H12101

NOAA Form 76-35A

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Survey

# DESCRIPTIVE REPORT

Type of Survey: Hydrographic Lidar

Registry Number: H12101

## LOCALITY

State: Alaska

General Locality: Shumagin Islands

Sub-locality: Bird Island

**2009**

**CHIEF OF PARTY**
Scott Ramsay, Tenix LADS, Inc.

LIBRARY & ARCHIVES

Date:

| NOAA FORM 77-28 (11-72) | U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION | REGISTRY NUMBER: |
|---|---|---|
| **HYDROGRAPHIC TITLE SHEET** | | **H12101** |

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

| | |
|---|---|
| State: | **Alaska** |
| General Locality: | **Shumagin Islands** |
| Sub-Locality: | **Bird Island** |
| Scale: | **1: 10,000** |
| Dates of Survey: | **05/30/2009 to 08/16/2009** |
| Instructions Dated: | **April 2009** |
| Project Number: | **OPR-P183-KRL-09** |
| Field Unit: | **Tenix LADS Aircraft, VH-LCL** |
| Chief of Party: | **Scott Ramsay, Tenix LADS, Inc.** |
| Soundings by: | **LADS Mk II** |
| Imagery by: | **Redlake MegaPlus II ES 2020** |
| Verification by: | **Pacific Hydrographic Branch** |
| Soundings Acquired in: | **meters at Mean Lower Low Water** |
| HCell Compilation Units: | ***meters at Mean Lower Low Water*** |

Remarks:

***Horizontal Coordinate System: UTM Zone 4N. The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold, red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.***

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**DESCRIPTIVE REPORT TO ACCOMPANY**

**HYDROGRAPHIC SURVEY H12101**

**SCALE 1:10,000, SURVEYED IN 2009**

**FUGRO LADS AIRCRAFT, VH-LCL**

**FUGRO LADS, INC. (FLI)**

**MARK SINCLAIR, HYDROGRAPHER**

**PROJECT**

**Project Number:** OPR-P183-KRL-09
**Original:** DG 133C-06-CQ-0066
**Date of Instructions:** April 2009
**Task Order:** T0005

**Registry Number:** H12101
**Sheet:** A

## A. AREA SURVEYED [1]

Survey operations covered four registered sheets over the OPR-P183-KRL-09 project area, Shumagin Islands, AK (see Figure 1 and Figure 2).

A total of 2346 lineal nautical miles were illuminated in the process of flying 259 main scheme survey lines. An additional 1472 lineal nautical miles were illuminated flying 163 reflies and 587 lineal nautical miles flying 54 crosslines / investigations. The total seabed area surveyed across the project area, from the Mean High Water (MHW) line to lidar extinction depth, was 42.6 square nautical miles (see Appendix III for further information).

The Fugro LADS aircraft first attempted to land at the main base of operations in Sand Point, AK on May 29, 2009. However, due to adverse weather conditions on the Alaskan Peninsula and the absence of an ILS landing approach at the Sand Point airport, the aircraft was unable to land on this date. The aircraft was stationed in Kodiak, and then Anchorage awaiting improvement in weather conditions, until it was finally able to complete the ferry to Sand Point on June 8, 2009. Very poor weather continued throughout the week following the arrival of the aircraft. The official mobilization day, despite the aircraft being absent for the first week, was May 30, 2009.

Survey operations commenced in the project area on June 13, 2009 and were conducted concurrently with the OPR-P184-KRL-09, Southwest Alaska Peninsula – Pavlof Islands project and the Bering Sea Reconnaissance flights to Nunivak and St. Lawrence Islands. The final flight to the Shumagin Islands area was conducted on August 11, 2009. Demobilization of the site was conducted on August 16, 2009 and the aircraft departed Sand Point on August 17, 2009.

Survey work at the Shumagin Islands project area was attempted on 19 separate flights. Due to adverse weather and / or poor water clarity, the aircraft sometimes diverted to the P184 project area, or the sortie was aborted altogether.

During a flight to the Shumagin Islands on 26 July 2009, low cloud coverage prevented any operations being conducted, resulting in 0:00 time on task. The aircraft diverted to the P184 project area for the remainder of this flight. In order to optimize periods of good weather and water clarity conditions at the Shumagin Islands, 'double flights' were conducted to the project area(s) on 15 July, 29 July and 9 August 2009, requiring a refuel at Sand Point between successive sorties.

The specific dates of data acquisition, hours flown and time on task for the Shumagin Islands project were as follows:

| Date | Sortie No. | Hours Flown | Time on Task |
|---|---|---|---|
| 13-Jun-09 | 1 | 3:37 | 1:09 |
| 15-Jun-09 | 11 | 5:43 | 3:31 |
| 20-Jun-09 | 12 | 5:14 | 2:13 |
| 21-Jun-09 | 13 | 6:16 | 5:26 |
| 23-Jun-09 | 15 | 7:00 | 6:10 |
| 25-Jun-09 | 16 | 6:49 | 6:00 |
| 26-Jun-09 | 17 | 2:39 | 0:33 |
| 27-Jun-09 | 19 | 6:31 | 5:32 |
| 08-Jul-09 | 23 | 5:18 | 0:35 |
| 15-Jul-09 | 25 | 4:45 | 3:31 |
| 15-Jul-09 | 26 | 5:30 | 4:48 |
| 19-Jul-09 | 27 | 6:26 | 2:39 |
| 23-Jul-09 | 29 | 6:52 | 1:19 |
| 26-Jul-09 | 30 | 2:05 | 0:00 |
| 29-Jul-09 | 31 | 5:59 | 5:16 |
| 29-Jul-09 | 32 | 3:44 | 3:06 |
| 8-Aug-09 | 35 | 6:13 | 2:12 |
| 9-Aug-09 | 36 | 5:31 | 5:02 |
| 11-Aug-09 | 39 | 5:31 | 5:05 |

**Table 1: Specific Dates of Data Acquisition**

Environmental factors such as water clarity, tide, wind strength and direction, daylight hours, cloud base height and clouds over high terrain influenced the area and duration of data acquisition on a daily basis. See Section B.2.3 for further details.

This Descriptive Report describes Sheet A, which covers Bird Island (see Figure 2).

The sheet limits are as follows for Sheet A (Coordinates are NAD83):

| H12101 (A) | Latitude (N) | Longitude (W) |
|---|---|---|
| **NW corner** | 54° 52' 12.12" | 159° 51' 05.21" |
| **SW corner** | 54° 45' 43.76" | 159° 50' 57.06" |
| **SE corner** | 54° 45' 47.94" | 159° 39' 45.42" |
| **NE corner** | 54° 52' 16.32" | 159° 39' 51.78" |

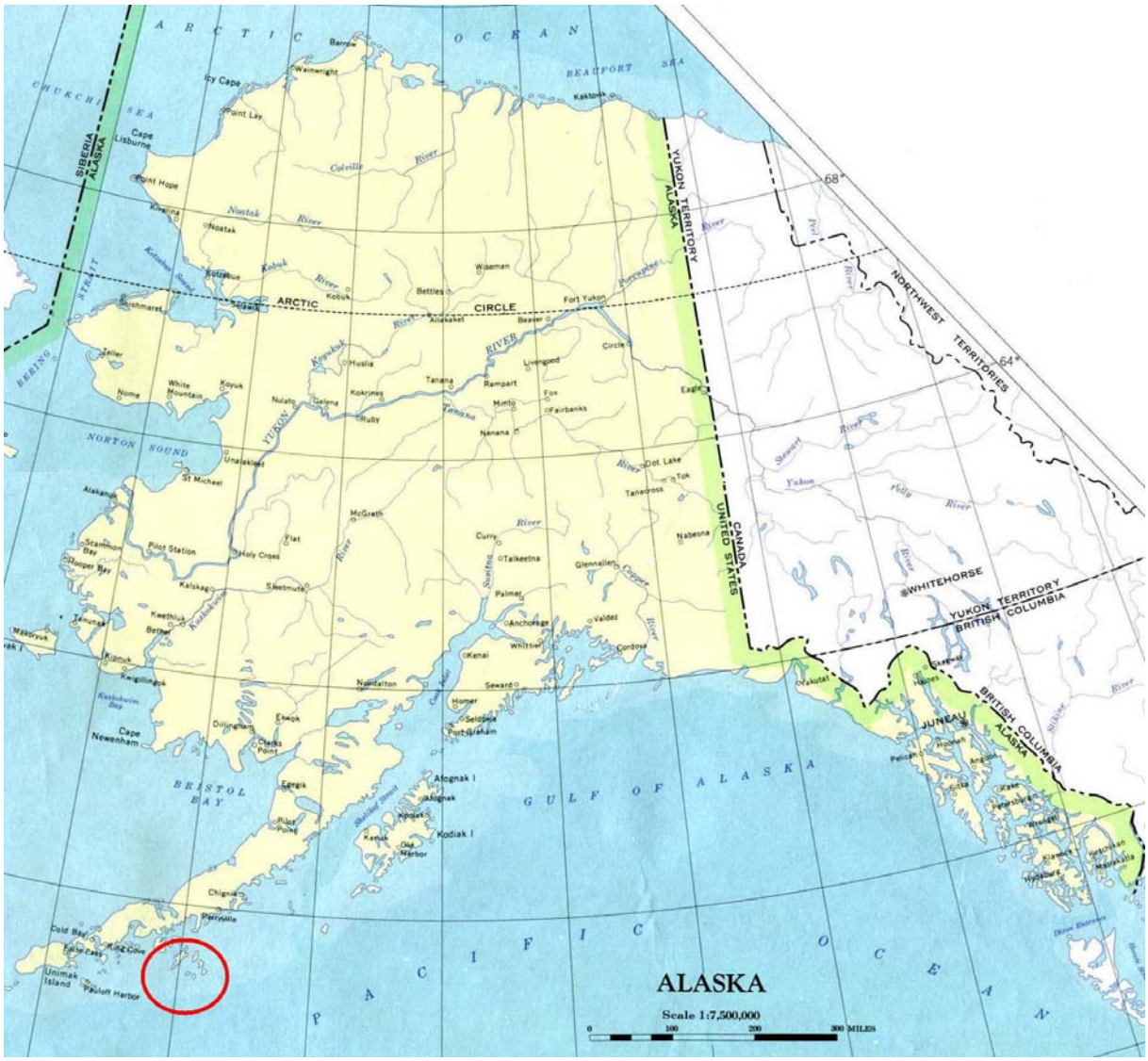


**Figure 1 – General Locality of OPR-P183-KRL-09**

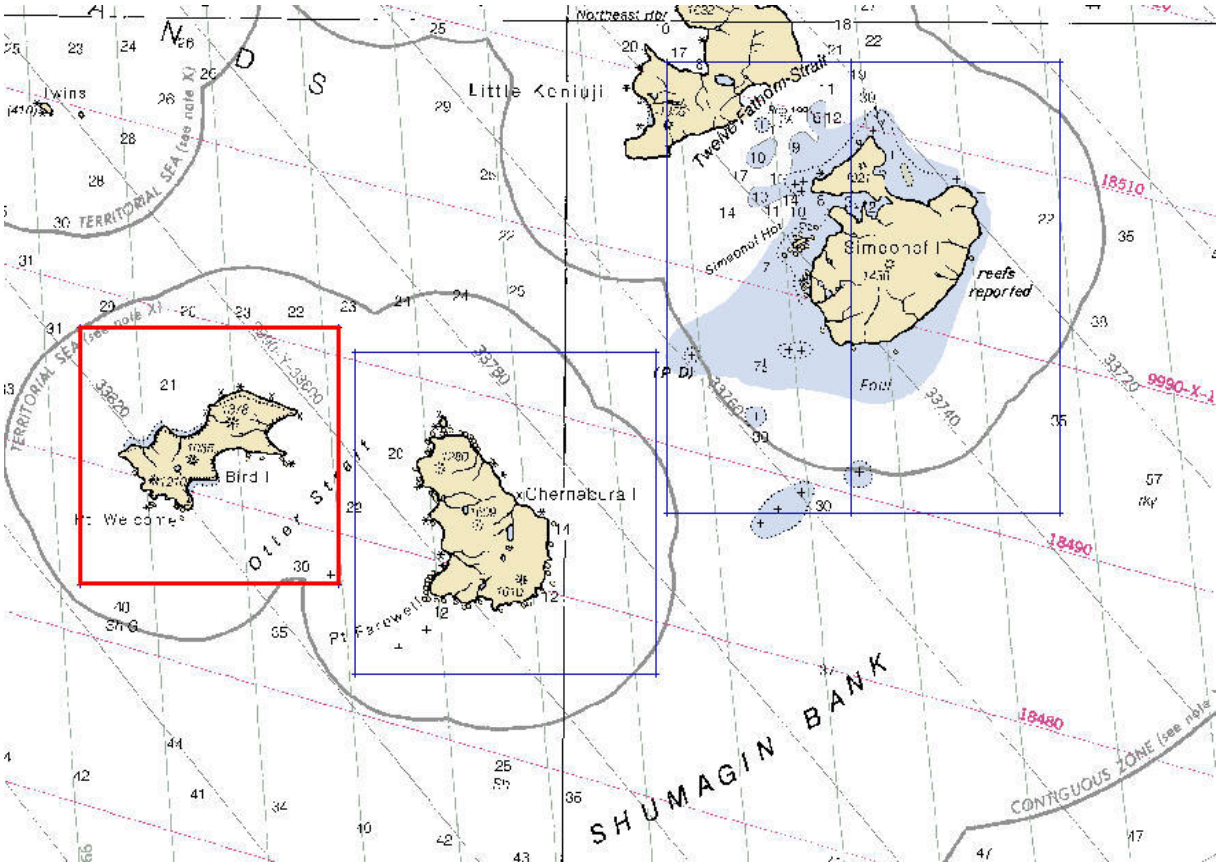


**Figure 2 – Sub-Locality of H12101**

# B. DATA ACQUISITION AND PROCESSING

Refer to the Data Acquisition and Processing Report for a detailed description of the equipment, processing, and quality control procedures used during LADS surveys. 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 (AS), data processing using the LADS Mk II Ground System (GS), and data visualization, quality control and final products using CARIS HIPS and SIPS 6.1 and CARIS BASE Editor 2.1.

### *B.1.1 Airborne System*

The LADS Mk II AS platform consists of a De Havilland Dash 8-200 Series aircraft, which has a transit speed of 250kts, at altitudes of up to 25,000ft, and an endurance of up to eight hours. Survey operations are conducted from heights between 1,200 and 2,200ft, at ground speeds of between 140 and 210kts. The aircraft is fitted with an 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 from a stabilized platform to provide a number of different spot spacings across the seabed.

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 height of the aircraft is determined by the infrared laser return, which is supplemented by the inertial height from the Attitude and Heading Reference System (AHRS) and a Global Positioning System (GPS) receiver. Real-time positioning is obtained by an Ashtech GG24 GPS receiver providing autonomous GPS, or is combined with WADGPS (Fugro Omnistar), to provide a differentially corrected position, when coverage is available. Ashtech Z12 GPS receivers are also provided as part of the AS and GS to log data on the aircraft and at a locally established GPS base station.

A digital camera was installed on the LADS Mk II system platform in 2007. This allowed high quality images to be captured in real-time, georeferenced and overlaid with the processed survey data. These images are also combined into a georeferenced image deliverable across the extent of the survey area. The specifications for the Redlake MegaPlus II ES 2020 digital camera are provided in the Data Acquisition and Processing Report.

### *B.1.2 Ground System*

The LADS Mk II GS ‘hydra’ was used to conduct data processing in the field. Hydra, a newly developed distributed processing and shared storage system, replaces the portable Compaq Alpha ES40 Series 3 processor server. The hydra system is a cluster of networked PC’s (nodes). The individual nodes are HP Compaq dc7900 Small Form Factor PC's consisting of Core 2 Duo E8400 processors, 4GB DDR-2 RAM, with 1 TB of storage. The controlling node is connected to SDLT, DLT and DAT drives to allow backups of data, and is networked to plotters and printers for producing documents and plots. The number of nodes networked is dependant on the requirements of the survey. Upon completion of the data

collection phase of the survey, when operations returned to the FLI office in Biloxi, MS, the controlling node was Nas2, an HP Proliant DL380 Generation 4 server consisting of a dual core 3.20GHz processor, 4GB DDR-2 RAM, with 2.3TB of storage. Quality control checks and editing of the data were conducted on Nas2 at the FLI office in Biloxi, MS.

The GS supports survey planning, data processing, quality control and data export. The GS also includes a KGPS base station, which provides independent post-processed position and height data.

## B.2 QUALITY CONTROL

### *B.2.1 Quality Control Checks*

The internal relative consistency of the survey data was checked with crossline depth comparisons, dynamic position checks, navigation position checks and by observing position confidence quality factors on the GS. System integrity was checked, in an absolute sense, with depth benchmark comparisons in Popof Strait, the local GPS base station site confirmation and the static position check.

#### *B.2.1.1 Crosslines*

No specific crosslines were planned due to the high number of investigation / additional coverage lines (54) flown perpendicular to main scheme survey runs (259). Additionally, main scheme lines flown perpendicular to each other were used in these comparisons. Below are the overall depth comparison results for the 61 crossline / main scheme line intersections. A complete summary is presented in the Separates Report.

| Total Number of Comparisons | Mean Depth Difference (m) | Mean Standard Deviation (m) |
|---|---|---|
| 167170 | 0.04 +/- 0.12 | 0.29 +/- 0.16 |

#### *B.2.1.2 Depth Benchmarks*

The depth benchmark areas in Popof Strait were derived from the 2003 lidar survey, Shumagin Islands and Vicinity (OPR-P183-KR-03). These pre-surveyed benchmark areas were utilized for system checks again in 2004 and 2005 and were used to check the absolute depth accuracy of the LADS Mk II system for the H12101 survey in 2009. Center coordinates for the benchmark areas are as follow:

Popof Strait

| | | UTM (N) Zone 4 | |
|---|---|---|---|
| **Benchmark Name** | **Nominal Depth** | **Easting** | **Northing** |
| BM_1 | 15m | 404 100 | 6 135 080 |
| BM_2 | 5m | 403 090 | 6 133 140 |

Benchmark lines flown during sorties were reduced to MLLW using Sand Point final tides.

The LADS survey 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. These noisy outliers are flagged as the shoalest and deepest differences.

A summary of the average of the MDD and SD for all depth benchmark area comparisons is presented below. Refer to the Separates Report for detailed results of the depth benchmark comparison results.

Popof Strait

| GS ID | BM Name | Nominal Depth | Mean MDD (m) | Mean SD (m) |
|---|---|---|---|---|
| 1 | BM_1 | 15m | -0.09 +/- 0.04 | 0.16 +/- 0.02 |
| 2 | BM_2 | 5m | -0.11 +/- 0.05 | 0.16 +/- 0.03 |

The depth benchmark comparison results and the crossline comparisons results are within expected tolerances and show that the LADS Mk II depth performance was within specifications throughout the survey period.

### *B.2.1.3 Positioning Checks*

Two independent positioning systems were used during the survey. Real-time positions were determined by autonomous GPS. Post-processed KGPS positions were determined relative to a local GPS base station that was established by JOA on the rooftop of the Popof Pizza Building in Sand Point. The post-processed KGPS positions were applied to each sounding during processing and the KGPS height was used in the topographic datum filter.

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

a. Local GPS Base Station Site Confirmation. A 24-hour certification of the local GPS base station established was conducted on June 2–3, 2009. The results reveal that the local GPS base station is free from site specific problems such as multipath and obstructions. Details are provided in the Horizontal and Vertical Control Report and scatter plots in the Separates Report.

b. Static Position Check. Prior to commencing data collection, the coordinates of the aircraft GPS antenna were determined relative to single point that was surveyed by Fugro LADS Inc. on the tarmac of Sand Point Airport. Data was logged by each LADS Mk II positioning system while the aircraft was static, enabling the positions to be checked against the known GPS antenna point. The absolute accuracy of the post-processed KGPS solution during the static position check was 0.185m (95% confidence). The results and details of the static position check are enclosed in the Horizontal and Vertical Control Report and Separates Report.

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 and post-processed GPS positions. The mean difference between the real-time and post-processed positions was 2.227m, with an average SD of 0.172m. Details are provided in the Horizontal and Vertical Control Report.

d. Navigation Position Check. Navigation checks were also conducted over the GPS Base Station on top of the Popof Pizza Building in Sand Point, AK. This enabled the known position of the GPS base station to be checked against the downward-looking digital image. This provided a gross error check of position. The mean error in Eastings was observed to be -0.32 +/- 1.38m and –1.40 +/- 3.03m in the Northings. Further details are provided in the Separates Report.

e. Position Confidence. The position quality was also monitored on the GS 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 were within the expected tolerances and demonstrated that the positioning systems were functioning correctly throughout the survey period.

### *B.2.2 Uncertainty Values*

For this survey area, global horizontal and vertical uncertainties have been assigned based on the defined horizontal and vertical error budget, as stated in the Horizontal and Vertical Control Report. The assigned horizontal uncertainty is 3.17m and the assigned vertical uncertainty is 0.44m.

However, when the calculated grid node SD is greater than the assigned vertical uncertainty, the SD is used as the uncertainty value. This has occurred in areas of high relief, which is common throughout the survey area. In some cases the SD may exceed IHO Order-1 limits. This could be attributed to the seabed gradient and a 5m grid resolution being used.

### *B.2.3 Environmental Factors*

#### *B.2.3.1 Sea Conditions - Sea State, White Water, Calm Seas, Swell*

The survey area is exposed to the North Pacific Ocean and was affected by swell from the SE through to the NW. The sea state ranged from 1 to 3 on the Beaufort Scale throughout the survey period. During periods of high sea state, expansive areas of white water were observed along the coast and over shallow features. When such conditions were observed, operations were either suspended, or redirected to alternate or offshore areas, to minimize lidar coverage gaps due to white water.

Calm seas were experienced on occasions. Under such calm conditions the sea became glassy, which degraded the sea surface model, and resulted in shallow water gaps at nadir, where the sea surface returns were completely saturated and seabed returns attenuated.

Long period swell was experienced during the survey and an allowance has been made in the assessment of vertical accuracy.

### *B.2.3.2 Water Clarity*

The water clarity in the survey area varied significantly during the period of data collection, and this required careful management to achieve the best possible seabed coverage across the project area. Water clarity varied from extremely poor to good.

### *B.2.3.3 Kelp*

Kelp is one of the factors that increases the complexity of a particular survey area. It is one of the reasons why 200% coverage is typically recommended in Alaskan waters. Kelp reduces laser penetration and the resultant seabed coverage achieved by lidar. Kelp also increases the amount of data processing that is required and the amount of boatwork that is recommended, as described in Section D.2.1. Large areas of kelp exist throughout the survey area.

Kelp areas can be recognized in the data by the following indicators:

- Mid-water column returns are of low amplitude.
- Waveforms have poorly defined leading edges.
- Returns from the seabed are highly attenuated.
- Soundings in shallow water are very sparse.
- Soundings may not correlate with overlapping data from adjacent lines.

Kelp areas can appear as data gaps in the BASE Surface. In such areas of partial bottom coverage, kelp area polygons (WEDKLP) have been defined in the S-57 feature file at the boundaries of data gaps attributed to kelp. Where kelp is present, but seabed coverage was still achieved, kelp point objects (WEDKLP) have been defined in the S-57 feature file (US512101.000).

Rocks or shoals detected by the system in kelp areas may be difficult to discriminate as true bottom or kelp returns. When it is uncertain if the return is from seabed or kelp, a decision whether the feature has ‘least depth found’ (LDF) by lidar is provided in Section D.1.6. If it is determined that the LDF on a significant feature has not been achieved by lidar, due to the presence of kelp, the item will appear as a feature for examination in the investigation file (H12101_Inv.hob).

### *B.2.3.4 Topography*

The LADS Mk II system can measure topographic heights up to 50m elevation, subject to the depth / topographic logging window selected. For this survey, a 20m topographic height logging window was selected. As a result, the coastline was surveyed and elevations up to 20m were measured.

#### *B.2.3.5 High Ground*

For this survey high ground was an issue, and a number of survey lines over Bird, Chernabura and Simeonof Islands were required to be flown at 2,200ft. Low cloud coverage was often prevalent over high terrain which forced operations to be carried out in areas that could be flown at between 1,200 and 1,800ft.

#### *B.2.3.6 Wind*

Survey operations were conducted in wind strengths of up to 25kts during the survey. In general, the wind strength during sorties was between 10 and 15kts. In certain areas, wind strengths above 10kts generated turbulence that made data collection difficult. In circumstances when wind speeds were forecast to be greater than 20kts, no flights were planned due to the possibility of dangerous levels of turbulence.

#### *B.2.3.7 Cloud*

Low cloud coverage and rain was a significant factor during the survey. When the cloud base was below 2,000ft, only offshore areas and survey lines over low terrain could be executed, at operational altitudes between 1,200 and 1,800ft. Poor weather was monitored using, and decisions on the flying program were based on:

- Local weather conditions at Sand Point
- Real-time satellite imagery
- Aviation reports

Two Internet sites proved to be invaluable for forecasting the weather. An aviation site, http://adds.aviationweather.gov, provided METAR data, actual wind speed and direction, cloud base and satellite cloud data. The observations were updated every twenty minutes. A NOAA weather site, http://pafc.arh.noaa.gov, provided aviation and general weather forecasts.

### *B.2.4 Data Coverage and Object Detection*

#### *B.2.4.1 Nature of the Seabed*

The nature of the seabed surrounding Bird Island is diverse. The area contains numerous islands and islets. The W coast is rugged with many drying features and an undulating bottom, while to the N, E and S the seabed is relatively featureless, with low slope bays.

Throughout the area there are numerous rocks, islets and shoals, often surrounded by thick areas of kelp. Typically, kelp grows from the MLLW line to 20m water depth. It is often visible on, or just below the sea surface, in the downward-looking digital imagery. Most gaps in lidar data coverage, in less than 20m depth, are directly attributed to the presence of kelp.

The seabed gradient is generally high along the W coast of Bird Island, with the seabed dropping from the coastline to beyond 20m depth quickly. For the most part, the remainder of Bird Island has a gently sloping, undulating seabed.

### *B.2.4.2 Data Coverage*

The survey area was illuminated at 5x5m laser spot spacing, resulting in a 240m swath width. Mainlines of sounding were spaced at 110m, which provided the required 200% coverage.

The gain levels automatically set by the AS accommodate for changes in the sea surface, water column and seabed conditions. In some areas, after long overland passages, low gain levels were initialized when 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.

The raw laser waveform returns from the areas that were covered with kelp are considerably attenuated. In order to detect the seabed in such areas, the threshold in the GS was lowered to detect pulses with low signal-to-noise ratios (SNR). This often enabled the seabed depth to be extracted from the waveform, but also resulted in increased false bottom detects, which in turn increased data validation times.

The variable water clarity observed throughout the survey period resulted in maximum lidar extinction depths of 30m for the project, but typically full seabed coverage to 25m depth was achieved for H12101.

### *B.2.4.3 Object Detection*

At the sea surface the footprint of the laser beam is approximately 2.5m in diameter. As the beam passes through the water column, it slowly diverges due to scattering. It should be noted that at 5x5m laser spot spacing, there is a gap of 2.0 to 2.5m 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 5x5m soundings, and not be detected. A description of the Bottom Object Detection (BOD) algorithm used in data processing is presented in the Data Acquisition and Processing Report.

## B.3 CORRECTIONS TO SOUNDINGS

Refer to the Data Acquisition and Processing Report for a description of corrections to soundings. There were no deviations from the corrections described therein.

## B.4 DATA PROCESSING

### *B.4.1 Data Management*

The database is identified as follows:

| Database Name | Sub-Locality | Sheet |
|---|---|---|
| 09_5shum | Bird Island | A |

A detailed table of survey line identifiers is presented in the Data Acquisition and Processing Report.

### *B.4.2 Data Processing Sites*

The data acquired during survey flights was processed at the operating site in Sand Point following each sortie. Final validation, checking, approving, reports and products were conducted at the office in Biloxi, MS. The quality control of the data was conducted using CARIS software and was conducted in the Biloxi office.

### *B.4.3 CARIS BASE Surface*

One BASE Surface covers the entire survey area. The Shoal layer of the BASE Surface should be used as the official hydrographic record of the survey. A grid resolution of 5m was used for the BASE Surface. Grid resolution does not change relative to depth, as the laser pulse footprint stays relatively constant regardless of depth, and the laser spot spacing is constant irrespective of aircraft altitude. The 5m grid provides the largest amount of detail that can be supported by the lidar density (5x5 laser spot spacing at 200% coverage).

### *B.4.4 Gap and Feature Tagging*

During data processing on the GS, the operators have the ability to assign S-57 and user-defined tags to gaps and features in the data. This enables accurate delineation and attribution of unsurveyed polygons for the S-57 feature file (US512101.000).

For this survey, the following user-defined tags were used to delineate the seaward extent of gaps in the lidar seabed coverage, typically at a 50m interval:

| | |
|---|---|
| GC | Topography data gap due to extremely steep coastline. |
| GK | Bathymetry data gap due to kelp. |
| GS | Bathymetry / topography data gap due to the secondary exclusion zone (SEZ). |
| GW | Bathymetry data gap due to white water. |
| GLS | Bathymetry data gap due to glassy seas. |

Detailed descriptions of these gaps in seabed coverage are presented in Section B.8 of the Data Acquisition and Processing Report.

The following tags were used in the GS for features that require further examination:

| | |
|---|---|
| FEK | Feature for examination in kelp, as the least depth has not been determined. |
| FERA | Feature for examination of a rock awash, as the feature has not been surveyed adequately due to the presence of white water or limitations of the SEZ. |

The tags associated with features requiring further examination have been compiled in the H12101_Inv.hob file, and each have been given certain priority and a suggested examination method for the undertaking of additional boatwork. Each feature investigation within this file has not had least depth determined by lidar and required further examination by boat to survey accurately.

### *B.4.5 Georeferenced Imagery*

Digital imagery was captured on each sortie. The imagery was used in the validating, checking, and approval stages of survey data cleaning. The images were also combined to produce a georeferenced mosaic covering each of the registered sheets.

### *B.4.6 Progress Sketches*

Progress sketches were provided to NOAA on a monthly basis. The final progress sketch can be found in Appendix III.

### *B.4.7 Deliverables Data Formats*

Data is provided in the following formats:

- Digital S-57 feature file
- CARIS BASE Surface
- Lidar coverage and Lidar uncertainty images in geo .tif format
- CARIS features for investigation and chart comparison files in .hob format and corresponding GS screen captures in .jpg format
- CARIS compatible data – CAF Format – LADS soundings and waveforms, which can be imported into CARIS HIPS
- Chart Comparison Spreadsheet in .xls format
- CARIS compatible data – HDCS Format – LADS soundings in CARIS HIPS native format
- Tidal data provided in ASCII, .xls and .csv formats
- Digital georeferenced image in .ecw format

Refer to the Data Acquisition and Processing Report for specific details.

# C. VERTICAL AND HORIZONTAL CONTROL

Refer to the Horizontal and Vertical Control Report for a detailed description of the horizontal and vertical control used during this survey. Refer to Appendix IV for specific times and dates of relevant tide data. A summary of horizontal and vertical control used for the survey follows.

## C.1 VERTICAL CONTROL

Vertical control for this survey was based on MLLW at the National Water Level Observation Network (NWLON) station at Sand Point, AK (9459450).

Station details are as follows:

| | | NAD83 | |
|---|---|---|---|
| **Gauge** | **Location** | **Latitude (N)** | **Longitude (W)** |
| 9459450 | Sand Point | 55° 19.9' | 160° 30.2' |

## C.2 ZONING

Tide zones covering the extent of the survey area were derived from tide zone coordinates supplied by NOAA. Each of these tide zones use time and range correctors relative to the Sand Point tide station. An additional tide zone was established over Popof Strait for the reduction of soundings over the depth benchmark areas. These are as follows:

| Tide Zone | GS Identifier | Time Corrector | Range Corrector | Reference Station |
|---|---|---|---|---|
| SWA193 | TA1 | -6 minutes | x1.02 | 9459450 |
| SWA204 | TA2 | -6 minutes | x0.98 | 9459450 |
| Sand Point | TA3 | 0 minutes | x1.00 | 9459450 |

For final tide application, the time and range correctors were applied to NOAA verified tide data, smoothed by JOA. Soundings were then reduced to MLLW using these final tides. An analysis of depth benchmark and crossline comparisons, and overlaps of the mainlines of sounding concluded that final tide zoning was adequate.

The derived value for the difference between MLLW and MHW at the Sand Point tide gauge is 1.99m. From the final zoning, a range factor of 0.98 was applicable for Sheet A, resulting in a MHW value of 1.95m.

## C.3 HORIZONTAL CONTROL

Data collection and processing were conducted on the AS and GS in World Geodetic System (WGS84) on Universal Transverse Mercator (Northern Hemisphere) projection UTM (N) in Zone 4, Central Meridian 159° W. This data was post-processed and all soundings are positioned relative to the North American Datum 1983 (NAD83). All units are in meters.

### *C.3.1 LADS Local GPS Base Station – Sand Point*

Real-time positions were determined using an Ashtech GG24 GPS receiver on the aircraft, operating in autonomous GPS mode. A local GPS base station was established by JOA on the roof of the Popof Pizza building, Sand Point on March 28 and 29, 2004, and this site was reoccupied in order to post-process KGPS positions following survey flights.
The derived NAD83 coordinates for the local GPS base station are:

| **NAD83** | | **UTM (N) Zone 4** | | |
|---|---|---|---|---|
| **Latitude (N)** | **Longitude (W)** | **Easting (m)** | **Northing (m)** | **Ellipsoidal Height (m)** |
| 55° 20' 42.544" | 160° 28' 53.447" | 406 048.735 | 6 134 199.851 | 72.980 |

Post-processed KGPS positions were determined offline using data logged at the local GPS base station and on the aircraft. This data was processed with Waypoint GrafNav software to calculate a KGPS position solution for the survey flights. The post-processed KGPS positions were imported into the GS and applied to all soundings. This provided increased sounding position accuracy from the real-time autonomous GPS.

# D. RESULTS AND RECOMMENDATIONS

The results for the H12101 survey are submitted separately to this Descriptive Report as the S-57 feature file, BASE Surface, CARIS .hob files, georeferenced imagery, Chart Comparison Spreadsheet, etc. on the USB flash drive. Refer to Appendix II of the Data Acquisition and Processing Report for a list of all the deliverable files from H12101.

Below is a table listing the S-57 feature objects found in the S-57 feature file (US512101.000):

| S-57 Object Class | S-57 Object Acronym | Geometry | Description | Spatial Attribute | Attribute 1 | Attribute 2 | Attribute 3 | Attribute 4 | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Coastline | COALNE | L | The high waterline. Where depth equals 0 relative to MHW. | Quality of position (QUAPOS) | Category of Coastline (CATCOA) | | | | The spatial attribute QUAPOS is used when coastline is interpolated from the (GC) tags or the georeferenced imagery. |
| Depth Contour | DEPCNT | L | The approximate location of the line of equal depth. Also referred to as a depth curve. | | Value of depth contour (VALDCO) | | | | Fugro is only responsible for defining the 0m curve. |
| Lake Area | LAKARE | A | A large body of water entirely surrounded by land. | | | | | | Lidar returns from a lake's surface are removed from the final data set. |
| Land Area | LNDARE | P | The solid portion of the Earth's surface, as opposed to sea, water. | | | | | | Used for defining islet point features. |
| Land Elevation | LNDELV | P | The vertical distance of a point or level measured from a specified vertical datum. | | Elevation (ELEVAT) | | | | Used for defining islet heights related to MLLW. |
| Underwater / Awash Rock | UWTROC | P | A concreted mass of stony material or coral which dries, is awash or is below the water surface. | | Water level effect (WATLEV) | Quality of sounding measurement (QUASOU) | Technique of sounding measurement (TECSOU) | Value of sounding (VALSOU) | For H12101 drying rocks are between -2.55m and -0.60m above MLLW, awash rocks are between -0.59m and 0.60m relative to MLLW, and all submerged rocks are 0.61m and deeper relative to MLLW. |

| S-57 Object Class | S-57 Object Acronym | Geometry | Description | Spatial Attribute | Attribute 1 | Attribute 2 | Attribute 3 | Attribute 4 | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Weed / Kelp | WEDKLP | P, A | Usually large, blade-shaped or vine-like brown algae. | | Category of weed / kelp (CATWED) | | | | Polygon limits defined using the (GK) tags exported from the GS. Kelp point features defined using the (GK) tags exported from the GS and georeferenced imagery. |
| Water Turbulence | WATTUR | A | Disturbance of water caused by the interaction of any combination of waves, currents, tidal streams, wind, shoal patches and obstructions. | | Category of water turbulence (CATWAT) | | | | Used to define gaps in data coverage due to areas of white water, as tagged GW in the GS. |
| *Meta Objects* | | | | | | | | | |
| Coverage | M_COVR | A | A geographical area that describes the coverage and the extent of spatial objects. | | Category of coverage (CATCOV) | | | | M_COVR: CATCOV = 1 polygons define the extents of good LIDAR data coverage. |
| Quality of Data | M_QUAL | A | An area within which a uniform assessment of the quality of the data exists. | | Category of zone of confidence in data (CATZOC) | | | | |

**Table 2: S-57 Attribution for the S-57 feature file (US512101.000)**

Recommendations for registry number H12101 are divided into 2 components:

1. Recommended charting action, primarily for MCD.
2. Recommended further boatwork to sufficiently junction with lidar seabed coverage and examine uncertain lidar features.

Recommendations for charting action for registry number H12101 are provided in Sections D.1.1 to D.1.6 below. The Chart Comparison Spreadsheet has historically been one of the sources for the lidar features for examination list. In order to provide just <u>one</u> list of features for examination to field units, the Chart Comparison Spreadsheet has had some minor adjustments for this survey (H12101_Chartcomp.xls). All features that appear in the chart comparison, but have not accurately had least depth determined by lidar, appear in the features for examination file. Where the least depth has not been found by lidar, no recommended charting action has been specified. Instead, a vessel-based verification method is suggested.

The determination of least depth is at the discretion of the ships conducting junctioning / investigations and their results should be reported for charting action to MCD in due course.

Recommendations for ship junctioning and investigations are provided in Section D.2.1. In order to minimize the historical double handling of reporting uncertain lidar soundings on features, the features for examination are now contained exclusively in the CARIS .hob file (H12101_Inv.hob). The features for examination have been prioritized with respect to multibeam junctioning, investigating features in 'coastal' foul areas and within the NALL.

A summary of charting actions and investigations is provided in Section D.2.2.

## D.1 CHART COMPARISON

H12101 LADS survey deliverables were compared to:

ENC US3AK50M Edition 11, compiled from Raster Charts 16540 12th Edition. ENC issue date September 11, 2009 at scale 1:300,000.

These charts were downloaded from the NOAA Office of Coast Survey – NOAA Electronic Navigational Charts download website on October 4, 2009.
(http://chartmaker.ncd.noaa.gov/mcd/ENC/download.htm)

Recommendations for charting action are described in Sections D.1.4 to D.1.6.

### *D.1.1 Dangers to Navigation*

Danger to Navigation (DTON) reports were submitted to Pacific Hydrographic Branch (PHB) from the field and during deliverables compilation. The first DTON submission from the field coincided with the delivery of the monthly progress sketch at the end of July 2009. Final DTON recommendations were provided to PHB, as part of the preliminary survey delivery, during October 2009. However, no additional DTON's were selected by PHB for submission to MCD, as part of this preliminary PHB review.

The DTON report submitted to PHB for H12101 is provided at Appendix I.

### *D.1.2 AWOIS*

No AWOIS were assigned to this Task Order.

### *D.1.3 Aids to Navigation*

No Aids to Navigation exist within the survey area for H12101.

### *D.1.4 Charted Depths and Features*

Registry number H12101 covers parts of NOAA ENC US3AK50M and Raster Chart 16540. From the Source Diagram, the H12101 survey area was covered by NOS surveys between 1940 and 1969, presumably by single beam echosounder. Partial bottom coverage was achieved. However, the chart in this area was inadequately surveyed, with only the coastline

and a number of rocks and islets along the coast portrayed. It should be noted that large differences exist between the coastline and drying features in the ENC and the coastline and drying features on the Raster Chart.

The area surveyed is represented by the BASE Surface and S-57 feature file in considerably more detail than is currently shown on the ENC. The following general recommendations are relevant when comparing the area surveyed to the ENC:

a. Coastline. The charted coastline agrees well with the surveyed coastline for the larger islands and islets. The surveyed coastline differs from the charted position by a maximum of 65m in some parts of the survey area. There are a few locations where the charted coastline has been surveyed as drying shelf. It is recommended that the coastline on the chart be amended to match the LADS surveyed and interpolated MHW line.

b. Inshore Islets. A large number of islets have been surveyed close to the coastline. Generally, there is good agreement between the charted data and the surveyed data. It is recommended that the chart be amended to match the LADS survey deliverables. Where there is a significant difference, these islets are detailed in the Chart Comparison Spreadsheet in Section D.1.6.

c. Rocks. Many drying rocks and submerged shoals have been surveyed along the coastline, which are not presently shown on the chart. It is recommended that the chart be amended to match the LADS survey deliverables. Where significant, these items are detailed in the Chart Comparison Spreadsheet in Section D.1.6.

### *D.1.5 Detailed Chart Comparison*

In addition to the general recommendations above, some 39 specific differences between the chart and the LADS survey have been identified and are described in Section D.1.6. An expanded version of the spreadsheet is included digitally on the USB flash drive (H12101_ChartComp.xls). A CARIS .hob file containing just the chart comparison items has also been compiled and is provided as part of survey deliverables (H12101_ChartComp.hob). The attribution methodology for this file is presented below:

| S-57 Object Class | S-57 Object Acronym | Geometry | Description | Attribute 1 | Attribute 2 | Attribute 3 | Attribute 4 |
|---|---|---|---|---|---|---|---|
| Built-up Area | BUAARE | P | Used as a placeholder to store information relating to the chart comparison | OBJNAM (used for storing a unique chart comparison ID) | INFORM (used for storing the charting recommendation) | NINFOM (used for storing a reference to a Feature for Investigation) | PICREP (used for storing a link to GS screen captures) |

The chart comparison was conducted by reviewing the electronic and raster charts, the LADS survey deliverables and the digital georeferenced imagery. For each item identified, screen dumps of the Local Area Display, Raw Waveform Display and Digital Image Window were extracted from the LADS Mk II GS.

These have been reviewed in order to make the following assessments:

a. Type of Feature
b. Kelp Area
c. Least Depth Found
d. Charting Recommendation
e. Remarks

When the least depth has been adequately surveyed by lidar, the LDF Column is populated with a 'Y' for yes. The charting recommendation for a feature that has an adequately surveyed least depth will be either 'Insert' for a new feature, 'Replace' for an amendment to an existing charted feature or 'Remove' for a disproved charted feature.

When the least depth has NOT been found by lidar (populated with an 'N'), the chart comparison number has been used as the identifier within the S-57 feature file that contains the features for examination. If a chart comparison item had previously been identified as a feature for examination during data processing, a reference is made in the 'Remarks' column to the S-57 feature for examination item. For all chart comparison items that have not had least depth surveyed adequately, a suggested boatwork examination method acronym has been assigned. The description of these is provided in Section D.2.1.4.

Each chart comparison was categorized as follows:

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

The fields in the Chart Comparison Spreadsheet have been developed from experience learned and feedback received from previous lidar surveys in Alaska, witnessing survey operations aboard NOAA ship Rainier, from meetings at PHB and UNH and the 2007 NOAA Field Procedures Workshop. They have been designed for ease of use and to minimize double handling of data and transcription. Continued feedback is welcomed in order to develop these formats to achieve further efficiencies in data handling.

*D.1.6 Chart Comparison Spreadsheet*

| | | | CHARTED | | | SURVEYED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sequence No** | **Shoal No** | **Category** | **Charted Depth (meters)** | **NAD83 Latitude N (DMS)** | **NAD83 Longitude W (DMS)** | **Surveyed Depth (meters)** | **NAD83 Latitude N (DMS)** | **NAD83 Longitude W (DMS)** | **Type of Feature** | **Kelp Area** | **Least Depth Found** | **Charting Recommendation** | **Remarks**<br><br>**All items covered by 5x5m laser spot spacing at 200% lidar coverage.** |
| 1 | A1 | 1 | | | | 8.05 | 54° 49' 46.25" | 159° 41' 22.24" | Rk | Y | N | BV | Possible Rk in kelp. Refer to FEKA8. See Danger to Navigation Report. Item 1. Submitted during field operations. |
| 2 | A2 | 1 | | | | 4.35 | 54° 47' 27.62" | 159° 46' 41.81" | Rk | Y | Y | Insert | |
| 3 | A3 | 1 | | | | 14.84 | 54° 50' 57.44" | 159° 44' 25.39" | Rk | Y | N | JV | Possible Rk in kelp. Refer to FEKA10. |
| 4 | A4 | 2 | Drying Rk | 54° 50' 32.29" | 159° 42' 46.41" | | | | Kelp Area | Y | N | Remove | Not detected by lidar, not observed in digital imagery. |
| 5 | A5 | 2 | Drying Rk | 54° 50' 19.6" | 159° 42' 52.76" | -5.80 | 54° 50' 19.48" | 159° 42' 52.71" | Islet | N | Y | Replace | |
| 6 | A6 | 2 | Drying Rk | 54° 50' 22.7" | 159° 43' 0.2" | -4.08 | 54° 50' 22.58" | 159° 43' 0.08" | Islet | N | Y | Replace | Note: Several charted drying rocks in vicinity surveyed as coastline. |
| 7 | A7 | 1 | | | | -0.67 | 54° 50' 29.68" | 159° 43' 41.92" | Drying Rk | N | Y | Insert | |
| 8 | A8 | 2 | Drying Rk | 54° 50' 31.2" | 159° 43' 49.86" | | | | Slope | N | Y | Remove | Not detected by lidar, not observed in digital imagery. |
| 9 | A9 | 2 | Drying Rk | 54° 50' 45.14" | 159° 44' 9.57" | | | | Kelp Area | Y | N | Remove | Not detected by lidar, not observed in digital imagery. |
| 10 | A10 | 2 | Drying Rk | 54° 50' 33.43" | 159° 44' 9.34" | -8.17 | 54° 50' 33.43" | 159° 44' 9.34" | Islet | N | Y | Replace | Note: Additional charted drying rock in vicinity surveyed as an islet. |
| 11 | A11 | 2 | Drying Rk | 54° 50' 30.59" | 159° 44' 28.11" | | | | Coast | Y | Y | Remove | Not detected by lidar, not observed in digital imagery. |
| 12 | A12 | 1 | | | | 3.71 | 54° 50' 34.66" | 159° 44' 22.37" | Rk | Y | Y | Insert | |

Shoal Categories:
1 = New Shoal Found
2 = Charted Shoal Disproved / Not Found

Recommended Further Investigation Method:
VV = visual verification
BV = bathymetric verification
JV = junctioning verification

| | | | CHARTED | | | SURVEYED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sequence No | Shoal No | Category | Charted Depth (meters) | NAD83 Latitude N (DMS) | NAD83 Longitude W (DMS) | Surveyed Depth (meters) | NAD83 Latitude N (DMS) | NAD83 Longitude W (DMS) | Type of Feature | Kelp Area | Least Depth Found | Charting Recommendation | Remarks<br>All items covered by 5x5m laser spot spacing at 200% lidar coverage. |
| 13 | A13 | 2 | Drying Rk | 54° 50' 35.93" | 159° 44' 59.46" | | | | Slope | N | Y | Remove | Not detected by lidar, not observed in digital imagery. |
| 14 | A14 | 2 | Drying Rk | 54° 50' 24.27" | 159° 44' 51.7" | | | | Coast | Y | Y | Remove | Not detected by lidar, not observed in digital imagery. |
| 15 | A16 | 2 | Drying Rks | 54° 49' 43.63" | 159° 47' 33.63" | -5.99 | 54° 49' 43.4" | 159° 47' 33.59" | Islet | Y | Y | Replace | Note: Two charted drying rocks in surveyed as an islet. |
| 16 | A19 | 2 | Islets | 54° 50' 7.12" | 159° 45' 34.11" | | | | Coast | Y | Y | Remove | Note: Additional charted islet in vicinity surveyed as coastline. |
| 17 | A21 | 2 | Islet | 54° 49' 27.72" | 159° 47' 46.89" | | | | Coast | Y | Y | Remove | Note: Several charted drying features in vicinity surveyed as coastline. |
| 18 | A22 | 2 | Drying Rk | 54° 49' 21.69" | 159° 47' 55.73" | -5.01 | 54° 49' 20.91" | 159° 47' 55.05" | Islet | Y | Y | Replace | Note: Additional charted drying rock in vicinity surveyed as an islet. |
| 19 | A23 | 2 | Drying Rks | 54° 49' 14.54" | 159° 47' 54.21" | -11.98 | 54° 49' 14.56" | 159° 47' 54.32" | Islet | Y | Y | Replace | Note: Two charted drying rocks surveyed as an islet. |
| 20 | A24 | 1 | | | | -3.24 | 54° 48' 59.77" | 159° 49' 19.57" | Islet | Y | Y | Insert | |
| 21 | A25 | 2 | Drying Rk | 54° 49' 0.66" | 159° 43' 49.43" | -4.00 | 54° 49' 0.7" | 159° 43' 49.58" | Islet | Y | Y | Replace | Note: Several charted drying features in vicinity surveyed as coastline. |
| 22 | A28 | 2 | Drying Rks | 54° 49' 0.25" | 159° 42' 57.44" | -4.30 | 54° 49' 0.05" | 159° 42' 57.32" | Islet | Y | Y | Replace | Note: Two charted drying rocks surveyed as an islet. |
| 23 | A29 | 2 | Islet | 54° 48' 50.36" | 159° 42' 7.11" | | | | Slope | N | Y | Remove | |
| 24 | A30 | 2 | Drying Rk | 54° 48' 49.99" | 159° 41' 51.86" | | | | Slope | N | Y | Remove | |
| 25 | A31 | 1 | | | | -2.44 | 54° 48' 43.51" | 159° 42' 11.81" | Drying Rk | Y | Y | Insert | |

Shoal Categories:
1 = New Shoal Found
2 = Charted Shoal Disproved / Not Found

Recommended Further Investigation Method:
VV = visual verification
BV = bathymetric verification
JV = junctioning verification

| | | | CHARTED | | | SURVEYED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sequence No** | **Shoal No** | **Category** | **Charted Depth (meters)** | **NAD83 Latitude N (DMS)** | **NAD83 Longitude W (DMS)** | **Surveyed Depth (meters)** | **NAD83 Latitude N (DMS)** | **NAD83 Longitude W (DMS)** | **Type of Feature** | **Kelp Area** | **Least Depth Found** | **Charting Recommendation** | **Remarks**<br><br>**All items covered by 5x5m laser spot spacing at 200% lidar coverage.** |
| 26 | A32 | 1 | | | | 16.47 | 54° 48' 47.28" | 159° 41' 18.45" | Rk | Y | N | JV | Possible Rk in kelp. Refer to FEKA7. |
| 27 | A33 | 1 | | | | 13.58 | 54° 48' 44.03" | 159° 41' 53.67" | Rk | N | Y | Insert | |
| 28 | A34 | 1 | | | | 16.26 | 54° 48' 41.1" | 159° 42' 44.43" | Rk | N | Y | Insert | |
| 29 | A35 | 1 | | | | 16.08 | 54° 48' 41.47" | 159° 43' 3.01" | Rk | Y | Y | Insert | |
| 30 | A36 | 1 | | | | 11.56 | 54° 48' 18.43" | 159° 44' 36.93" | Rk | Y | N | BV | Possible Rk in kelp. Refer to FEKA5. |
| 31 | A37 | 1 | | | | 16.81 | 54° 48' 8.15" | 159° 44' 50.55" | Rk | N | Y | Insert | |
| 32 | A38 | 1 | | | | -1.04 | 54° 48' 16.08" | 159° 45' 8.44" | Drying Rk | Y | Y | Insert | |
| 33 | A39 | 1 | | | | 0.44 | 54° 48' 10.41" | 159° 48' 30" | Drying Rk | Y | Y | Insert | |
| 34 | A40 | 1 | | | | 5.86 | 54° 48' 19.79" | 159° 49' 2.32" | Rk | Y | Y | Insert | |
| 35 | A41 | 1 | | | | 2.65 | 54° 48' 29.76" | 159° 48' 50.13" | Rk | Y | Y | Insert | |
| 36 | A42 | 2 | Drying Rk | 54° 48' 10.27" | 159° 48' 22.91" | -4.41 | 54° 48' 10.25" | 159° 48' 22.55" | Islet | Y | Y | Replace | |
| 37 | A43 | 1 | | | | -5.14 | 54° 48' 25.61" | 159° 48' 46.13" | Islet | Y | Y | Insert | |
| 38 | A44 | 1 | | | | -0.68 | 54° 47' 39.87" | 159° 47' 3.39" | Drying Rk | Y | Y | Insert | |
| 39 | A45 | 2 | Drying Rk | 54° 50' 1.98" | 159° 41' 32.23" | | | | Slope | N | Y | Remove | Not detected by lidar, not observed in digital imagery. |

**Table 3: Chart Comparison Spreadsheet**

Shoal Categories:
1 = New Shoal Found
2 = Charted Shoal Disproved / Not Found

Recommended Further Investigation Method:
VV = visual verification
BV = bathymetric verification
JV = junctioning verification

## D.2 ADDITIONAL RESULTS

### *D.2.1 Supplemental Information for Boatwork*

For the H12101 survey, the supplemental information for further boatwork was compiled by:

1. Defining the seaward limit of good lidar seabed coverage as a M_COVR, CATCOV=1 polygon.
2. Reviewing the features for investigation compiled during data processing and adding the uncertain soundings identified during the chart comparison to this examination list.
3. Prioritizing all features for investigation with respect to the M_COVR polygon and dangers to safe vessel-based examination.
4. Recommending the vessel-based method of disproving 'suspicious' lidar features or confirming 'real' lidar feature detections and determining least depth.

#### *D.2.1.1 Seaward Limit of Lidar Coverage*

The survey area H12101 consists of a large number of islands, islets and many kelp covered submerged rocks close to the coast. Heavy kelp is present throughout the survey area. As a result of periods of poor water clarity experienced during lidar data acquisition and the presence of heavy kelp, several areas across the sheet have poor seabed coverage. This is reflected by gaps in the BASE Surface rendered as part of the survey deliverables.

In particular, the areas of poor lidar seabed coverage include:

- W coast of Bird Island, at position 54° 48' 26" N, 159° 48' 54" W, due to kelp.
- NW coast of Bird Island, at position 54° 49' 45" N, 159° 47' 38" W, due to kelp.
- N coast of Bird Island, at position 54° 50' 27" N, 159° 45' 11" W, due to kelp.
- S coast of Bird Island, at position 54° 48' 30" N, 159° 44' 39" W, due to kelp.

Traditionally, the suggested lidar-ship junctioning polyline was drawn too far to seaward, across areas of sparse, 'noisy' lidar coverage. For this survey, the polyline submitted as an S-57 M_COVR CATCOV=1 polygon is the seaward extent of good lidar coverage. When there is poor lidar coverage due to poor water clarity, or expansive white water, the polyline has been drawn just to seaward of the MLLW line. It should be noted that FLI is not providing a recommended junctioning line. The determination of where multibeam survey lines need to be conducted is at the discretion of the PHB and the ships conducting the junctioning.

When planning multibeam junctioning with lidar seabed coverage, the NALL and the following must be taken into consideration:

- Lidar / georeferenced imagery derived MHW line, MLLW line.
- Drying, awash and shallow features detected by lidar.
- Features for examination.
- 'Unsurveyed' polygons due to kelp, and white water.

These are all provided in the S-57 feature file (US512101.000) and the H12101_Inv.hob file for H12101.

The areas of good lidar seabed coverage include:

- N coast of Bird Island, at position 54° 49’ 48” N, 159° 46’ 40” W.
- E coast of Bird Island, at position 54° 49’ 30” N, 159° 41’ 59” W.
- NE coast of Bird Island, at position 54° 50’ 52” N, 159° 43’ 04” W.
- S coast of Bird Island, at position 54° 48’ 55” N, 159° 44’ 40” W.

The seaward limit of good lidar data coverage has been described by the S-57 feature object M_COVR in the S-57 feature file (US512101.000).

*D.2.1.2 Lidar Features Requiring Further Investigation*

A list of uncertain lidar soundings was collated during data processing and is presented in an S-57 feature file. For example, some detections on isolated rocks in thick kelp beds were difficult to correctly classify as either rock or kelp.

Tagging in the GS was used to flag features for which the least depth has not been found. Typically this meant that there were less than 4 supporting soundings, within 0.5 – 1.0m of the depth, on the primary and overlapping lines. These tags were then exported from the GS and compiled in CARIS BASE Editor. Features for examination have been captured within the H12101_Inv.hob as M_NPUB feature objects. Where these features correlate with an item listed in the Chart Comparison Spreadsheet, a reference has been made in the H12101_Inv.hob file. The S-57 attribution methodology for lidar features requiring further investigation is presented below:

| S-57 Object Class | S-57 Object Acronym | Geometry | Description | Attribute 1 | Attribute 2 | Attribute 3 | Attribute 4 |
|---|---|---|---|---|---|---|---|
| Built-up Area | BUAARE | P | Used as a placeholder to store information relating to the chart comparison | OBJNAM (used for storing a unique Feature for Investigation ID) | INFORM (used for storing the recommended examination method) | NINFOM (used for storing a reference to a Chart Comparison) | PICREP (used for storing a link to waveform screen captures) |

Refer to Section B.4.4 for the descriptions of the GS tagging philosophy used for all lidar seabed coverage gaps and recommended features for investigation.

In circumstances where least depth has not been found over a significant feature, a recommendation for investigation by boat for 12 uncertain soundings has been made in the CARIS H12101_Inv.hob file. All features in the chart comparison that have not had least depth adequately surveyed also appear in this file.

*D.2.1.3 Prioritization of Features Requiring Further Investigation*

All features for investigation have been assigned a priority, based on location with respect to the lidar coverage polyline, the coastal foul areas, and the NALL. In addition, they have been attributed with a recommended examination method, as specified in the following section. The priorities are assigned using the following table:

| Priority | Location w.r.t. Polyline | Coastal Foul Area / NALL | Examination Method | Remarks |
|---|---|---|---|---|
| 1 | Seaward | No | Typically BV or VV / BV for shallow features | MUST be examined prior to multibeam junctioning. |
| 2 | Inshore | No NALL<br>Possibly within Foul | Typically BV or VV / BV for shallow features | Investigation at ships discretion.<br>Typically for uncertain shallow features. |
| 3 | Inshore / Seaward | NALL<br>Coastal kelp | VV / BV | Investigation at ships discretion.<br>Typically for drying rocks or rocks awash. |
| 4 | Seaward | No | JV | Can be safely navigated over during multibeam.<br>Post acquisition comparison required. |
| 5 | Inshore / Seaward | Generally No | Typically BV or VV / BV for shallow features | Doubtful sounding.<br>Possibly floating kelp / whale or fish strikes. |

Note: All features recommended for investigation are reported as possible hazards when conducting survey work by boat.

**Table 4: Prioritization Hierarchy for Features Requiring Further Investigation**

*D.2.1.4 Recommended Examination Method of Features Requiring Further Investigation*

Each feature for investigation has been attributed with a recommended examination method, based on the general depth around the feature, the least depth as detected by lidar and the nature of the feature (kelp, white water, etc.). The examination methods are categorized as follows:

| Acronym | Examination Method |
|---|---|
| VV | Visual Verification - may be hazardous to approach even with shallow draft vessel running single beam. |
| VV / BV | Visual Verification required prior to Bathymetric Verification - potentially shoaler than 3m depth. |
| BV | Bathymetric Verification, generally greater than 3m depth. |
| JV | Junctioning Verification, generally greater than 6m depth. |

**Table 5: Recommended Examination Methods for Features Requiring Further Investigation**

*D.2.1.5 Recommended Junctioning with Unsurveyed Lidar Areas*

The 'unsurveyed' gaps in lidar seabed coverage are defined as polygons in the S-57 feature file. They were constructed utilizing the export of the operator assigned gap tags covered in Section B.4.4. In the case of 'unsurveyed' areas for kelp, and white water, junctioning is not recommended for the obvious risks to surface vessels.

*D.2.1.6 Comparison with prior Surveys*

Comparison with prior surveys was not required under this Task Order. See Section D.1 for comparison to the nautical charts.

### *D.2.2 Summary of Charting Actions and Investigations – H12101*

#### *D.2.2.1 Summary of Charting Actions – H12101*

Total number of new significant islets recommended for insertion on chart: 2
Total number of new significant drying rocks recommended for insertion on chart: 5
Total number of new significant rocks awash recommended for insertion on chart: 0
Total number of new significant rocks recommended for insertion on chart: 8
Total number of charted features disproved by lidar (Remove): 11
Total number of charted features recommended for amendment by lidar (Replace): 9
Total number of chart comparison items requiring further investigation: 4

Total number of DTONs submitted to PHB during field operations: 1
Total number of Anti-DTONs submitted to PHB during field operations: 0
Total number of DTONs submitted to PHB during product compilation: 0
Total number of Anti-DTONs submitted to PHB during product compilation: 0
**Total number of DTONs submitted to PHB for H12101: 1**
**Total number of Anti-DTONs submitted to PHB for H12101: 0**

#### *D.2.2.2 Summary of Lidar Features Requiring Further Investigation – H12101*

Total number of Priority 1 investigations identified: 1
Total number of Priority 2 investigations identified: 5
Total number of Priority 3 investigations identified: 2
Total number of Priority 4 investigations identified: 4
Total number of Priority 5 investigations identified: 0

Total number of investigations recommended during data processing: 12
Total number of investigations recommended from georeferenced imagery review: 0
Total number of investigations recommended from chart comparison compilation: 0
**Total number of recommended feature investigations: 12**

# E. APPROVAL SHEET

## LETTER OF APPROVAL – OPR-P183-KRL-09

This report and the accompanying LADS survey deliverables 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 LADS survey deliverables have been closely reviewed and are considered complete and adequate as per the Statement of Work.

| Report | Submission Date |
|---|---|
| Descriptive Report – H12101 | January 15, 2010 |

Mark Sinclair
Hydrographer
Fugro LADS, Incorporated

Date January 15, 2010

## Revisions and Corrections Compiled During Office Processing and Certification

[1] Select bathymetry and features from the LIDAR survey referenced in this Descriptive Report have been applied to the junctioning multibeam survey H12593. No stand-alone LIDAR information was compiled to chart update products. LIDAR does not meet IHO object detection requirements. LIDAR was not used to supersede shoaler charted soundings or to disprove charted features.

# APPENDIX I – DANGERS TO NAVIGATION

## DTONS Submitted to PHB

### I.1.1 Danger to Navigation Report

Hydrographic Survey Registry Number: H12101

State: Alaska

Locality: Shumagin Islands

Sub-locality: Bird Island

Project Number: OPR-P183-KRL-09

Survey Dates: May – August 2009

Depths are in meters and reduced to Mean Lower Low Water using preliminary tides. Drying heights are in meters relative to MLLW. Islets are related to MHW. Positions are based on the NAD83 horizontal datum. All times and dates are relative to UTC.

**Charts Affected**

| Number | Edition | Date | Scale |
|---|---|---|---|
| US3AK50M | 8th | 7/7/2009 | 1:300,000 |

The following items were found during hydrographic survey operations:

| No. | Feature | Depth (m) | Latitude (N) | Longitude (W) | Time, Date, Year | Investigate |
|---|---|---|---|---|---|---|
| 1 | Rk | 8.0 | 54° 49' 46.25" | 159° 41' 22.24" | 23:55:06, July 29, 2009 | Yes |

**COMMENTS:** Final verified tides have been applied from the Sand Point tide gauge (9459450). The shoal was found using LIDAR. DTON item 1 was submitted during data collection from the field.

Questions concerning this report should be directed to the Survey Manager, Mr. Scott Ramsay, in the Fugro LADS, Inc. office in Biloxi MS, at (228) 594-6800.

## DTONS Submitted to MCD

### I.1.2 Danger to Navigation Report (Submitted during field operations)

# Danger to Navigation Report for Lidar Survey H12101

**Registry Number:** H12101
**State:** Alaska
**Locality:** Shumagin Islands
**Sub-locality:** Bird Island
**Project Number:** OPR-P183-KRL-09
**Survey Dates:** June 13, 2009 - August 11, 2009

## Charts Affected

| Number | Edition | Date | Scale (RNC) | RNC Correction(s)* |
|---|---|---|---|---|
| 16540 | 12th | 01/01/2005 | 1:300,000 (16540_1) | USCG LNM: 02/24/2009 (07/21/2009)<br>NGA NTM: 01/21/2006 (08/01/2009) |
| 16011 | 37th | 11/01/2007 | 1:1,023,188 (16011_1) | [L]NTM: ? |
| 16006 | 35th | 04/01/2008 | 1:1,534,076 (16006_1) | [L]NTM: ? |
| 500 | 8th | 06/01/2003 | 1:3,500,000 (500_1) | [L]NTM: ? |
| 530 | 32nd | 06/01/2007 | 1:4,860,700 (530_1) | [L]NTM: ? |
| 50 | 6th | 06/01/2003 | 1:10,000,000 (50_1) | [L]NTM: ? |

* Correction(s) - *source: last correction applied (last correction reviewed--"cleared date")*

## Features

| No. | Feature Type | Survey Depth | Survey Latitude | Survey Longitude |
|---|---|---|---|---|
| 1.1 | Rock | 8.06 m | 54° 49' 46.3" N | 159° 41' 22.2" W |

*Generated by Pydro v9.6 (r2698) on Wed Aug 26 18:26:36 2009 [UTC]*

# 1 - Danger To Navigation

## 1.1) GP No. - 1 from H12101_Pydro.xls

### DANGER TO NAVIGATION

### Survey Summary

| | |
|---|---|
| **Survey Position:** | 54° 49' 46.3" N, 159° 41' 22.2" W |
| **Least Depth:** | 8.06 m (= 26.44 ft = 4.407 fm = 4 fm 2.44 ft) |
| **TPU (±1.96σ):** | **THU (TPEh)** [None] ; **TVU (TPEv)** [None] |
| **Timestamp:** | 2009-210.23:55:06.000 (07/29/2009) |
| **GP Dataset:** | H12101_Pydro.xls |
| **GP No.:** | 1 |
| **Charts Affected:** | 16540_1, 16011_1, 16006_1, 500_1, 530_1, 50_1 |

**Remarks:**

This feature was found during Lidar hydrographic survey operation by Fugro LADS Inc. Depth was reduced to Mean Lower Low Water using preliminary tides from the King Cove tide gauge (9459881).

### Hydrographer Recommendations

Chart as surveyed.

**Cartographically-Rounded Depth (Affected Charts):**

4 ¼fm (16540_1, 16011_1, 16006_1, 530_1)

8.1m (500_1, 50_1)

### S-57 Data

| | |
|---|---|
| **Geo object 1:** | Underwater rock / awash rock (UWTROC) |
| **Attributes:** | SORDAT - 20090811 |
| | SORIND - US,US,nsurf,H12101 |
| | TECSOU - 7:found by laser |
| | VALSOU - 8.06 m |
| | VERDAT - 12:Mean lower low water |
| | WATLEV - 3:always under water/submerged |

APPROVAL PAGE

H12101

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NGDC for archive

- H12101_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12101_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications.

Approved: 
Digitally signed by HOLMBERG.PETER.SCOTT.1365886101
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOLMBERG.PETER.SCOTT.1365886101
Date: 2014.10.29 13:01:39 -07'00'

**Peter Holmberg**
Cartographic Team Lead, Pacific Hydrographic Branch

The survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Approved: 
Digitally signed by EVANS.BENJAMIN.K.1237217094
Reason: I am approving this document
Date: 2014.10.29 14:10:00 -07'00'

**CDR Benjamin K. Evans, NOAA**
Chief, Pacific Hydrographic Branch