NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

DESCRIPTIVE REPORT

Type of Survey Hydrographic/Lidar

Project No. OPR-B370-KRL-04

Registry No. H11225

LOCALITY

State Connecticut

General Locality Long Island Sound

Sublocality Goshen Point to Black Point

2004

HYDROGRAPHER MARK SINCLAIR

CHIEF OF PARTY DARREN STEPHENSON

LIBRARY & ARCHIVES

DATE

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION **HYDROGRAPHIC TITLE SHEET**	REGISTRY NO. **H11225**
INSTRUCTIONS – The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office	FIELD No. **N/A**

State: Connecticut

General Locality: Long Island Sound

Sub-Locality: Goshen Point to Black Point

Scale: 1:10,000 **Date of Survey:** January 20 to March 05, 2004

Instructions dated: April 28, 2003 **Project No:** OPR-B370-KRL-04

Vessel: Tenix LADS Aircraft, VH – LCL

Hydrographer: Mark Sinclair **Chief of Party:** Darren Stephenson

Surveyed by: Michael Hawkins, Tom Farrow, Jeff Young, Graeme Stringfellow, Harry Newsham, Luke Chamberlain, Hugh Parker

Soundings taken by echo sounder, hand lead, pole: Laser Airborne Depth Sounder

Graphic record scaled by: Chris Johnson

Graphic records checked by: Mark Sinclair

Protracted by: N/A **Automated plot:** HP Design Jet 800PS

Verification by: ***Atlantic Hydrographic Branch Personnel***

Soundings in: Feet at MLLW

Bold, Italic, Red notes in the Descriptive Report were made during office processing.

REMARKS: Contract # DG 133 C-03-CQ-0011

Contractor: Tenix LADS Incorporated, 2548 Beach Blvd, Suite 200 Biloxi, MS, 39531

Sub contractor: Science Application International Corporation, 221 Third Street, Suite 200, Newport, RI 02840

LOWE Engineers LLC, Sugar Mill Road, Suite B-150, Atlanta, GA 30350

Times: All times are recorded in UTC

Purpose: The purpose of this survey is to provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area

Projection is UTM Zone 18

TABLE OF CONTENTS

DESCRIPTIVE REPORT TO ACCOMPANY HYDROGRAPHIC SURVEY ~~H11224~~ *H11225* SCALE 1:10000, SURVEYED 2004 TENIX LADS INC (TLI) MARK SINCLAIR, HYDROGRAPHER

PROJECT
Project Number: OPR-B370-KRL-04
Dates of Instructions: April 28, 2003
Original: DG 133 C-03-CQ-0011
Task Order: 0004
Dates of Supplemental Instructions: May 7, 2003 email regarding meeting with NOAA
January 16, 2004 Amendment to Statement of Work Task Order 0004
January 21, 2004 Amendment to Statement of Work Task Order 0004
February 19, 2004 email regarding ice in the bays
February 20, 2004 email regarding navigational aids

Sheet Letter: B
Registry Number: H11225

PURPOSE

The purpose of this survey is to provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.

A. AREA SURVEYED

The LADS Mk II aircraft operated out of Groton New London airport from January 20 to March 05, 2004. During this period 15 survey sorties were flown under Task Order 4 OPR-B370-KRL-04 in Long Island Sound, Connecticut.

The survey covers two sheets as follows:

a) Sheet A - H11224

b) Sheet B - H11225

Each sheet has a separate Descriptive Report. However one Data Acquisition and Processing Report,* Vertical and Horizontal Control Report* and Separates Report* covers both sheets. This Descriptive Report covers Sheet B.

The survey area is shown in Figure 1.

Environmental factors such as wind strength and direction, cloud cover, ice and water clarity influenced the area of data acquisition on a day by day basis. See section B.2

** Data filed at the Atlantic Hydrographic Branch (AHB).*

The planned and actual linear miles sounded for the areas are provided at Appendix III.

The sheets limits for H11225 are as follows:

NW Corner	41.3298064159	-72.2626410157
SE Corner	41.2476409648	-72.0987355458

The limits of Sheet B have been changed in order to overlap with Sheet A (H11224) which was moved in order to include the area around Race Rock and part of the south coast of Fishers Island. The size of Sheet B was amended to make it the same as Sheet A.

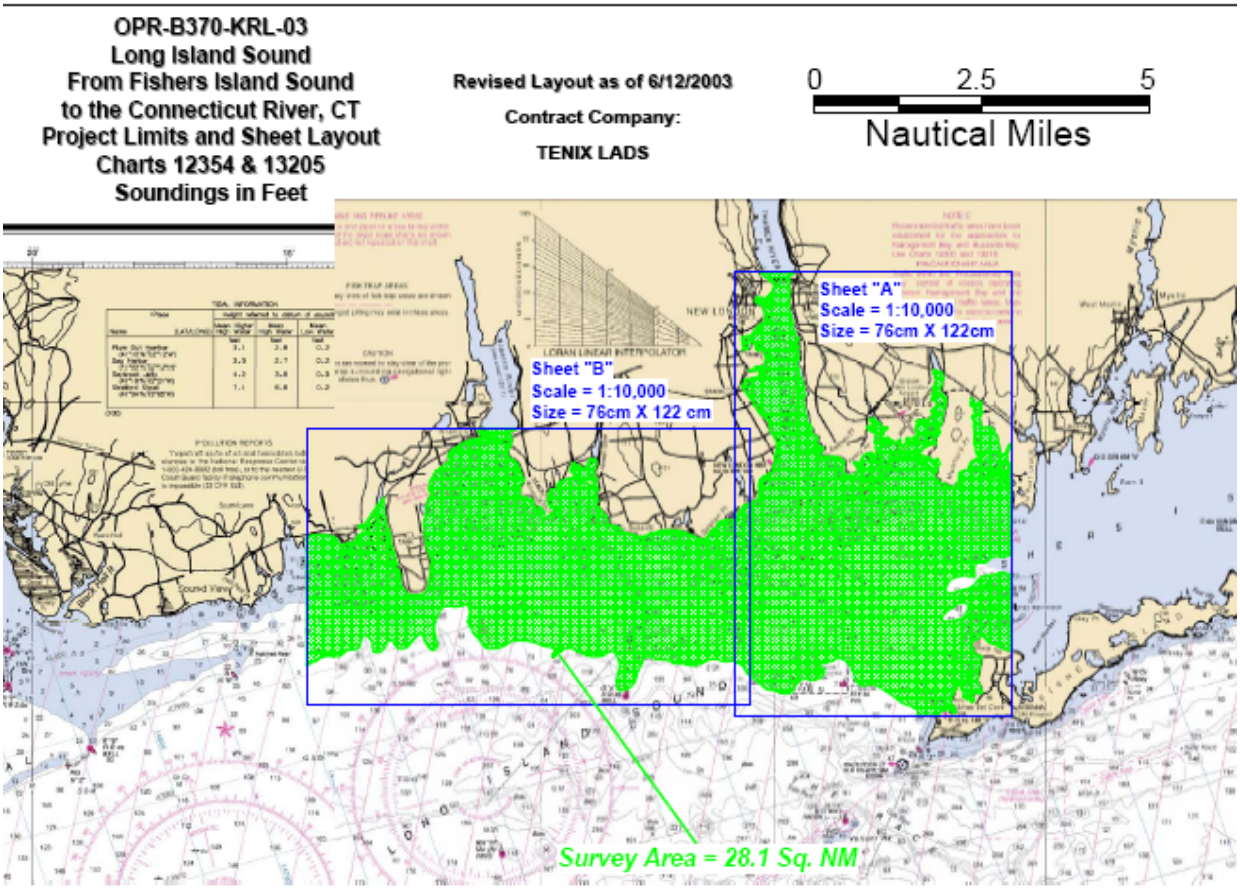


Figure 1 - Survey Area for Task Order 4

B. DATA ACQUISITION AND PROCESSING

See also the Evaluation Report.

Refer to the Data Acquisition and Processing Report* for a detailed description of the equipment, processing and quality control procedures. A general description and items specific to this survey are discussed in the following sections.

B.1 EQUIPMENT

Data collection was conducted using the LADS Mk II Airborne System, data processing using the LADS Mk II Ground System and data visualization, quality control and final products using Caris HIPS 5.3, GMT/VTK, Terramodel and MicroStation version 8.

B.1.1 Airborne System

The LADS Mk II Airborne System (AS) consists of a Dash 8-200 series aircraft, which has a transit speed of 250 knots at altitudes of up to 25,000 feet and an endurance of up to eight hours. Survey operations are conducted from heights between 1,200 and 1,800 feet at ground speeds between 140 and 175 knots. The maximum operating altitude has since been increased to 2200 feet. The aircraft is fitted with a Nd: YAG laser which is eye safe in accordance with ANSI Z136.1-2000, American National Standard for Safe Use of Lasers. The laser operates at 900 Hertz to provide 5x5 or 4x4 meter laser spot spacing in the main line sounding mode of operation, and is mounted on a stabilized platform. These modes require an aircraft speed of 175 or 140 knots over the ground, and operate across a laser swath width of 240 or 192 meters. The electro-mechanical scanner also provides examination modes of sounding with laser spot spacings of 3x3 and 2x2 meters and swath widths of 100 and 50 meters respectively.

Green laser pulses are scanned beneath the aircraft in a rectilinear pattern. The pulses are reflected from the land, sea surface, within the water column and from the seabed. The green returned laser energy is captured by the green receiver and then digitized and logged onto digital linear tape. An infra-red beam is also directed vertically beneath the aircraft. The height of the aircraft is determined by the infra-red laser return, which is supplemented by the inertial height from the Attitude and Heading Reference System and GPS height. The LADS Mk II system can operate by day and night, and operations at night are enhanced by removing a daylight filter from the receiving optics. Real-time positioning is obtained by either an Ashtech GG24 GPS receiver combined with Wide Area DGPS provided by Thales GeoSolutions or an Ashtech GG24 GPS receiver providing stand-alone GPS. Ashtech Z12 GPS receivers are also provided as part of the Airborne System and Ground Systems to log GPS data on the aircraft and at a locally established base station and provide post processed KGPS position solutions.

B.1.2 Ground System

The LADS Mk II Ground System (GS) Gandalf was used to conduct data processing in the field. Gandalf consists of a three 833 MHz CPU HP (Compaq) ES40 Alpha server with 1 GB

**** Data filed at AHB.***

EEC RAM, 764 GB disk space, digital linear tape (DLT) drives, digital audio tape (DAT) drive, CD ROM drive and is networked to up to 12 Compaq 1.5 GHz PCs and a HP 800pd Design Jet Plotter and QC workstations. Gandalf is transported in the LADS Mk II aircraft to the deployment site.

Quality control checks and editing of the data were conducted on Ground System Frodo or Ground System Forrest, each comprising a three 833 MHz CPU HP (Compaq) ES40 Alpha Server with 1 GB RAM, 600 GB disk space, digital linear tape (DLT) drives, digital audio tape (DAT) drive, CD ROM drive and is networked to up to 12 Compaq 1.5 GHz PCs and an HP 800ps Design Jet Plotter, printers and QC workstations.

The GS supports survey planning, data processing, quality control and data export. The GS component also includes a KGPS base station, which provides independent post-processed position and height data. A comprehensive description of the GS is provided in the Data Acquisition and Processing Report.**** Data filed at AHB.***

B.2 QUALITY

B.2.1 Data Density

The majority of the survey areas were sounded at 3x3 meter laser spot spacing with 40 meter line spacing, which provided the required 200% coverage.

The area inshore of the line from Bartlett Reef (eastern part of Sheet B) to Seaflower Reef (eastern part of Sheet A) was sounded using 3x3 meter spot spacing to provide IHO target detection.

The remainder was sounded using a 4x4 meter spot spacing. This includes the offshore areas seaward of the line between Bartlett and Seaflower Reefs. The western part of Sheet B including Niantic Bay, was also sounded at 4x4 meter laser spot spacing.

At the sea surface the footprint of the laser beam is approximately 2.5 meters in diameter. As the beam passes through the water column it slowly diverges due to scattering. It should be noted that at 4x4 meter laser spot spacing there is a gap of between 1 to 1.5 meters between the illuminated area of adjacent soundings at the sea surface. There is a possibility that small objects in shallow water along the coastline may fall between consecutive 4x4 meter soundings and not be detected. To achieve IHO target detection, 3x3 meter laser spot spacing is used.

B.2.2 Water Clarity

The water clarity in the survey area was generally good for laser survey. The maximum lidar depths measured during the survey exceeded 20 meters, although 10 meters was the generally achieved depth.

Some localized areas of turbidity were experienced in the survey area due to westerly winds. The westerly wind caused the plume from the Connecticut River to be blown into the survey

area causing large amounts of turbidity. A number of areas required several reflies in addition to the 200% planned coverage.

It was first envisaged to conduct this survey during the late summer of 2003. Secchi disk measurements were conducted on May 09 throughout the survey area indicated that depths to the 30-foot contour could be achieved under current conditions. This reconnaissance confirmed that the Connecticut River had a large impact in the water clarity of Long Island Sound. This eliminated the possibility of conducting lidar operations at the mouth of the Connecticut River, and Sheet C was removed from the draft statement of work.

It was planned that after lidar operations finished in Alaska that operations would commence in Long Island sound in late July however, a repeat of the secchi disk measurements on June 23 showed that the water clarity had deteriorated significantly since May 09; the commencement of operations was postponed until such time that the water clarity improved.
The secchi disk observations were repeated on June 27 and July 10 with the same results.
The secchi disk observations were conducted during the neap tide cycles and 3 hours before high tide when the tidal stream at its lowest flow to minimize sediment movement.

Further secchi disk readings were conducted on July 20 and August 09 with much the same results. Whilst in New London, the Tenix LADS Inc Survey Manager visited the Department of Marine Sciences at the University of Connecticut. A meeting was conducted with Ivar Bab who is a marine biologist and is the director of the National Undersea Research Center and James O'Donnell, Professor of Physical Oceanography, to discuss the water clarity of Long Island Sound.

It was their opinion that there are two main influences on water clarity in Long Island Sound. Firstly, the temperature of the water needs to be cold to minimize the growth of biological matter. Secondly, the flow of the Connecticut River should be at its lowest. Looking at these two factors it was determined that the months when the water would be the clearest is from the month of January through to April.

The water temperature was monitored on the Internet form a series of buoys that the University of Connecticut has deployed which among other things log water temperature. The web site is www.mysound.ucomm.edu

Further secchi disk observations conducted on October 08, November 16, November 17 and December 05 indicated that the water clarity was improving but was still not good enough to deploy and commence survey operations.

On January 11 the secchi disk readings showed that the water had cleared enough to deploy and commence survey operations. This was the eleventh water clarity reconnaissance that had been conducted in Long Island Sound. The water clarity in the survey area varied during the course of the survey. Operations were conducted in the most suitable areas. The collection of 200% coverage of the survey area provided additional data on a different day, which enabled the coverage to be improved.

The water clarity also improved towards the end of the survey. On the last three sorties the best data was obtained, and the opportunity was taken to collect additional data to improve coverage in a number of areas.

B.2.3 Data Management

The survey area was managed in one database referred to as 'Connecticut'. A detailed table of the line numbers is presented in the Data Acquisition and Processing Report.*****

B.2.4 Data Acquisition

Survey operations were planned when suitable weather conditions prevailed. The first survey sortie was flown on January 25, 2004. Survey sorties were conducted when there was minimal low cloud in the survey area. In general the aircraft departed at 1500 hours local time to take advantage of the better GPS satellite availability and geometry and returned at 2100 hours local time. Flying into the night enabled the day filter to be removed and the receiver gains to be increased to allow for more depth penetration. Also flying into the night allowed for minimal air traffic along the coast to cause delays due to air traffic control conflicts.

The department of Homeland security was notified of our survey operations as the Groton nuclear submarine base and Millstone nuclear power plant were in the survey area.

The final survey sortie was conducted on March 03, 2004.

B.2.5 Sea Conditions - Sea State, Waves, Swell, White Water

The sea state ranged from 1 to 2-3 throughout the survey, and was generally between states 1 and 2.

Very calm seas were experienced on occasions. Under such very calm conditions the sea may become glassy which degrades the sea surface model. When such conditions existed, survey operations were diverted to a more suitable area.

Long period swell was not significant during the survey.

B.2.6 No Bottom At (NBA)

NBA depths have been assigned to noise pulses where the water was too dirty or too deep to detect the seabed. The NBA depth is assigned based on inspection of the raw laser waveforms. In the opinion of the hydrographic surveyor the NBA depth is a depth less than which seabed returns are not expected. Areas where NBA depths have been assigned can be seen from the gray areas on the coverage plots.

In general, NBA areas in deep water have been retained in the data set. In shallow water, NBA areas have been rejected from the data where better data was collected on a subsequent flight; in this case the NBA area is superseded.

**** Data filed at AHB.***

In some shallow areas, data has been collected which is partly good but contains NBA depths. In some cases this data has been retained to improve the coverage of the seabed. Where this has occurred, the gray NBA areas can be seen overlaying the seabed on the coverage plot.

B.2.7 Nature of the Seabed

From Goshen Ledge to Seaside Point there are a number of rocky outcrops and ledges inside the 30 foot isobath.

Bartlett Reef and Twotree Island are rocky ridges which stand out of a sandy sedimentary seabed. Twotree Island Channel passes to the north of these features and is sedimentary. In the eastern entrance to the channel, west of Little Goschen Reef, there are sandwaves on the northern side of the channel in deeper water. Rocky outcrops rise above the 20 feet isobath further west on the north side of the channel.

The bay at the outlet of Jordan Cove is sedimentary with a number of rock outcrops inshore the 30 foot isobath.

Niantic Bay is moderately deep and sandy. There are rocks on the eastern side in the vicinity of White Rock, and on the western shore, in the vicinity of Threefoot Rock, but the center of the bay is clear and sedimentary. There are some rocks and foul areas inshore of the 15 foot isobath on both sides of the bay. There is also a shoaling on the sandbank on the NW side of the channel which runs NE into the entrance to the Niantic River.

West of Black Point the seabed is sandy with a number of rocky ridges running south from Giants Neck to Hatchett Point, which give rise to a number of islets and rocky outcrops.

Further west, the area becomes less suitable for lidar, as the Connecticut River is approached.

B.2.8 Datums

On completion of each flight the GPS data logged on the aircraft and at the base station was processed to determine the Post Processed KGPS position and height of the aircraft. This data is used in the calculation of the sea surface datum.

B.2.9 Wind

Survey operations were conducted in wind strengths of up to 25 knots during the survey. In general the wind strength during the time of survey was around 10 knots. The direction of the wind had a significant influence on the area for survey operations such that a day of calm winds was required after strong westerlies to settle down the turbidity.

B.2.10 Cloud

Low cloud was a factor. The winter storms affected the cloud base in the survey area as they passed by. The progress of the storms and marine conditions were managed as follows from a variety of internet sites:

1. Generic weather was obtained from two sources www.weather.com and from the National Weather service for Groton at www.crh.noaa.gov/forecasts. Both of which gave 7 day forecasts which were used for planning purposes.
2. United States Coastal Marine Forecasts located at www.nws.noaa.gov/om/marine/zone/east/okxmz.html which provide marine wind speed and direction forecast for 5 days.
3. A NOAA website provided METAR data, actual wind speed and direction, cloud base and satellite cloud data for Groton New London Airport which was in the survey area. The observations were updated every hour. The site is www.srh.noaa.gov/data/obshistory/KGON.html.

B.2.11 Effects of High Ground

High ground did not affect survey operations.

B.2.12 Effects of Ice

Extremely cold temperatures caused ice to form in the sheltered rivers and bays along the coast.

Ice caused the NOAA tide gauge in New London Harbor to cease operation, and the gauge at Silver Eel Pond had to be used for tide control on a number of occasions.

In addition, the formation of ice in Jordan Cove, Niantic River and Pattagansett River limited the lidar coverage in parts of these areas. See Appendix V, Supplemental Survey Records and Correspondence.

B.2.13 Drying Heights and Topographic Data

Topographic data has been collected up to a height of approximately 20 meters above the water level at the time of acquisition.

In the digital data, drying heights and topographic heights are above the MLLW datum in negative meters. On the hardcopy smooth sheet and MicroStation files, drying heights are expressed in negative feet above MLLW and topographic heights above 2.3 feet above MHW are expressed in feet above MHW.

It should be noted that on islets which have a height above 20 meters, the maximum height of the island may not have been measured. In such cases in the Results and Recommendations section the annotation ‘Height of islet > 33 feet’ would be used.

The topographic height range of the LADS MkII system has since been extended to 50 meters.

B.2.14 Receiver Gain

Changes in gain levels in the Airborne System automatically accommodate for changes in the sea surface, water column and seabed conditions. In some areas after long over-land passages low gains levels were initially set on passing back over the water. Where this has been identified in the data these lines were reflown from the opposite direction to improve the coverage.

B.2.15 Data Processing

The data was processed at the operating site in Mystic on return from each sortie. Initial validation of the data was conducted at this site. Final validation, checking and approval by hydrographic surveyors were then conducted back at either the Tenix LADS depot in Biloxi, MS or Adelaide, South Australia.

The data quality improved on the last three flights due to a lowering of turbidity in late February and early March.

At this time, a number of areas were reflown to obtain better coverage. In areas where this has been achieved, the later data has been retained, and any turbid data from earlier flights that has been superceded has been rejected from the final data set.

B.2.16 Progress Sketches

Progress sketches were provided to NOAA on a bi-weekly basis from the commencement of operations.

B.2.17 Final Data

Final data for Task Order 4 was delivered on December 29, 2004.

B.3 DIGITAL DATA FORMATS

Refer to the Data Acquisition and Processing Report Appendices I and II. ***Data filed at AHB.***

B.4 BENCHMARK AND CROSS TIE RESULTS

B.4.1 Benchmark Areas

Four depth benchmark areas were created from the LADS data. Two benchmarks lay along a line south of Fishers Island and through Fishers Island Sound on sheet A and two more benchmarks on a line across Goshen Reef offshore Goshen Point on sheet B. These benchmarks were surveyed to check the system accuracy.

Center coordinates for the benchmark areas are as follows:

Goshen Benchmark Line (Sheet B)

Benchmark Name	Nominal Depth	Easting (NAD 83)	Northing (NAD 83)
BM_3	4.5 m	742 117	4 575 774
BM_4	5.6 m	740 617	4 575 818

Table 1 – Benchmarks

Either one or both benchmark lines were flown during each sortie. The total number of benchmarks compared during the survey was 38. The tidal model in use for the comparison of benchmarks was the same as for main line sounding and benchmark comparisons were conducted after the application of verified tides. Comparison summaries are provided in the Separates. ***Data filed with field records.***

The LADS data is compared against the gridded benchmark surface in the GS and statistics are generated which include the number of points compared, the Mean Depth Difference (MDD) and the Standard Deviation (SD) between the data sets. The benchmark comparison function compares the data against the benchmark surface, and as this data is unedited it may contain noise normally removed during the validation process which is flagged as the shoalest and deepest differences.

B.4.1.1 Mean Depth Differences (MDD) and Standard Deviation (SD)

The averages of the mean depth differences and standard deviation for each benchmark run are as follows:

Goshen Benchmarks (Sheet B)

GS ID	BM Name	Nominal Depth	Average MDD	SD
3	BM_3	4.5 m	0.10 +/- 0.05	0.08 +/- 0.01
4	BM_4	5.6 m	0.08 +/- 0.06	0.09 +/- 0.01

Table 2 – Benchmark Results

These results are excellent and show that the depth difference means and the standard deviation of all the benchmarks are very consistent. These results indicate that the LADS Mk II system operated correctly.

B.4.2 Cross Tie Comparisons

Crosslines were planned after the majority of main lines had been completed. Areas were selected where the seabed was reasonably flat. This minimizes the apparent differences in depths due to minor positional differences, which occurs in steeper areas of seabed.

Five crosslines were sounded at 4x4 meter laser spot spacing, three of which are on Sheet B:

Sheet B

Line 50.0.1	43 crossline intersections.	West of Black Point.
Line 51.0.1	83 crossline intersections.	Into Niantic Bay.
Line 52.0.1	105 crossline intersections.	West of Goshen Point.

B.4.2.1 Mean Depth Differences (MDD) and Standard Deviation (SD)

The averages of the mean depth differences and standard deviation for each crossline are as follows:

Reference Line Number	Sortie Flown	Lines Compared	Soundings Compared	Mean Depth Difference at Intersection	Standard Deviation	Mean Normalised Confidence
Sheet B						
50.0.1	13	15	28432	-0.13 +/- 0.08	0.10 +/- 0.03	6.7
51.0.1	13	22	52944	-0.13 +/- 0.05	0.08 +/- 0.02	6.7
52.0.1	13	28	56138	-0.05 +/- 0.10	0.10 +/- 0.03	6.4

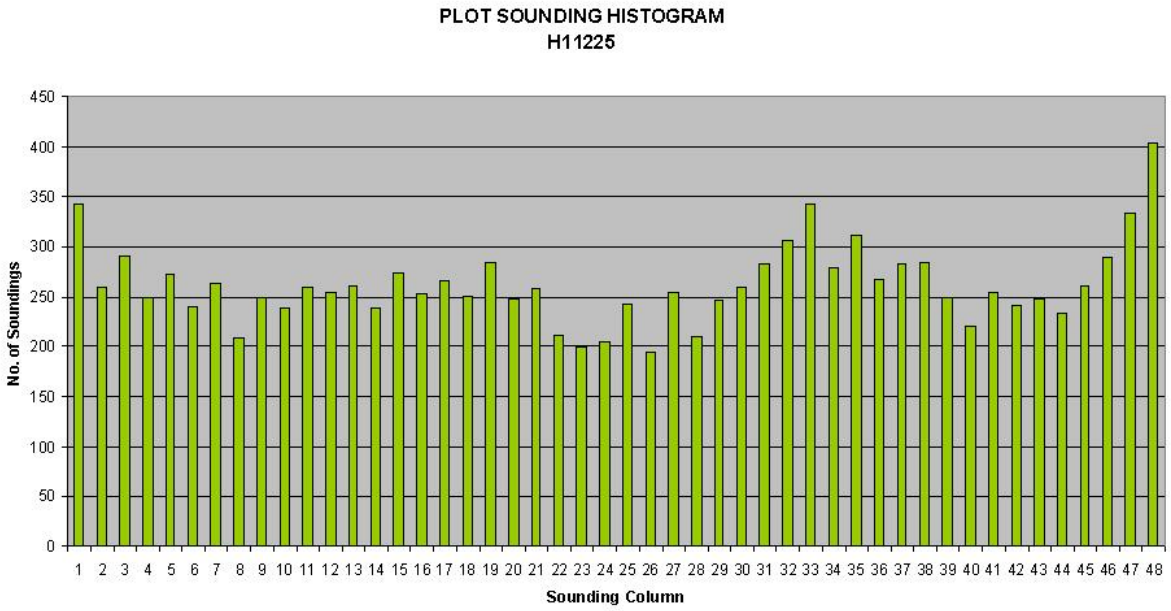
Table 3 – Crossline Comparison Results

Crossline comparison details are provided in the Separates Report. ***Data filed with field records.***

These results are consistent with IHO Order-1 depth accuracy.

B.5 ANALYSIS OF RESULTS

A sounding histogram has been produced of the column and occurrence of each sounding shown on the smooth sheet. The graph shows there is no significant scan angle bias in the data, however a higher yield from columns 1 and 48 is observable.



Graph 1 – Sounding Histogram Smooth Sheet H11225

B.6 POSITION CHECKS

Two independent positioning systems were used during the survey. Real-time positions were determined by stand-alone GPS with differential corrections input from the Thales LandStar system using the Auburn Wide Area Differential GPS reference station. A post processed KGPS position was also determined relative to a local GPS base station which was established on the rooftop of a hanger at the Groton New London Airport. The post processed KGPS position and height were applied to soundings during post-processing.

Position checks were conducted prior to, during and following data collection, as follows:

a. DGPS Site Confirmation. A 24-hour certification was conducted of the local GPS base station established at the Groton New London Airport.

b. Static Position Check. Prior to commencing data collection the coordinates of the aircraft GPS antenna were determined relative to three marks, which were surveyed on the tarmac at the Groton New London Airport. Data was then logged by each LADS Mk II positioning system enabling the positions to be checked against the known surveyed points. The accuracy of the KGPS (PNAV C/A code + carrier phase) during the static position check was 0.08 meters (95% confidence). The results and details of the static position check are enclosed in Vertical and Horizontal Control Report. ***Data filed at AHB.***

c. Dynamic Position Check. During each sortie GPS data was logged on the aircraft and at the local GPS base station. This provided a check between the real-time GPS and post-processed positions. The mean difference between the real-time and post-processed position ranged from 0.706 to 1.173 meters, with the mean standard deviation from 0.142 to 0.283 meters. Details are provided in the Vertical and Horizontal Control Report. ***Data filed at AHB.***

d. Position Confidence. The position quality was also monitored by checking a post-processed position confidence (C3), which is determined from the AS platform error, GPS error and residual errors between the actual GPS positions and aircraft position as determined from the line of best fit. No position anomalies were detected.

The position checks provided results that were within the expected tolerances and showed that the positioning systems were functioning as expected.

B.7 CORRECTIONS TO SOUNDINGS

Refer to the Data Acquisition and Processing Report for a description of corrections to soundings, which demonstrates that corrections to the soundings were being applied correctly. ***Data filed at AHB.***

There were no deviations from the corrections described therein.

C. VERTICAL AND HORIZONTAL CONTROL

Refer to the Vertical and Horizontal Control Report* for a detailed description of the vertical and horizontal control used during this survey. A summary of vertical and horizontal control for the survey follows.

C.1 VERTICAL CONTROL

Vertical control for the survey was based on the Mean Lower Low Water tidal datum (MLLW) from the NOAA station at New London Harbor (8461490) and when this was frozen the NOAA station Silver Eel Pond (8510719) was used.

Station details are as follows:

			WGS84	
Gauge	Location	GS No.	Latitude	Longitude
8461490	New London Harbor	TS1	41° 21.3' N	072° 05.2' W

Table 4 – New London Harbor Tide Gauge

			WGS84	
Gauge	Location	GS No.	Latitude	Longitude
8510719	Silver Eel Pond	TS2	41° 15.4' N	072° 01.8' W

Table 5 – Silver Eel Pond Tide Gauge

C.2 ZONING

Tide zones that cover the extent of the survey area were supplied by NOAA with time and range correctors relative to New London Harbor NOAA gauge (8461490) and Silver Eel Pond (8510719).**

During the course of the survey, the gauge at New London Harbor stopped operating due to the formation of ice. During these periods, the NOAA gauge at Silver Eel Pond (8510719) was used. NOAA provided new time and range correctors for all tide zones relative to the Silver Eel Pond gauge.**

A list of tide zones and correctors is provided on page A-3 of Vertical and Horizontal Control Report.** ***Approved tides and zoning were applied during field processing.***

A table of sortie information including which tide gauge was used at what time is provided in Appendix IV in the Abstract of Times of Hydrography.

* ***Data filed at AHB.***

When soundings are exported, there is a datum change from MLLW and MHW between soundings and heights. The Silver Eel Pond gauge was used as datum control for the project, and used to determine the MHW value within each tide zone.

Prior to the commencement of the survey, a tidal zoning analysis of the areas was conducted by surveying company 'Science Applications International Corporation' in Newport Rhode Island. The result of this analysis concluded that the zoning provided by NOAA should be adequate to meet the accuracy specifications for soundings and the datum jump between tide zones should be below 0.09 meters with the majority of the differences in the 5 centimeter range. A complete copy of this analysis can be found in Appendix VI of the Vertical and Horizontal Control Report. **** Data filed a AHB.***

The verified tides supplied by NOAA were independently checked by SAIC. The tides were compared to predictions at the time of survey to ensure that there were no meteorological effects at the tide gauge. Once the data was checked a fifth degree polynomial was applied to the tidal data and this data was then supplied to Tenix LADS Inc.

For final processing, tidal correctors were applied to the tidal data provided by SAIC. The time and height correctors listed above were used for processing the data for tides.

Data across zone boundaries showed no data steps, the crosslines also showed no data deviation across the tidal zones. The preliminary tidal zoning has been considered adequate and therefore the preliminary tide zoning correctors have been considered to be the final zoning correctors. ***Approved tides and zoning were applied during field processing.***

C.3 HORIZONTAL CONTROL *See also the Evaluation Report.*

Data collection and processing were conducted on the Airborne and Ground Systems in World Geodetic System (WGS84) on Universal Transverse Mercator (Northern Hemisphere) projection UTM(N) in Zone 18, Central Meridian 075° West. All units are in meters. This data was post-processed and all soundings are relative to the North American Datum 1983 (NAD83).

C.3.1 LADS Local GPS Base Station – Groton

A local GPS base station was established by LOWE Engineers on the roof of a hanger at Groton New London Airport, Connecticut on June 19 2003. A 24 hour DGPS site certification was conducted on the local GPS base station prior to survey operations.

The derived NAD83 coordinates for the local GPS base station, are:

NAD83		UTM (N)		
Latitude (N)	Longitude (W)	Easting (m)	Northing (m)	Ellipsoidal Height (m)
41°19'57.09717"	072° 02'53.52459"	747 013.089	4 579 876.001	-21.139

Table 5 – GPS Base Station

Real-time WADGPS positions were determined using an Ashtech GG24 GPS receiver, and differential corrections received via the Thales LandStar system from the Auburn Wide Area Differential GPS reference station.

Post-processed positions were determined off-line using data logged at the base station and on the aircraft. This data was processed through Ashtech PNAV software to calculate both a DGPS and Coarse Acquisition (C/A) code + carrier phase smoothed position solution. The C/A code + carrier phase smoothed positions were then imported into the GS and were applied to all soundings. This provided increased sounding position accuracy and horizontal redundancy.

A static position check was conducted at New London airport. Real-time and post-processed positions were compared against marks surveyed on the tarmac. The check demonstrated the systems were operating correctly.

A dynamic position check was also conducted between the real-time and post-processed positions during survey operations. This check also demonstrated the two position solutions were consistent throughout the survey. Details of the geodetic observations, position checks and assessment of position accuracy are provided in the Vertical and Horizontal Control Report. ***Data filed at AHB.***

D. RESULTS AND RECOMMENDATIONS ***See also the Evaluation Report.***

Recommendations for charting action are provided in D.1.

During the checking and approval of the data, some features were identified which require further investigation. These are provided in D.2.

A number of Navigation Aids were detected during the survey. These are provided in D.3.

The recommended overlap for boat work is provided in D.4.

A number cultural features were detected in the data and verified by the downward looking video are shown as solid black lines on the smooth sheet.

D.1 CHART COMPARISON SPREADSHEET – H11225 *See also the Evaluation Report.*

Sheet B was compared to charts:

- 13211 14th Edition, September 11/04
- 13212 36th Edition, March 6/04
- 13213 41st Edition, March 13/04

The chart comparison was conducted by reviewing the chart, the lidar sun-illuminated images and the lidar smooth sheet in MicroStation. For each item identified, screen dumps of the Local Area Display and Raw Waveform Display were extracted from the LADS Mk II Ground System. These have been reviewed in order to make the following assessments:

a. Type of Feature
b. Kelp Area
c. Further Examination Recommended
d. Charting Recommendation
e. Remarks

Each chart comparison was categorized as follows:

1. New shoal found
2. Charted shoal disproved
3. Charted shoal not found / disproved

There are 129 items in the chart comparison. They are provided in the chart comparison table on pages D-4 top D-16. To assist in data handling, a full digital version of the chart comparison spreadsheet is also provided on CD in Excel format with the digital data (SheetB_V1_ChartComp.xls). The screen dumps of the Local Area Display and Raw Waveform Display are provided with the digital data to assist review. They are in a sub-directory *Screen_Dumps* as .jpg files which are hyperlinked to the spreadsheet to assist review.

The items in the chart comparison have been given a unique identifier (B1 to B129). This identifier with its associated position is also provided as a .dgn file to assist in data handling. It is provided with the digital data (SheetB_V1_ChartComp.pzip) in MicroStation Version 7 format.

The fields in Chart Comparison spreadsheet have been developed from experiences learned and feedback received from previous lidar surveys in Alaska, witnessing survey operations in NOAA ship RAINIER and from meetings at PHB and UNH. They have been designed for ease of use and to minimize double handling of data and transcription. Feedback is welcomed in order to develop these formats in order to achieve further efficiencies in data handling.

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
1	B1	1				2.39	8	41.292493	-72.243847	Rk	Y	Y	N/A	Area of poor coverage *
2	B2	2	Rk	41.297016	-72.228312	1.74	5	41.297073	-72.228289	Rk	Y	Y	Retain	Area of poor coverage *
3	B3	2	7	41.292940	-72.228433	3.76	12	41.292839	-72.228222	Rk	Y	Y	Retain	Area of poor coverage *
4	B4	2	Rock which covers, uncovers	41.292438	-72.228307	1.93	6	41.292324	-72.228133	Rk	Y	Y	Retain	Area of poor coverage *
5	B5	1				0.65	2	41.291947	-72.228154	Rk	Y	Y	N/A	Area of poor coverage, close N *
6	B6	2	Rock awash	41.291569	-72.227338	1.17	4	41.291379	-72.227170	Rk	Y	Y	Retain	Area of poor coverage, close N *
7	B7	2	Rock which covers, uncovers	41.290488	-72.227404	2.95	9	41.290361	-72.227186	Rk	Y	Y	Retain	Area of poor coverage, close N *
8	B8	2	12	41.288679	-72.227031	3.24	10	41.291547	-72.227007	Rk	Y	Y	N/A	Kelp.See item 16. Danger to Navigation Report *
9	B9	1				3.77	12	41.285051	-72.225338	Rk	Y		Insert	**
10	B10	1	27	41.284905	-72.224231	5.27	17	41.285184	-72.223960	Rk	Y		Insert	**

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
11	B11	2	3	41.283624	-72.224413	1.75	5	41.283786	-72.224069	Rk	Y		Retain	Area of poor coverage 5m East **
12	B12	1				1.73	5	41.289423	-72.221359	Rk	Y	Y	N/A	Small gap in coverage on shoal and shoal close W *
13	B13	1				2.14	7	41.288694	-72.221685	Rk	Y	Y	Insert	**
14	B14	1				2.33	7	41.288121	-72.221795	Rk	Y		Insert	**
15	B15	2	2	41.287766	-72.222403	1.40	4	41.287669	-72.222310	Rk	Y		Retain	Area of poor coverage, close W *
16	B16	1				3.78	12	41.286405	-72.221780	Rk	Y		Insert	See item 2. Danger to Navigation Report. Note B17 95m SW *
17	B17	1	41	41.286017	-72.220907	5.31	17	41.285849	-72.220891	Rk	Y		Replace	**
18	B18	2	19	41.285444	-72.218576	5.25	17	41.285365	-72.218306	Rk	Y		Replace	**
19	B19	1				8.41	27	41.277810	-72.221978	Rk	Y		Insert	See item 4. Danger to Navigation Report *
20	B20	1				9.11	30	41.278746	-72.221028	Rk	Y		Insert	**

**** See final charting recommendation in feature report of the Descriptive Report.***

***** Shoaler features and/or depths in close proximity. Do not chart.***

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
21	B21	2	26	41.280251	-72.216962	10.18	33	41.280354	-72.216929	Rk	Y	Y	Retain	Turbid *
22	B22	2	6	41.289001	-72.215439	2.89	9	41.288954	-72.215542	Rk	Y	Y	Retain	4*4 meter spot spacing may not have detected least depth *
23	B23	2	24	41.282739	-72.216375	6.57	21	41.282778	-72.216522	Rk	Y		Replace	See item 5. Danger to Navigation Report *
24	B24		21	41.281074	-72.211034	5.75	19	41.280839	-72.211125	Rk	Y		Replace	**
25	B25		36	41.279816	-72.204473	10.29	33	41.280163	-72.204789	Bank			Replace	**
26	B26	1	33	41.281451	-72.202645	8.64	28	41.281007	-72.202495	Rk			Replace	See item 7. Danger to Navigation Report *
27	B27		Rock awash	41.284681	-72.206386	3.29	11	41.284705	-72.206631	Bank		Y		Not found, existance doubtful *
28	B28	1	15	41.292053	-72.200792	2.80	9	41.292387	-72.200878			Y		Possible obstruction *
29	B29	2	5	41.297271	-72.201686	2.39	8	41.297513	-72.201568	Rk	Y	Y	Retain	Lesser depths may exist at 4*4 meter laser spot spacing. *
30	B30	3	4	41.298040	-72.201399	3.39	11	41.298001	-72.201544	Bank		Y	Retain	Existance doubtful, however, lesser depths may exist at 4*4 meter laser spot spacing. *

**** See final charting recommendation in feature report of the Descriptive Report. ** Shoaler features and/or depths in close proximity. Do not chart.***

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
31	B31	2	15	41.302084	-72.200966	3.52	11	41.302256	-72.201240	Rk	Y	Y	N/A	Turbid *
32	B32	2	6	41.304813	-72.201830	1.15	4	41.304981	-72.202127	Rk	Y	Y	N/A	Area of poor coverage N *
33	B33	2	9	41.310280	-72.199828	2.32	7	41.310253	-72.200020	Rk	Y	Y	N/A	Rock in Kelp / Insufficient coverage *
34	B34	1				2.44	8	41.305115	-72.197119	Rk	Y		Insert	See item 8. Danger to Navigation Report *
35	B35	1				5.32	17	41.309220	-72.193532	Bank			Insert	Turbid **
36	B36	2	6	41.315917	-72.198214	1.65	5	41.315565	-72.198219	Rk	Y		Replace	**
37	B37	1				2.80	9	41.317517	-72.193009	Rk	Y	Y	N/A	Kelp area
38	B38	1	5	41.321164	-72.179855	0.41	1	41.321247	-72.179802	Bank			Replace	**
39	B39	2	5	41.320042	-72.182334	1.05	3	41.319984	-72.181976	Bank			Replace	**
40	B40	2	Rock awash	41.317812	-72.179453	0.69	2	41.317921	-72.179798	Rk	Y		Retain	Foul area ***Concur Retain as charted.***

**** See final charting recommendation in feature report of the Descriptive Report.***

***** Shoaler features and/or depths in close proximity. Do not chart.***

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
41	B41	2	10	41.314084	-72.178820	2.50	8	41.313971	-72.178415	Rk	Y		Replace	**
42	B42	2	9	41.310190	-72.177997	2.19	7	41.310417	-72.177905	Rk	Y		Replace	**
43	B43	2	Rock which covers, uncovers	41.309801	-72.177762	1.14	3	41.309904	-72.177646	Rk	Y	Y	Retain	Foul area *
44	B44	1				4.93	16	41.304350	-72.171236	Rk	Y		Insert	See item 15. Danger to Navigation Report. *
45	B45	1				4.76	15	41.304425	-72.170389	Rk	Y		Insert	**
46	B46	2	Rock awash	41.302797	-72.174309	0.61	2	41.302760	-72.174642	Rk	Y		Retain	*Concur See AWOIS 12148 for charting recommendation.*
47	B47	2	Rock which covers, uncovers	41.303017	-72.174278	1.02	3	41.303054	-72.174121	Rk	Y		Retain	*Concur See AWOIS 12148 for charting recommendation.*
48	B48	1	17	41.303548	-72.164135	3.67	12	41.303609	-72.164149	Rk	Y		Replace	See item 14. Danger to Navigation Report. *
49	B49	1	9	41.304129	-72.164407	1.40	4	41.304102	-72.164390	Rk	Y		Replace	Foul **
50	B50	2	Rock awash	41.304540	-72.163869	1.30	4	41.304555	-72.163642	Rk	Y		Retain	Foul *Concur Retain as charted.*

** See final charting recommendation in feature report of the Descriptive Report. ** Shoaler features and/or depths in close proximity. Do not chart.*

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
51	B51	1				2.63	8	41.304331	-72.160709	Rk	Y		Insert	**
52	B52	2	14	41.306609	-72.158380	3.12	10	41.306330	-72.158792	Rk	Y	Y	N/A	Kelp. See item 9. Danger to Navigation Report *
53	B53	1				2.62	8	41.306817	-72.159754	Rk	Y		Insert	**
54	B54	2	Rock awash	41.307907	-72.160254	0.61	2	41.307848	-72.160136	Rk	Y		Retain	Small gap in coverage, close N ***Concur Retain as charted.***
55	B55	1				3.32	11	41.308362	-72.156874	Rk	Y	Y		Possible Rk in kelp *
56	B56	1	32	41.299453	-72.154292	8.55	28	41.299255	-72.154385	Rk	Y	Y	N/A	Turbid. See item 10. Danger to Navigation Report *
57	B57	2	Rock which covers, uncovers	41.297098	-72.152681	0.54	2	41.297062	-72.152703	Rk	Y		Retain	***Concur Retain as charted.***
58	B58	2	Rock awash	41.295951	-72.154218	1.77	6	41.295925	-72.154325	Rk	Y		Retain	Foul close E ***Concur Retain as charted.***
59	B59	3	Rock awash	41.295416	-72.154380	3.65	12	41.295246	-72.154515		Y	Y	Retain	Charted Rk close N not found, Foul to E *
60	B60	1				-9.83	30	41.294737	-72.153604			Y		Possible Obst *

**** See final charting recommendation in feature report of the Descriptive Report.*** ***** Shoaler features and/or depths in close proximity. Do not chart.***

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
61	B61	1				-8.34	25	41.294595	-72.153683			Y		Possible Obst *
62	B62	1				-14.14	44	41.294328	-72.153561			Y		Possible Obst *
63	B63	2	24	41.287795	-72.156843	8.06	26	41.287642	-72.157144	Rk			Replace	**
64	B64	2	foul	41.293001	-72.151916	0.91	3	41.292830	-72.151998	Rk	Y		Retain	F, N and S (more)**
65	B65	2	7	41.306407	-72.151291	3.05	10	41.306464	-72.151115	Rk	Y	Y	Retain	4*4 meter spot spacing may not have detected least depth. *
66	B66	2	Rock awash	41.304466	-72.149769	1.05	3	41.304448	-72.149349	Rk	Y		Retain	Foul area ***Concur Retain as charted.***
67	B67	2	Rock which covers, uncovers	41.305828	-72.146924	0.98	3	41.305745	-72.146705	Rk	Y		Retain	Foul area ***Concur Retain as charted.***
68	B68	1	10	41.305012	-72.146618	1.37	4	41.305166	-72.146743	Rk	Y	Y	N/A	*Kelp. See item 12. Danger to Navigation Report
69	B69	2	12	41.303617	-72.148985	3.12	10	41.303198	-72.149328	Rk	Y	Y	N/A	*Turbid. See item 13. Danger to Navigation Report
70	B70	1				2.82	9	41.302230	-72.144075	Rk	Y		Insert	Foul close NE ***Retain as charted.***

**** See final charting recommendation in feature report of the Descriptive Report.***

***** Shoaler features and/or depths in close proximity. Do not chart.***

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
71	B71	1				3.19	10	41.300909	-72.142553	Rk	Y		Insert	**
72	B72	2	6	41.301130	-72.142137	2.35	7	41.301248	-72.141826	Rk	Y		Replace	Charted 6 is generalised representation of shoals 71 and 72. ***Concur*** ***Retain as charted.***
73	B73	1				2.95	9	41.301062	-72.141059	Rk	Y		Insert	**
74	B74	1	7	41.300627	-72.139729	1.29	4	41.300744	-72.139549	Rk	Y	Y	N/A	Rock in kelp **
75	B75	1	10	41.300056	-72.136925	2.09	7	41.300205	-72.137333	Rk	Y	Y	N/A	**Rock in kelp / Insufficient coverage
76	B76	2	4	41.299521	-72.134600	1.88	6	41.299405	-72.134719	Rk	Y	Y	Retain	*Kelp area / Insufficient coverage
77	B77	3	4	41.294340	-72.140638	2.40	8	41.294618	-72.140661	Bank		Y		Not found using 4*4 meter laser spot spacing, doubtful**
78	B78	2	3	41.292726	-72.141516	1.74	5	41.292928	-72.141431	Rk	Y		Retain	Small gap in coverage**
79	B79	2	Rock awash	41.291329	-72.140402	0.57	2	41.291192	-72.140264	Rk	Y		Retain	Small gap in coverage ***Concur*** ***Retain as charted.***
80	B80	3	10	41.289674	-72.136455	4.95	16	41.289678	-72.136905	Bank			Replace	Disproved**

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
81	B81	3	6	41.287420	-72.137970	3.75	12	41.287655	-72.137769	Bank			Replace	Disproved-***Concur***
82	B82	2	9	41.288523	-72.134953	3.52	11	41.288489	-72.135003	Bank			Replace	***Chart present survey depths.***
83	B83	2	12	41.287421	-72.134698	4.49	14	41.287700	-72.134674	Bank			Replace	***Chart present survey depths.***
84	B84	3	4	41.285058	-72.135926	1.85	6	41.284903	-72.135723	Rk	Y		Retain	Foul area, N/S *
85	B85	1				2.51	8	41.283680	-72.134248	Rk	Y		Insert	* *
86	B86	2	12	41.276881	-72.136349	2.84	9	41.277270	-72.136037	Rk	Y		Replace	Small gap in coverage close SE* *
87	B87	2	3	41.275813	-72.136462	2.01	6	41.276059	-72.136119	Rk	Y		Retain	Foul S *
88	B88	3	27	41.274197	-72.140117	11.34	37	41.274083	-72.140038			Y	Retain	Not found; close to limit of coverage* *.
89	B89	1				7.93	26	41.272096	-72.138718	Ridge			Insert	* *
90	B90	3	3	41.275313	-72.132198	3.56	11	41.275497	-72.131746	Bank			Replace	Disproved **

**** See final charting recommendation in feature report of the Descriptive Report. ** Shoaler features and/or depths in close proximity. Do not chart.***

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
91	B91	2	9	41.276540	-72.131135	3.68	12	41.276552	-72.130917	Ridge	Y		Replace	***Chart present survey depths.***
92	B92	2	Rock awash	41.298958	-72.132547	1.03	3	41.298759	-72.132437	Rk	Y		Retain	Foul N ***Concur Retain as charted.***
93	B93	2	13	41.297309	-72.131761	3.40	11	41.297308	-72.131637	Rk	Y	Y	N/A	Turbid. See item 11. Danger to Navigation Report *
94	B94	2	12	41.297950	-72.129807	2.88	9	41.297901	-72.129935	Rk	Y		Replace	**
95	B95	2	6	41.298827	-72.128943	1.43	4	41.298792	-72.129508	Rk	Y		Replace	**
96	B96	2	Rock awash	41.299635	-72.128547	1.44	4	41.300039	-72.128122	Rk	Y		Retain	Foul - small close SW, and large area N ***Retain as charted.***
97	B97	2	2 (see B99)	41.298315	-72.128146	1.37	4	41.298690	-72.128415	Rk	Y		Retain	Small gap in coverage **
98	B98	1				1.83	6	41.298055	-72.128276	Rk	Y		Insert	
99	B99	2	2 (see B97)	41.298315	-72.128146	1.44	4	41.298231	-72.127798	Rk	Y	Y	Retain	Kelp area / Insufficient coverage **
100	B100	2	11	41.298047	-72.126868	2.32	7	41.298112	-72.126865	Rk	Y		Replace	See item 6. Danger to Navigation Report *

**** See final charting recommendation in feature report of the Descriptive Report.***

***** Shoaler features and/or depths in close proximity. Do not chart.***

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
101	B101	1	15	41.298909	-72.126261	2.20	7	41.298957	-72.126436	Rk	Y		Replace	**
102	B102	2	9	41.299074	-72.122455	2.13	7	41.299075	-72.122158	Rk	Y	Y	N/A	Turbid. See item 3. Danger to Navigation Report *
103	B103	2	6	41.299701	-72.120889	1.30	4	41.299912	-72.120847	Rk	Y		Replace	**
104	B104	1				3.05	10	41.299040	-72.121268	Rk	Y		Insert	**
105	B105	1				3.05	10	41.299159	-72.120523	Rk	Y		Insert	**
106	B106	1				3.34	11	41.298808	-72.120111	Rk	Y		Insert	**
107	B107	2	2	41.292451	-72.114549	1.65	5	41.292571	-72.114287	Rk	Y	Y	Retain	4*4 meter spot pacing may not have detected least depth. ***Retain as charted.***
108	B108	2	6	41.291989	-72.113739	1.64	5	41.292093	-72.113924	Rk	Y		Replace	***Chart present survey depths.***
109	B109	3	24	41.287526	-72.115442	8.58	28	41.287533	-72.115726	Bank			Replace	Disproved ***Chart present survey depths.***
110	B110	1	33	41.286734	-72.113923	7.65	25	41.287178	-72.114241	Rk		Y	N/A	Possible Wk or Rk *

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
111	B111	1		41.300944	-72.108003	1.51	5	41.301428	-72.108004	Rk	Y		Insert	***Retain as charted.***
112	B112	2	3	41.300944	-72.108003	1.43	4	41.300910	-72.107966	Rk	Y	Y	Retain	**Rock in Kelp / insufficient coverage
113	B113	1				1.69	5	41.298711	-72.108443	Rk	Y		Insert	***Chart present survey depths.***
114	B114		Rock which covers, uncovers	41.302626	-72.103906	-0.55	-2	41.302622	-72.104023	Rk	Y		Retain	***Retain as charted.***
115	B115					1.77	6	41.300412	-72.104671	Rk	Y		Insert	***Chart present survey depths.***
116	B116	2	Rock which covers, uncovers	41.302402	-72.101463	0.13	0	41.302257	-72.101558	Rk	Y		Retain	Foul ***Chart present survey depths.***
117	B117	1	12	41.300292	-72.102970	2.82	9	41.300337	-72.102720	Rk	Y		Replace	***Chart present survey depths.***
118	B118	1	13	41.299797	-72.102259	2.46	8	41.299816	-72.102769	Rk	Y		Replace	***Chart present survey depths.***
119	B119	1				3.03	10	41.298897	-72.103140	Rk	Y		Replace	See item 1. Danger to Navigation Report *
120	B120	2	3	41.299589	-72.101100	-0.89	-3	41.299601	-72.100972	Rk	Y	Y	N/A	Confirm whether drying rock or obstruction *

			CHARTED			SURVEYED								
Sequence No	**Shoal No**	**Category**	**Charted Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Surveyed Depth** (meters)	**Surveyed Depth** (feet)	**NAD 83 Latitude** (decimal degrees)	**NAD 83 Longitude** (decimal degrees)	**Type of Feature**	**Kelp Area**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks**
121	B121	2	9	41.295826	-72.107505	3.58	11	41.295630	-72.107423	Rk			Replace	***Chart present survey depths.***
122	B122	2	19	41.296539	-72.104990	5.02	16	41.296549	-72.104424	Bank			Replace	***Chart present survey depths.***
123	B123	3	12	41.295580	-72.103443	6.07	20	41.295579	-72.103460	Bank			Replace	Disproved ***Chart present survey depths.***
124	B124	1	21	41.290529	-72.104270	5.40	17	41.290745	-72.104551		Y	Y		Small object on seabed. ***Disproved-Chart present survey depths.***
125	B125	3	16	41.290269	-72.099233	6.42	21	41.290222	-72.099029	Bank			Replace	Disproved ***Chart present survey depths.***
126	B126	1	17	41.307199	-72.156534	3.21	10	41.306972	-72.156953	Rk	Y		Insert	***Chart present survey depths.***
127	B127	2	Rock awash	41.292373	-72.151615	1.06	3	41.292082	-72.151628	Rk	Y		Retain	Foul area. ***Retain as charted.***
128	B128	3	21	41.278447	-72.210777	8.35	27	41.278655	-72.211115	Slope			Replace	Disproved ***Chart present survey depths.***
129	B129	2	25	41.279672	-72.211179	6.79	22	41.279628	-72.211336	Ridge			Replace	***

**** See final charting recommendation in feature report of the Descriptive Report. ** Shoaler features and/or depths in close proximity. Do not chart.***

D.2 FEATURES REQUIRING INVESTIGATION SPREADSHEET – H11225

During the approval of the data a number of features were identified where it was considered that lesser depths may exist or that the surveyed depth was doubtful. A table of these items is provided on pages D-18 and D-19.

Depths associated with the features may coincide with shoaler depths on the smooth sheet. The depths obtained for the features were done during the approval stage which is prior to any data outputs which have undergone a shoal biased clash.

The full spreadsheet is also provided in Excel format with the digital data (SheetB_V1_Features_Inv.xls).

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		SURVEYED								
Sequence No	**Shoal No**	**Surveyed Depth** (meters)	**Eastings**	**Northings**	**Sortie No**	**Run No**	**Frame**	**Row**	**Column**	**Remarks**
1	FB10	-0.11	734215	4577369	14	65.0.1	69	1	40	Kelp area*
2	FB11	2.38	739830	4574382	13	845.0.1	56	6	20	Insufficient coverage*
3	FB12	0.09	739853	4573330	13	700.0.1	42	14	43	Insufficient coverage*
4	FB14	1.96	734389	4576978	9	114.0.1	86	18	35	See item 33. Chart Comparison. Rock in Kelp / insufficient coverage*
5	FB19	1.97	742297	4576139	5	644.0.1	89	5	31	Possible Rk in kelp*
6	FB20	1.43	742128	4576197	5	642.0.1	83	12	38	See item B112. Chart Comparison. Rock in Kelp / insufficient coverage. *
7	FB22	0.23	740475	4575850	5	640.0.1	62	10	7	See item B99. Chart Comparison. Kelp area / insufficient coverage*
8	FB23	0.05	739902	4575951	13	635.0.1	162	7	32	See item B76. Chart Comparison. Kelp area / insufficient coverage*
9	FB24	2.16	739852	4576016	12	634.0.1	56	7	33	Kelp area / insufficient coverage*
10	FB25	2.09	739672	4576037	12	632.1.1	54	5	24	See item B75. Chart Comparison. Rock in Kelp - insufficient coverage*
11	FB27	1.29	739485	4576091	5	629.0.1	170	11	40	Rock in Kelp / insufficient coverage*
12	FB32	-4.15	734259	4577065	13	111.0.1	61	6	39	Possible pontoon or structure*
13	FB33	4.28	740304	4573322	15	702.0.1	47	16	30	Possible object on seabed in turbid area*
14	FB34	4.53	739984	4573911	15	685.0.1	163	7	38	Possible object on seabed in turbid area*
15	FB35	7.80	742009	4574696	18	677.0.2	139	12	30	Possible object on seabed*
16	FB36	7.65	741654	4575655	18	676.1.1	144	13	31	Possible object on seabed*
17	FB38	4.40	741796	4575168	18	665.0.2	141	16	17	Possible object on seabed*
18	FB50	2.80	734948	4577807	19	108.1.1	43	1	43	Rk in kelp area - insufficient coverage*
19	FB51	1.15	736246	4576983	19	126.1.1	65	5	38	Rock in Kelp / area of poor coverage*
20	FB54	4.09	734270	4575908	20	123.1.1	79	14	10	Possible beacon - deleted from data*
21	FB55	2.80	734379	4574995	20	134.2.1	99	16	23	See item B28. Chart Comparison. Possible obstruction. *

		SURVEYED								
Sequence No	**Shoal No**	**Surveyed Depth** (meters)	**Eastings**	**Northings**	**Sortie No**	**Run No**	**Frame**	**Row**	**Column**	**Remarks**
22	FB61	9.78	739210	4574220	20	674.1.1	38	16	27	Possible object on seabed*
23	FB62	7.67	738132	4574879	19	162.1.1	72	5	31	Possible object on seabed*
24	FB63	9.16	737507	4576366	20	143.1.1	117	15	45	Possible object on seabed*

Items verified or disproved by hydrographer during data collection for survey H11442 (2005).

D.3 NAVIGATION AIDS – H11225

During the survey a number of navigation aids were detected in the data. These have been identified as buoys, beacons and lights from the chart.

Some of these items were detected a number of times on different lines. In these cases, a mean position has been adopted.

There are some minor differences in the surveyed positions of the buoys when compared with the chart. It should be noted that as the buoys were not necessarily surveyed on both the flood and ebb streams, no recommendations for charting action has been made.

Not all buoys and beacons were detected. This is expected, as some of the objects are quite small. In particular, at 4x4 meter laser spot spacing, laser pulses may have fallen either side of them.

Where these Navigation Aids were detected, they are depicted on the smooth sheet.

A table is provided on pages D-21.

The full spreadsheet is also provided in Excel format with the digital data (SheetB_V1_Nav_Aids.xls).

Nav Aid No.	NAD 83 Latitude (decimal degrees)	NAD 83 Longitude (decimal degrees)	Eastings	Northings	Year	JD	Time	Run No	Frame	Row	Column	Description
NB1	41.27445718	-72.1372326	739752.69	4573160.4	2004	44	2:57:56	702.0.1.1	41	2	17	Bartlett Reef Light
NB2	41.30631946	-72.17261742	736688.95	4576601	2004	47	22:28:33	603.0.1.2	21	6	44	Buoy, Mooring
NB3	41.30853326	-72.17195803	736740.47	4576848.6	2004	34	19:50:05	131.0.1.3	57	10	33	Buoy
NB4	41.30775866	-72.17081528	736838.97	4576765.7	2004	63	19:25:50	132.2.1.3	125	11	4	Buoy
NB5	41.28908531	-72.11186763	741839.37	4574855	2004	63	16:38:32	672.1.1.1	140	16	28	Buoy
NB6	41.32598588	-72.18038363	735952.09	4578763.4	2004	34	19:35:31	106.0.1.2	111	8	20	Buoy
NB7	41.30606895	-72.19625228	734700.49	4576508.9	2004	56	17:46:06	120.2.1.2	78	9	35	Buoy
NB8	41.30006141	-72.17489702	736505.16	4575899.9	2004	56	19:13:37	140.2.1.5	62	13	17	Buoy
NB9	41.27468876	-72.13168745	740220.96	4573201.5	2004	44	21:15:03	704.0.1.1	47	6	27	Buoy
NB10	41.31546989	-72.19605379	734693.95	4577553.3	2004	44	20:08:25	109.1.1.2	48	12	38	Buoy
NB11	41.30709924	-72.16982039	736920.35	4576695.2	2004	56	18:44:13	135.1.1.2	126	18	39	Buoy
NB12	41.30622899	-72.16876997	737011.45	4576601.4	2004	56	18:44:14	135.1.1.2	127	2	6	Buoy
NB13	41.29828504	-72.15431425	738250.65	4575759	2004	56	19:53:50	154.1.1.3	97	6	37	Buoy
NB14	41.29592845	-72.14159654	739324.25	4575532.4	2004	56	17:28:04	643.1.1.6	174	8	11	Buoy
NB15	41.29124491	-72.10469571	742431.55	4575114.8	2004	63	16:24:49	668.1.1.1	128	13	43	Buoy

D.4 SURVEY POLYGONS – H11225

A recommendation for overlap with the lidar data by surface vessel has been made. This recommendation is provided as a .dgn file (SheetB_ V1_Overlap.pzip). It is provided with the digital data in MicroStation 7 format.

In the Chart Comparison section (D.1) there are also some recommendations for investigation by surface vessel for some items.

In the Features Requiring Investigation section (D.2) there are also some recommendations for some other items where it was considered that lesser depths may exist or that the surveyed depth was doubtful.

E. APPROVAL SHEET

LETTER OF APPROVAL – OPR-B370-KRL-04

This report and the accompanying smooth sheets are respectfully submitted.

Field operations contributing to the accomplishment of this survey were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and the accompanying smooth sheets have been closely reviewed and are considered complete and adequate as per the Statement of Work.

Report	**Submission Date**
Descriptive Report – H11225	December 24, 2004

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Mark Sinclair
Hydrographer
Tenix LADS Incorporated

Date_____