H11665

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:	H11665

LOCALITY

State:	Alaska
General Locality:	Southeast Coast of Kodiak Island
Sub-locality:	Geese Channel

2007

CHIEF OF PARTY
Scott Ramsay, Tenix LADS, Inc.

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Date:

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET		**H11665**

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:	**Southeast Coast of Kodiak Island**
Sub-Locality:	**Geese Channel**
Scale:	**1: 10,000**
Dates of Survey:	**04/27/2007 to 06/20/2007**
Instructions Dated:	**03/15/2007**
Project Number:	**OPR-P135-KRL-07**
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 5N. The purpose of this survey is to provide contemporary survey to update National Ocean Service (NOS) charts. All separates are filed with the hydrographic data. Revisions and notes in red were generated during office processing. The processing branch concurs with all information and recommendations in the DR unless otherwise noted. Page numbering may be interrupted or non-sequential. All pertinent records for this survey, including the Descriptive Report, 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 H11665

SCALE 1:10,000, SURVEYED IN 2007

TENIX LADS AIRCRAFT, VH-LCL

TENIX LADS, INC. (TLI)

MARK SINCLAIR, HYDROGRAPHER

PROJECT

Project Number: OPR-P135-KRL-07
Original: DG 133C-06-CQ-0066
Date of Instructions: March 15, 2007
Task Order: T0001

Date of Supplemental Instructions:

- August 15, 2007 – Email from Dave Scharff (NOAA COTR) indicating CO-OPS authorized rezoning for the project area (refer to Appendix V).
- March 12, 2008 – Email from Toshi Uozumi (NOAA) regarding Rock Selection (refer to Appendix V).

Registry Number: H11665
Sheet: B

A. AREA SURVEYED

Survey operations covered five registered sheets over the OPR-P135-KRL-07 project area, Southeast Coast of Kodiak Island, AK (see Figure 1 and Figure 2).

A total of 2457 lineal nautical miles were illuminated in the process of flying 234 main scheme survey lines. An additional 1708 lineal nautical miles were illuminated flying 157 reflies and 437 lineal nautical miles flying 81 crosslines / investigations. The total seabed area surveyed across the project area, from the 0m curve to lidar extinction depth, was 30 square nautical miles (see Appendix III for further information).

The first survey flight was conducted in the Southeast Coast of Kodiak Island, AK project area on April 27, 2007. A total of 19 sorties were flown in the project area, with the final 2 flights occurring on June 20, 2007. The specific dates of data acquisition, hours flown and time on task were as follows:

Date	Sortie No.	Hours Flown	Time on Task
27 April 2007	1	4:22	3:10
28 April 2007	3	5:01	2:54
01 May 2007	4	4:02	2:35
02 May 2007	6	5:58	5:05
03 May 2007	7	1:15	0:30
04 May 2007	8	4:36	3:43
19 May 2007	9	4:43	3:30
19 May 2007	10	3:41	2:47
20 May 2007	11	6:45	5:30
21 May 2007	12	6:36	5:40
03 June 2007	13	6:37	5:38
04 June 2007	14	6:05	4:52
08 June 2007	16	2:14	0:55
10 June 2007	17	4:57	3:02
12 June 2007	19	6:08	4:53
16 June 2007	20	5:44	5:05
17 June 2007	21	6:48	5:25
20 June 2007	22	5:22	4:35
20 June 2007	23	4:22	2:40

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 B, which covers Geese Channel (see Figure 2).

The sheet limits are as follows for Sheet B:

H11665 (B)	Latitude (N)	Longitude (W)
N corner	56° 50' 33.17"	153° 55' 23.34"
E corner	56° 47' 54.30"	153° 49' 41.38"
S corner	56° 41' 19.34"	153° 59' 49.66"
W corner	56° 43' 57.74"	154° 05' 31.32"

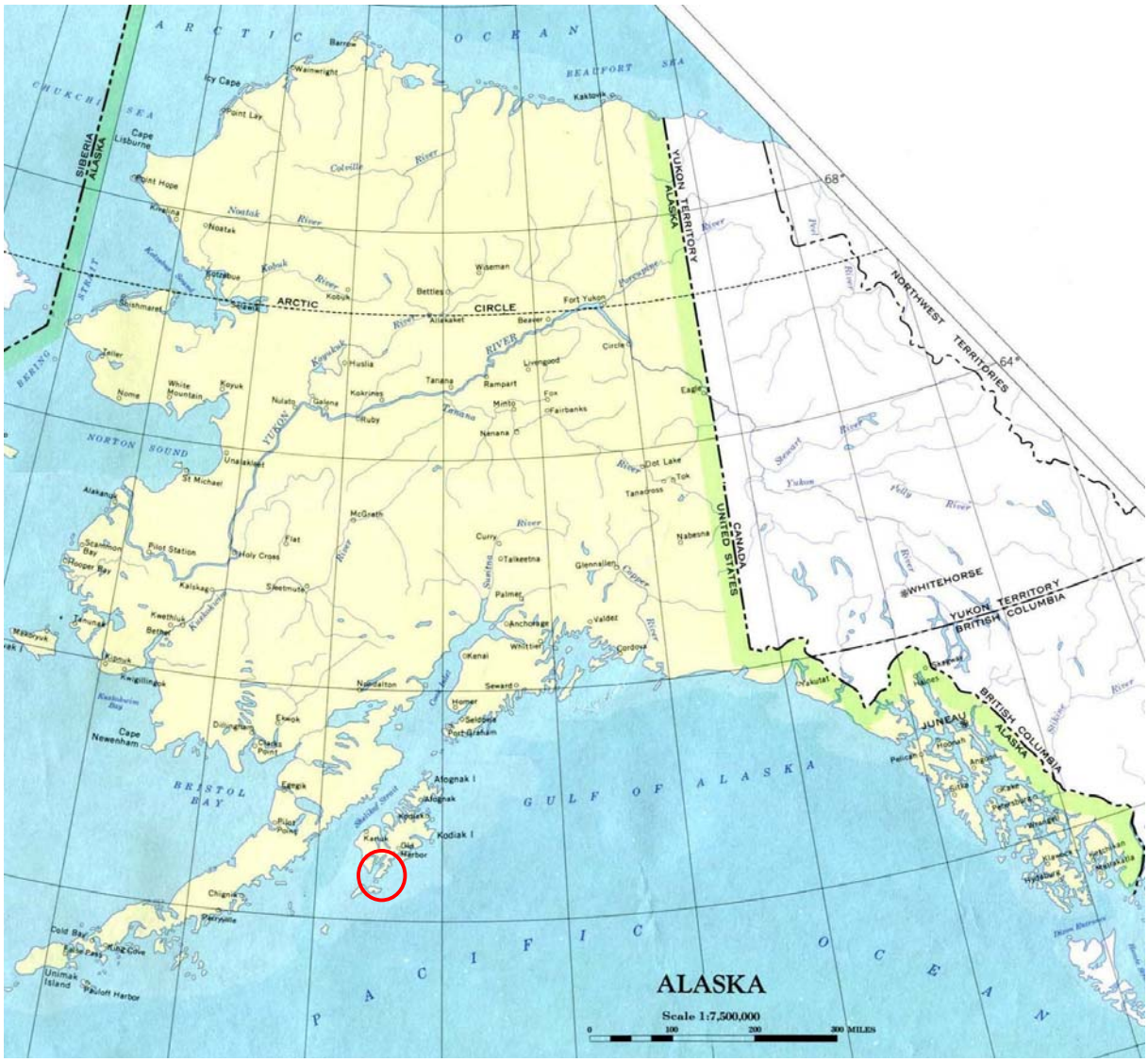

Figure 1 – General Locality of OPR-P135-KRL-07

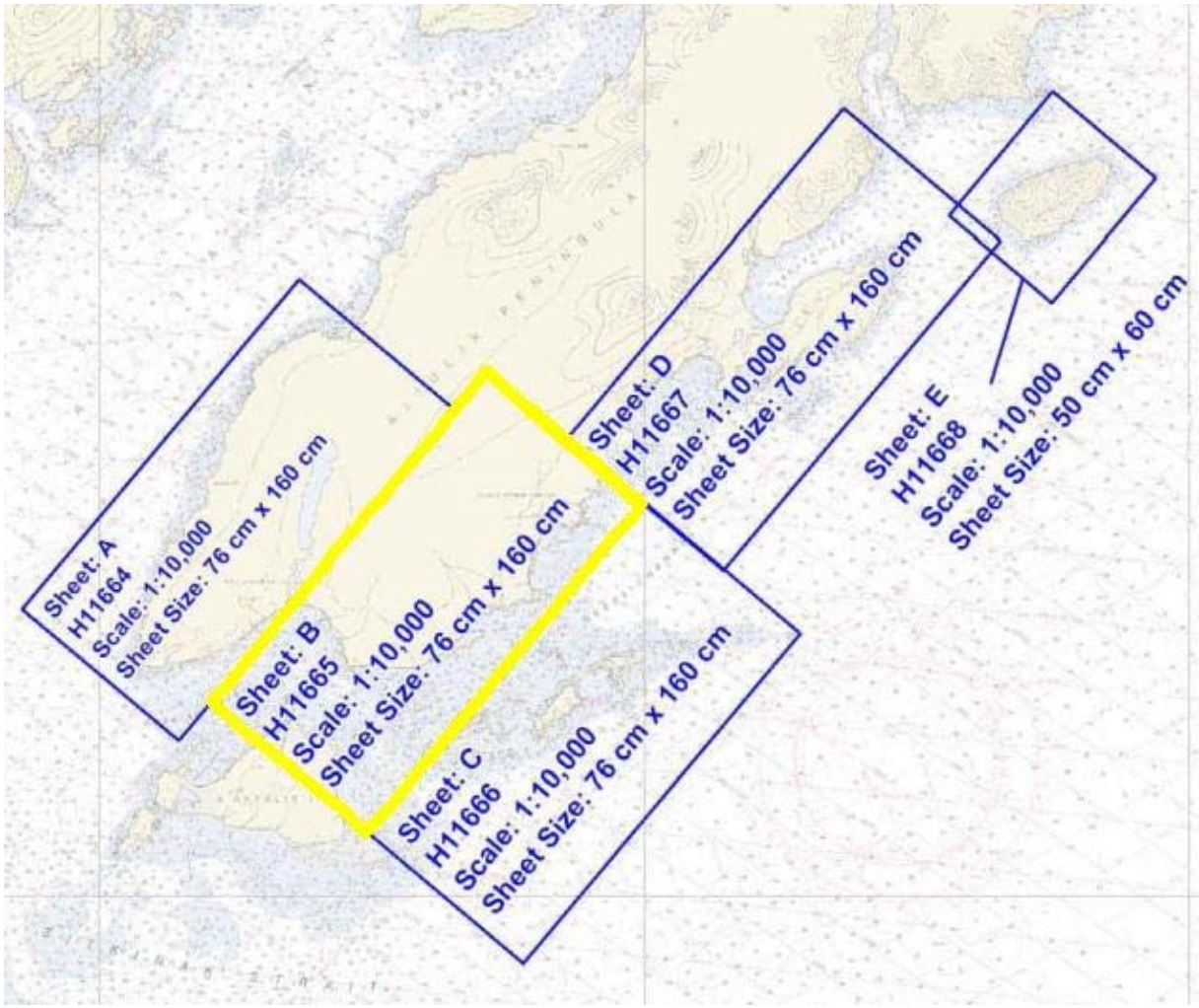

Figure 2 – Sub-Locality of H11665

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 prior to commencement of this survey. This allowed high quality images to be captured in real-time, georeferenced and overlaid with the processed survey data. These images were 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 ‘Gandalf’ was used to conduct data processing in the field. Gandalf consists of a portable Compaq Alpha ES40 Series 3 processor server with 1 GB EEC RAM, 764 GB disk space, digital linear tape (DLT) drives and magazines, a digital audio tape (DAT) drive, a CD ROM drive, and is networked to up to 12 Compaq 1.5 GHz PCs and a HP 800ps Design Jet Plotter, printers and QC workstations. 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.

Quality control checks and editing of the data were conducted on GS 'Katrina', at the TLI office in Biloxi, MS, upon completion of the data collection phase of the survey.

B.2 QUALITY CONTROL

B.2.1 Quality Control Checks

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

B.2.1.1 Crosslines

No specific crosslines were planned due to the high number of investigation / additional coverage lines (81) flown perpendicular to main scheme survey runs (234). Due to the complex nature of the seabed and extent of kelp areas, a total of 8 crossline runs were selected for depth comparison. These 8 lines exhibited good water clarity and generally low gradient slopes, enabling meaningful statistics to be calculated. Below are the overall depth comparison results for the 125 crossline comparisons. A complete summary is presented in the Separates Report.

Total Number of Comparisons	Mean Depth Difference	Mean Standard Deviation
181948	0.11 +/- 0.16	0.15 +/- 0.05

B.2.1.2 Depth Benchmarks

Five gridded depth benchmark areas were created from bathymetry collected over benchmark run 19.0, which was flown on June 17, 2007. Comparisons between the gridded benchmark areas and bathymetry collected on benchmark runs flown at the commencement of each sortie were used to check the relative depth accuracy of the LADS Mk II system for the H11665 survey. Center coordinates for the benchmark areas are as follows:

Russian Harbor / Geese Channel Benchmarks

		UTM (N) Zone 5	
Benchmark Name	**Depth Range**	**Easting**	**Northing**
BM 1	4m to 7m	440 435	6 288 567
BM 2	4m to 8m	439 182	6 288 559
BM 3	9m to 11m	436 163	6 288 552
BM 4	11m to 12m	431 752	6 288 538
BM 5	16m to 18m	430 776	6 288 537

The benchmark runs were reduced to MLLW using Alitak final tides and zoning, and compared against the gridded benchmark surfaces in the GS. Statistics are generated which include the number of points compared, the mean depth difference (MDD) and the standard deviation (SD) between the data sets.

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.

GS ID	BM Name	Depth Range	Number of Comparisons	MDD	SD
1	BM 1	4m to 7m	24114	0.25 +/- 0.10	0.09 +/- 0.01
2	BM 2	4m to 8m	40391	0.20 +/- 0.08	0.08 +/- 0.01
3	BM 3	9m to 11m	29342	0.14 +/- 0.11	0.12 +/- 0.01
4	BM 4	11m to 12m	33634	0.15 +/- 0.13	0.10 +/- 0.03
5	BM 5	16m to 18m	2405	0.16 +/- 0.23	0.16 +/- 0.01

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 top of the Tenix office, located at 220 Center Street, Kodiak, AK. 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 was conducted on April 27-28, 2007. The results revealed that the local GPS base station was 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 three marks, which were surveyed by JOA on the tarmac at the Kodiak 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 0.171m (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 2.076m, with an average SD of 0.305m. Details are provided in the Horizontal and Vertical Control Report.

d. Navigation Position Check. Navigation checks were also conducted over Cape Alitak Light where the known position of the structure was checked against the downward-looking digital image. This provided a gross error check of position. The mean error in Easting was 1.14 +/- 2.14m and –1.31 +/- 1.86m in the Northing. 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 3.34m and the assigned vertical uncertainty is 0.50m.

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.[1]

B.2.3 Environmental Factors

B.2.3.1 Sea Conditions - Sea State, Waves, Swell, White Water

The sea state ranged from 1 to 4 on the Beaufort Scale throughout the survey period, but was generally between states 1 and 2 in the western areas including Russian Harbor and Geese Channel. The areas to the north of Geese Channel and around Twoheaded Island were exposed to the weather and sea states to 4 were observed. Where areas of white water were present, reflies and additional lines were flown during calmer conditions.

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

Long period swell was not significant during the survey. However, 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. No secchi disk observations were taken due to the limited availability of surface vessels in the area. A reconnaissance by light aircraft was conducted on May 16, 2007, after a period of poor weather, to assess the water clarity conditions prior to commencing survey flights in the project area.

B.2.3.3 Kelp

Kelp is one of the factors that increase the complexity of a particular survey area. It is one of the reasons why 200% coverage is 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 do not correlate with overlapping data from adjacent lines.

Kelp areas 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 (US511665.000).

Rocks detected by the system in kelp areas may be difficult to discriminate as rock or kelp returns. When it is uncertain if the return is from rock 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 chart comparison file (H11665_Chartcomp.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

Due to the high ground on Twoheaded Island and along the Aliulik Peninsula, survey lines were generally flown at 2200ft.

B.2.3.6 Wind

Survey operations were conducted in wind strengths of up to 20kts during the survey. In general, the wind strength during sorties was between 5 and 15kts. In certain areas, wind strengths above 10kts generated turbulence that made data collection difficult and unsafe. When wind speeds were forecasted 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 was experienced during the survey and on occasion resulted in diversion to other survey areas or termination of sorties. Poor weather was monitored using, and decisions on the flying program were based on:

- Real-time satellite imagery
- Radar data
- Aviation reports
- Reports from local contacts at the Alitak cannery
- Pilot weather reports
- Images viewed from the Federal Aviation webcam located at Akhiok

B.2.4 Data Coverage and Object Detection

B.2.4.1 Nature of the Seabed

The nature of the seabed surrounding Geese Channel is very complex. The area contains numerous rocks 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.[2]

The seabed gradient is generally high south of the Geese Islands sloping to beyond 20m depth quickly. Within Geese Channel seabed gradient is more gradual with depths averaging 5 to 10m. The seabed at the southwestern extent of the sheet appears to be made up of loosely consolidated sediments, as dynamic sand wave fields were observed in the data in this area during the survey. These sand wave fields have been delineated in the S-57 feature file (US511665.000) as “SNDWAV” polygon features.

B.2.4.2 Data Coverage

The survey area was illuminated at 4x4m laser spot spacing, resulting in a 192m swath width. Mainlines of sounding were spaced at 85m, 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. In some inshore areas, reciprocal lines could not be flown due to the proximity of high ground at the start / end of the line. This adversely affected seabed coverage along some coastlines.

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 effort.

The variable water clarity throughout the survey period resulted in maximum lidar extinction depths of 25m for the project, but typically full seabed coverage to 15m depth was achieved for H11665.

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 4x4m laser spot spacing, there is a gap of 1.0 to 1.5m 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 4x4m 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	General Locality	Sub-Locality	Sheet
07_5Ali	Southeast Coast of Kodiak Island	Geese Channel	B

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 Kodiak 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 completed using CARIS software and was conducted in the Biloxi, MS 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 3m 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 3m grid provides the largest amount of detail that can be supported by the lidar data density.

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 (US511665.000).

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:

GK	Bathymetry data gap due to kelp.
GS	Bathymetry / topography data gap due to the secondary exclusion zone (SEZ).

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.
FERK	Feature for examination of a rock awash, as the feature has not been surveyed adequately due to the presence of white water.

The tags associated with features requiring further examination have been compiled in the H11665_Inv.hob file, and each have been given certain priority and a suggested examination method for the undertaking of additional boatwork.

In most cases the least depth has not been found on a feature in this file and it requires further examination by boat to determine the least depth.

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 of the survey area.

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
- CARIS features for investigation and chart comparison files in .hob format
- CARIS compatible data – CAF Format – LADS soundings and waveforms, which can be imported into CARIS HIPS
- 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 .tif / .tfw 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. A summary of horizontal and vertical control used for the survey follows.

C.1 VERTICAL CONTROL

The preliminary vertical control for this survey was based on the National Water Level Observation Network (NWLON) stations at Kodiak, AK (9457292) and Alitak, AK (9457804). Final tide zoning was based on revised information received from CO-OPS and utilized tide data from and time / range correctors relative to Alitak, AK (9457804) only.

The vertical control for the survey was based on the Mean Lower Low Water (MLLW) tidal datum. During field operations tide data for the National Water Level Observation Network (NWLON) station at Kodiak and Alitak were downloaded from the CO-OPS website and these preliminary tide values were used to reduce depth soundings.

The final tidal levels for Alitak were computed by JOA from verified tides obtained from the NWLON.

Station details are as follows:

		WGS84	
Gauge	**Location**	**Latitude**	**Longitude**
9457292	Kodiak Island	57° 43' 54"	152° 30' 42"
9457804	Alitak	56° 53' 54"	154° 14' 48"

C.2 ZONING

NOAA initially supplied tide zoning with time and range correctors relative to Kodiak and Alitak in the Statement of Work (SOW) dated March 15, 2007. During data collection and preliminary tide reduction, a tide step was identified between adjacent tide zones, SWA141A (time and range correctors from Kodiak) and SS85 (time and range correctors from Alitak). A request for rezoning was submitted to the COTR. Final vertical control and zoning was based on revised information received from CO-OPS via an email received on August 15, 2007. The final time and range correctors were based off Alitak, AK (9457804) only. These supplemental instructions are provided at Appendix V.

The final tide zones and correctors are as follows:

Tide Zone	GS Identifier	Time Corrector	Range Corrector	Reference Station
SS72	TA4	+6 minutes	x0.93	9457804
SS73	TA3	+6 minutes	x0.95	9457804
SS74	TA2	+6 minutes	x0.97	9457804

Tide Zone	GS Identifier	Time Corrector	Range Corrector	Reference Station
SS75	TA5	+6 minutes	x0.91	9457804
SS83	TA6	-6 minutes	x0.89	9457804
SS84	TA7	-6 minutes	x0.87	9457804
SS85	TA8	-12 minutes	x0.84	9457804
SS108	TA1	+6 minutes	x1.00	9457804
SWA124	TA14	-24 minutes	x0.75	9457804
SWA124A	TA13	-24 minutes	x0.74	9457804
SWA139	TA12	-24 minutes	x0.77	9457804
SWA140	TA11	-18 minutes	x0.79	9457804
SWA141	TA10	-12 minutes	x0.81	9457804
SWA141A	TA9	-12 minutes	x0.83	9457804

For final tide application, the time and range correctors were applied to the smoothed tidal data provided by JOA. Soundings were then reduced to MLLW using these corrected 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 Alitak tide gauge is 3.30m. From the final zoning, 5 tide zones intersect the survey area. The range factor for each zone was used to calculate an average MHW value for the entire sheet. The resulting MHW value of 3.32m was used for Sheet B.

C.3 HORIZONTAL CONTROL

Data collection and processing were conducted in the AS and GS in the World Geodetic System (WGS84) datum on Universal Transverse Mercator (Northern Hemisphere) projection UTM (N) in Zone 5, Central Meridian 153° 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 – Kodiak

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 Tenix LADS office building in Kodiak, AK on May 9, 2006, in order to post-process KGPS positions following survey flights. This base station was used in the 2006 OPR-P133-KRL-06 survey and was reused for the 2007 OPR-P135-KRL-07 survey.

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

NAD83		UTM (N) Zone 5		
Latitude (N)	**Longitude (W)**	**Easting (m)**	**Northing (m)**	**Ellipsoidal Height (m)**
57° 47' 19.2830"	152° 24' 22.1333"	535 308.385	6 405 339.545	28.354

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 Ashtech PNAV software to calculate both a DGPS and 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 H11665 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 hard drive. Refer to Appendix II of the Data Acquisition and Processing Report for a list of all the deliverable files from H11665.

Below is a table listing the S-57 feature objects found in the S-57 feature file (US511665.000):

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 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)				Tenix is only responsible for defining the 0m curve.
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 MHW.
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)	
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 (GKP) tags exported from the GS and georeferenced imagery.

S-57 Object Class	S-57 Object Acronym	Geometry	Description	Spatial Attribute	Attribute 1	Attribute 2	Attribute 3	Attribute 4	Comments
Unsurveyed Areas	UNSARE	A	Unsurveyed area.		Information (INFORM)				Used to define gaps in data coverage. INFORM has been identified as SEZ (GS) tags.
Lakes	LAKARE	A	A large body of water entirely surrounded by land.						Used to define data gaps as a result of lakes in close proximity to the MHW line.
Rivers	RIVERS	L	A relatively large natural stream of water.						Used to define small rivers that intersect the MHW line.
Sand Waves	SNDWAV	A	A large mobile wave-like sediment feature in shallow water and composed of sand.						Used to define seabed areas where sand waves are present. The seabed in these areas is dynamic and least depth may have changed since the time of the survey.
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 (US511665.000)

Recommendations for registry number H11665 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 H11665 are provided in Sections D.1.1 to D.1.6 below and can be referenced in the Chart Comparison Spreadsheet (H11665_V1_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 (H11665_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

H11665 LADS survey deliverables were compared to:[3]

ENC US4AK5LM Edition 3 compiled from Raster Chart 16590 10th Edition. ENC update application date 2007-08-09, at scale 1:81,529.
This chart was downloaded from the NOAA Office of Coast Survey – NOAA Electronic Navigational Charts download website on May 20, 2008.
(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) during data acquisition from the field and after data acquisition during deliverables compilation. Recommendations from the field were provided to PHB in July, 2007. Recommendations were provided to PHB, as part of the preliminary survey delivery in June, 2008.[4] All DTON recommendations for the survey are provided at Appendix I.[5] A description of each DTON for H11665 is provided below:

- Item number 1 is a 13.6m rock located approximately 1600m ENE of the Aiaktalik Island Light. This item was submitted from the field.
- Item number 2 is a possible 5.2m Rk in kelp, located seaward of a charted 7.3m sounding. This feature requires further investigation by boat to determine the extent and least depth.
- Item number 3 is a 2.5m Rk in kelp, in the vicinity of a charted 3.6m sounding, located approximately 1450m W of the "G 1" gong buoy within Geese Channel.
- Item number 4 is a 6.9m Rk, located approximately 500m N of the Aiaktalik Island Light.
- Item number 5 is an 11.8m Rk in the vicinity of a charted 11.8m sounding, located approximately 1800m ENE of the Aiaktalik Island Light.
- Item number 6 is a 6.5m Rk in kelp, in the vicinity of a charted 9.5m sounding, located approximately 1000m N of the Geese Islands.
- Item number 7 is a 5.6m Rk in kelp, in the vicinity of a charted 10.0m sounding, located approximately 1000m NW of the Geese Islands.

- Item number 8 is a 4.5m Rk in kelp, located approximately 1000m N of the "G 1" gong buoy within Geese Channel.

D.1.2 AWOIS

No AWOIS were assigned to this Task Order.

D.1.3 Aids to Navigation

The following table lists Aids to Navigation that were detected by Lidar and observed in the digital imagery within the survey area of H11665:

Navaid Name	Charted Position		Average Surveyed Position		Difference In Position (m)	Lidar Hits
	Latitude (N)	Longitude (W)	Latitude (N)	Longitude (W)		
Fl (1) R 4s3M by 3	56° 43' 29.99"	153° 58' 34.48"	56° 43' 29.46"	153° 58' 34.41"	17	4
Fl (1) R 4s3M by 4	56° 43' 40.13"	153° 59' 05.59"	56° 43' 39.52"	153° 59' 04.74"	24	3
Aiaktalik Island Light 5	56° 43' 53.14"	154° 03' 05.57"	56° 43' 52.86"	154° 03' 07.51"	35	1

D.1.4 Charted Depths and Features

Registry number H11665 covers part of NOAA ENC US4AK5LM and Raster Chart 16590, covering the area surrounding Geese Channel. From the Raster Chart Source Diagram, the area covered by survey area H11665 was covered by NOS surveys between 1900 and 1939, presumably by leadline. The chart in this area was inadequately surveyed, with only the coastline and a number of rocks and islets along the coast portrayed, and charted soundings spaced at approximately 400m.

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

a. Coastline. The charted coastline agrees well with the surveyed coastline for Geese Channel. Some of the smaller near-shore surveyed islets were not previously charted. The surveyed coastline differs from the charted position by a maximum of 80m 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 MHW line.

b. Inshore Islets. Approximately 14 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 significant, these islets are detailed in the Chart Comparison Spreadsheet in Section D.1.6. Surveyed islet heights have been populated in the Surveyed Depth column of the Chart Comparison Spreadsheet, are given as a negative height related to MLLW.

c. Rocks. Many rocks and drying rocks 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 rocks are detailed in the Chart Comparison Spreadsheet in Section D.1.6.

D.1.5 Detailed Chart Comparison[6]

In addition to the general recommendations above, some 61 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 hard drive (H11665_Chartcomp.xls). A CARIS .hob file containing just the chart comparison items has also been compiled and is provided as part of survey deliverables (H11665_Chartcomp.hob). The S-57 Object Built-up Area (BUUARE) is used simply as a placeholder for defining the location of a chart comparison and for storing information concerning the comparison. 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 Areas	BUUARE	P	An area containing a concentration of buildings and the supporting road or rail infrastructure.	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 if applicable)	PICREP (used for storing a link to GS screen captures)

The chart comparison was conducted by reviewing the ENC, 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 CARIS .hob file (H11665_Inv.hob) 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 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** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
1	B1	1				13.61	56° 44' 11.98"	154° 1' 37.2"	Rk	N	Y	Insert	See Danger to Navigation report. Item 1. Submitted from field.
2	B2	1				-0.44	56° 48' 25.01"	153° 51' 7.59"	Rk Awash	Y	Y	Insert	
3	B3	1				0.61	56° 48' 23.03"	153° 51' 21.11"	Rk	Y	N	VV	Possible Rk in kelp. Refer to FEKB14.
4	B4	1				0.24	56° 48' 19.56"	153° 51' 30.6"	Rk Awash	Y	N	VV	Possible Rk in kelp. Refer to FERKB1.
5	B5	1				0.01	56° 48' 1.96"	153° 51' 44.28"	Rk Awash	Y	Y	Insert	
6	B6	1				-0.72	56° 48' 4.89"	153° 51' 40.45"	Drying Rk	Y	Y	Insert	
7	B7	2	Drying Rk	56° 48' 15.38"	153° 51' 36.57"				Intertidal Area	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
8	B8	1				0.19	56° 48' 13.7"	153° 51' 24.72"	Rk Awash	Y	Y	Insert	
9	B11	1				2.38	56° 48' 0.75"	153° 50' 41.82"	Rk	Y	N	VV/BV	Possible Rk in kelp. Refer to FEKB12.
10	B12	2	10.0	56° 47' 58.2"	153° 51' 11.31"	7.22	56° 47' 58.46"	153° 51' 1.84"	Rk	Y	N	BV	Possible Rk in kelp.
11	B13	2	7.3	56° 47' 52.3"	153° 51' 28.46"	5.24	56° 47' 50.67"	153° 51' 22.44"	Rk	Y	N	BV	See Danger to Navigation report. Item 2.
12	B14	1				-0.13	56° 47' 58.21"	153° 52' 6.23"	Rk Awash	Y	Y	Insert	
13	B15	1				-0.01	56° 47' 31.72"	153° 51' 55.71"	Rk Awash	Y	Y	Insert	

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			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 All items covered by 4x4m laser spot spacing at 200% lidar coverage.
14	B16	1				-0.25	56° 47' 40.19"	153° 51' 50.66"	Rk Awash	Y	Y	Insert	
15	B17	1				8.41	56° 47' 18.33"	153° 51' 43.37"	Rk	Y	Y	Insert	
16	B19	1				0.29	56° 47' 23.53"	153° 52' 16.22"	Rk Awash	Y	Y	Insert	
17	B20	2	Drying Rk	56° 47' 23.51"	153° 52' 29.03"				Slope	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
18	B21	2	Drying Rk	56° 47' 9.89"	153° 53' 46.75"				Intertidal Area	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
19	B22	2	Drying Rk	56° 47' 0.45"	153° 53' 38.11"				Slope	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
20	B24	1				-0.12	56° 47' 8.22"	153° 52' 36.81"	Rk Awash	Y	Y	Insert	
21	B25	1				0.12	56° 46' 47.98"	153° 53' 42.13"	Rk Awash	Y	Y	Insert	
22	B26	2	Drying Rk	56° 46' 53.4"	153° 53' 58.28"				Intertidal Area	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
23	B27	2	Drying Rk	56° 46' 46.83"	153° 54' 0.97"				Intertidal Area	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
24	B28	2	Islet	56° 46' 45.25"	153° 54' 4.34"				Intertidal Area	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
25	B29	2	Drying Rk	56° 46' 42.46"	153° 54' 3.95"				Intertidal Area	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
26	B31	1				-0.30	56° 45' 49.07"	153° 54' 24.8"	Rk Awash	Y	Y	Insert	

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			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** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
27	B32	1				-0.45	56° 45' 52.07"	153° 54' 21.59"	Rk Awash	Y	Y	Insert	
28	B34	1				0.08	56° 45' 46.9"	153° 54' 35.81"	Rk Awash	Y	Y	Insert	
29	B35	1				-0.08	56° 45' 43.81"	153° 54' 42.3"	Rk Awash	Y	Y	Insert	
30	B37	1				0.12	56° 45' 33.4"	153° 55' 20.43"	Rk Awash	Y	Y	Insert	
31	B39	2	3.6	56° 45' 24.58"	153° 54' 35.8"	2.48	56° 45' 24.29"	153° 54' 30.27"	Rk	Y	Y	Replace	
32	B40	2	2.7	56° 45' 11.99"	153° 54' 16.85"	1.90	56° 45' 16.59"	153° 54' 15.84"	Rk	Y	Y	Replace	
33	B41	1				-0.14	56° 44' 47.94"	153° 56' 58.76"	Rk Awash	Y	Y	Insert	
34	B42	2	7.3	56° 44' 43.79"	153° 54' 59.3"	5.49	56° 44' 47.85"	153° 54' 56.94"	Rk	Y	Y	Replace	
35	B43	2	3.6	56° 44' 54.5"	153° 54' 39.07"	2.50	56° 44' 50.81"	153° 54' 35.75"	Rk	Y	Y	Replace	See Danger to Navigation report. Item 3.
36	B44	1				-0.47	56° 44' 33.07"	154° 0' 6.76"	Rk Awash	Y	Y	Insert	
37	B45	1				-1.41	56° 44' 33.51"	154° 1' 8.69"	Drying Rk	Y	Y	Insert	
38	B46	1				6.94	56° 44' 9.69"	154° 3' 7.46"	Rk	N	Y	Insert	See Danger to Navigation report. Item 4.

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			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** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
39	B47	2	11.8	56° 44' 15.08"	154° 1' 25.61"	9.51	56° 44' 13.41"	154° 1' 26.65"	Rk	N	Y	Replace	See Danger to Navigation report. Item 5.
40	B48	1				1.63	56° 44' 24.54"	153° 59' 38.88"	Rk	Y	Y	Insert	
41	B51	2	9.5	56° 44' 13.36"	153° 55' 35.39"	6.48	56° 44' 11.5"	153° 55' 26.93"	Rk	Y	Y	Replace	See Danger to Navigation report. Item 6.
42	B52	2	10.0	56° 43' 56.54"	153° 57' 34.79"	5.62	56° 43' 55.78"	153° 57' 22.47"	Rk	Y	Y	Replace	See Danger to Navigation report. Item 7.
43	B54	2	Drying Rk	56° 44' 1.24"	154° 3' 2.48"				Slope	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
44	B55	1				4.58	56° 43' 43.95"	153° 58' 20.83"	Rk	Y	Y	Insert	See Danger to Navigation report. Item 8.
45	B56	1				5.12	56° 43' 30.66"	153° 58' 56.77"	Rk	Y	N	BV	Possible Rk in kelp. Refer to FEKB4.
46	B57	2	6.7	56° 43' 10.22"	153° 59' 7.61"	4.64	56° 43' 8.58"	153° 58' 57.97"	Rk	Y	N	BV	Possible Rk in kelp. Refer to FEKB2.
47	B60	2	9.1	56° 42' 51.97"	153° 58' 48.16"	6.70	56° 42' 55.18"	153° 58' 52.45"	Rk	Y	Y	Replace	
48	B61	2	8.5	56° 42' 53.57"	153° 59' 13.91"	7.16	56° 42' 59.27"	153° 59' 16.93"	Rk	N	Y	Replace	
49	B62	2	11.3	56° 42' 34.17"	153° 58' 22.08"	10.20	56° 42' 36.74"	153° 58' 29.96"	Rk	N	Y	Replace	
50	B63	1				8.28	56° 42' 42.72"	153° 58' 18.12"	Rk	Y	Y	Insert	
51	B64	1				-0.32	56° 44' 45.38"	154° 1' 6.97"	Rk Awash	Y	Y	Insert	

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			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** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
52	B65	1				0.10	56° 44' 48.65"	154° 1' 12.27"	Rk Awash	Y	Y	Insert	
53	B66	1				-1.72	56° 44' 58.73"	154° 1' 18.16"	Drying Rk	Y	Y	Insert	
54	B67	1				-1.78	56° 45' 21.35"	154° 1' 30.43"	Drying Rk	Y	Y	Insert	
55	B68	1				-5.59	56° 45' 22.22"	154° 1' 38.5"	Islet	Y	Y	Insert	
56	B69	2	1.2	56° 45' 28.5"	154° 1' 47.39"	-1.80	56° 45' 27.26"	154° 1' 44.98"	Drying Rk	Y	Y	Replace	
57	B70	1				1.53	56° 45' 30.17"	154° 2' 4.9"	Rk	Y	N	VV/BV	Possible Rk in kelp. Refer to FEKB7.
58	B71	1				-1.10	56° 45' 41.43"	154° 1' 52.28"	Drying Rk	Y	Y	Insert	
59	B72	1				-0.54	56° 45' 49.71"	154° 2' 34.49"	Rk Awash	Y	Y	Insert	
60	B73	2	Drying Rk	56° 44' 1.86"	154° 3' 8.63"				Slope	N	Y	Remove	Not detected by lidar, not observed in digital imagery.
61	B74	2	Wreck	56° 43' 33.1"	153° 58' 55.54"				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

D.2 ADDITIONAL RESULTS[7]

D.2.1 Supplemental Information for Boatwork

For the H11665 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 H11665 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 extent of sheet, N of the Aiaktalik Island Light, at position 56° 45' 21" N, 154° 02' 53" W, due to kelp.
- S of Geese Islands, at position 56° 42' 56" N, 153° 58' 04" W, due to kelp.
- In the vicinity of Hawk Point, at position 56° 48' 44" N, 154° 04' 10" W, due to kelp.
- From position 56° 46' 24" N, 153° 53' 22" W to N extent of sheet, 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, the presence of kelp, or expansive white water, the polyline has been drawn just to seaward of the MLLW line. It should be noted that TLI 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 derived MHW line, MLLW line.
- Drying, awash and shallow features detected by lidar.
- Features for examination.
- 'Unsurveyed' polygons due to kelp, poor water clarity and the SEZ.

These are all provided in the S-57 feature file (US511665.000) or the H11665_Inv.hob file for H11665.

The areas of good lidar seabed coverage include:

- N of the Geese Islands, at position 56° 44' 20" N, 153° 56' 27" W.
- SW of the Geese Islands, at position 56° 42' 41" N, 153° 58' 53" W.
- In the vicinity of the Aiaktalik Island Light, at position 56° 44' 28" N, 154° 03' 28" 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 (US511665.000).

D.2.1.2 Lidar Features Requiring Further Investigation

A list of uncertain lidar soundings was collated during data processing and is presented in a CARIS .hob file (H11665_Inv.hob). 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 H11665_Inv.hob file as BUUARE feature objects. Where these features correlate with an item listed in the Chart Comparison Spreadsheet, a reference has been made in the H11665_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 Areas	BUUARE	P	An area containing a concentration of buildings and the supporting road or rail infrastructure.	OBJNAM (used for storing a unique feature for examination ID)	INFORM (used for storing the method of investigation recommendation)	NINFOM (used for storing a reference to a Chart Comparison if applicable)	PICREP (used for storing a link to GS 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 15 uncertain soundings has been made in the CARIS H11665_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 Possibly within Foul	Typically BV or VV / BV for shallow features	Investigation at ships discretion. Typically for uncertain shallow features.
3	Inshore / Seaward	NALL Coastal kelp	VV / BV	Investigation at ships discretion. Typically for drying rocks or rocks awash.
4	Seaward	No	JV	Can be safely navigated over during multibeam. Post acquisition comparison required.
5	Inshore / Seaward	Generally No	Typically BV or VV / BV for shallow features	Doubtful sounding. 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 SEZ, 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 – H11665

D.2.2.1 Summary of Charting Actions – H11665

Total number of new significant islets recommended for insertion on chart: 1
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: 19
Total number of new significant rocks recommended for insertion on chart: 6
Total number of charted features disproved by lidar (Remove): 11
Total number of charted features recommended for amendment by lidar (Replace): 11
Total number of chart comparison items requiring further investigation: 8

Total number of DTONs submitted to PHB during data acquisition: 1
Total number of DTONs submitted to PHB during data processing: 7
Total number of DTONs submitted to PHB for H11665: 8

D.2.2.2 Summary of Lidar Features Requiring Further Investigation – H11665

Total number of Priority 1 investigations identified: 3
Total number of Priority 2 investigations identified: 7
Total number of Priority 3 investigations identified: 5
Total number of Priority 4 investigations identified: 0
Total number of Priority 5 investigations identified: 0

Total number of investigations recommended during data processing: 13
Total number of investigations recommended from georeferenced imagery review: 0
Total number of investigations recommended from chart comparison compilation: 2
Total number of recommended feature investigations: 15

E. APPROVAL SHEET

LETTER OF APPROVAL – OPR-P135-KRL-07

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 – H11665	June 10, 2008

Mark Sinclair
Hydrographer
Tenix LADS, Incorporated

Date June 10, 2008

Revisions and Corrections Compiled During Office Processing and Certification

[1] Higher uncertainties are expected in areas of dynamic topography or steep slopes. The data is adequate for charting except in areas where the data density is both sparse and deeper than the charted depths.
[2] LIDAR data coverage gaps are to be expected in areas of thick kelp and turbulent water.
[3] Details of a chart comparison conducted during office processing are as follows:

Chart 16590 (11th Edition, September 1, 2007, NTM Update December 29, 2012)
The sparse nature of LIDAR data made chart comparison more difficult than usual. Soundings from survey H11665 generally agreed within 1 fathom of the depths on chart 16590. Contours generated in CARIS BASE Editor were consistent with charted depth curves in most cases. Surveyed features were somewhat consistent with charted features in terms of characterization, however there appeared to be a shift in the chart, so the positions of the features and coastline generally did not agree. It is recommended that the features be charted as they are depicted in the HCell and that the coastline be updated with the latest GC source.

US4AK5LM (Issue Date October 12, 2010)
The chart comparison details for chart 16590 are also applicable to this ENC.

[4] Eight total features were reported as DTONs. All have been applied to the charts, however, the charted positions appear to be slightly shifted from surveyed positions. All the DTONs are included in the chart update product at the surveyed positions.
[5] See attached DTON Report.
[6] See endnote 3.
[7] There are no junctioning multibeam surveys planned for this area as originally intended. Therefore, all references to boat work, junctioning and future investigations are no longer applicable. The LIDAR surveys in this project will be applied to the charts on a stand-alone basis.

APPENDIX I – DANGERS TO NAVIGATION

DTONS Submitted to PHB

I.1.1. Danger to Navigation Report

Hydrographic Survey Registry Number: H11665

State: Alaska

Locality: Southeast Coast of Kodiak Island

Sub-locality: Geese Channel

Project Number: OPR-P135-KRL-07

Survey Dates: April – June 2007

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

Charts Affected

Number	Version	Date	Scale
US4AK5LM	3rd Ed	2007-08-09	1:81,529

The following items were found during hydrographic survey operations:

No.	Feature	Depth	Latitude (N)	Longitude (W)	Time and Date	Investigate?
1	Rk	13.59	56° 44' 12.04"	154° 01' 37.19"	21:16:04, June 4	No
2	Rk	5.24	56° 47' 50.67"	153° 51' 22.44"	23:29:21, May 21	Yes
3	Rk	2.50	56° 44' 50.81"	153° 54' 35.75"	01:30:58, June 13	No
4	Rk	6.94	56° 44' 09.69"	154° 03' 07.46"	21:16:25, June 4	No
5	Rk	9.51	56° 44' 13.41"	154° 01' 26.65"	19:36:00, June 3	No

No.	Feature	Depth	Latitude (N)	Longitude (W)	Time and Date	Investigate?
6	Rk	6.48	56° 44' 11.50"	153° 55' 26.93"	19:57:26, June 3	No
7	Rk	5.62	56° 43' 55.78"	153° 57' 22.47"	02:22:35, May 21	No
8	Rk	4.58	56° 43' 43.95"	153° 58' 20.83"	16:13:41, June 17	No

COMMENTS: Final verified tides have been applied from the Alitak tide gauge (9457804). The shoals were found using LIDAR. DTON item 1 was submitted to PHB from the field while DTON items 2 through 8 were submitted following data processing from the Biloxi office.

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

APPROVAL PAGE

H11665

Data partially meet 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 specific areas as delineated during office processing.

The following products will be sent to NGDC for archive:

- H11665_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H11665_GeoImage.pdf

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

Approved: BROWN.KURT.E.1156712600 Digitally signed by BROWN.KURT.E.1156712600 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=BROWN.KURT.E.1156712600 Date: 2013.10.28 11:36:21 -07'00'

Kurt Brown
Physical Scientist, Pacific Hydrographic Branch

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

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: 2013.10.28 12:43:47 -07'00'

Peter Holmberg
Cartographic Team Lead, Pacific Hydrographic Branch