Appendix E-5

BITS Marine Geophysical Landfall Survey

DEEPWATERWIND

OSI
MARINE AND FRESHWATER
SURVEY SERVICES

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25 July 2012

AECOM
10 Orms Street, Suite 405
Providence, RI 02904
Attn: Mark Gardella

SUBJECT: MARINE GEOPHYSICAL SITE INVESTIGATIONS (REPORT NO. 12ES048-TS)
BITS LANDFALL SURVEYS FOR DEEPWATER WIND PROJECT

Dear Mr. Gardella:

Ocean Surveys, Inc. (OSI) is pleased to submit this letter report documenting site investigations performed on 18 and 19 June 2012 for the Deepwater Wind project. Shallow water geophysical surveys were conducted in the nearshore zone using a small, shallow draft vessel to access as close to shore as possible. These are areas where the larger offshore vessel could not safely navigate during the previous field program. The surveys were completed at the Narragansett landfall (18 June) and the Block Island landfall (19 June) during the high tide period early in the morning. The primary objective of the investigations was to provide geophysical survey coverage and data in the nearshore zones to support surficial and subsurface mapping and assessments by members of the project's scientific team (archaeologists, biologists, engineers). This work was conducted under contract with AECOM based on OSI's proposal dated 16 May 2012.

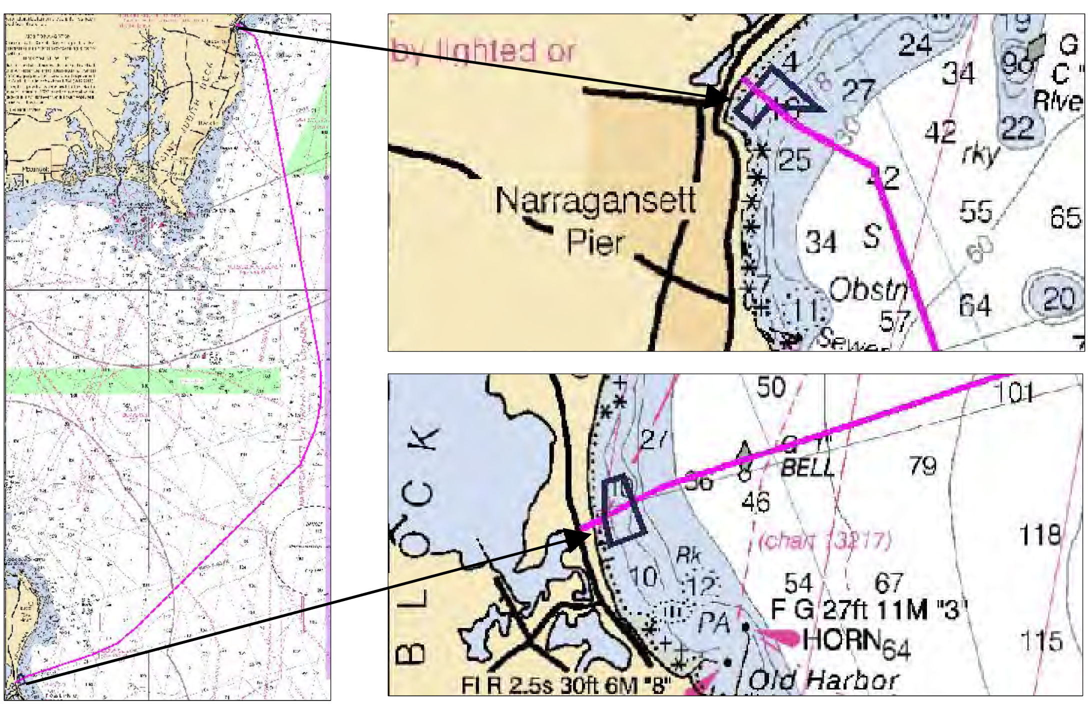


Figure 1. Location map of the entire BITS route, on left, and nearshore survey areas on right (Narragansett – upper, Block Island – lower) NOAA Chart 13218 in background.

These investigations supplement the offshore field program completed for the BITS (Block Island Transmission System) from September 2011 to January 2012. Please refer to the final report produced for that project (listed below) for detailed descriptions of the overall project, geophysical survey procedures, data processing and analysis, seafloor and subsurface characterization, and site mapping and results.

- OSI Report No. 11ES074, Marine Site Characterization Study, Geophysical and Geotechnical Investigations, Block Island Transmission System, Submarine Cable Route, Rhode Island Sound, Block Island to Narragansett, Rhode Island, dated 10 March 2012, 204 pages.

Survey Plan and Tasks

A suite of geophysical equipment was utilized to acquire marine scientific data within the designated survey areas adjacent to each landfall. The following tasks were accomplished:

- **Hydrography (depth sounder)**: to determine water depths and reveal the existing bottom topography using the single beam depth sounding technique

- **Seafloor imaging (side scan sonar)**: to identify geomorphologic variations and natural and man-made targets present on the bottom using surficial acoustic imaging techniques

- **Magnetic intensity measurements (magnetometer)**: to measure variations in the earth's total magnetic field to identify ferrous objects on and below the seafloor

- **Shallow subbottom profiling (chirp)**: to map shallow subsurface sediments and geologic features, as well as potential large buried obstructions

All geophysical systems were operated along 15 meter spaced tracklines covering the 300 meter wide survey corridor approaching each landfall. All tracklines and geophysical data overlapped with the prior offshore vessel survey coverage. Figure 2 illustrates the tracklines surveyed at each landfall.

The field program was purposely planned when high tide occurred in the early morning before the town beaches were open, to minimize any impact on public recreational use of the areas. The investigations were successfully carried out at the appropriate times and avoided any disturbance to public use as well as the nearshore environment.

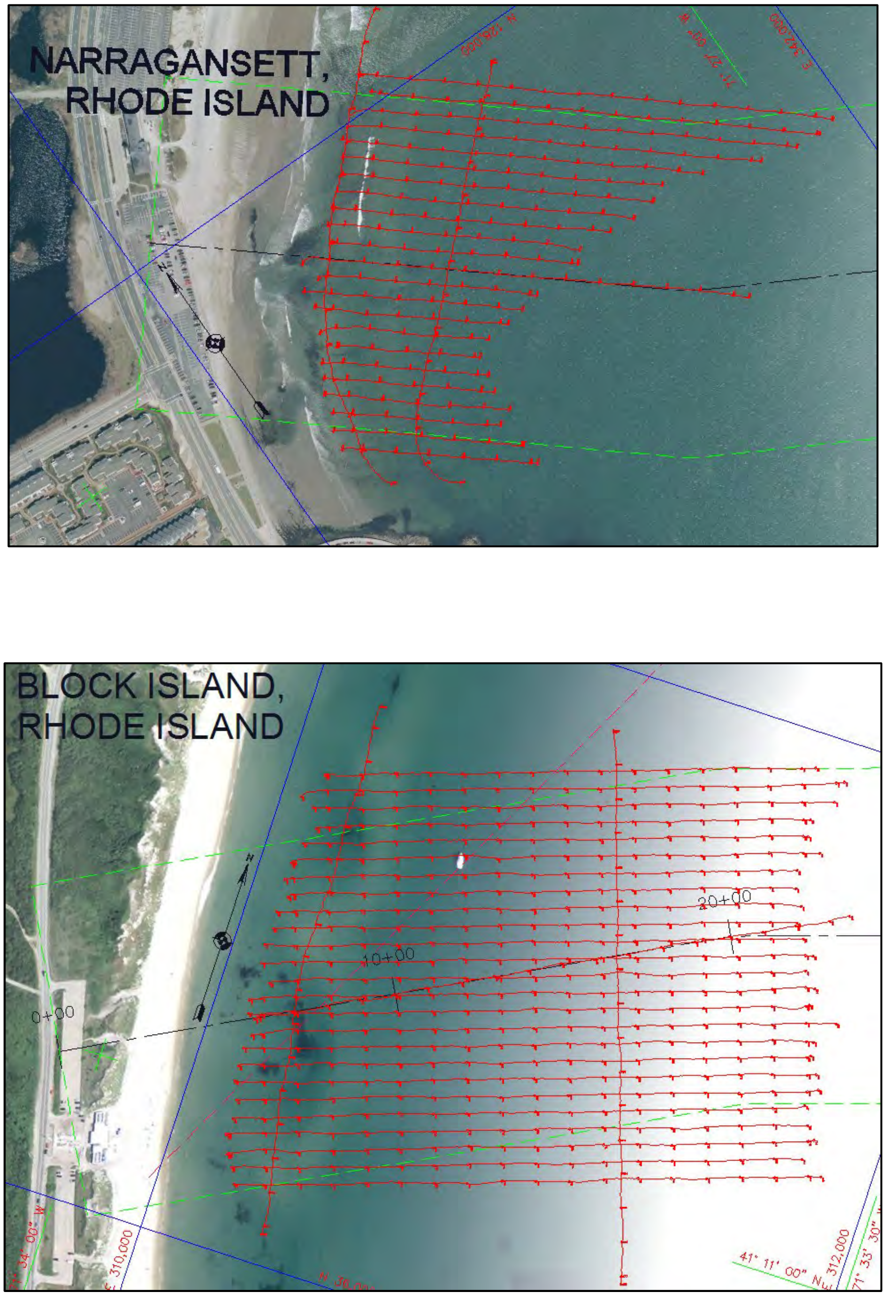


Figure 2. Geophysical tracklines surveyed in the vicinity of the two landfalls (Narragansett - upper; Block Island – lower).

Equipment and Field Operations

To accomplish the project tasks, the equipment were mobilized to the site onboard a 27-foot coastal survey vessel (*R/V Osprey*) with enclosed cabin, dual-outboard engines, and winch and davit for handling towed sensors. A detailed discussion of each system and operational procedures used to collect the data is included in Attachment 1.

- Trimble Differential Global Positioning System (DGPS), including a Trimble 4000 Receiver interfaced with a Trimble ProBeacon USCG Differential Receiver
- HYPACK Navigation and Data Logging Computer System
- Odom HydroTrac 200 kHz Survey Grade Echosounder
- TSS DMS-05 Motion Sensor
- KVH AutoComp 1000 Fluxgate Compass
- Klein 3000 100/500 kHz Side Scan Sonar System
- Geometrics G882 Cesium Marine Magnetometer
- EdgeTech 3200XS 2-16 kHz Chirp Subbottom Profiler

The surveys were conducted as close to shore as the weather conditions would allow. Breaking waves from easterly swell forced the survey to end in approximately 5-7 feet of water at the time of the survey, at the seaward edge of the surf zone. Figure 3 shows the equipment configuration aboard the *RV Osprey* for these investigations.

All systems were run on every trackline. Side scan sonar imagery was acquired using a 50-meter sweep range (164 feet out to both sides of the towfish) providing overlapping sonar coverage of the nearshore zone. The chirp subbottom profiler recorded signals down to over 30 meters, well below the depth of interest for shallow features. The magnetometer was flown astern of the vessel 2-3 feet below the water surface to reduce the effects of sea conditions in very shallow water. A bow mount configuration was attempted at each site; however, the 2-3 foot swells present on both survey days were not conducive to the sensor being hard mounted to the vessel. The repeated vertical motion of the sensor with each passing wave produced a larger cyclic magnetic fluctuation in the bow mounted configuration than in the stern tow configuration.

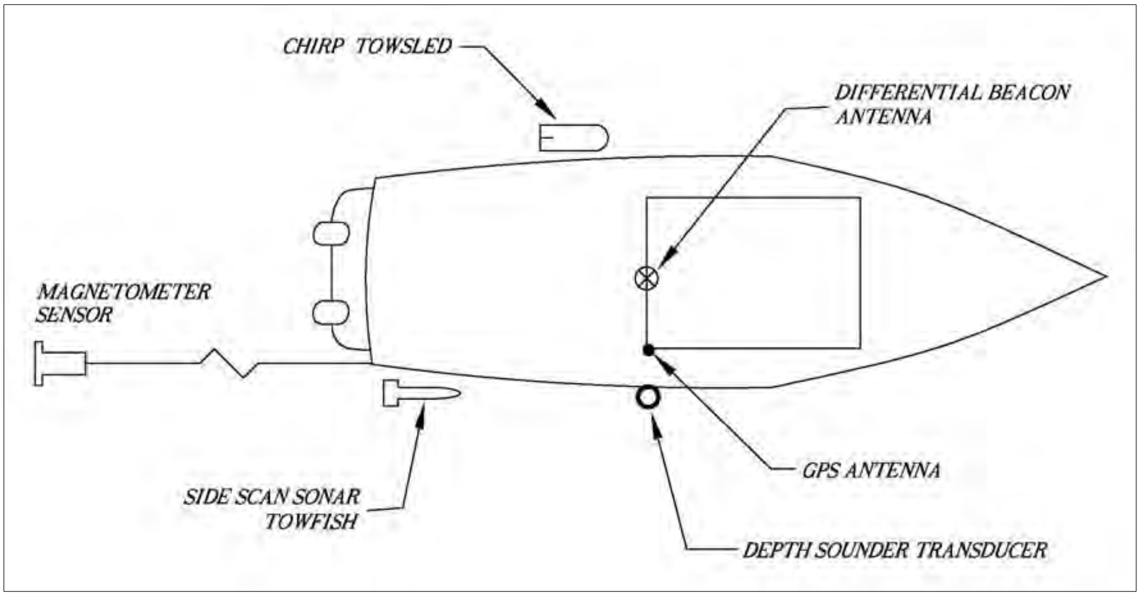


Figure 3. System configuration aboard the *RV Osprey* for these landfall surveys.

Survey Control and Data Reference

Navigation and positioning of the survey vessel were accomplished using a Trimble differential global positioning system (DGPS) interfaced to a navigation computer running HYPACK software. Differential correctors were received from the U.S. Coast Guard reference station in Acushnet, Massachusetts (306 kHz at 200 bps) by the Trimble ProBeacon receiver interfaced to a Trimble 4000 GPS receiver. Geodetic position data output by the DGPS were converted by HYPACK navigation and data acquisition software in real time to the Rhode Island State Plane Coordinate system (Zone 3800) and referenced to the North American Datum of 1983 (NAD 83) in feet. Navigation checks were performed at the beginning and end of each day at the marinas where the vessel was docked to ensure the DGPS was providing accurate horizontal positions. In this configuration, the manufacturer's state an accuracy of ±1 meter is typical; however, positioning repeatability of less than a meter is commonly observed in the field.

Vertical reference for the field investigations was Mean Lower Low Water (MLLW) based on predicted and observed tides for NOAA (National Oceanic and Atmospheric Administration) stations bordering the survey areas in Rhode Island Sound. Resulting water depths have been reported in feet below MLLW.

Data Processing and Products

Following completion of the field program, the data were processed, analyzed, interpreted, and plotted to match previous products generated for the project. Data were disseminated and distributed to project team members as needed. A number of preliminary products were submitted to expedite the transmission of geophysical data and results in support of other assessments by the project team. The following table summarizes the datasets and products generated from the processing and analysis of the different geophysical data.

System	Data Generated/Information Obtained	Description
Depth sounder	Water depth contours	Depth points contoured at a 2-foot interval to show bottom topography
	Seafloor features & topography	Review of depth data and contours for bottom geomorphology
Side scan sonar	Acoustic targets	Sonar imagery interpreted to locate discrete reflective targets on the surface
	Seafloor mosaic	Overlapping sonar imagery combined to develop a mosaic of the bottom
	Seafloor features & geology	Review of the individual sonar images and mosaic to map natural geologic features
	Surficial sediment types	Interpretation of the sonar reflectivity to classify and map surficial sediment types
Magnetometer	Magnetic anomalies	Interpretation of the magnetic intensity measurements to determine the presence of discrete ferrous objects
	Magnetic contours	Magnetic data points contoured to show the earth's total magnetic field background gradient
Subbottom profiler	Centerline subsurface profile	Chirp profile processing and export for display on final drawing
	Subsurface features & geology	Interpretation of the chirp profile to develop a geologic cross section and identification of subsurface geologic structures
	Subsurface sediment types	Interpretation of the subbottom reflector characteristics to suggest possible subsurface layer types

The geophysical data and results obtained at the landfalls were added to the existing route alignment drawings for the BITS. Information was added to the following drawings:

<u>BITS Primary Route Alignment</u> (OSI Project No. 11ES074)

Drawing #1 Sheet 1 Block Island landfall
Drawing #1 Sheet 11 Narragansett landfall

<u>BITS Magnetic Contours</u>

Drawing #5 Sheet 1 Block Island landfall
Drawing #5 Sheet 3 Narragansett landfall

Results

Narragansett Landfall

Prior to the survey, DWW provided OSI with a modified route centerline shifted slightly to the north from the previous route survey. Water depths along the centerline range from greater than 13 feet at Station 1140+00 to less than 4 feet at the closest point to shore that the survey vessel was able to reach. Side scan sonar imagery revealed a generally smooth, featureless seafloor (Type 1) indicative of finer sediments (silt-fine sand). Some patches of rougher texture on the sonar imagery indicative of coarser material (Type 3, Type 4) were previously identified south of the modified route centerline, nearer to shore. No additional areas of coarse material were identified during this survey.

Only one additional side scan sonar target was identified; SS4013, located near the southern border of the route corridor. Analysis of the magnetometer data identified 31 anomalies, of which 15 were Class 1 (≤ 10 gammas), 8 were Class 2 (10-50 gammas) and 8 were Class 3 (> 50 gammas). Most of the anomalies are isolated and none have associated side scan sonar targets; however, a few anomalies appear correlated to anomalies detected on adjacent lines. Anomalies M1909 and M1932 (51 and 43 gammas, respectively) are located 60-75 feet south of the centerline at Station 1140+50 and likely represent the same object as M1165 identified previously. Anomaly M1908 is the largest amplitude anomaly identified (195 gammas) and is located approximately 60 feet from Anomalies M1907 and M1910 and about 150 feet from the M1909-M1932-M1165 cluster. Close to shore, north of the centerline, a series of anomalies appear to form a linear trend (M1902, M1928, M1927, M1926, M1925); however, four of these were detected on the tie line and appear to be discrete anomalies based on the magnetic signature. No surface targets were identified on side scan sonar imagery in the vicinity.

The chirp subbottom records were reviewed, and a shallow subsubsurface reflector was mapped; however, no paleochannels were identified. No other shallow hazards were identified in the nearshore area.

Block Island Landfall

Single beam depth data were integrated into the previously acquired multibeam data to generate depth contours as close to shore as possible. Water depths shoal along the centerline from greater than 12 feet at Station 10+00 to less than 4 feet near Station 5+50. Side scan sonar imagery displayed low reflectivity with few surface features, correlating well the previously acquired imagery. The entire nearshore area is classified as Type 1, indicating predominantly fine-grained sediments.

Side scan sonar imagery was reviewed for isolated objects and nine relatively small targets (heights 0-1.1 feet) were identified. One target, SS4008 is likely the same as Target SS9, identified in the previous survey. Analysis of the magnetometer data revealed a moderate concentration of anomalies, increasing toward shore. As described in the field summary section, the variability in magnetic intensity, especially in the shallow nearshore area, makes distinction between anomalies caused by man-made objects difficult to distinguish from those resulting from other conditions (sea state, rapid sensor height changes, etc).

Of the 62 magnetic anomalies identified, 38 were Class 2 (10-50 gammas) and 23 were Class 3 (> 50 gammas). The largest amplitude anomaly, M2022 (465 gammas) identified close to shore approximately 320 feet north of the centerline near Station 8+40. Several other large anomalies were identified nearby (M1961, M1963, M1962, M2021); however, there is no associated side scan sonar target. Several other clusters of anomalies were also identified, some of which had associated side scan sonar targets. Anomalies M1967 and M1968 are associated with Target SS4003, located 160 feet north of the centerline near Station 11+50. Several other anomalies are nearby, including M1072 and M1073 identified from the previous survey data. There are also groupings of anomalies located directly on or very near the centerline at Stations 10+00 and 13+00. Anomalies identified at those locations in the current survey correlated well with previously identified anomalies.

The chirp subbottom records were reviewed, and a shallow subsurface reflector was mapped on the profile panel of the drawing. A deeper reflector mapped offshore was not resolved on the new chirp profile. No paleochannels or other shallow hazards were identified in the nearshore area either from subbottom data or side scan sonar data. Although there is a charted fish trap area close to shore, there were no associated objects identified during the survey.

Summary

The landfall surveys described herein were successful in extending geophysical data coverage closer to each shoreline while avoiding impacts to the physical environment and public use of the town beaches. High quality scientific data were acquired nearshore to supplement the offshore surveys already completed. There were no issues with quality due to site conditions or other factors that might have hampered the ability of OSI scientists to interpret surface and subsurface geologic features and hazards. The current plan for submarine cable installation at the landfalls is via horizontal directional drilling (HDD) which would circumvent any environmental disturbance concerns in the intertidal zone and nearshore area both on the seafloor or in the shallow subsurface.

A number of magnetic anomalies with some scattered side scan sonar targets were identified. Most magnetic anomalies did not correlate with sonar target positions, thus likely representing ferrous objects buried below the seafloor. In the Block Island shorefall area the concentration of magnetic anomalies was relatively high, although it is possible that some of these anomalies may be caused by a combination of sea conditions and not specifically associated with man-made objects.

Unconsolidated sediments are apparent on the chirp subbottom profiles down to at least 30 feet below the seafloor at both shorefalls. No paleochannels or shallow hazards were identified in either area.

We appreciate the opportunity to continue our support of AECOM and the Deepwater Wind project. Please contact us if you have any questions about the information contained in this report.

Sincerely,

Jeffrey D. Gardner P.G., C.P.G.
Senior Geophysical Project Manager

Margaret H. Sano
Senior Geophysical Scientist

JDG/MHS/lf

Attachment 1 – Equipment Operations and Procedures
Attachment 2 – Side Scan Sonar Target Listing
Attachment 3 – Magnetic Anomaly Listing

ATTACHMENT 1

EQUIPMENT OPERATIONS AND PROCEDURES

- Trimble Differential Global Positioning System
- HYPACK Navigation Software
- Odom HydroTrac 200 kHz Survey Grade Echosounder
- TSS DMS-05 Motion Sensor
- KVH AutoComp 1000 Fluxgate Compass
- Klein 3000 100/500 kHz Side Scan Sonar System
- Geometrics G882 Cesium Marine Magnetometer
- EdgeTech 3200XS 2-16 kHz “Chirp” Subbottom Profiler

EQUIPMENT OPERATIONS AND PROCEDURES

Trimble Differential Global Positioning System

A Trimble 4000 DGPS provides reliable, high-precision positioning and navigation for a wide variety of operations and environments. The system consists of a GPS receiver, a GPS volute antenna and cable, RS232 output data cables, and a secondary reference station receiver, in this case a Trimble ProBeacon receiver. The beacon receiver consists of a small control unit, a volute antenna and cable, and RS232 interface to the Trimble GPS unit.

Fully automated, the Trimble 4000 provides means for 9 channel simultaneous satellite tracking with real-time display of geodetic position, time, date, and boat track if desired. The Trimble unit is mounted on the survey vessel with the ProBeacon receiver which continuously receives differential satellite correction factors via radio link from one of the DGPS United States Coast Guard beacons. The Trimble 4000 accepts the correction factors via the ProBeacon interface and applies the differential corrections to obtain continuous, high accuracy, real-time position updates. The Trimble 4000 system is interfaced to the OSI data logging computer and HYPACK navigation software for trackline control. The output data string from the Trimble receiver can be modified to send all or part of the data parameters to the computer for logging.

The Coast Guard beacon located at Acushnet, Massachusetts (frequency of 306 kHz, @ 200 bps) was used during this project with good reliability and signal strength.

HYPACK Navigation Software

Survey vessel trackline control and position fixing were obtained by utilizing an OSI computer-based data logging package running HYPACK navigation software. The data acquisition computer is interfaced with the Trimble 4000 DGPS system onboard the survey vessel. Vessel position data from the Trimble 4000 were updated at 1.0-second intervals and input to the HYPACK navigation system which processes the geodetic positions into State Plane coordinates used to guide the survey vessel accurately along preselected tracklines. The incoming data are logged on disk and processed in real time allowing the vessel position to be displayed on a video monitor and compared to each pre-plotted trackline as the survey progresses. Digital charts, aerial photos and the locations of existing structures, buoys, and control points can also be displayed on the monitor in relation to the vessel position. The OSI computer logging system combined with the HYPACK software thus provide an accurate visual representation of survey vessel location in real time, combined with highly efficient data logging capability and post-survey data processing and plotting routines.

Odom HydroTrac 200 kHz Survey Grade Echosounder

Precision water depth measurements were obtained by employing an Odom HydroTrac digital depth sounder with a 200 kilohertz, 8° beam transducer. The HydroTrac unit has been specifically designed for small boat surveys where equipment space is a premium and the potential for water contact is high (watertight, sealed keypad). The unit is compact, portable, and rugged, built to survive tough field conditions. The HydroTrac recorder provides precise, high resolution depth records using a solid state thermal printer as well as digital data output (via RS232) which allows integration with the OSI computer-based navigation system including HYPACK software. Other features include internal or external eventing, gain sensitivity controls, power output control, auto scale changing, and auto pulse length selection, among others. The recorder also incorporates both tide and draft corrections plus a calibration capability for local water mass sound speed. A depth resolution of 0.1-foot is reported by the manufacturer.

Sound speed calibrations were accomplished by performing "bar checks." The bar check procedure consists of lowering an acoustic target, typically a 20 pound lead disk, on a measured sounding line to the specified project depth. The speed of sound control is adjusted such that the reflection from the disk is printed precisely at this known depth on the recorder. The acoustic target is then raised to successively shallower depths and calibration readings at these depths are similarly recorded. Variations which exist in the indicated depth at these calibration points are incorporated in the sounding data processing to produce maximum accuracy in the resulting depth measurements. Bar checks were performed at the beginning and end of each field day to check the sound speed calibration.

TSS DMS-05 Motion Sensor

Vessel heave, pitch and roll information was measured and logged utilizing TSS's DMS-05 Dynamic Motion Sensor. Incorporating an enhanced external velocity and heading aiding algorithm for improved accuracy during dynamic maneuvers, the solid state angular sensor offers reliability and the highest performance of any TSS produced vertical reference unit. The DMS-05 motion sensor was designed for use with multibeam echosounders and incorporates advanced processing techniques and high grade inertial sensing elements to attain heave, pitch, and roll measurements with high dynamic accuracy and immunity to vessel turns and speed changes. The DMS-05 allows full utilization of all echosounder beams and survey capabilities to IHO standards. The DMS-05 has a dynamic roll and pitch accuracy to 0.05° over a 30° range and dynamic heave accuracy to 5 centimeters or 5% (whichever is greater). The unit can output digital data at a rate up to 200 hertz and accepts a standard NMEA-0183 message string. Digital data are logged by the HYPACK navigation computer. The DMS-05 permits survey operations to continue through degrading weather conditions, increasing project productivity and efficiency.

KVH AutoComp 1000 Flux Gate Compass

The KVH AutoComp 1000 fluxgate compass was used to measure magnetic compass headings along survey tracklines. The AutoComp 1000 incorporates next generation electronic fluxgate technology to provide 0.5 degree accuracy and an automatic compensation system that automatically corrects for compass deviation on the vessel, without a compass adjuster. The system automatically calibrates itself after installation by steering the survey vessel in a circle so the microprocessor controlled unit can measure, process, and compensate for the magnetic field. The unit corrects for B, C, D, and E coefficient errors, while standard NMEA 0183 output provides easy interfacing with other equipment. The digital data are logged on the HYPACK navigation computer.

Klein 3000 100/500 kHz Side Scan Sonar System

Side scan sonar images of the bottom were collected using a Klein 3000 dual frequency, high-resolution sonar system operating at frequencies of 100 and 500 kilohertz. The system consists of a topside computer, color monitor, keyboard, mouse, an EPC1086 dual-channel thermal graphic recorder, tow cable, and sonar towfish. All system components are interfaced via a local network hub and cable connections. The system contains an integrated navigational plotter which accepts standard NMEA 0183 input from a GPS system. This allows vessel position to be displayed on the monitor and speed information to be used for controlling sonar ping rate. Sonar sweep can also be plotted in the navigation window for monitoring bottom coverage in the survey area.

The hardware listed above is interfaced to the Klein SonarPro data acquisition and playback software package which runs on the topside computer. All sonar images are stored digitally and can be enhanced real-time or post-survey by numerous mathematical filters available in the program software. Imagery is displayed in a waterfall window in either normal or ground range (water column removed) formats. Other software functions that are available during data acquisition include; changing range scale and delay, display color, automatic or manual TVG (time variable gain), speed over bottom, multiple enlargement zoom, target length, height, and area measurements, logging and saving of target images, and annotation frequency and content. The power of this system is its real-time processing capability for determining precise dimensions of targets and areas on the bottom.

As with many other marine geophysical instruments, the side scan sonar derives its information from reflected acoustic energy. A set of transducers mounted in a compact towfish generate the short duration acoustic pulses required for extremely high resolution. The pulses are emitted in a thin, fan-shaped pattern that spreads downward to either side of the fish in a plane perpendicular to its path. As the fish progresses along the trackline this acoustic beam sequentially scans the bottom from a point directly beneath the fish outward to each side of the survey trackline.

Acoustic energy reflected from any bottom discontinuities is received by the set of transducers in the towfish, amplified and transmitted to the survey vessel via the tow cable where it is further amplified, processed, and converted to a graphic record by the side scan recorder. The sequence of reflections from the series of pulses is displayed on a video monitor and/or dual-channel graphic recorder on which paper is incrementally advanced prior to printing each acoustic pulse. The resulting output is essentially analogous to a high angle oblique "photograph" providing detailed representation of bottom features and characteristics. This system allows display of positive relief (features extending above the bottom) and negative relief (such as depressions) in either light or dark opposing contrast modes on the video monitor. Examination of the images thus allows a determination of significant features and objects present on the bottom within the survey area.

Geometrics G882 Cesium Marine Magnetometer

Total magnetic field intensity measurements were acquired along the survey tracklines using a Geometrics G882 cesium magnetometer that has an instrument sensitivity of 0.1 gamma. The G882 magnetometer system includes the sensor head with a coil and optical component tube, a sensor electronics package which houses the AC signal generator and mini-counter that converts the Larmor signal into a magnetic anomaly value in gammas, and a RS-232 data cable for transmitting digital measurements to a data logging system. The cesium-based method of magnetic detection allows a center or nose tow configuration off the survey vessel, simultaneously with other remote sensing equipment, while maintaining high quality, quiet magnetic data with ambient fluctuations of less than 1 gamma. The G882 also features an altimeter which outputs sensor height above the seafloor along with the magnetic intensity readings at a 10-hertz sampling rate. Data were recorded on the OSI data-logging computer by the HYPACK software.

The G882 magnetometer acquires information on the ambient magnetic field strength by measuring the variation in cesium electron energy level states. The presence of only one electron in the atom’s outermost electron shell (known as an alkali metal) makes cesium ideal for optical pumping and magnetometry.

In operation, a beam of infrared light is passed through a cesium vapor chamber producing a Larmor frequency output in the form of a continuous sine wave. This radio frequency field is generated by an H1 coil wound around a tube containing the optical components (lamp oscillator, optical filters and lenses, split-circular polarizer, and infrared photo detector). The Larmor frequency is directly proportional to the ambient magnetic intensity, and is exactly 3.49872 times the ambient magnetic field measured in gammas or nano-Teslas. Changes in the ambient magnetic field cause different degrees of atomic excitation in the cesium vapor which in turn allows variable amounts of infrared light to pass, resulting in fluctuations in the Larmor frequency.

Although the earth's magnetic field does change with both time and distance, over short periods and distances the earth's field can be viewed as relatively constant. The presence of magnetic material and/or magnetic minerals, however, can add to or subtract from the earth's magnetic field creating a magnetic anomaly. Rapid changes in total magnetic field intensity, which are not associated with normal background fluctuations, mark the locations of these anomalies.

Determination of the location of an object producing a magnetic anomaly depends on whether or not the magnetometer sensor passed directly over the object and if the anomaly is an apparent monopole or dipole. A magnetic dipole can be thought of simply as a common bar magnet having a positive and negative end or pole. A monopole arises when the magnetometer senses only one end of a dipole as it passes over the object. This situation occurs mainly when the distance between opposite poles of a dipole is much greater than the distance between the magnetometer and the sensed pole, or when a dipole is oriented nearly perpendicular to the ambient field thus shielding one pole from detection. For dipolar anomalies, the location of the object is at the point of maximum gradient between the two poles. In the case of a monopole, the object associated with the anomaly is located below the maximum or minimum magnetic value.

EdgeTech 3200XS 2-16 kHz "Chirp" Subbottom Profiler

High-resolution subbottom profiling was accomplished utilizing an EdgeTech 3200 XStar Full Spectrum "Chirp" subbottom profiler system operating with frequencies of 2-16 kHz. The subbottom profiler consists of three components: the deck or topside unit (computer processor, amplifier, monitor, keyboard, and trackball), an underwater cable, and a Model 216 towed vehicle housing the transducers. Data are displayed on a color monitor while saved in a JSF proprietary digital format on the XS topside computer.

The 3200 XS Chirp sonar is a versatile subbottom profiler that generates cross-sectional images and collects normal incidence reflection data over many frequency ranges. The system transmits and receives an FM pulse signal generated via a streamlined towed vehicle (subsurface transducer array). The outgoing FM pulse is linearly swept over a full spectrum range of 2-16 kHz for a period of approximately 20 milliseconds. The acoustic return received at the hydrophone array is cross-correlated with the outgoing FM pulse and sent to the deck unit for display and archiving, generating a high-resolution image of the subbottom stratigraphy. Because the FM pulse is generated by a converter with a wide dynamic range and a transmitter with linear components, the energy, amplitude, and phase characteristics of the acoustic pulse can be precisely controlled and enhanced.

The "chirp" subbottom profiler is designed for acquiring high-resolution subsurface data from the upper portions of the stratigraphic column (20-50 ft depending on site conditions). The higher end frequencies allow good resolution of subbottom layering while the lower end acoustic frequencies provide significant penetration. This particular system is capable of providing excellent acoustic imagery of the nearsurface in a wide variety of marine environments.

During data acquisition, all records were annotated with relevant supporting information, field observations, line number, run number, navigation event marks and numbers for later interpretation and correlation with vessel position data.

ATTACHMENT 2

SIDE SCAN SONAR TARGET TABLE
TARGET IMAGES

SIDE SCAN SONAR TARGETS

Target ID[1]	Easting[2]	Northing[2]	Length[3]	Width[3]	Height[3]	Description	Magnetic Association[4]
	feet	feet	feet	feet	feet		
Narragansett Shorefall							
SS4013	340509	127061	20.3	1.8	0.0	Linear target	
Block Island Shorefall							
SS4001	311328	37289	2.5	0.9	1.1	Linear target	M1972, M1982
SS4002	311301	37296	5.2	2.7	0.6	Oblong target - part of sandwave?	M1972, M1982
SS4003	310556	37101	9.7	8.7	0.0	Rounded target?	M1967, ?M1968
SS4004	311634	36918	3.6	2.0	0.6	Oblong target	
SS4005	311027	36683	3.6	2.1	1.0	Oblong target	M2004
SS4006	310892	36744	5.0	2.1	0.3	Oblong target	M1998
SS4007	310756	36654	2.4	1.3	0.5	Oblong target	?M1999
SS4008	310698	36684	4.2	1.4	0.2	Oblong target	?M1999
SS4012	311433	37565	2.2	1.5	0.6	Oblong target	

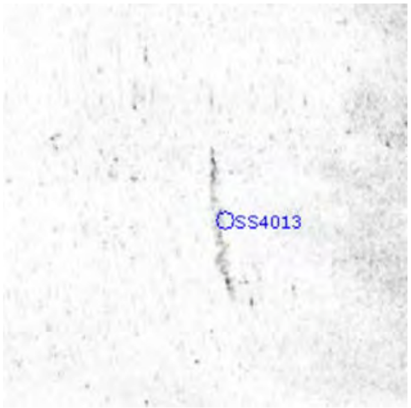
Notes:

1. Target ID numbers are non-sequential.
2. Coordinates are referenced to RI State Plane, Zone 3800, NAD83, in feet.
3. Target dimensions are based on the acoustic reflection and may not represent the actual size of the object (due to orientation of object relative to sonar, partial burial of object, etc.).
4. ? symbolizes the magnetic anomaly is nearby, but not close enough to make a definitive correlation.

Side Scan Sonar Target Images

Contact Image **Contact Info**

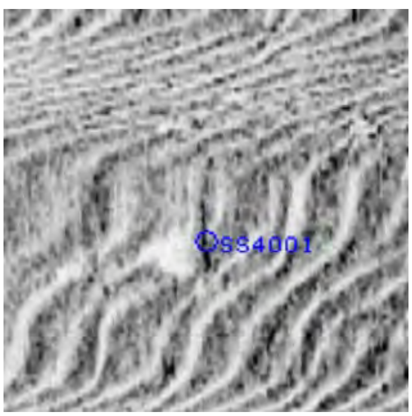
Narragansett



SS4013
(X) 340509 (Y) 127061

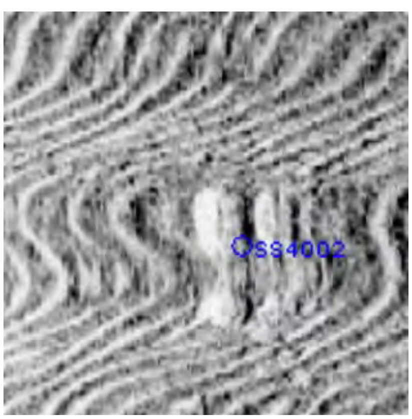
Dimensions
Target Height: 0.0 US Feet
Target Length: 20.3 US Feet
Target Width: 1.8 US Feet
Mag Anomaly:
Description: Linear target

Block Island



SS4001
(X) 311328 (Y) 37289

Dimensions
Target Height: 1.1 US Feet
Target Length: 2.5 US Feet
Target Width: 0.9 US Feet
Mag Anomaly:
Description: Linear target

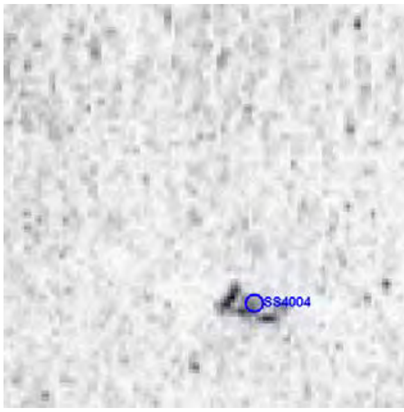


SS4002
(X) 311301 (Y) 37296

Dimensions
Target Height: 0.6 US Feet
Target Length: 5.2 US Feet
Target Width: 2.7 US Feet
Mag Anomaly:
Description: Oblong target - part of sandwave?

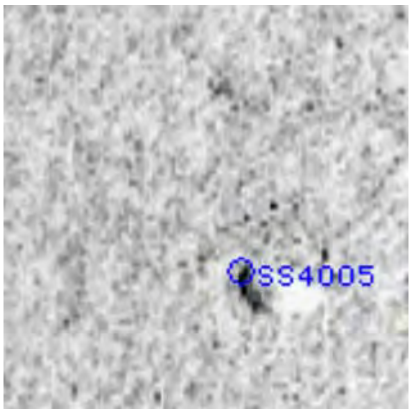
SS4003
(X) 310556 (Y) 37101

Dimensions
Target Height: 0.0 US Feet
Target Length: 9.7 US Feet
Target Width: 8.7 US Feet
Mag Anomaly:
Description: Rounded target?



SS4004
(X) 311634 (Y) 36918

Dimensions
Target Height: 0.6 US Feet
Target Length: 3.6 US Feet
Target Width: 2.0 US Feet
Mag Anomaly:
Description: Oblong target

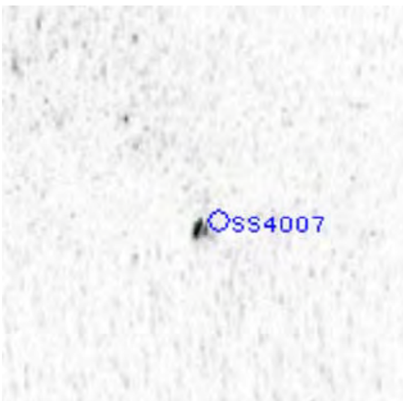


SS4005
(X) 311027 (Y) 36683

Dimensions
Target Height: 1.0 US Feet
Target Length: 3.6 US Feet
Target Width: 2.1 US Feet
Mag Anomaly:
Description: Oblong target

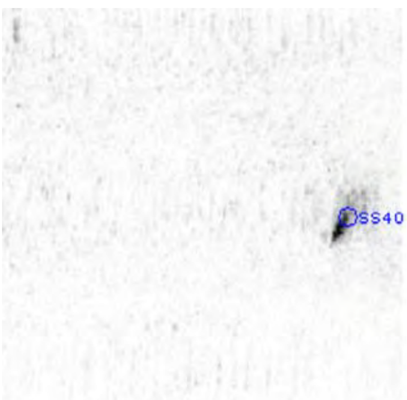
SS4006
(X) 310892 (Y) 36744

Dimensions
Target Height: 0.3 US Feet
Target Length: 5.0 US Feet
Target Width: 2.1 US Feet
Mag Anomaly:
Description: Oblong target



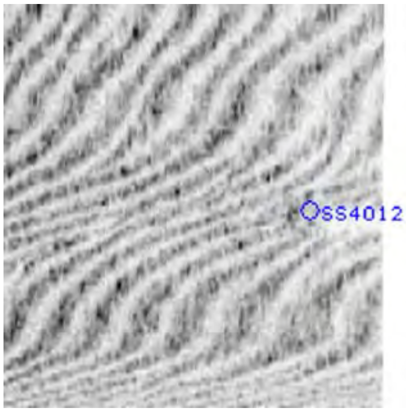
SS4007
(X) 310756 (Y) 36654

Dimensions
Target Height: 0.5 US Feet
Target Length: 2.4 US Feet
Target Width: 1.3 US Feet
Mag Anomaly:
Description: Oblong target



SS4008
(X) 310698 (Y) 36684

Dimensions
Target Height: 0.2 US Feet
Target Length: 4.2 US Feet
Target Width: 1.4 US Feet
Mag Anomaly:
Description: Oblong target



SS4012
(X) 311433 (Y) 37565

Dimensions
Target Height: 0.6 US Feet
Target Length: 2.2 US Feet
Target Width: 1.5 US Feet
Mag Anomaly:
Description: Oblong target

ATTACHMENT 3

MAGNETIC ANOMALY LISTING

MAGNETIC ANOMALIES

Anomaly ID[1]	Easting [2]	Northing[2]	Amplitude	Duration	Type[3]	Event	Altitude	Sonar Association[4]
	feet	feet	gammas	feet			meters	
Narragansett Shorefall								
M1901	340835	127992	5	34	M-	51.3	2	
M1902	340738	127950	76	52	Di	95.2	2	
M1903	340969	127683	8	41	M-	103.6	4	
M1904	340873	127761	4	26	M-	104.9	3	
M1905	340716	127634	22	59	Di	144.5	3	
M1906	340719	127563	7	28	M+	153.9	3	
M1907	340615	127585	16	27	M-	184.6	3	
M1908	340616	127523	195	102	Di	193.2	3	
M1909	340703	127387	51	88	Di	199.8	4	
M1910	340548	127512	51	47	Di	201.8	3	
M1911	340461	127519	4	18	M+	210.7	2	
M1912	340422	127557	7	26	M-	211.6	2	
M1913	340709	127251	10	47	M+	214.2	4	
M1914	340541	127321	4	21	M+	223.1	3	
M1915	340420	127356	11	50	M-	231.4	2	
M1916	340474	127246	26	65	Di	237.3	3	
M1917	340494	127157	10	41	Di	243.8	3	
M1918	340430	127216	17	46	Di	244.7	3	
M1919	340336	127235	6	20	M+	252.6	2	
M1920	340313	127188	71	44	Di	260.6	2	
M1921	340634	126852	6	25	M+	264.3	5	
M1922	340476	126984	5	28	M+	266.2	4	
M1923	340354	127085	5	31	M+	267.9	2	
M1924	340377	127580	55	47	M+	276.3	1	
M1925	340544	127790	24	26	M-	278.9	2	
M1926	340573	127819	117	40	Di	279.4	2	
M1927	340638	127878	7	19	M+	280.2	2	
M1928	340669	127909	100	41	Di	280.7	2	
M1929	340848	128083	17	28	M+	283.2	1	
M1931	340961	127661	8	30	M+	291.8	4	
M1932	340697	127407	43	48	M-	295.5	4	

Anomaly ID[1]	Easting [2]	Northing[2]	Amplitude	Duration	Type[3]	Event	Altitude	Sonar Association[4]
	feet	feet	gammas	feet			meters	
Block Island Shorefall								
M1955	310419	37373	30	39	M+	393.7	3	
M1956	310559	37368	30	60	M+	409.3	4	
M1957	310289	37269	34	46	M-	412.2	2	
M1958	310612	37335	33	64	M+	425.9	5	
M1959	310536	37311	12	20	M-	426.7	4	
M1960	310277	37216	9	31	M+	429.5	3	
M1961	310186	37134	123	48	M+	447.6	2	
M1962	310296	37118	91	39	M+	463.6	3	
M1963	310230	37101	256	66	M+	464.3	3	
M1964	310576	37159	44	27	M+	477.8	4	
M1965	310181	37027	234	54	M+	482.0	2	
M1966	311276	37345	15	66	M-	487.5	8	SS4001, SS4002
M1967	310551	37097	32	25	M+	495.3	4	SS4003
M1968	310508	37082	30	52	M+	495.7	4	?SS4003
M1969	310319	37021	17	35	M+	497.8	3	
M1970	310272	37008	35	31	M+	498.3	3	
M1971	310221	36989	13	27	M+	498.8	2	
M1972	311301	37305	65	117	Di	504.5	8	SS4001, SS4002
M1973	310612	37067	13	24	M-	511.8	4	
M1974	310280	36950	16	33	M+	515.3	3	
M1975	310207	36926	31	34	M+	516.1	2	
M1976	310164	36913	84	29	M+	516.7	1	
M1977	311284	37247	28	124	M-	522.8	8	SS4001, SS4002
M1978	310828	37087	48	77	M+	527.7	4	
M1979	310284	36903	51	48	M+	533.3	2	
M1980	310212	36879	25	34	M+	534.1	2	
M1981	310177	36870	25	34	M+	534.7	2	
M1982	311302	37298	87	111	Di	542.3	8	SS4001, SS4002
M1983	310770	37017	43	30	M+	548.3	4	
M1984	310735	37000	26	28	M-	548.7	4	
M1985	310503	36872	9	15	M+	551.4	3	
M1986	310772	37014	53	28	M+	566.5	4	
M1987	310806	36975	52	60	M+	584.2	4	
M1988	310722	36946	55	62	M+	585.1	4	

Anomaly ID[1]	Easting[2]	Northing[2]	Amplitude	Duration	Type[3]	Event	Altitude	Sonar Association[4]
	feet	feet	gammas	feet			meters	
Block Island Shorefall								
M1989	310320	36808	33	52	M+	589.3	2	
M1990	311114	37030	18	53	M+	600.2	6	
M1991	310814	36925	22	54	M+	603.4	4	
M1992	310387	36777	22	59	M-	607.8	3	
M1993	310756	36850	92	97	M-	623.1	4	
M1994	310573	36736	38	93	M+	644.2	4	
M1995	310365	36664	50	59	M+	646.5	2	
M1996	310248	36623	31	48	M+	647.7	2	
M1997	310245	36569	59	44	Di	666.9	2	
M1998	310842	36722	40	73	M+	679.7	4	SS4006
M1999	310777	36702	86	90	M-	680.4	4	?SS4007, ?SS4008
M2000	310405	36573	22	42	M-	684.3	3	
M2001	310274	36527	31	32	M+	685.7	2	
M2002	311173	36784	79	96	Di	695.4	6	
M2003	311378	36803	114	102	Di	711.3	7	
M2004	311055	36692	41	67	M+	714.8	5	SS4005
M2005	310577	36472	237	34	M+	738.0	3	
M2007	310422	36366	19	38	Di	759.9	2	
M2009	310787	36438	51	67	Di	775.2	4	
M2010	310329	36282	71	37	Di	780.0	2	
M2012	310502	36284	12	39	Di	798.4	3	
M2013	310371	36244	16	41	Di	799.7	2	
M2017	310309	36169	19	38	M-	819.5	1	
M2019	310255	36590	41	18	M-	848.3	1	
M2020	310204	36897	20	24	Di	851.4	1	
M2021	310204	37017	215	66	M+	852.5	1	
M2022	310212	37111	465	67	M+	853.5	2	

Notes:

1. Anomaly ID numbers are non-sequential.
2. Coordinates are referenced to RI State Plane, Zone 3800, NAD83, in feet.
3. Anomaly Types: M+=positive monopole, M-=negative monopole, Di=dipole
4. ? symbolizes the sonar target is nearby, but not close enough to make a definitive correlation.