seasons and weather patterns. Though benthic sampling indicates nearly all of the candidate dredged holes are azoic and that hypoxia occurs for extended periods of time, dissolved oxygen levels less than 2mg/l were not observed in many of them. Assessing relatively persistent environmental parameters that result from hypoxia may provide a more consistent means of identifying dredged holes that experience hypoxia and have potential to be priority sites. Water quality sampling was performed by Versar in Dredged Hole 101 (USACE #35) in September of 2002 and February of 2000 prior to permitting and did not find hypoxic conditions during the time of the surveys. Versar (2002) determined that hypoxia occurred for extended periods from azoic conditions observed in grab samples and the presence of hydrogen sulfide (a result of bacteria breaking down organic material in the absence of oxygen) at the bottom of the dredged hole. For hypoxia to be documented solely by dissolved oxygen content, continuous or more frequent water quality monitoring efforts may have to be applied.

Capacity

Capacity of dredged holes has potential to change as habitat restoration practices are modified and gain acceptance. The current guidelines for habitat restoration of dredged holes has loosely been established by the restoration of Dredged Holes 50 (USACE #5) and 101 (USACE #35) to an elevation of -18ft (-5.5m) MLW. While placement of dredged material to a depth of -18ft (-5.5m) MLW has been documented to improve habitat (USACE, 2003), placement of material to shalow depths and restoration of dredged holes to saltmarsh elevations may have even greater benefits to habitat (USACE, 2010). The USACE (2009) suggested restoring dredged holes to a target dissolved oxygen content of 6mg/l at the bottom of the feature due to the oxygen requirement of various finfish and benthic organisms. Water quality surveys performed by the CRC for this project indicate that target elevations for the restoration of dredged holes may be significantly less than -18ft (-5.5m) MLW and require significantly more dredged material to achieve a dissolved oxygen content of 6mg/l at the bottom. For example, field readings of dissolved oxygen for priority Dredged Hole #78 show persistent hypoxic conditions at -16ft (-4.9m) MLW and below the 6mg/l target dissolved oxygen level at -6ft (-1.8m) MLW. Raising the bottom elevations to the -6ft (-1.8m) MLW depth would not only dramatically increase the capacity for dredged material, but also has the potential of significantly improving local benthic habitat.

Recommendations

Habitat Restoration of Priority Dredged Holes

The project team recommends five priority dredged holes for potential habitat restoration (18, 25, 78, 86 (USACE #34), and 93). These dredged holes provide opportunities for the dual benefit of restoring degraded habitat and alleviating shoaling of navigation channels through the beneficial use of dredged material. Water quality surveys and benthic grab samples confirm hypoxia is occurring in these dredged holes and that the benthic habitat is azoic. Through the placement of dredged material the bottom of these dredged holes can be raised to shallower depths limiting the stratification of the water column and subsequent stagnation and hypoxia. An engineering feasibility analysis was completed by OCC for each priority site to identify appropriate dredged material placement methodologies and the need for any pre-placement dredging or engineering designs (Appendix B).

Candidate and Non-Priority Dredged Holes

Though only five of the 122 features in the dredged hole database are classified as priority sites, many non-priority sites may offer opportunities for dredged material placement and habitat restoration, particularly if permit requirements are established to allow restoration of dredged holes to shallower depths than allowed in previous restoration efforts. Nearly all candidate sites have the potential to be classified as priority sites as field reconnaissance surveys suggest that the benthic habitat is azoic. The discriminating factors in preventing these holes from being classified as priority sites were largely hypoxic dissolved oxygen levels recorded during the reconnaissance surveys and the limited available capacities calculated from bathymetric survey data (if filled to -18ft [-5.5m] MLW). Continuous or more frequent water quality monitoring is expected to document hypoxia in many of these features as benthic grab sampling indicates that these dredged holes are experiencing hypoxia for extended periods of time. Based on the dredging needs in a given area (and a lack of available placement options), if a candidate site is found to be proximal to a shoaled state channel, the project team recommends further investigation into whether the site experiences hypoxia and if habitat restoration is appropriate.

Permitting Requirements

Restoration of dredged holes in New Jersey's coastal bays is a relatively new and infrequent practice which does not have guidelines defined by the regulatory agencies for permitting the placement of dredged material to improve habitat within these features. Restoration of only two dredged holes (52 [USACE # 6] and 101 [USACE #35]) provide the only (unofficial) guidelines for successful implementation of this type of work (see Versar, 2002 and USACE, 2003). The project team recommends establishing a set of specific guidelines based on previous restoration efforts, research and expert knowledge.

References

Barone, D.A., Farrell, S.C., Howard, B.S., Flynn, M.J., 2013. New Jersey Dredged Hole Assessment: Bass River and Drag Island Dredged Holes. The Richard Stockton College Coastal Research Center.

Cox, J.L.J., 2003. Phase 1A Cultural Resources Reconnnaissance New Jersey Intracoastal Waterway Cape May, Atlantic, and Ocean Counties, New Jersey. Dolan Research, Inc.

Guan, W., Chamberlain, R.H., Sabol, B.M., Doering, P.H., 1999. Mapping submerged aquatic vegetation with GIS in the Caloosahatchee Estuary: evaluation of different interpolation methods. Mar. Geod. 22, 69–91.

Molly, R., Piercy, C., Jarvis, J., Sabol, B., Macon, C., 2012. Ground Truth Sampling to Support Remote Sensing Research and Development: Submersed Aquatic Vegetation Species Discrimination Using an Airborne Hypers pectral/L idar S ys tem. ERDC TN-DOER-E30.

Murawski, W.S., 1969. A Study of Submerged Dredge Holes in New Jersey Estuaries with Respect to Their Fitness as Finfish Habitat. New Jersey Department of Environmental Protection, Bureau of Marine Fisheries.

Parsons Brinckerhoff, 2013. Emergency Protective Measures/Superstorm Sandy Response In State Channels (Technical Memorandum), Methodology/Results. New Jersey Office of Emergency Management, Trenton, NJ.

Reine, K., Clarke, D., Ray, G., Dickerson, C., 2012. Fishery resource utilization of a restored estuarine borrow pit: A beneficial use of dredged material case study Technical Note ERDC TN-DOER-E33. Vicksburg, MS, U.S. Army Engineer Research and Development Center, 30pp.

Sabol, B., Lord, E., Reine, K., Shafer, D., 2008. Comparison of acoustic and aerial photographic methods for quantifying the distribution of submersed aquatic vegetation in Sagamore Creek, NH. DTIC Document.

Sabol, B., Melton, E., Shafer, D., Jarvis, J., Evert, S., Loyd, R., 2014. SAVEWS Jr. User's Manual, Version 1.0. U.S. Army Corps of Engineers, Engineer Research and Development Center.

Sabol, B.M., Melton, R.E., Chamberlain, R., Doering, P., Haunert, K., 2002. Evaluation of a digital echo sounder system for detection of submersed aquatic vegetation. Estuaries 25, 133–141.

Sabol, B., Shafer, D.J., Lord, E., 2005. Dredging effects on eelgrass (Zostera marina) in a New England small boat harbor. J. Mar. Environ. Eng. 8, 57–81.

Submerged aquatic vegetation (SAV) CRSSA image classification of the Barnegat Bay - Little Egg Harbor estuary, New Jersey: 2009, 2009. , Submerged aquatic vegetation (SAV) mapping of Barnegat Bay and Little Egg Harbor, New Jersey. Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University.

USACE, 2009. New Jersey Intracoastal Waterway Ecosystem Restoration Feasibility Study. U.S. Army Corps of Engineers, Philadelphia and The New Jersey Department of Environmental Protection District and the New Jersey Department of Environmental Protection.

USACE, 2010. Environmental Assessment Dredged Hole #35 Restoration and Beneficial Use of Dredged Material Cape May County, New Jersey. Philadelphia District U.S. Army Corps of Engineers.

USACE, 2014. New Jersey Intracoastal Waterway Dredged Hole 34 Restoration: Philadelphia District Marine Design Center Fact Sheet (Technical Report to the New Jersey Department of Transportation, Office of Maritime Resources, Trenton, New Jersey). U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers, Philadelphia and The New Jersey Department of Environmental Protection District, 2003. Environmental Restoration of Dredged Hole #6 Barnegat Bay, New Jersey Feasibility Report & Environmental Assessment. U.S. Army Corps of Engineers, Philadelphia and The New Jersey Department of Environmental Protection District.

Versar, 2000. Winter Fish and Blue Crab Survey for Dredged Holes Number 5 and 6 in Barnegat Bay and Holes 34 and 35 Near Atlantic City, New Jersey. US Army Corps of Engineers, Philadelphia, PA.

Versar, 2002. Water, Sediment, and Biological Monitoring for an Ongoing Feasibility Study of the New Jersey Intracostal Waterway, New Jersey (Technical Report). US Army Corps of Engineers, Philadelphia, PA.

Table of Conversion Factors, Non-SI to SI (US EPA- http://www.epa.gov/greatlakes/arcs/EL-90-25/conv.gif)

CONVERSION FACTORS, NON-SI TO SI (METRIC)
UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
atmospheres, standard	101.325	kilopascals
British thermal units (mean)	1,055.87	joules
centipoises (dynamic viscosity)	0.001	pascal-seconds
cubic feet	0.02831685	cubic meters
cubic yards	0.7645549	cubic meters
degrees (angle)	0.01745329	radians
Fahrenheit degrees	5/9	Celsius degrees or kelvins*
feet	0.3048	meters
gallons (US liquid)	3.785412	cubic decimeters
inches	2.54	centimeters
miles (US nautical)	1.852	kilometers
miles (US statute)	1.609347	kilometers
pounds (force) per square inch	6.894757	kilopascals
pounds (mass)	0.4535924	kilograms
pounds (mass) per ton	0.0005	kilograms
square feet	0.09290304	square meters
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

Appendices

A. Dredged Hole Index
B. Water Quality Data
C. NJ Dredged Hole Analysis (OCC, 2014)

New Jersey Dredged Holes Index

NJ Coastal Bays

January 2015

Prepared for:

New Jersey Department of Transportation
Bureau of Research
&
Office of Maritime Resources
Project No. 2013-10

Prepared by:
B. Steven Howard
Daniel A. Barone
Alex Ferencz
Marcus Gruver
Mat Suran
Kimberly K. McKenna

The Richard Stockton College of New Jersey
Coastal Research Center
Phone: (609) 652-4245
Fax: (609) 748-0656

Contents

Dredged Hole Index

The New Jersey Dredged Hole Index consists of 122 delineations of submerged features throughout New Jersey's coastal bays that are considered either dredged holes or areas of interest that bear a resemblance to dredged holes (i.e. meadow cuts). Of the 122 delineations 38 were provided by the U.S. Army Corps of Engineers (USACE) and were first identified by Murawski [1].

Delineation Methods

The Richard Stockton College of New Jersey Coastal Research Center (CRC) completed a literature review and collection of existing information related to dredged hole location, history, current status, and any other available data. The majority of the pre-existing detailed information for dredged holes within New Jersey's coastal waterways was provided by the USACE and New Jersey Department of Environmental Protection (NJDEP) (see Table 1 in the main report).

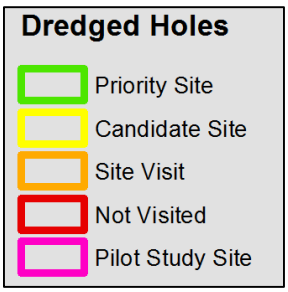
All of the existing data from the referenced reports were combined with dredged hole delineations identified by the CRC staff using ESRI's geographic information system (GIS) software, ArcGIS, through the use of aerial photography and navigation charts. ArcGIS was used to populate a geodatabase with the dredged hole information provided by the USACE and those identified by the CRC. Digital and paper maps were produced that showed the locations of the dredged holes, coastal channels, and thorofares and were used to support discussions and decisions by the project working group that was comprised of staff from New Jersey Department of Transportation/Office of Maritime Resources (NJDOT-OMR), New Jersey Department of Transportation/Bureau of Research (NJDOT-Bureau of Research), Ocean and Coastal Consultants (OCC), and the CRC.

Dredged Hole Identification Numbers

Since the majority of the features identified and delineated as a result of this investigation have not been previously catalogued, a numerical identification (ID) number was assigned to each feature in the dredged hole database. The ID numbers ascend from north to south with the exception of three features (120, 121, and 122) that were identified following the initial labeling scheme. A number of dredged holes were previously identified by Murawski (1969) and the USACE. These identification numbers were not maintained in the new identification scheme; however, these IDs are maintained as a secondary ID, "USACE ID".

Dredged Hole Classifications

All of the submerged features in the dredged hole index are symbolized using five classifications that represent the amount of data obtained for this review:



Priority Sites: Five priority sites were chosen from discussions of the findings from field reconnaissance and bathymetric surveys with the project working group. The priority sites were determined to be the most suitable for dredged material placement considering the following criteria:

- Capacity of dredged hole to receive dredged material for proximal state channels.

[1] *A Study of Submerged Dredge Holes in New Jersey Estuaries with Respect to Their Fitness as Finfish Habitat*.

- Dissolved oxygen levels displaying hypoxia (dissolved oxygen content less than 2 mg/l) during field reconnaissance surveys.
- Degraded benthic environment conditions based on field grab samples.
- State navigation channel dredging needs proximal to the dredged hole.

Candidate: Candidate sites were identified during the reconnaissance field surveys and are defined as deeper than 18 feet measured by the on-board depth sounder. Candidate sites were deep enough to warrant a bathymetric survey, benthic grab sample and bottom water quality reading at the deepest location within the dredged hole during the reconnaissance field survey. The -18-foot (-5.5m) water depth threshold was chosen from discussions with the project working group regarding sufficient space for potential fill placement and the recommendation from a previous study to fill a dredged hole to an elevation of -18ft MLW[2].

Site Visit: Criteria for a dredged hole to be considered for a field site visit included:

- Clearly defined in aerial photography or previously identified by USACE and/or NJDEP
- Proximity to state navigation channel
- Sufficient acreage (qualitative assessment)
- Dredging need in vicinity of suspected dredged hole

Not Visited: These sites were delineated but were not visited during this assessment.

Pilot Study Site: Bathymetric, water quality, and benthic community surveys were completed by Barone and others[3] during a pilot study.

Supplemental Map Layer Credits

Aerial Photography, March through April 2012: NJ Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS)

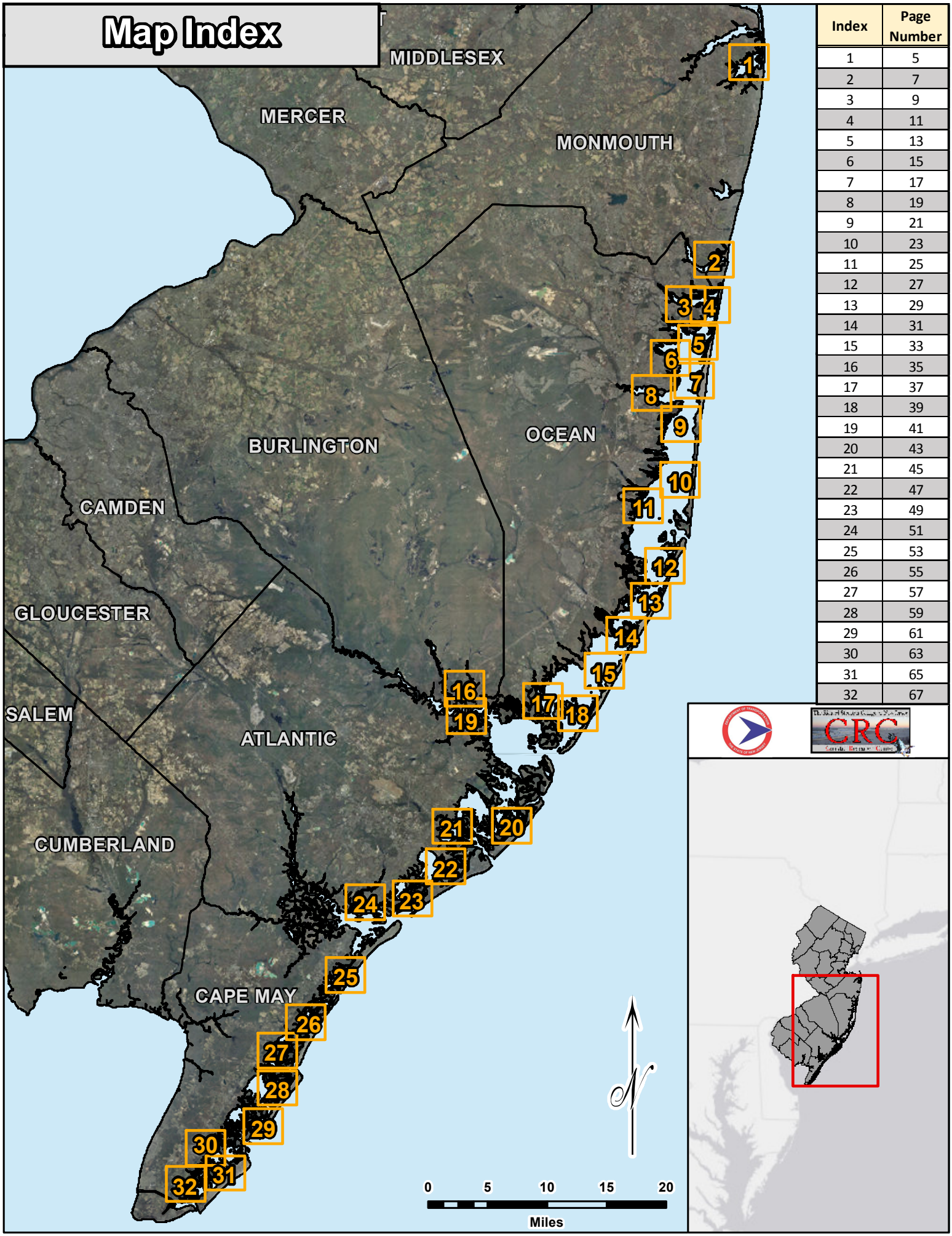
State Channel Delineations: NJDEP BCE (Bruce Clark and Chris Steffieri), NJDOT-OMR (Genevieve Boehm),GeoDecisions (Nick Hutton)

Municipal Boundary Delineations: NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)

[2] U.S. Army Corps of Engineers, Philadelphia and The New Jersey Department of Environmental Protection District, *Environmental Restoration of Dredged Hole #6 Barnegat Bay, New Jersey Feasibility Report & Environmental Assessment*; USACE, *New Jersey Intracoastal Waterway Ecosystem Restoration Feasibility Study*; USACE, *Environmental Assessment Dredged Hole #35 Restoration and Beneficial Use of Dredged Material Cape May County, New Jersey*.

[3] Barone et al., *New Jersey Dredged Hole Assessment: Bass River and Drag Island Dredged Holes*.

Map Index



Index	Page Number
1	5
2	7
3	9
4	11
5	13
6	15
7	17
8	19
9	21
10	23
11	25
12	27
13	29
14	31
15	33
16	35
17	37
18	39
19	41
20	43
21	45
22	47
23	49
24	51
25	53
26	55
27	57
28	59
29	61
30	63
31	65
32	67

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
1	-	Not Visited	MONMOUTH	2012 Orthos	10.62	*n/a*	*n/a*	*n/a*	*n/a*	40.35	-73.98	
2	-	Not Visited	MONMOUTH	2012 Orthos	0.13	*n/a*	*n/a*	*n/a*	*n/a*	40.34	-74.00	
3	-	Not Visited	MONMOUTH	2012 Orthos	4.57	*n/a*	*n/a*	*n/a*	*n/a*	40.33	-74.00	

Map: 1

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

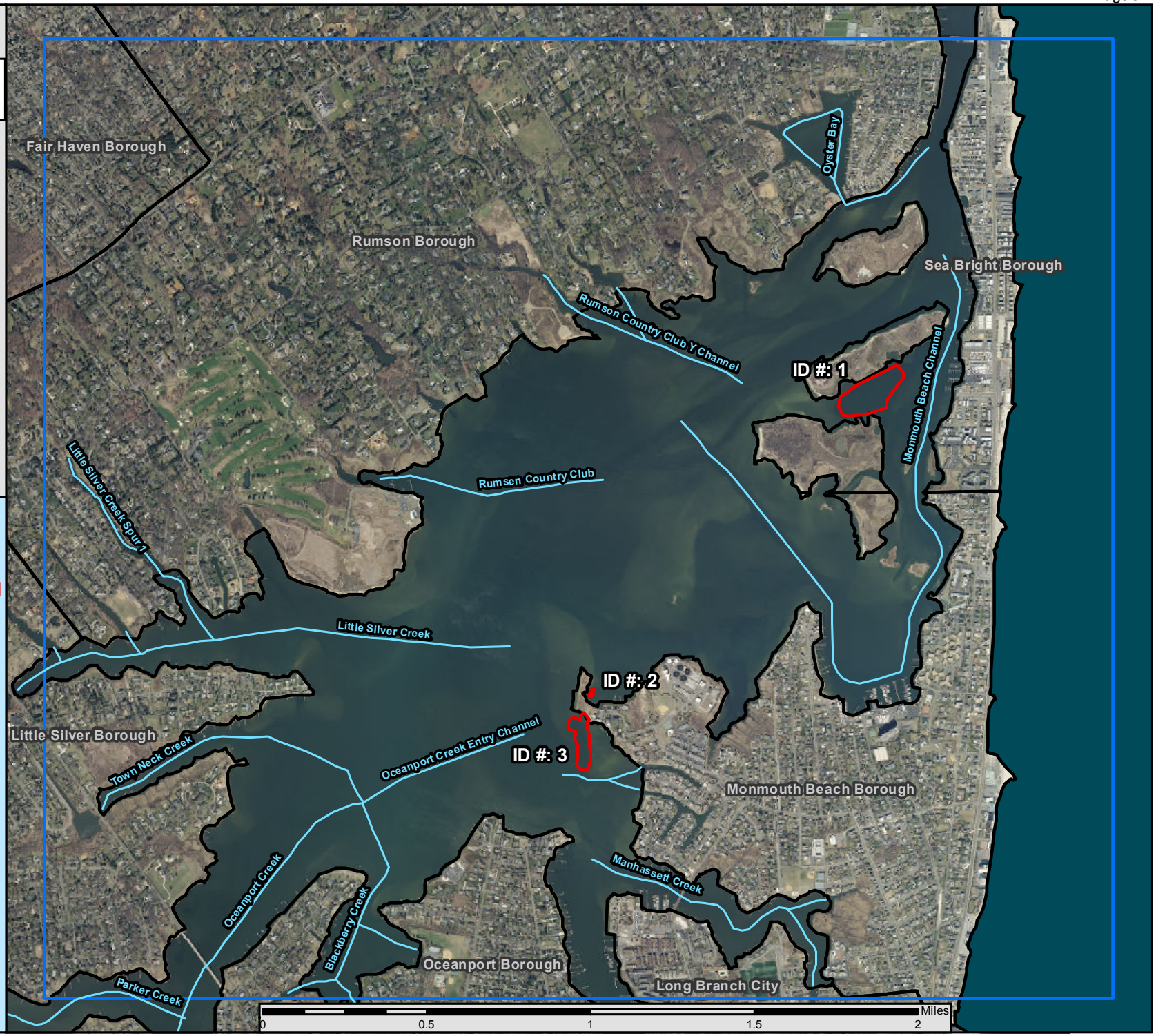
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
4	15	Not Visited	MONMOUTH	ACE	2.23	*n/a*	*n/a*	*n/a*	*n/a*	40.09	-74.07	

Map: 2

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Sea Girt Borough

Manasquan Borough

Wall Township

Watsons Creek

Crabtown Creek

Brielle Borough

KINGS BRIDGE CHANNEL

Wills Hole Thorofare

Wills Hole West

Brick Township

Clarke's Landing

Lower Manasquan River

ID #: 4

ACE ID #: 15

Point Pleasant Beach Borough

Point Pleasant Borough

Miles

0 0.5 1 1.5 2

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
6	31	Site Visit	OCEAN	ACE	15.48	*n/a*	*n/a*	*n/a*	*n/a*	40.05	-74.11	Small feature, ~17-20ft depth
13	-	Not Visited	OCEAN	2012 Orthos	6.50	*n/a*	*n/a*	*n/a*	*n/a*	40.03	-74.08	
14	-	Not Visited	OCEAN	2012 Orthos	1.95	*n/a*	*n/a*	*n/a*	*n/a*	40.03	-74.07	

Map: 3

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

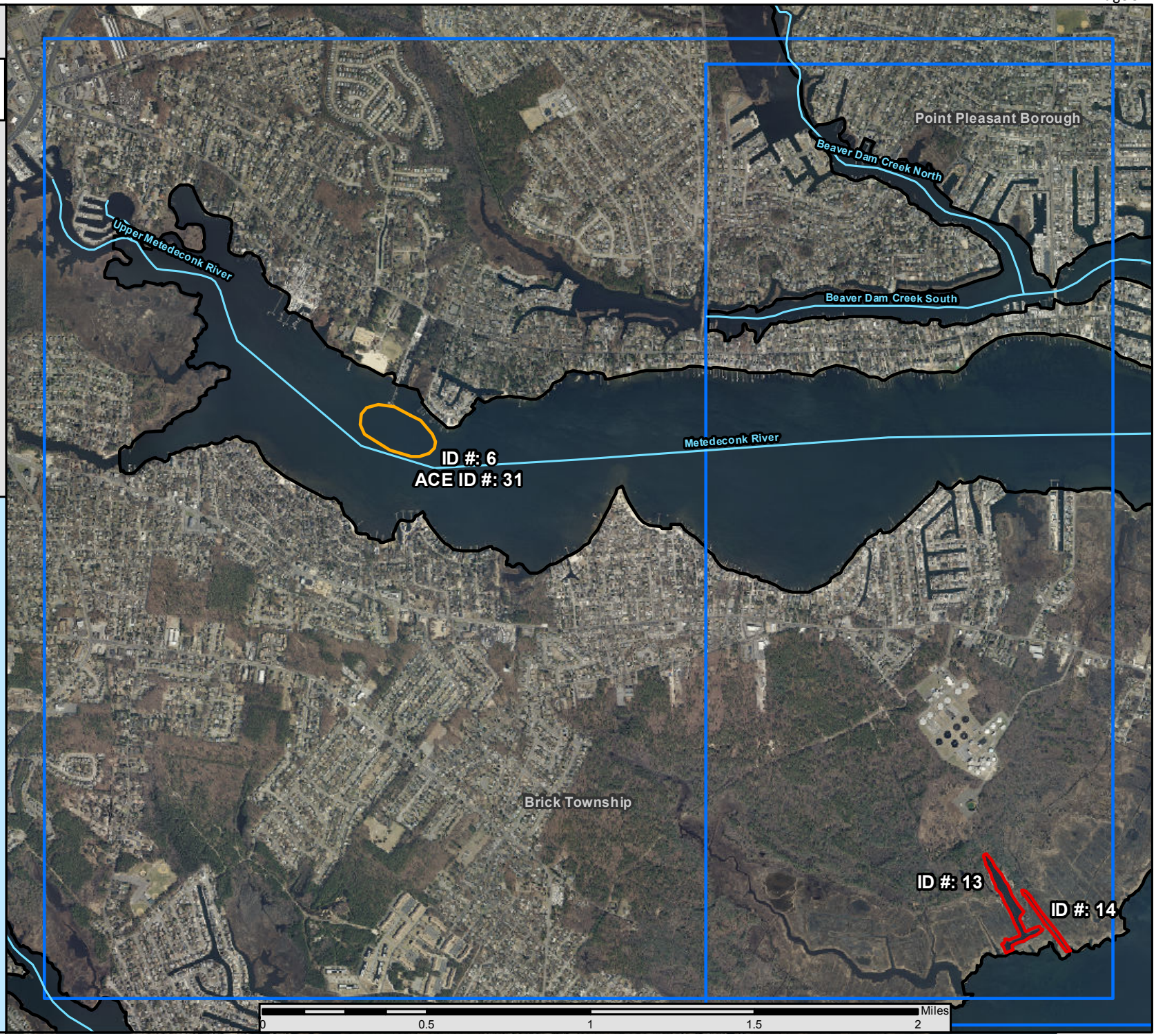
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
5	16	Site Visit	OCEAN	ACE	33.93	*n/a*	*n/a*	*n/a*	*n/a*	40.06	-74.05	~15ft max depth, mid-channel
7	-	Not Visited	OCEAN	2012 Orthos	1.82	*n/a*	*n/a*	*n/a*	*n/a*	40.05	-74.06	
8	-	Not Visited	OCEAN	2012 Orthos	4.67	*n/a*	*n/a*	*n/a*	*n/a*	40.04	-74.06	
9	14	Not Visited	OCEAN	ACE	7.86	*n/a*	*n/a*	*n/a*	*n/a*	40.05	-74.05	
10	7	Not Visited	OCEAN	ACE	1.80	*n/a*	*n/a*	*n/a*	*n/a*	40.04	-74.05	
11	-	Not Visited	OCEAN	2012 Orthos	1.61	*n/a*	*n/a*	*n/a*	*n/a*	40.04	-74.05	
12	-	Not Visited	OCEAN	2012 Orthos	0.77	*n/a*	*n/a*	*n/a*	*n/a*	40.03	-74.05	
13	-	Not Visited	OCEAN	2012 Orthos	6.50	*n/a*	*n/a*	*n/a*	*n/a*	40.03	-74.08	
14	-	Not Visited	OCEAN	2012 Orthos	1.95	*n/a*	*n/a*	*n/a*	*n/a*	40.03	-74.07	

Map: 4

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

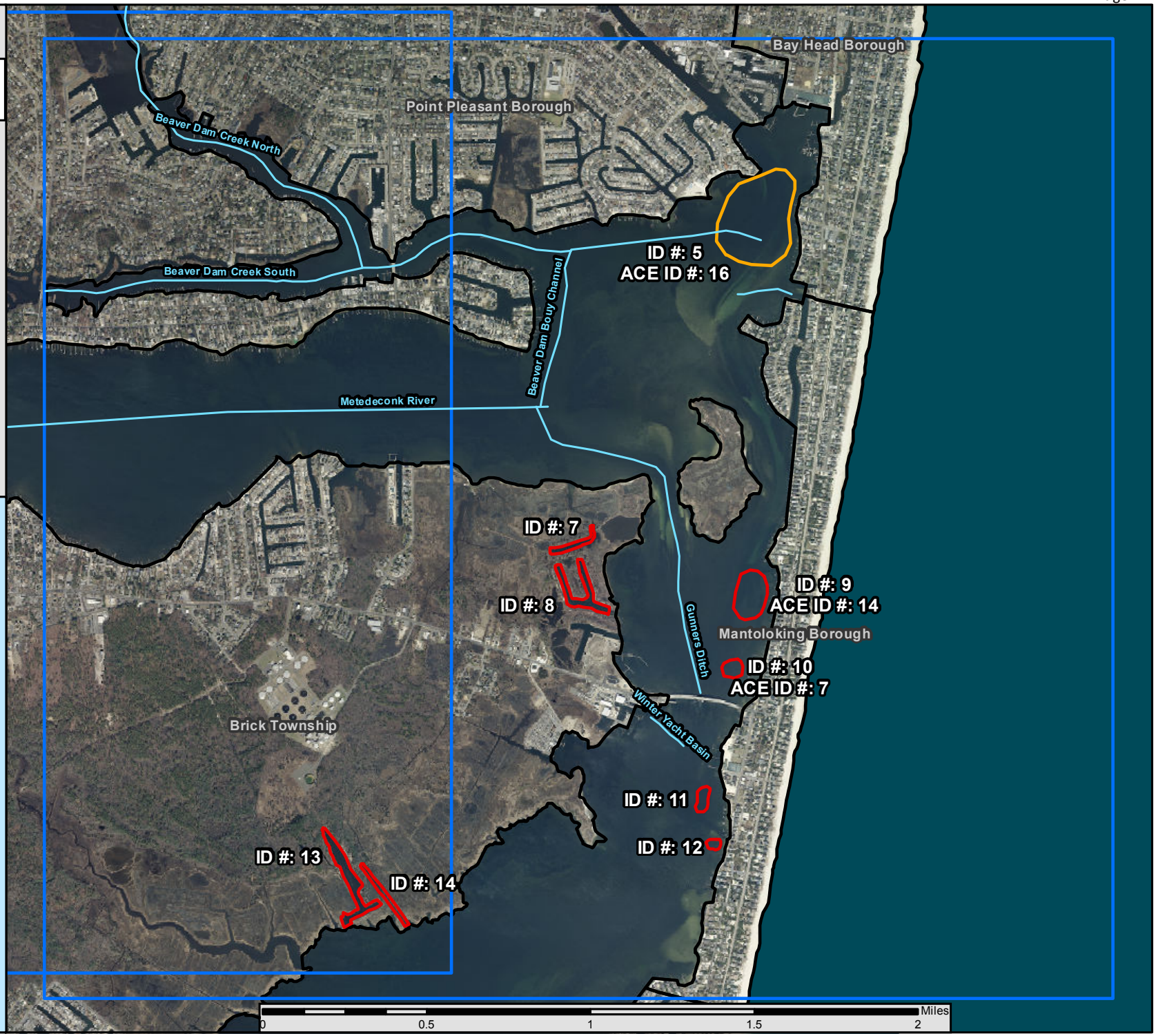
Pilot Study Site

N

Base aerial photography: 2012

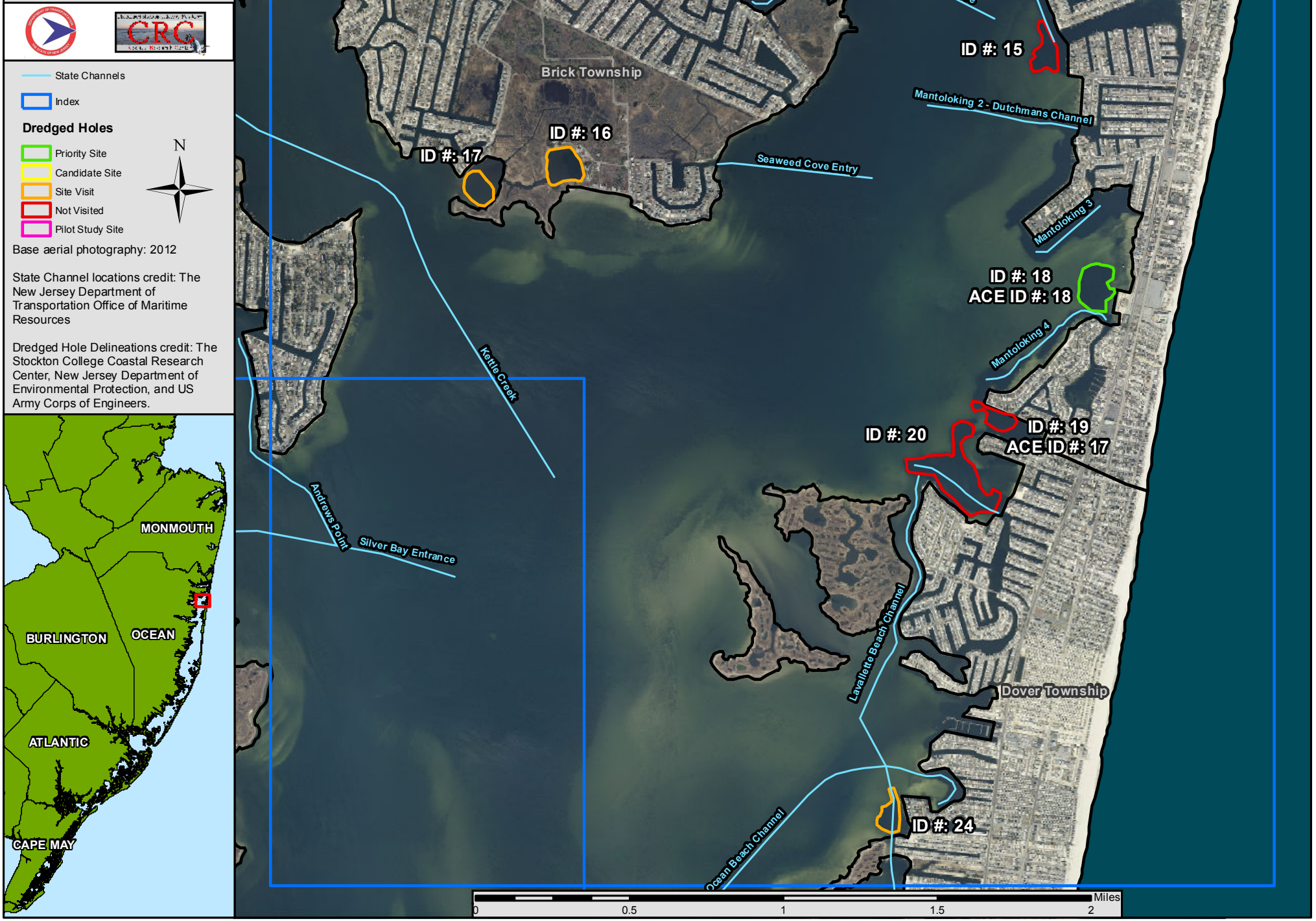
State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
15	-	Not Visited	OCEAN	2012 Orthos	5.62	*n/a*	*n/a*	*n/a*	*n/a*	40.02	-74.06	
16	-	Site Visit	OCEAN	2012 Orthos	7.42	*n/a*	*n/a*	*n/a*	*n/a*	40.02	-74.09	No access, Too shallow
17	-	Site Visit	OCEAN	2012 Orthos	4.99	*n/a*	*n/a*	*n/a*	*n/a*	40.01	-74.10	No access, Too shallow <2ft depth
18	18	Priority Site	OCEAN	ACE	8.95	-22.6	69,930	28,703	11,852	40.01	-74.06	~24ft max depth
19	17	Not Visited	OCEAN	ACE	3.85	*n/a*	*n/a*	*n/a*	*n/a*	40.00	-74.07	
20	-	Not Visited	OCEAN	2012 Orthos	21.53	*n/a*	*n/a*	*n/a*	*n/a*	40.00	-74.07	
24	-	Site Visit	OCEAN	2012 Orthos	4.13	*n/a*	*n/a*	*n/a*	*n/a*	39.98	-74.07	~12-15ft depths

Map: 5


State Channels
Index
Dredged Holes
Priority Site
Candidate Site
Site Visit
Not Visited
Pilot Study Site
N
Base aerial photography: 2012
State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources
Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.
MONMOUTH
BURLINGTON
OCEAN
ATLANTIC
CAPE MAY
Havens Cove
Brick Township
ID #: 15
Mantoloking 2 - Dutchmans Channel
ID #: 16
ID #: 17
Seaweed Cove Entry
Mantoloking 3
ID #: 18
ACE ID #: 18
Mantoloking 4
Kettle Creek
ID #: 20
ID #: 19
ACE ID #: 17
Andrews Point
Silver Bay Entrance
Lavallette Beach Channel
Dover Township
ID #: 24
Ocean Beach Channel
Miles
0
0.5
1
1.5
2

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
21	20	Not Visited	OCEAN	ACE	6.70	*n/a*	*n/a*	*n/a*	*n/a*	40.00	-74.12	
22	21	Not Visited	OCEAN	ACE	3.85	*n/a*	*n/a*	*n/a*	*n/a*	40.00	-74.14	
23	-	Not Visited	OCEAN	2012 Orthos	12.29	*n/a*	*n/a*	*n/a*	*n/a*	39.99	-74.13	
26	19	Not Visited	OCEAN	ACE	4.23	*n/a*	*n/a*	*n/a*	*n/a*	39.97	-74.11	

Map: 6

State Channels

Index

Dredged Holes

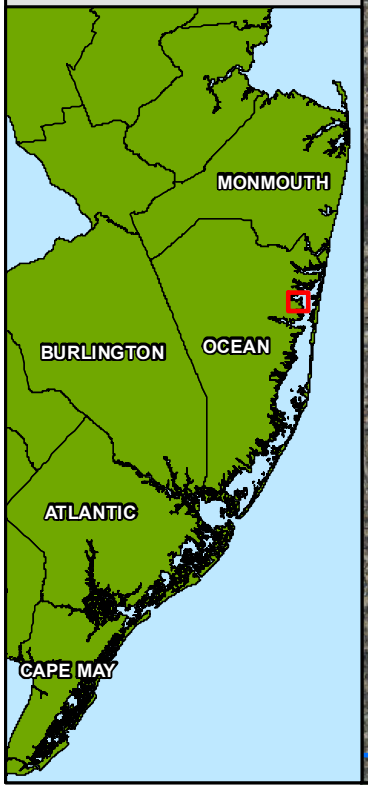
- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



ID #: 21
ACE ID #: 20

ID #: 22
ACE ID #: 21

ID #: 23

ID #: 26
ACE ID #: 19

Silver Bay

Silver Bay Entrance

Andrews Point

Kettle Creek

Dover Township

Ocean Beach Channel

Goose Creek

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
25	-	Priority Site	OCEAN	2012 Orthos	18.69	-20.5	104,638	27,067	4,328	39.97	-74.08	~20ft max depth
26	19	Not Visited	OCEAN	ACE	4.23	*n/a*	*n/a*	*n/a*	*n/a*	39.97	-74.11	
27	-	Not Visited	OCEAN	2012 Orthos	1.03	*n/a*	*n/a*	*n/a*	*n/a*	39.96	-74.09	
28	-	Site Visit	OCEAN	2012 Orthos	10.41	*n/a*	*n/a*	*n/a*	*n/a*	39.95	-74.09	~12-13ft max depth
32	-	Site Visit	OCEAN	2012 Orthos	4.50	*n/a*	*n/a*	*n/a*	*n/a*	39.94	-74.09	~10ft deep

Map: 7

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

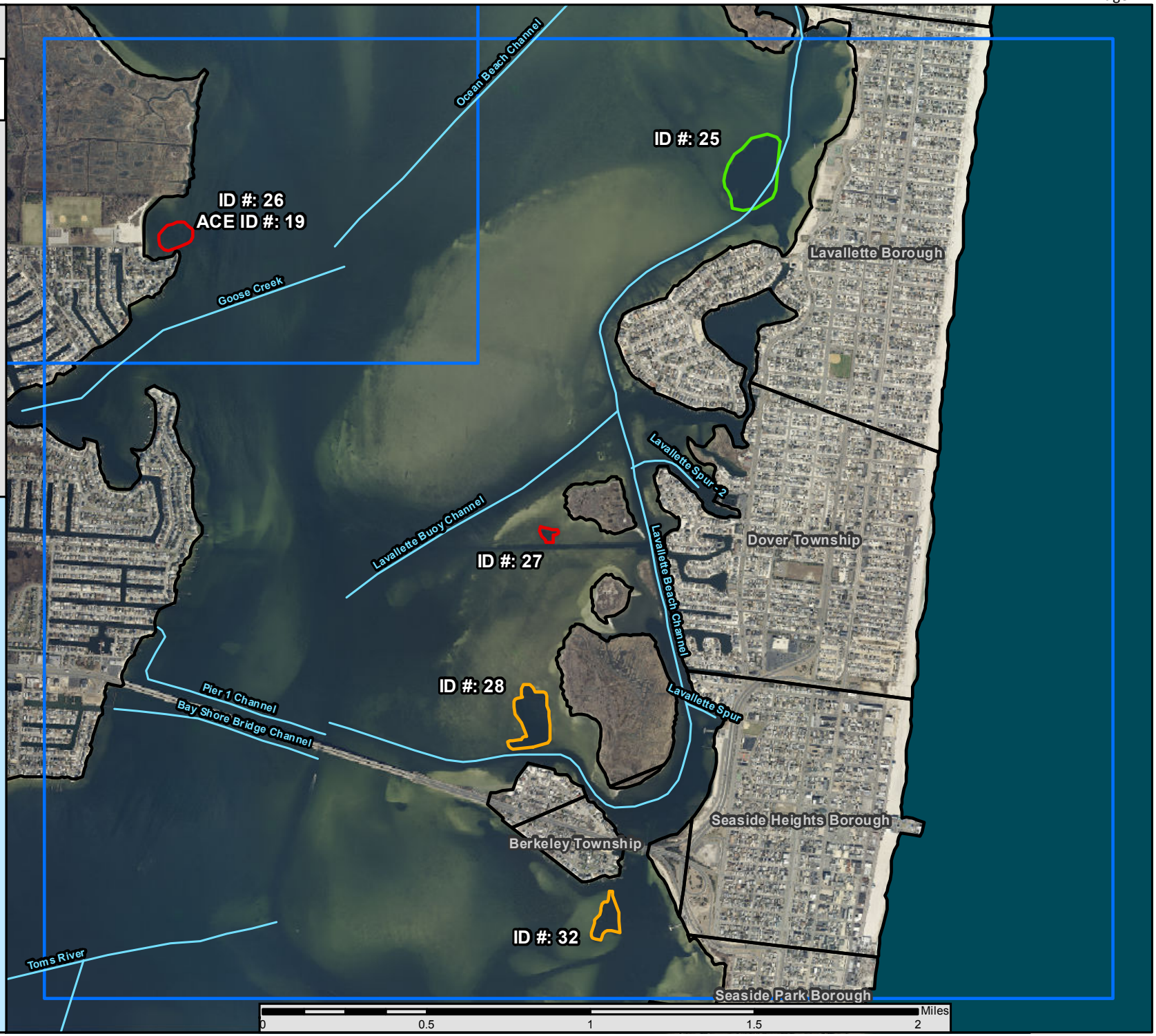
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
29	28	Not Visited	OCEAN	ACE	0.76	*n/a*	*n/a*	*n/a*	*n/a*	39.95	-74.18	
30	23	Not Visited	OCEAN	ACE	2.37	*n/a*	*n/a*	*n/a*	*n/a*	39.95	-74.18	
31	29	Not Visited	OCEAN	ACE	0.77	*n/a*	*n/a*	*n/a*	*n/a*	39.94	-74.18	
33	12	Not Visited	OCEAN	ACE	9.78	*n/a*	*n/a*	*n/a*	*n/a*	39.94	-74.15	
34	11	Not Visited	OCEAN	ACE	2.48	*n/a*	*n/a*	*n/a*	*n/a*	39.93	-74.13	

Map: 8

State Channels

Index

Dredged Holes

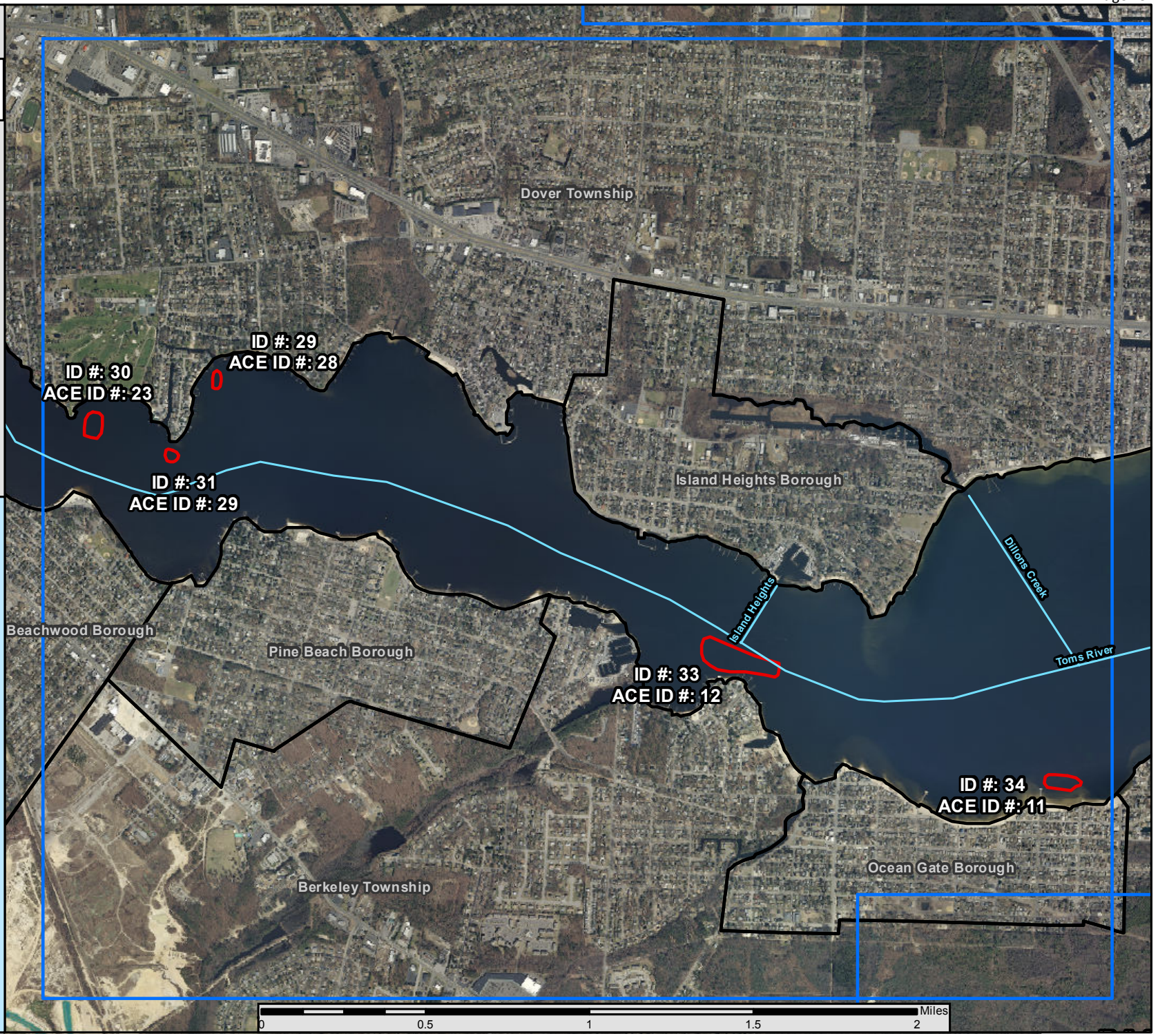
- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
35	10	Site Visit	OCEAN	ACE	16.01	*n/a*	*n/a*	*n/a*	*n/a*	39.92	-74.08	Shallow, <5ft deep
36	-	Not Visited	OCEAN	2012 Orthos	0.98	*n/a*	*n/a*	*n/a*	*n/a*	39.92	-74.12	
37	-	Not Visited	OCEAN	2012 Orthos	3.66	*n/a*	*n/a*	*n/a*	*n/a*	39.92	-74.12	
38	-	Site Visit	OCEAN	2012 Orthos	44.03	*n/a*	*n/a*	*n/a*	*n/a*	39.91	-74.09	Too shallow, < 7ft
39	32	Not Visited	OCEAN	ACE	9.64	*n/a*	*n/a*	*n/a*	*n/a*	39.91	-74.09	
40	-	Not Visited	OCEAN	2012 Orthos	2.62	*n/a*	*n/a*	*n/a*	*n/a*	39.91	-74.13	
41	9	Not Visited	OCEAN	ACE	3.23	*n/a*	*n/a*	*n/a*	*n/a*	39.89	-74.09	

Map: 9

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

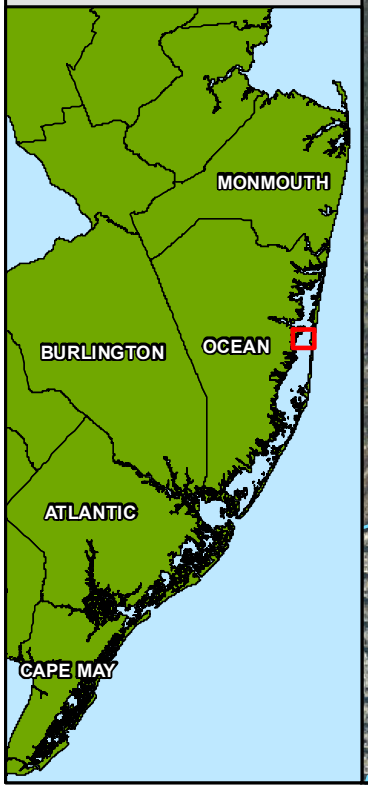
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Ocean Gate Borough

Good Luck Point Channel

ID #: 36

ID #: 37

ID #: 35
ACE ID #: 10

Seaside Park Borough

Berkeley Township

Berkeley Shores Channel

ID #: 38

ID #: 39
ACE ID #: 32

Sloop Creek

ID #: 40

Clamming Creek North

Clamming Creek South

Writes Channel

Maple Creek

ID #: 41
ACE ID #: 9

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
42	13	Not Visited	OCEAN	ACE	2.90	*n/a*	*n/a*	*n/a*	*n/a*	39.84	-74.09	

Map: 10

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

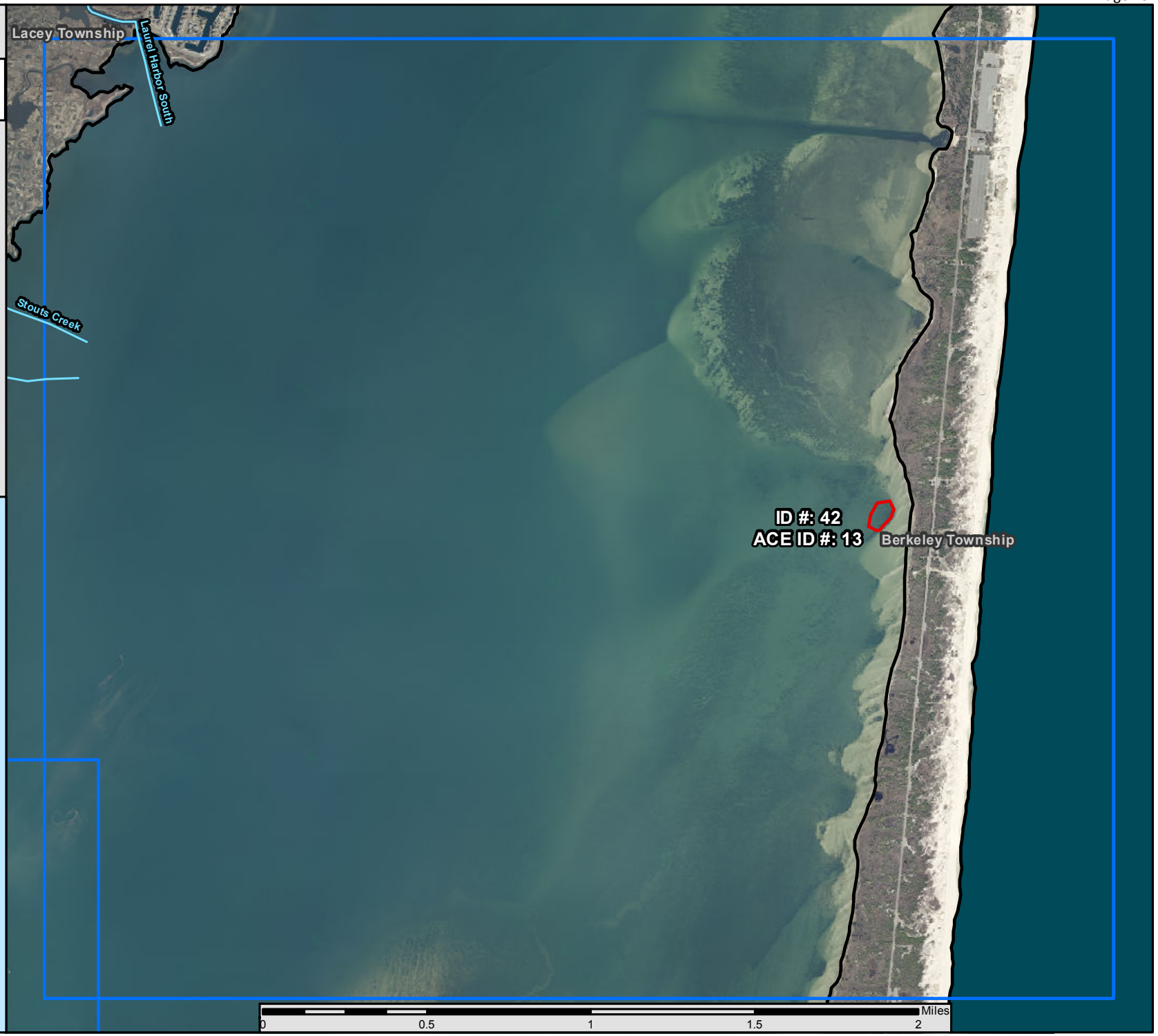
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
43	8	Not Visited	OCEAN	ACE	1.94	*n/a*	*n/a*	*n/a*	*n/a*	39.82	-74.16	
44	-	Not Visited	OCEAN		1.03	*n/a*	*n/a*	*n/a*	*n/a*	39.79	-74.18	

Map: 11

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

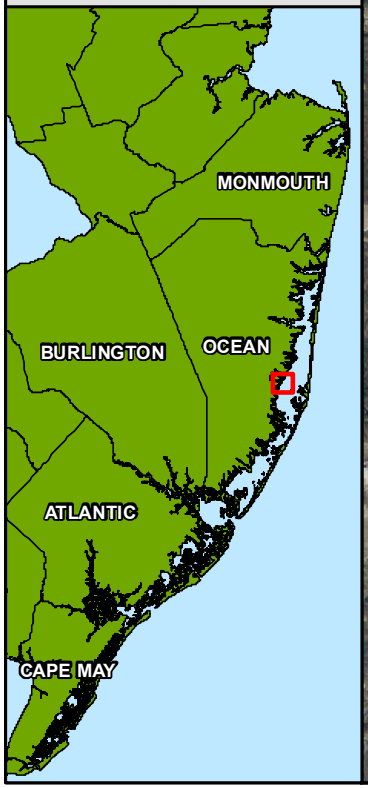
Pilot Study Site

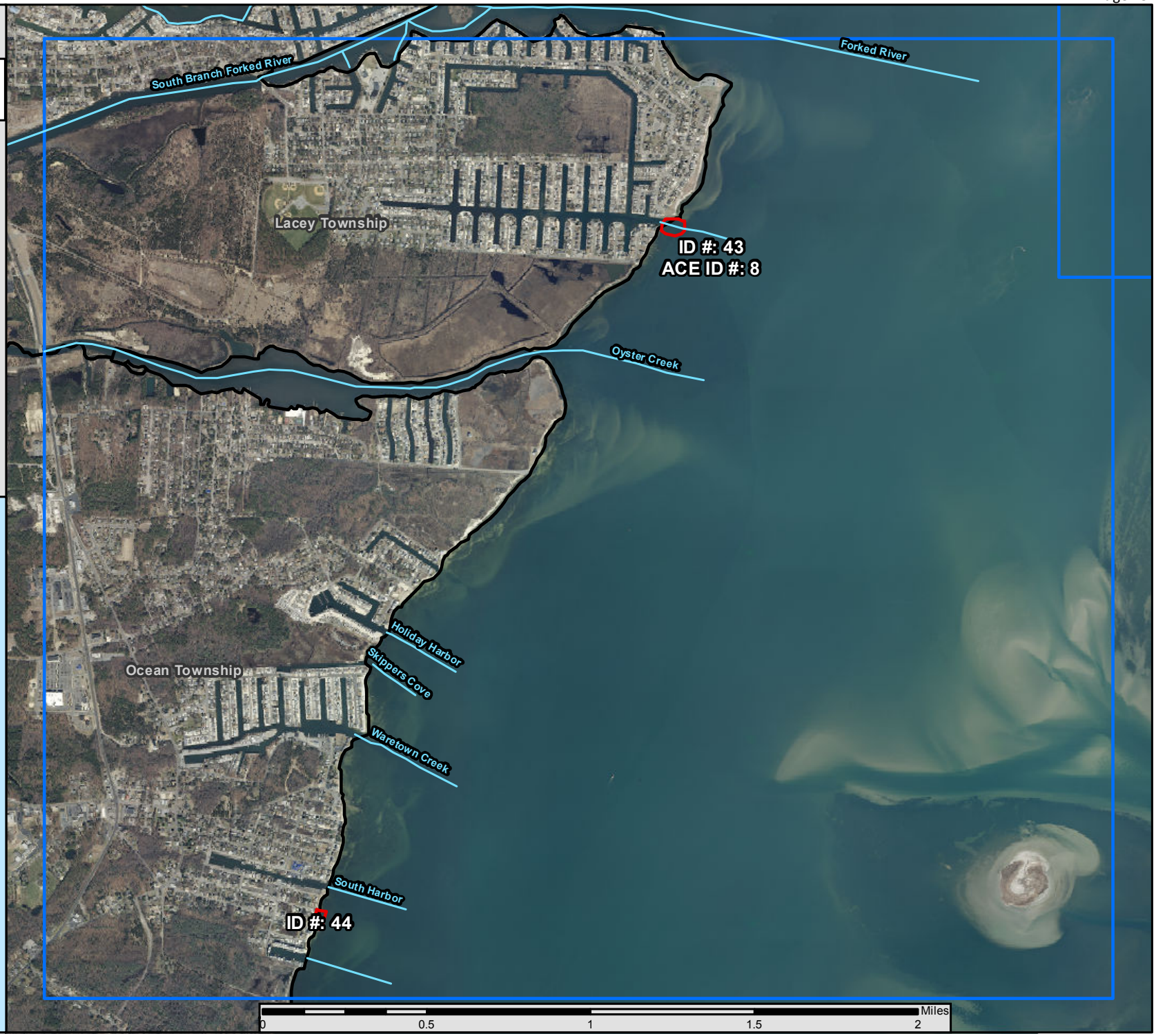
N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.





Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
45	-	Site Visit	OCEAN	2012 Orthos	5.53	*n/a*	*n/a*	*n/a*	*n/a*	39.75	-74.12	~11ft max depth
46	-	Site Visit	OCEAN	2012 Orthos	4.67	*n/a*	*n/a*	*n/a*	*n/a*	39.74	-74.12	~14ft max depth
47	-	Site Visit	OCEAN	2012 Orthos	1.88	*n/a*	*n/a*	*n/a*	*n/a*	39.74	-74.12	Small area over 19ft deep
48	-	Not Visited	OCEAN	2012 Orthos	1.31	*n/a*	*n/a*	*n/a*	*n/a*	39.73	-74.13	
49	-	Not Visited	OCEAN	2012 Orthos	0.53	*n/a*	*n/a*	*n/a*	*n/a*	39.73	-74.13	
50	5	Not Visited	OCEAN	ACE	3.32	*n/a*	*n/a*	*n/a*	*n/a*	39.72	-74.13	
51	-	Not Visited	OCEAN	2012 Orthos	4.86	*n/a*	*n/a*	*n/a*	*n/a*	39.71	-74.13	

Map: 12

State Channels

Index

Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Barnegat Light Borough

ID #: 45

ID #: 46

Loveladies vol-sedge

ID #: 47

ID #: 48

ID #: 49

Long Beach Township

Loveladies North Spur

Loveladies

ID #: 50
ACE ID #: 5

ID #: 51

Harvey Cedars 2

Stafford Township

Harvey Cedars Borough

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
52	6	Not Visited	OCEAN	ACE	4.76	*n/a*	*n/a*	*n/a*	*n/a*	39.71	-74.14	
53	-	Site Visit	OCEAN	2012 Orthos	10.03	*n/a*	*n/a*	*n/a*	*n/a*	39.71	-74.14	~10 ft max depth
54	-	Candidate Site	OCEAN	2012 Orthos	24.04	30.8	317,123	187,615	132,818	39.69	-74.15	Max depth 31ft, Temp -.36C
55	-	Candidate Site	OCEAN	2012 Orthos	2.94	-24.4	21,423	5,926	2,334	39.67	-74.16	~23ft, Small area deeper than 21
56	36	Site Visit	OCEAN	ACE	73.03	*n/a*	*n/a*	*n/a*	*n/a*	39.67	-74.17	Max depth ~16ft, Avg.10-14ft
121	-	Site Visit	OCEAN		2.74	*n/a*	*n/a*	*n/a*	*n/a*	39.67	-74.16	Max depth 13ft

Map: 13

State Channels

Index

Dredged Holes

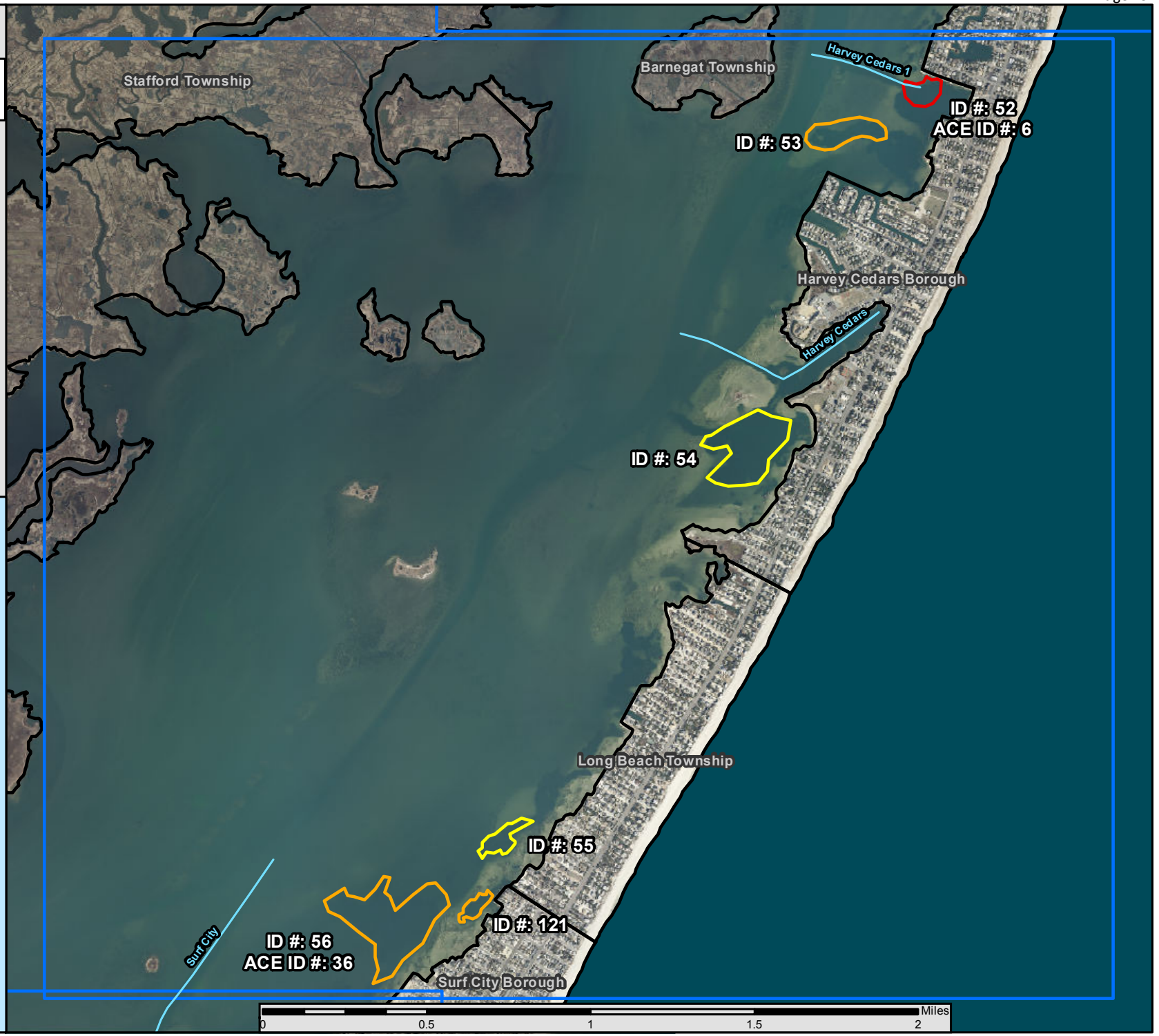
- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
57	30	Site Visit	OCEAN	ACE	17.81	*n/a*	*n/a*	*n/a*	*n/a*	39.66	-74.21	Max Depth ~15ft, to bridge/chnl
58	22	Site Visit	OCEAN	ACE	23.12	*n/a*	*n/a*	*n/a*	*n/a*	39.66	-74.18	Small area in a channel, ~16ft
59	-	Candidate Site	OCEAN	2012 Orthos	4.41	-26.5	95,930	39,161	19,477	39.64	-74.19	Max depth ~24ft
60	-	Site Visit	OCEAN	2012 Orthos	3.73	*n/a*	*n/a*	*n/a*	*n/a*	39.64	-74.19	Close to channel, Max ~16ft
61	37	Candidate Site	OCEAN	ACE	34.08	-32.8	282,456	131,054	78,250	39.63	-74.20	

Map: 14

State Channels

Index

Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
62	-	Site Visit	OCEAN	2012 Orthos	11.17	*n/a*	*n/a*	*n/a*	*n/a*	39.62	-74.21	Max depth 23ft (small area)
63	4	Not Visited	OCEAN	ACE	14.82	*n/a*	*n/a*	*n/a*	*n/a*	39.62	-74.21	
64	3	Not Visited	OCEAN	ACE	3.10	*n/a*	*n/a*	*n/a*	*n/a*	39.62	-74.20	
65	-	Not Visited	OCEAN	2012 Orthos	39.10	*n/a*	*n/a*	*n/a*	*n/a*	39.61	-74.26	
66	-	Not Visited	OCEAN	2012 Orthos	5.60	*n/a*	*n/a*	*n/a*	*n/a*	39.61	-74.21	
67	2	Site Visit	OCEAN	ACE	3.38	*n/a*	*n/a*	*n/a*	*n/a*	39.60	-74.22	Max depth 12ft
68	1	Site Visit	OCEAN	ACE	12.10	*n/a*	*n/a*	*n/a*	*n/a*	39.59	-74.22	Max depth ~16ft

Map: 15

State Channels

Index

Dredged Holes

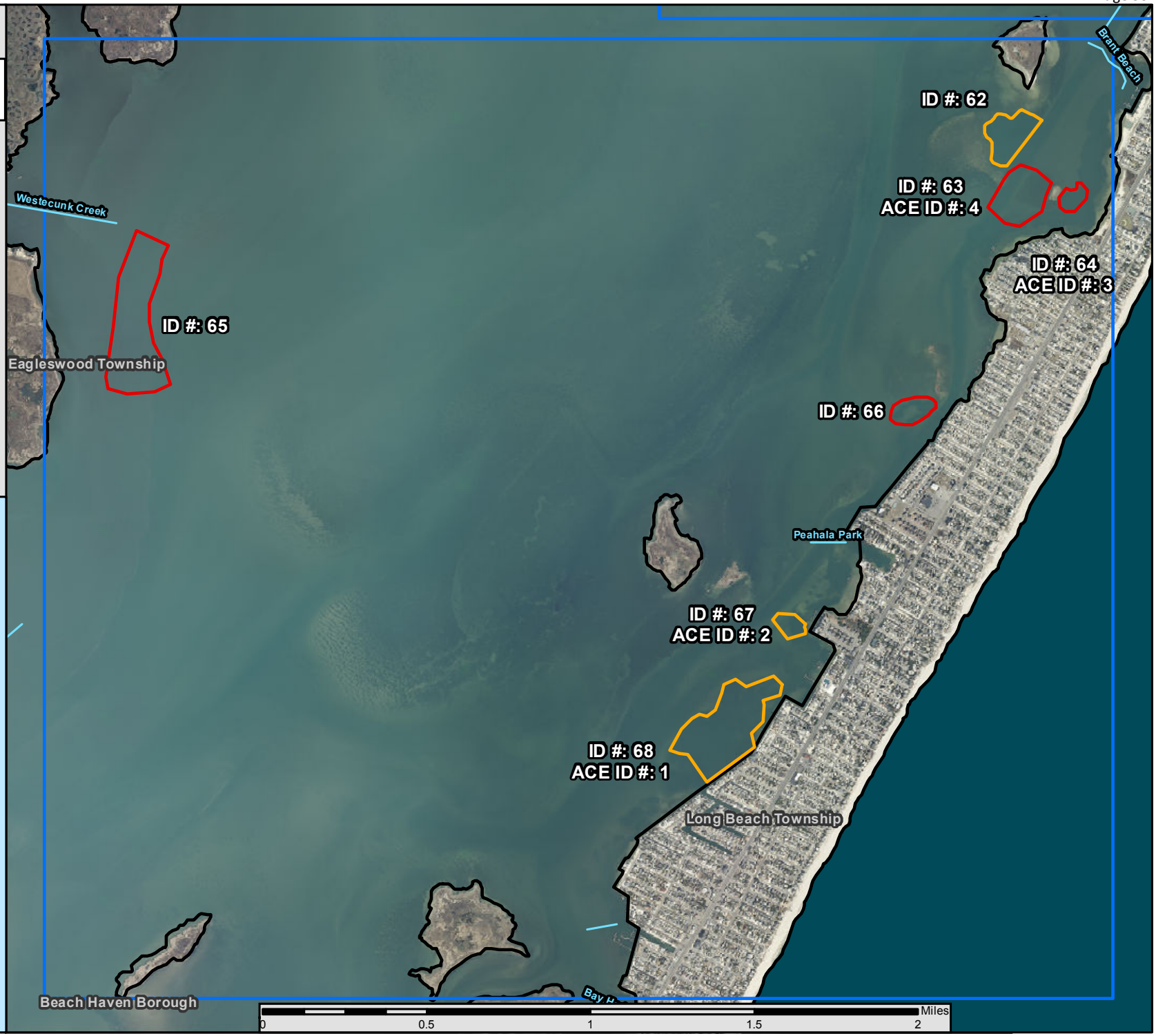
- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
69	-	Not Visited	BURLINGTON	2012 Orthos	3.58	*n/a*	*n/a*	*n/a*	*n/a*	39.59	-74.45	
70	-	Not Visited	BURLINGTON	2012 Orthos	4.09	*n/a*	*n/a*	*n/a*	*n/a*	39.59	-74.45	
71	27	Pilot Study Site	BURLINGTON	ACE	21.27	-48.3	660,719	542,333	485,072	39.58	-74.45	Deed restrictions

Map: 16

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

ID #: 69

ID #: 70

Bass River Township

ID #: 71
ACE ID #: 27

Washington Township

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
72	-	Not Visited	OCEAN	Nav Charts	4.72	*n/a*	*n/a*	*n/a*	*n/a*	39.57	-74.34	

Map: 17

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Tuckerton Borough

Tuckerton Creek Channel

Big Thorofare

ID #: 72

Little Egg Harbor Township

Marshelder Channel

Miles

0 0.5 1 1.5 2

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
122	-	Site Visit	OCEAN		6.54	*n/a*	*n/a*	*n/a*	*n/a*	39.55	-74.26	Max depth 9ft, Average 7ft

Map: 18

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Little Egg Channel

Liberty Thorofare

Beach Haven Borough

ID #: 122

Buoy 77 Channel

Penna's Channel

Long Beach Township

Little Egg Harbor Township

Marshelder Channel

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
73	-	Not Visited	ATLANTIC	2012 Orthos	6.43	*n/a*	*n/a*	*n/a*	*n/a*	39.55	-74.42	
74	-	Not Visited	ATLANTIC	2012 Orthos	3.62	*n/a*	*n/a*	*n/a*	*n/a*	39.55	-74.45	
75	38	Not Visited	ATLANTIC	ACE	7.77	*n/a*	*n/a*	*n/a*	*n/a*	39.55	-74.48	
120	-	Not Visited	ATLANTIC	2012 Orthos	6.04	*n/a*	*n/a*	*n/a*	*n/a*	39.55	-74.44	

Map: 19

State Channels

Index

Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Little Egg Harbor Township

Bass River Township

Washington Township

ID #: 120

ID #: 73

ID #: 74

ID #: 75
ACE ID #: 38

Mullica River

Nacote Creek

Port Republic City

Nacote Creek Basin

Galloway Township

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
76	-	Not Visited	ATLANTIC	2012 Orthos	39.02	*n/a*	*n/a*	*n/a*	*n/a*	39.42	-74.37	
77	-	Site Visit	ATLANTIC	2012 Orthos	27.25	*n/a*	*n/a*	*n/a*	*n/a*	39.42	-74.36	
78	-	Priority Site	ATLANTIC	2012 Orthos	15.01	-26.4	136,733	68,066	42,806	39.42	-74.36	
80	-	Not Visited	ATLANTIC	Nav Charts	9.57	*n/a*	*n/a*	*n/a*	*n/a*	39.40	-74.38	
81	-	Not Visited	ATLANTIC	2012 Orthos	39.20	*n/a*	*n/a*	*n/a*	*n/a*	39.40	-74.39	

Map: 20

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
79	25	Not Visited	ATLANTIC	ACE	2.75	*n/a*	*n/a*	*n/a*	*n/a*	39.41	-74.49	

Map: 21

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

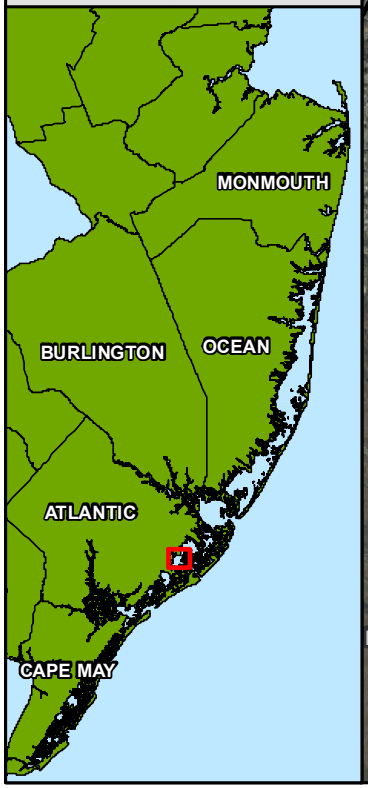
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Absecon City

Galloway Township

Absecon Creek

ID #: 79
ACE ID #: 25

Atlantic City

Pleasantville City

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
82	-	Site Visit	ATLANTIC	2012 Orthos	33.93	*n/a*	*n/a*	*n/a*	*n/a*	39.38	-74.50	Max depth 12ft
83	24	Candidate Site	ATLANTIC	ACE	15.17	-27.4	18,311	7,751	4,506	39.37	-74.50	Max depth ~30ft
84	33	Not Visited	ATLANTIC	ACE	11.72	*n/a*	*n/a*	*n/a*	*n/a*	39.37	-74.48	
85	-	Candidate Site	ATLANTIC	2012 Orthos	21.96	-23.9	151,118	67,612	35,259	39.37	-74.46	~28ft Max depth,
86	34	Priority Site	ATLANTIC	ACE	14.40	-57.4	494,928	399,418	357,091	39.36	-74.47	Max depth ~58ft
87	-	Not Visited	ATLANTIC	2012 Orthos	4.22	*n/a*	*n/a*	*n/a*	*n/a*	39.36	-74.48	
88	-	Not Visited	ATLANTIC	2012 Orthos	1.84	*n/a*	*n/a*	*n/a*	*n/a*	39.36	-74.48	
89	-	Candidate Site	ATLANTIC	2012 Orthos	33.97	-41.1	347,742	158,330	92,547	39.36	-74.49	
90	-	Candidate Site	ATLANTIC	2012 Orthos	27.10	-25.1	154,497	53,962	25,022	39.35	-74.50	~27ft deep

Map: 22

State Channels

Index

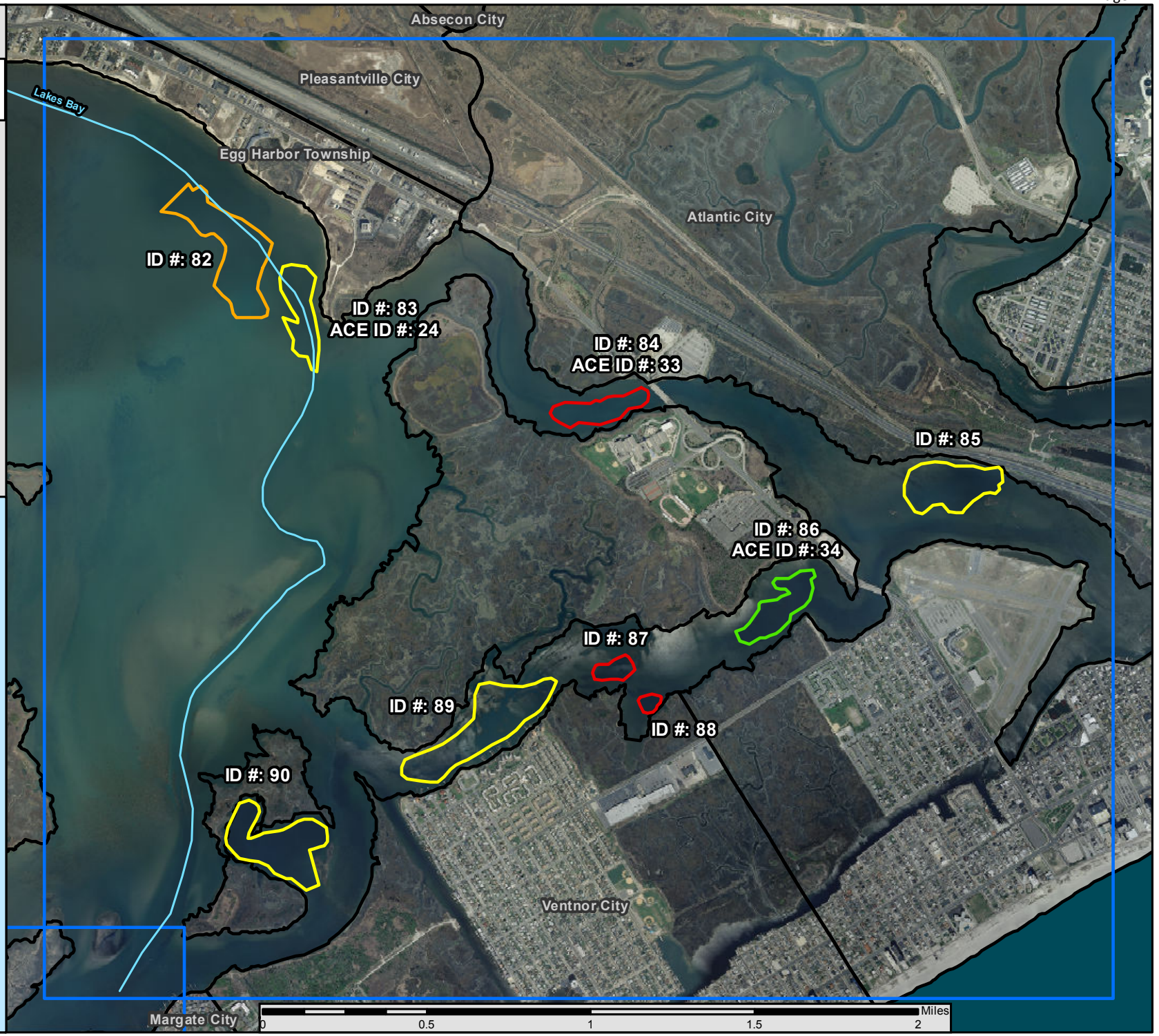
Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
92	-	Not Visited	ATLANTIC	2012 Orthos	24.18	*n/a*	*n/a*	*n/a*	*n/a*	39.34	-74.51	
94	-	Not Visited	ATLANTIC	2012 Orthos	20.51	*n/a*	*n/a*	*n/a*	*n/a*	39.33	-74.52	
97	-	Not Visited	ATLANTIC	2012 Orthos	2.60	*n/a*	*n/a*	*n/a*	*n/a*	39.31	-74.54	

Map: 23

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

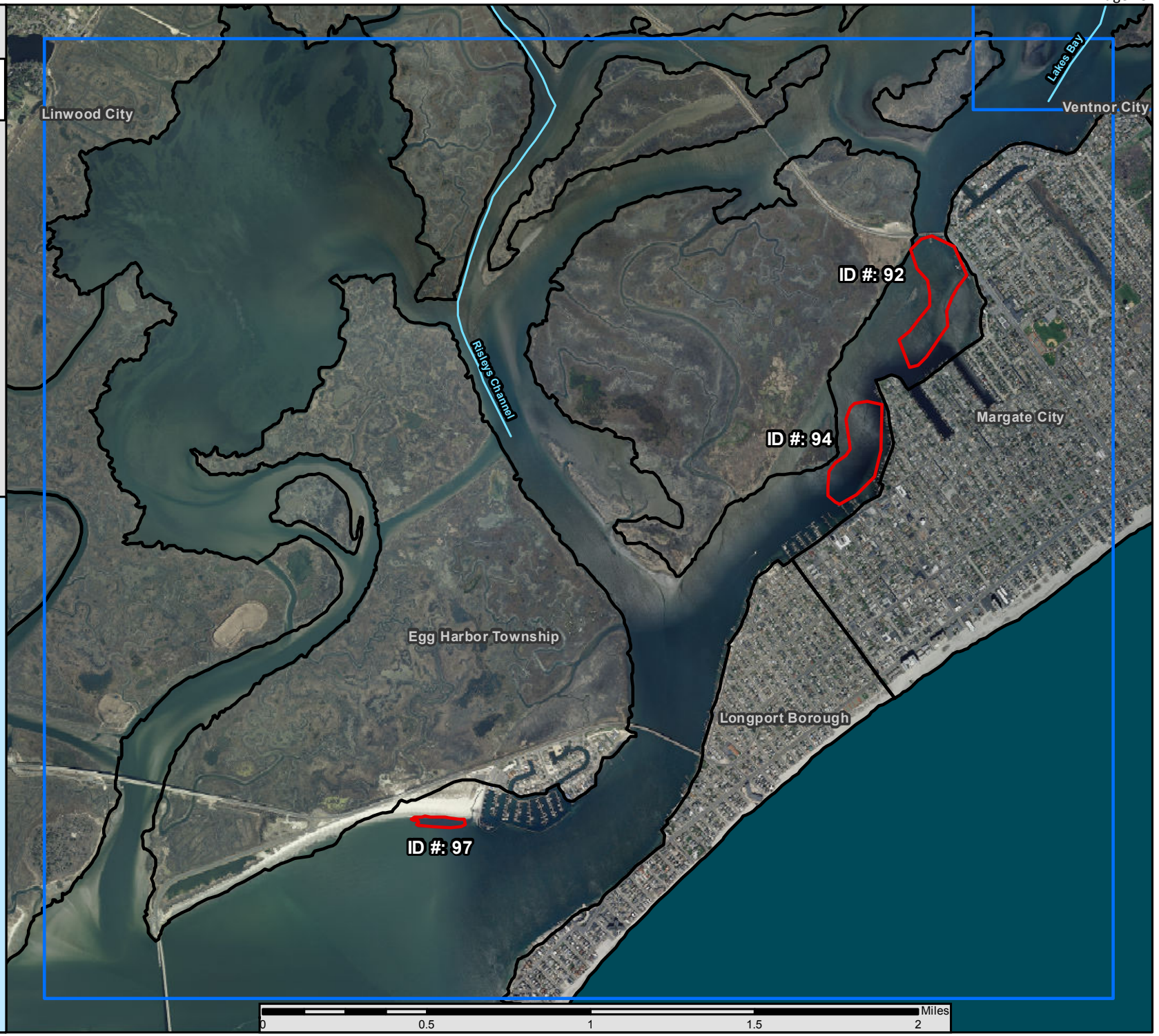
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
91	-	Site Visit	ATLANTIC	2012 Orthos	8.46	*n/a*	*n/a*	*n/a*	*n/a*	39.34	-74.60	Too shallow, 7-8ft max depth
93	-	Priority Site	ATLANTIC	2012 Orthos	16.50	-23.9	11,404	4,497	2,475	39.33	-74.61	~20ft average w/ ~28ft max
95	-	Candidate Site	ATLANTIC	2012 Orthos	10.60	-18.3	5,354	545	4	39.33	-74.62	~23ft depth
96	-	Site Visit	ATLANTIC	Nav Charts	5.71	*n/a*	*n/a*	*n/a*	*n/a*	39.31	-74.63	Shallow, 3-5ft max depth
98	-	Pilot Study Site	ATLANTIC	Nav Charts	34.78	-29.3	382,763	219,228	147,764	39.30	-74.60	Surveyed previously
99	-	Pilot Study Site	ATLANTIC	Nav Charts	16.23	30.5	92,682	36,487	18,784	39.30	-74.62	Surveyed previously

Map: 24

State Channels

Index

Dredged Holes

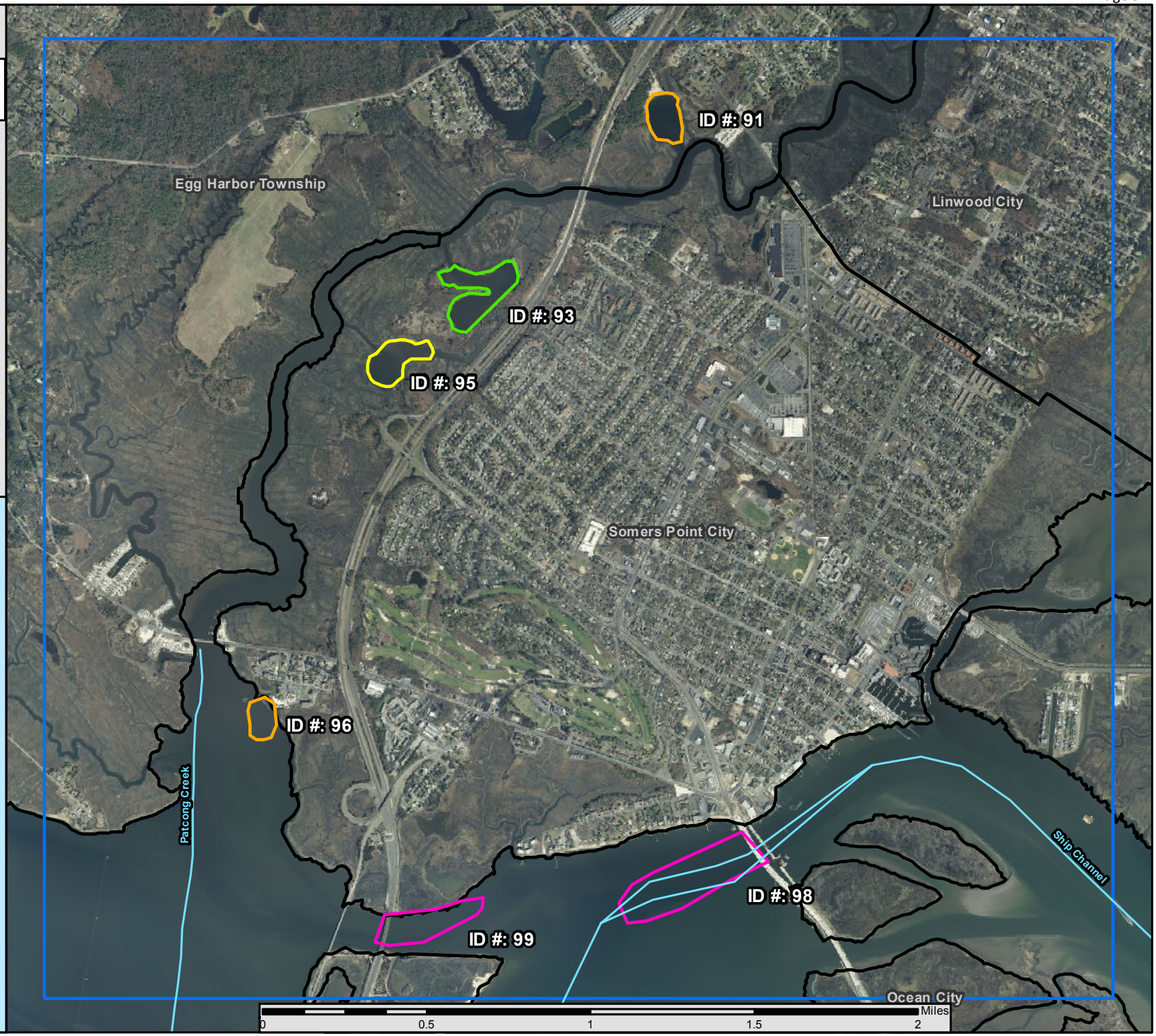
- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
100	-	Not Visited	CAPE MAY	2012 Orthos	4.06	*n/a*	*n/a*	*n/a*	*n/a*	39.24	-74.63	
101	35	Not Visited	CAPE MAY	ACE	3.87	*n/a*	*n/a*	*n/a*	*n/a*	39.23	-74.65	Restored in 2010

Map: 25

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

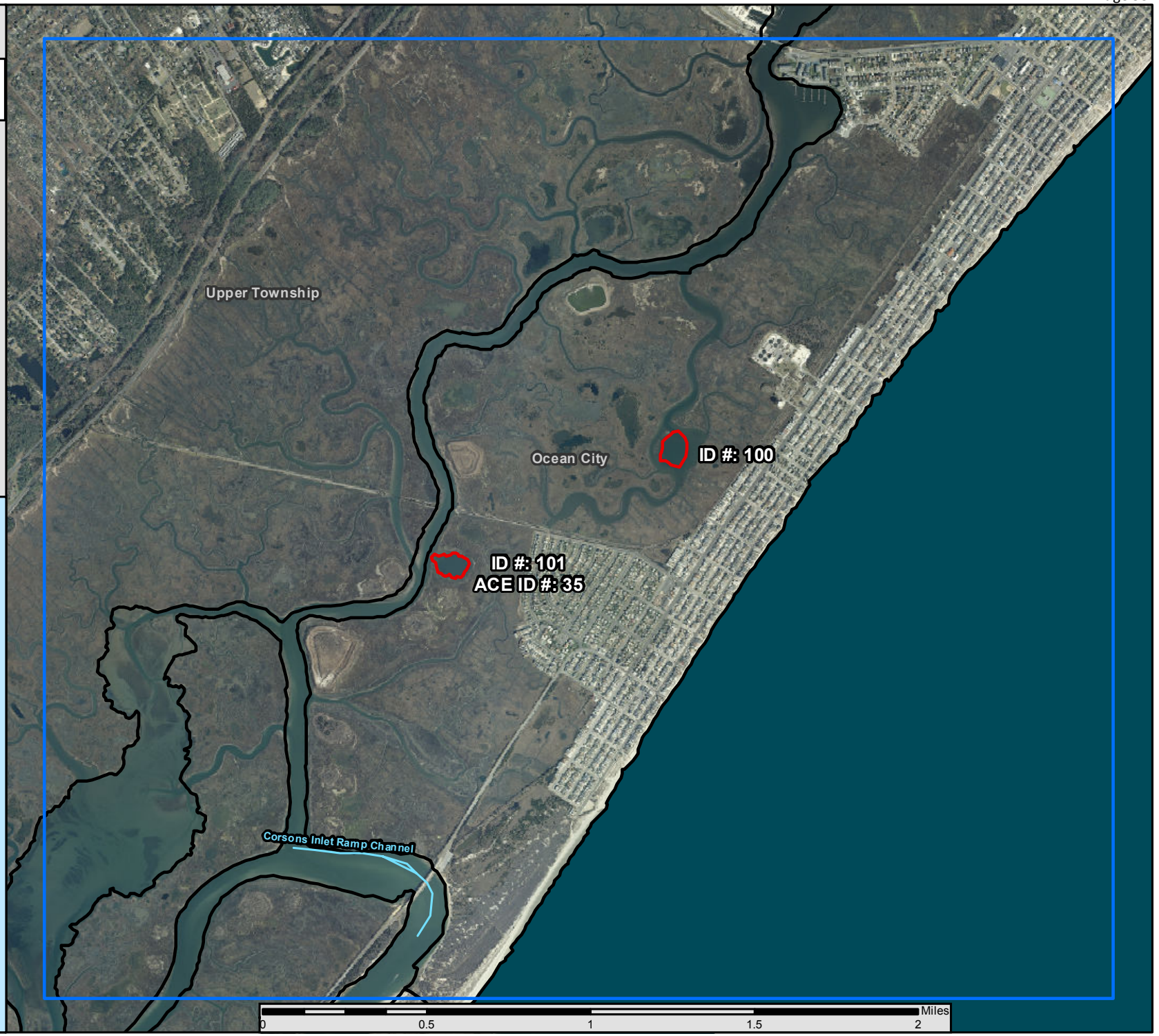
Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
102	26	Not Visited	CAPE MAY	ACE	14.35	*n/a*	*n/a*	*n/a*	*n/a*	39.17	-74.69	
103	-	Not Visited	CAPE MAY	2012 Orthos	2.47	*n/a*	*n/a*	*n/a*	*n/a*	39.16	-74.72	

Map: 26

State Channels

Index

Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Upper Township

Flat Creek

Dennis Township

ID #: 102
ACE ID #: 26

ID #: 103

Sea Isle City

North Basin

Middle Basin

South Basin

0 0.5 1 1.5 2 Miles

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
104	-	Not Visited	CAPE MAY	2012 Orthos	2.64	*n/a*	*n/a*	*n/a*	*n/a*	39.15	-74.75	

Map: 27

State Channels

Index

Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Dennis Township

ID #: 104

Middle Township

Sea Isle City

Avalon Borough

Miles
0 0.5 1 1.5 2

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
105	-	Not Visited	CAPE MAY	2012 Orthos	9.18	*n/a*	*n/a*	*n/a*	*n/a*	39.10	-74.73	
106	-	Not Visited	CAPE MAY	2012 Orthos	17.85	*n/a*	*n/a*	*n/a*	*n/a*	39.10	-74.73	
107	-	Not Visited	CAPE MAY	2012 Orthos	5.52	*n/a*	*n/a*	*n/a*	*n/a*	39.10	-74.73	
108	-	Not Visited	CAPE MAY	2012 Orthos	3.51	*n/a*	*n/a*	*n/a*	*n/a*	39.10	-74.73	

Map: 28

State Channels

Index

Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
110	-	Not Visited	CAPE MAY	2012 Orthos	5.60	*n/a*	*n/a*	*n/a*	*n/a*	39.03	-74.77	

Map: 29

State Channels

Index

Dredged Holes

- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

Avalon Borough

Middle Township

Stone Harbor Borough

ID #: 110

North Wildwood City

Miles
0 0.5 1 1.5 2

Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
109	-	Not Visited	CAPE MAY	2012 Orthos	5.71	*n/a*	*n/a*	*n/a*	*n/a*	39.04	-74.85	
112	-	Not Visited	CAPE MAY	2012 Orthos	22.70	*n/a*	*n/a*	*n/a*	*n/a*	39.00	-74.87	

Map: 30

State Channels

Index

Dredged Holes

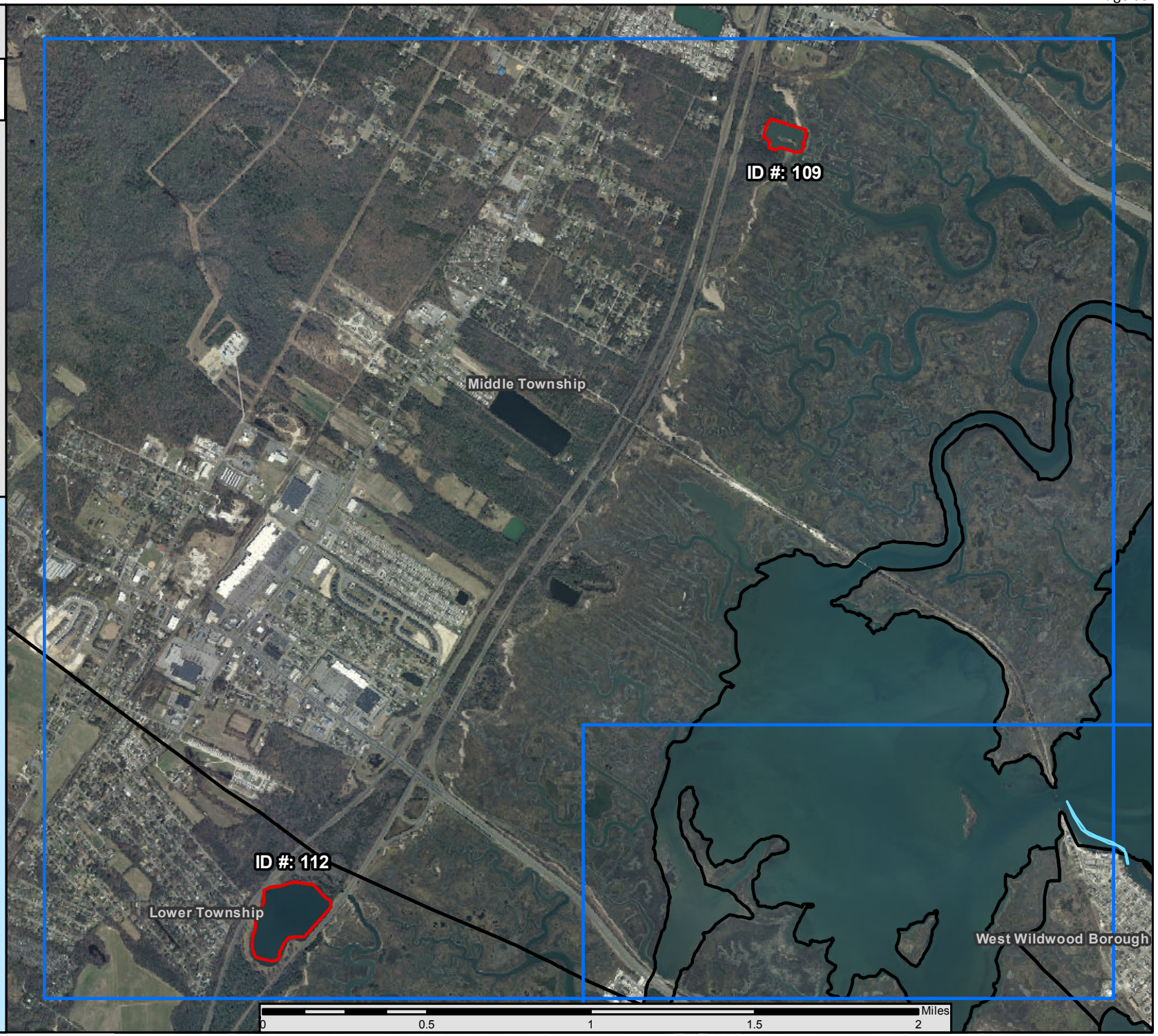
- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
111	-	Not Visited	CAPE MAY	Nav Charts	8.28	*n/a*	*n/a*	*n/a*	*n/a*	39.01	-74.80	
113	-	Site Visit	CAPE MAY	Nav Charts	14.27	*n/a*	*n/a*	*n/a*	*n/a*	39.00	-74.83	6ft max depth
116	-	Site Visit	CAPE MAY	2012 Orthos	15.44	*n/a*	*n/a*	*n/a*	*n/a*	38.97	-74.84	Shallow, 7-9ft max depth
118	-	Candidate Site	CAPE MAY	Nav Charts	18.51	-18.8	47,022	3,948	160	38.97	-74.85	~21ft max depth, small area

Map: 31

State Channels

Index

Dredged Holes

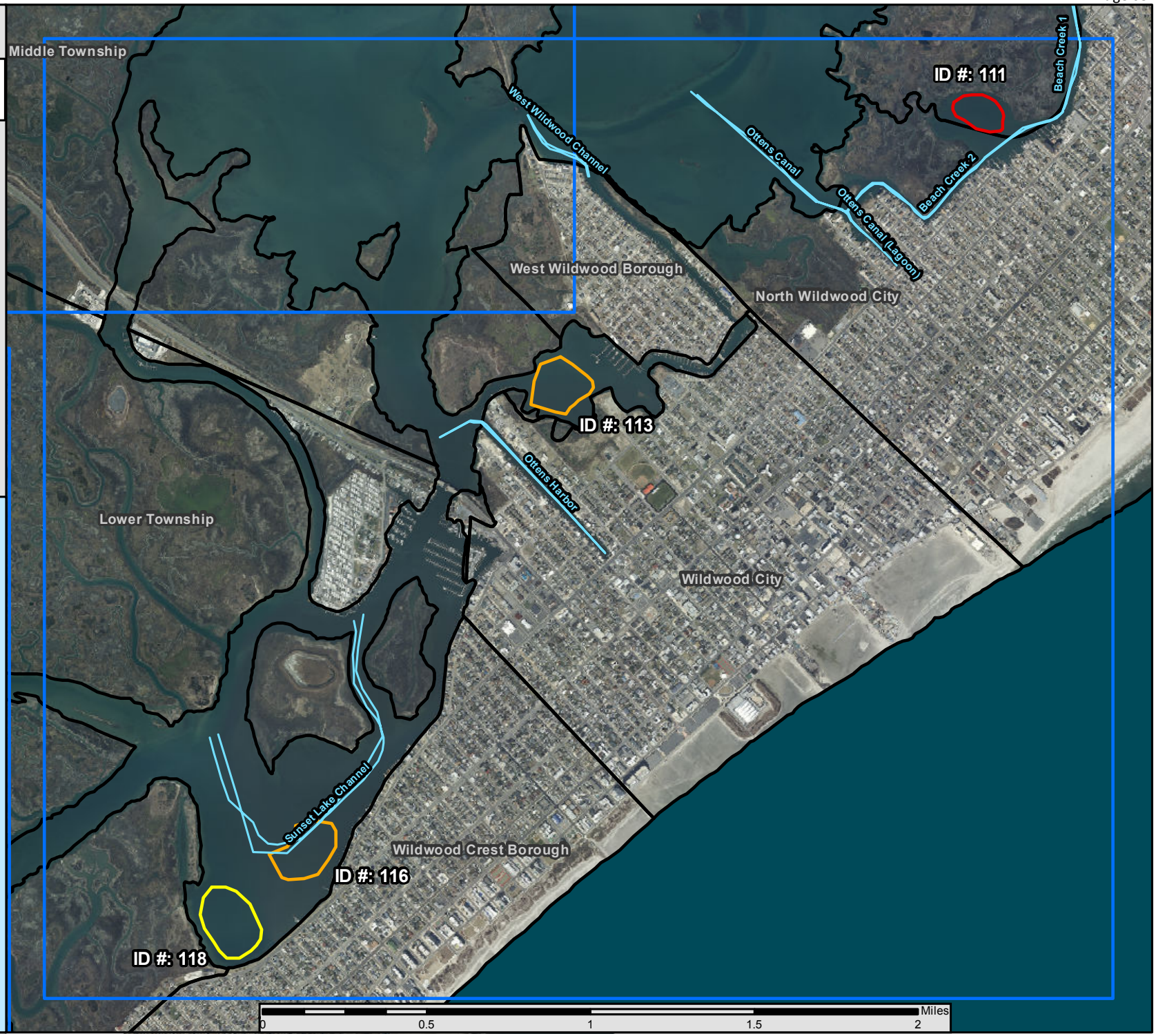
- Priority Site
- Candidate Site
- Site Visit
- Not Visited
- Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.



Dredged Hole ID	ACE ID	Classification	County	Source	Area *(Acres)*	Max Depth *(MLW ft)*	Capacity Below -12ft MLW (*yd³*)	Capacity Below -16ft MLW (*yd³*)	Capacity Below -18ft MLW (*yd³*)	Lat	Lon	Field Notes
114	-	Not Visited	CAPE MAY	2012 Orthos	3.38	*n/a*	*n/a*	*n/a*	*n/a*	38.99	-74.88	
115	-	Not Visited	CAPE MAY	2012 Orthos	4.74	*n/a*	*n/a*	*n/a*	*n/a*	38.99	-74.88	
117	-	Not Visited	CAPE MAY	2012 Orthos	6.14	*n/a*	*n/a*	*n/a*	*n/a*	38.97	-74.89	
119	-	Not Visited	CAPE MAY	2012 Orthos	16.03	*n/a*	*n/a*	*n/a*	*n/a*	38.96	-74.90	

Map: 32

State Channels

Index

Dredged Holes

Priority Site

Candidate Site

Site Visit

Not Visited

Pilot Study Site

N

Base aerial photography: 2012

State Channel locations credit: The New Jersey Department of Transportation Office of Maritime Resources

Dredged Hole Delineations credit: The Stockton College Coastal Research Center, New Jersey Department of Environmental Protection, and US Army Corps of Engineers.

ID #: 115

ID #: 114

Lower Township

ID #: 117

ID #: 119

Middle Thorofare Lagoon

0 0.5 1 1.5 2 Miles

Dissolved Oxygen Spot Checks (mg/l)

Dredged Hole	Oct. 22, 2013	Oct. 24, 2013	Oct. 25, 2013	Nov. 5, 2013	Dec. 4, 2013	Dec. 17, 2013	Jan. 13, 2014	Jan. 20, 2014	Feb. 6, 2014	Feb. 19, 2014	July 1, 2014	June 30, 2014
25	1.13											
18		2.90										
6		3.60										
78			8.24									
85			8.60									
95				7.40								
93				7.21								
118					10.57							
59						13.03						
61							13.50					
83								11.70				
86								9.62				
54									6.30			
55									13.40			
90										11.50		
89										11.60		
54											5.08	
55											5.65	
59											5.75	
61											6.05	
78											1.90	
93												0.38
90												5.37
83												6.30
95												0.49
85												4.80
86												0.58
89												6.40

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH18 **Date: 8/7/14** **Time: 11:55am**

Site name: DH 18 Shallow 17ft South

Alt name: South

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.85	105.6	19.38	7.97	24.95	2.5
1.0	3.28	7.76	104.6	19.37	7.97	24.87	2.6
2.0	6.56	7.50	100.9	19.44	7.94	24.62	3.2
3.0	9.84	6.55	87.9	19.45	7.83	24.39	4.0
4.0	13.12	5.77	77.1	19.47	7.73	24.26	3.7

Sediment Sample Description :

Weather conditions/ other notes:

Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH18 **Date: 8/7/14** **Time: 11:37am**

Site name: DH 18 Middepth 18ft Center

Alt name: Center

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.87	106.0	19.43	7.97	24.87	2.6
1.0	3.28	7.78	104.7	19.41	7.96	24.82	2.7
2.0	6.56	7.67	103.1	19.41	7.96	24.65	2.5
3.0	9.84	6.18	82.8	19.44	7.77	24.33	2.8
4.0	13.12	5.92	78.9	19.45	7.72	24.28	3.1
5.0	16.40	5.75	76.7	19.47	7.72	24.22	4.7

Sediment Sample Description :

Black mud with small amount of coarse sand.

Weather conditions/ other notes:

Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH18 **Date: 8/7/14** **Time: 11:12am**

Site name: DH 18 Deepest 22ft North
Alt name: North

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.02	106.2	19.47	7.93	24.62	2.7
1.0	3.28	7.67	102.9	19.47	7.93	24.60	2.7
2.0	6.56	7.62	102.2	19.49	7.93	24.52	2.7
3.0	9.84	7.51	100.0	19.52	7.91	24.40	3.0
4.0	13.12	6.90	92.3	19.53	7.87	24.36	3.4
5.0	16.40	6.55	87.4	19.52	7.81	24.30	3.5
6.0	19.68	6.14	82.0	19.52	7.76	24.25	3.5
7.0	22.97	6.08	81.0	19.52	7.77	24.25	4.7

Sediment Sample Description :
Black mud with plant debris from land.

Weather conditions/ other notes:
Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH18 **Date: 8/7/14** **Time: 12:21pm**

Site name: DH 18 Control Shallow
Alt name: Control Shallow

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.22	111.5	19.45	8.03	25.20	2.6
1.0	3.28	8.07	109.0	19.45	8.02	25.04	2.9

Sediment Sample Description :
Clean medium gray sand w/ plant debris

Weather conditions/ other notes:
Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH18 **Date: 8/7/14** **Time: 12:10pm**

Site name: DH 18 Control Channel

Alt name: Control Channel

YSI Readings

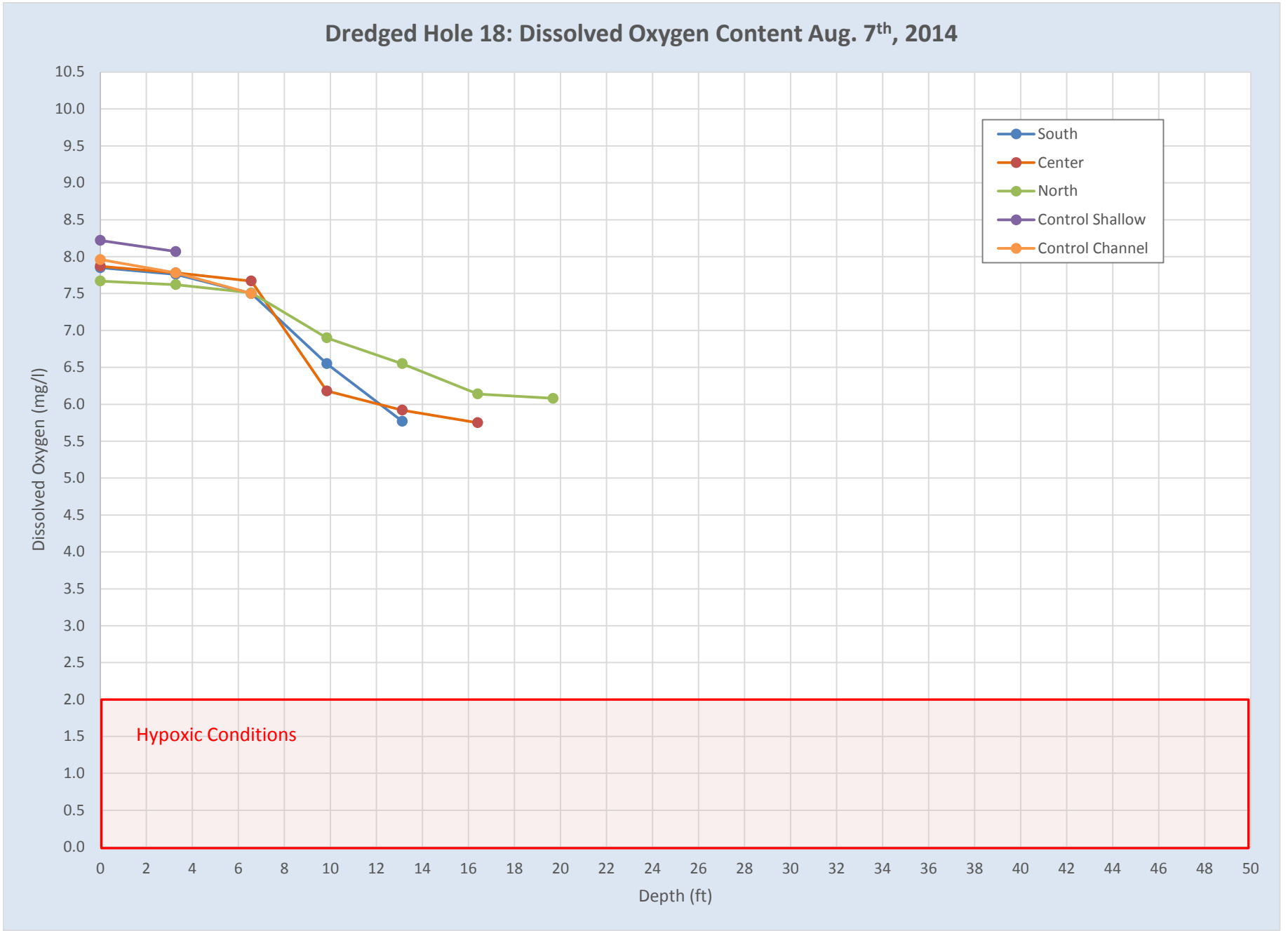
Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.96	107.9	19.34	7.99	25.26	2.4
1.0	3.28	7.78	105.5	19.42	8.00	25.14	2.4
2.0	6.56	7.50	100.2	19.48	7.95	24.56	4.5

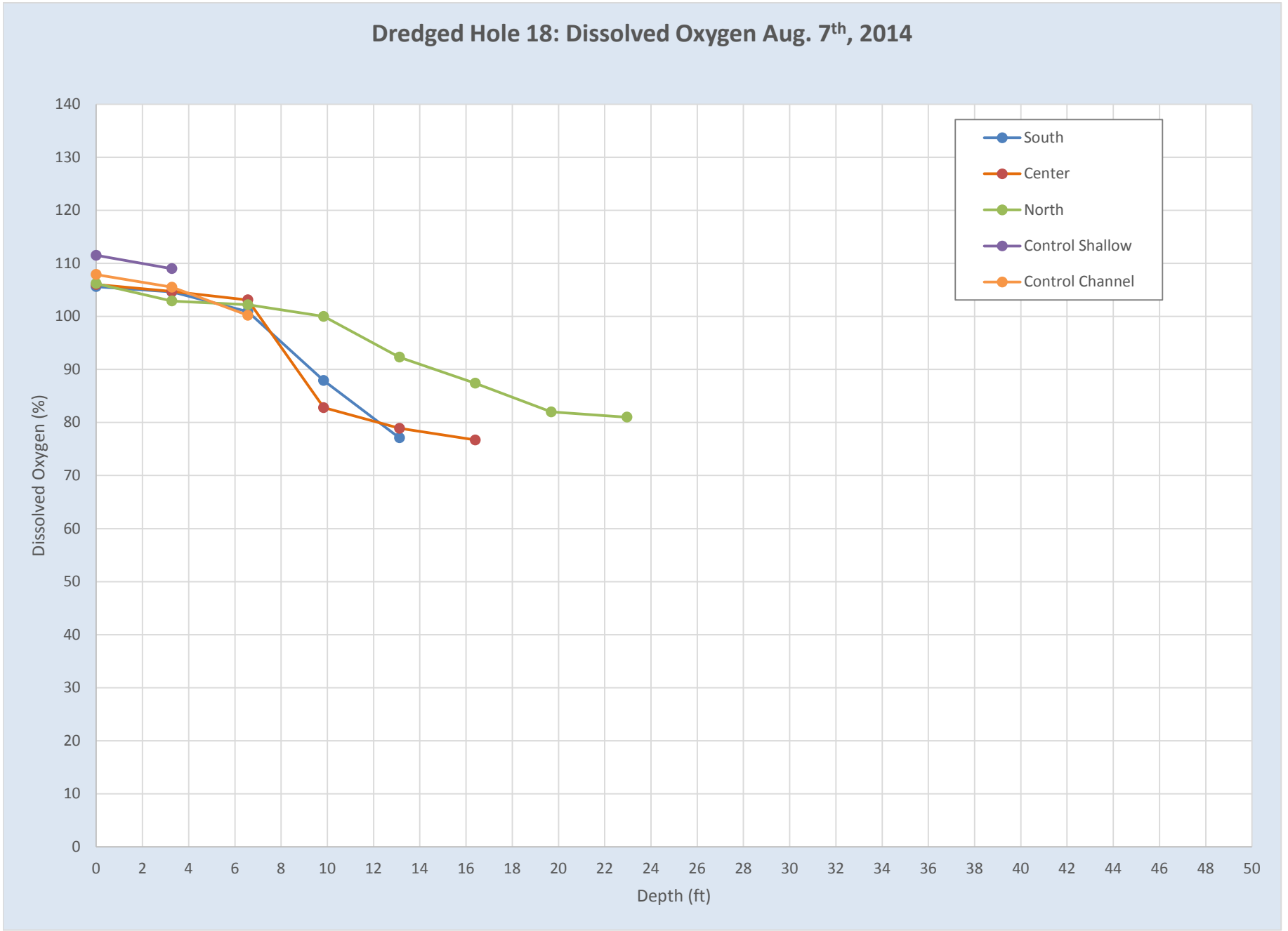
Sediment Sample Description :

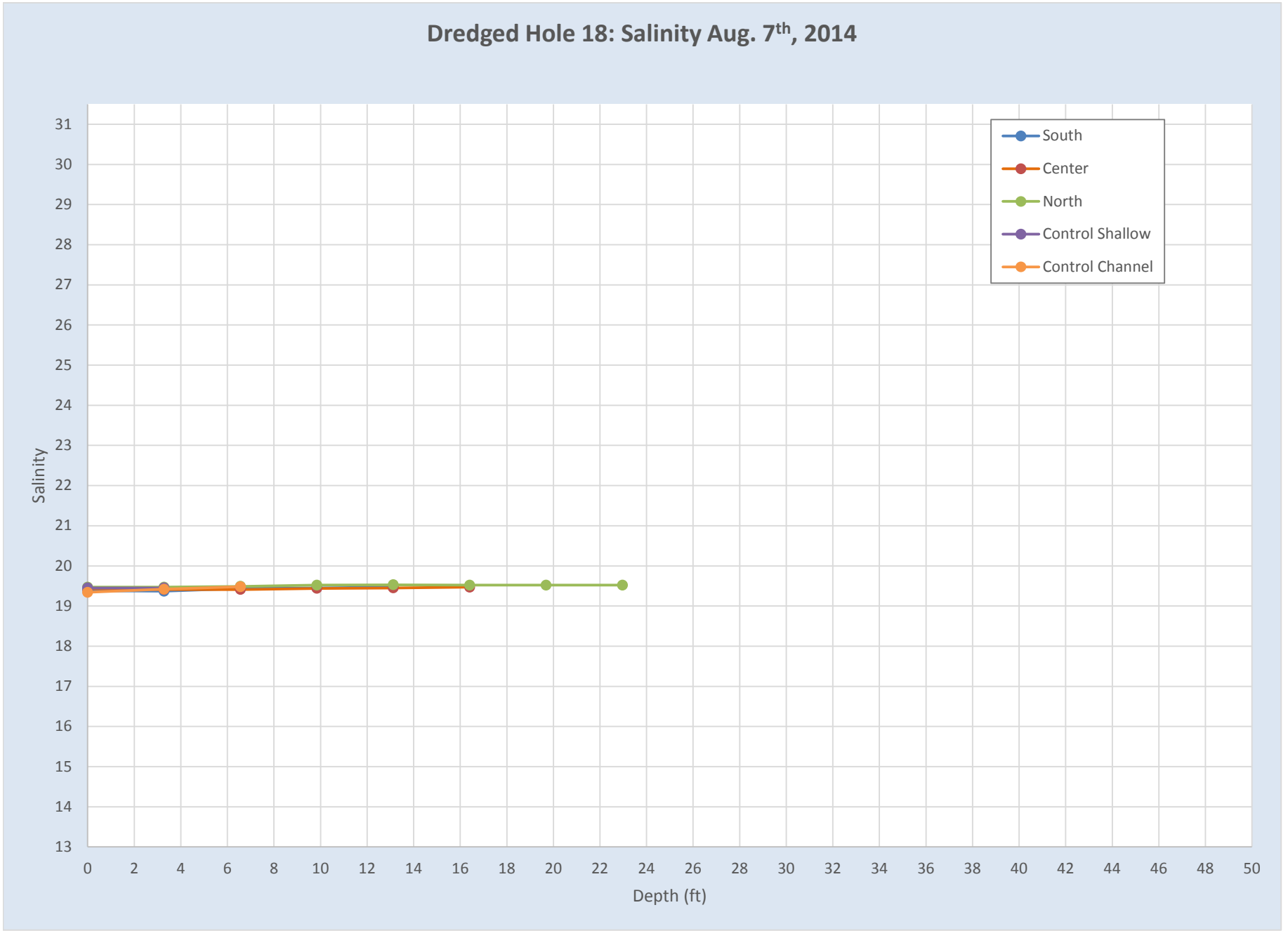
Black sandy mud with black stained plant debris few pebbles.

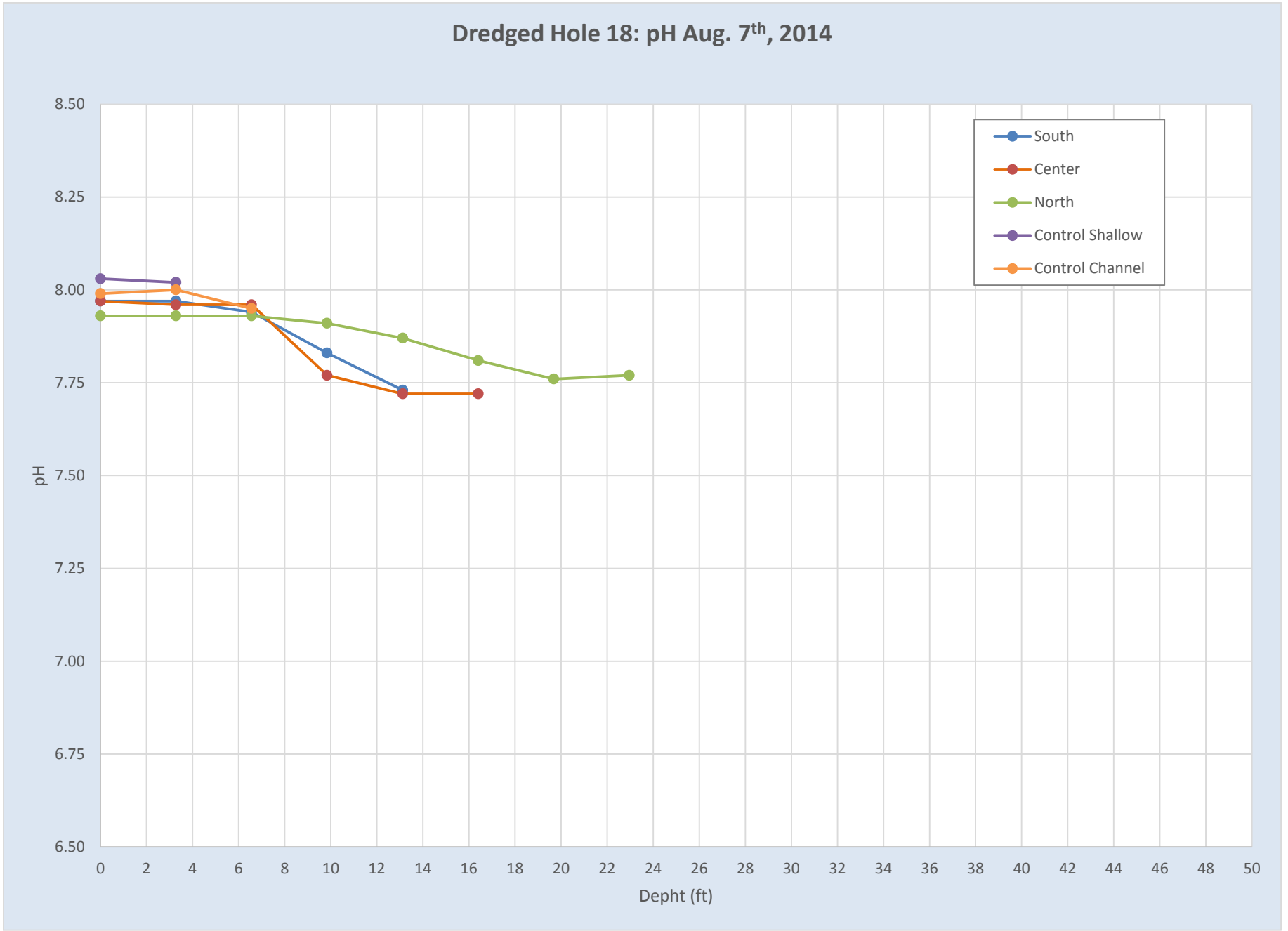
Weather conditions/ other notes:

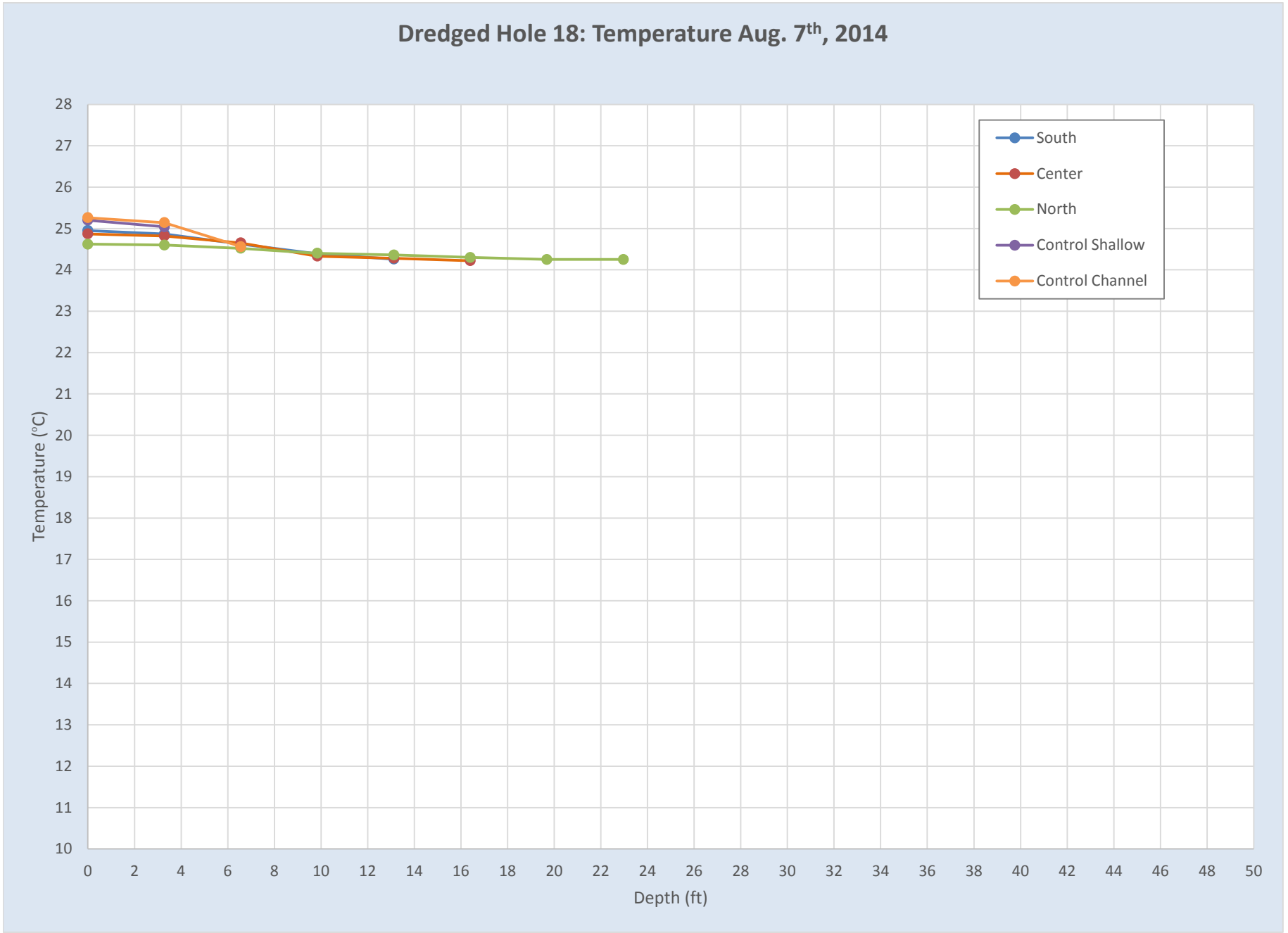
Sunny, wind NW 10-15mph


Dredged Hole 18: Dissolved Oxygen Content Aug. 7th, 2014
Dissolved Oxygen (mg/l)
Depth (ft)
South
Center
North
Control Shallow
Control Channel
Hypoxic Conditions
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50


Dredged Hole 18: Dissolved Oxygen Aug. 7th, 2014
Dissolved Oxygen (%)
Depth (ft)
South
Center
North
Control Shallow
Control Channel
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 18: Salinity Aug. 7th, 2014
Salinity
Depth (ft)
South
Center
North
Control Shallow
Control Channel
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 18: pH Aug. 7th, 2014
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
pH
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depht (ft)
South
Center
North
Control Shallow
Control Channel


Dredged Hole 18: Temperature Aug. 7th, 2014
Temperature (°C)
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
South
Center
North
Control Shallow
Control Channel

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH25 **Date: 8/7/14** **Time: 1:45pm**

Site name: DH 25 Shallow 12ft South

Alt name: South

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.45	115.1	19.22	8.16	25.62	2.8
1.0	3.28	8.22	110.9	19.22	8.16	25.35	2.3
2.0	6.56	7.96	107.6	19.20	8.14	25.17	2.3
3.0	9.84	5.96	80.3	19.20	7.95	24.72	3.6
4.0	13.12	5.90	78.2	19.23	7.86	24.39	4.3

Sediment Sample Description :

Black mud w/ plant debris

Weather conditions/ other notes:

Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH25 **Date: 8/7/14** **Time: 1:30pm**

Site name: DH 25 Deepest 20ft Center

Alt name: Center

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.15	111.0	19.21	8.14	25.56	2.1
1.0	3.28	8.07	109.2	19.21	8.13	25.23	2.4
2.0	6.56	7.89	106.5	19.20	8.12	25.05	2.4
3.0	9.84	6.72	90.1	19.21	7.99	24.48	2.4
4.0	13.12	5.40	71.8	19.23	7.80	24.16	2.6
5.0	16.40	2.46	33.0	19.30	7.33	23.75	3.5
6.0	19.68	2.10	27.7	19.30	7.25	23.60	12.1

Sediment Sample Description :

Black mud w/ plant debris

Weather conditions/ other notes:

Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH25 **Date: 8/7/14** **Time: 1:12pm**

Site name: DH 25 Middepth 15ft North

Alt name: North

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.95	108.1	19.22	8.10	25.38	2.2
1.0	3.28	7.98	108.0	19.20	8.10	25.23	2.2
2.0	6.56	7.12	95.4	19.19	8.07	24.81	2.3
3.0	9.84	6.72	89.9	19.22	7.97	24.47	2.9
4.0	13.12	6.65	88.8	19.22	7.96	24.41	2.2

Sediment Sample Description :

Black mud w/ plant debris

Weather conditions/ other notes:

Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH25 **Date: 8/7/14** **Time: 2:00pm**

Site name: DH 25 Control Shallow

Alt name: Control Shallow

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.50	116.5	19.19	8.18	25.89	2.2
1.0	3.28	8.44	115.6	19.19	8.18	25.88	5.6

Sediment Sample Description :

Fine grey sand w/ plant/shell debris and few small pebbles. Live snail found in sample

Weather conditions/ other notes:

Sunny, wind NW 10-15mph

Dredged Hole Monitoring Worksheet

Dredged Hole ID: DH25 **Date: 8/7/14** **Time: 1:00pm**

Site name: DH 25 Control Channel

Alt name: Control Channel

YSI Readings

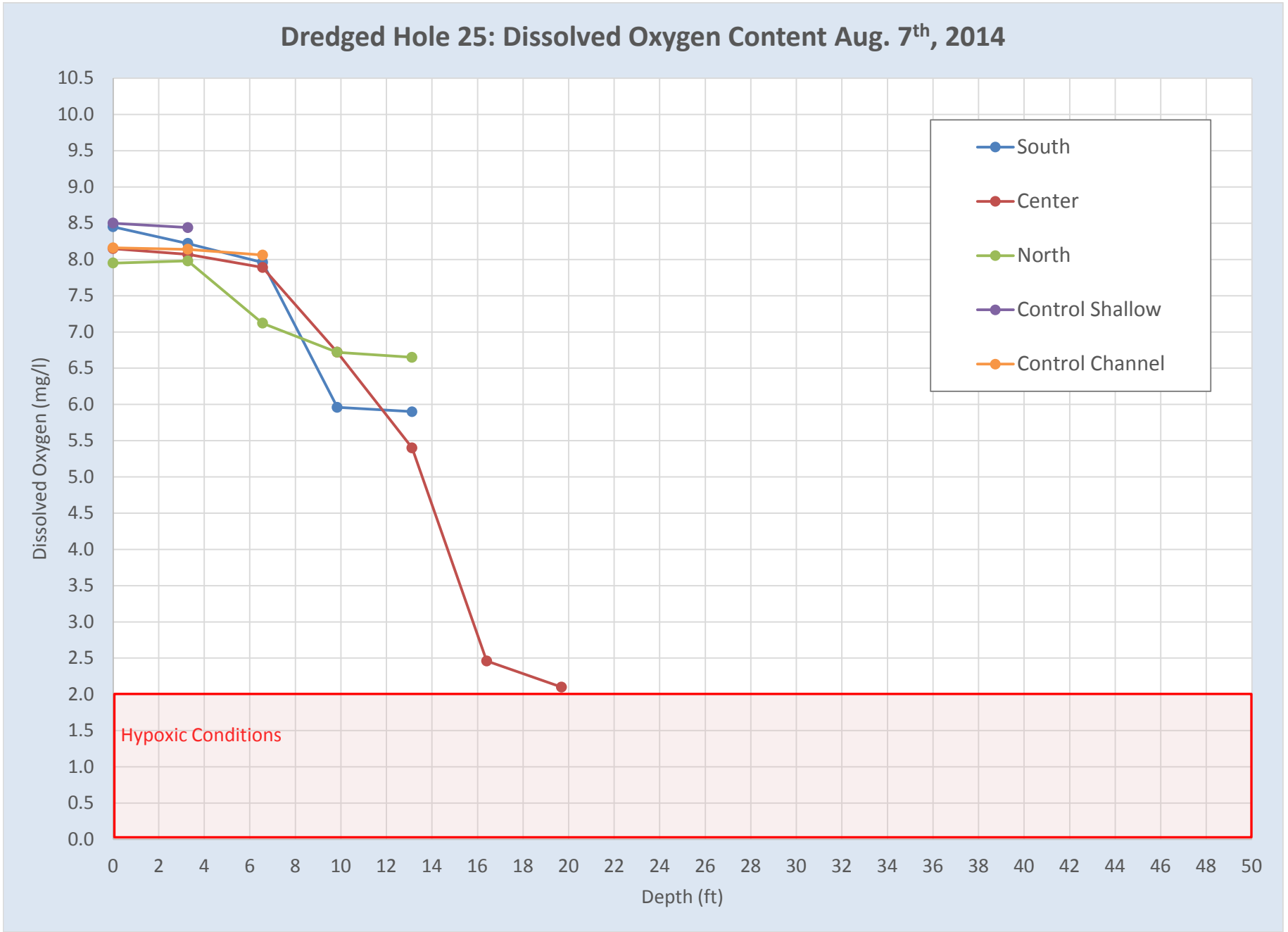
Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.16	110.5	19.27	8.08	25.20	1.9
1.0	3.28	8.14	109.9	19.27	8.08	25.09	2.2
2.0	6.56	8.06	108.9	19.27	8.08	25.07	2.7

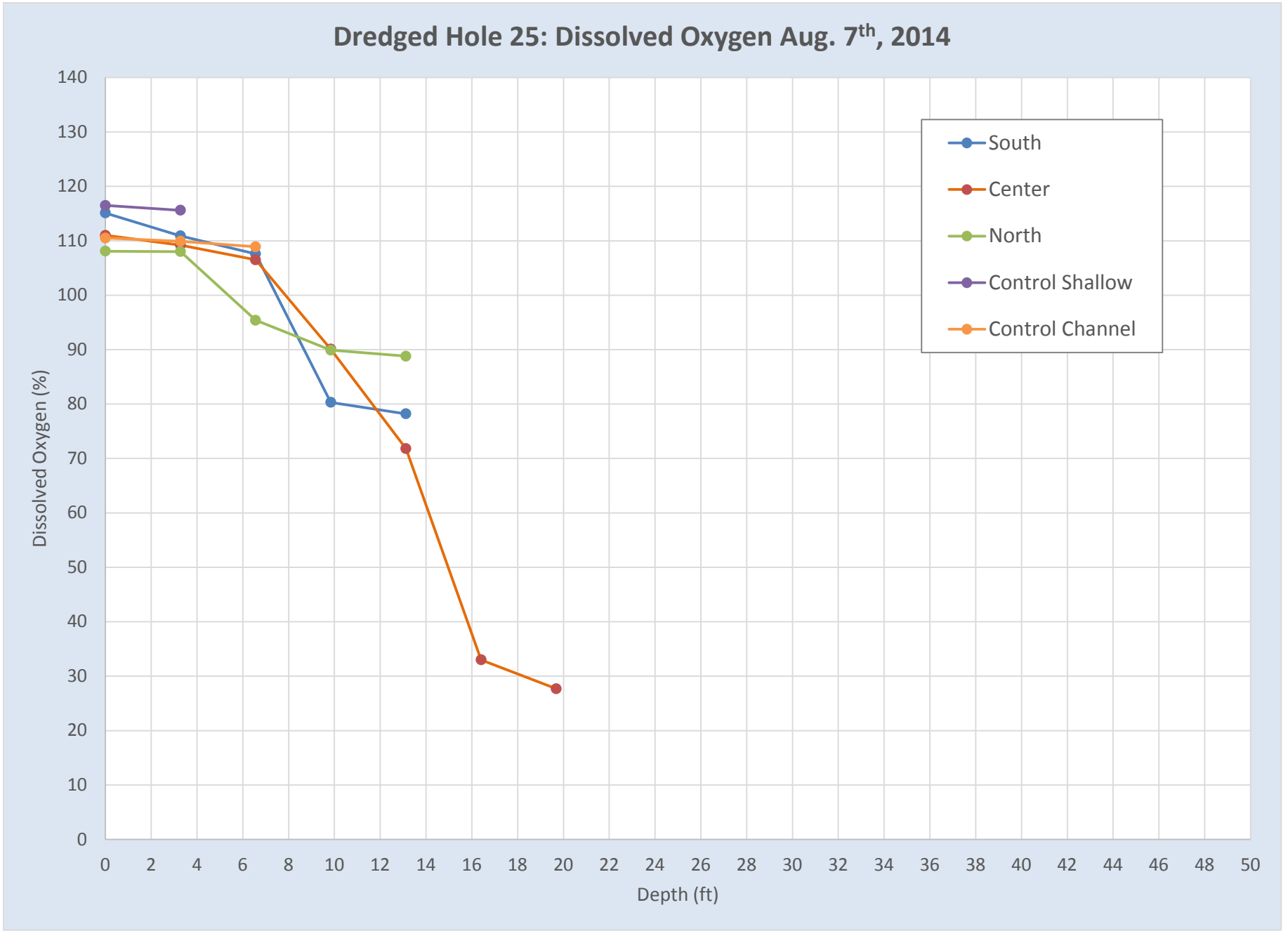
Sediment Sample Description :

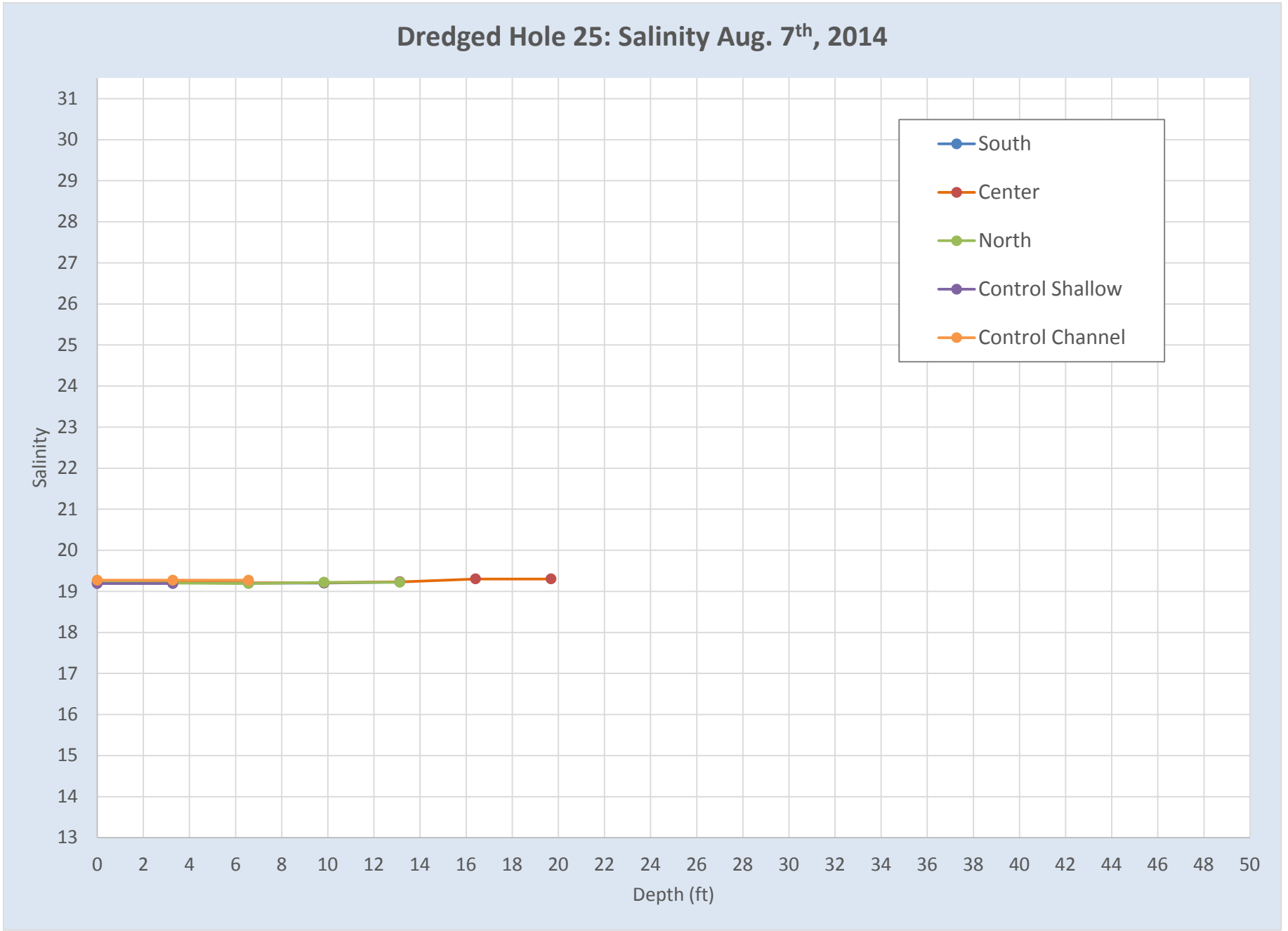
Black/Gray sandy mud

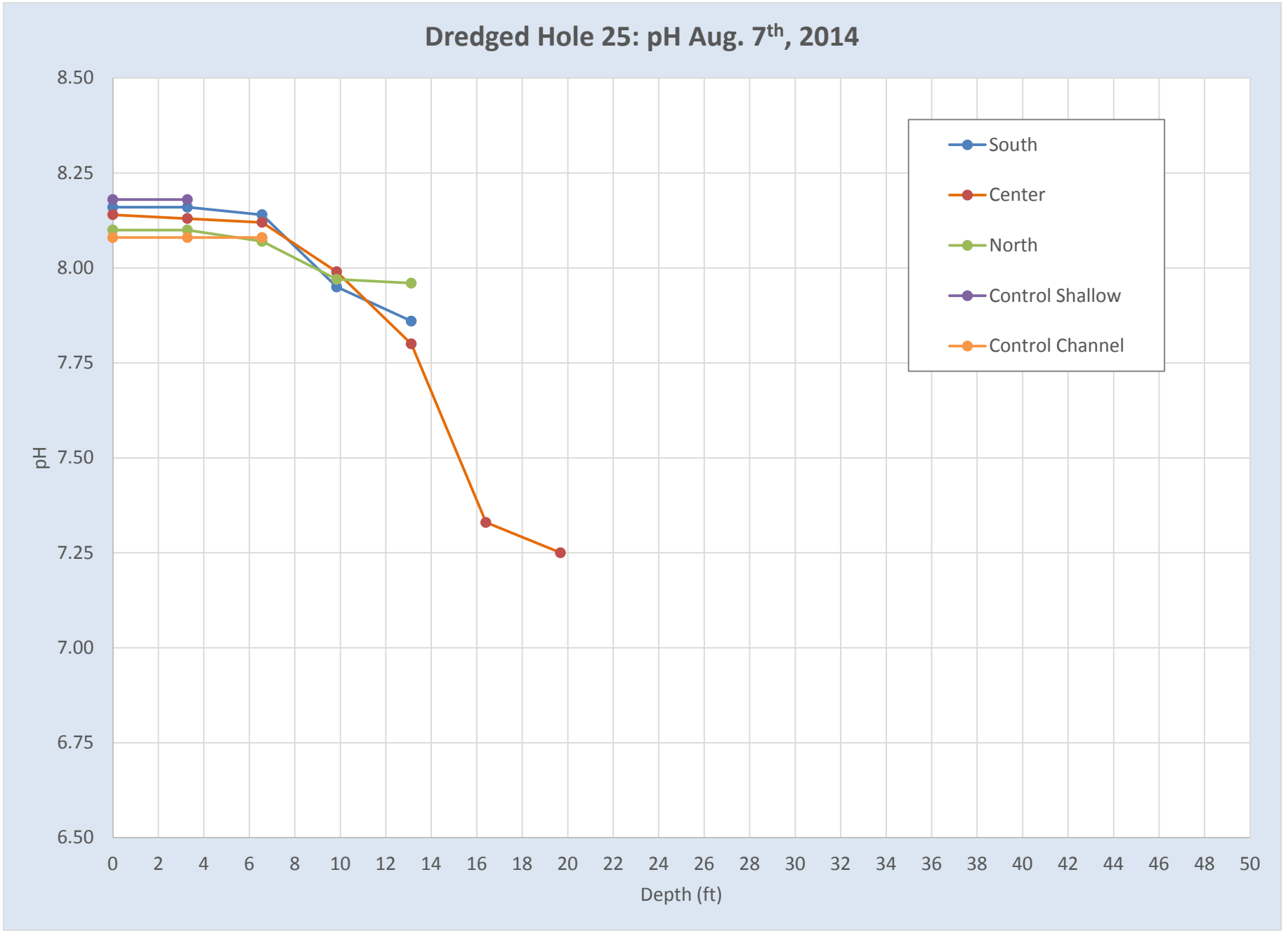
Weather conditions/ other notes:

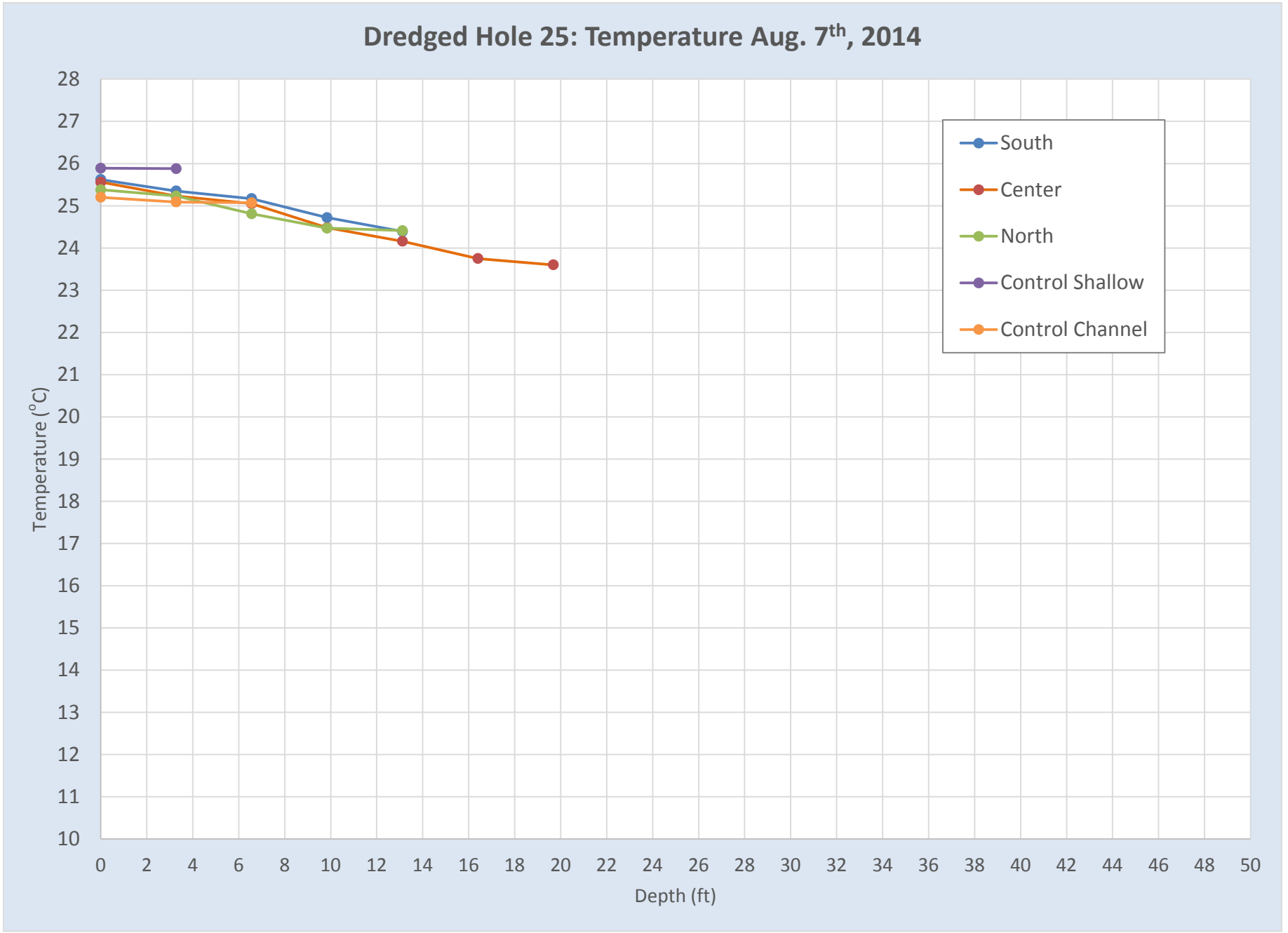
Sunny, wind NW 10-15mph


Dredged Hole 25: Dissolved Oxygen Content Aug. 7th, 2014
Dissolved Oxygen (mg/l)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Depth (ft)
South
Center
North
Control Shallow
Control Channel
Hypoxic Conditions


Dredged Hole 25: Dissolved Oxygen Aug. 7th, 2014
Dissolved Oxygen (%)
Depth (ft)
South
Center
North
Control Shallow
Control Channel
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 25: Salinity Aug. 7th, 2014
Salinity
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control Shallow
Control Channel


Dredged Hole 25: pH Aug. 7th, 2014
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
pH
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Depth (ft)
South
Center
North
Control Shallow
Control Channel


Dredged Hole 25: Temperature Aug. 7th, 2014
Temperature (°C)
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control Shallow
Control Channel

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 78 **Date: 8/11/14** **Time: 9:45am**

Site name: dh 78 Deepest - most southern location

Alt name: South

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	5.65	80.1	29.99	7.77	25.08	2.8
1.0	3.28	5.78	82.7	30.01	7.79	24.88	3.5
2.0	6.56	4.72	66.4	30.05	7.69	24.69	3.5
3.0	9.84	4.66	66.6	30.05	7.71	24.60	3.3
4.0	13.12	4.58	64.9	30.11	7.67	24.43	3.5
5.0	16.40	0.57	8.1	30.56	7.12	22.96	3.5
6.0	19.68	0.67	9.2	31.04	6.96	21.16	9.7
7.0	22.97	0.76	10.1	31.18	6.81	19.84	5.6
8.0	26.25	0.91	11.8	31.11	6.77	19.22	2.8
8.5	27.89	0.84	10.8	31.06	6.76	18.99	2.5

Sediment Sample Description :

Dark Gray Silt, detritus, sulfer odor.

Weather conditions/ other notes:

80°F Sunny

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 78 **Date: 8/11/14** **Time: 10:15am**

Site name: dh 78 deeper - center location

Alt name: Center

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	5.11	72.5	29.87	7.72	25.12	2.0
1.0	3.28	4.92	69.9	29.90	7.69	24.99	1.9
2.0	6.56	4.76	67.5	29.93	7.71	24.62	2.8
3.0	9.84	4.61	65.0	29.96	7.67	24.43	2.4
4.0	13.12	2.60	36.0	30.07	7.41	24.16	3.7
5.0	16.40	0.76	9.6	30.47	7.15	22.98	3.1
6.0	19.68	0.64	8.4	31.01	7.00	21.00	9.6
7.0	22.97	0.69	9.1	31.08	6.87	19.34	5.2
8.0	26.25	0.84	10.8	31.05	6.83	18.59	3.6
9.0	29.53	0.95	12.1	31.10	6.80	18.16	10.4

Sediment Sample Description :

Dark Gray Silt, detritus, sulfer odor.

Weather conditions/ other notes:

80°F Sunny

Dredged Hole Monitoring Worksheet

Dredged Hole ID:78 **Date: 8/11/14** **Time: 10:45am**

Site name: dh 78 Northen most - Mid Depth

Alt name: North

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	5.47	76.0	29.83	7.77	25.03	2.5
1.0	3.28	5.29	75.0	29.88	7.76	24.66	2.9
2.0	6.56	4.79	67.3	29.91	7.68	24.46	3.2
3.0	9.84	4.12	57.3	29.93	7.56	24.39	3.1
4.0	13.12	3.98	56.6	29.92	7.64	24.28	3.3
5.0	16.40	1.03	14.1	30.35	7.19	23.15	5.7
6.0	19.68	0.96	12.1	31.15	7.01	21.06	9.7
7.0	22.97	0.89	11.6	30.97	6.85	19.43	5.8
7.5	24.61	1.05	13.5	31.00	6.81	18.76	6.0

Sediment Sample Description :

Dark Gray Silt, detritus, sulfer odor.

Weather conditions/ other notes:

80°F Sunny

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 78 **Date: 8/11/14** **Time: 11:00am**

Site name: dh 78 Shallow control

Alt name: Control

YSI Readings

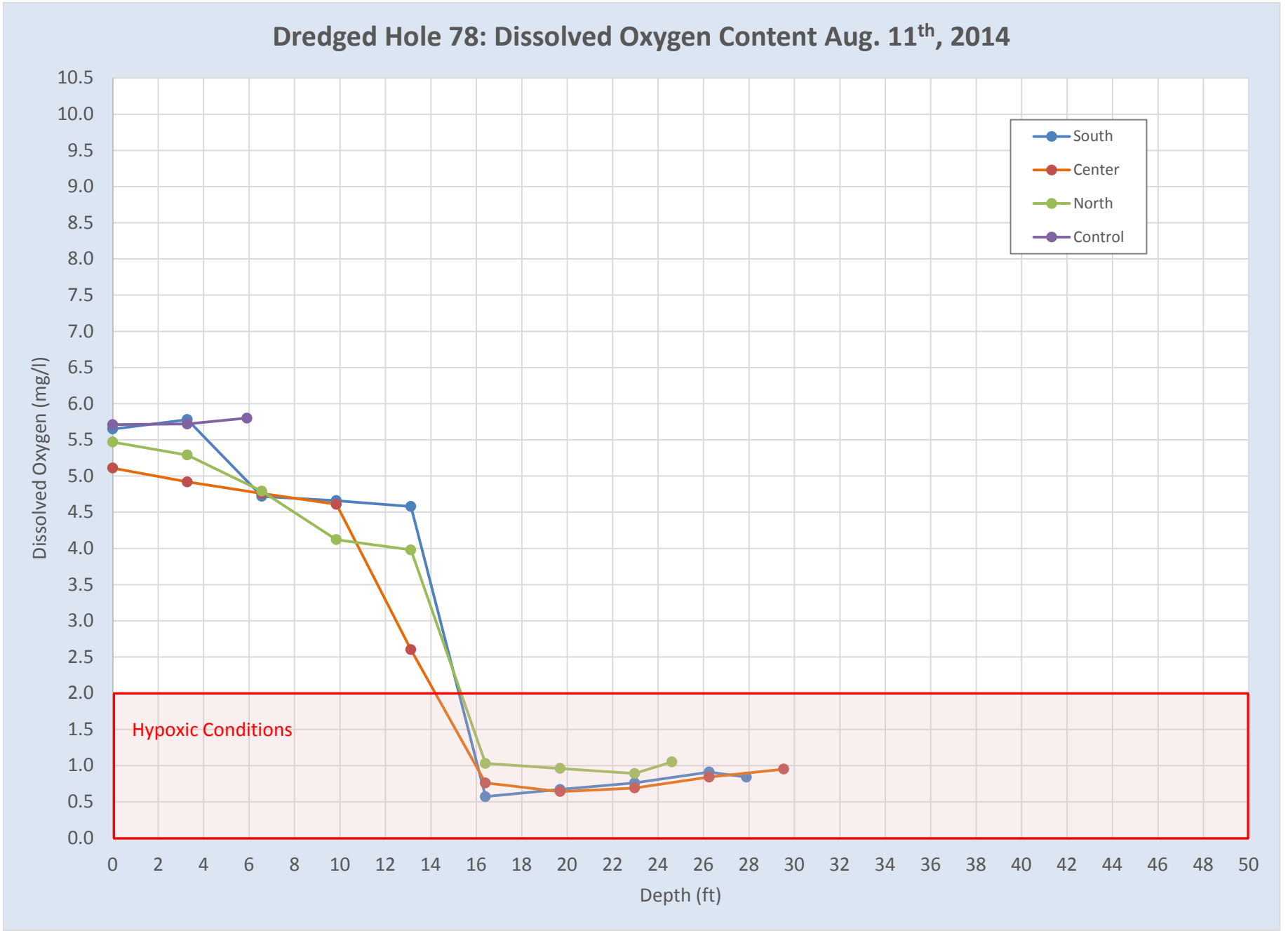
Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	5.71	82.1	29.75	7.81	25.45	2.3
1.0	3.28	5.72	82.5	29.81	7.83	25.09	2.7
1.8	5.91	5.80	82.6	29.88	7.84	24.56	13.3

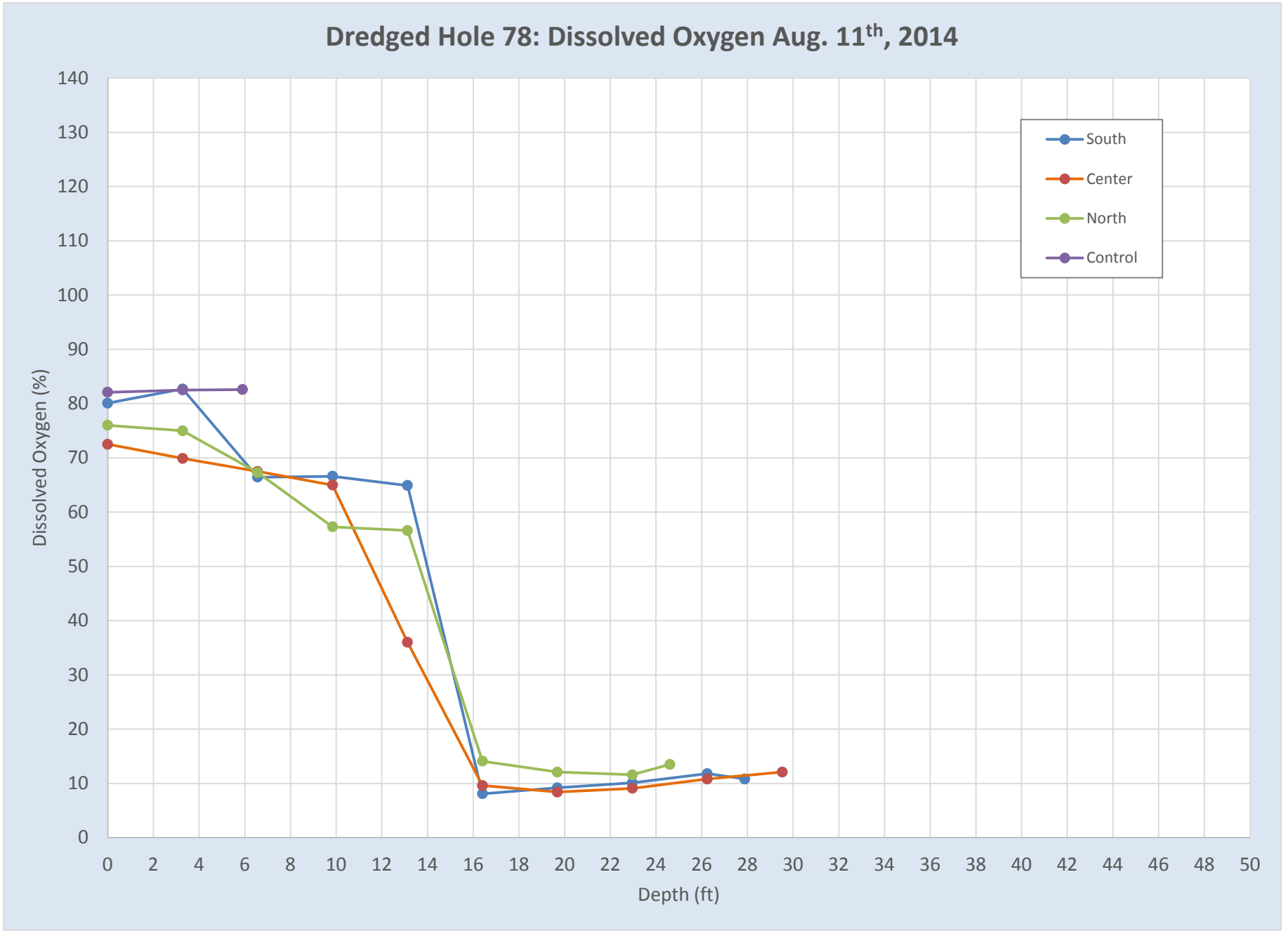
Sediment Sample Description :

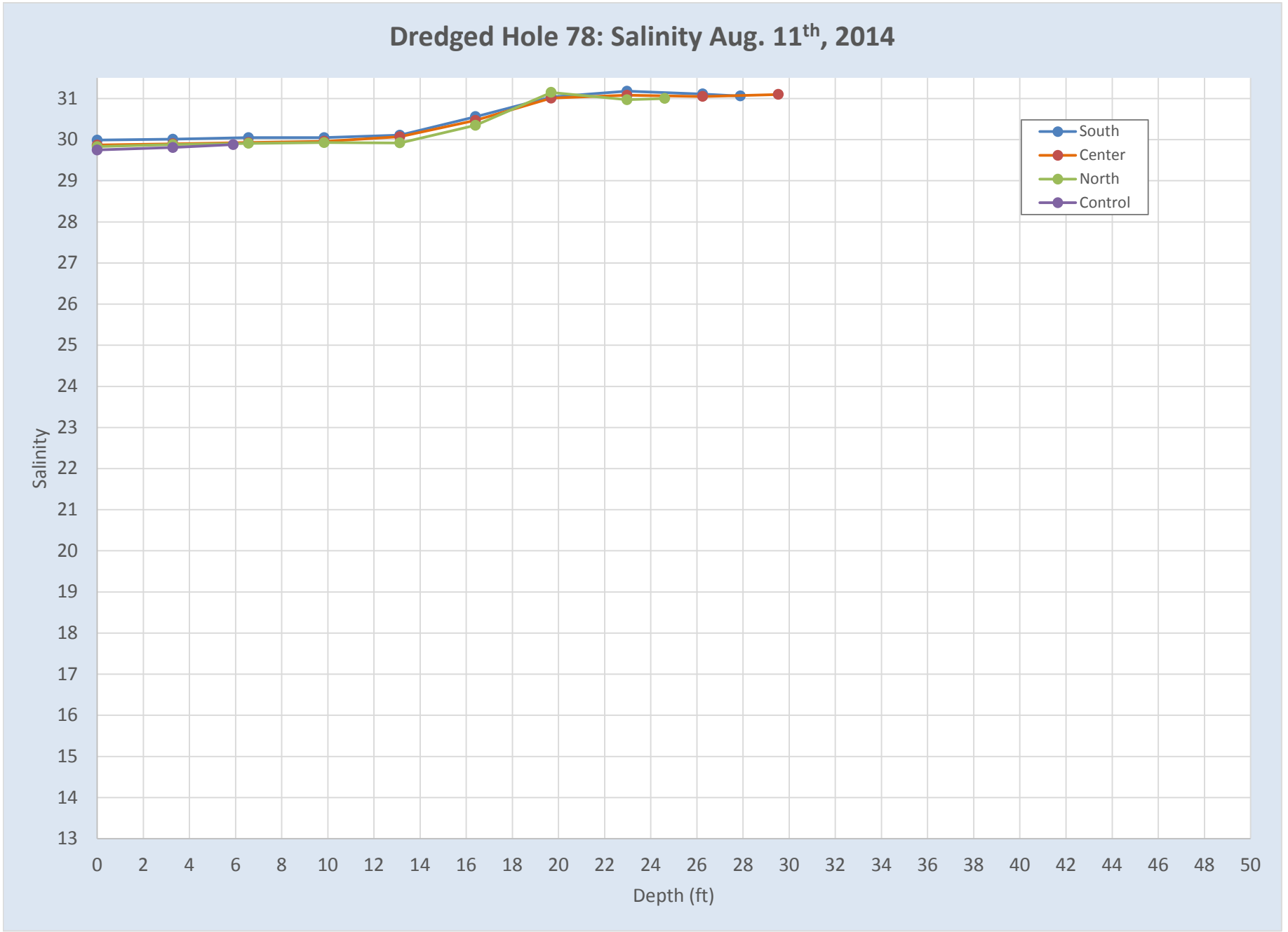
Gray Sandy Silt, Shell fragments, Seaweed.

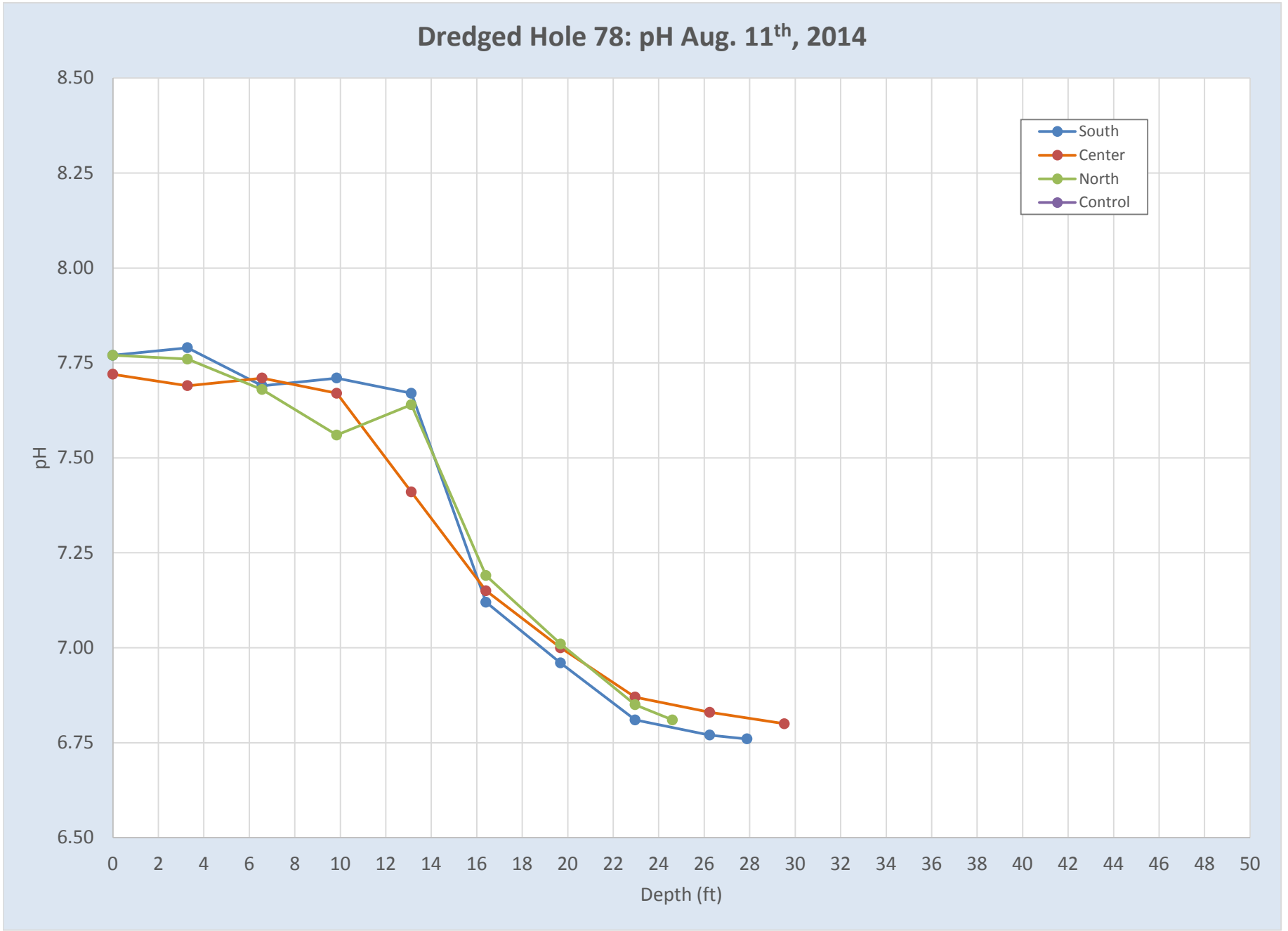
Weather conditions/ other notes:

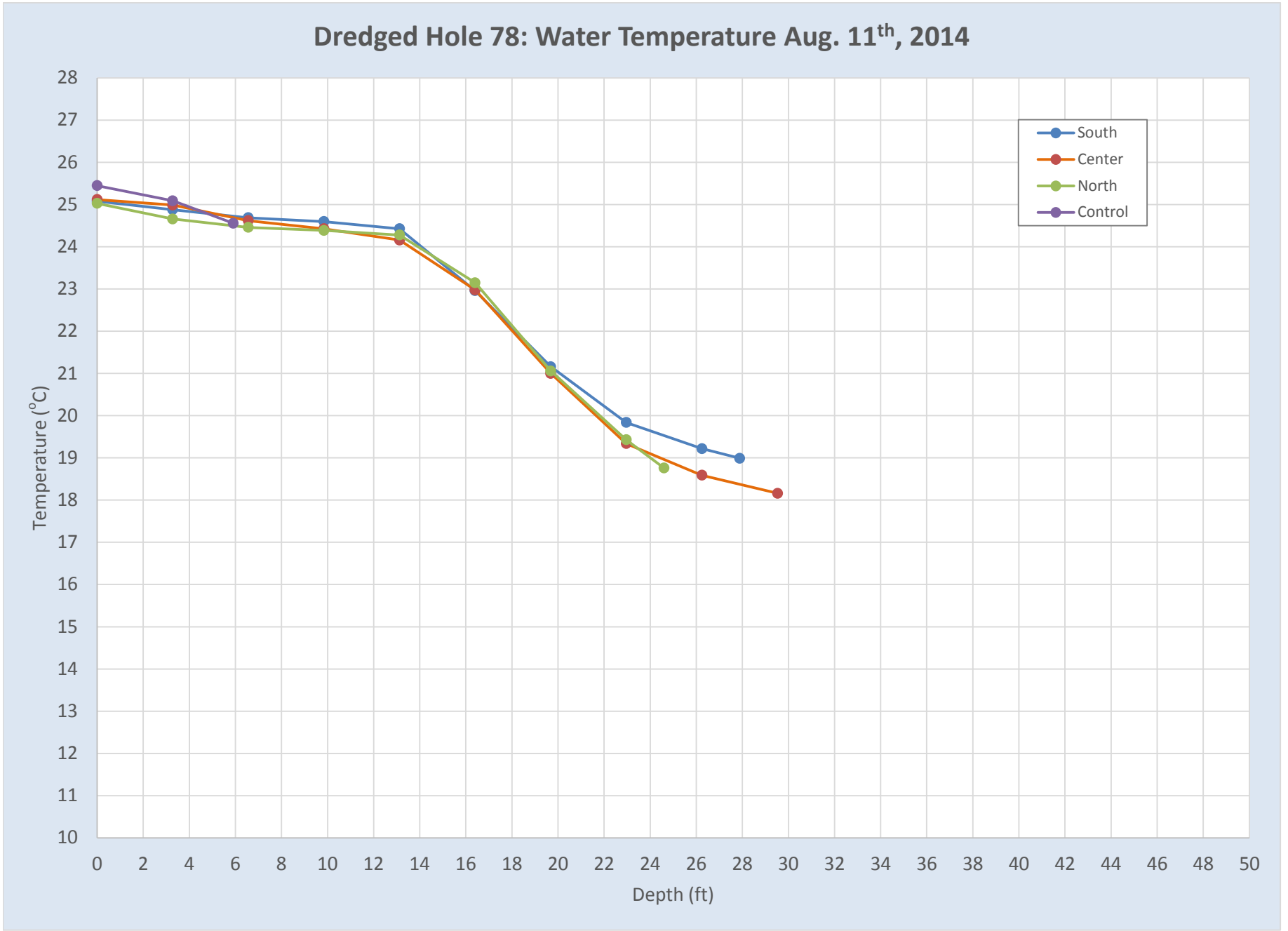
80°F Sunny


Dredged Hole 78: Dissolved Oxygen Content Aug. 11th, 2014
Dissolved Oxygen (mg/l)
Depth (ft)
South
Center
North
Control
Hypoxic Conditions
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50


Dredged Hole 78: Dissolved Oxygen Aug. 11th, 2014
Dissolved Oxygen (%)
Depth (ft)
South
Center
North
Control
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 78: Salinity Aug. 11th, 2014
Salinity
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Depth (ft)
South
Center
North
Control


Dredged Hole 78: pH Aug. 11th, 2014
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
pH
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Depth (ft)
South
Center
North
Control


Dredged Hole 78: Water Temperature Aug. 11th, 2014
Temperature (°C)
Depth (ft)
South
Center
North
Control
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 86 **Date: 8/11/14** **Time: 1:30pm**

Site name: DH 86 Deepest - Most Southern
Alt name: South

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	6.68	99.2	29.18	7.76	26.65	2.6
1.0	3.28	6.88	100.6	29.16	7.76	26.64	2.7
2.0	6.56	6.05	87.7	29.24	7.65	26.08	2.7
3.0	9.84	5.06	72.0	29.29	7.60	25.50	2.1
4.0	13.12	4.02	57.0	29.33	7.50	25.11	1.6
5.0	16.40	3.47	49.3	29.43	7.46	24.87	1.7
6.0	19.68	2.70	37.5	29.33	7.40	24.47	1.4
7.0	22.97	0.77	10.4	29.62	7.24	23.86	1.3
8.0	26.25	0.69	8.8	29.97	7.18	22.55	0.7
9.0	29.53	0.83	10.5	30.00	7.05	20.64	0.3
10.0	32.81	1.25	15.2	29.97	6.95	18.34	0.5
11.0	36.09	1.47	17.5	30.22	6.85	14.73	1.3
12.0	39.37	1.84	21.4	30.17	6.77	12.22	2.1
13.0	42.65	2.35	25.9	30.11	6.72	11.19	2.3
14.0	45.93	2.67	29.1	30.12	6.71	10.17	2.4
14.9	48.88	2.89	31.7	30.11	6.76	10.66	2.2

Sediment Sample Description:
Black Silt

Weather conditions/ other notes:
80°F Sunny

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 86 **Date: 8/11/14** **Time: 3:00pm**

Site name: DH 86 Mid
Alt name: Center

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.32	108.3	29.10	7.80	27.13	3.2
1.0	3.28	7.28	106.6	29.13	7.78	26.93	3.2
2.0	6.56	5.31	76.3	29.14	7.65	25.61	2.3
3.0	9.84	4.63	66.4	29.31	7.58	25.28	2.1
4.0	13.12	3.91	55.6	29.35	7.51	25.04	1.9
5.0	16.40	3.38	41.8	29.34	7.47	24.81	1.9
6.0	19.68	1.53	21.6	29.43	7.32	24.11	3.3
7.0	22.97	0.84	11.1	29.83	7.22	23.34	1.5
8.0	26.25	0.69	9.4	30.04	7.13	21.70	0.5
9.0	29.53	0.84	10.9	30.12	6.98	18.96	0.4
9.5	31.17	0.95	12.2	30.00	6.95	18.52	23.8

Sediment Sample Description :
Black Silt

Weather conditions/ other notes:
80°F Sunny

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 86 **Date: 8/11/14** **Time: 3:15pm**

Site name: DH 86 Deep - Northern most
Alt name: North

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.55	111.8	29.11	7.83	27.22	3.2
1.0	3.28	7.50	111.0	29.05	7.82	27.20	3.1
2.0	6.56	7.00	99.5	29.39	7.71	25.67	2.3
3.0	9.84	4.77	67.7	29.31	7.58	25.18	2.0
4.0	13.12	3.94	56.1	29.34	7.52	25.40	1.9
5.0	16.40	3.04	43.2	29.35	7.45	24.68	1.5
6.0	19.68	1.60	22.5	29.51	7.30	24.30	1.8
7.0	22.97	0.75	10.5	29.66	7.26	23.53	4.4
8.0	26.25	0.72	9.7	29.95	7.12	21.61	0.4
9.0	29.53	0.88	11.6	29.98	7.03	19.87	0.5
10.0	32.81	1.12	14.2	29.96	6.92	17.22	0.7
11.0	36.09	1.35	16.8	29.98	6.88	16.30	0.9
12.0	39.37	1.54	18.7	29.96	6.85	15.21	1.2
13.0	42.65	1.83	21.5	30.03	6.81	13.93	1.1
14.0	45.93	2.04	23.8	30.01	6.79	13.30	1.1
14.5	47.57	2.84	32.6	29.71	6.78	13.28	80.2

Sediment Sample Description :
Black Silt

Weather conditions/ other notes:
80^{o}F Sunny

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 86 **Date: 8/11/14** **Time: 2:15pm**

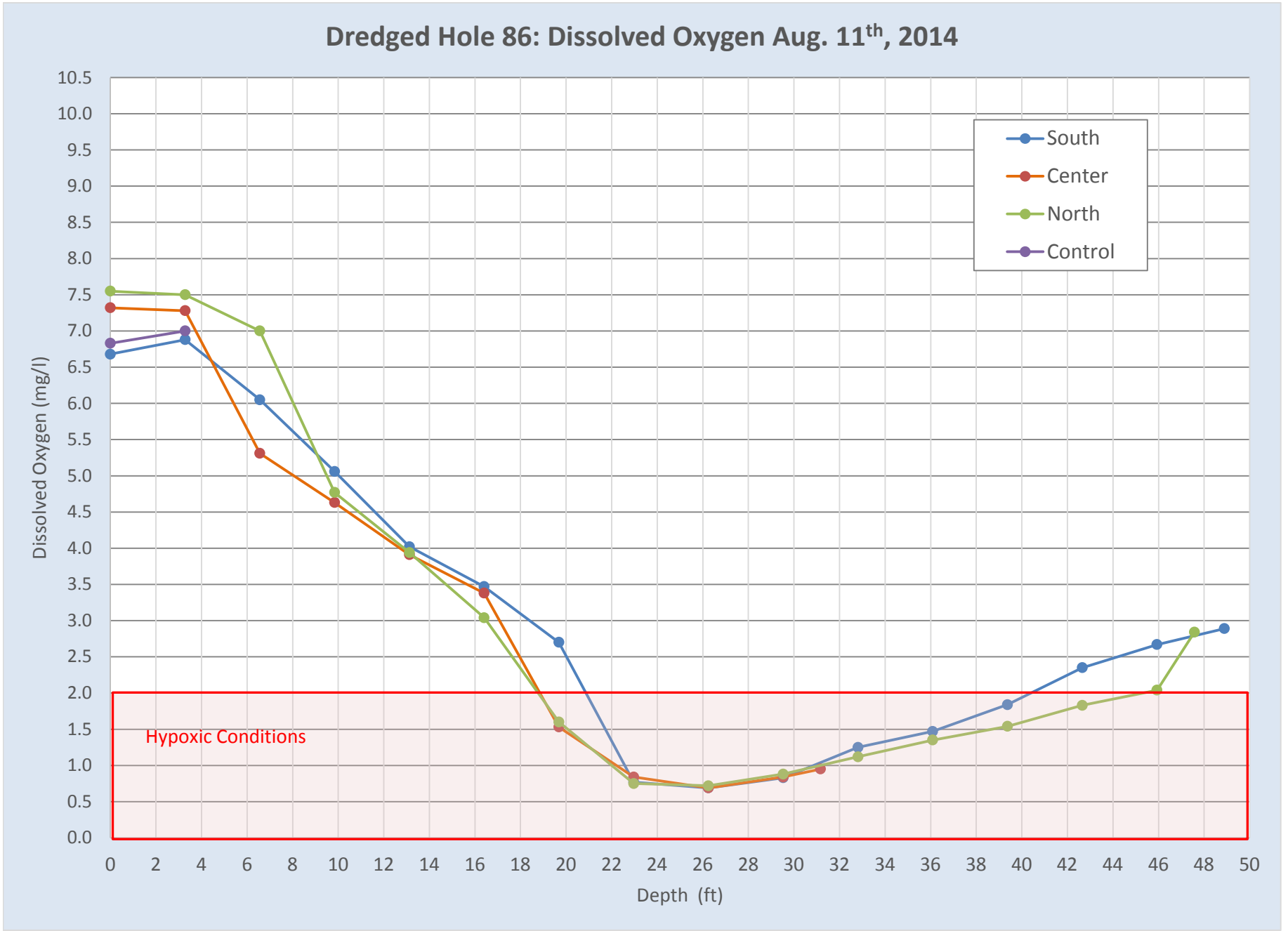
Site name: DH 86 Control Shallow - Southern most
Alt name: Control

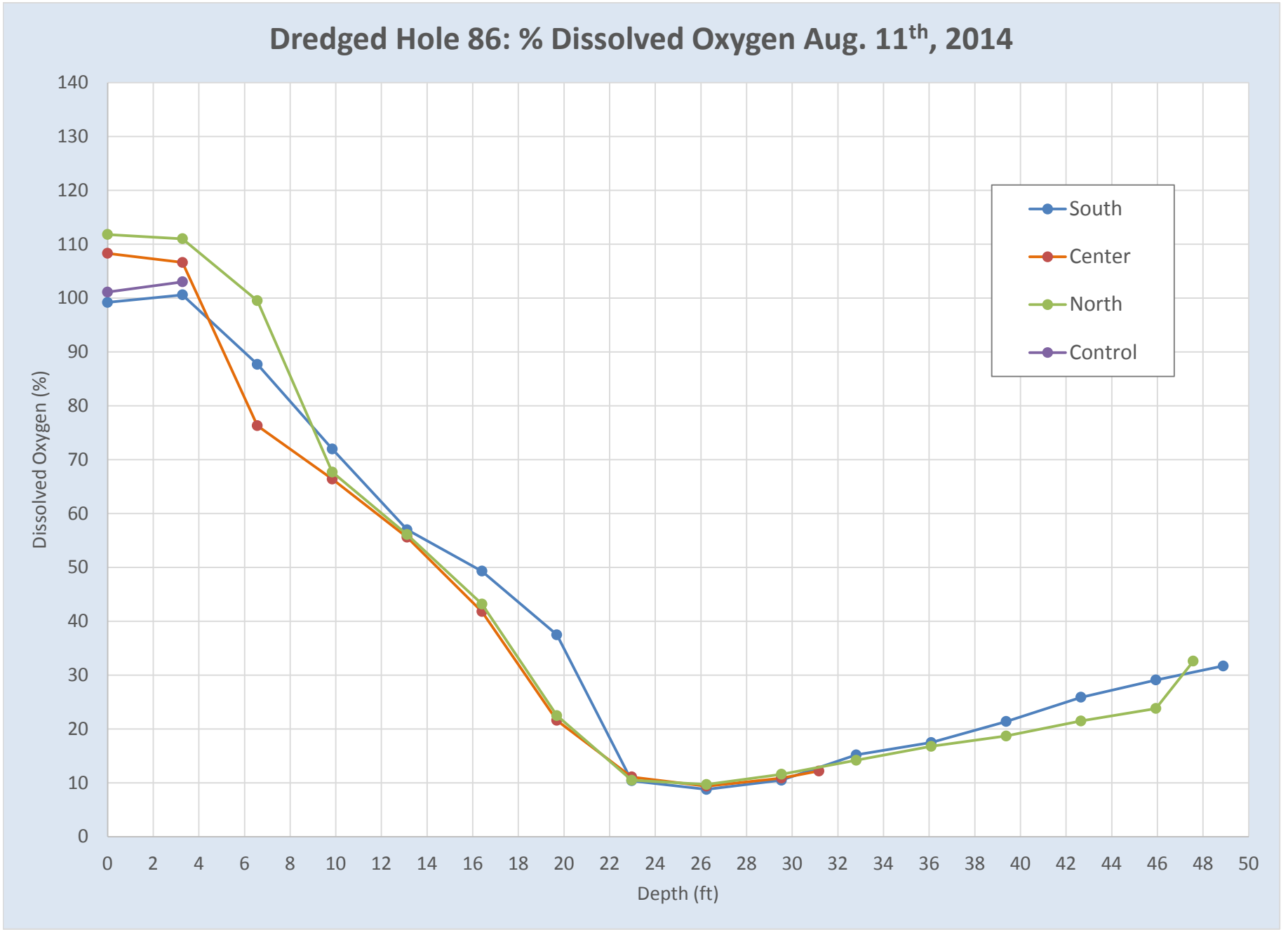
YSI Readings

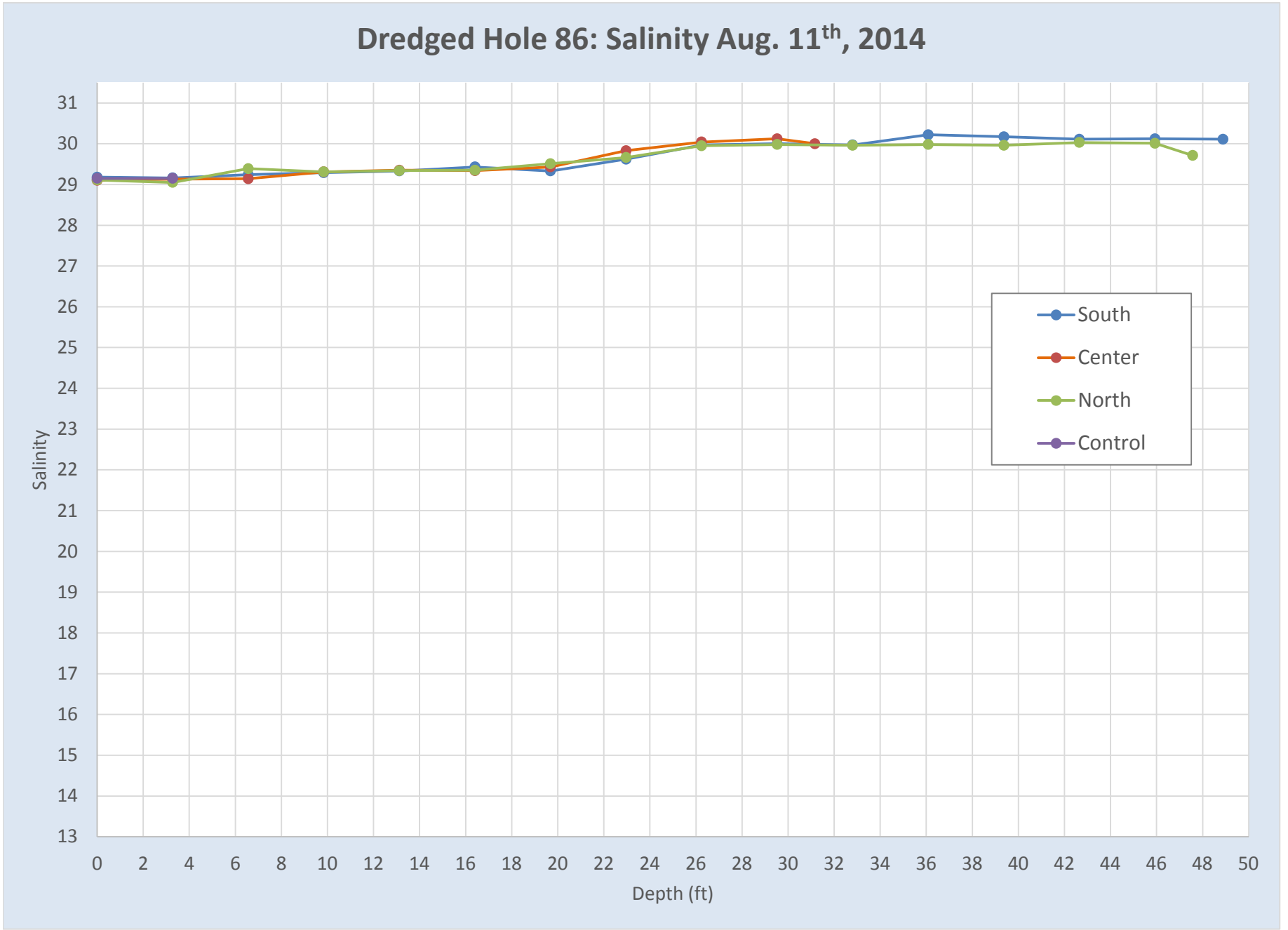
Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	6.83	101.1	29.15	7.80	26.96	2.6
1.0	3.28	7.00	103.0	29.15	7.80	26.93	54.4

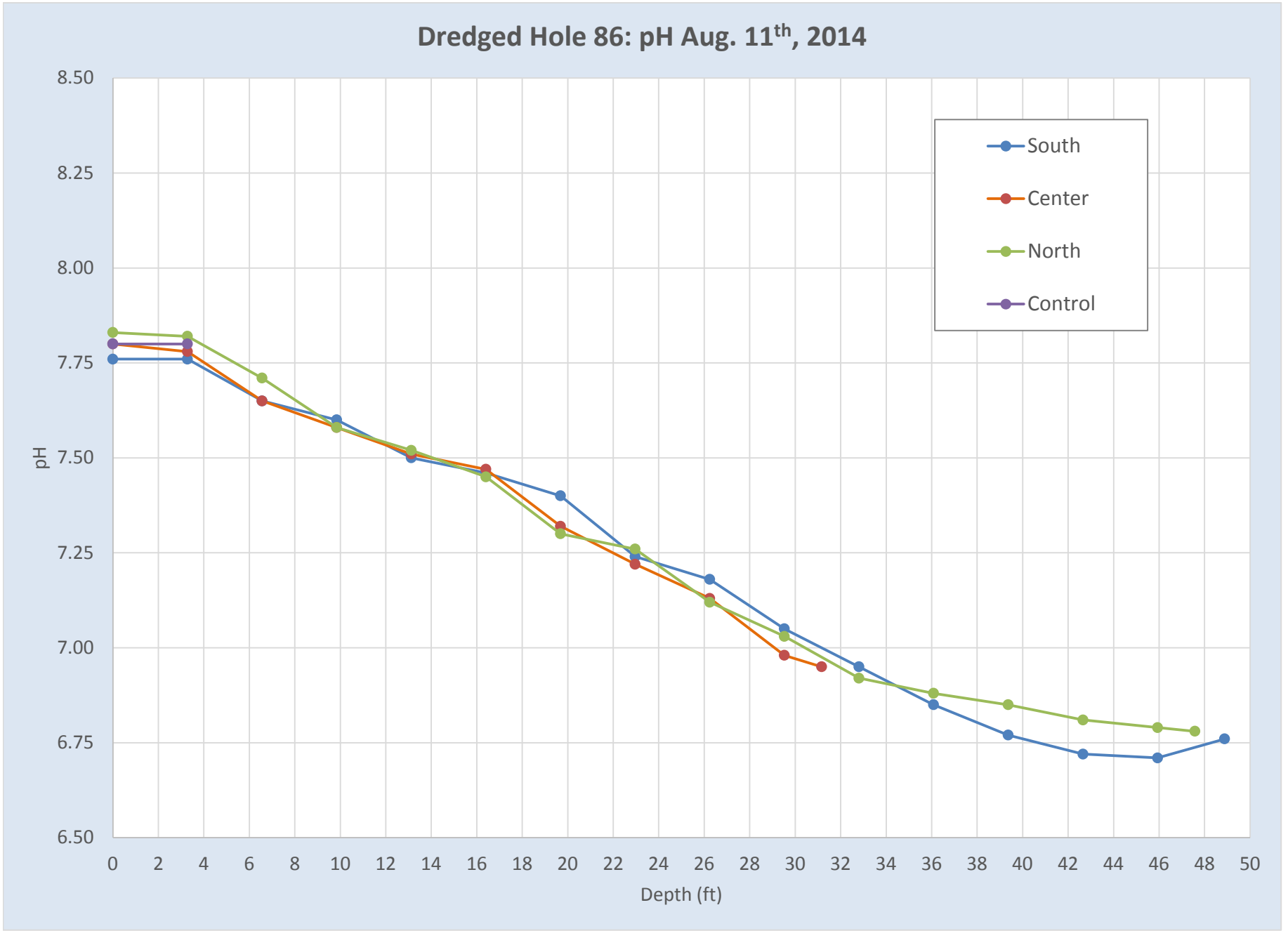
Sediment Sample Description :
Gray Silty Sand

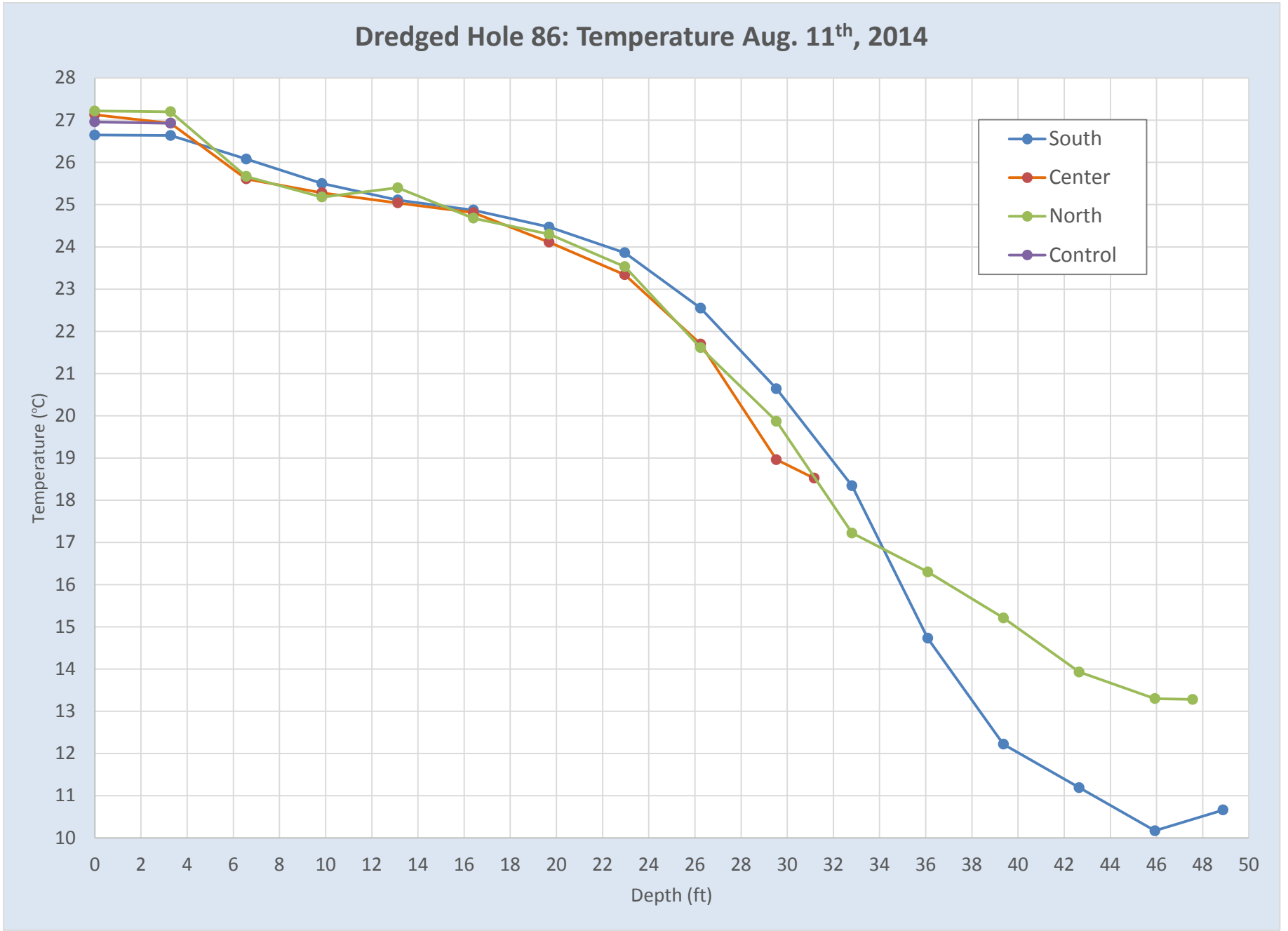
Weather conditions/ other notes:
80°F Sunny


Dredged Hole 86: Dissolved Oxygen Aug. 11th, 2014
Dissolved Oxygen (mg/l)
Depth (ft)
South
Center
North
Control
Hypoxic Conditions
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 86: % Dissolved Oxygen Aug. 11th, 2014
Dissolved Oxygen (%)
Depth (ft)
South
Center
North
Control
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 86: Salinity Aug. 11th, 2014
Salinity
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control


Dredged Hole 86: pH Aug. 11th, 2014
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
pH
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control


Dredged Hole 86: Temperature Aug. 11th, 2014
Temperature (°C)
Depth (ft)
South
Center
North
Control
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50

Dredged Hole Monitoring Worksheet

Dredged Hole ID: dh 93 **Date: 08/14/14** **Time: 12:47pm**

Site name: dh93_15ft_west
Alt Name: South

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.78	113.5	13.56	7.27	25.69	5.4
1.0	3.28	4.40	57.7	18.20	6.91	24.33	6.4
2.0	6.56	2.94	40.3	21.94	6.93	25.11	5.9
3.0	9.84	2.54	35.4	25.00	6.98	25.14	3.4
4.0	13.12	2.04	28.4	25.50	6.96	24.93	4.4
4.7	15.42	1.95	27.2	25.61	6.97	24.83	43.5

Sediment Sample Description :
blk siltno signs of life

Weather conditions/ other notes:
Sunny 80deg F, AT 5 meters DO went between .3mgl to 1.3 mg/l

Dredged Hole Monitoring Worksheet

Dredged Hole ID: dh 93 **Date: 08/14/14** **Time: 12:25pm**

Site name: DH 93 center

Alt name: Center

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	6.66	88.4	13.58	7.66	25.44	5.5
1.0	3.28	4.45	58.5	16.25	7.45	24.33	6.5
2.0	6.56	3.25	44.2	21.67	7.21	25.10	4.0
3.0	9.84	2.91	40.6	25.15	7.28	25.09	1.7
4.0	13.12	2.47	34.4	25.57	7.29	24.93	3.2
5.0	16.40	2.76	38.6	25.72	7.36	24.87	2.9
6.0	19.68	2.94	41.1	25.84	7.36	24.85	2.8
7.0	22.97	2.75	38.5	25.91	7.33	24.78	3.6
7.5	24.61	2.63	36.6	25.94	7.31	24.74	4.8

Sediment Sample Description :

black/grey silt no living organisms

Weather conditions/ other notes:

Sunny 80deg F

Dredged Hole Monitoring Worksheet

Dredged Hole ID: dh 93 **Date: 08/14/14** **Time: 11:45am**

Site name: DH 93 deepst most western
Alt name: North

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	5.78	75.8	13.58	7.32	25.01	6.3
1.0	3.28	4.68	61.0	15.22	7.16	24.41	6.9
2.0	6.56	3.67	49.5	19.80	7.12	24.84	5.7
3.0	9.84	2.86	40.1	25.05	7.17	25.11	2.5
4.0	13.12	2.84	39.7	25.44	7.21	24.99	2.6
5.0	16.40	2.77	38.8	25.64	7.20	24.89	3.2
6.0	19.68	2.63	36.8	25.92	7.23	24.79	2.6
7.0	22.97	2.69	37.6	26.00	7.22	24.77	3.6
8.0	26.25	2.38	33.2	26.01	7.20	24.75	4.3

Sediment Sample Description :
dark gray silt, with some detritus.

Weather conditions/ other notes:
Sunny 80deg F

Dredged Hole Monitoring Worksheet

Dredged Hole ID: dh 93 **Date: 08/14/14** **Time: 1:14pm**

Site name: Shallow East Control

Alt name: Control Shallow

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	10.50	139.5	13.64	7.73	25.74	5.2
1.0	3.28	5.01	65.8	16.78	6.99	24.30	6.2
1.5	4.92	4.81	63.7	17.82	6.97	24.25	8.8

Sediment Sample Description :

brown silt covering blk silt, Worm located in sample.

Weather conditions/ other notes:

Sunny 80deg F

Dredged Hole Monitoring Worksheet

Dredged Hole ID: dh 93 **Date: 08/14/14** **Time: 1:54pm**

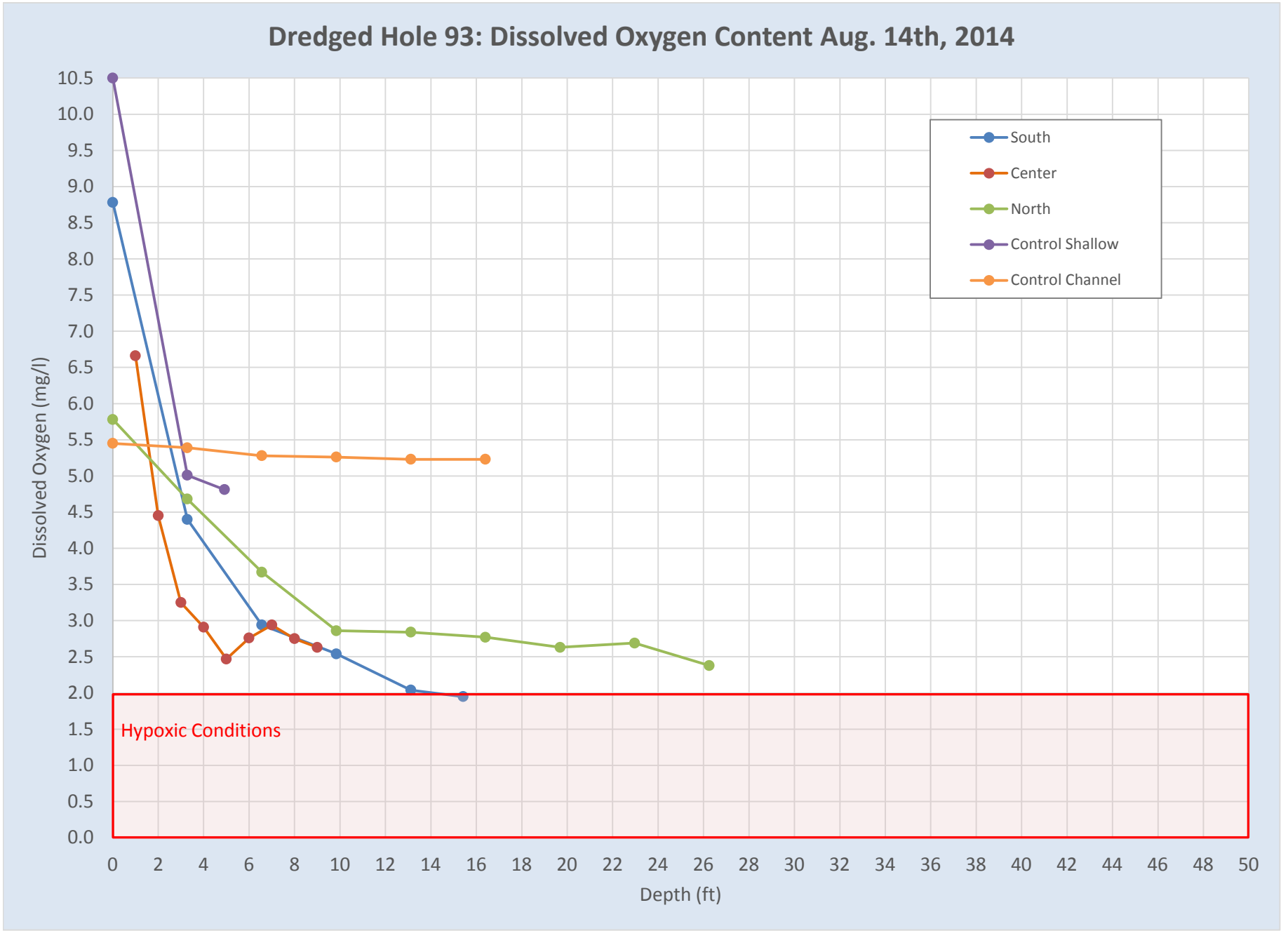
Site name: DH93 control Outside
Alt name: Control Channel

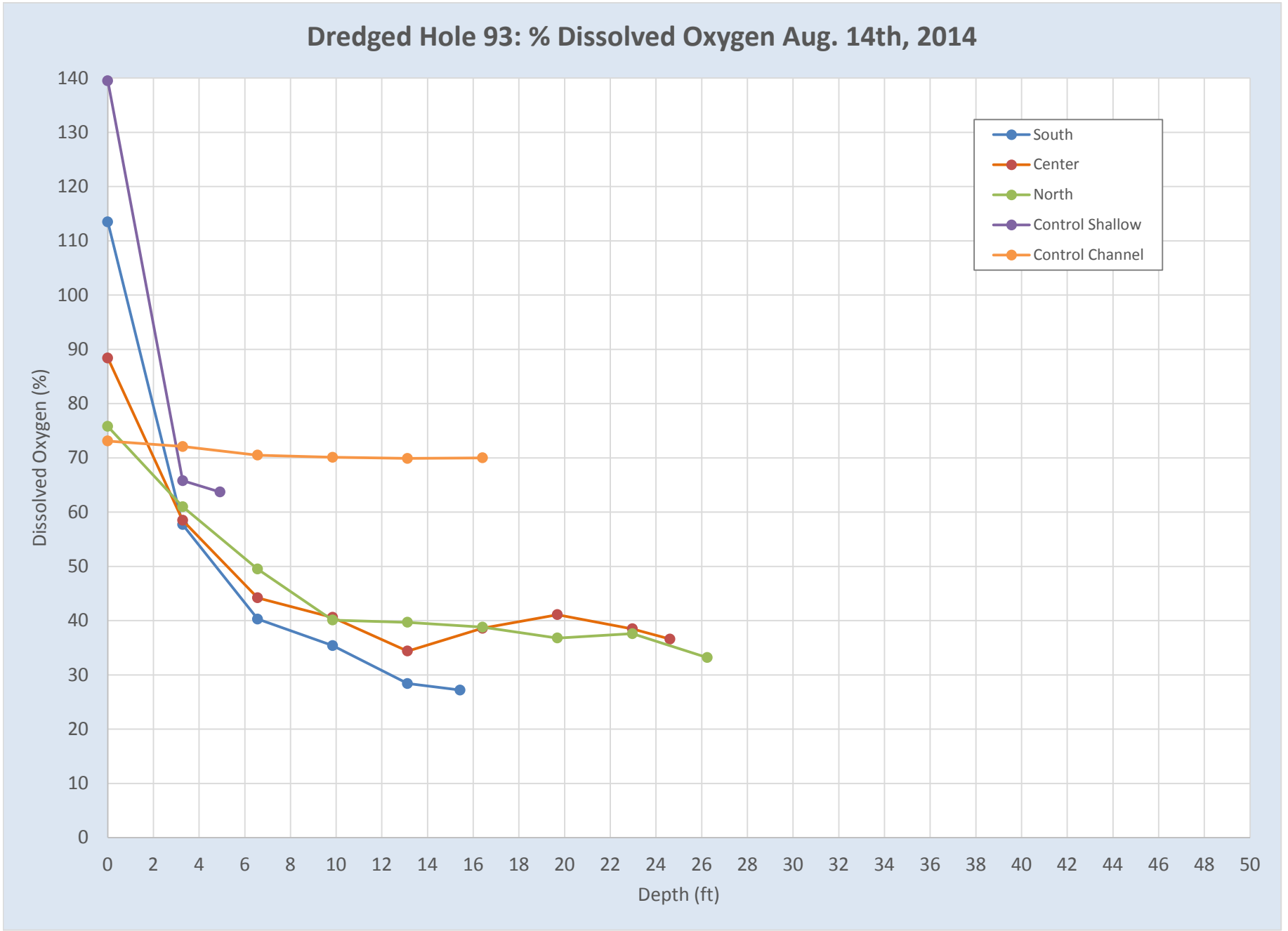
YSI Readings

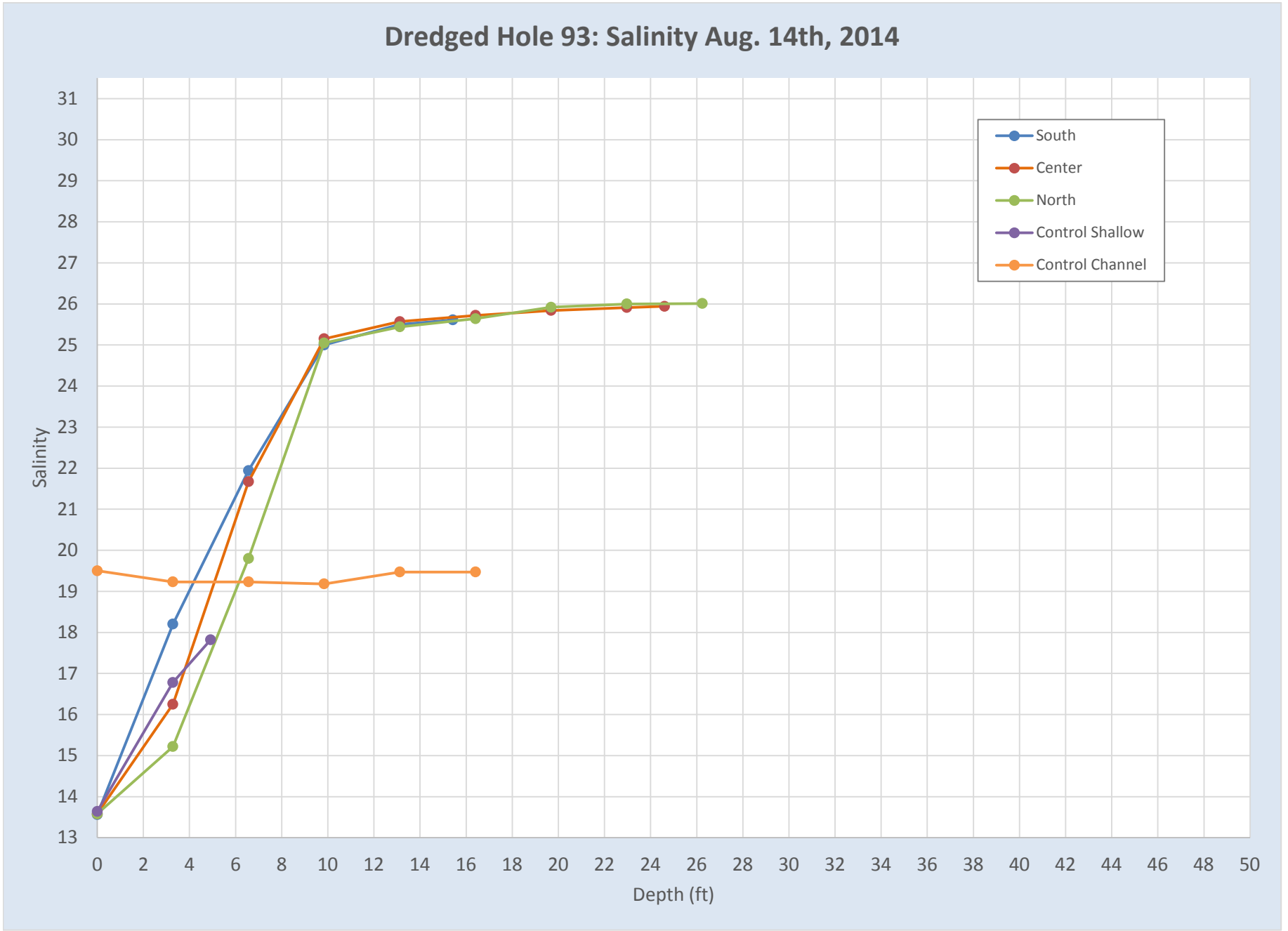
Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	5.45	73.1	19.50	7.09	24.53	6.0
1.0	3.28	5.39	72.1	19.23	7.09	24.46	5.7
2.0	6.56	5.28	70.5	19.23	7.08	24.41	7.7
3.0	9.84	5.26	70.1	19.18	7.08	24.41	11.7
4.0	13.12	5.23	69.9	19.47	7.08	24.37	12.8
5.0	16.40	5.23	70.0	19.47	7.08	24.39	16.6

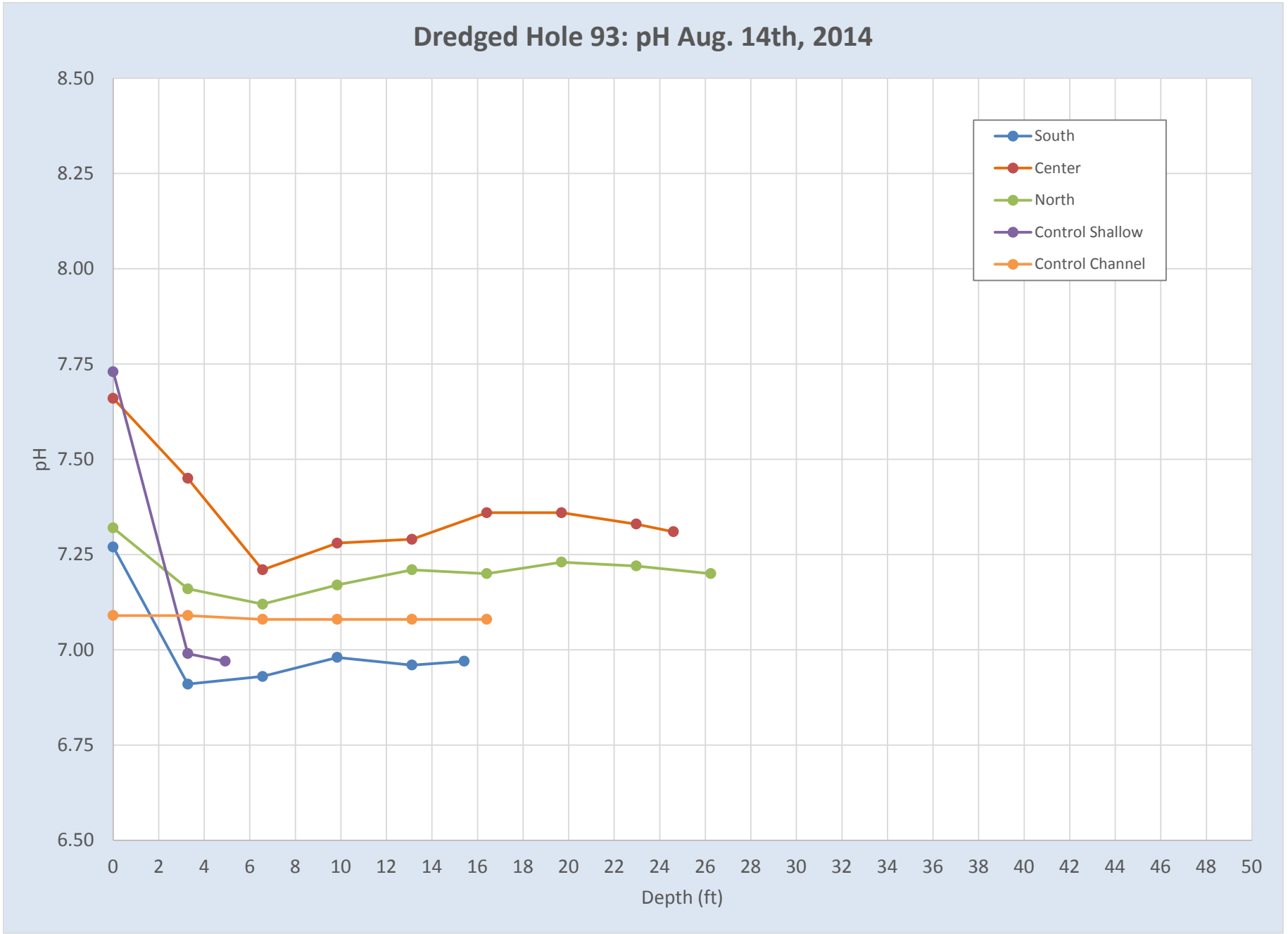
Sediment Sample Description :
dark brown silt, some shells, little amounts of detritus

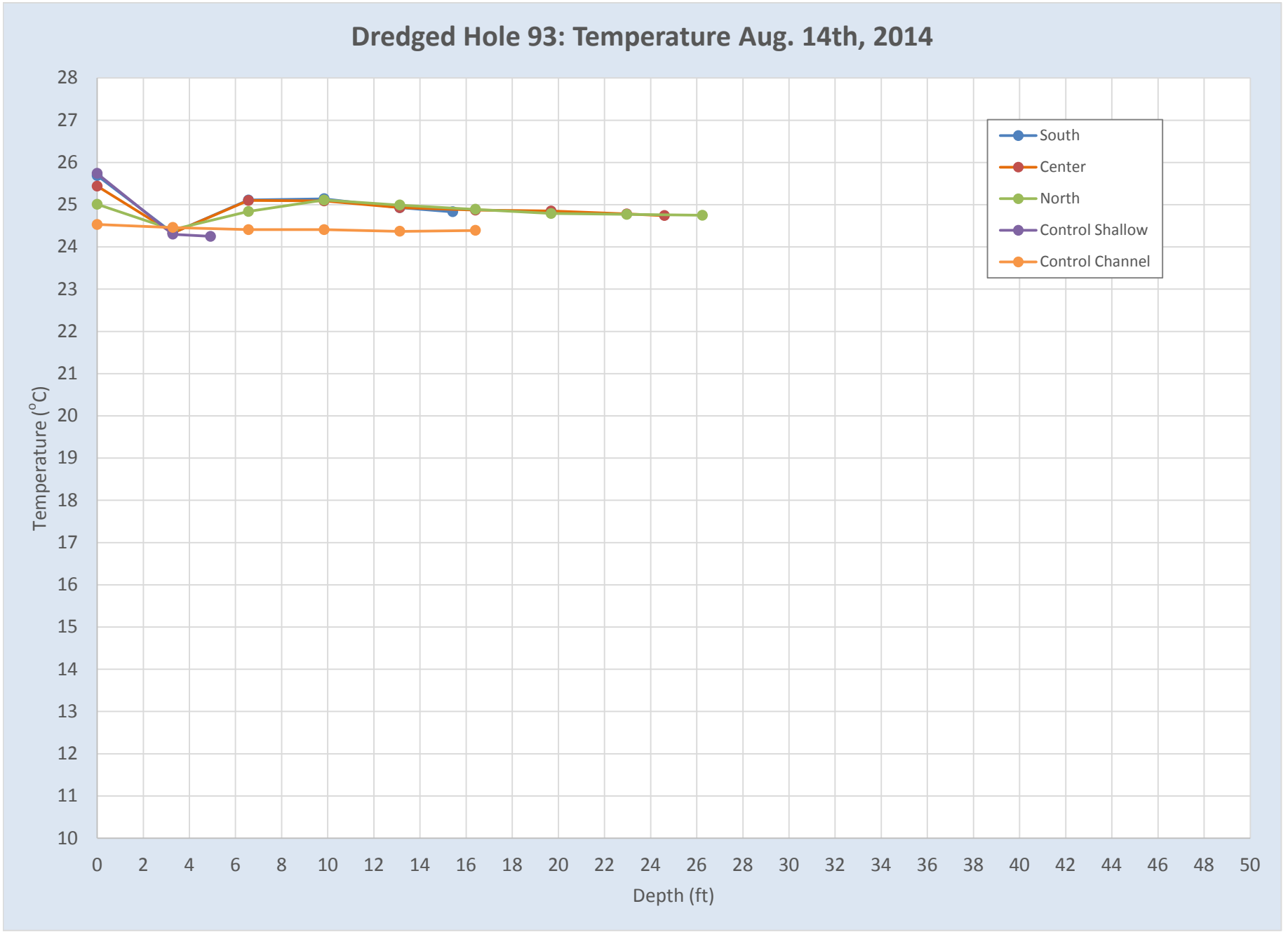
Weather conditions/ other notes:
Sunny 80deg F


Dredged Hole 93: Dissolved Oxygen Content Aug. 14th, 2014
Dissolved Oxygen (mg/l)
Depth (ft)
South
Center
North
Control Shallow
Control Channel
Hypoxic Conditions
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50


Dredged Hole 93: % Dissolved Oxygen Aug. 14th, 2014
Dissolved Oxygen (%)
Depth (ft)
South
Center
North
Control Shallow
Control Channel
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 93: Salinity Aug. 14th, 2014
Salinity
Depth (ft)
South
Center
North
Control Shallow
Control Channel


Dredged Hole 93: pH Aug. 14th, 2014
pH
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Depth (ft)
South
Center
North
Control Shallow
Control Channel


Dredged Hole 93: Temperature Aug. 14th, 2014
Temperature (°C)
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control Shallow
Control Channel

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 18 **Date: 09/12/14** **Time: 1:10pm**

Site name: DH 18 Shallow 17ft South

Alt Name: South

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.39	108.6	18.92	7.89	22.77	0.3
1.0	3.28	8.43	109.0	18.97	7.89	22.66	0.3
2.0	6.56	6.94	90.3	21.33	7.67	22.33	0.2
3.0	9.84	6.72	87.4	22.17	7.62	22.00	-0.1
4.0	13.12	6.03	78.5	22.31	7.51	21.96	-0.1
5.0	16.40	3.82	49.4	22.38	7.25	21.91	1.8
5.7	18.70	3.22	41.8	21.22	7.17	21.88	4.0

Sediment Sample Description :

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 18 **Date: 09/12/14** **Time: 1:30pm**

Site name: DH 18 Middepth 18ft Center
Alt Name: Center

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0	0.00	8.41	109.0	18.86	7.91	22.85	0.2
1	3.28	8.46	109.6	18.88	7.91	22.83	0.2
2	6.56	7.11	92.6	21.32	7.68	22.34	0.3
3	9.84	6.59	85.7	22.09	7.63	22.00	-0.1
4	13.12	5.96	77.3	22.23	7.54	21.96	-0.2
5	16.40	5.04	65.5	22.34	7.42	21.93	0.1
5.8	19.03	3.25	42.1	22.38	7.2	21.87	4.2

Sediment Sample Description :

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 18 **Date: 09/12/14** **Time: 1:40pm**

Site name: DH 18 Deepest 22ft North
Alt Name: North

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.39	108.8	18.86	7.93	22.85	0.3
1.0	3.28	8.48	109.8	18.87	7.93	22.81	0.2
2.0	6.56	7.42	96.3	20.80	7.74	22.41	0.3
3.0	9.84	6.49	84.5	22.17	7.59	22.00	-0.1
4.0	13.12	5.92	76.9	22.27	7.52	21.96	-0.1
5.0	16.40	5.16	67.1	22.33	7.46	22.93	-0.1
6.0	19.68	3.85	50.0	22.40	7.28	21.89	0.4
6.7	21.98	2.40	31.4	22.42	7.07	21.83	3.2

Sediment Sample Description :

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 18 **Date: 09/12/14** **Time: 12:51pm**

Site name: DH 18 Control Channel

Alt Name: Control in Channel

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.35	107.9	18.84	7.88	22.69	0.3
1.0	3.28	8.38	108.2	18.83	7.88	22.67	0.3
2.0	6.56	6.72	87.3	20.60	7.66	22.32	0.6
2.5	8.20	5.36	70.0	21.87	7.50	22.20	2.7

Sediment Sample Description:

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 18 **Date: 09/12/14** **Time: 1:00pm**

Site name: DH 18 Control Shallow

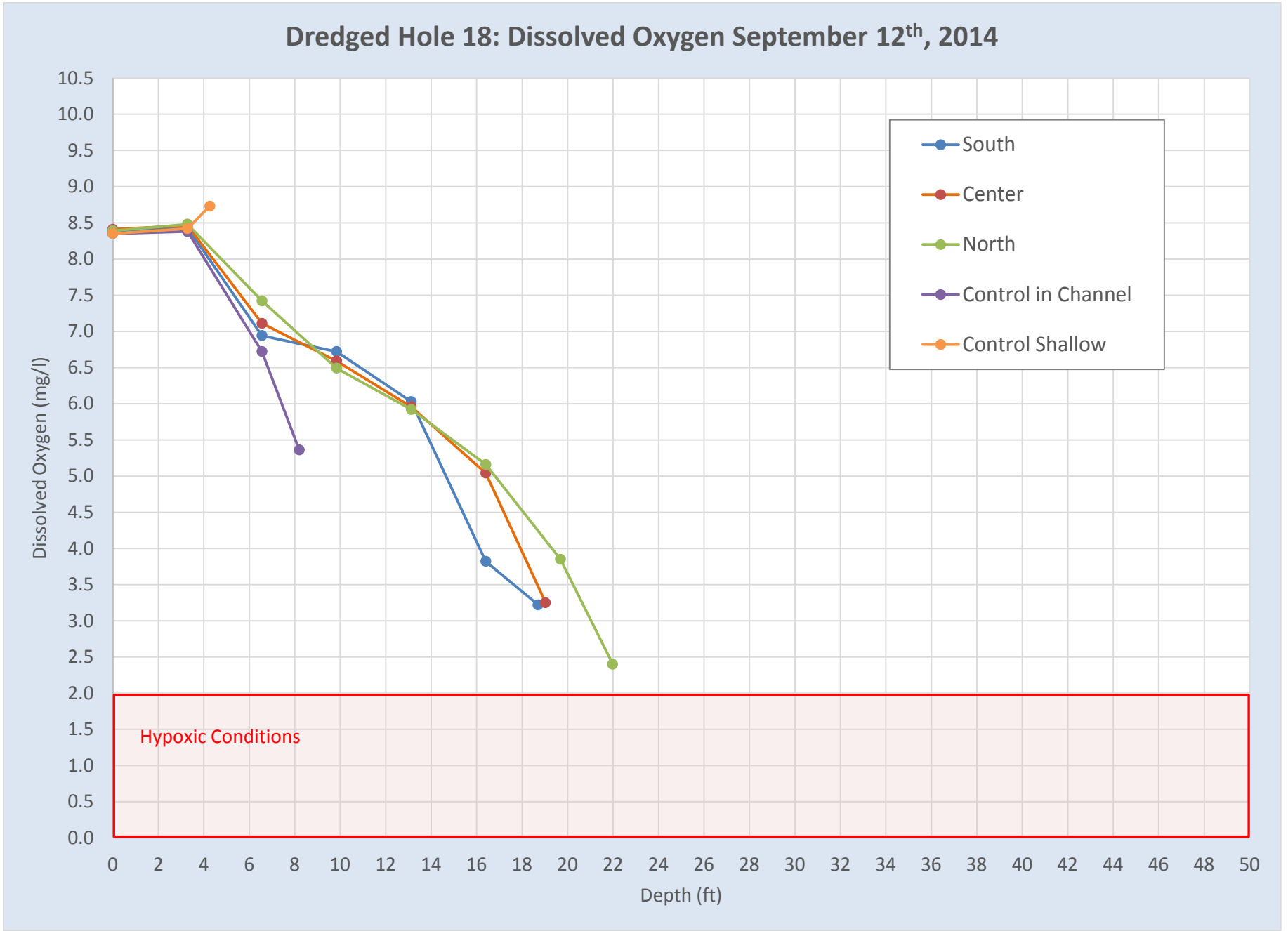
Alt Name: Control Shallow

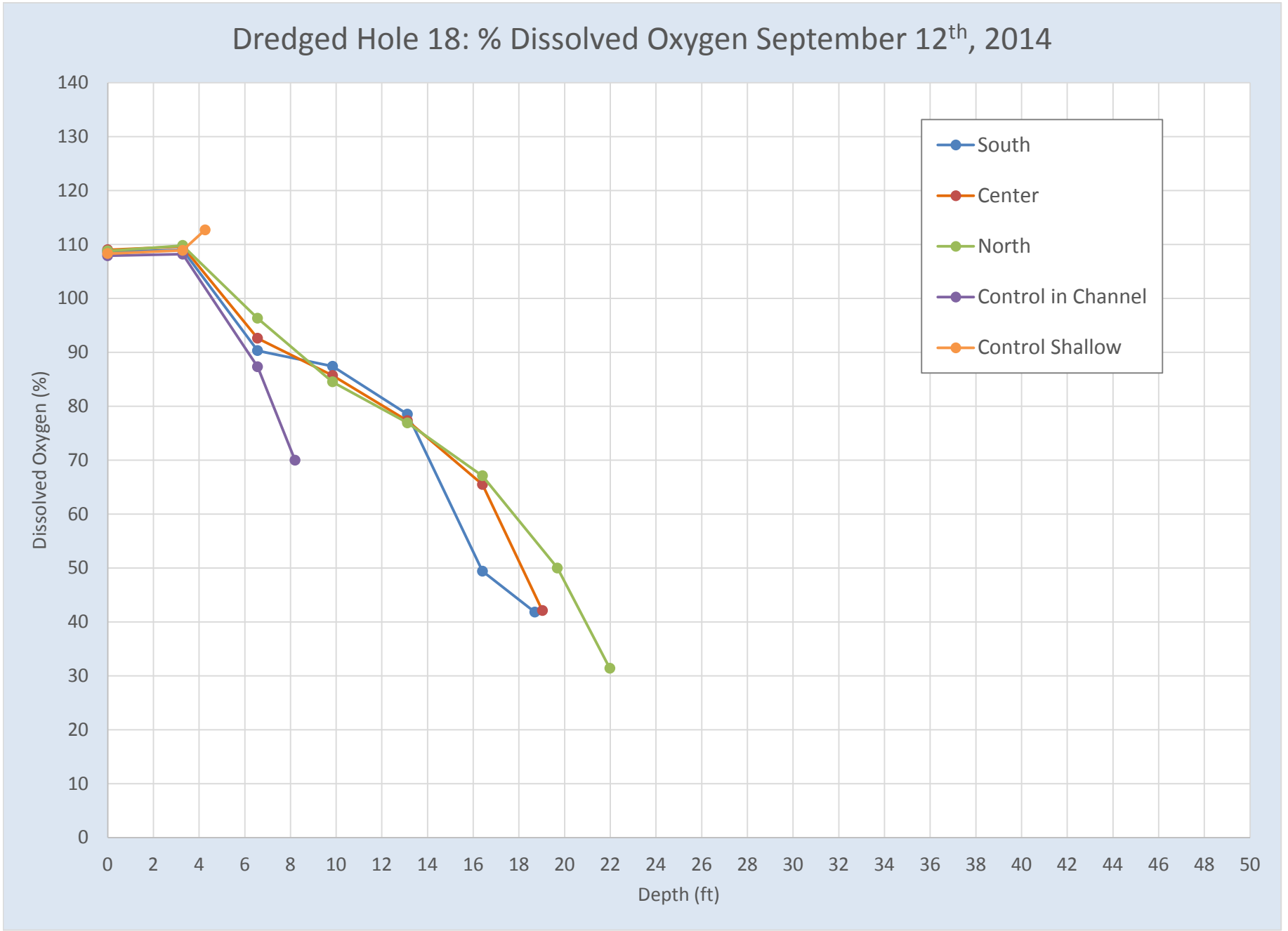
YSI Readings

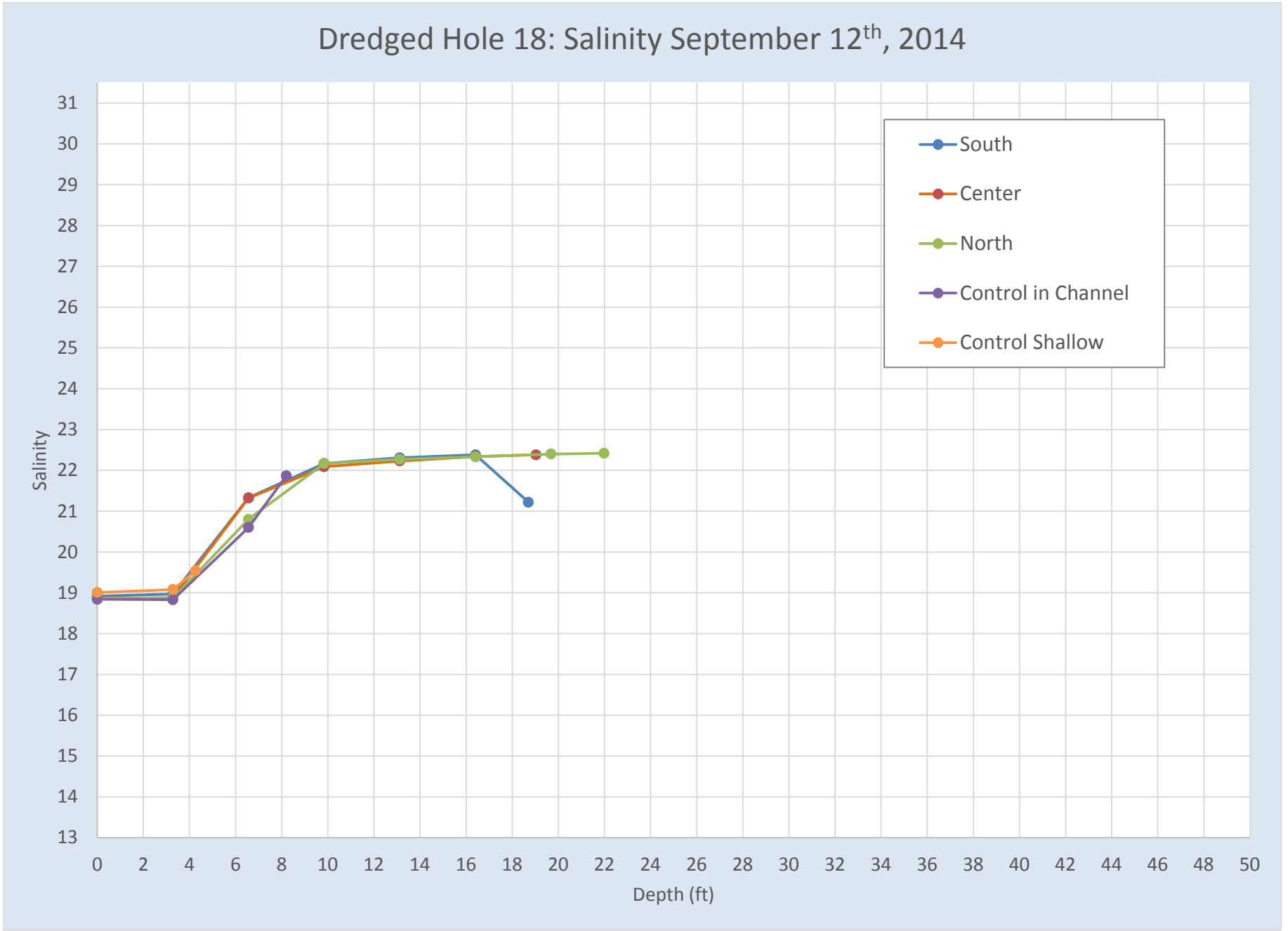
Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.35	108.3	19.01	7.91	22.75	0.6
1.0	3.28	8.42	108.9	19.08	7.90	22.67	0.2
1.3	4.27	8.73	112.7	19.54	7.92	22.42	0.6

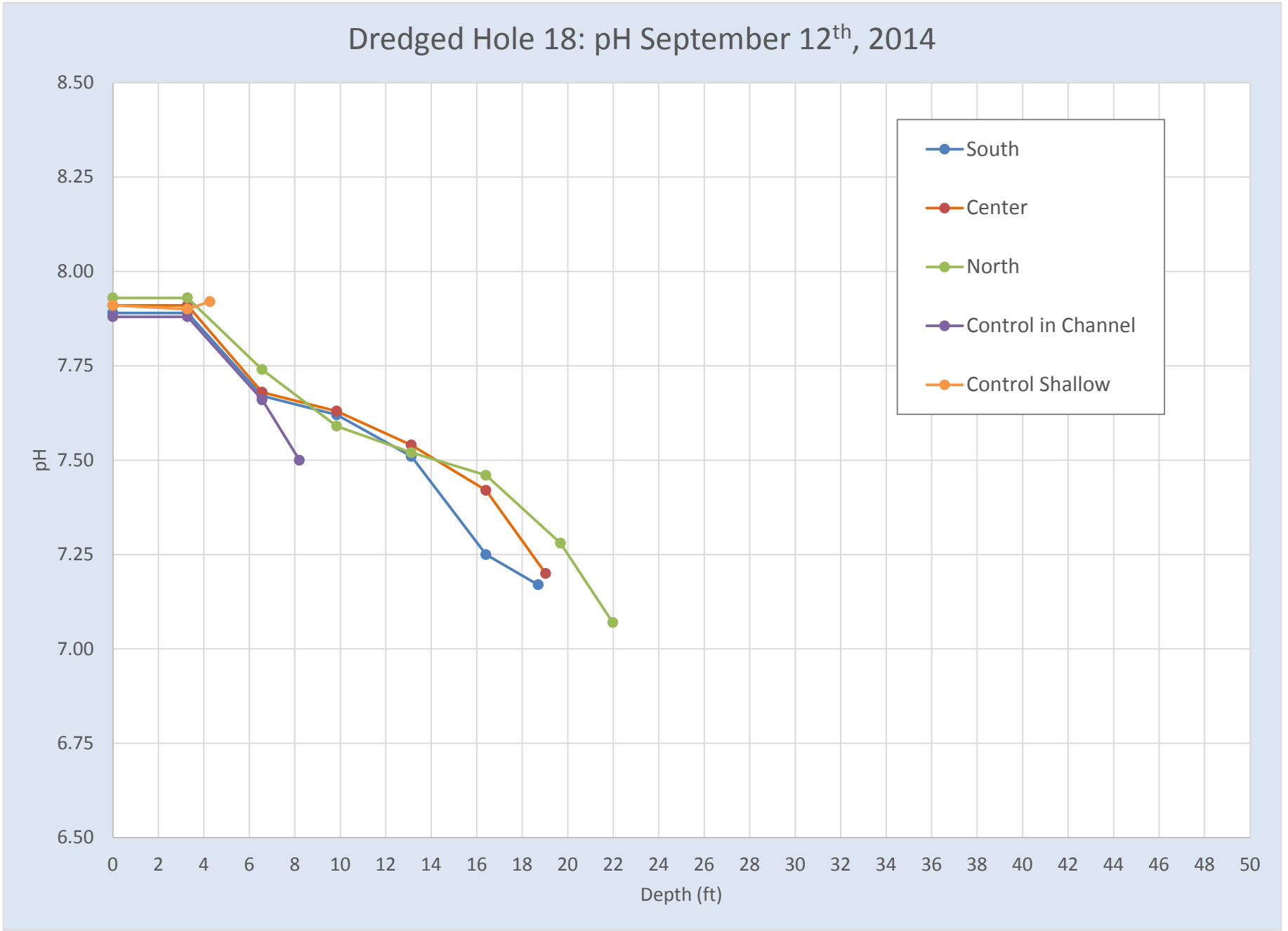
Seiment Sample Description:

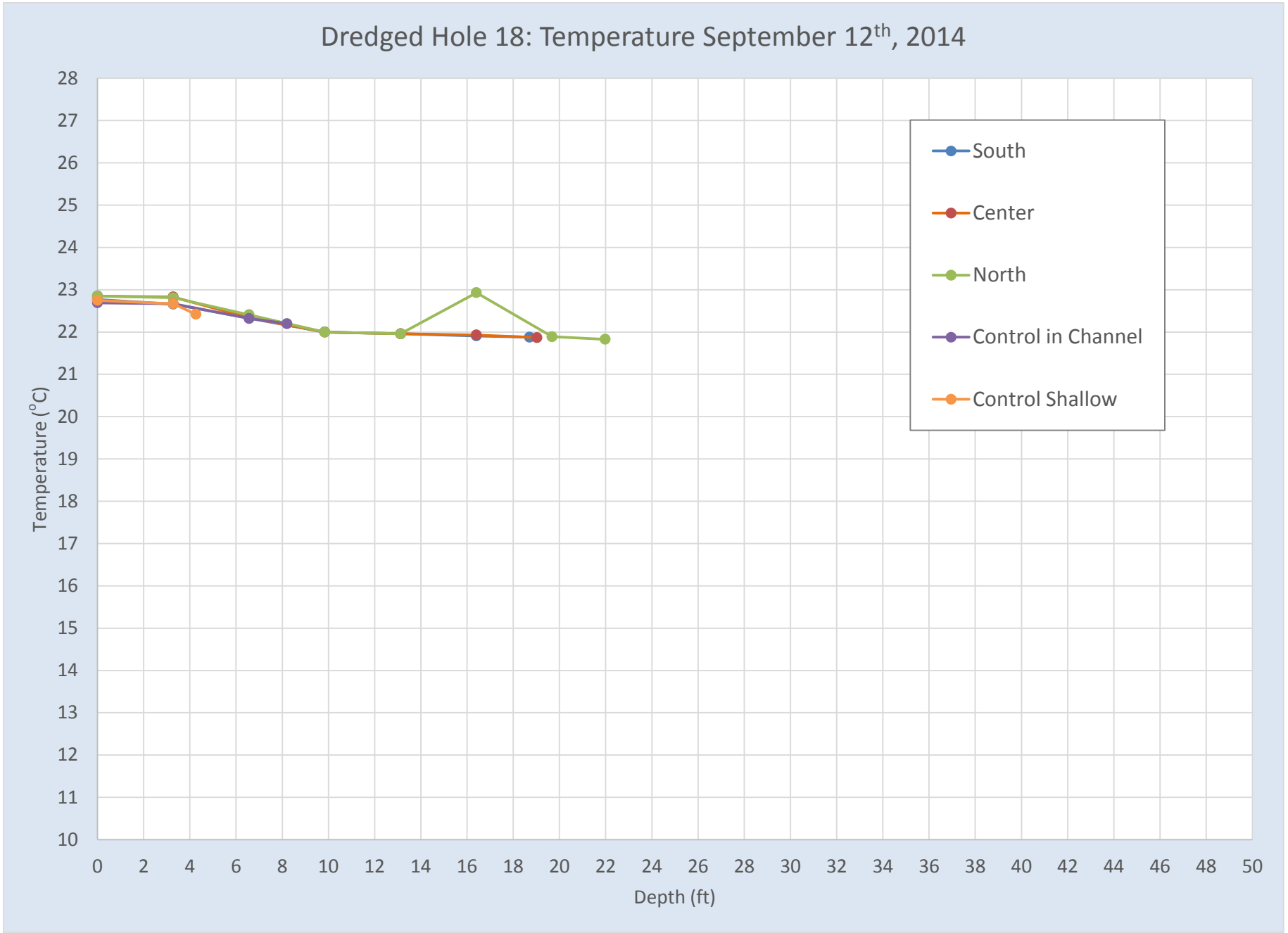
Weather conditions/ other notes:


Dredged Hole 18: Dissolved Oxygen September 12th, 2014
Dissolved Oxygen (mg/l)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Depth (ft)
South
Center
North
Control in Channel
Control Shallow
Hypoxic Conditions


Dredged Hole 18: % Dissolved Oxygen September 12th, 2014
Dissolved Oxygen (%)
Depth (ft)
South
Center
North
Control in Channel
Control Shallow
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 18: Salinity September 12th, 2014
Salinity
Depth (ft)
South
Center
North
Control in Channel
Control Shallow
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 18: pH September 12th, 2014
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
pH
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Depth (ft)
South
Center
North
Control in Channel
Control Shallow


Dredged Hole 18: Temperature September 12th, 2014
Temperature (°C)
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control in Channel
Control Shallow

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 25 **Date: 09/12/14** **Time: 12:05**

Site name: DH 25 Shallow 12ft South
Alt Name: South

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	8.07	103.7	17.57	7.89	22.81	0.1
1.0	3.28	8.09	102.9	17.55	7.89	22.76	0.2
2.0	6.56	8.08	103.8	17.56	7.89	22.77	0.2
3.0	9.84	8.09	103.9	17.55	7.89	22.74	0.1
3.3	10.83	8.05	103.4	17.55	7.89	22.75	1.4

Sediment Sample Description :

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 25 **Date: 09/12/14** **Time: 11:50**

Site name: DH 25 Deepest 25ft Center

Alt Name: Center

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.96	102.2	17.57	7.88	22.72	0.1
1.0	3.28	7.96	102.1	17.57	7.88	22.67	0.2
2.0	6.56	7.94	101.8	17.58	7.88	22.65	0.3
3.0	9.84	7.75	99.1	17.56	7.87	22.55	0.5
4.0	13.12	7.62	97.7	17.57	7.83	22.50	1.4
5.0	16.40	7.68	98.1	17.57	7.84	22.43	2.2
6.0	19.68	7.98	101.9	17.57	7.84	22.40	8.0

Sediment Sample Description :

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 25 **Date: 09/12/14** **Time: 11:35am**

Site name: DH 25 Middepth 15ft North
Alt Name: North

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0	0.00	7.80	99.9	17.58	7.86	22.63	0.5
1	3.28	7.78	99.7	17.58	7.85	22.63	0.4
2	6.56	7.69	98.4	17.59	7.84	22.56	0.5
3	9.84	7.53	96.2	17.58	7.83	22.48	0.6
4	13.12	7.48	95.4	17.56	7.81	22.36	1
5	16.40	7.35	93.7	17.57	7.8	22.34	0.9

Sediment Sample Description :

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 25 **Date: 09/12/14** **Time: 11:24am**

Site name: DH 25 Control Channel

Alt Name: Control Channel

YSI Readings

Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	7.87	100.7	17.69	7.90	22.55	0.1
1.0	3.28	7.83	100.2	17.64	7.90	22.50	1.6
2.0	6.56	7.82	99.8	17.63	7.89	22.46	0.6
2.2	7.22	7.79	99.6	17.62	7.88	22.49	3.0

Sediment Sample Description :

Weather conditions/ other notes:

Dredged Hole Monitoring Worksheet

Dredged Hole ID: 25 **Date: 09/12/14** **Time: 12:15pm**

Site name: DH 25 Control Shallow

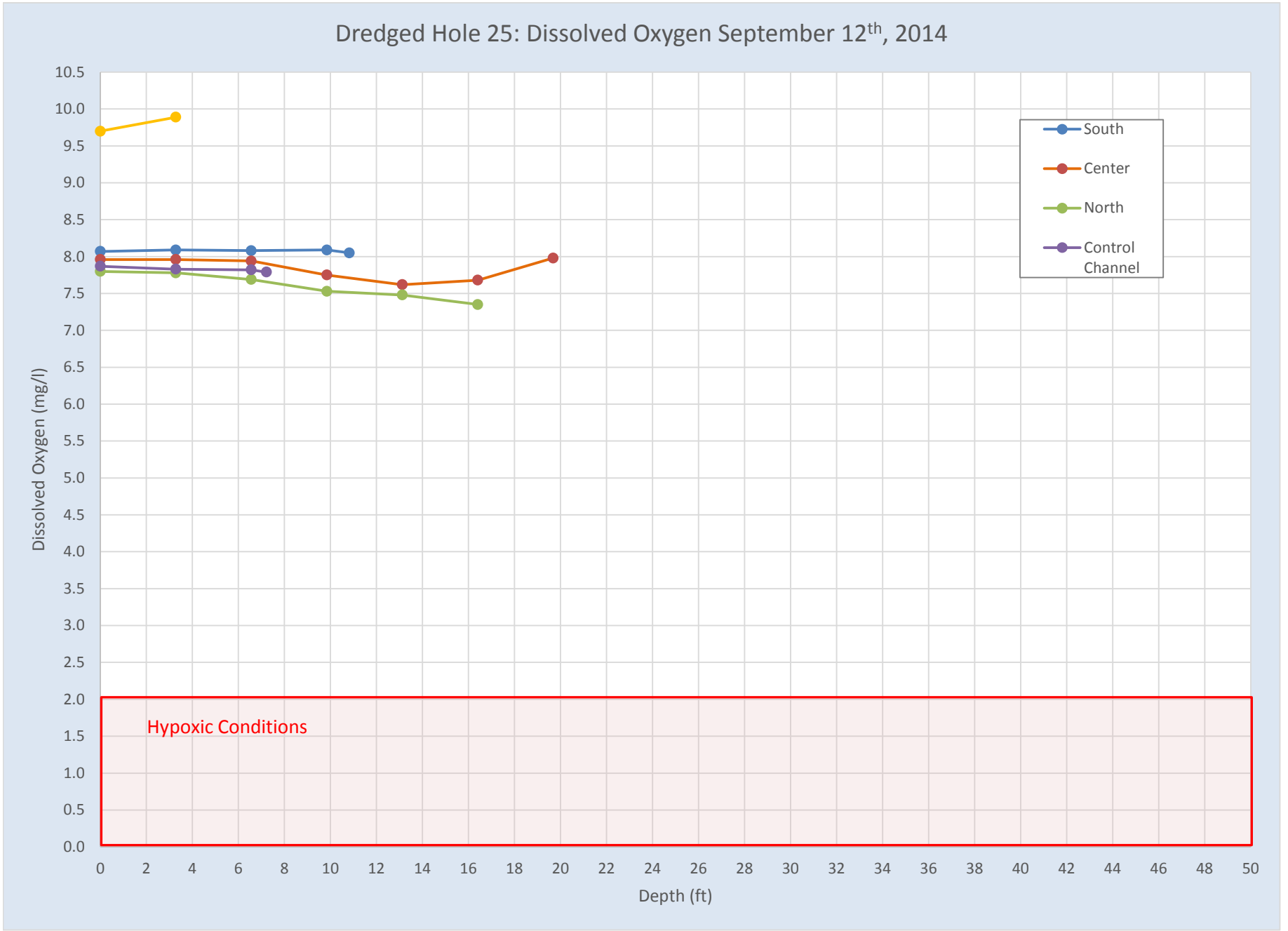
Alt Name: Control Shallow

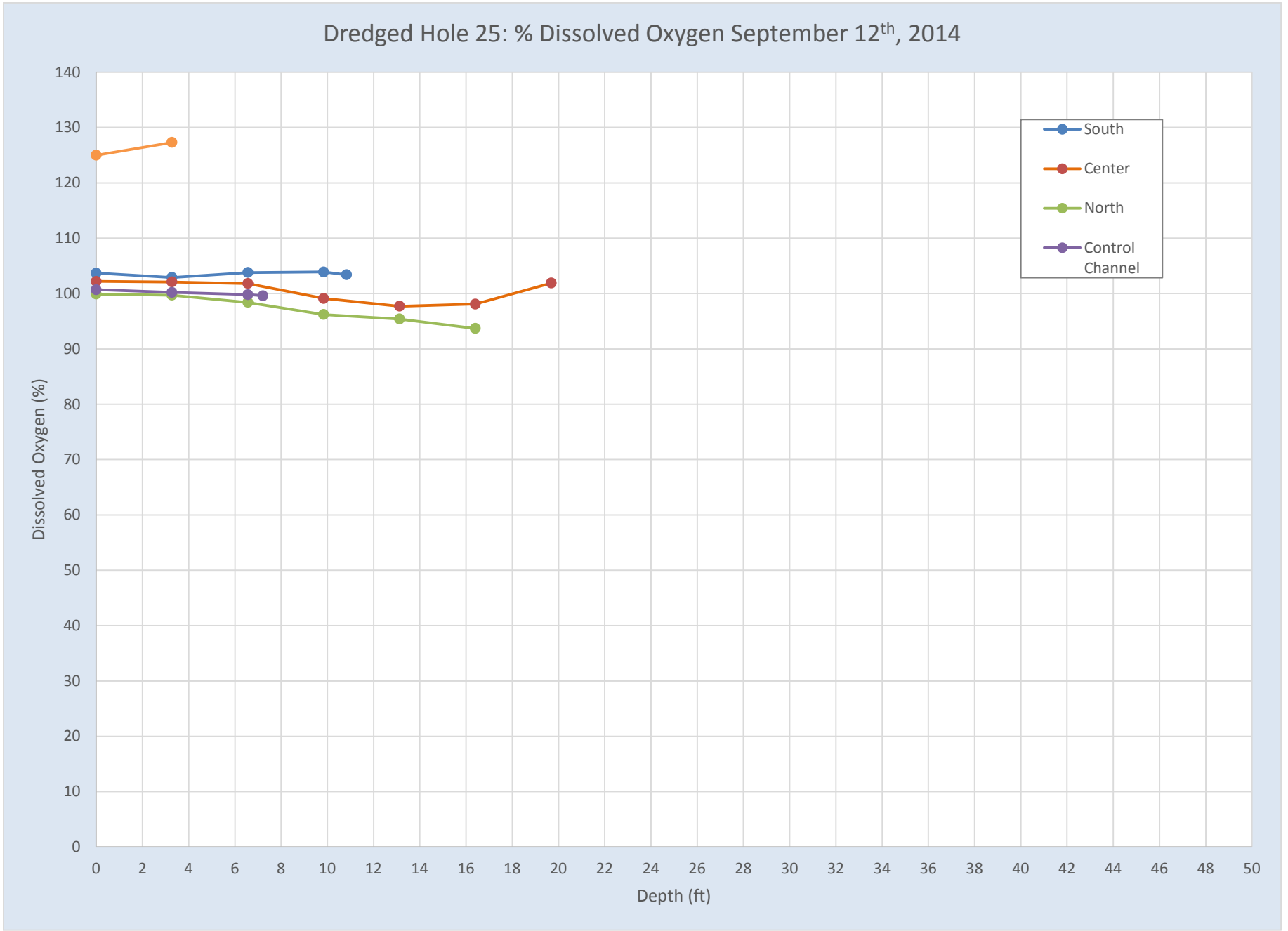
YSI Readings

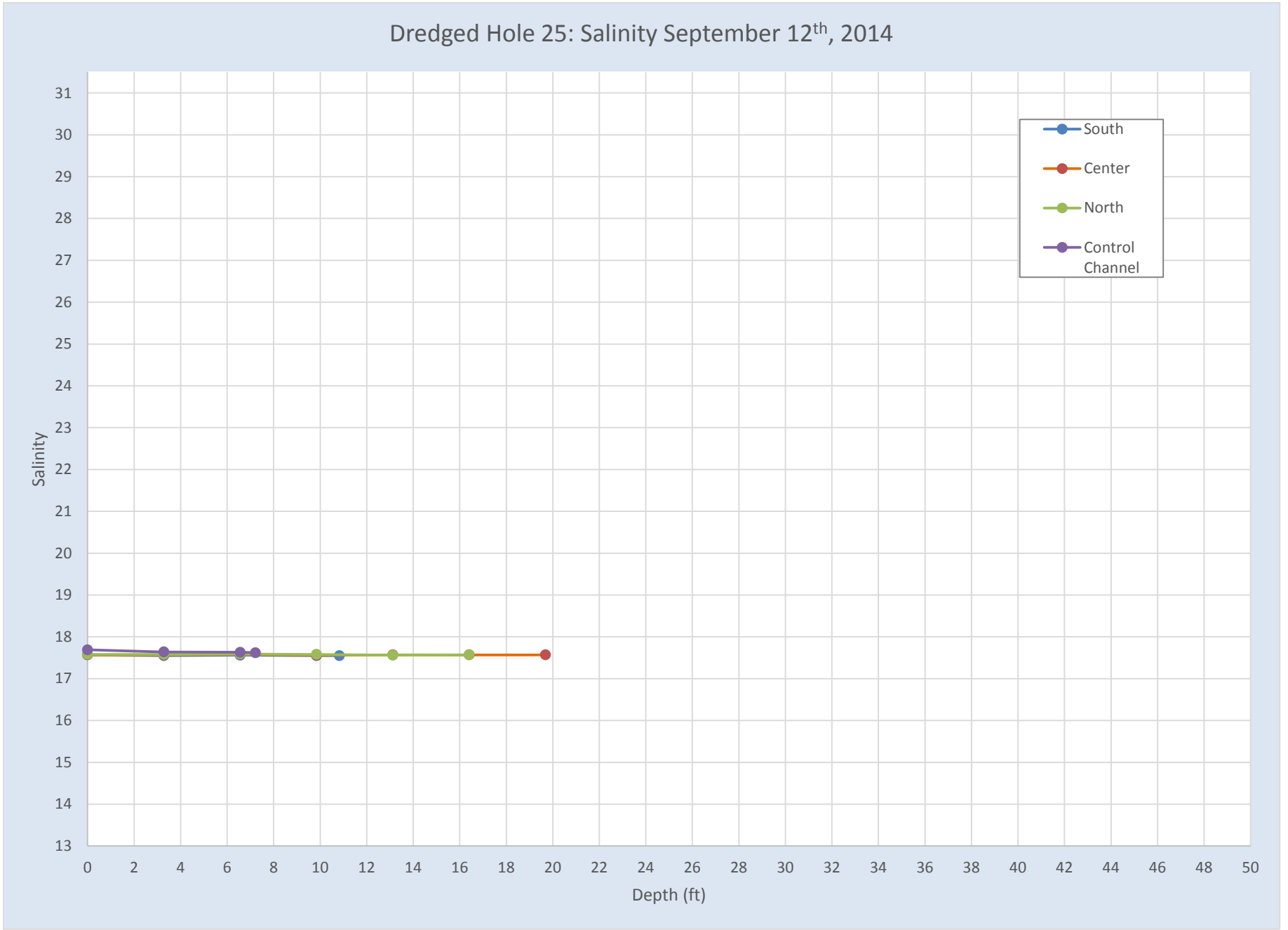
Depth (m)	Depth (ft)	DO (mg/L)	DO (%)	Sal	Ph	Temp C	NTU
0.0	0.00	9.70	125.0	17.67	8.16	22.85	-0.7
1.0	3.28	9.89	127.3	17.68	8.17	22.86	7.0

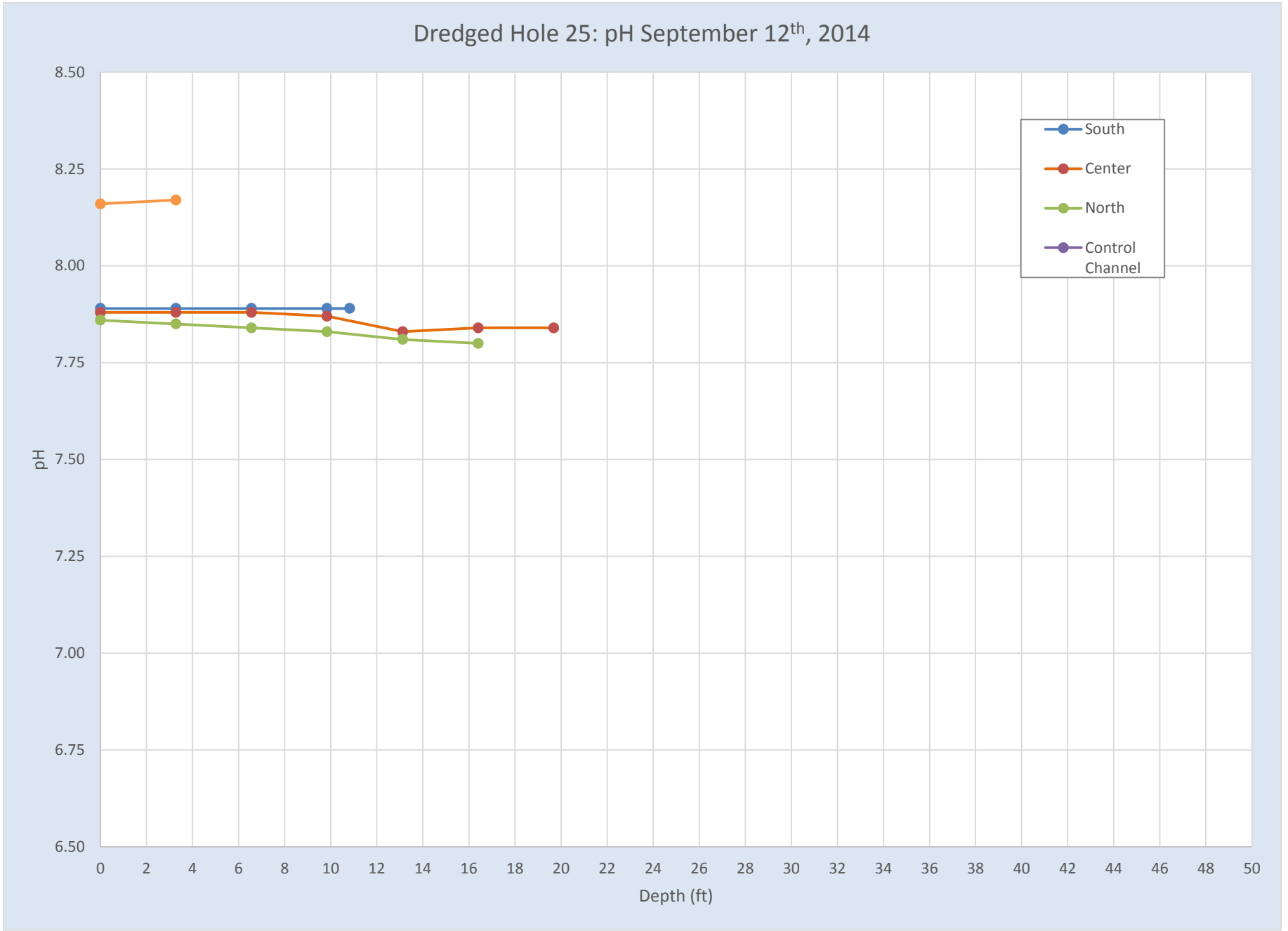
Sediment Sample Description :

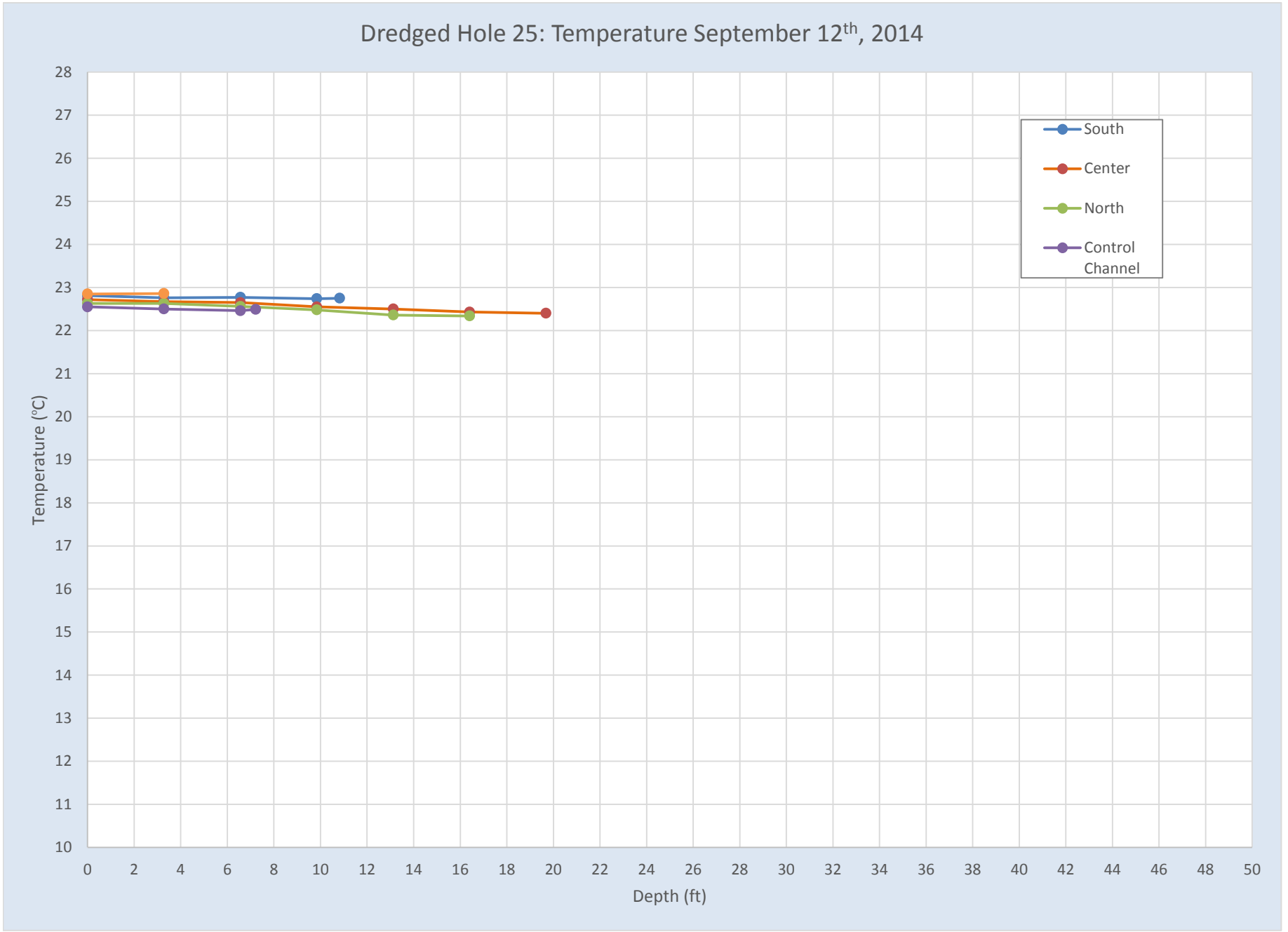
Weather conditions/ other notes:


Dredged Hole 25: Dissolved Oxygen September 12th, 2014
Dissolved Oxygen (mg/l)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control Channel
Hypoxic Conditions


Dredged Hole 25: % Dissolved Oxygen September 12th, 2014
Dissolved Oxygen (%)
Depth (ft)
South
Center
North
Control Channel
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 25: Salinity September 12th, 2014
Salinity
Depth (ft)
South
Center
North
Control Channel
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50


Dredged Hole 25: pH September 12th, 2014
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
pH
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
Depth (ft)
South
Center
North
Control Channel


Dredged Hole 25: Temperature September 12th, 2014
Temperature (°C)
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
South
Center
North
Control Channel

NOVEMBER 2014
RICHARD STOCKTON COLLEGE OF NEW JERSEY - COASTAL RESEARCH CENTER

STATE CHANNEL MAINTENANCE CAPACITY: EVALUATION OF DREDGED HOLES

ENGINEERING FEASIBILITY REPORT

Ocean and Coastal Consultants | COWI

Ocean and Coastal Consultants | COWI

ADDRESS Ocean and Coastal
Consultants, Inc.
20 E. Clementon Road
Suite 201N
Gibbsboro, NJ 08026

TEL 856-248-1200
FAX 856-248-1206
WWW ocean-coastal.com

NOVEMBER 2014
RICHARD STOCKTON COLLEGE OF NEW JERSEY - COASTAL RESEARCH CENTER

STATE CHANNEL MAINTENANCE CAPACITY: EVALUATION OF DREDGED HOLES

ENGINEERING FEASIBILITY REPORT

PROJECT NO.	213061
DOCUMENT NO.	01
VERSION	03
DATE OF ISSUE	04 NOVEMBER 2014
PREPARED	CDNI
CHECKED	MADN
APPROVED	FMLU

CONTENTS

1 Introduction

The Richard Stockton College of New Jersey Coastal Research Center (CRC) and the New Jersey Department of Transportation Office of Maritime Resources (NJDOT OMR) identified five (5) dredged hole sites within New Jersey's inland coastal waterways for the potential placement of dredged material. Ocean and Coastal Consultants, Inc. (OCC) conducted an engineering feasibility analysis of each site to identify appropriate dredged material placement methodologies and the need for any pre-placement dredging or engineering. Our engineering evaluation considered physical dredged hole site data and characteristics. Based on this analysis, OCC ranked the dredged hole sites in order of engineering suitability for NJDOT OMR to consider for further evaluation. Suitability for placement based on environmental site conditions was not included in this analysis.

2 Placement Alternatives Summary

In New Jersey inland coastal waterways, the two primary methods available to place dredged material in dredged holes are mechanical and hydraulic placement. Hopper dredging and placement is another alternative; however, the limited depths of New Jersey inland coastal waterways prevent hopper dredges with a typical loaded draft greater than 12 feet from accessing these waterways. The sections below provide a summary of the mechanical and hydraulic methods and site control options.

2.1 Mechanical Placement

Mechanical placement of dredged material at a dredged hole site consists of transporting the dredged material to the project site in a barge and then mechanically placing the material into the water column either with a bucket or bottom-dump scow. Mechanical placement requires transportation to the placement site via a self-powered barge or a barge with tug assist. Placement requires a barge mounted dredge that may be part of the dredged material transport or a separate unit. Challenges for mechanical placement include transportation logistics and potential impacts to water quality at the discharge site.

Transportation of dredged material in barges through New Jersey's inland coastal waterways can be difficult due to restricted water depths, small radius turns, and low air draft (bridge) clearances. When identifying transportation routes for specific projects, the engineer must evaluate the transportation logistics. This insures the depth of the waterways is sufficient for the draft of a loaded scow. Challenges to the transportation logistics can reduce project productions rates. For bottom-dumping scows, it is necessary to insure that the scow can access the site and then completely discharge the dredged material.

Throughout the mechanical placement program, the engineer and contractor should employ best management practices to minimize impacts to water quality. Impacts to water quality are a function of material type, placement method, and the quantity of material placed at a single time. If adverse impacts to water quality cannot be addressed by restrictions on methodology, seasonal constraints on the placement may afford the solution to the concerns. During actual dredged material placement, some sediment is resuspended. This occurs during its decent to the seabed, upon contact with the accumulated sediment within the hole or a combination of these events. During the settlement phase, fine-grained sediments entrain adjacent water and become suspended in the water column. The extent and persistence of the suspension is related to the grain size and specific gravity of the dredged material being placed. Fine grained or organically enriched material is of particular concern as it can degrade water quality. Additionally, when the material settles at the bottom it

can displace sediments already within the hole. If those bottom sediments consist of a highly hydrated mixture (a.k.a. fluid mud or higher water content), the mixture can been energized into motion. The amount of energy imparted to this material may be sufficient to cause it to exit the placement site. Steep side slopes along with the distance from the discharge to the top of the hole can help reduce or avoid the problem of offsite migration of sediments. Finally, the contractor should employ practical best management practices to address this problem and avoid, minimize, or mitigate offsite migration or water quality degradation. This includes controlled placement of the dredged material in the center of the dredged hole site by the contractor, use of a silt curtain if local conditions allow or timing the project to avoid sensitive or peak biological activity periods.

Silt Curtains are floating vertical barriers fabricated from solid or permeable materials. Typically, they are fastened to a floating boom and positioned around the discharge location where an existing containment feature does not exist (i.e. wetlands, bulkhead). Their purpose is to limit the migration of suspended solids into open waters beyond the project site during the discharge process. According to ERDC TN-DOER-E21, areas with currents greater than 1 to 1.5 knots will prove to be problematic and even a slight current will reduce the effectiveness of a silt curtain.

2.2 Hydraulic Placement

Hydraulic placement via an hydraulic pipeline cutterhead dredge consists of hydraulically discharging a fluid slurry into the dredged hole site via pipeline. Dredged material is directly pumped from the dredge site to the placement site. The ability to pump long distances between the sites is determined by the material's physical characteristics, dredge pump horsepower, and pipeline diameter. Booster pumps can be added to the system to provide additional head increasing distance or height of the discharge point. When identifying pipeline routes for specific projects, the engineer must evaluate the transportation logistics to identify pipeline and pump locations to successfully discharge the dredged material.

The principal concern with hydraulic placement is water quality degradation at the discharge location. A hydraulic dredged material slurry contains between 10 and 20 percent solids and is typically discharged at velocities from 15-20 feet per second. This discharge can results in a suspended sediment plume in the water column, especially with fine grained or organically enriched sediments. To reduce discharge velocities, the dredger can attach a hydraulic discharge diffuser to the end of the hydraulic pipeline. The diffuser may rest on the bottom and spreads the material along the floor. This device allows for a more accurate placement, reduces the water column turbidity, while retaining the economic benefits of using hydraulic discharge. Additionally, a silt curtain can be deployed around the perimeter of the site to further mitigate offsite migration of sediments.

3 Site Summary and Evaluation

The Richard Stockton Coastal Research Center (CRC) provided OCC with bathymetric survey data for the five (5) dredged holes for engineering analysis. The table below provides a summary of the dredged hole physical site characteristics. OCC evaluated the dredged holes surrounding, topography, and capacity to make preliminary recommendations on the appropriate placement method.

Table 1 – Dredged hole Physical Site Characteristics Summary:

SITE ID NO.	LOCATION	AREA [AC]	MAX DEPTH [FT]	ESTIMATED CAPACITY [CY]
18	Mantoloking Estates, Ocean County	9	-23	11,800
25	Lavallette, Ocean County	19	-21	4,300
78	Brigantine, Atlantic County	15	-26	42,800
86	Atlantic City, Atlantic County	14	-57	357,000
93	Somers Point, Atlantic County	3	-25	2,200
Data provided by the Richard Stockton College of New Jersey Coastal Research Center. Estimated capacity calculated by CRC below a depth of minus18 feet MLW from 2013 hydrographic survey data.				

3.1 Dredged Hole 18

Dredged hole 18 is located in upper Barnegat Bay, east of the New Jersey Intracoastal Waterway (NJIWW), and west of Mantoloking Estates in Ocean County. Shallow open waters with depths between 2 and 4 feet below MLW form the perimeter of the dredged hole. Open waters in Barnegat Bay are located on the north and west perimeter of the dredged hole. Residential waterfront properties are less than 200 feet from the east and south limits of the dredged hole.

The dredged hole has a rectangular shape, approximately 800 feet long by 500 feet wide. The hole has steep side slopes extending from shallow waters to an approximate depth of 16 feet MLW. The bottom of the dredged hole is relatively flat with a few depressions that extend below 18 feet MLW.

Hydraulic and mechanical placement methods are feasible from an engineering standpoint. Due to the shallow surrounding waterways, mechanical placement of dredged material will have a reduced production rate. Due to the capacity and relatively steep side slopes, OCC recommends hydraulic dredging with a discharge diffuser and silt curtain surrounding Dredged hole 18.

3.2 Dredged Hole 25

Dredged hole 25 is located in the upper Barnegat Bay, east of the NJIWW, and west of the community of Lavallette in Ocean County. The dredged hole is located at the intersection of three narrow channels. A channel with depths around minus 8-feet MLW runs north to the residential properties located in the Great Swan Bay. A channel with depths around minus 8-feet MLW runs southwest along the west of West Point Island. A channel with depth around minus 4-feet MLW runs south between West Point Island and Long Island. Open water surround the remainder of the perimeter with depths between minus 2 and 6 feet MLW. Jacobsen Park, a recreational sandy bay beach, is located approximately 1,000 feet to the east of the dredged hole. Residential waterfront properties are located less than 700 feet from the south perimeter of the dredged hole.

The dredged hole has an ellipse shape, and is approximately 1,300 feet by 700 feet. On all sides, except the southeast, steep side slopes extend to an approximate depth of minus 16 feet MLW. The southeast slope is not as steep. The bottom of the dredged hole is relatively flat with a few depressions that extend below 18 feet MLW and a few shoals that extend above 14 feet MLW.

Hydraulic and mechanical placement methods are feasible from an engineering standpoint. Due the proximity to Jacobsen Park, and the limited placement capacity, OCC recommends mechanical placement with a silt curtain deployed between the dredged hole and Jacobsen Park at Dredged hole 25.

3.3 Dredged Hole 78

Dredged hole 78 is located in Steelman Bay, east of the NJIWW, and at the north end of Brigantine in Atlantic County. Wetlands surround the northern half of the dredged hole. Open waters with depths between minus 2 and 4 feet MLW surround the southern half of the dredged hole. Residential waterfront properties are located less than 250 feet from the southern limit of the dredged hole.

The dredged hole has an ellipse shape, approximately 1,600 feet by 500 feet with the primary axis oriented north to south. Steep slopes extend to an approximate depth of minus 20 feet MLW. The bottom of the dredged hole has two large depressions in the north and south that extend below 26 feet below MLW and a shallow relief feature in the middle that rises above the minus 16 feet MLW elevation.

Hydraulic and mechanical placement methods are feasible from an engineering standpoint. Due to the available capacity, steep slopes, shallow surrounding waters

and partial containment from the surrounding wetlands, OCC recommends hydraulic placement with a discharge diffuser and silt curtain along the southern perimeter of Dredged hole 78. Additionally, because of the likely seabed instability created by the hole, filling this site could reduce sediment erosion along the tidal wetlands.

3.4 Dredged Hole 86

Dredged hole 86 is located along Beach Thoroughfare, west of the NJIWW, and west of Bader Field, Atlantic City in Atlantic County. The dredged hole actually bisects Beach Thoroughfare. Wetlands surround the east and west perimeter of the dredged hole. Open water with an approximate depth of minus 5-feet MLW surround the northern and southern limits of the dredged hole.

The dredged hole has an ellipse shape, approximately 1,600 feet by 500 feet with the primary axis oriented north to south. At the southern portion of the dredged hole, steep slopes extend to an approximate depth of 50 feet MLW. In the northern portion of the dredged hole, gentler slopes extend to the approximately minus 50-foot MLW water depth. The bottom of the dredged hole has a large depression in the south quadrant and a smaller depression in the north that extend below minus 50-feet MLW. There is a relief structure in the middle of the dredged hole that extends upwards to above 35 feet MLW.

Hydraulic and mechanical placement methods are feasible from an engineering standpoint. Due to the available capacity, steep slopes, shallow surrounding waters, and partial containment from the surrounding wetlands, OCC recommends hydraulic placement with a discharge diffuser and silt curtain across the northern and southern limits of Dredged hole 86. As with Dredged hole 78, the presence of nearby wetlands is cause to consider filling this hole to reduce local erosion conditions.

3.5 Dredged Hole 93

Dredged hole 93 is located off the Patcong Creek, west of the NJIWW, and west of Somers Point in Atlantic County. Wetlands surround the west, north, and east perimeters. Shallow waters with depths between zero and minus 2-feet at MLW are located south of the dredged hole.

The dredged hole has a circular shape, approximately 400 feet in diameter. At the southern portion of the dredged hole, gentle slopes extend to an approximate depth of minus 24 feet MLW. The slopes that border the wetlands are relatively steep. The slopes come together at a central point and form a cone-like feature with a minimal flat bottom area.

Hydraulic and mechanical placement methods are feasible from an engineering standpoint. Due to the available capacity, steep slopes, shallow surrounding waters and partial containment from the surrounding wetlands, OCC recommends hydraulic placement with a discharge diffuser and silt curtain across southern limits of Dredged hole 93.

3.6 Evaluation Summary

The CRC provided site information for five dredged holes. OCC evaluated the site information to determine and identify recommend placement methods based on available information. Both hydraulic and mechanical placement methods are feasible at all locations from an engineering standpoint; however, OCC does not recommend NJDOT OMR pursue both options due to logistical concerns that can reduce production rates. The table below provides a summary of the recommended placement methods and site controls.

SITE ID NO.	RECOMMENDED PLACEMENT METHOD
18	Hydraulic placement with discharge diffuser and silt curtain
25	Mechanical placement with silt curtain
78	Hydraulic placement with discharge diffuser and silt curtain
86	Hydraulic placement with discharge diffuser and silt curtain
93	Hydraulic placement with discharge diffuser and silt curtain

Based on the available information, pre-placement dredging is not required at this time. Pre-placement dredging could be conducted to remove contaminated sediments or to mine beach quality sand once any overburden is removed. If contaminated or characteristically unsuitable sediments are identified within the dredged hole, the material could be removed with pre-placement dredging however, it is preferred to cap the sediments with the discharge of dredge material being used to fill the holes. Capping unsuitable sediments with a sand layer can prevent mobilization and mixing of contaminated sediments. Additionally, if the sediments at the bottom of the dredged hole have a higher user value than those material that will be placed in the dredged hole (i.e. beach quality sand), pre-dredging may be desirable to mine the valuable material and increase the hole's placement capacity of less desirable material (i.e. fine silt and clays).

4 Site Ranking and Conclusion

OCC conducted a preliminary engineering evaluation to evaluate the feasibility of placing dredged material in five (5) dredged hole sites that were identified and surveyed by the Richard Stockton College of New Jersey Coastal Research Center (CRC). Based on our engineering evaluation, OCC considers all sites are viable for dredged hole restoration.

All the dredged hole site are suitable for placement of dredged material from an engineering stand point, however some are more suitable and therefore more preferred than others. The table below ranks the site from 1 (most preferred) to 5 (least preferred) based on capacity, max depth, and preferred placement method. This ranking does not include environmental considerations or dredging demand factors. OCC ranked Site 86 highest. This site is the deepest water depths and largest t capacity. Additionally, it can utilize hydraulic placement methods that will provide an economic advantage to the site filling and nearby dredging operations. OCC ranked Site 25 fifth. This site has limited capacity and is located adjacent to a recreational bay beach. OCC recommends mechanical placement.

Table 2 - Dredged Hole Placement and Ranking

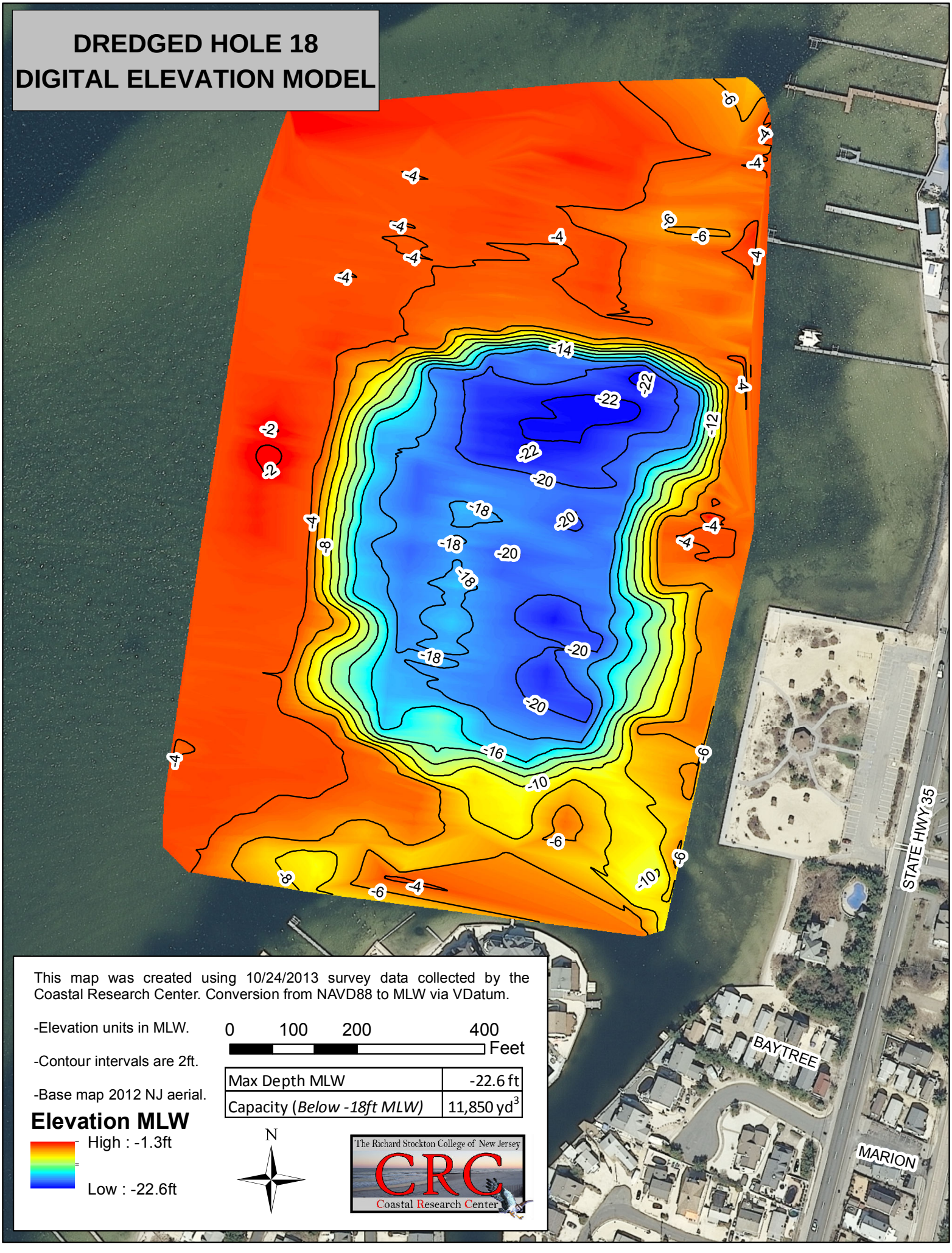
SITE ID NO.	CAPACITY BELOW -18 MLW (CU YD)	MAX DEPTH (FT)	PREFERRED PLACEMENT METHOD	SITE RANK
18	11,850	-22.6	Hydraulic	3
25	4,328	-20.5	Mechanical	5
78	42,806	-26.4	Hydraulic	2
86	357,000	-57.4	Hydraulic	1
93	2,260	-24.8	Hydraulic	4

The NJDOT OMR should consider all five (5) sites for further evaluation. The recommended next step in the engineering analysis for a dredged hole restoration project is to consider the potential source of dredged material to restore the hole. Once potential dredged material sources areas are located and characterized, the placement method should be re-evaluated based on the identified physical and chemical properties of the dredged material, quantities of material to be relocated , distance to disposal area, and the physical environments at and between the dredging and disposal areas.

Appendix A CRC Dredged Hole DEMs

List of Figures:

DREDGED HOLE 18
DIGITAL ELEVATION MODEL



This map was created using 10/24/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.

-Elevation units in MLW.

-Contour intervals are 2ft.

-Base map 2012 NJ aerial.

0 100 200 400 Feet

Max Depth MLW	-22.6 ft
Capacity (*Below -18ft MLW*)	11,850 yd^3

Elevation MLW

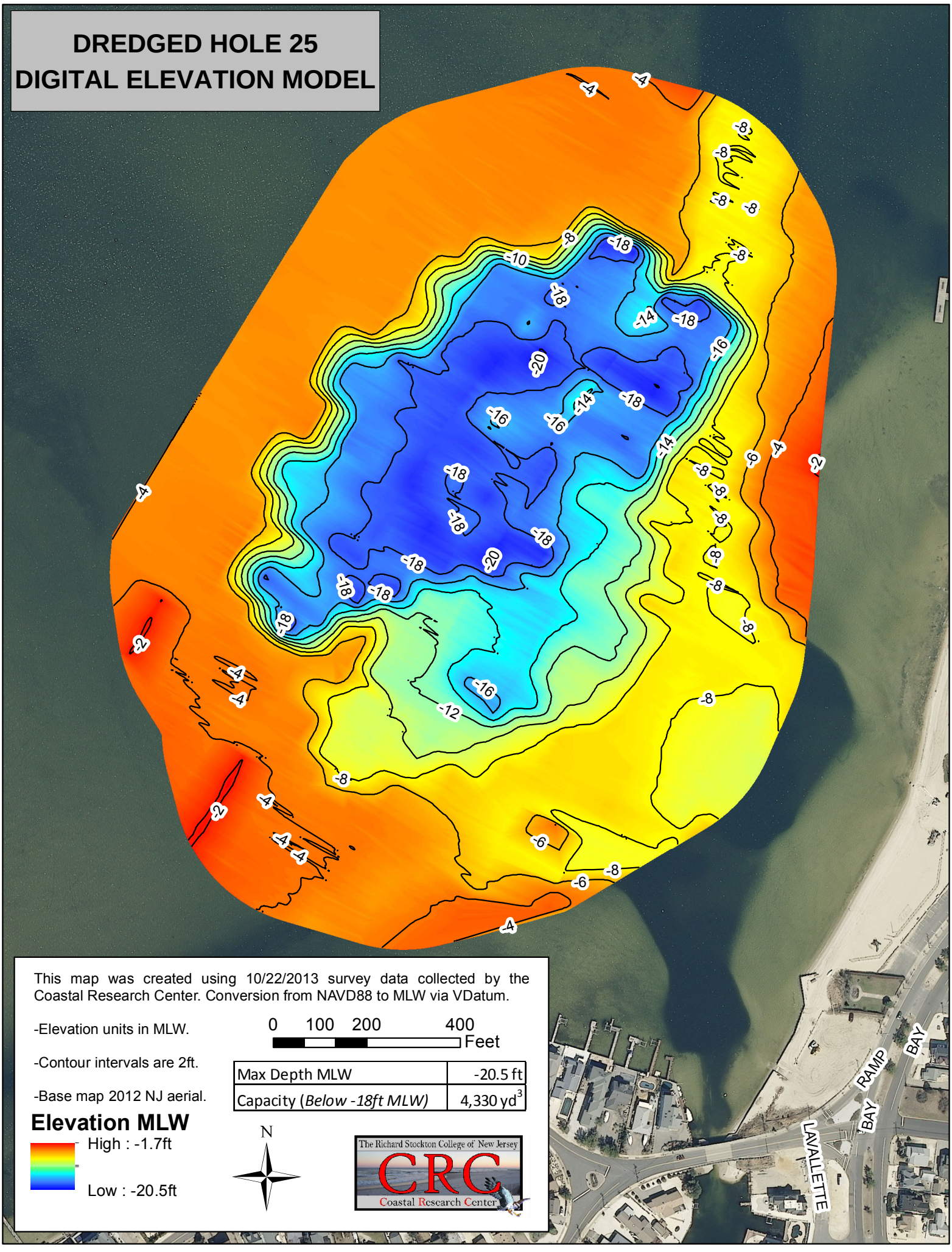
High : -1.3ft

Low : -22.6ft

N

The Richard Stockton College of New Jersey
CRC
Coastal Research Center

DREDGED HOLE 25
DIGITAL ELEVATION MODEL



This map was created using 10/22/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.

-Elevation units in MLW.

-Contour intervals are 2ft.

-Base map 2012 NJ aerial.

0 100 200 400 Feet

Max Depth MLW	-20.5 ft
Capacity (*Below -18ft MLW*)	4,330 yd^3

Elevation MLW

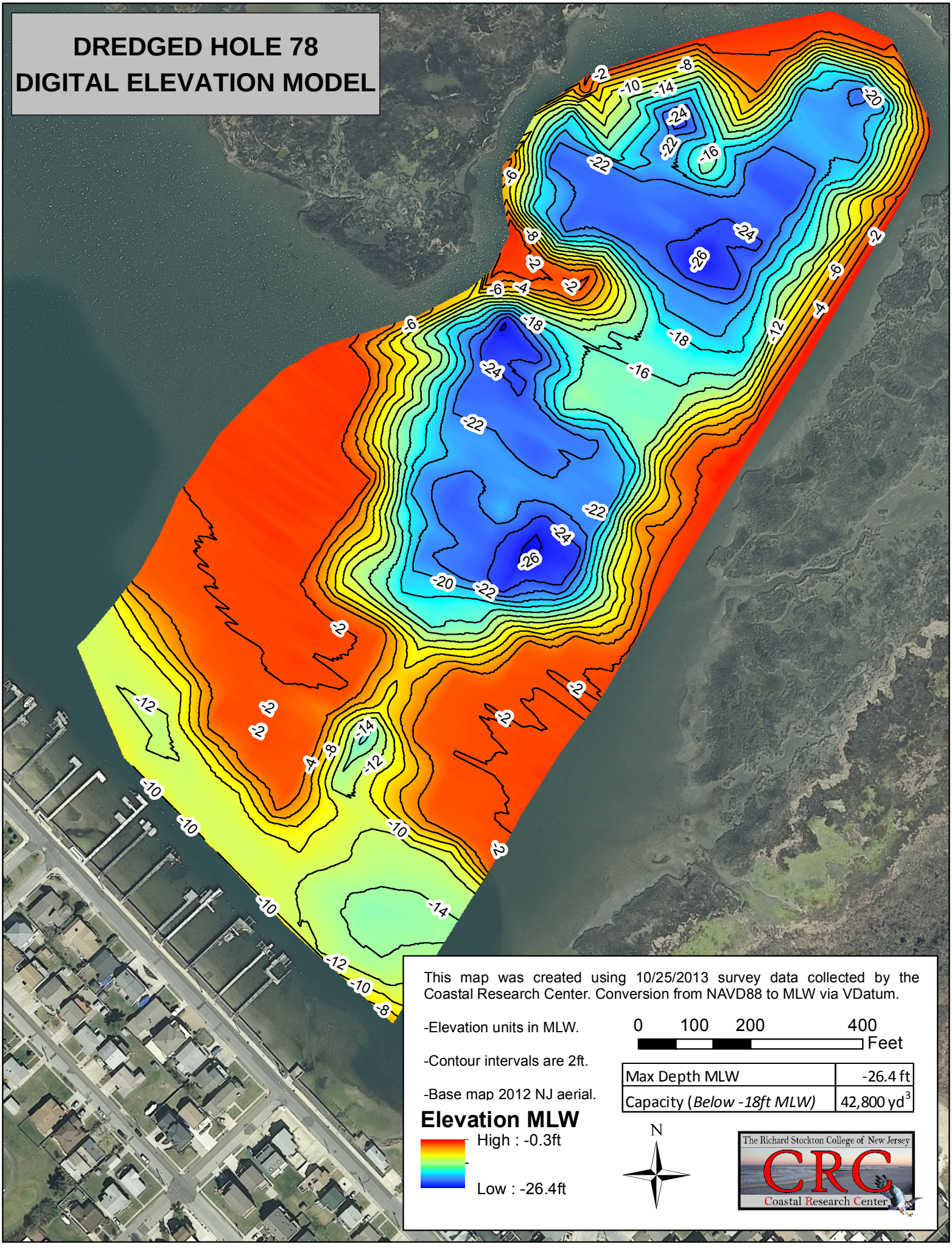
High : -1.7ft

Low : -20.5ft

N

The Richard Stockton College of New Jersey
CRC
Coastal Research Center

DREDGED HOLE 78
DIGITAL ELEVATION MODEL



This map was created using 10/25/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.

-Elevation units in MLW.

-Contour intervals are 2ft.

-Base map 2012 NJ aerial.

0 100 200 400 Feet

Max Depth MLW	-26.4 ft
Capacity (*Below -18ft MLW*)	42,800 yd^3

Elevation MLW

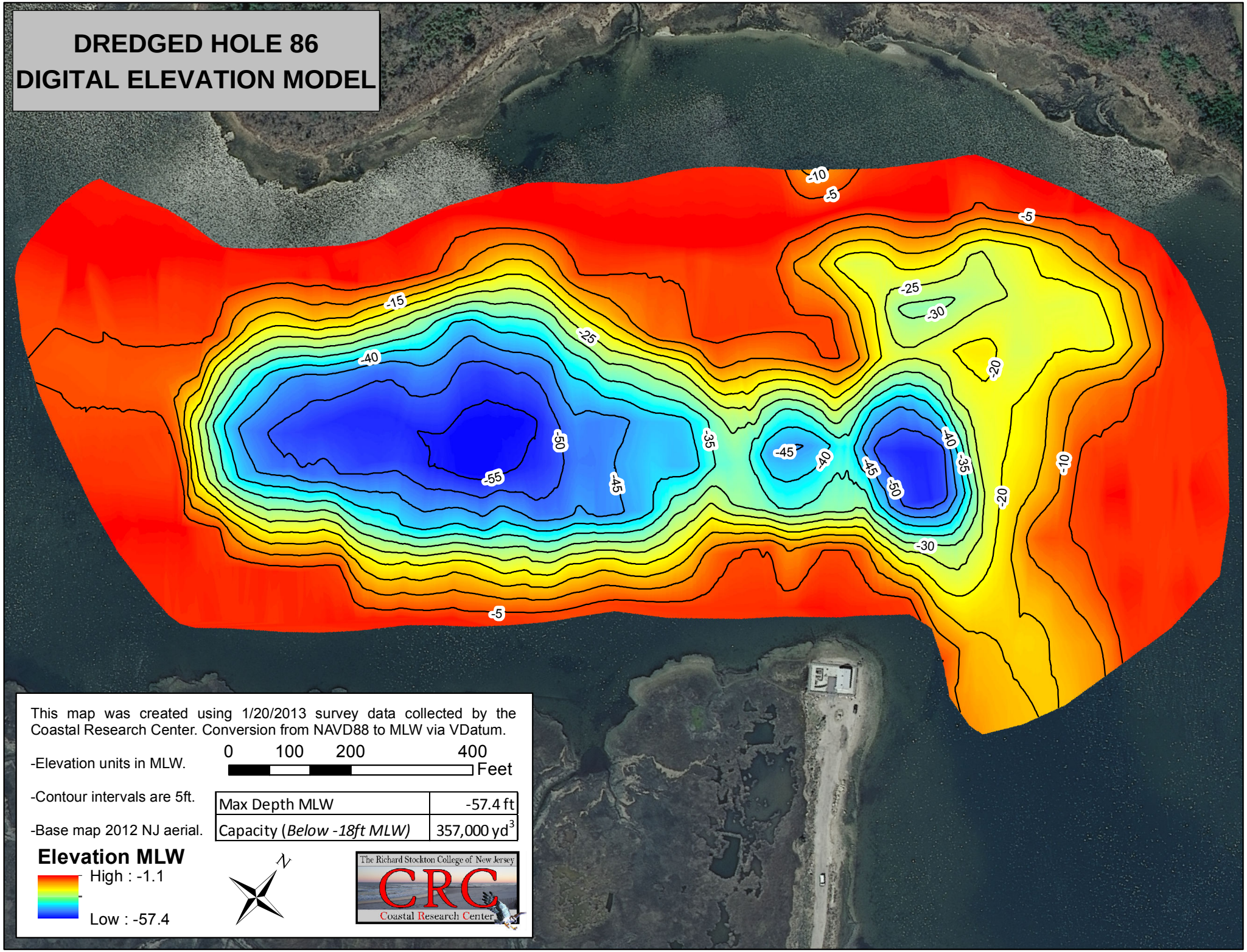
High : -0.3ft

Low : -26.4ft

N

The Richard Stockton College of New Jersey
CRC
Coastal Research Center

DREDGED HOLE 86
DIGITAL ELEVATION MODEL



This map was created using 1/20/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.

-Elevation units in MLW.

0 100 200 400 Feet

-Contour intervals are 5ft.

-Base map 2012 NJ aerial.

Max Depth MLW	-57.4 ft
Capacity (*Below -18ft MLW)*	357,000 yd^3

Elevation MLW

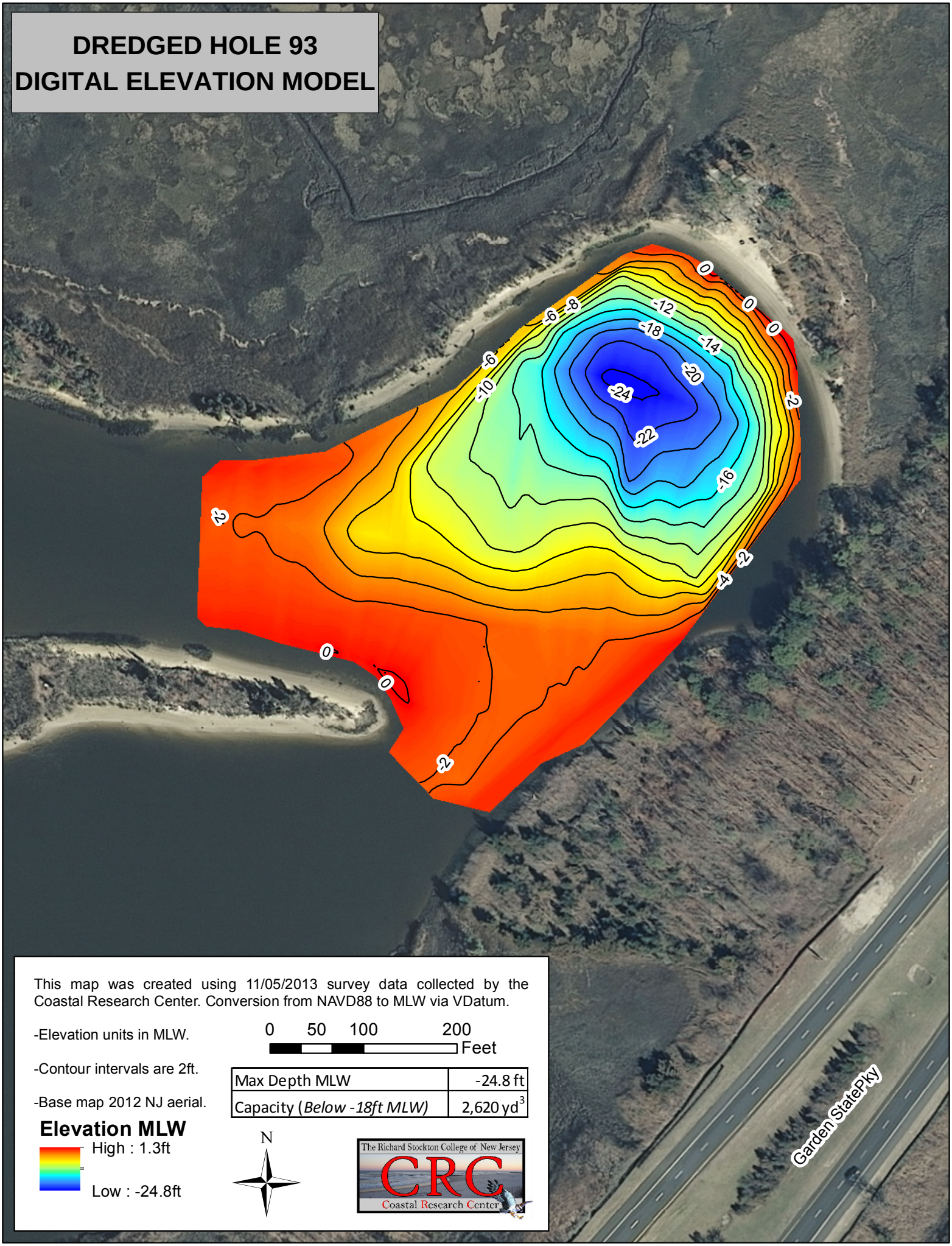
High : -1.1

Low : -57.4

N

The Richard Stockton College of New Jersey
CRC
Coastal Research Center

DREDGED HOLE 93
DIGITAL ELEVATION MODEL



This map was created using 11/05/2013 survey data collected by the Coastal Research Center. Conversion from NAVD88 to MLW via VDatum.

-Elevation units in MLW.

-Contour intervals are 2ft.

-Base map 2012 NJ aerial.

0 50 100 200 Feet

Max Depth MLW	-24.8 ft
Capacity (*Below -18ft MLW)*	2,620 yd^3

Elevation MLW

High : 1.3ft

Low : -24.8ft

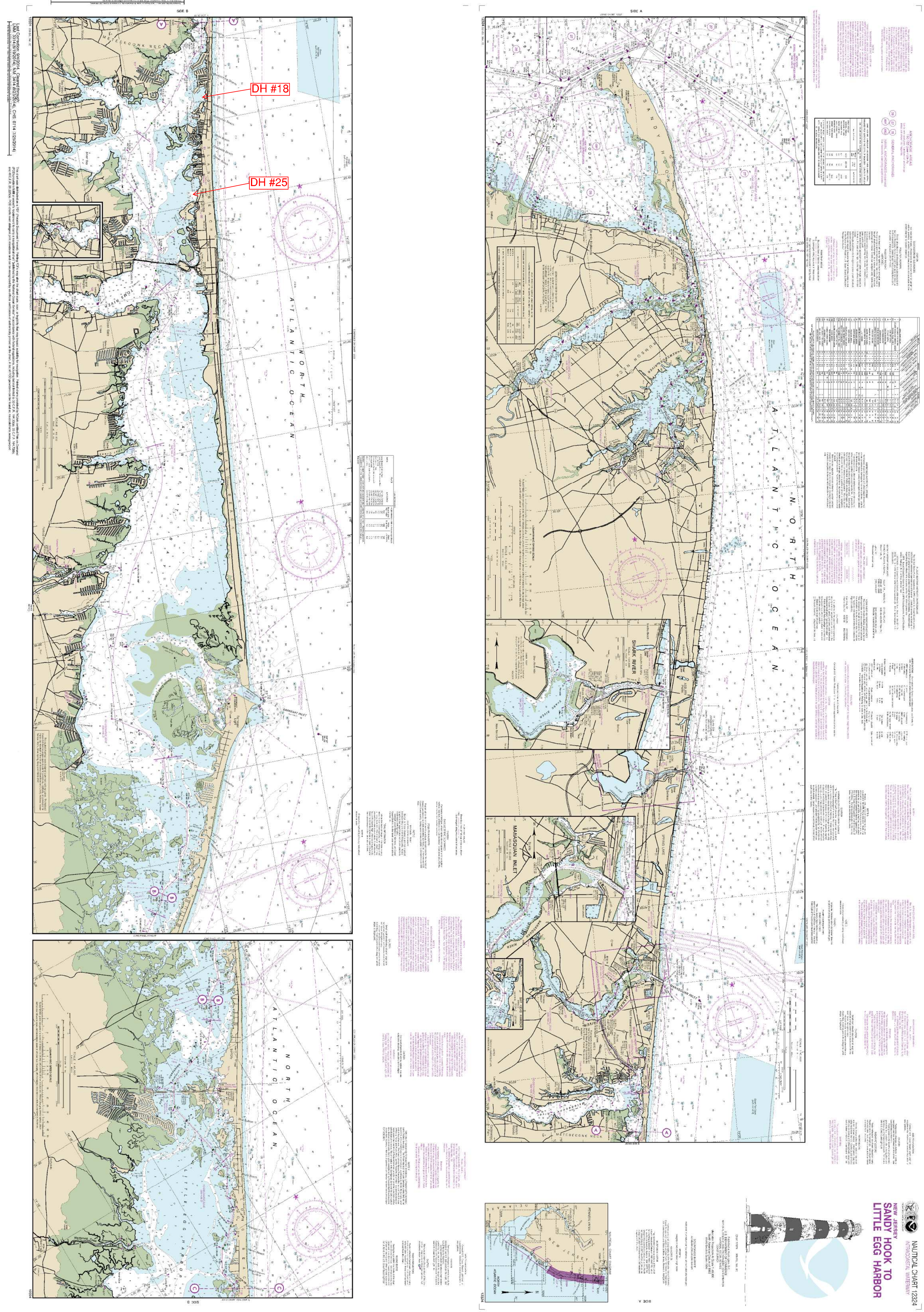
N

The Richard Stockton College of New Jersey
CRC
Coastal Research Center

Appendix B NOAA Charts

List of Charts:

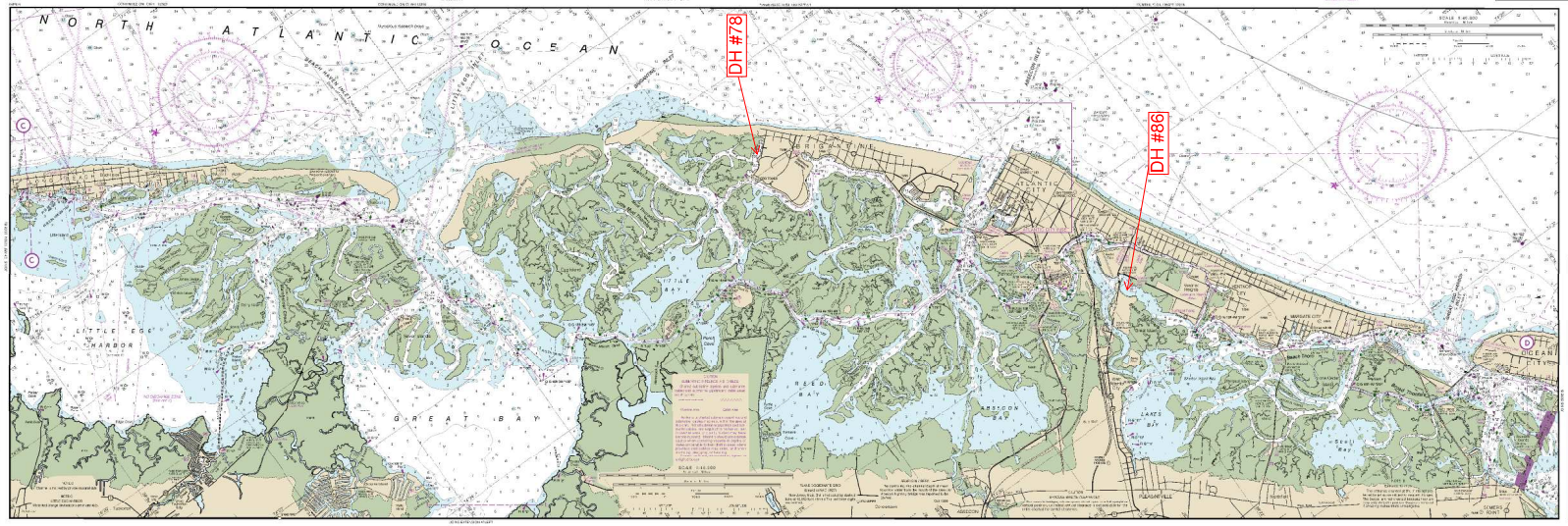
- NOAA Chart 12324
- NOAA Chart 12316

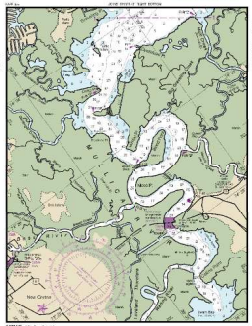

DH #18
DH #25
NAUTICAL CHART 12324
INTRACOASTAL WATERWAY
NEW JERSEY
SANDY HOOK TO
LITTLE EGG HARBOR
NORTH ATLANTIC OCEAN
SHARK RIVER
MANASQUAN INLET
BARNEGAT INLET
SIDE A
SIDE B

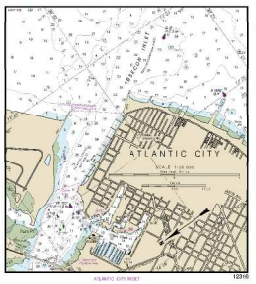
NAUTICAL CHART 12316
INTRACOASTAL WATERWAY

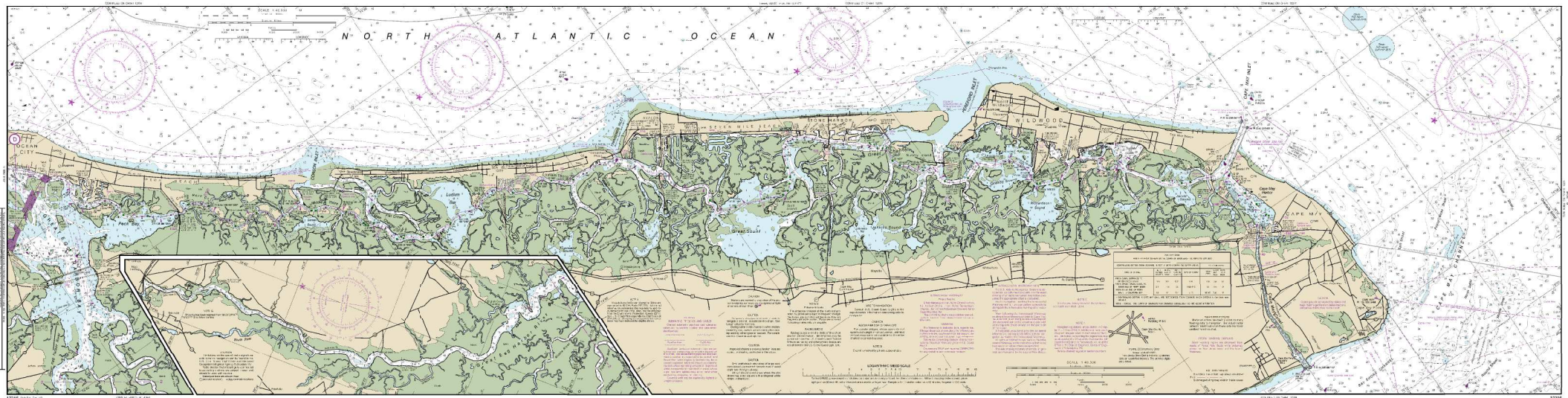
NEW JERSEY

LITTLE EGG HARBOR TO CAPE MAY









Last Correction: 8/29/2014. Cleared through:
LNM: 3414 (8/26/2014). NM: 3614 (8/5/2014)