Appendices

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Appendix A

Multibeam Bathymetry and Sidescan Sonar Survey Results

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SURVEY REPORT

HYDROGRAPHIC AND GEOPHYSICAL SURVEYS AT NORTHLAKE SHIPYARD

SEATTLE, WASHINGTON

SUBMITTED TO
ECOLOGY AND ENVIRONMENT, INC
DECEMBER, 2008

SUBMITTED BY

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1 Introduction

The following document describes a high resolution, multibeam sonar bathymetric survey and a sidescan imagery sonar survey which were conducted for Ecology and Environment, Inc., by Tetra Tech EC, Inc. (TtEC), on December 10, 12 and 16, 2008, at the Northlake Shipyard in Seattle, Washington. The multibeam sonar system provided high resolution, full bottom coverage bathymetry for the shipyard and adjacent area, from which contour lines and hill-shade maps (hard copy and electronic) digital terrain models where created.

The survey was conducted in accordance with the procedures in the US Army Corps of Engineers Manual 1101-2-1003, *Engineering and Design Hydrographic Surveying*.

The survey data was collected to chart bottom features and provide detailed bathymetric data to:

- support future site characterization activities;
- determine bathymetric anomalies; and
- provide data for potential remedial designs.

Additionally, the collected data may also be used to analyze bottom substrate composition and evaluate sediment transportation.

Table 1-1 lists the project team and their roles in the survey.

Table 1-1 - Project Team

Company	Personnel
Tetra Tech EC, Inc.	Robert Feldpausch – Project Manager Burton Bridge – Hydrographer Richard Funk - Geophysicist Lou Schwartz – Vessel Captain David Humes – RTK GPS Tech Kyle Enright – RTK GPS Tech

2 System Setup

The survey systems were installed on a Tetra Tech survey launch, a 21 foot aluminum jet boat configured for shallow water surveying (Figure 2-1). The equipment used for the survey is shown in Table 2-1. Manufacturers' product data sheets, describing the system characteristics and specifications of the primary survey hardware, are provided in Appendix C.

Table 2-1 - Survey Equipment

Sensor Type	Manufacturer/Model
Multibeam Sonar	Dual RESON SeaBat 7125
Motion Sensor	Applanix POS/MV
Heading	Applanix POS/MV
Position	Leica 1230 RTK GPS
Sound Speed Profiler	SeaBird SBE-19
Sound Speed at the Multibeam Sonar	SeaBird SBE-37 MicroCat
Water Height Corrections	Leica 1230 RTK GPS
Sidescan Sonar	GeoAcoustics SS941/159D

Data collection and navigation software for the bathymetry survey was Hypack®/HYSWEEP®. The data were processed and data products generated using a combination of HYSWEEP, IVS 3D Fledermaus, and ESRI ArcGIS. Sidescan data were collected and processed with SonarWiz software from Chesapeake Technologies.

Software settings for bathymetry data acquisition include the serial I/O configuration and sensor offsets in HYPACK, and HYPACK Navigation device offsets in the HYSWEEP hardware configuration.

Figure 2-1 - Tetra Tech Jet Boat

2.1 Interconnections

Figure 2-2 shows the data flow and communications setup for the devices which make up the bathymetry survey system.

The sidescan sonar system used was an analogue GeoAcoustics SS941/159D, which consists of a selectable, dual frequency (100/410 kHz) towfish which is connected to a transceiver unit that controls the sidescan (gain, Time Varying Gain - TVG, and automatic gain control – AGC). The analogue signal is then split into three recording systems. An EPC Model GSP 1086 thermal recorder, a Sony DAT and a Chesapeake analogue to digital data acquisition system. The EPC records the processed (gained) data onto thermal paper, the DAT records the raw sidescan data, as well as the processed (gained) data, and the Chesapeake digital acquisition system converts the processed (gained) analogue sidescan data into a digital signal that is then recorded on a laptop computer using Chesapeake SonarWiz software for real-time mosaic generation, and data recording for later post-processing and target picking.

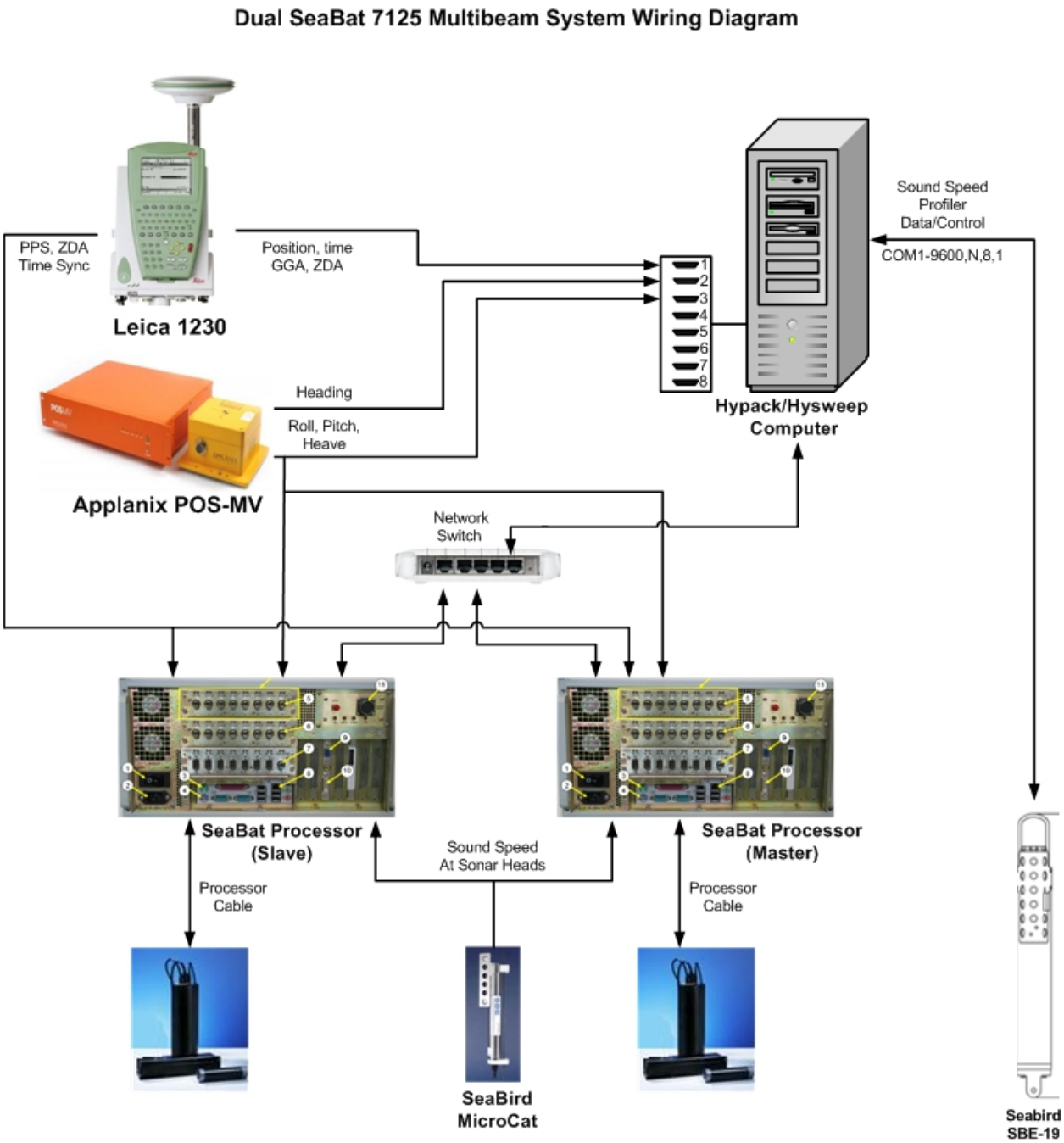


Figure 2-2 – 7125 Multibeam Survey System

2.2 Device Offsets

Device offsets are precisely defined for the multibeam and sidescan sonars, attitude sensor and GPS antenna, so that the HYPACK/HYSWEEP and SonarWizMap acquisition software can accurately convert the input sonar and support sensor data into XYZ soundings on the earth.

2.2.1 Sensor Offsets

The offsets, in feet, used for the HYSWEEP and SonarWizMap sensors are listed in Table 2-2 and Table 2-3 below:

Table 2-2 – Bathymetry Sensor Offsets (feet)

Sensor	Across	Along	Vertical
Port SeaBat 7125	-1.09	14.00	0.55
Starboard SeaBat 7125	1.06	14.02	0.48
Motion Sensor (Applanix POS/MV)	0.00	0.00	0.00
HYPACK Navigation (Leica antenna)	-0.05	14.09	-5.95

Table 2-3 – Sidescan Sonar Sensor Offsets (feet)

Sensor	Across	Along	Vertical
GeoAcoustics SS941/159D	2.0	0.0	na
SonarWiz Navigation (Leica antenna)	0.0	0.0	na

2.3 Multibeam and Sidescan Sonar Mounts

The multibeam sonar heads were mounted to the vessel using a retractable bow mount pole, shown in Figure 2-3 (mount up for transport). The mount is rigidly attached to the bow of the vessel, with the Leica GPS antenna mounted on an extension pole, directly above the sonar. When the vessel is launched, the pole is rotated to vertical, and secured with a bracket mounted at the waterline. For this survey, to facilitate viewing under other vessels and structures, each of the two sonar heads were rotated approximately 30 degrees outboard.

The sidescan sonar was suspended on lines from the starboard bow ~2 feet below the water surface. The GPS antenna was mounted 2 feet to port of the sidescan at the same along track position.

Figure 2-3 – TtEC Multibeam Sonar Mount

2.4 Geodesy Settings

The geodesy settings shown in Table 2-3 were used for the Northlake Shipyard project.

Table 2-4 - Survey Geodesy Settings

Parameter	Setting
Grids	State Plane NAD-83
Zone	WA-4601 Washington North
Distance Unit	US Survey Feet
Depth Unit	US Survey Feet
Ellipsoid	NAD-83
Geoid	NAVD 88
Vertical Datum	USACE Datum (NAVD88 + 3.24 ft)[1]
Horizontal Control	NOAA NGS SAG SY4165
Vertical Control	NOAA NGS SAG SY4165

1 Refer to the RETEC memorandum included in Appendix E for information related to vertical datum conversion.

The elevations output by the Leica RTK were referenced to the NAVD88 geoid. Corrections to convert the output data elevations from NAVD-88, to the USACE vertical datum, were applied to the HYPACK Max® matrix XYZ file.

2.5 GPS Reference Station

The RTK GPS base station was set up over NOAA National Geodetic Survey (NGS) SAG SY4595, as shown in Figure 3-1. The published description of the control point is provided in Appendix E.

3 Survey Procedures

This was a project condition survey to assess the bottom bathymetry and the presence of man-made debris in the shipyard and surrounding area. To provide the highest possible resolution, a dual RESON SeaBat 7125 multibeam sonar and GeoAcoustics SS941/159D sidescan sonar were used. The SeaBat 7125 system is currently the highest resolution multibeam sonar commercially available. It has an along-track beamwidth of 1.0 degrees and an across-track beamwidth of 0.5 degrees normal to the array, increasing to 1.0 degrees at +/- 60 degrees. The sidescan sonar system used was a a selectable, dual frequency (100/410 kHz) analogue GeoAcoustics SS941/159D. The support sensors, used to measure vessel attitude (roll, pitch, heave), position, heading, and sound speed through the water column, were selected to ensure that the associated accuracies commensurate with the accuracy and resolution of the sonar systems.

Figure 3-1 - RTK GPS Base Station – Gas Works Park (SAG SY4165)

3.1 Position/height

To compensate for any variation in the water surface elevation, vessel squat and settlement and varying draft due to vessel loading, RTK GPS was used for both position (x, y) and height (z). Tetra Tech staff set up a RTK base station on the NOAA National Geodetic Survey (NGS) monument shown in Appendix E. The locations of the control points are shown as green circles in Figure 3-2.

The base station was set up at monument Designation SAG (PID SY4165), as shown in Figure 3-1. For QC checks during the survey operations, the rover unit was then taken to the Washington State Department of Transportation (WSDOT) monument Designation Brian Cary (Monument ID 3967), and Washington Council of County Surveyors (WCCS) Point Name 2609CC 58A (Point Alias 7575) vertical control point. The horizontal position matched the Brian Cary monument to approximately 0.09 ft. and vertically to 0.03 ft. The 2609CC 58A benchmark did not have precise horizontal coordinates, however the vertical matched to 0.02 ft.

The base station was set up each morning of the survey and the rover was used to re-check the position at the Brian Cary control point. The same results were obtained in each case.

The 93V-445 control point shown in Appendix E could not be located.

Figure 3-1 - Control Point Locations

3.2 Sensor Offset Measurements

All sensor offsets were measured relative to the XYZ position of the Inertial Measurement Unit (IMU). Measurements were performed on a leveled trailer with a total station and repeated at the dock, in calm water, using a tape measure.

The vertical offset between the GPS antenna and the acoustic center of the sonar is a critical measurement, and was checked by two of the survey staff.

3.3 Multibeam Patch Test Results

A standard patch test was carried out within the survey area to determine the calibration offsets between the multibeam echosounder and the motion reference unit. The offsets shown in Table 3-1 were calculated from the patch test which was conducted on December 9, 2008. These offsets were applied in the data processing software to correct residual misalignments in the mechanical installation of the sensors, and to compensate for any latency in the positioning system.

Figure 3-3 shows the site, the survey lines and data collected for the patch test calibration. There is a sunken barge at this location, in the canal northwest of Lake Union (approximately 1,271,914 East and 240,469 North), which provided a distinct feature, with significant changes in depth over very short distances along track. This in turn provided very consistent results from the patch test and processed data.

The data collection software was time synchronized to GPS UTC time, and the time stamp from the GPS position messages was used for the position data, which typically provides a latency value of zero. This had been verified with this same hardware and software configuration multiple times in the past, so a latency test was not specifically done for this survey. Review of the full survey data set showed none of the position offsets that would result from a latency error.

Table 3-1 – Multibeam Patch Test Calibration Results

Parameter	Value (deg.)	
	Port Sonar Head	**Starboard Sonar Head**
Roll	27.70	-32.15
Pitch	-0.50	-1.75
Yaw	2.00	3.00
Latency	0.0 sec	0.0 sec

The multibeam data were processed using the Patch Test toolkit in the HYPACK MB Max processing software, using the procedures defined in the HYPACK documentation. Collections were performed so that at least two independent data sets were used to derive each measurement. No significant differences were observed in the results for each measurement.

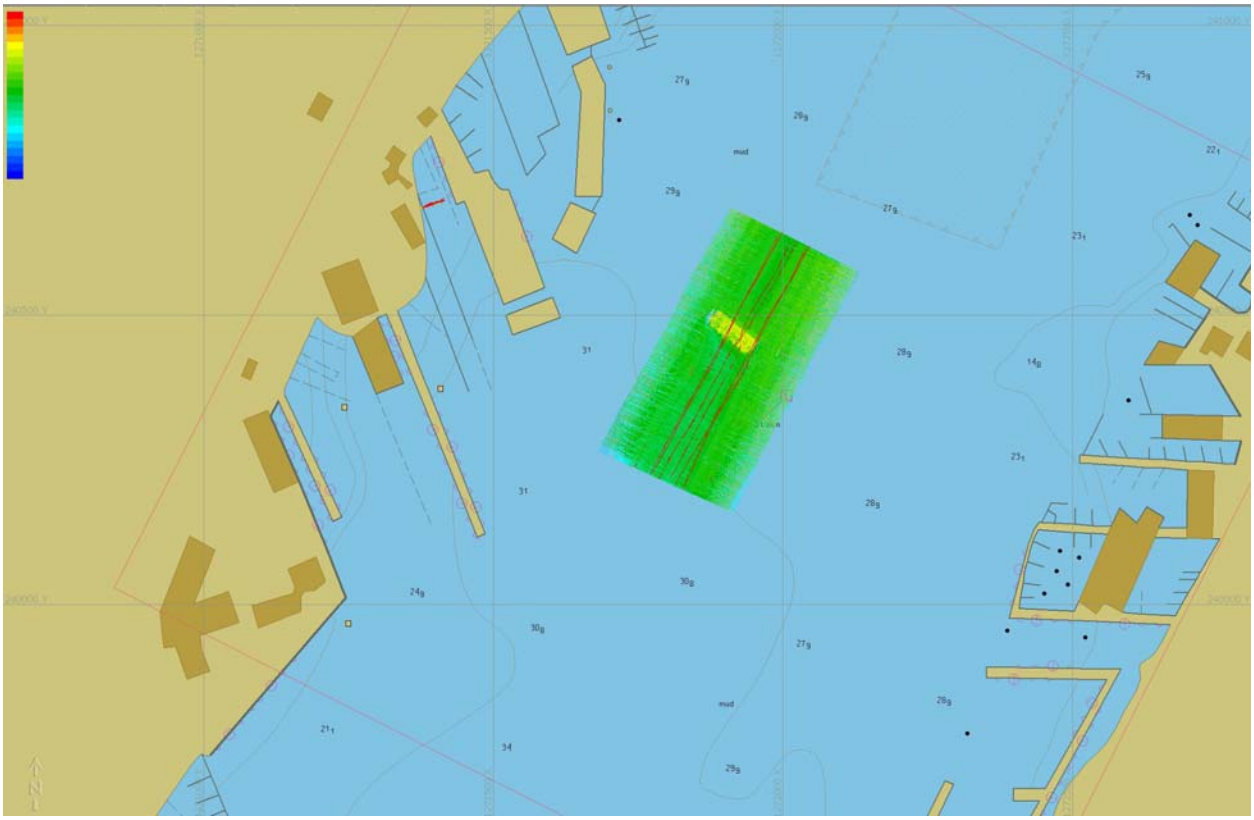


Figure 3-2 – Multibeam Patch Test Site

3.4 Sound Speed Casts

Sound speed casts were performed at the beginning and end of the bathymetry survey day. A comparison of the cast data showed no significant differences in the induced depth offsets out to the +/- 65 degree swath coverage of the sonar.

4 Sidescan Sonar Data

The following is a description of the methods used to process the sidescan sonar data and produce final deliverables.

4.1 Sidescan Sonar Processing

Only high frequency (410 kHz) data were recorded for this survey. The range setting was 50 meters. Line spacing was 75 feet. Data processing was performed in Chesapeake Technologies SonarWiz.MAP software. Each file is bottom tracked to remove the water column from the data to allow for proper slant range and beam angle corrections to be applied. Final data presentation materials were generated using a combination of SonarWiz.MAP and Arc GIS.

4.2 Sidescan Sonar Results

The results from the sidescan sonar survey, including an imagery mosaic of the survey area, and a target pick list, are shown in Appendix B.

5 Bathymetry Results

The following is a description of the processing used to convert the raw collected data to depths and positions, and to remove invalid soundings from the processed data set.

5.1 Bathymetry Processing

The collected data were processed in HYSWEEP to generate the XYZ soundings, in the survey coordinate system and units. The preliminary data cleaning was also performed in HYSWEEP, to eliminate any gross outliers induced by noise in the sensor systems or the acoustic environment. A subsequent area based cleaning, using the merged data from all the survey lines, was then conducted using Fledermaus, an advanced 3D editing application. The results of this processing were then exported back to the HYPACK HS2 files and exported an ASCII grid file.

Final data presentation materials were generated using a combination of Fledermaus and ArcView.

5.2 Bathymetry Results

The results from the multibeam bathymetry survey are shown in Figure 5-1 and in Appendix A. Appendix D contains the survey collection logs, which record the survey collection lines and any significant conditions or events noted during the survey. Bathymetry data extended from near shore to approximately 19 ft below the USACE local datum.

There were some near-shore areas that were inaccessible due to vessels and docks. It was not possible to get full coverage under the large pier on the east side of the shipyard due to the size and draft of the vessels tied up to the pier.

At least two sunken vessels and one rectangular structure that could be a barge or sunken dock section were observed in the bathymetry, along with large amounts of piles and/or pipes and various other unidentified debris.

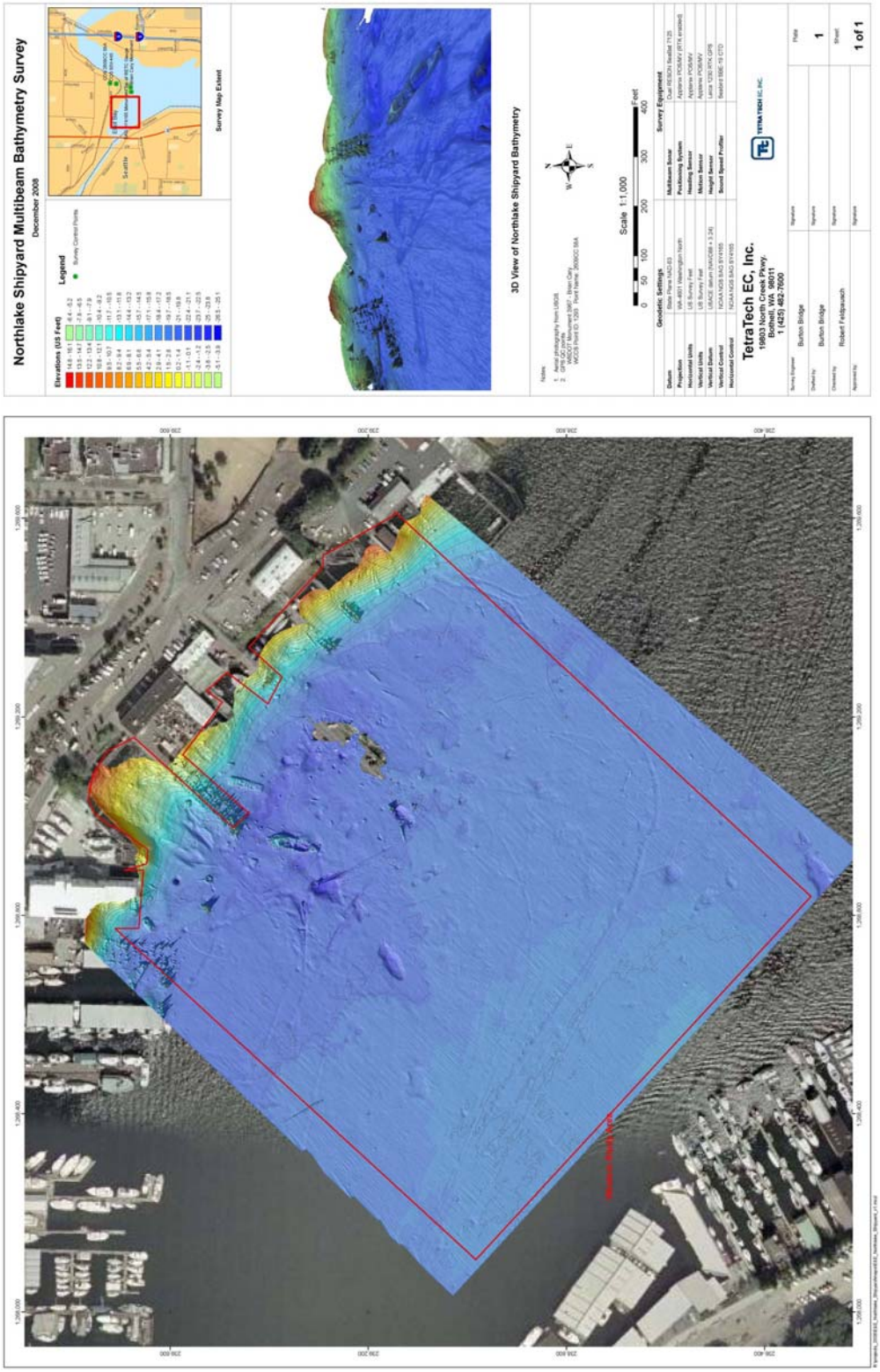


Figure 5-1 - Bathymetry Survey Chart

6 Summary

The acquired multibeam and sidescan sonar data provides a high resolution view of the bathymetry in the vicinity of the Northlake Shipyard, as well as debris and potential items of interest on the lake bottom.

The high resolution bathymetry and sidescan sonar data clearly shows features 0.5 feet or less above the surrounding bottom. These data can be used to locate and identify debris that may need to be considered during future site characterization activities, evaluated as part of potential remedial designs and/or removed from the site during remedial activities.

Appendix A. Northlake Shipyard Bathymetry, December 2008

Appendix B. Northlake Shipyard Sidescan Sonar Mosaic, December 2008

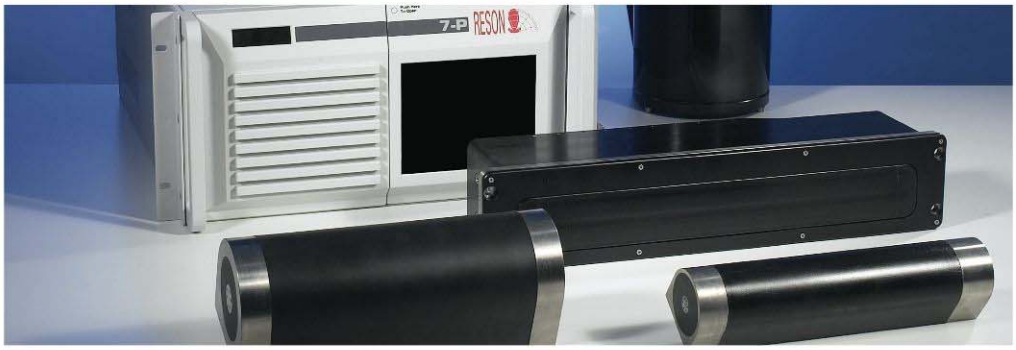
Appendix C. Equipment Data Sheets

The following are copies of the equipment data sheets, provided by the manufacturers, for the primary hardware systems used for the survey.

RESON

SeaBat 7125

High-Resolution Multibeam Echosounder System



SeaBat 7125

- **Unparalleled Resolution and Installation Flexibility**
- **Single or Dual-Frequency Operation (200 and/or 400kHz)**
- **256 or 512 Focused 0.5° Beams at 400kHz (1° at 200kHz)**
- **128° Swath Coverage (4x Water Depth)**
- **400 meter Depth Rated (6000 meter option)**
- **Built-in test environment (BITE)**
- **Complies to IHO SP44 Special Order + USACE Class 1**

The new generation SeaBat 7125 represents yet another technological breakthrough in high quality performance. With unparalleled resolution and installation flexibility, the SeaBat 7125 is ideal for a great variety of hydrographic, offshore, military, bathymetric, sidescan & snippets applications from a surface vessel, ROV to 6000 meter depth.

The SeaBat 7125 is a single and / or dual frequency (200/400kHz) multibeam echosounder system. In the 200kHz configuration, the receiver forms 256 equi-angle or equi-distant dynamically focused 1° receive beams to cover a 128° swath, with a maximum range of 500 meters. In the 400kHz configuration, the receiver forms 256 equi-angle focused 0.5° receive beams or 512 in equi-distant mode, to cover a 128° swath, with ultra high resolution and a typical range of 200 meters.

The SeaBat 7125 is controlled by the 7-P, a high performance Sonar Processor that manages data flow and signal processing using a state-of-the-art FPGA architechture. The 7-P provides a Windows®-based GUI user interface, allowing system configuration, control, data output, storage and built-in test environment (BITE) displays to assist the operator.

Equi-distant or equi-angular beam spacing across the entire swath is selectable by the operator to provide uniform sounding density and maximize usable outer swath. Data logging of beamformed water column data or pre-beamformed stave data to a RAID disk system is also optionally provided.

The SeaBat 7125 receiver sonar head design provides increased bandwidth, improved dynamic range and noise immunity over earlier models and makes full use of Commercial-off-the-Shelf (COTS) hardware and software to increase cost effectiveness with a well defined path for future upgrades and expansion.

SeaBat 7125

High-Resolution Multibeam Echosounder System

SYSTEM PERFORMANCE

Frequency:	200kHz	400kHz
Max Range:	500 m	200 m
Swath Coverage:	128°	128°
Number of Beams:	256 Equi-angle or Equi-distant	256 / 512 Equi-angle or 512 Equi-distant
Max Update Rate:	50 Hz	50 Hz
Waveform:	Gated CW	Gated CW
Depth Resolution:	5 mm	5 mm
Pulse Length:	33 to 300 µseconds	33 to 300 µseconds
Depth Rating:	400 m (standard) 6000 m (option)	400 m (standard) 6000 m (option)
Across-Track Beamwidth:	Transmit: >142° Receive: 1.1° ± 0.05° (center)	Transmit: >145° Receive: 0.54° ± 0.03° (center)
Along-Track Beamwidth	Transmit: 2.2° ± 0.05° Receive: 28.5° ± 3°	Transmit: 1° ± 0.02° Receive: 31° ± 3.5°

INTERFACE

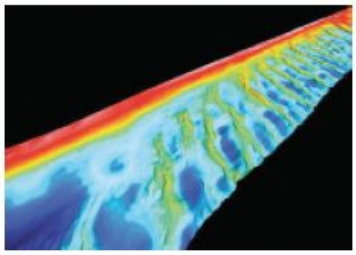
System Control:	7-P Processor Unit
Power Requirements:	48V DC 58W (Provided by sonar processor) 110/220 VAC 50/60Hz, 300W
Data Transfer:	Ethernet,1Gbit

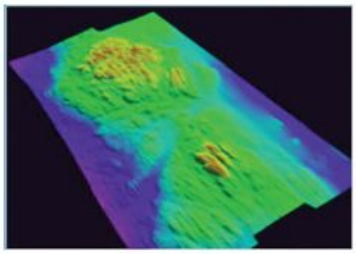
MECHANICAL

Weight:	200kHz	400kHz
Receive Array:	9.6 kg (dry), 4.6 kg (wet)	9.6 kg (dry), 4.6 kg (wet)
Transmit Array:	7.5 kg (dry), 6.4kg (wet)	2.75 kg (dry), 1.75 kg (wet)
7-L LCU:	15.7 kg (dry), 5.2 kg (wet) 7-P	15.7 kg (dry), 5.2 kg (wet) 7-P
Processor:	30 kg	30 kg
Dimensions:		
Receive Array:	102 x 496 x 131 mm	102 x 496 x 131 mm
Transmit Array:	100 x 259 x 117 mm	62 x 285 mm
Link Control Unit:	530.9 x 174 mm	530.9 x 174 mm
7-P Processor:	431 x 146 mm	431 x 146 mm
Temperature:	Operating: 0° to +40° C	Operating: 0° to +40° C
	Storage: -30° to +55° C	Storage: -30° to +55° C

OPTIONS

Dual Frequency
Mounting Bracket with Fairing
10m Array to LCU Cable Set
SVP-70 Sound Velocity Profiler with 25m Cable
Extended Warranty / Support & Maintenance Contracts
Fiber-Optic Conversion for ROV Installations
Full Calibration (calibrated backscatter) & Element Data Recording (includes 1 TB external RAID array)
System Integration & Training





Unless otherwise specified, beams are measured unsteered, at centre frequency and at a sound velocity of 1480m/sec

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Version: B066 080824 / US

TETRA TECH, INC.

ROBUST POSITION AND ORIENTATION SOLUTIONS FOR MARINE MAPPING

Applanix Position and Orientation Systems for Marine Vessels (POS MV) are engineered to support water science data collection operations, particularly those where accurate, uninterrupted, and robust solutions are needed for direct georeferencing and mapping. Professionals involved in surf zone and coastal area mapping, harbor lane surveys, environmental assessments, channel inspection and dredging assessment, offshore resource exploration, erosion mapping, maritime and coastal waterway infrastructure inventory mapping depend on POS MV solutions.

Employing state-of-the-art high precision gyros which are tightly coupled to supporting GPS, the POS MV provides continuous and accurate position and orientation data logging for vessel and sensor guidance. Reliable POS MV output is produced in severe sea conditions, during periods of blocked or intermittent GPS, in areas where GPS reception is compromised by multipath effects, or at times when position drift must be reduced and faster signal reacquisition is essential.

POS MV delivers a full six degree-of-freedom position and orientation solution measuring location, velocity, attitude, and heave plus acceleration and angular rate vectors. Applanix marine solutions are able to affix position and orientation data accurately under the most demanding conditions, regardless of vessel dynamics, 200 times each second, making direct georeferencing and motion compensation for maritime remote sensing operations a productive and practical option.

PERFORMANCE SUMMARY - POS MV Accuracy

POS MV 320	DGPS	RTK	GPS Outage
Position	0.5 - 2 m[1]	0.02 - 0.10 m[1]	<2.5 m for 30 s outages, <6 m for 60 s outages
Roll & Pitch	0.020°	0.010°	0.020°
True Heading	0.020° with 2 m baseline 0.010° with 4 m baseline	-	Drift less than 1° per hour (negligible for outages <60 s)
Heave	5 cm or 5%[2]	5 cm or 5%[2]	5 cm or 5%[2]

POS MV WaveMaster	DGPS	RTK	GPS Outage
Position	0.5 - 2 m[1]	0.02 - 0.10 m[1]	<3 m for 30 s outages, <10 m for 60 s outages
Roll & Pitch	0.030°	0.020°	0.040°
True Heading	0.030° with 2 m baseline	-	Drift less than 2° per hour
Heave	5 cm or 5%[2]	5 cm or 5%[2]	5 cm or 5%[2]

POS MV Elite	DGPS	RTK	GPS Outage
Position	0.5 - 2 m[1]	0.02 - 0.10 m[1]	<1.5 m for 60 s outages DGPS, <0.5 m for 60 s outage RTK
Roll & Pitch	0.005°	0.005°	0.005°
True Heading	0.025°	0.025°	Drift less than 0.1° per hour (negligible for outages <60 s)
Heave	3.5 cm or 3.5%[2]	3.5 cm or 3.5%[2]	3.5 cm or 3.5%[2]

[1] One Sigma, depending on quality of differential corrections
[2] Whichever is greater, for periods of 20 seconds or less

Leica GPS1200
Technical specifications and system features

GPS1200 receivers	GX1230 GG/ATX1230 GG	GX1230/ATX1230	GX1220	GX1210
GNSS technology	SmartTrack+	SmartTrack	SmartTrack	SmartTrack
Type	Dual frequency	Dual frequency	Dual frequency	Single frequency
Channels	14 L1 + 14 L2 GPS 2 SBAS 12 L1 + 12 L2 GLONASS 72 Channels	12 L1 + 12 L2 GPS 2 SBAS	12 L1 + 12 L2 GPS 2 SBAS (with DGPS option)	12 L1 2 SBAS (with DGPS option)
RTK	SmartCheck+	SmartCheck	No	No
Status indicators	3 LED indicators: for power, tracking, memory			

GPS1200 receivers	GX1230 GG/GX1230/GX1220	GX1210	ATX1230 GG/ATX1230
Ports	1 power port, 3 serial ports, 1 controller port, 1 antenna port		1 power/controller port, Bluetooth® port
Supply voltage,	Nominal 12 VDC		Nominal 12 VDC
Consumption	4.6 W receiver + controller + antenna		1.8 W
Event input and PPS	Optional:	Optional:	
	1 PPS output port	1 PPS output port	
	2 event input ports	2 event input ports	
Standard antenna	SmartTrack+ AX1202 GG	SmartTrack AX1201	SmartTrack+ ATX1230 GG
Built-in groundplane	Built-in groundplane	Built-in groundplane	Built-in groundplane

The following apply to all receivers except where stated.

Power supply	Two Li-Ion 3.8 Ah/7.2 V plug into receiver. One Li-Ion 1.9 Ah/7.2 V plugs into ATX1230 and RX1250.
Plug-in Li-Ion batteries Same for GPS and TPS	Power receiver + controller + SmartTrack antenna for about 15 hours (for data logging).
	Power receiver + controller + SmartTrack antenna + low power radio modem or phone for about 10 hours (for RTK/DGPS). Power SmartAntenna + RX1250 controller for about 5 hours (for RTK/DGPS)
External power	External power input 10.5 V to 28 V.
Weights	Receiver 1.20 kg. Controller 0.48 kg (RX1210) and 0.75 kg (RX1250). SmartTrack antenna 0.44 kg. SmartAntenna 1.12 kg. Plug-in Li-Ion battery 0.09 kg (1.9 Ah) and 0.19 kg (1.9 Ah).
	Carbon fiber pole with SmartTrack antenna and RX1210 controller: 1.80 kg.
	All on pole: carbon fiber pole with SmartAntenna, RX1250 controller and plug-in batteries: 2.84 kg.

Temperature	Operation:	Receiver	−40° C to +65° C
ISO9022	Antennas		−40° C to +70° C
MIL-STD-810F	Controllers		−30° C to +65° C
	Storage:	Receiver	−40° C to +80° C
	Antennas		−55° C to +85° C
	Controllers		−40° C to +80° C
Humidity ISO9022, MIL-STD-810F	Receiver, antennas and controllers Up to 100 % humidity.		
Protection against water, dust and sand IP67, MIL-STD-810F	Receiver, antennas and controllers: Waterpoof to 1 m temporary submersion. Dust tight		
Shock/drop onto hard surface	Receiver: withstands 1 m drop onto hard surface. Antennas: withstand 1.5 m drop onto hard surface.		
Topple over on pole	Receiver, antennas and controllers: withstand fall if pole topples over.		
Vibrations ISO9022 MIL-STD-810F	Receiver, antennas and controllers: withstand vibrations on large construction machines. No loss of lock.		

MicroCAT C-T Recorder (Serial interface & Memory)

SBE 37-SM

The SBE 37-SM MicroCAT is a high-accuracy conductivity and temperature (pressure optional) recorder with internal battery and memory. Designed for moorings or other long duration, fixed-site deployments, the MicroCAT includes a standard serial interface and non-volatile FLASH memory. Construction is of titanium and other non-corroding materials to ensure long life with minimum maintenance, and depth capability is 7000 meters (23,000 feet).

Calibration coefficients are stored in EEPROM, and uploaded data is presented in ASCII engineering units. The data always includes Conductivity, Temperature, and Pressure (if optional pressure sensor is installed). If desired, time can be added to each scan, and the MicroCAT can calculate and output salinity and sound velocity (Chen-Millero). The MicroCAT retains the temperature and conductivity sensors used in our time-proven SEACAT products; however, new acquisition techniques provide increased accuracy and resolution while reducing power consumption. Electrical isolation of the conductivity electronics eliminates any possibility of ground-loop noise.

The MicroCAT's unique internal-field conductivity cell permits the use of expendable anti-foulant devices. The aged and pressure-protected thermistor has a long history of exceptional accuracy and stability.

The MicroCAT's optional pressure sensor, developed by Druck, Inc., has a superior new design that is entirely different from conventional 'silicon' types in which the deflection of a metallic diaphragm is detected by epoxy-bonded silicon strain gauges. The Druck sensor employs a micro-machined *silicon diaphragm* into which the strain elements are implanted using semiconductor fabrication techniques. Unlike metal diaphragms, silicon's crystal structure is perfectly elastic, so the sensor is essentially free of pressure hysteresis. Compensation of the temperature influence on pressure offset and scale is performed by the MicroCAT's CPU.

SENSOR INTERFACE ELECTRONICS

Temperature is acquired by applying an AC excitation to a hermetically-sealed VISHAY reference resistor and an ultra-stable aged thermistor (drift rate typically less than 0.002 °C per year). The ratio of thermistor resistance to reference resistance is determined by a 24-bit A/D converter; this A/D also processes the pressure sensor signal. Conductivity is acquired using an ultra-precision Wien-Bridge oscillator. A high-stability reference crystal with a drift rate of less than 2 ppm/year is used to count the frequency from the oscillator.

COMMUNICATIONS AND INTERFACING

The MicroCAT communicates directly with a computer via standard RS-232 interface. Data can be uploaded at up to 38.4K baud. Real-time data can be transmitted at distances of up to 1600 meters (5200 feet) at 600 baud, simultaneously with recording. An optional RS-485 interface allows multiple MicroCATs to share a common 2-wire cable, minimizing cable complexity for C-T chains.

User-selectable operating modes include:

- **Autonomous Sampling** – At pre-programmed intervals of 5 seconds to 9.1 hours, the MicroCAT wakes up, samples, stores the data in its FLASH memory, and goes to sleep.
- **Polled Sampling** – On command from a computer or satellite, radio, or wire telemetry equipment, the MicroCAT takes a sample and transmits the data.
- **Serial Line Sync** – In response to a pulse on the serial line, the MicroCAT wakes up, samples, stores the data in its FLASH memory, transmits real-time data, and goes to sleep.

SOFTWARE

The MicroCAT is supplied with a powerful Windows 95/98/NT/2000/XP software package, SEASOFT®-Win32, which includes:

- SEATERM® – terminal program for easy communication and data retrieval.
- SBE Data Processing® – programs for calculation, display, and plotting of conductivity, temperature, pressure (optional), and derived variables such as salinity and sound velocity.

SBE **Sea-Bird Electronics, Inc.**
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com
E-mail: seabird@seabird.com
Telephone: (425) 643-9866
Fax: (425) 643-9954

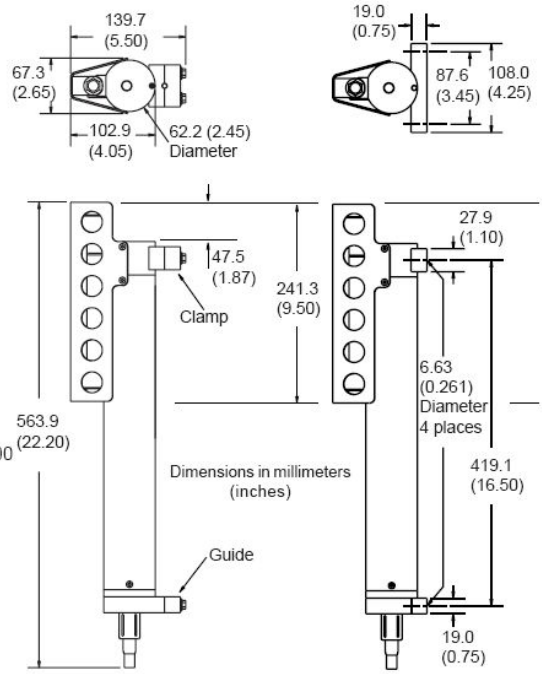
MicroCAT C-T Recorder (Serial interface and Memory) SBE 37-SM

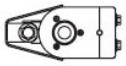
DATA STORAGE AND BATTERY ENDURANCE

Converted temperature and conductivity are stored 5 bytes per sample, time 4 bytes per sample, and optional pressure 2 bytes per sample; memory capacity is in excess of 185,000 samples. The MicroCAT is powered by a 7.2 Ampere-Hour (nominal) battery pack consisting of six 9-volt lithium batteries which, when removed from the MicroCAT, can be shipped without hazardous material restrictions. The pack provides sufficient internal battery capacity for more than 300,000 samples. *

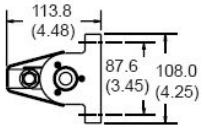
SPECIFICATIONS

Measurement Range	
Conductivity:	0 - 7 S/m (0 - 70 mS/cm)
Temperature:	-5 to 35 °C
Optional Pressure:	20/100/350/600/1000/2000/3500/7000 (meters of deployment depth capability)
Initial Accuracy	
Conductivity:	0.0003 S/m (0.003 mS/cm)
Temperature:	0.002 °C
Optional Pressure:	0.1% of full scale range
Typical Stability *(per month)*	
Conductivity:	0.0003 S/m (0.003 mS/cm)
Temperature:	0.0002 °C
Optional Pressure:	0.004% of full scale range
Resolution	
Conductivity:	0.00001 S/m (0.0001 mS/cm)
Temperature:	0.0001 °C
Optional Pressure:	0.002% of full scale range
Time Resolution	1 second
Clock Accuracy	13 seconds/month
Quiescent Current *	10 microamps
Sampling and Communication Current *	
Without external power option	
Communication	38 milliamps
Sampling	20 milliamps for autonomous or serial line sync sampling; 39 milliamps for polled sampling
With external power option	
Communication	35 milliamps
Sampling	35 milliamps
Acquisition Time	1 - 3 seconds/sample (for 1 measurement/sample), *dependent on sampling mode and inclusion of pressure sensor*
Optional External Input Power	0.5 Amps at 9-24 VDC
Housing	Titanium
Depth Capability	7000 m (23,000 feet)
Weight	
in air:	3.8 kg (8.3 lbs)
in water:	2.3 kg (5.1 lbs)

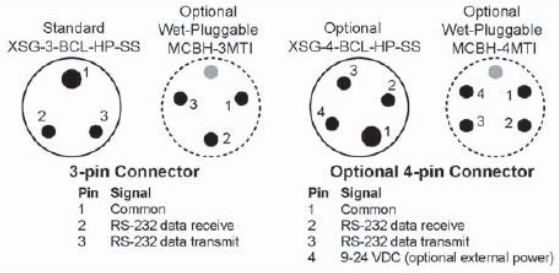




Standard Wire Mounting Clamp and Guide



Alternate Flat Surface Mounting Brackets



3-pin Connector

Pin	Signal
1	Common
2	RS-232 data receive
3	RS-232 data transmit

Optional 4-pin Connector

Pin	Signal
1	Common
2	RS-232 data receive
3	RS-232 data transmit
4	9-24 VDC (optional external power)

* Power consumption / battery endurance values are for standard RS-232 interface; for optional RS-485 interface, see RS-485 manual

05/05

Sea-Bird Electronics, Inc.
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com
E-mail: seabird@seabird.com
Telephone: (425) 643-9866
Fax: (425) 643-9954

Appendix D. Survey Log Sheets

Tetra Tech EC, Inc. Survey Log Sheet

Date: 12/10/08 Julian Date: 344 Reach / Area: A To: A Survey Name: NS_121008_A-A_MB1

Survey Vessel: R/V Storm Surveyor(s): B. Bridge B. Johnston Time Zone: UTC

Survey Type: Multibeam Captain: L. Schwartz

Client: E & E Northlake Shipyard

Device Information

	POS MV WaveMaster	Trimble AG 132	SeaBat 7125	SeaBat 7125	Leica RTK GPS
Starboard:	0.00	0.02	1.06	-1.09	-0.05
Forward:	0.00	0.12	14.02	14.00	14.09
Vertical:	0.00	-8.28	0.48	0.55	-5.95
Yaw:			3.00	2.00	
Pitch:			-1.75	-0.50	
Roll:			-32.15	27.70	
Latency:					

SVP File:
Patch Test Date: 12/09/08
Tide File:
Freeboard

Start Time	Stop Time	Raw File Name	Line Type	Survey Direction	Survey Speed	Comments
18:51:32	18:53:29	003_1851				Water Level Check
						False Start no matrix redo
20:05:21	20:09:45	011_2005	Standard	Southeast	2.8	
20:10:53		0011_2010	Starboard Shore	Northwest		Shoreline
20:24:39	20:30:12	002_2024	Standard	Northeast	2.6	Shoreline
20:32:16		010_2032	Starboard Shore	Northwest	2.5	Shoreline
20:35:58		011_2035	Starboard Shore		1	backing at start
20:51:23	20:53:39		Starboard Shore		1	backing at start lots of bubbles
20:53:40		002_2053	Starboard Shore	Northwest	1.5	
20:59:12	21:11:35	003_2059	Starboard Shore	Northeast	1.8	double up coverage start PosPac
21:17:22	21:21:10	010_2117	Standard	Southeast	3	
21:22:16	21:26:05	009_2122	Standard	Northwest	2.9	
21:27:06	21:30:44	008_2127	Standard	Southeast	3.3	
21:32:53	21:36:33	007_2132	Standard	Northwest	3.1	
21:37:18	21:41:00	006_2137	Standard	Southeast	3.2	boat wake @ 21:40
21:41:35	21:45:30	005_2141	Standard	Northwest	3.2	
21:46:20		004_2146	Standard	Southeast	3.2	
21:52:11	21:56:00	003_2152	Standard	Northwest	3.2	
21:56:53	22:00:00	002_2156	Standard	Southeast	3.5	
22:01:40			Standard	Northwest	3.5	Hypack crash restart
22:03:09		001_2203	Standard	Northwest	3	
22:11:13	22:15:00	011_2211	Cross	Southwest	3	
22:17:23			Cross	Northeast	3	stop line to pick up Ecology Ride-A-Long John Keeling
22:28:39	22:32:00	009_2228	Cross	Southwest	3.2	
22:35:34	22:40:00	008_2235	Standard	Northeast	2	Fill in
22:40:45	22:42:00	007_2240	Standard			Fill in
22:46:02	22:50:00	006_2245	Standard	Northeast	2	Fill in
22:52:42	22:55:00	005_2252	Standard	Southewest	1	Fill in
23:14:41		004_2314	Standard			Fill in
23:27:00	23:30:00	003_2326	Standard	Northeast	3	Fill in
23:32:49	23:36:00	002_2332	Standard			Fill in

Survey Manager: Signature:

Appendix E. Base Station Benchmark Description

```
DATABASE = Sybase ,PROGRAM = datasheet, VERSION = 7.41
1        National Geodetic Survey,   Retrieval Date = SEPTEMBER 24, 2006
 SY4165 ***********************************************************************
 SY4165  DESIGNATION -  SAG
 SY4165  PID         -  SY4165
 SY4165  STATE/COUNTY-  WA/KING
 SY4165  USGS QUAD   -
 SY4165
 SY4165                          *CURRENT SURVEY CONTROL
 SY4165 ______________________________________________________________________
 SY4165* NAD 83(1991)-  47 38 40.09478(N)     122 20 08.91982(W)     ADJUSTED
 SY4165* NAVD 88     -          5.7     (meters)       19.     (feet)  VERTCON
 SY4165 ______________________________________________________________________
 SY4165  LAPLACE CORR-           -2.28  (seconds)                     DEFLEC99
 SY4165  GEOID HEIGHT-          -23.74  (meters)                      GEOID03
 SY4165
 SY4165  HORZ ORDER  -  THIRD
 SY4165
 SY4165.The horizontal coordinates were established by classical geodetic methods
 SY4165.and adjusted by the National Geodetic Survey in December 1991..
 SY4165
 SY4165.The NAVD 88 height was computed by applying the VERTCON shift value to
 SY4165.the NGVD 29 height (displayed under SUPERSEDED SURVEY CONTROL.)
 SY4165
 SY4165.The Laplace correction was computed from DEFLEC99 derived deflections.
 SY4165
 SY4165.The geoid height was determined by GEOID03.
 SY4165
 SY4165;                      North          East      Units Scale Factor Converg.
 SY4165;SPC WA N      -    72,755.458   387,118.736   MT  0.99997619   -1 07 07.1
 SY4165;SPC WA N      -   238,698.53  1,270,072.05   sFT  0.99997619   -1 07 07.1
 SY4165;UTM  10       - 5,276,999.529   549,884.860   MT  0.99963058   +0 29 27.0
 SY4165
 SY4165!              -  Elev Factor  x  Scale Factor =   Combined Factor
 SY4165!SPC WA N      -   1.00000283  x   0.99997619  =   0.99997902
 SY4165!UTM  10       -   1.00000283  x   0.99963058  =   0.99963341
 SY4165
 SY4165|-----------------------------------------------------------------------|
 SY4165| PID    Reference Object                     Distance      Geod. Az  |
 SY4165|                                                           dddmmss.s |
 SY4165| SY4164 SG 1 TEMP                            84.963 METERS 07200     |
 SY4165| SY3992 LYNN                                APPROX. 1.0 KM 2351310.8 |
 SY4165|-----------------------------------------------------------------------|
 SY4165
 SY4165                           SUPERSEDED SURVEY CONTROL
 SY4165
 SY4165  NAD 83(1986)-  47 38 40.08831(N)     122 20 08.92502(W) AD(       ) 3
 SY4165  NAD 27      -  47 38 40.73648(N)     122 20 04.47231(W) AD(       ) 3
 SY4165  NGVD 29 (07/19/86)    4.6     (m)           15.     (f) VERT ANG
 SY4165
 SY4165.Superseded values are not recommended for survey control.
 SY4165.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 SY4165.See file dsdata.txt to determine how the superseded data were derived.
 SY4165
 SY4165_U.S. NATIONAL GRID SPATIAL ADDRESS: 10TET4988577000(NAD 83)
 SY4165_MARKER: DD = SURVEY DISK
 SY4165_SETTING: 35 = SET IN A MAT FOUNDATION OR CONCRETE SLAB OTHER THAN
 SY4165+WITH SETTING: PAVEMENT
 SY4165_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
 SY4165+STABILITY: SURFACE MOTION
 SY4165
 SY4165  HISTORY     - Date     Condition        Report By
 SY4165  HISTORY     - 1977     MONUMENTED       NOS
 SY4165
 SY4165                           STATION DESCRIPTION
 SY4165
 SY4165'DESCRIBED BY NATIONAL OCEAN SERVICE 1977 (RBM)
```

```
SY4165'THE STATION IS LOCATED IN SEATTLE, ON THE NORTH SHORE OF
SY4165'LAKE UNION AND IN GAS WORKS PARK.
SY4165'
SY4165'THE STATION IS A NATIONAL OCEAN SURVEY DISK,
SY4165'STAMPED---SAG 1977---CEMENTED INTO A DRILL HOLE IN A SLAB
SY4165'OF CONCRETE, 38 FEET SOUTH OF THE SOUTH EDGE OF THE
SY4165'ASPHALT FOOTPATH AROUND THE PARK, 3.9 FEET NORTHEAST OF
SY4165'THE SOUTHWESTERNMOST CORNER OF THE CONCRETE BULKHEAD
SY4165'THAT PROTECTS THE SOUTH SHORE OF THE PARK, 2.0 FEET
SY4165'NORTHWEST OF AN OLD 3-FOOT HIGH CONCRETE FOUNDATION
SY4165'AND ABOUT 2 FEET HIGHER THAN THE NORMAL LEVEL OF THE LAKE.
SY4165'
SY4165'HEIGHT OF THE SIGNAL WAS 1.5 METERS.

*** retrieval complete.
Elapsed Time = 00:00:01
```

Washington State Department of Transportation **Geographic Services**

SURVEY INFORMATION SYSTEM **Report of Survey Mark**

GENERAL MONUMENT INFORMATION

Designation:	BRIAN CARY	**T.R.S:**	25N, 4E , 19	**ACCOUNTS INFORMATION**
Monument ID:	3967	**Corner Code:**		**BOOK** 182 **PROJECT** 0L3734 **INVOICE** 23-99039
State:	WASHINGTON	**State Route:**		
County:	KING	**Mile Post:**		
Region:	NW	**Station:**		
Nearest Town:	SEATTLE	**Offset:**		
Usgs Quad:	SEATTLE NORTH	**Owner:**	GS	
		Bearing:	M	

Description

TO REACH THE STATION FROM THE JUNCTION OF SR 520 AND SR 005 IN SEATTLE, GO NORTHERLY 0.89 MILES ALONG SR 005 TO THE N.E. 50TH STREET EXIT (NUMBER 169). TAKE THE EXIT AND GO NORTHERLY 0.62 MILES ALONG THE RAMP TO THE INTERSECTION WITH N.E. 50TH STREET, TURN LEFT AND GO WESTERLY 1.00 MILE ALONG N.E. 50TH STREET TO THE INTERSECTION WITH STONE WAY N. TURN LEFT AND GO SOUTHERLY 1.15 MILES ALONG STONE WAY N. TO THE INTERSECTION WITH N. NORTHLAKE WAY, TURN LEFT AND GO EASTERLY 0.40 MILES ALONG N. NORTHLAKE WAY TO THE EASTERLY ONE OF TWO ENTRANCES TO GAS WORKS PARK, TURN RIGHT AND GO SOUTHERLY 90.0 METERS THROUGH THE PARKING LOT TO A DRIVEWAY ENTERING THE PARK,

CONTINUE SOUTHERLY 0.15 MILES ALONG THE DRIVEWAY TO THE NORTH SHORE OF LAKE UNION AND THE MARK. IT IS LOCATED IN THE WESTERLY CONCRETE CURB AROUND A BRICK PAVED OVERLOOK AND IS SOUTH OF THE OLD GAS WORKS MACHINERY, 7.5 METERS @ 160 DEGREES FROM THE NORTHWEST CORNER OF A RED BRICK SCENIC OVERLOOK, 26.2 METERS @ 240 DEGREES FROM THE NORTHERN MOST LAMP-POST ON THE EAST END OF A SCENIC OVERLOOK AND 3.1 METERS @ 335 DEGREES FROM THE NORTH END OF THE WESTERLY HANDRAIL. THE MARK IS A WSDOT BRASS DISK CEMENTED INTO A DRILL HOLE AND SET 2 CM BELOW THE CONCRETE SURFACE.

CURRENT SURVEY CONTROL

DATUM	LATITUDE	UNIT	LONGTITUDE	UNIT	NETWORK	METHOD
NAD 83/91	47 38 40.521979	N	122 20 04.746738	W	PRIMARY	GPS

	ELLIP HGT					
NAD 83	-12.809	M				GPS

SPC ZONE	NORTHING	UNIT	EASTING	UNIT	SCALE	CONV.ANGLE
N	72766.949	M	387206.072	M	0.99997617	-1 07 03.9

MONUMENTATION HISTORY

DATE	RECOVERED BY	CONDITION
06/23/1999	GEOGRAPHIC SERVICES	MONUMENTED

Control Point Detail

Print Close

Survey Control Database - Point ID: **1293**

Identification

Point Name (Designation): **2609CC 58A**
Point Alias (Designation Alias): **7575**
PLSS Corner: **No** Horizontal Control: **No**
Geocode:
BLM Corner Code:
Vertical Control: **Yes**

Coordinates

Feet Unit Type: **U.S. Survey Foot**
Latitude:
Longitude:
NORTHING (ft): **239962.000**
EASTING (ft): **1270593.000**
ORTHO (ft): **60.344**
ELLIP (ft): **0.000**
GEOID (ft): **0.000**
Scale Factor (not CGF): **0.000000000000**
Convergence:
Combined Grid (CGF): **0.000000000000**
NORTHING (m): **73140.564**
EASTING (m): **387277.521**
ORTHO (m): **18.393**
ELLIP (m): **0.000**
GEOID (m): **0.000**

Origin

County/Municipality: **City of Seattle**
State: **WA**

Geodesy

H. Netw. Relationship: **L**
Horizontal Datum: **91**
Coord System Zone: **4601**
Horizontal Accuracy: **<=50.000m / 164.042ft.**
Horizontal Method: **Computerized Map Scaling**
Horizontal Calc By: **City of Seattle**
Horizontal Calc Date: **14-Jan-03**
V. Netw. Relationship: **L**
Vertical Datum: **88**
Vertical Accuracy: **<=0.010m / 0.033ft.**
Vertical Method: **Digital Level**
Vertical Calc By: **City of Seattle**
Vertical Calc Date: **15-May-02**
Geoid Method: **N/A**

PLSS

Meridian: **Willamette**
Section/Township/Range
Primary: **S18T25NR04E**
Alternate 1:
Alternate 2:
Alternate 3:

Reference Document

Survey / Project #: **UNK**
Field Book #: **2609 CC**
Page #: **58**
Image File Ref: **N/A**
Document File Ref: **N/A**

Reference

Monument Type: **Vertical Control Station**
Monument Condition: **Set**
Monument Set By: **City of Seattle**
Monument Date Set: **15-Apr-02**
PLS ID: **18081**
Visit By: **City of Seattle**
Visit Date:
Cased Monument: **No**

Monument Description: Brass cap stamped "C of S" "7575"

Site Description: 1ft north of intx bkcw's at SE corner N 34th St & Meridian Ave N

Drive-to Description: N 34th St & Meridian Ave N
Cross References:
Field Ties:
Comments:

Custodian

Organization: **Seattle Public Utilities**
E-Mail: **russ.dodge@ci.seattle.wa.us**

Control Point Detail

Print Close

Survey Control Database - Point ID: 695

Identification

Point Name (Designation): 93V-445
Point Alias (Designation Alias): 445
PLSS Corner: No Horizontal Control: No
Geocode:
BLM Corner Code:
Vertical Control: Yes

Coordinates

Feet Unit Type:	U.S. Survey Foot	Scale Factor (not CGF):	0.000000000000
Latitude:	47 38 49.03	Convergence:	
Longitude:	122 20 02.13	Combined Grid (CGF):	0.000000000000
NORTHING (ft):	239594.402	NORTHING (m):	73028.520
EASTING (ft):	1270554.345	EASTING (m):	387265.739
ORTHO (ft):	35.970	ORTHO (m):	10.964
ELLIP (ft):	0.000	ELLIP (m):	0.000
GEOID (ft):	0.000	GEOID (m):	0.000

Origin

County/Municipality: City of Seattle
State: WA

Geodesy

H. Netw. Relationship:	L	V. Netw. Relationship:	L
Horizontal Datum:	91	Vertical Datum:	88
Coord System Zone:	4601	Vertical Accuracy:	<=0.005m / 0.016ft.
Horizontal Accuracy:	<=50.000m / 164.042ft.	Vertical Method:	Digital Level
Horizontal Method:	Scaled	Vertical Calc By:	Parametrix Inc.
Horizontal Calc By:	Parametrix Inc.	Vertical Calc Date:	27-May-94
Horizontal Calc Date:	01-Sep-94	Geoid Method:	N/A

PLSS

Meridian: Willamette
Section/Township/Range
Primary: S17T25NR04E
Alternate 1:
Alternate 2:
Alternate 3:

Reference Document

Survey / Project #: 93AC-V
Field Book #:
Page #:
Image File Ref: N/A
Document File Ref: N/A

Reference

Monument Type: Unknown
Monument Condition: Existing or Recovered
Monument Set By: Unknown
Monument Date Set:
PLS ID: 999999
Visit By: Parametrix Inc.
Visit Date:
Cased Monument: No

Monument Description: NOT IN REPORT

Site Description: NOT IN REPORT

Drive-to Description:
Cross References:
Field Ties:
Comments: The 93/94 Aerial Control Project, aka JAMP, established vertical control neccesary for the City of Seattle's Base Mapping Poroject which extended southerly from the King-Snohomish line between Lake Washington and the Puget Sound to S. 176th Street.The vertical datum is NAVD88 contrained to NGS first order benchmarks. A third order control network was performed in the project area constraining 42 NGS points to include over 400 new points. The work was done by parametrix Inc. as a subconsultant to Walker and Assoc. in 1993 and 1994.

Custodian

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162

206.624. 9349 Phone
206.624. 2839 Fax
www.retec.com

MEMORANDUM

RETEC

TO: RETEC Project Files PSE10-18628
FROM: Nick Bacher
DATE: 4/26/05
CLIENT: PSE
TASK: PSE10-18628-235
RE: Installation of site staff gauge

Introduction

On November 18, 2005, RETEC installed a staff gauge on the southwest corner of the concrete prow at the southern end of Gas Works Park. The gauge is located in the vicinity of the existing SAG benchmark that is used for daily navigational checks during the field event.

Installation

The gauge is a Style A heavy 18 gage steel covered with a baked-on porcelain enamel finish to resist rust of discoloration. The markings are black on a white background and the gauge is graduated every foot, tenth of a foot, and 0.02 ft with total elevations. The Style A gauge comes in 3.33 ft sections and two sections were installed for a total gauge span of 0 to 6.66 ft. Two sections were used to adequately capture the seasonal lake level fluctuation.

The gauge was installed from a boat provided by Research Support Services using a hammer-drill to pre-drill holes for the concrete anchors. The gauge was secured after it had been vertically leveled using a water level. The top center of the gauge was marked with a black marker for subsequent surveying.

Surveying

Bush, Roed, and Hitchings, Inc. (BRH) of Seattle, WA was contracted to survey the staff gauge both horizontally and vertically. In addition, BRH was asked to survey the two uplands monuments (SAG and BRIAN CARY) that were used for daily navigational checks during the field event. The data was transmitted to RETEC on November 22, 2004 via email. The information in the email is presented in Table 1.

TABLE 1. Coordinates and Elevations

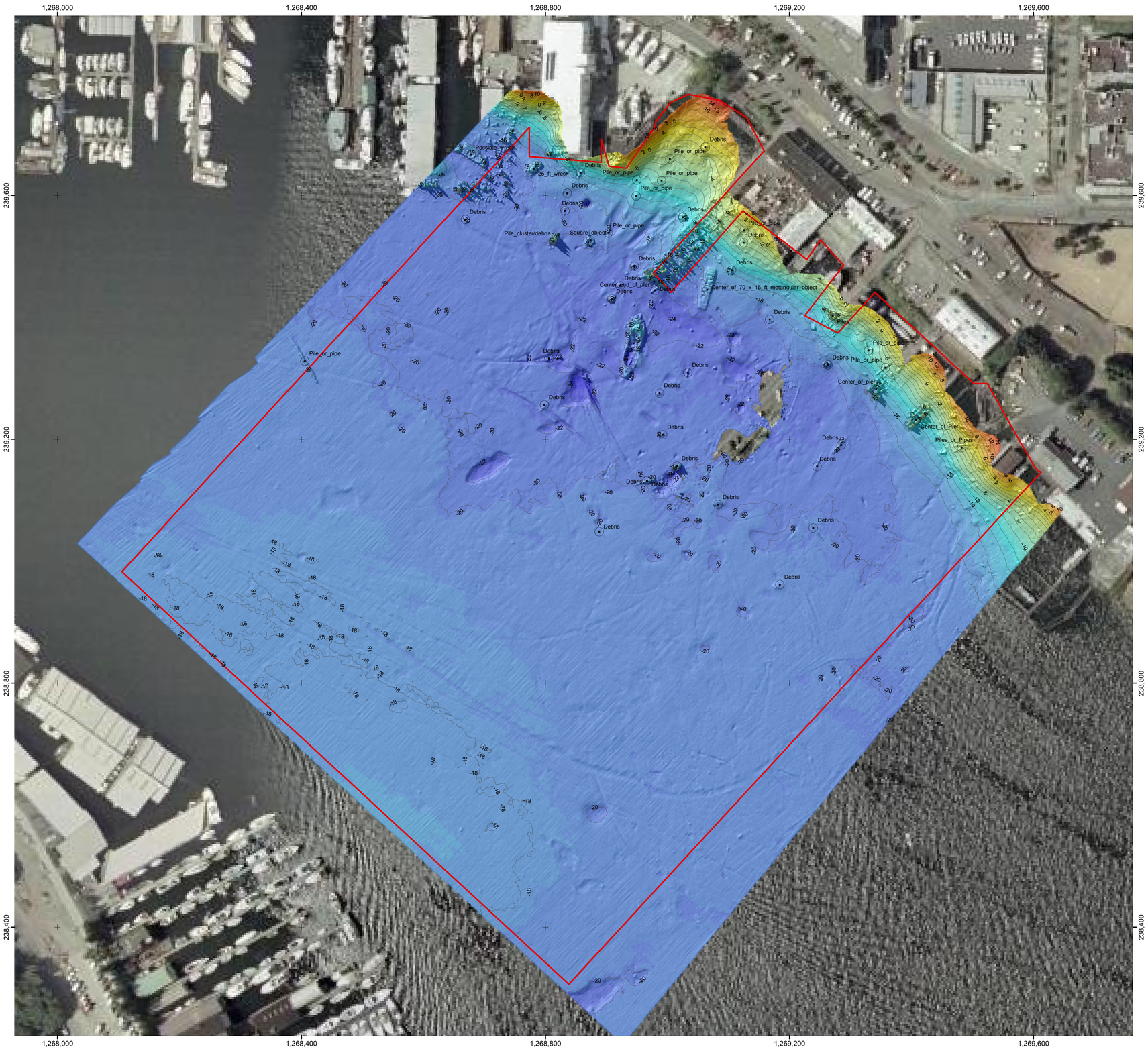
Description	Northing (NAD83/91)	Easting (NAD83/91)	Elevation (NAVD88)	Elevation (USACE)
Top of RETEC gauge	238,695.22	1,270,075.48	22.45	25.69
BRIAN CARY monument	238,736.2317	1,270,358.5892	35.1	38.34
SAG SY4165 monument	238,698.5309	1,270,072.0534	18.71	21.95

Note: City of Seattle benchmark Point Name 2609cc 58A (a brass cap stamped: CoS 7575) at the southeast corner of N 34th Street and Meridian Avenue N was used as a starting point to establish the locations of the staff gauge and the two uplands navigational control points.

A daily reading of the RETEC staff gauge was recorded in the field notebook during the field event for subsequent elevation control during data processing and mapping.

Northlake Shipyard Multibeam Bathymetry Survey
(Survey Report Appendix A)

December 2008

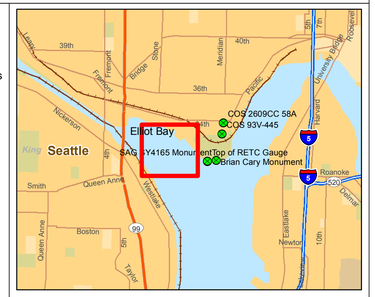


Elevations (US Feet)

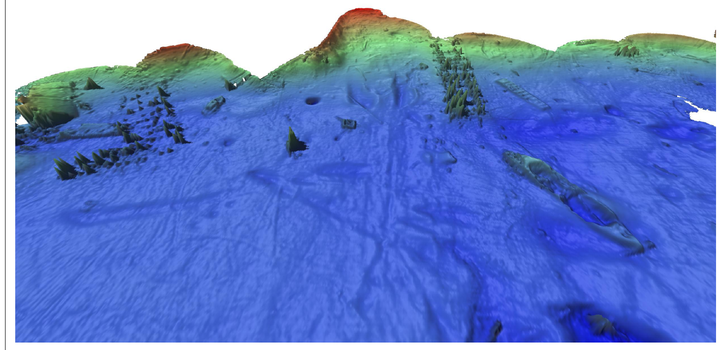
14.8 - 16.1	-6.4 - -5.2
13.5 - 14.7	-7.8 - -6.5
12.2 - 13.4	-9.1 - -7.9
10.8 - 12.1	-10.4 - -9.2
9.5 - 10.7	-11.7 - -10.5
8.2 - 9.4	-13.1 - -11.8
6.9 - 8.1	-14.4 - -13.2
5.5 - 6.8	-15.7 - -14.5
4.2 - 5.4	-17.1 - -15.8
2.9 - 4.1	-18.4 - -17.2
1.5 - 2.8	-19.7 - -18.5
0.2 - 1.4	-21 - -19.8
-1.1 - 0.1	-22.4 - -21.1
-2.4 - -1.2	-23.7 - -22.5
-3.8 - -2.5	-25 - -23.8
-5.1 - -3.9	-26.5 - -25.1

Legend

- Survey Control Points
- Bathymetry Target Picks
- Elevation Contours



Survey Map Extent



3D View of Northlake Shipyard Bathymetry

Notes:

1. Aerial photography from USGS.
2. GPS QC points
   WSDOT Monument 3967 - Brian Cary
   WCCS Point ID: 1293 Point Name: 2609CC 58A

N W E S

Scale 1:1,000

0 50 100 200 300 400 Feet

Geodetic Settings		Survey Equipment	
Datum	State Plane NAD-83	**Multibeam Sonar**	Dual RESON SeaBat 7125
Projection	WA-4601 Washington North	**Positioning System**	Applanix POS/MV (RTK enabled)
Horizontal Units	US Survey Feet	**Heading Sensor**	Applanix POS/MV
Vertical Units	US Survey Feet	**Motion Sensor**	Applanix POS/MV
Vertical Datum	USACE datum (NAVD88 + 3.24)	**Height Sensor**	Leica 1230 RTK GPS
Vertical Control	NOAA NGS SAG SY4165	**Sound Speed Profiler**	Seabird SBE-19 CTD
Horizontal Control	NOAA NGS SAG SY4165		

TetraTech EC, Inc.
19803 North Creek Pkwy.
Bothell, WA 98011
1 (425) 482-7600

TETRA TECH EC, INC.

Survey Engineer: Burton Bridge	Signature	Plate: 1
Drafted by: Burton Bridge	Signature	
Checked by: Robert Feldpausch	Signature	Sheet: 1 of 1
Approved by: Pamela Sargent	Signature	

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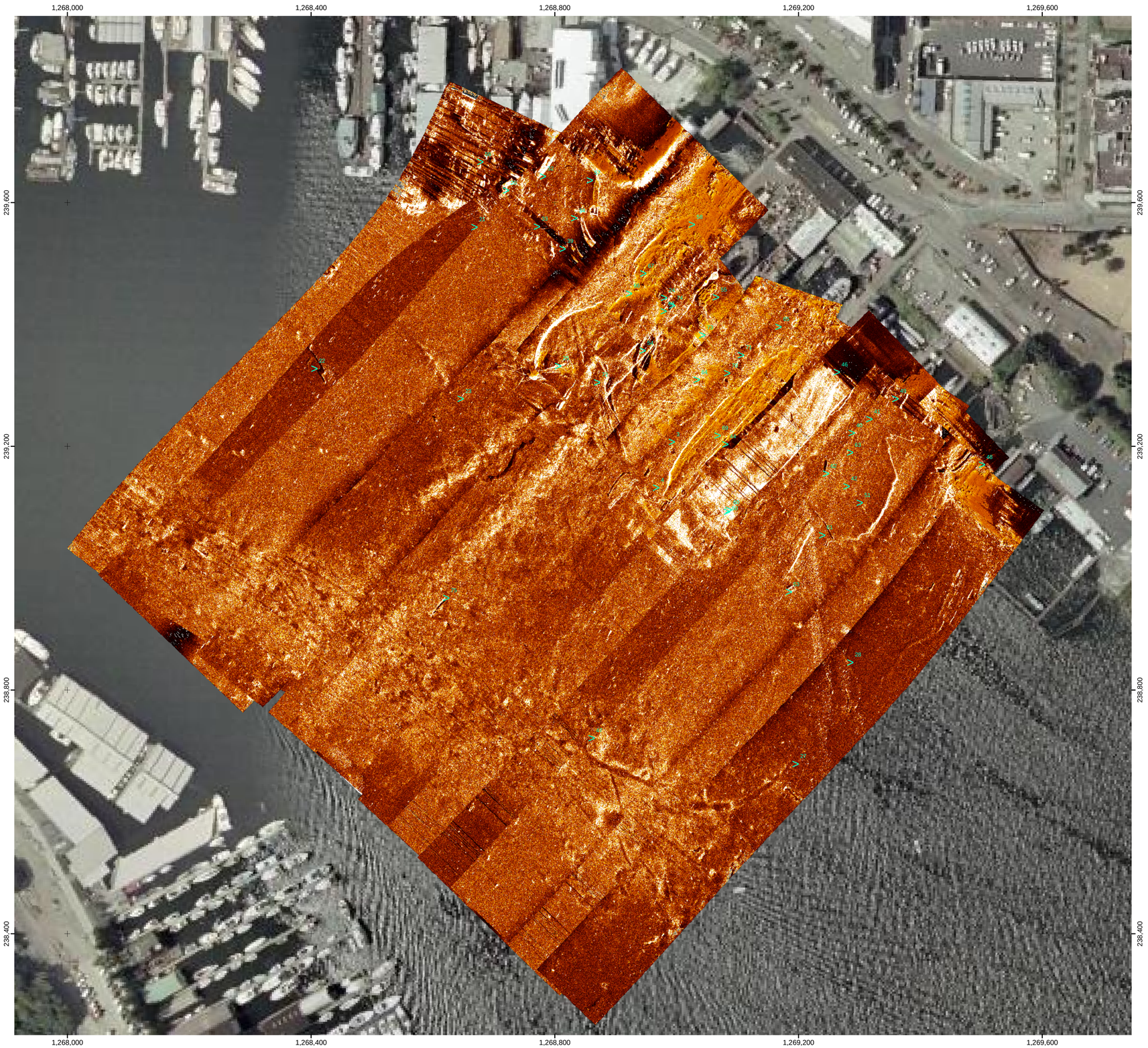
Northlake Shipyard Sidescan Imagery Survey
(Survey Report Appendix B)

December 2008



Legend

> Northlake Shipyard SS Targets

Survey Map Extent

Notes:

1. Aerial photography from USGS.
2. GPS QC points
   WSDOT Monument 3967 - Brian Cary
   WCCS Point ID: 1293 Point Name: 2609CC 58A

Scale 1:1,000

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Geodetic Settings		Survey Equipment	
Datum	State Plane NAD-83	**Sidescan Sonar**	GeoAcoustics SS941/159D
Projection	WA-4601 Washington North	**Positioning System**	Leica 1230 RTK GPS
Horizontal Units	US Survey Feet	**Heading Sensor**	Applanix POS/MV
Vertical Units	US Survey Feet	**Motion Sensor**	Applanix POS/MV
Vertical Datum	USACE datum (NAVD88 + 3.24)	**Secondary Positioning**	Applanix POS/MV (RTK Enabled)
Vertical Control	NOAA NGS SAG SY4165	**Sound Speed Profiler**	Seabird SBE-19 CTD
Horizontal Control	NOAA NGS SAG SY4165		

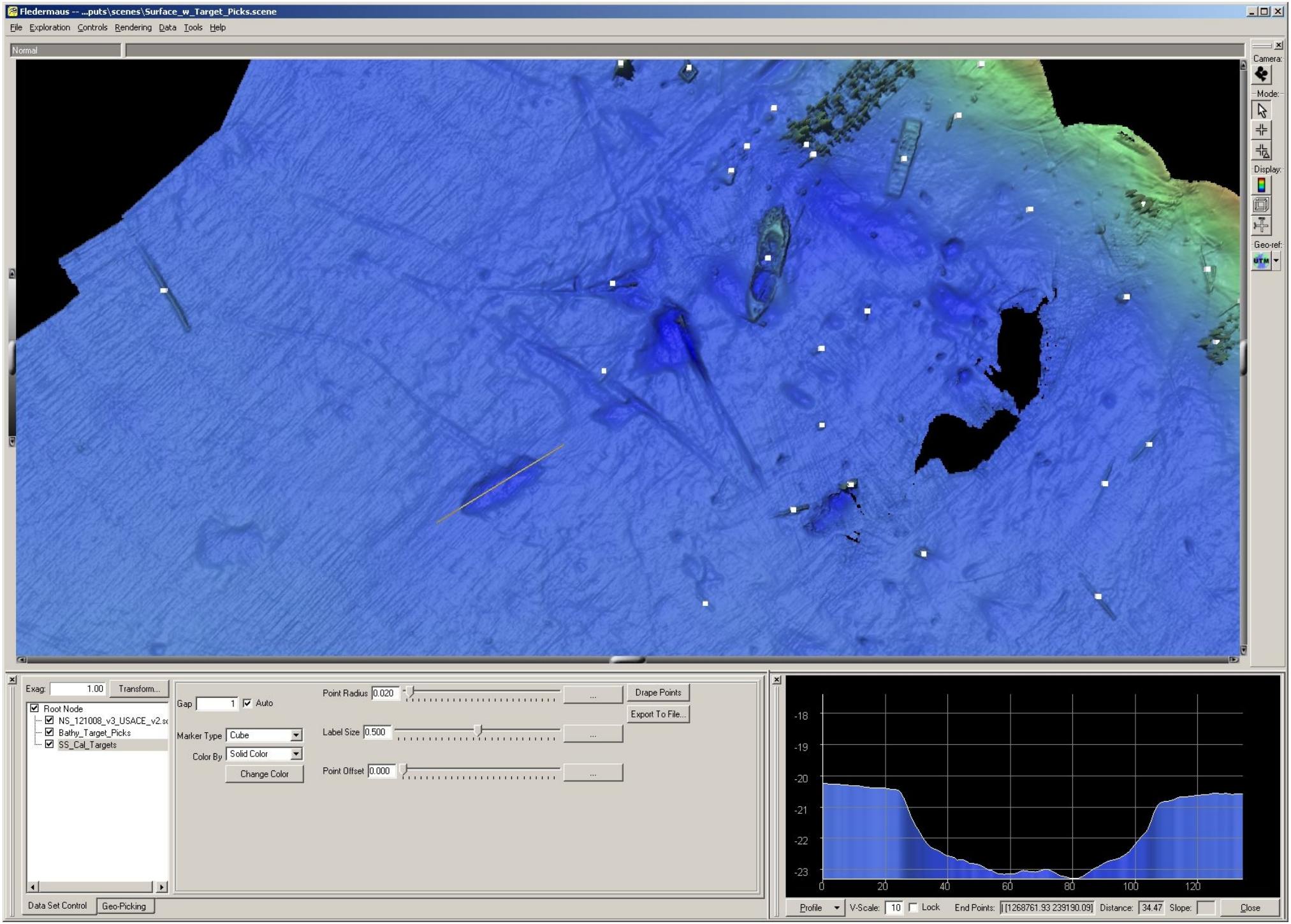
TetraTech EC, Inc.
19803 North Creek Pkwy.
Bothell, WA 98011
1 (425) 482-7600

TETRA TECH EC, INC.

Survey Engineer: Richard Funk	Signature	Plate: **1**
Drafted by: Burton Bridge	Signature	
Checked by: Robert Feldpausch	Signature	Sheet: **1 of 1**
Approved by: Pamela Sargent	Signature	

R:\projects_2008\E&E_Northlake_Shipyard\maps\E&E_Northlake_Shipyard_SS_v1d.mxd

Transect A1 – A1′



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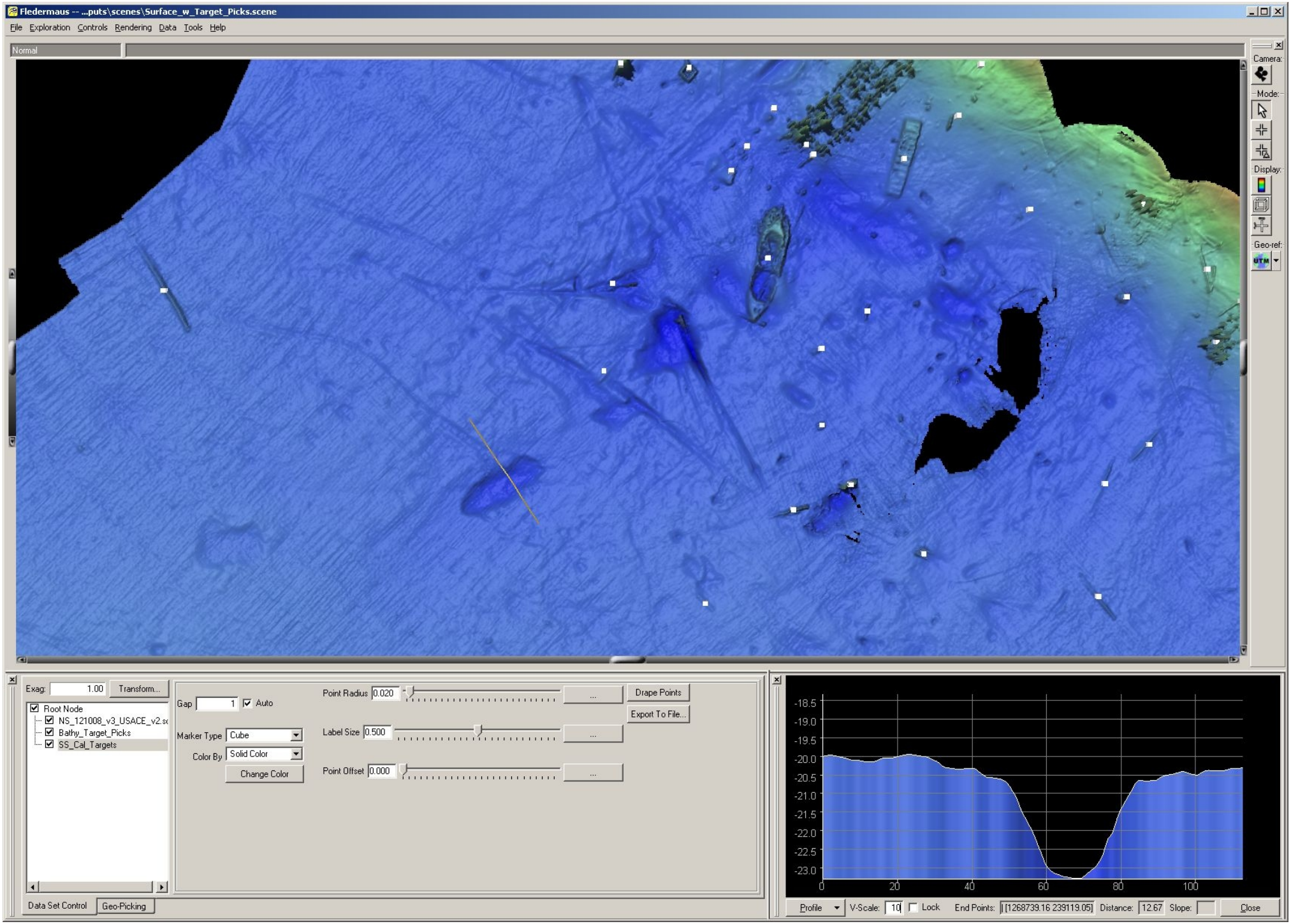
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Display:
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Bathy_Target_Picks
SS_Cal_Targets
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Marker Type Cube
Color By Solid Color
Change Color
Point Radius 0.020
Label Size 0.500
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Geo-Picking
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-23.0
0
20
40
60
80
100
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Slope:
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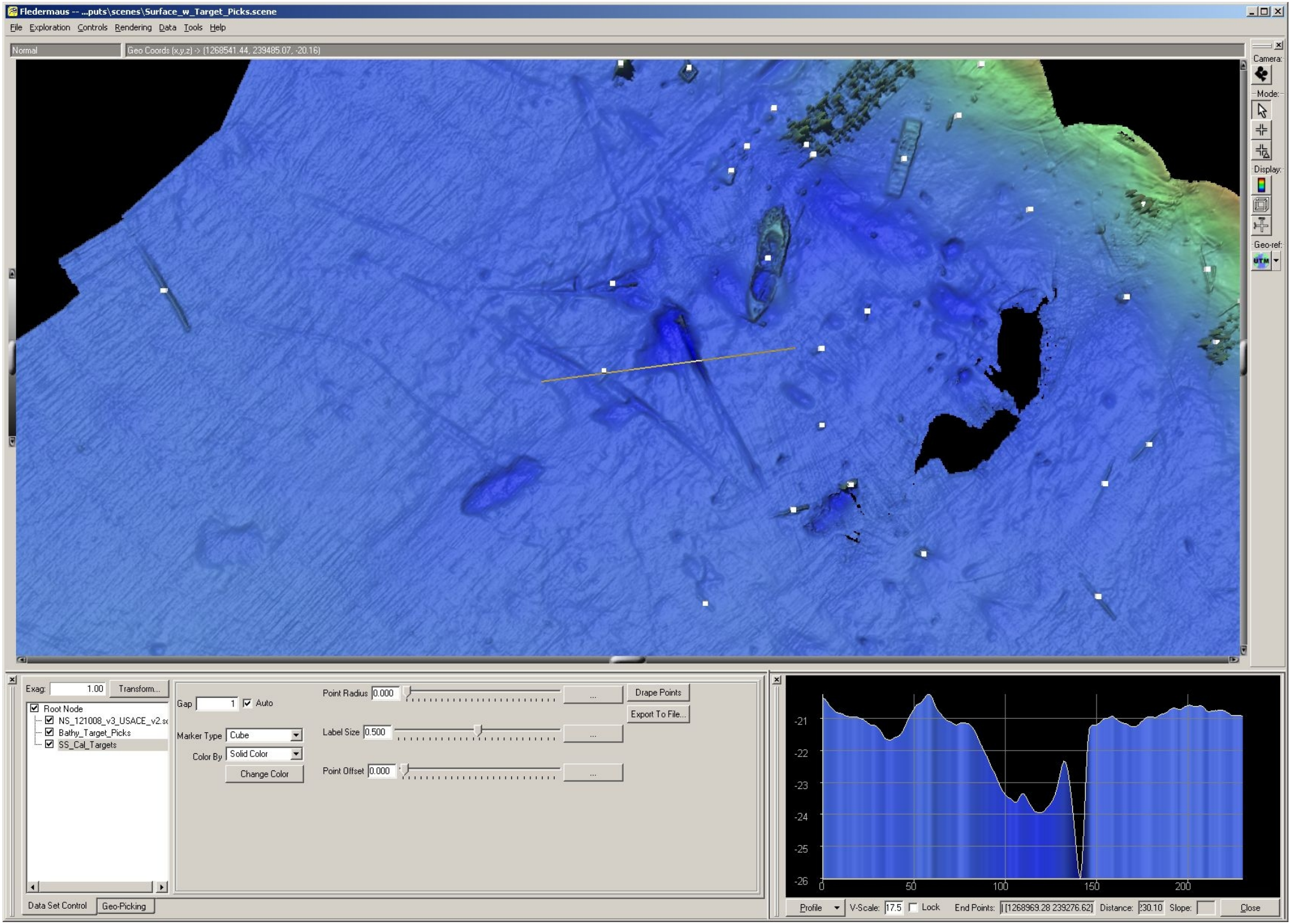
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Point Offset 0.000
Drape Points
Export To File...
Data Set Control
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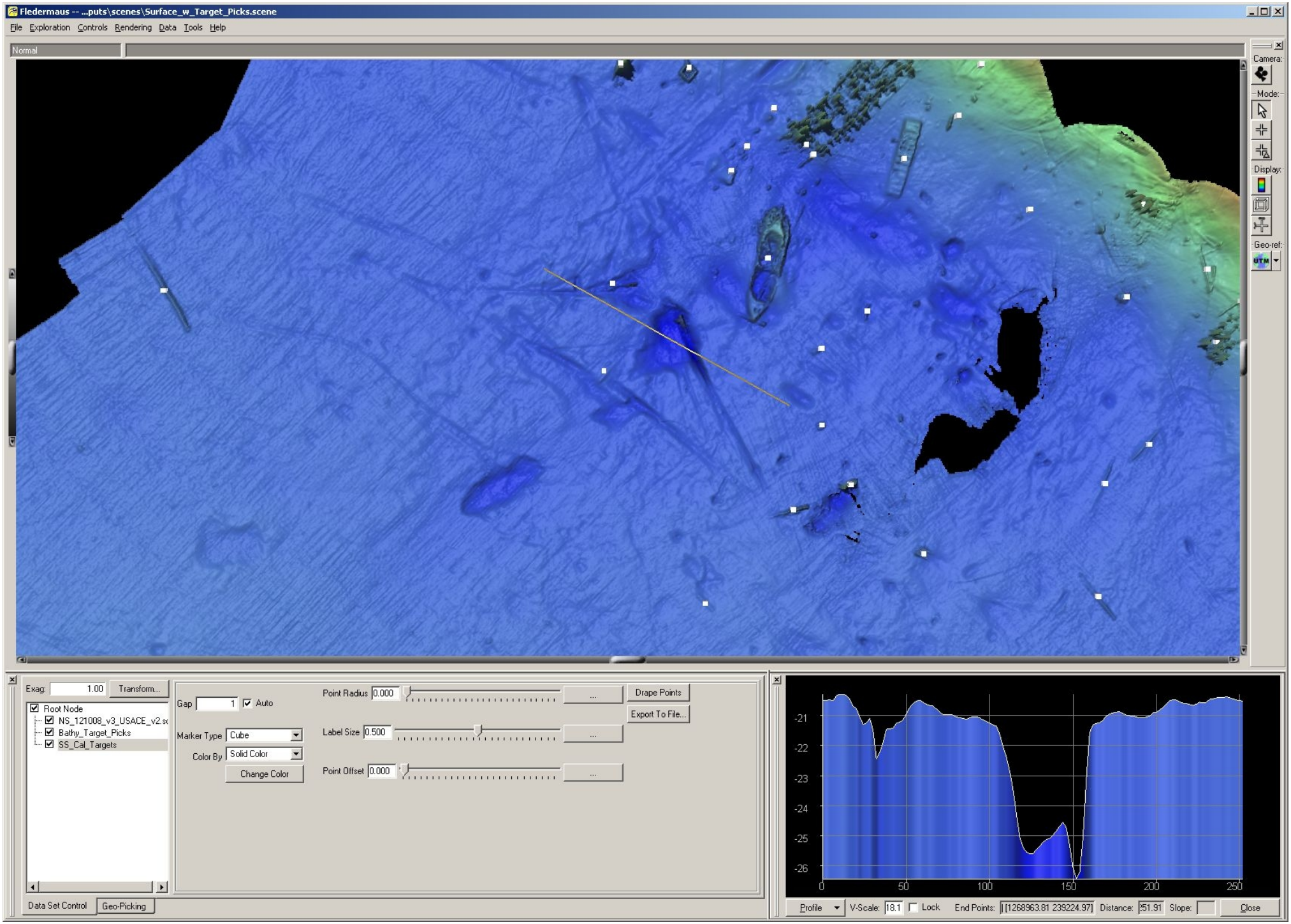
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Mode:
Display:
Geo-ref:
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Bathy_Target_Picks
SS_Cal_Targets
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Marker Type Cube
Color By Solid Color
Change Color
Point Radius 0.000
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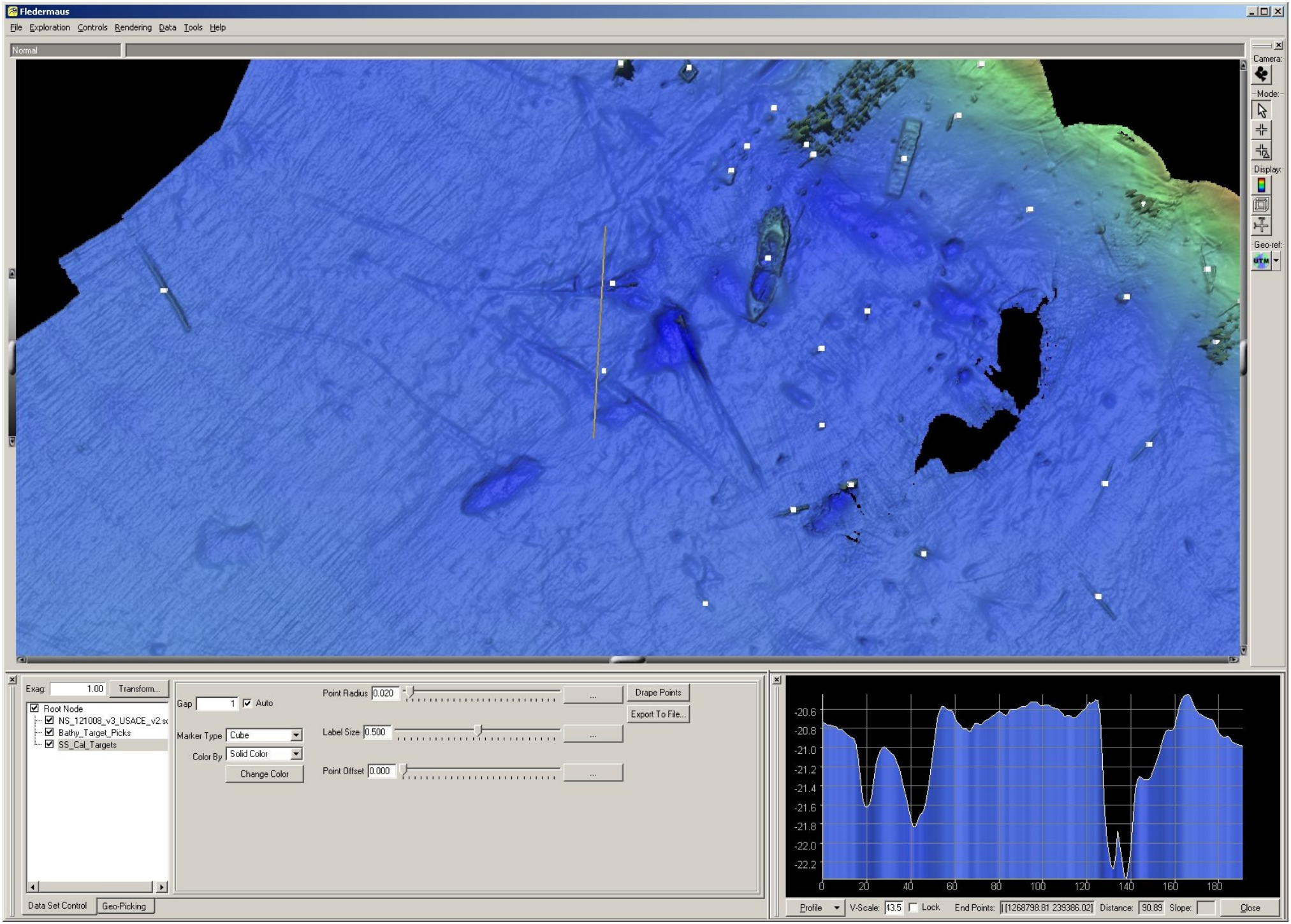
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Color By Solid Color
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Drape Points
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160
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V-Scale: 43.5
Lock
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Distance: 90.89
Slope:
Close

Appendix B

Core Collection Logbook and Core Collection Forms

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13 APR 09 -AS-

NORTHLAKE SHIPYARD SEDIMENT SAMPLING

-1ST DAY, CURRENTLY OVERCAST WITH LIGHT RAIN AT TIMES, COOL (~48°F)

0730 ARRIVED AT SITE, MET REB Z AND MARIC CONDITIONS

- BEGAN SETTING UP CORE PROCESSING AREA

0830 STARTED CLEANING CORE TUBES WITH DAVID (E+E) - CLEANED 9 TUBES

1100 - REVIEWED HASP WITH ENTIRE GROUP RSS SIGNED HASP (ERIC, DON, + ANDREW)

1150 - RSS FINALLY READY, BEGINNING TO LOWER CORE OVER STATION NS-01, collected NS-01

1400 - COLLECTED NS-02 CORE - MUCH BETTER PENETRATION

- COLLECTED NS-03 CORE, ENDED UP APP. 12 FEET OFF OF SAMPLE LOCATION DUE TO DON'S COMPASS MALFUNCTIONING (FROM BEING UNDER LARGE STEEL SHIPS)

- SPOKE WITH ECOLOGY REP + MARK L WHO BOTH WANTED TO KEEP THE CORE BECAUSE DON INDICATED THAT HE PLACED THE CORER ON A MOUND OF SEDIMENT

14 APR 09

NORTH. SHIP. SED SAMPLING

- ARRIVED @ SITE AT 0730, ONLY DAVID PRESENT! RSS DID NOT ARRIVE UNTIL 0800 - ERIC THOUGHT WE HAD AGREED TO MEET THEN - NOT TRUE! Will get him to get more reliable.

- 0900 - ERIC PROVIDED LOCATION OF NS03 CORE:

- NS-03 LOCATION:

X COOR. 549515.807

Y COOR 5277218.599

: 15.76 FT, BEARING: 315°

* SKIPPED NS04 + NS05 DUE TO DRY DOCK WORK CURRENTLY TAKING PLACE

0910 - BEGIN ATTEMPT AT CORING AT STATION NS-06

DON NOTING LOTS METAL DEBRIS - THIN PIECES AND SOME ORGANIC DEBRIS, AND A THIN LAYER (1") of SILTY SAND

0930 - NS-06 CORE COLLECTED BY DON, ESTIMATED PENETRATION OF 20"

→ AS THE CORE WAS BEING RAISED OUT OF THE WATER, ALL OF THE SEDIMENT DRAINED OUT OF THE TUBE →

- CALLED MARK L, WHO SAID THAT WE COULD MOVE OFF (SOUTH) 20 FEET AND TRY SAMPLING AGAIN

TEAM: ERIC / DON / ANDREW FOR RSS

14 APR 09

- NS-06 CORE COLLECTED
- 39" PENETRATION / 37.5" RECOVERY
- MAJOR OIL SHEEN OBSERVED AT THIS LOCATION: FROM BOTTOM + TOP OF CORE SAMPLE; HEAVY PETROLEUM ODOR ALSO OBSERVED
CORE DROPPED OFF @ PROCESSING AREA

- ARRIVED @ NS-07
OFFSET CORE LOCATION 15 FT (TO THE WEST) DUE TO ORIGINAL LOCATION UNDER A DOCKED BOAT
CORE COLLECTED @ NS-07
- 66" PENET. / 59.5" RECOVERY

1230 NS-0E - ARRIVED @ STATION
- OFFSET STATION SLIGHTLY DUE TO LOCATION JUST UNDER DOCKED BOAT
1255 NS-0E CORE COLLECTED
74" PENETRATION / 71" RECOVERY
[illegible]

1350 - ARRIVED @ NS-10
- SKIPPED NS-09 BECAUSE IT IS LOCATED APP. 40 FT UNDER DOCKED BOAT (ALASKA VELOCITY)
- SPENT ~20 MINUTES PLACING ANCHORS, SETTING BOAT UP OVER STATION FOR CORING
- STATION LOCATION: 1.9 FT / 154° FROM ORIGINAL SPOT
X: 549514.201 / Y: 5277150.094
1440 - CORE COLLECTED @ NS-10
MOSTLY FINES OBSERVED FROM ORIGINAL PORTION OF CORE - NO SAND/GRIT OBSERVED
WATER DEPTH: 40 FT
1530 NS-11
- ARRIVED AT STATION, SPENT ~20 MINUTES LOCATING BOAT OVER STATION
1618 CORE COLLECTED @ NS-11
- NOTICEABLY GOOD PENETRATION, BUT NOT AS MUCH AS AT NS-10 + NS-8

1700 NS-12
- ARRIVED AT STATION.
- DROPPED OFF DEN, PICKED UP MARGARET
1752 COLLECTED CORE AT NS-12
VERY GOOD SAMPLE: 74.5" PEN. / 74.5" RECOVERY
- LOTS OF FINES (IE SILT + CLAY)
- DARK (BLACK) ON TOP 1.5 FT, DARK BROWN BELOW

15 APR 09 -AS-

Northlake Shipyard Sed Sampling

- Marine layer present currently - forecasted to be sunny + warmer today

0730 - arrived at site; RBS already on site preparing to sed. sample

0830 - debrief for sediment sampling
- checked stations NS04 and NS05, both of which are ~ 20-25 ft under the dry dock + floating walkway RZ wants us to sample under dry dock, will talk with Mark L and Ecology to see what they want us to do.
- Also check station NS13; boats docked in adjoining property are re-arranging and new storage container also being installed where pile-driving operation was located. After discussions with people overseeing the work, we will avoid working in this area until their work is completed

0903 NS16
- spud ~ 30 min. positioning the boat for coring

1001 - core collected @ NS16
- dark brown with distinct oxidized zone 1.5 ft from surface. Eric did not observe any debris near the core station

15 APR 09

1100 arrived at station NS04
- spoke with Mark L (E+E) and John Keating (Ecology) about the location of NS04 + NS05 under the dry dock - they said if we sampled within 30 ft of the original station location, that would be OK. They also did not want to spend the additional time it would take to sample under the dry dock.

1140 core collected @ NS04
- Eric noted no debris + ~2" of sediment on a distinct hard layer (which is likely sand grit)
- Eric also had to break up the hard layer with his probe in order to get the corer through it

1300 - arrives @ NS05
- sampled app. 18 ft (to the east) of the original core station location
- Eric noted some debris while diving/coring, including several mussel shells and a block used by dry docks to prop up boats
- good penetration/recovery
- core collected at NS05

15 APR-09

1420 - ARRIVED AT NS13
JOHN KREATING (ECOLOGY) JOINING THE CORING CREW
- WEATHER NOW SUNNY AND WARM
1502 - CORE COLLECTED @ NS13

1550 NS14
- ARRIVED AT SITE
1625 - CORE COLLECTED, SEE SAMPLE RECORD FOR NOTES

1710 NS15
- ARRIVED AT SITE
1745 - CORE COLLECTED
- CORE LAYER MUCH CLOSER TO SURFACE OF SEDIMENT THAN PREVIOUS CORES
- PRIMARILY SILT + CLAY, NO DEBRIS OBSERVED IN PROXIMITY OF CORE LOCATION

1830 FINISHED PREPARING NS15 CORE FOR PROCESSING, CLEANED CORE CATCHERS - DONE FOR DAY

16 APR 09 -AS-

NORTH LAKE SHIPYARD
- SUNNY + MILD TO START OFF THE DAY, FORECASTS RAIN TOMORROW NIGHT / MORNING

0730 ARRIVED @ SITE - RSS PREPARING FOR CORING, JEN + DAVID (E+E) JUST ARRIVED
RSS TEAM: ERIC, ANDREW, AND MARGARET
- CLEANED MORE CORE TUBES
- ALSO SPOKE W/ MARK L: KEEP SAMPLING SEQUENTIALLY
0830 NS 17
- ARRIVED AT SITE, SPENT ~20 MINUTES POSITIONING
0933 - CORE COLLECTED @ NS17
- ERIC OBSERVED A FEATURELESS BOTTOM WITH NO DEBRIS, AND A SOFT SILT BOTTOM
2.6FT/198° Y:5277033.357 X:549554.793
1015 NS18
- ARRIVED @ STATION
- 2 REPRESENTATIVES FROM ECOLOGY AND ON THE BOAT TO OBSERVE CORING ACTIVITIES
0.7FT/56° Y:5277080.088 X:549595.345

16 APR 09

1200 NS19

- ARRIVED AT SITE, WITH TWO NEW RCC'S FROM ECOLOGY
1227 - CORE COLLECTED @ NS19
DECENT/RECOVERY: 72" PENET. / 62" RECOVERY
LOCATION:
1300 - DROPPED CORE OFF, ECOLOGY TOUR OF FIELD OPERATIONS IS OVER
1330 - FINISHED UNLOADING CORE, CROSSED OVER CABLE TO GAS UP BOAT, + TOOK SHORT BREAK TO EAT LUNCH.
1345 ARRIVED AT NS20
- NO PROBLEM ACCESSING STATION!
1420 - COLLECTED CORE
- ERIC NOTED THE PRESENCE OF DEBRIS, INCLUDING METAL PIPING + CARPETING
- SOFT SILT BOTTOM
LOCATION:

1500 - DROPPED NS20 CORE OFF
- RECONNED NS09 SITE, + ERIC THINKS WE COULD MOVE THE OUTER 2 BOATS WITH THE RSS BOAT SO THAT WE COULD ACCESS THE NS09 STATION FOR CORING
- UNABLE TO REACH EITHER MARK L OR MACK (N.S.), WILL ATTEMPT SAMPLING TOMORROW AT THIS STATION

16 APR 09

1530 NS21

- ARRIVED AT STATION
- NOTIFIED HARBOR PATROL OF OUR ACTIVITIES
- SPENT ~20 MINUTES POSITIONING BOAT
- ERIC + MARGARET DIVING; NOTES INCLUDE:
- SILTY WITH PEA GRAVEL, A LOT OF WOODY DEBRIS, A RUSTY CAR TIRE, AND OTHER METAL DEBRIS. SEDIMENT SURFACE: SILT WITH PEA GRAVEL.
1622 - CORE COLLECTED @ NS21
- STRONG PETROLEUM ODOR FROM CORE
- ALSO OBSERVED VERY COLORFUL OIL SHEEN ON TOP OF THE CORE BEFORE WE TURNED IT OVER TO E+E FOR PROCESSING
1650 - DROPPED CORE OFF
- MET WITH MARK L, WHO SAID WE SHOULD SAMPLE NS29 NEXT, SINCE WE HAD NOT DETERMINED THE WESTERNMOST BOUNDARY OF THE SANDBLAST GRIT
LOCATION: 1.6FT / 177°
1700 NS29
- ARRIVED AT STATION, CALLED FREMONT BRIDGES TO NOTIFY THEM OF OUR ACTIVITIES
1748 COLLECTED CORE
1.4FT/234° X 549376.823
Y 5277107.901

17 APR 09 -AS-

NORTHLAKE SHIPYARD SEDIMENT SAMPLING

- RAINED OVERNIGHT, CURRENTLY PARTLY CLOUDY AND APPEARS TO BE CLEARING

0730 - ARRIVED AT SITE, CLEANED CORE TUBES IN PREPARATION FOR TODAY'S SAMPLING
0845 - LEFT PIER TO SAMPLE; RSS TEAM: ERIC, DON, AND ANDREN

0850 NS28
- ARRIVED AT STATION
- VERY WINDY CURRENTLY, WHICH IS MAKING IT DIFFICULT FOR ERIC TO POSITION BOAT
0940 - CORE COLLECTED AT NS28
DON OBSERVED A SOFT SILT BOTTOM WITH FINE OM, NO DEBRIS
WATER DEPTH: 38 FT
PENET. D: 68.5 INCHES / RECOV: 60 INCHES
LOCATION: 1.5 FT / 156° Y: 5277067.680 X: 549423.232
1000
- TOO WINDY TO MOVE BOATS AT END OF PIER TO SAMPLE NS09; WILL TRY LATER IN THE DAY IF THE WIND DIES DOWN (SPOKE WITH MARK, WHO OK'D THE IDEA). MARK L SAID TO SAMPLE NS27 NEXT

17 APR 09

1030 ARRIVED AT NS27
- STILL FAIRLY WINDY ON THE LAKE NOW
- MARK L ALSO CONTACTED ME, SAYING TO TELL THE DIVERS NOT TO EXCEED 36" IN PENETRATION DEPTH, WHICH I PASSED ON TO DON + ERIC (THE DIVE TEAM).
1100 — CORE COLLECTED @ NS27
- NO VISIBLE DEBRIS, SOFT SILT BOTTOM WITH FINE OM.

LOCATION: 1.2 FT / 78°
Y: 5277028.168 X: 549469.476
WATER DEPTH: 38 FT
PENETRATION D: 70.5" RECOVERY: 53"

1130 DROPPED CORE OFF, PICKED UP MORE SEDIMENT CORE RECORDS FROM MARK L, PACKAGED FOR NEXT CORE SAMPLE.

- VERBAL CONFIRMATION FROM MARK LONGING TO CORE AT STATION NS26

17 APR 09

1200 NS26

- ARRIVED AT STATION

1215 - CORE COLLECTED @ NS26

WATER DEPTH: 39 FT

LOCATION INFO:

- DON NOTED SOME SMALL PIECES OF WOOD + BRICK, NO OTHER DEBRIS. SOFT SILT BOTTOM

- NOTE: PER CONVERSATION WITH MARK L, DON WAS INSTRUCTED NOT TO COLLECT MORE THAN 36" OF SEDIMENT (RECOVERY), IF POSSIBLE.

PENETRATION D: 49" RECOVERY: 45"

17 APR 09

1305 NS33

- NEW STATION CREATED BY MARK LONGTINE TODAY; TRYING TO DELINEATE THE WEST BOUNDARY OF THE SANDBLAST GRIT CONTAMINATION

1330 - CORE COLLECTED @ NS33

WATER DEPTH: 41 FT

LOCATION: 1.0 FT / 214°

Y: X:

PENETRATION D: 54" RECOVERY: 43"

- NO DEBRIS OBSERVED

17 APR 09

1415 NS34

- ARRIVED AT STATION NS34; COORDINATES PROVIDED BY MARK L.
- ROB Z (HERRERA) JOINING US FOR THIS CORING EVENT, MARGARET NOW ON RSS BOAT; ANDREW FINISHED (LEAVING ON VACATION).

1452 - CORE COLLECTED @ NS34

LOCATION FROM TARGET COOR: 0.7FT/266°
Y: 5277143.984 X: 549341.782
WATER DEPTH: 39 FT
DON - NOTED SOFT SILT BOTTOM WITH FINE OM AND SOME SMALL PIECES OF BARK + WOOD DEBRIS, NO OTHER DEBRIS OBSERVED
PENETRATION D: 54" RECOVERY: 49"

17 APR 09

1540 NS23

- ARRIVED AT STATION
- ROB Z JOINING US FOR THIS CORE
- MARK L SAID TO SAMPLE AT NS23, AND SKIP NS22 AT THIS POINT

1607 - CORE COLLECTED @ NS23

LOCATION FROM TARGET LOCATION:
Y: 5277039.628 X 549640.748
WATER DEPTH 39 FT
PENETRATION D: 83.5" RECOVERY: 73"

SOFT SILT FLAT BOTTOM WITH SOME AQUATIC PLANT GROWTH
NOTE: VACUUM FORMED INSIDE CORE TUBE WHEN IT WAS RETRACTED, CAUSING THE TUBE TO BE FLATTENED IN UPPER PORTION - RETURNED TO ORIGINAL FORM WHEN TOP OF CORE WAS CUT

~~- DECIDED WITH ALLOWING MARK L. TO DETERMINE THE LOCATIONS OF THE GEOTECH CORES~~

18

17 APR 09

1700 NS24

- ARRIVED AT STATION

1725 - CORE COLLECTED AT NS24

WATER DEPTH: 39FT

DISTANCE/DIRECTION FROM ORIGINAL STATION: 0.3FT/256°

Y: 5276993.979

X: 549601.016

PEN. D: 54" RECOVERY 49"

19

20 APR 09 - AS -

NORTHLAKE SHIPYARD SEDS. INVESTIGATION

- CURRENTLY SUNNY + WARM, FORECASTED TO BE IN LOW 70'S TODAY

0730 - ARRIVED AT CORE PROCESSING AREA

- CLEANED CORE TUBES WITH LIQUINOX + DI WATER

0815 - ARRIVED AT NS09; SPOKE WITH MARK L WHO SAID NOT TO SPEND A LOT OF TIME MOVING BOATS TO ACCESS STATION, SO WE WILL OFFSET THE STATION ~45 FT FOR BETTER ACCESS

0905 - CORE COLLECTED @ NS09

WATER DEPTH: 40 FT

PENETRATION D: 54" RECOVERY: 45"

LOCATION FROM TARGET LOCATION:

Y: 5277131.101 X: 549529.433

0938 - DROPPED CORE OFF

- ENCOUNTERED A DECAY WHILE WAITING FOR MARK L TO DETERMINE THE LOCATIONS OF THE GEOTECH CORES

RSS TEAM: ERIC, DON, AND MARGARET

20 APR 09

1040 NS-01-G

- ARRIVED AT NS01-G TO COLLECT THE FIRST GEOTECH CORE
- PREVIOUS CORE AT THIS LOCATION HAD A PENETRATION DEPTH OF 32 INCHES - WILL ATTEMPT TO REACH SIMILAR PENE. DEPTH

WATER DEPTH: 26 FT

1100 - CORE COLLECTED -> REFUSAL #1

LOCATION FROM TARGET STATION: 2.1 FT / 254°

1130 - SET UP AGAIN; CORE #2 BEING COLLECTED

WATER DEPTH: 26 FT

1205 - CORE #2 COLLECTED

PENET. D: 26" RECOVERY 10"

LOCATION FROM TARGET: 4.7 FT / 209°

X: 549564.604

Y: 5277276.740

20 APR 09

1220 NS05-G

- ARRIVED @ STATION FOR ANOTHER GEOTECH CORE

WATER DEPTH: 39 FT

1305 - CORE #1 COLLECTED @ NS05-G

LOCATION FROM TARGET STATION:

X: 549585.441

Y: 5277215.735

PENET. D: 67.5" RECOVERY: 63.5"

GOOD LOOKING CORE!

22 20 APR 09 12, 6, 18

1315 NS35

- ARRIVED AT SITE; WILL SAMPLE AT THE END OF THE EAST DRY DOCK NEXT TO THE WEST DRYDOCK (WHICH EXTENDS APP. 25 FEET FURTHER THAN THE EAST D.D.)

WATER DEPTH: 44 FT

1400 - CORE #1 HIT REFUSAL @ 22"

CORE COORDINATES: ~~[illegible]~~ NA - ERIC DID NOT LOG THE L.

X: 549525.181

Y: 5277184.073

PENETRATION D: 22" RECOVERY: 18"?

- DUE TO TIME CONSTRAINTS, MARK L SAID TO TAKE THE GEOTECH CORES NOW, STARTING WITH NS12

20 APR 09 23

1435 NS12-6

- ARRIVED AT STATION, WILL COLLECT A GEOTECH CORE AT THIS LOCATION.

WATER D: 40 FT

1505 - GEOTECH CORE COLLECTED @ NS12-6

LOCATION FROM TARGET: NA

X: NA - ERIC FORGOT TO LOG POINT,
Y: WITH 2-3 FEET OF PREVIOUS CORE (HOLE)

PENETRATION D 71.5" RECOVERY 62"

SOFT SILT BOTTOM, NO DEBRIS

20 APR 09

1545 NS18-6

ARRIVED AT SITE; WILL TAKE A GEOTECH CORE AT THIS LOCATION, PER CONVERSATION WITH MARK L.

WATER DEPTH: 39FT

1620 CORE COLLECTED @ NS18-G

LOCATION FROM TARGET: 2.5 FT / 42°

X: 549595.671

Y: 5277080.537

PENETRATION D: 74" RECOVERY 65.5

-GOOD CORE / RECOVERY

20 APR 09

1705 NS06-6

-ARRIVED AT FINAL GEOTECH CORE LOCATION, PER CONVERSATION WITH MARK L

WATER DEPTH: 30 FT

1730 CORE COLLECTED @ NS06-6

LOCATION FROM TARGET: 1.8FT. / 17°

X 549629.742

Y 5277220.407

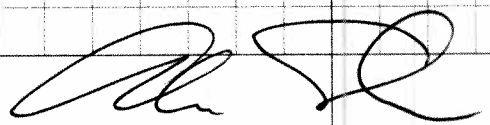
PENETRATION DEPTH: 31" RECOVERY: 27.5"

-METAL, CABLE DEBRIS + WOOD DEBRIS

-SILTY SAND

-SOME GRAVEL ALSO OBSERVED

-OIL SHEEN OBSERVED AT TOP OF CORE AFTER IT WAS CUT AT THE MUD LINE



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SEDIMENT CORE RECORD

PROJECT NAME/NUMBER: Northlake Shipyard Grit Characterization/ 06-03386-008 | PROJECT LOCATION: North Lake Union | SAMPLE DATES: 4/13/09

SAMPLING CREW: Herrera and RSS
ALEX, ERIC, DON, AND ANDREW

DATA RECORDER: Alex Svendson (Herrera)

SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
	1	549565.3056	527727.8.0369	0	4/13/09	1225	26.0	0.67	NA	NA		ENCOUNTERED DEBRIS, INCLUDING A STEEL PLATE, CABLES, BRANCHES
NS	1	"	"	0	4/13/09	1244	26.0	32"	22"	69%		CLAMS (ORGANICS), SIGNS (SILTY
01												PEBS

Foonotes: NS-01: AFTER REFUSAL FOR CORE #1, DON PROBED NEARBY NS-01 LOCATION TO DETERMINE WHERE #2 SHOULD BE TAKEN. HE NOTED THAT THE FIRST 8" WAS HIGHLY COMPACTED, THEN MUCH SOFTER SEDIMENT WAS ENCOUNTERED BELOW. DON DECIDED THAT HE WOULD CONTINUE WITH THE FIRST LOCATION AND SEE IF HE COULD GET THRU THE UPPER 8"

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendsen (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH INCHES	RECOVERY DEPTH INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-02	1	549540.482867	5277249.1896	0/NA	4/13/09	1450	40.0	50"	48"			DARK GRAY, ENCOUNTERED METAL DEBRIS, BARK, METAL PIPING, AND MISC. ORGANIC DEBRIS — WHICH WAS ESTIMATED AT 8" IN DEPTH NEAR TAC STATION

Foonotes: DON ALSO NOTED THAT THE VISIBILITY WAS VERY POOR AT THIS LOCATION SO HE WAS UNABLE TO OBSERVE AS MUCH AS AT STATION NS-01

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SEDIMENT CORE RECORD

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendsen (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH ~~(FT)~~ INCHES	RECOVERY DEPTH ~~(FT)~~ INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-03	1	549519.1854	5277215.1467	SEE FOOTNOTES 12FT/	4/13/09	1610	41.0	66"	60"			MORE METAL DEBRIS WAS OBSERVED AT THE STATION (GENERAL AREA), BUT DON NOTED THAT THERE WAS LESS ORGANIC DEBRIS AT THIS STATION RELATIVE TO NS-01 AND NS-02 — DON ALSO NOTED THAT HE COLLECTED THE CORE AT THE TOP OF A SEDIMENT HEAP APPROX. 3' ~~FEET~~ HIGH

Foonotes: THE STATION IS LOCATED UNDER A DRY DOCK (WESTERN MOST); ERIC IS ABLE TO GET THE BOAT WITHIN 10 FEET OF THE STATION (WHICH IS EAST OF THE BOAT). CALLED MARK LONGTINE WHO SAID WE NEED TO DO OUR BEST TO REACH THE STATION SO DON WILL ATTEMPT TO WALK TO CORER UNDER THE DRY DOCK. DON WALKED CORER ~10 FT AND STARTED CORING — AFTER ~ A MINUTE, ERIC OBSERVED THAT DON HAD GONE THE WRONG DIRECTION, AND WAS NOT CORING AT THE CORRECT LOCATION — ~~WILL HAVE TO DO ANOTHER ATTEMPT!~~
AFTER RETURNING TO THE CORE PROCESSING AREA MARK AND [illegible] REP. DECIDED TO KEEP THE CORE

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS04	1	549554.642	5277181.194	17.8/132°	4/15/09	1140	40	31"	27"			

Foonotes: ERIC OBSERVED ~~A VARIETY OF~~ DEBRIS IN THE VICINITY OF THE STATION. HE ALSO OBSERVED APP. 2 INCHES OF SEDIMENT ON TOP OF A HARD LAYER. ERIC WAS UNABLE TO GET THE CORER THROUGH THE HARD LAYER, SO HE USED A PROBE TO BREAK UP THE HARD LAYER ~~FOR~~ TO ENABLE THE CORER TO PENETRATE IT.

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	(TARGET) DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 10	1	549514.201	5277150.094	19FT / 154°	4/14/09	1440						

Foonotes:

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STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT) INCHES	RECOVERY DEPTH (FT) INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-11	1	549480.196	5277180.477	0.6/ 326°	4/14/09	1618	40	49.5	44.5			DARK GREY, LOOKS LIKE PREDOMINANTLY SILT/ CLAY, OIL SHEEN IN UPPER PORTION OF CORE

Foonotes: SOFT SILT SURFACE FRACTION NOTED BY ERIC, ALSO NOTED HE DID NOT OBSERVE ANY DEBRIS. ALSO NOTE THAT ANOIL SHEEN WAS OBSERVED EMANATING FROM THE TOP OF THE CORE WHEN THE TOP PORTION OF CORE TUBE WAS CUT.

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STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-12	1	549445.665	5277210.479	0.8/335°	4/14/09	1752	40	74.5	74.5	100		BLACK IN APP. TOP 1.5 FT, DARK BROWN BELOW, NO DEBRIS OBSERVED, APPEARS TO BE PREDOMINANT FINES (i.e., SILT + CLAY)

Foonotes: SOFT SILT ON SEDIMENT SURFACE OBSERVED BY ROV, ALSO NOTED THAT THERE WAS NO DEBRIS OBSERVED AT THIS LOCATION.

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union

SAMPLE DATES: 4/15/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	INCHES RECOVERY DEPTH (FT)	IN CHES PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-13	4/15/09	1502	1	40	~~[illegible]~~ ~68"	62"			THE TOP 3 FEET OF SEDIMENT AS DARK BROWN-TO-BLACK IN COLOR, LIGHT GREY SEDIMENT OBSERVED BELOW. NO DEBRIS OBSERVED. APPEARS TO BE MAINLY FINE SEDIMENT (IE., SILT + CLAY).

Notes: EMC OBSERVED A SOFT SILT BOTTOM WITH NO DEBRIS (ERIC DID NOTE THAT VISIBILITY WAS ONLY ~1 FT SO HE WAS NOT ABLE TO SEE MUCH OR OBSERVE THE AREA AROUND THE CORING LOCATION.

SAMPLE LOCATION: 0.8FT/295° Y: 5277244.815 X: 549475.779

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DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS | SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS14	4/15/09	1625	1	39	[illegible]	[illegible]			
					65"	62.5"			

Notes: ERIC OBSERVED A SOFT SILT BOTTOM + ENCOUNTERED MORE RESISTANCE WHILE POUNDING THE CORE EARLIER THAN AT THE PREVIOUSLY SAMPLED STATIONS

LOCATION: ~~ALONG~~ 0.3 FT / 288° Y 5277154.14E X: 549417.09E

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STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT) INCHES	RECOVERY DEPTH (FT) INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 05	1	5495584.634	5277217.213	13.63/118°	4/15/09	1312	37	66.5"	57.5"			SEDIMENT DARK BROWN – BLACK, GOOD RECOVERY, PETROLEUM ODOR

Foonotes: ERIC NOTED SEVERAL MUSSELS (DEBRIS) AND 1 BLOCK FROM THE DRY DOCK (BLOCKS USED FOR STANDING SHIPS UPRIGHT IN THE DRY DOCK). PETROLEUM ODOR PRESENT WHEN CORE WAS REMOVED FROM WATER, ERIC'S GLOVE ALSO HAD A SIMILAR ODOR.

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SAMPLING CREW: Herrera and RSS | DATA RECORDER: Alex ~~Svendsen~~ SVENDSEN (Herrera) | SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-06	1	549624.467109	5277219.8908	0/NA	4/14/09	0930	29	20"	0	0		
	2	549619.948	5277216.166	19.5/231°	4/14/09	1015	33	39"	27"			

Foonotes: #1 DON NOTED THAT THERE WAS A SUBSTANTIAL AMOUNT OF METAL DEBRIS, INCLUDING SCRAPS THIN PIECES + SOME ORGANIC DEBRIS. ALSO NOTED A LAYER OF SILTY SAND APP. 1" DEEP ON TOP OF THE METAL DEBRIS. DON ALSO NOTED A LARGE LOG, A TIRE, AND OTHER DEBRIS NEAR THE STATION. SPOKE WITH MARK L, WHO SAID IT WAS OK TO MOVE THE STATION ~20FT SO THAT WE CAN GET A SAMPLE.

#2 DON OBSERVED 8" OF SEDIMENT; BASE PLATE SUNK IN COMPLETELY — TOP 8" VERY LIGHT / HIGHLY SUSPENDED OIL SHEEN PROMINENT IN BOTTOM OF CORE (SMALL AMTS SPILLED OUT)

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STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH ~~(FT)~~ INCHES	RECOVERY DEPTH ~~(FT)~~	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-07	1	549599.551	5277791.879	15.0/241°	4/14/09	1142	41.0	66"	59.5"			DARK GRAY, SANDY ON TOP, NO DEBRIS VISIBLE IN CORE

Foonotes: -8" OF SUSPENDED SEDIMENT, BOTTLE OF ACETYLENE OBSERVED NEARBY
-DUE TO LOCATION OF NS-07 UNDER A DOCKED BOAT, CORE WAS TAKEN WITH A 15 FEET OFFSET (WEST OF THE ORIGINAL SAMPLE LOCATION)

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STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-08	1	549573.690	5277159.823	0.4/40°	4/14/09	1255	41	74"	71"			TIPS, METAL RODS, GLASS, ROCKS

Foonotes: TIPS, METAL RODS + SCRAPS, GLASS, AND VARIETY OF GARBAGE SURROUNDING STATION AREA. SEDIMENT (SUSPENDED) WITH OM APP. 6" ON SURFACE. STATION LOCATED ON OUTER EDGE OF DOCKED BOAT

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STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH ~~(FT)~~ INCHES	RECOVERY DEPTH ~~(FT)~~ INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 09	1	549529.433	5277131.101	46.7FT / 314°	4/20/09	0905	40	54"	45"			

Foonotes: DON NOTED A SOFT SILT BOTTOM WITH ~~ONE~~ TWO LARGE TIRES IN PROXIMITY TO THE CORING STATION AND ONE ADDITIONAL SMALL TIRE. DON ALSO OBSERVED A WELDING MASK NEAR THE CORE STATION AS WELL.

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union

SAMPLE DATES: 4/16/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (~~FT~~ INCHES)	RECOVERY DEPTH (~~FT~~ INCHES)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS20	4/16/09	1420	1	36	42"	37"			SEDIMENT DARK BROWN/BLACK, NO DEBRIS
									FINES (IE, SILT/CLAY), MINERAL SHEEN
									OBSERVED AT TOP OF CORE.

Notes: ERIC OBSERVED METAL PIPE DEBRIS TCARPETING AROUND THE IMMEDIATE VICINITY OF THE STATION. SOFT SILT ON TOP ALSO NOTED.

LOCATION: 7.4FT/226° Y: 5277161.536 X: 549665.249

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SAMPLE DATES: 4/16/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS21	4/16/09	1622	1	35	31"	26"			SEDIMENT COLOR IS GRAY, APPEARS TO HAVE A LARGE PROPORTION OF SANDY MATERIAL. WOODY DEBRIS OBSERVED IN SHOE OF CORE — LIKELY CAUSE OF THE REFUSAL @ 31". ALSO OBSERVED A SHEEN (OIL) IN THE WOOD/SAND MATRIX THAT FELL OUT OF BOTTOM OF THE CORE UPON RETRIEVAL.

Notes: ERIC NOTED A VARIETY OF DEBRIS IN THE VICINITY OF NS21, INCLUDING WOODY DEBRIS, A RUSTY CAR TIRE, AND SOME METAL DEBRIS. ERIC ALSO OBSERVED SEVERAL FRESHWATER MUSSELS AROUND THE CORING AREA. SEDIMENT SURFACE WAS CHARACTERIZED AS SILTY MIXED WITH PEA GRAVEL.

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PROJECT NAME/NUMBER: Northlake Shipyard Grit Characterization/ 06-03386-008	PROJECT LOCATION: North Lake Union	SAMPLE DATES: 4/17/09
SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE (NAUTICAL)	Y COORDINATE (NAUTICAL)	DISTANCE (FT)/ DIRECTION (DEGREES) FROM (TARGET) XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 23	1	549640.748	5297039.628	1.8ft / 219°	4/17/09	1607	39	8.35	~~7.5~~ 7.3			

Foonotes: DON OBSERVED A FLAT BOTTOM WITH A SOFT SILT SEDIMENT SURFACE WITH MINOR AMOUNTS OF AQUATIC PLANTS GROWING IN THE IMMEDIATE VICINITY. UPON EXTRACTION, A VACUUM FORMED IN UPPER PORTION OF CORE TUBE, CAUSING IT TO FLATTEN. CORE TUBE RETURNED TO ORIGINAL FORM AS SOON AS THE VACUUM WAS BROKEN.

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SEDIMENT CORE RECORD

PROJECT NAME/NUMBER: Northlake Shipyard Grit Characterization/ 06-03386-008 | PROJECT LOCATION: North Lake Union | SAMPLE DATES: 4/17/09

SAMPLING CREW: Herrera and RSS | DATA RECORDER: Alex Svendson (Herrera) | SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD. (TARGET)	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 24	1	549601.016	5276993.979	0.3ft/256°	4/17/09	1725	39	54"	49"			COLOR DARK BROWN-BLACK, FINE GRAINED (SILT/MUD), WOODY DEBRIS OBSERVED IN BOTTOM OF CORE

Foonotes: DAN OBSERVED A SOFT SILT BOTTOM WITH MINOR AMOUNTS OF ORGANIC MATTER DEBRIS, NO OTHER DEBRIS OBSERVED. ALSO NOTE THAT THERE WAS SOME WOODY DEBRIS IN THE SIDE OF THE CORE WHEN IT WAS RAISED OUT OF THE WATER

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PROJECT NAME/NUMBER: Northlake Shipyard Grit Characterization/ 06-03386-008 | PROJECT LOCATION: North Lake Union | SAMPLE DATES: 4/17/09

SAMPLING CREW: Herrera and RSS | DATA RECORDER: Alex Svendson (Herrera) | SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH ~~(FT)~~ INCHES	RECOVERY DEPTH ~~(FT)~~	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 26	1	549515.174	5276988.062	1.3FT/ 81°	4/17/09	1215	39	49"	45"			DARK BROWN-BLACK COLOR, NO DEBRIS VISIBLE, FINE TEXTURED (SILT/CLAY)

Foonotes: DEN OBSERVED SEVERAL SMALL PIECES OF WOOD/BARK, NO OTHER DEBRIS NOTED, SOFT SILT BOTTOM WAS ENCOUNTERED.

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SEDIMENT CORE RECORD

PROJECT NAME/NUMBER: Northlake Shipyard Grit Characterization/ 06-03386-008	PROJECT LOCATION: North Lake Union	SAMPLE DATES: 4/17/09
SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT) INCHES	RECOVERY DEPTH (FT) INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-27	1	549469.476	5277028.168	1.2FT/ 78°	4/17/09	1100	38	70.5"	53"			DARK BROWN, NO DEBRIS

Foonotes: DON OBSERVED NO VISIBLE DEBRIS NEAR STATION AND A 3 FT SILT BOTTOM WITH FINE OM.

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union

SAMPLE DATES: 4/15/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (~~FT~~ INCHES)	RECOVERY DEPTH (~~FT~~ INCHES)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS15	4/15/09	1745	1	40	56.5"	56.5"			CORE DARK BROWN FOR TOP 3", THEN GREY FOR 1-1.5 FT, BROWN >1.5 FT BELOW SURFACE. APPEARS PREDOMINANTLY FINE GRAINED (i.e., SILT + CLAY). NO DEBRIS OBSERVED.

Notes: ERIC OBSERVED A SILT BOTTOM WITH NO DEBRIS ON THE BOTTOM (IN CLOSE PROXIMITY TO THE CORE STATION)

LOCATION: 7.7FT/83° Y: 5277114.369 X: 549465.459

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SEDIMENT CORE RECORD

PROJECT NAME/NUMBER: Northlake Shipyard Grit Characterization/ 06-03386-008	PROJECT LOCATION: North Lake Union	SAMPLE DATES:
SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	SAMPLE DATE	SAMPLE TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT) INCHES	RECOVERY DEPTH (FT) INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS-16	1	549509.861	5277074.274	2.6/ 71°	4/15/09	1001	39	74.5	69			DARK BROWN, WITH THE EXCEPTION OF A DISTINCT GLEY LAYER APP. 1.5FT BELOW THE SEDIMENT SURFACE. SEDIMENT APPEAR TO BE PREDOMINANTLY FINES (IE, SILT + CLAY).

Foonotes: ERIC OBSERVED SOFT SILT BOTTOM WITH NO DEBRIS.

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union

SAMPLE DATES: 4/16/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH ~~(FT)~~ (INCHES)	RECOVERY DEPTH ~~(FT)~~ (INCHES)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS17	4/16/09	0933	1	39	70"	62.5"			DARK BROWN, DOMINATED BY FINES (SILT + CLAY), NO DEBRIS OBSERVED.

Notes: ERIC NOTED THAT THE SEDIMENT SURFACE AROUND NS17 WAS FEATURELESS WITH NO DEBRIS AND A SOFT SILT BOTTOM. HE ALSO DID NOT HAMMER THE CORE TO REFUSAL PER CONVERSATION WITH MARK L. WHO WAS NOT INTERESTED IN DEEP CORES IN THIS AREA, ESPECIALLY THE BROWN SEDIMENT UNDER THE UPPER GREY SEDIMENT, WHICH IS USUALLY AROUND 1-2 FEET DEEP.

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LOCATION: 7.6FT / 199° Y 5277033.357 X: 549554.792

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union

SAMPLE DATES: 4/16/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS18	4/16/09	1055	1	39	76.5"	73.5"			DARK GREY, FINE SEDIMENT (IE SILT + CLAY), NO DEBRIS

Notes: ERIC NOTED A SOFT SILT BOTTOM @ NS18, AND NO DEBRIS IN THE IMMEDIATE VICINITY OF NS18.

LOCATION: 0.7 FT / 56° Y: 5277080.088 X: 549595.345

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union

SAMPLE DATES: 4/16/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS19	4/16/09	1227	1	40	72"	62"			DARK GREY, APPEARS TO BE MAINLY FINE GRAINED MATERIAL (IE, SILT & CLAY) NO DEBRIS OBSERVED

Notes: ERIC NOTED SOFT SILTY BOTTOM AND NO DEBRIS IN PROXIMITY TO NS19. UPON RETRIEVAL OF THE CORE, A VERY STRONG PETROLEUM ODOR WAS NOTED, WITH AN OIL SHEEN FROM BOTTOM SEDIMENTS (OF CORE) AS WELL.

LOCATION: 0.8 FT/97° Y 5277125.932 X 549635.409

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union

SAMPLE DATES: 4/17/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS

SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS28	4/17/09	0940	1	38	68.5"	60"			CORE IS DARK BROWN (TOP 6"), THEN IS LIGHT BROWN FOR NEXT 1.0 FT BELOW, BROWN BELOW, APPEARS FINE TEXTURED (IE, SILT/CLAY), NO DEBRIS OBSERVED.

Notes: DON OBSERVED 8-10 INCHES OF SOFT SILT WITH FINE ORGANIC MATERIAL ON THE TOP OF THE SEDIMENT SURFACE. NO DEBRIS WAS OBSERVED.

LOCATION: 1.5ft/156° Y: 5277067.680 X 549423.323

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SEDIMENT SAMPLE RECORD

PROJECT NAME/NUMBER/LOCATION: Northlake Shipyard Grit Characterization/ 06-03386-008/ North Lake Union | SAMPLE DATES: 4/16/09

DATA RECORDER, SAMPLING CREW: Alex Svendson, RSS | SAMPLING METHOD: Diver coring with 6-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID/ LOCATION	DATE	TIME	REP. NO.	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	SAMPLE INTERVAL (FT)	CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS29	4/16/09	1748	1	38	62"	58 5"			DARK BROWN, FINE TEXTURED (SILT/CLAY), NO DEBRIS

Notes: ERIC OBSERVED NO DEBRIS IN THE VICINITY OF NS29, AND THAT IT HAD A SOFT SILT BOTTOM.

LOCATION: 1.4 FT / 234° Y: 5277107.901 X: 549376.823

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SEDIMENT CORE RECORD

PROJECT NAME/NUMBER: Northlake Shipyard Grit Characterization/ 06-03386-008	PROJECT LOCATION: North Lake Union	SAMPLE DATES: 4/17/09
SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH INCHES	RECOVERY DEPTH INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 33	1				4/17/09	1330	41	54"	43"			DARK BROWN ON TOP HALF, BROWN ON BOTTOM HALF, FINE TEXTURED, NO DEBRIS

Foonotes: DEN ENCOUNTERED VERY POOR VISIBILITY CONDITIONS AT THE SEDIMENT SURFACE AT NS33, BUT DID MANUALLY FEEL AROUND NS33 CORE SITE AND DID NOT FEEL ANY DEBRIS. HE ALSO NOTED A SOFT SILT BOTTOM.

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SEDIMENT CORE RECORD

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	NAVIGATION X COORDINATE	NAVIGATION Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM ~~TARGET XY COORD.~~	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH ~~(FT)~~ (INCHES)	RECOVERY DEPTH ~~(FT)~~ (INCHES)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 34	1	549341.782	5277143.984	0.7ft/266°	4/17/09	1452	39	54"	49"			DARK BROWN COLOR, NO DEBRIS, APPEARS FINE TEXTURED (SI, SILT/CLAY)

Foonotes: DIV OBSERVED A SOFT SILT BOTTOM WITH FINE TEXTURED CM, SOME SMALL PIECES OF WOOD/BARK DEBRIS AND NO OTHER DEBRIS.

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SEDIMENT CORE RECORD

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (INCHES)	RECOVERY DEPTH (INCHES)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 35	1	549525.181	5277184.073	NA	4/20/09	1400	44	22"	14"			

Foonotes: DON NOTED THAT BOTTOM WAS VERY SOFT. HE ALSO OBSERVED DEBRIS IN THE AREA, INCLUDING A METAL PLATE. DON HIT REFUSAL AT A PENETRATION DEPTH OF 22 INCHES. SAID HE CHECKED NEXT TO THE CORE TUBE BY REACHING DOWN THROUGH THE UPPER LAYER OF SOFT SEDIMENT + HE FELT GRAVELLY ROCKS, WHICH WERE LIKELY THE CAUSE OF THE REFUSAL. HE SAID HE DID NOT FEEL ANYTHING SANDY OR SANDBLAST-GRIT LIKE.

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT) INCHES	RECOVERY DEPTH (FT) (METERS)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS01G	1	549564.701	5277277.864	2.1 FT/254°	4/20/09	1100	26	18"	0"	0		DARK BROWN, NO DEBRIS OBSERVED, MIXTURE OF SAND & SILT
	2	549564.604	5277276.740	4.7/209°	4/20/09	1205	26	26"	10"			

CORE REJECTED. INADEQUATE RECOVERY FOR GEOTECH ANALYSIS

Foonotes: DON OBSERVED HOLE FROM PREVIOUS CORE COLLECTED ON FIRST DAY - OBSERVED SIMILAR DEBRIS FROM 1ST CORE, INCLUDING A SLOW SIGN, PIPING DEBRIS, AND ROPE DEBRIS. DON AGAIN ENCOUNTERED PROBLEMS PENETRATING CORE THROUGH SAND BLAST GRIT, WHICH HE ESTIMATES IS 6-8" IN DEPTH, SO HE BROKE UP THE CRUST AROUND THE PERIMETER OF THE CORE TUBE, POOR RECOVERY ON 2ND ATTEMPT - NOTIFIED MARK L, WHO SAID TO MOVE STATIONS NEXT DUE TO TIME CONSTRAINTS.

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SEDIMENT CORE RECORD

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD. (TARGET)	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (INCH)	RECOVERY DEPTH (INCH)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 05 G	1	549585.441	5277215.735	18.5 FT / 128°	4/20/09	1305	39	67.5"	63.5"			

Footnotes: DAN OBSERVED RELATIVELY FLAT, DEBRIS FREE CONDITIONS NEAR SAMPLE SITE. HOLE FROM PREVIOUS CORE IS ~5 FEET AWAY.

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH ~~(FT)~~ INCHES	RECOVERY DEPTH ~~(FT)~~ INCHES	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS06G	1	549624.742	5277220.707	18FT/17°	4/20/09	1730	30	31"	27.5			

Foonotes: FISH OBSERVED A SILTY SAND BOTTOM WITH METAL, CABLE, AND WOOD DEBRIS IN THE VICINITY OF THE STATION. SOME GRAVEL WAS ALSO OBSERVED. OIL SHEEN OBSERVED AT THE TOP OF CORE AFTER IT WAS CUT AT THE MUD LINE.

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SAMPLING CREW: Herrera and RSS	DATA RECORDER: Alex Svendson (Herrera)	SAMPLING METHOD: Diver coring with 7-foot-long, 4-inch polycarbonate tubes using hammer/piston

STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS12G	1	SEE BELOW (FOOTNOTES)			4/20/09	1505	40	71.5"	62"			

Foonotes: DON NOTED A SOFT SILT BOTTOM WITH NO DEBRIS. NOTE: THE GPS COORDINATE WAS NOT LOGGED BY ERIC, BUT DON SAID THE HOLE FROM THE PREVIOUS CORE WAS ~2-3 FEET AWAY FROM THIS CORE.

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STATION ID	CORE NO.	X COORDINATE	Y COORDINATE	DISTANCE (FT)/ DIRECTION (DEGREES) FROM XY COORD.	DATE	TIME	WATER DEPTH (FT)	PENETRATION DEPTH (FT)	RECOVERY DEPTH (FT)	PERCENT RECOVERY	CORE INTERVAL (FT)	SEDIMENT CHARACTERISTICS (COLOR, TYPE, DEBRIS)
NS 18 G	1	549595.671	527080.557	25 FT / 42°	4/20/09	1620	39	74"	65.5"			

Foonotes: SOFT SILT BOTTOM ENCOUNTERED BY KMC DURING CORING, HOLE FROM PREVIOUS CORE ALSO OBSERVED BY KMC IN CLOSE PROXIMITY TO CORING LOCATION.