

H11567

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey: Hydrographic/Lidar
Project No: OPR-I305-KRL-06
Registry Number: H11567

LOCALITY

State: Puerto Rico
General Locality: Southwest Puerto Rico
Sub-locality: Vicinity of Bahia Montalva

2006

CHIEF OF PARTY

Darren Stephenson, Tenix LADS

LIBRARY & ARCHIVES

DATE

HYDROGRAPHIC TITLE SHEET

NOAA FORM 77-28 U.S. DEPARTMENT OF COMMERCE (11-72) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION HYDROGRAPHIC TITLE SHEET	REGISTRY NO. H11567
INSTRUCTIONS – The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office	FIELD No. N/A
<p> State: <u>Puerto Rico</u> General Locality: <u>Southwest Puerto Rico</u> Sub-Locality: <u>Vicinity of Bahia Montalva</u> Scale: <u>1:10,000</u> Date of Survey: <u>April 2 to May 15, 2006</u> Instructions dated: <u>February 8, 2006</u> Project No: <u>OPR-I305-KRL-06</u> Vessel: <u>Tenix LADS Aircraft, VH – LCL</u> Hydrographer: <u>M.J. Sinclair</u> Chief of Party: <u>D.J. Stephenson</u> Surveyed by: <u>M.S. Hawkins, J.K. Young, B. McWilliam, M. Blackbourn</u> Soundings taken by echo sounder, hand lead, pole: <u>Laser Airborne Depth Sounder</u> Graphic record scaled by: <u>J.K. Young, L.R. Chamberlain, V. Sicari and B.A. Weidman</u> Graphic records checked by: <u>S.R. Ramsay and J.G. Guilford</u> Protracted by: <u>N/A</u> Automated plot: <u>N/A</u> Verification by: <u><i>Atlantic Hydrographic Branch</i></u> Soundings in: <u>Meters at MLLW</u> </p>	
<p> REMARKS: <u>Contract # NC-NJ3000-4-00010 01</u> Contractor: <u>Tenix LADS, Incorporated, 925 Tommy Munro Dr., Suite J, Biloxi, MS 39532</u> Sub contractor: <u>John Oswald and Associates, 12001 Audubon Dr, Anchorage, AK 99516</u> Times: <u>All times are recorded in UTC.</u> Purpose: <u>The purpose of this survey is to provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.</u> <u>Projection is UTM Zone 19.</u> <u><i>Bold, Italic, Red notes in the Descriptive Report were made during office processing.</i></u> </p>	

TABLE OF CONTENTS

COVER SHEET	
HYDROGRAPHIC TITLE SHEET	i
TABLE OF CONTENTS.....	ii
A. AREA SURVEYED	A-1
B. ACQUISITION AND PROCESSING	B-1
B.1 EQUIPMENT	B-1
<i>B.1.1 Airborne System</i>	<i>B-1</i>
<i>B.1.2 Ground System</i>	<i>B-1</i>
B.2 QUALITY	B-2
<i>B.2.1 Data Density.....</i>	<i>B-2</i>
<i>B.2.2 Water Clarity.....</i>	<i>B-2</i>
<i>B.2.3 Uncertainty values</i>	<i>B-2</i>
<i>B.2.4 Data Management.....</i>	<i>B-2</i>
<i>B.2.5 Data Acquisition.....</i>	<i>B-3</i>
<i>B.2.6 Sea Conditions - Sea State, Waves, Swell, White Water</i>	<i>B-3</i>
<i>B.2.7 Gaps and Features in the Data</i>	<i>B-3</i>
<i>B.2.8 Nature of the Seabed</i>	<i>B-4</i>
<i>B.2.9 Topography</i>	<i>B-4</i>
<i>B.2.10 Datums</i>	<i>B-5</i>
<i>B.2.11 Wind</i>	<i>B-5</i>
<i>B.2.12 Cloud.....</i>	<i>B-5</i>
<i>B.2.13 Effects of High Ground</i>	<i>B-5</i>
<i>B.2.14 Receiver Gain.....</i>	<i>B-5</i>
<i>B.2.15 Raw Laser Waveforms.....</i>	<i>B-6</i>
<i>B.2.16 Data Processing</i>	<i>B-6</i>
<i>B.2.17 Progress Sketches.....</i>	<i>B-6</i>
B.3 CORRECTIONS TO SOUNDINGS	B-6
B.4 DATA PROCESSING	B-6
B.5 DATA FORMATS	B-6
B.6 BENCHMARKS	B-7
<i>B.6.1 Mean Depth Differences (MDD) and Standard Deviation (SD).....</i>	<i>B-7</i>
B.7 CROSSLINES	B-8
<i>B.7.1 Mean Depth Differences (MDD) and Standard Deviation (SD).....</i>	<i>B-8</i>
B.8 POSITION CHECKS	B-8
C. VERTICAL AND HORIZONTAL CONTROL.....	C-1
C.1 VERTICAL CONTROL	C-1
C.2 ZONING.....	C-1
C.3 HORIZONTAL CONTROL	C-2
<i>C.3.1 LADS Local GPS Base Station – Puerto Rico</i>	<i>C-2</i>
D. RESULTS AND RECOMMENDATIONS.....	D-1
D.1 CHART COMPARISON – REGISTRY NUMBER H11567.....	D-3

<i>D.1.1 Dangers to Navigation</i>	<i>D-3</i>
<i>D.1.2 Charted Depths and Features</i>	<i>D-3</i>
<i>D.1.3 AWOIS.....</i>	<i>D-5</i>
<i>D.1.4 Chart Comparison Spreadsheet</i>	<i>D-6</i>
<i>D.1.5 Additional Boatwork inside the Lidar Area</i>	<i>D-11</i>
<i>D.1.5.1 Features Requiring Investigation</i>	<i>D-11</i>
<i>D.1.5.2 Gaps in the Data.....</i>	<i>D-11</i>
<i>D.1.6 Aid To Navigation</i>	<i>D-11</i>
<i>D.1.7 Recommended Overlap With Lidar Data.....</i>	<i>D-12</i>
E. APPROVAL SHEET	E-1

APPENDIX I – Dangers to Navigation	Appendix I-1
APPENDIX II – List of Geographic Names	Appendix II-1*
APPENDIX III – Progress Sketch	Appendix III-1*
APPENDIX IV – Tides and Water Levels	Appendix IV-1*
APPENDIX V – Supplemental Survey Records and Correspondence	Appendix V-1*
APPENDIX VI – AWOIS	Appendix VI-1*

**Data Filed with Original Field Records*

DESCRIPTIVE REPORT TO ACCOMPANY**HYDROGRAPHIC SURVEY H11567****SCALE 1:10,000, SURVEYED IN 2006****TENIX LADS AIRCRAFT, VH-LCL****TENIX LADS, INC. (TLI)****MARK SINCLAIR, HYDROGRAPHER****PROJECT****Project Number:** OPR-I305-KRL-06
Date of Instructions: February 8, 2006**Original:** DG 133C-03-CQ-0011
Task Order: T0008**Date of Supplemental Instructions:**

- Site visit by NOAA on September 12–13, 2006 to TLI to discuss the data delivery under the new Specifications and deliverables
- Email dated January 07, 2006 regarding rocks awash
- Email dated May 2, 2007 regarding the reporting of cultural features

Sheet Number: K
Registry Number: H11567**PURPOSE**

To provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.

A. AREA SURVEYED

Between April 7 and May 15, 2006 the LADS Mk II aircraft deployed to Puerto Rico for the project OPR-I305-KRL-06. During this period 21 survey sorties were flown under Task Order 8, Southwest Puerto Rico. Survey operations covered 11 survey registry numbers. This Descriptive Report describes H11567, which covers the area in the vicinity of Bahia Montalva, Southwest Puerto Rico (See Figure 1 and Figure 2).

Environmental factors such as wind strength and direction, cloud coverage, high ground and water clarity influenced the area of data acquisition on a daily basis. See section B.2 Quality.

The planned and actual linear miles sounded for the areas are provided at Appendix III*. The sheet limits are as follows for H11567: **Data Filed with Original Field Records*

	Latitude (NAD83)	Longitude (NAD83)
NW corner	17° 58' 59.50" N	67° 01' 31.05" W
SE corner	17° 52' 26.60" N	66° 57' 17.27" W

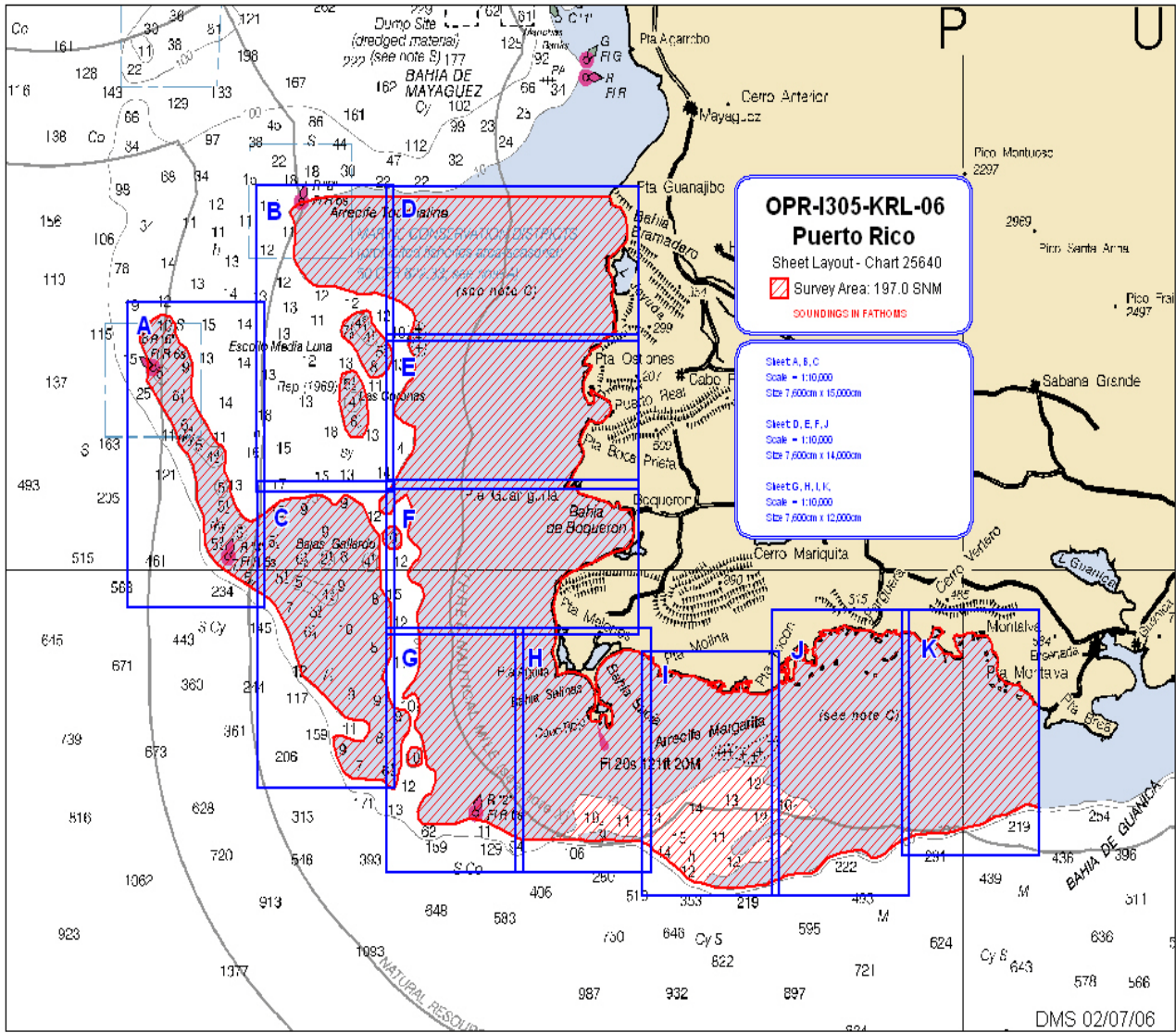


Figure 1 - Task Order 8 OPR-1305-KRL-06

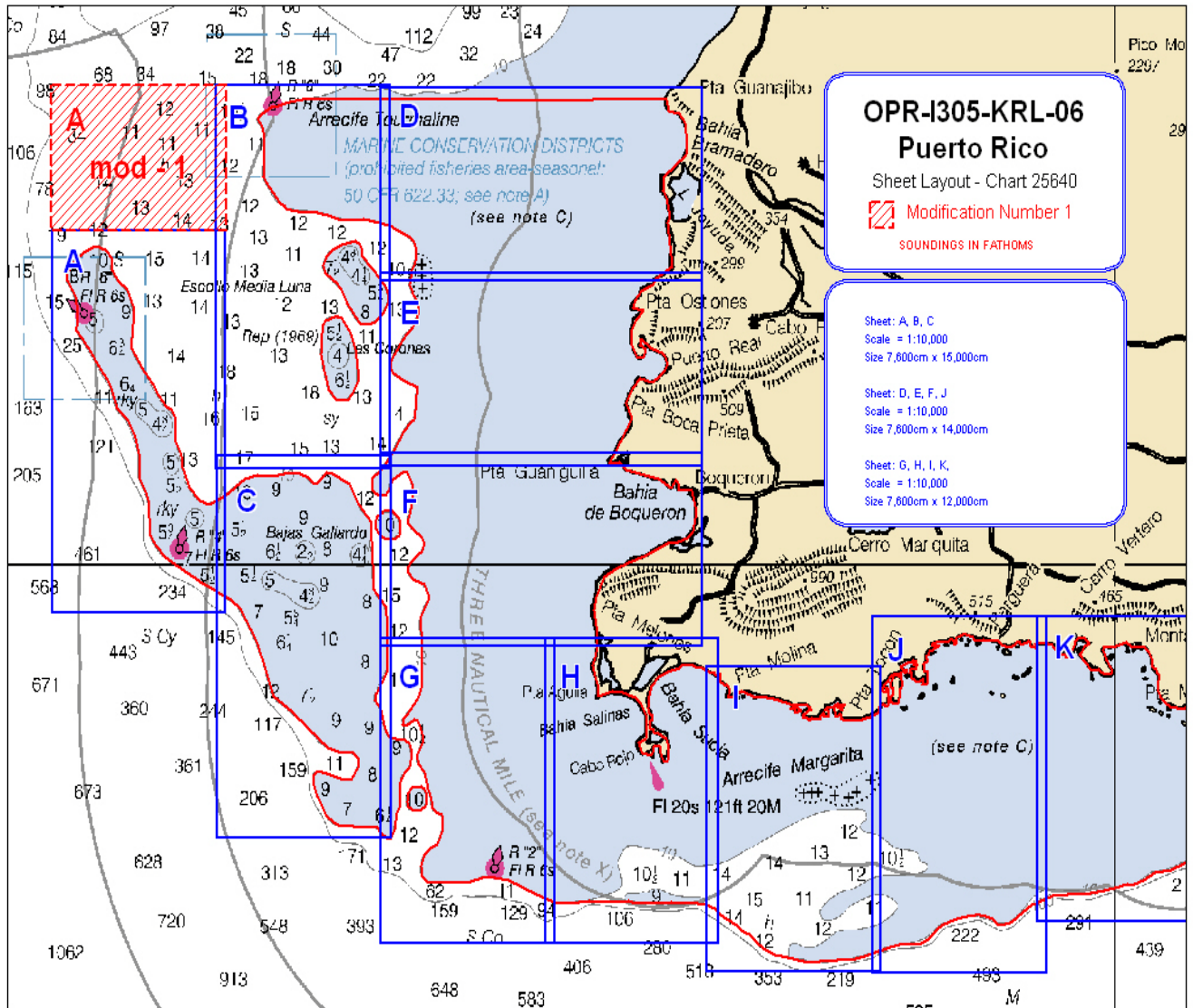


Figure 2 – Task Order 8 OPR-I305-KRL-06 Modification 1

B. ACQUISITION AND PROCESSING

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

B.1 EQUIPMENT

Data collection was conducted using the LADS Mk II Airborne System, data processing using the LADS Mk II Ground System and data visualization, quality control and final products using CARIS HIPS and SIPS 6.0.2 and CARIS BASE Editor 2.0.

A prototype Digital Imagery Capture system was installed at the commencement of this survey, which allowed digital images from the downward looking video to be captured.

B.1.1 Airborne System

The LADS Mk II Airborne System (AS) consists of a Dash 8-200 series aircraft, which has a transit speed of 250 knots at altitudes of up to 25,000ft and an endurance of up to eight hours. Survey operations are conducted from heights between 1,200 and 2,200ft at ground speeds between 140 and 175 knots. The aircraft is fitted with a Nd: YAG laser, which is eye safe in accordance with ANSI Z136.1-2000, American National Standard for Safe Use of Lasers. The laser operates at 900 Hertz from a stabilized platform to provide a number of different spot spacings.

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 and GPS height. Real-time positioning is obtained by an Ashtech GG24 GPS receiver combined with Wide Area DGPS provided by the Fugro Omnistar to provide a differentially corrected position. Ashtech Z12 GPS receivers are also provided as part of the Airborne System and Ground Systems to log KGPS data on the aircraft and at a locally established GPS base station. For more details on the airborne system refer to the Data Acquisition and Processing Report.

B.1.2 Ground System

The LADS Mk II Ground System (GS) 'Gandalf' was used to conduct data processing in the field. Gandalf consists of a portable Compaq Alpha ES40 Series 3 processor server with 1 GB EEC RAM, 764 GB disk space, digital linear tape (DLT) drives and magazines, digital audio tape (DAT) drive, 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. Gandalf was transported to the deployment site. Quality control checks and editing of the data were conducted on GS 'Katrina' in the Biloxi office upon completion of the data collection phase of the survey.

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

position and height data. A comprehensive description of the GS is provided in the Data Acquisition and Processing Report.

B.2 QUALITY

B.2.1 Data Density

The survey area was sounded at 4x4m laser spot spacing with main lines of sounding spaced at 80m, which provided the required 200% coverage.

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 between 1 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.

B.2.2 Water Clarity

The water clarity in the survey area was ideal for laser bathymetry as the water was very clear. Water depths to 55m were achieved before the reef dropped off quickly in the south. Consistent coverage was achieved throughout the survey area. The majority of the survey area is less than 20m depth. There are small areas where no depths were achieved due to turbidity. These areas mainly exist close to shore, around mangrove trees and are described in section B.2.7.

B.2.3 Uncertainty values

For this survey area, global horizontal and vertical uncertainties have been assigned based on the defined horizontal and vertical error budget as determined and stated in the Vertical and Horizontal Control Report. The assigned horizontal uncertainty is 2.80m and the assigned vertical uncertainty is 0.38m.

However when the calculated grid node standard deviation is greater than the assigned vertical uncertainty, the standard deviation is used as the uncertainty value. This has occurred in areas of high relief such as the predominant reef existing in the south of the survey area. In some cases the standard deviation may exceed IHO order 1 limits. This could be attributed to the fact that a 3m grid resolution has been used.

B.2.4 Data Management

The database is identified as follows:

Database Name	General Locality	Sheet(s)
06_3CaboRojo	Vicinity of Bahia Montalva	K

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

B.2.5 Data Acquisition

Survey operations were planned when suitable weather conditions prevailed. The first survey sortie was flown on April 9, 2006.

In general, the aircraft departed at 7 a.m. local time, prior to the build up of thunderstorms in the early afternoon.

For a summary of data acquisition statistics, refer to Appendix III Final Progress Sketch.

B.2.6 Sea Conditions - Sea State, Waves, Swell, White Water

The sea state ranged from 1 to 3 throughout the survey and was generally between states 1 and 2 as determined from the Beaufort Wind Scale. This did not affect data quality.

Calm seas were experienced on occasions in the sheltered bays along the west and south coasts. Depending on the wind direction, calm seas occurred inshore of exposed reefs as well. Under such calm conditions, the sea may become glassy which degrades the sea surface model.

Long period swell was not significant during the survey, however an allowance has been made in the assessment of vertical accuracy.

B.2.7 Gaps and Features in the Data

During the data processing, the operators have the ability to assign S-57 and user-defined tags to gaps and features in the data. For this survey area, no features were identified within the GS that require further examination. Tagging also allows for accurate delineation and attribution of unsurveyed polygons for the S-57 features file (US511567.000). The following gaps were tagged in the ground system.

Data gap due to mangroves	GM
Data gap due to Secondary Exclusion Zone	GS
Data gap due to turbidity	GT
Data gap due to buildings	GB

Data gap tags, exported from the GS, have been compiled as lines or polygons and defined in the S-57 features file (US511567.000). The type of tag determines the type of S-57 object that is compiled.

GS Tag Type	Primitive	S-57 Object	S-57 Attribute
GM	Line	COALNE	CATCOA = Mangroves
GS	Polygon	UNSARE	INFORM = Secondary Exclusion Zone
GT	Polygon	UNSARE	INFORM = Turbidity
GB	Line	SLCONS	CATSLC = Seawall

A gap due to the Secondary Exclusion Zone occurs in very shallow areas near the land / sea interface. The depth or height cannot be accurately determined from the waveform when the

bottom and sea surface returns merge. There are 100 areas where no data exists due to the Secondary Exclusion Zone. Many of these areas exist around off-lying reefs, around mangrove areas and along the coast.

It should be noted that gaps due to the Secondary Exclusion Zone exist in extremely shoal water in the order of decimeters. Depths within these gaps are most likely shoaler than surrounding data. An example of off-lying areas where the secondary exclusion zone exists and shoaler sounds may exist, is Arrecife Enmedio, Arrecife Romero and Turrumote I.

A gap due to turbidity occurs when extremely poor water clarity prevents accurate determination of the water depth. Thirty-nine areas exist in this survey area.

Of these thirty-nine areas, the majority of them are located in very shallow waters amongst mangroves along the coast, for example, at the head of Bahia Montalva. A number of areas exist in channels off the coast in water depths varying from 7 –18 meters. These areas are described in section D.1.5.2.

A data gap due to a building occurs when a building exists at the high water line resulting in the MHW line having to be interpolated.

Cultural Features. Two small jetties and some other possible cultural features exist along the coast in a bay to the north of Punta Jorobado.

B.2.8 Nature of the Seabed

The seabed throughout the survey area is strewn with many coral reefs. The seabed generally slopes from the coastline in the north to the extent of the reef structure in the south. The predominant orientation of the reef structures is east / west. Unconsolidated sediments exist throughout the survey area between coral outcrops.

Many coral outcrops exist throughout the survey area leading to an irregular seabed. Typically, the seabed is between 15 and 25m deep.

A number of shallow reefs exist approximately 1 mile off the coast, these include Arrecife Enmedio and Arrecife Romero.

The coastline is predominantly dominated by mangroves with some cultural features scattered along the coastline.

B.2.9 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. Mangroves were detected along most of the coastline. It was evident that many topographic returns were from foliage in these areas. Returns from the foliage were deleted from the data and tagged appropriately. Some buildings and other cultural features were detected in areas along the coastline. It was evident that returns were from manmade

objects and these returns were deleted in the data and tagged appropriately. Some topographic returns from beach areas were valid and left in the data, resulting in the delineation of the mean high water line. In general, heights along the coastline above 1.5m were deleted from the data.

B.2.10 Datums

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

B.2.11 Wind

Survey operations were conducted in wind strengths of up to 20 knots during the survey. In general, the wind strength during the time of survey was around 10 knots from the southwest.

During the morning wind strengths would increase slightly.

B.2.12 Cloud

Low cloud coverage was not a significant factor for the survey. During the early afternoon the clouds would build up over land and move offshore. The occurrence of cloud buildup offshore increased towards the end of the survey. The effects of low cloud coverage were managed as follows:

- a. Limited weather forecasts were available for the actual survey area. Weather conditions were interpolated from generic weather Internet sites and local media weather forecasts.
- b. For long-term trends the National Weather Service in San Juan provided information.
- c. An Internet site showed the current San Juan radar. This proved invaluable during the later part of the survey to monitor the movement of thunderstorms. This Internet site is <http://www.wunderground.com/radar/>.

B.2.13 Effects of High Ground

For this survey the high ground was not an issue and the majority of the survey lines were flown at 1,600ft.

B.2.14 Receiver Gain

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

B.2.15 Raw Laser Waveforms

The raw laser waveforms become dispersed in very complex areas, such as coral reefs, and in such areas the bottom object detection algorithm in the GS was used to define the extents and least depth of features.

The raw laser waveform is analyzed to determine areas of mangroves, turbidity and secondary exclusion zone and tagged appropriately using the GS gap tagging functions. It is also used in the decision making process of removing noise and data artifacts from the final dataset.

B.2.16 Data Processing

The data was processed at the operating site in San Juan on the return from each sortie. Final validation, checking, QC, approving and products were conducted in Biloxi, MS.

B.2.17 Progress Sketches

Progress sketches were provided to NOAA on a bi-weekly basis, the final progress sketch can be found in Appendix III.

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

One BASE surface covers the entire survey area. 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 consistent irrespective of aircraft altitude. The 3m grid provides the largest amount of detail that can be supported by the lidar data density.

B.5 DATA FORMATS

Data is provided in the following formats:

- Digital S-57 feature file
- CARIS BASE surface
- CARIS chart comparison file in .hob format
- CARIS compatible data - LADS soundings and waveforms, which can be imported into CARIS HIPS (.CAF File)
- Tidal Data provided in ASCII, xls and .csv formats
- Digital georeferenced orthophoto image in .tif / .tfw format

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

B.6 BENCHMARKS

The depth benchmark areas were identified on the first survey sortie and two benchmark lines were planned. The benchmark areas were used to check the performance of the LADS Mk II system for the I305 project, including this H11567 survey. These benchmarks were surveyed to check the repeatability of the LADS Mk II system accuracy.

The location of the benchmark lines and the position of the benchmark areas are detailed in the Separates.

Either one or both benchmark lines were flown during each sortie. The total number of benchmarks compared during the survey was 86. Benchmark comparisons were conducted after the application of final verified tides. Comparison summaries are also provided in the Separates.

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

B.6.1 Mean Depth Differences (MDD) and Standard Deviation (SD)

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

Benchmarks on the first line

GS ID	BM Name	Nominal Depth	MDD	SD
1	BM_1	13 m	-0.02 +/- 0.05	0.14 +/- 0.02
2	BM_2	8 m	-0.13 +/- 0.10	0.09 +/- 0.01
3	BM_3	22 m	-0.08 +/- 0.07	0.09 +/- 0.01

Benchmarks on the second line

GS ID	BM Name	Nominal Depth	MDD	SD
4	BM_4	12 m	-0.11 +/- 0.09	0.10 +/- 0.01
5	BM_5	9 m	-0.03 +/- 0.05	0.09 +/- 0.01

These results are within expected tolerances and show that the LADS Mk II depth performance was within specifications.

B.7 CROSSLINES

Seven crosslines were planned across the (I305) survey extents to be used for crossline comparisons against the main lines of survey. Areas were selected where common data existed and ideally, where the seabed was reasonably flat. This minimizes the apparent differences in depths due to minor positional differences in steeper areas of seabed.

Due to the tethered TARS balloon located on the southwest coast of Puerto Rico, the two planned crosslines were not flown. Two additional coverage lines were identified and used for crossline comparison purposes.

These lines are as follows:

Line 1102.0.1	27 crossline intersections.	Along the south coast SW of Isla Matel to E of Punta Jorobado.
Line 1652.0.1	21 crossline intersections.	Along the east coast of Bahia Montalva

B.7.1 Mean Depth Differences (MDD) and Standard Deviation (SD)

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

Run No.	Comparisons	Mean Confidence	Average MDD	Average SD
1102.0.1	91423	4.6	0.05 +/- 0.06	0.07 +/- 0.02
1652.0.1	42224	5.3	0.04 +/- 0.07	0.08 +/- 0.01

Crossline comparison details are provided in Appendix V* of the Separates.

**Data Filed with Original Field Records*

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

B.8 POSITION CHECKS

Two independent positioning systems were used during the survey. Real-time positions were aided by WADGPS. A post-processed KGPS position was also determined relative to a local GPS base station that was established on the rooftop of the Courtyard Marriott Hotel in San Juan. The post-processed KGPS position solutions were applied to each sounding during post-processing and the height used in the datum filter.

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

- a. DGPS Site Confirmation. A 24-hour certification was conducted of the local GPS base station established on the roof of the Courtyard Marriott Hotel in San Juan. The results reveal that the local GPS base station is free from site specific problems such as multipath and obstructions.

-
- b. **Static Position Check.** Prior to commencing data collection, the coordinates of the aircraft GPS antenna were determined relative to four NGS-CORS Base Stations in the southeast Puerto Rico area. Data was then logged by each LADS Mk II positioning system enabling the positions to be checked against the NGS-CORS coordinated position of the aircraft GPS antenna. The accuracy of the post-processed KGPS solution during the static position check was 0.133m (95% confidence). The results and details of the static position check are enclosed in the Vertical and Horizontal Control 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 position solutions. The mean difference between the real-time and post-processed position was 0.873m, with an average standard deviation of 0.206. Details are provided in the Vertical and Horizontal Control Report.
 - d. **Navigation Position Check.** Navigation checks were also conducted over a coordinated point on the roof of the terminal at Mayaguez airport. This enabled the known position of the structure to be checked against the image on the downward looking video. This provided a gross error check of position. The mean error was 1.9m with a standard deviation of 3.62m. Details are provided in the Separates.
 - e. **Position Confidence.** The position quality was also monitored by checking a post-processed position confidence (C3), which is determined from the AS platform error, GPS error and residual errors between the actual GPS positions and aircraft position as determined from the line of best fit. No position anomalies were detected.

The position checks were within the expected tolerances and showed that the positioning systems were functioning correctly during the survey.

C. VERTICAL AND HORIZONTAL CONTROL *See also the Evaluation Report.*

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

C.1 VERTICAL CONTROL

Vertical control for the survey was based on the Mean Lower Low Water tidal datum (MLLW). The operating National Water Level Observation Network (NWLON) station at Magueyes Island, PR (9759110) located at the eastern extent of the survey area served as preliminary vertical control.

A subordinate tide station at Punta Guanajibo (9759421) located at the northern extent of the survey area was installed and operated for the duration of the survey. Upon completion of the survey, the datum was established for the subordinate gauge and the final verified tides for both the subordinate and NWLON tide gauges provided the vertical control.

Station details are as follows:

Gauge	Location	WGS84	
		Latitude	Longitude
9759110	Magueyes Island	17° 58.3' N	67° 02.8' W
9759421	Punta Guanajibo	18° 09.6' N	67° 10.9' W

C.2 ZONING

NOAA supplied tide zones that cover the extent of the survey area, with time and range correctors relative to the Magueyes Island tide station. These are as follows:

Tide Zone	GS Identifier	Time Corrector	Range Corrector	Reference Station
PRS15	1	-18 minutes	1.59	9759110
PRS14	2	-18 minutes	1.45	9759110
PRS13	3	-18 minutes	1.23	9759110
PRS12	4	-18 minutes	1.09	9759110
PRS11	5	-24 minutes	1.01	9759110
PRS10	6	-24 minutes	0.94	9759110
PRS9	7	-24 minutes	0.94	9759110
PRS9A	8	-18 minutes	0.94	9759110
PRS8	9	-6 minutes	0.94	9759110
PRS7	10	0 minutes	0.94	9759110

The proposed final tide zoning was computed once the datum for the subordinate tide gauge was established. The proposed final zoning is a combination of both the NWLON gauge, in which the zoning for the southern part of the survey area was derived, and the subordinate gauge, which provided zoning for the western part of the survey area. The proposed final zoning areas are as follows:

Tide Zone	GS Identifier	Time Corrector	Range Corrector	Reference Station
JOA14	1/2	0 minutes	x 1.00	9759421
JOA13	3	0 minutes	x 0.90	9759421
JOA12	4	0 minutes	x 0.85	9759421
JOA11	5	-6 minutes	x 0.81	9759421
JOA10	6	-6 minutes	x 0.77	9759421
JOA09	7	-24 minutes	x 0.94	9759110
JOA09A	8	-18 minutes	x 0.94	9759110
JOA08	9	-6 minutes	x 0.94	9759110
JOA07	10	0 minutes	x 0.94	9759110

An analysis of crosslines and overlaps of the mainlines of soundings concluded that tide zoning was adequate; therefore, the proposed final tide zoning correctors have been considered to be the final zoning correctors for the survey.

The verified tides supplied by NOAA were independently checked by John Oswald and Associates. Once the data was checked, a fifth degree polynomial was applied to the tidal data and this data was then supplied to Tenix LADS Inc. for the application of tides.

The preliminary tide zone areas were adopted as the final tide zone areas. The range and time correctors changed, as zones JOA10-JOA14 are relative to the subordinate tide station.

For final processing, the time and amplitude correctors were applied to the tidal data delivered by John Oswald and Associates. Soundings were then reduced to MLLW using these corrected tides.

The data was viewed across the zone boundaries, which once again validated the final verified tides and zoning.

C.3 HORIZONTAL CONTROL

Data collection and processing were conducted on the Airborne and Ground Systems in World Geodetic System (WGS84) on Universal Transverse Mercator (Northern Hemisphere) projection UTM (N) in Zone 19, Central Meridian 69° West. All units are in meters. This data was post-processed and all soundings are relative to the North American Datum 1983 (NAD83).

C.3.1 LADS Local GPS Base Station – Puerto Rico

Real-time positions were determined using an Ashtech GG24 GPS receiver aided by Wide Area Differential GPS (WADGPS). A local GPS base station was coordinated by John

Oswald and Associates on the roof of the Courtyard Marriott Hotel, San Juan on March 7, 2006.

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

NAD83		UTM (N) Zone 8		
Latitude (N)	Longitude (W)	Easting (m)	Northing (m)	Ellipsoidal Height (m)
18° 27' 20.277"	66° 04' 56.271"	808 179.880	2 043 081.721	13.599

Post-processed KGPS positions were determined off-line using data logged at the local GPS base station and on the aircraft. This data was processed through Ashtech PNAV software to calculate both a DGPS and KGPS position solution. The post-processed KGPS positions were then imported into the GS and applied to all soundings. This provided increased sounding position accuracy and horizontal redundancy.

The local GPS base station site was checked for obstructions and multipath over a 24-hour period on April 20 and April 21, 2006. The results outlined in the Vertical and Horizontal Control Report reveal that the local GPS base station site is free from site specific problems such as multipath and obstructions.

On April 12, 2006 static position checks of the LADS Mk II positioning systems were undertaken. The results outlined in the Vertical and Horizontal Control Report revealed no gross errors and that all positioning systems functioned correctly.

During each sortie, GPS data was logged both on the aircraft and at the local GPS base station, which enabled a post-processed KGPS position solution to be determined. These positions were then compared to the position determined by the real-time positioning system. This dynamic positioning check provided quality control of the positioning systems and the positional differences were within tolerance for the survey. These differences are tabulated in the Vertical and Horizontal Control Report.

Navigation position checks were attempted over the terminal at the Mayaguez airport during each sortie when suitable weather conditions prevailed. Following each sortie the logged aircraft position was processed against the downward looking video record to determine the difference in position at the time of overflight. This provided a gross error check on the aircraft positioning.

The tabulated results are presented in the Vertical and Horizontal Control Report and revealed that the positioning systems functioned to within expectations.

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

The results for the H11567 survey are submitted separately and in conjunction with this Descriptive Report as the S-57 feature file, BASE surface, CARIS .hob file, orthophoto mosaic, chart comparison spreadsheet, etc. on the USB hard drive. Refer to Appendix III of the Data Acquisition and Processing Report for a list of all the applicable results files from H11567.

Below is a table listing the S-57 feature objects found in the S-57 feature file (US511567.000):

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 water line. 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 tags or the georeferenced orthophoto mosaic.
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 will only be responsible for defining the 0m curve.
Land Area	LNDARE	P	The solid portion of the Earth's surface, as opposed to sea, water.		Information (INFORM)				Used for defining islet point features. INFORM populated as mangroves where small mangrove features exist.
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)	
Unsurveyed Areas	UNSARE	A	Unsurveyed area.		Information (INFORM)				Define gaps in data coverage within polyline. INFORM has been identified as either Turbidity or Secondary Exclusion Zone
Shoreline Construction	SLCONS	L	A fixed artificial structure between the water and the land.		Category of shoreline construction (CATSLC)				Used for defining jetties and seawalls.
Buildings	BUISGL	L	Building						Used for defining buildings on the MHW line.
<i>Meta Objects</i>									
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 1: S-57 attribution for the S-57 feature file (US511567.000)

D.1 CHART COMPARISON – REGISTRY NUMBER H11567

H11567 was compared to:

ENC US4PR60M compiled from Raster Chart 25671, 18th Edition, updated application date March 2003, at scale 1:100,000, corrected through NM March 22, 2003 and LNM March 4, 2003.

This chart was downloaded from the NOAA Office of Coast Survey – NOAA Raster Navigational Charts download website on February 10, 2006.
(<http://chartmaker.ncd.noaa.gov/mcd/ENC/download.htm>.)

Recommendations for charting action are described in sections D.1.1 to D.1.4.

D.1.1 Dangers to Navigation

- Item 1 is a 12.9m shoal in 20m of water, located 160m SSE of a charted 20.1m sounding. ***Not processed as a DtoN, see also DR Correspondence.***

D.1.2 Charted Depths and Features

Registry number H11567 covers part of NOAA ENC US4PR60M approximately 15 NM east of Cabo Rojo. From the Source Diagram the area covered by the H11567 was covered by NOS surveys between 1940 and 1969, presumably by single beam echo sounder. Partial bottom coverage was achieved in both areas. The area surveyed is represented by the LADS deliverables in considerably more detail than is currently shown on the chart.

The following general recommendations are relevant:

- a. Coastline. The charted coastline is highly generalized. The surveyed coastline in most cases has been determined from the tags in the GS and the georeferenced orthophoto, due to the presence of mangroves, which dominate the coastline and in some cases, cultural features exist along the coastline. For the mangrove areas, the “coastline” (COALNE) S-57 objects have been attributed as approximate by using the spatial attribute QUAPOS and as mangroves using the attribute CATCOA. It is recommended that the coastline on the chart be amended to the LADS surveyed and extrapolated MHW line. The surveyed coastline, even though it has been interpolated, differs from the ENC by up to 50m in some areas.
- b. Artificial Coastline. For the coastline where cultural features exist, the object shoreline construction (SLCONS) is used to delineate the MHW line. A total of 4 areas have been identified as artificial coastline.
- c. Islets. The charted coastline is highly generalized. Many islets have been surveyed close to the coast. These islets are predominately mangroves and the extent of the mangroves has been determined from the tags in the GS and the georeferenced orthophoto. Where small isolated clumps of mangroves have been identified either through tags or orthophoto, a LNDARE point object attributed with INFORM = mangroves has been compiled in the S-57 feature file (US511567.000). The extent and location of the mangrove areas differ to the ENC by up to 30-50m in some places. On the chart, the islet

named Isla Matel is actually joined to the coast and is not an islet. Where significant, these islets are detailed in the Chart Comparison Spreadsheet in section D.1.4.

- d. Offshore Reefs and Islets. Due to the very shallow nature of many of the offshore reefs, such as Arrecife Enmedio and Arrecife Romero, they have not been entirely surveyed. Some offshore reefs fall into the secondary exclusion zone and these data gaps exist in the S-57 feature file (US511567.000).
- e. Rocks. Many coral outcrops and rocks awash have been surveyed in the exposed and shallow reefs, 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.1.4.
- f. Cultural Features. Some small recreational jetties exist along the coast to the northwest of Punta Jorobado. Due to the small size of these features, they may not have been detected by lidar or seen on the video. These cultural features have been surveyed in more detail than shown on the chart, and where detected, they exist in the S-57 feature file (US511567.000).

In addition to general recommendations above, some 86 significant differences between the chart and the LADS survey have also been identified. Specific recommendations for these differences are described in the Chart Comparison Spreadsheet in section D.1.4. An expanded version of the spreadsheet is included digitally with the survey report on the USB hard drive. The digital .xls version contains information that may be useful for planning of boat sounding and is easy to download into other survey packages (H11567_V1_ChartComp.xls).

A CARIS .hob file containing just the chart comparison items has also been compiled and is provided as part of survey deliverables (H11567ChartComp.hob). The attribution methodology for this file is presented in the table below.

S-57 Object Class	S-57 Object Acronym	Geometry	Description	Attribute 1	Attribute 2	Attribute 3	Attribute 4
Nautical publication information	M_NPUB	P	Used to relate additional nautical information or publications to the data.	INFORM (used for storing a unique chart comparison ID)	NINFOM (used for storing the charting recommendation)	PUBREF (used for storing a reference to a Feature for Investigation)	PICREP (used for storing a link to waveform screen captures)

Table 2: S-57 attribution for the CARIS H11567ChartComp.hob file

The chart comparison was conducted by reviewing the ENC, raster chart, BASE surface, S-57 feature file and the georeferenced orthophoto image. For each item identified, screen dumps of the Local Area Display and Raw Waveform Display were extracted from the LADS Mk II Ground System. These have been reviewed in order to make the following assessments:

- a. Type of Feature
- b. Further Examination Recommended

- c. Charting Recommendation
- d. Remarks

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, witnessing survey operations on NOAA ship Rainier and from meetings at PHB and UNH. They have been designed for ease of use and to minimize double handling of data and transcription. Continued feedback is welcomed in order to develop these formats in order to achieve further efficiencies in data handling.

D.1.3 AWOIS

No AWOIS were assigned to this Task Order.

*D.1.4 Chart Comparison Spreadsheet **Do not concur, all feature recommendations are superseded, see Evaluation Report.***

Sequence No	Shoal No	Category	CHARTED			SURVEYED			Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks
			Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)				
1	K1	2	Islet	17° 58' 5"	67° 1' 21"				Coast	N	Remove	Surveyed as coastline.
2	K2	2	2.50	17° 57' 58"	67° 1' 11"	1.76	17° 57' 56.6078"	67° 1' 10.4592"	Rk	N	Replace	
3	K3	1				0.19	17° 58' 8.6606"	67° 1' 26.4454"	Rk Awash	N	Insert	
4	K4	1				-3.53	17° 57' 59.8475"	67° 0' 54.4673"	Islet	N	Replace	
5	K5	1					17° 57' 41.18"	67° 0' 34.3372"	Islet	N	Insert	Charted coastline surveyed as islet.
6	K6	1				2.68	17° 57' 47.1575"	67° 1' 30.2567"	Rk	N	Insert	
7	K7	1				0.93	17° 57' 59.6891"	67° 1' 16.19"	Rk	N	Insert	
8	K8	1				2.36	17° 57' 49.0385"	67° 1' 0.8137"	Rk	N	Insert	
9	K14	2	Drying Rk	17° 57' 48"	66° 59' 21"	-2.11	17° 57' 50.2149"	66° 59' 20.4425"	Islet	N	Replace	
10	K16	1					17° 57' 52.4678"	66° 59' 8.5423"	Islet	N	Insert	Charted coastline surveyed as islet.
11	K17	1					17° 57' 45.3748"	66° 59' 3.6038"	Islet	N	Insert	Charted coastline surveyed as islet.
12	K19	1				0.35	17° 57' 17.4816"	66° 59' 38.8108"	Rk	N	Insert	
13	K20	1				0.27	17° 57' 43.735"	66° 59' 27.4942"	Drying Rk	N	Insert	
14	K21	1				0.29	17° 57' 38.4185"	66° 59' 29.1005"	Drying Rk	N	Insert	
15	K22	2	9.10	17° 57' 17"	66° 59' 23"	8.31	17° 57' 14.189"	66° 59' 21.4044"	Rk	N	Replace	
16	K23	1				1.04	17° 57' 34.3588"	67° 0' 29.7414"	Rk	N	Insert	
17	K24	2	7.30	17° 57' 6"	67° 0' 49"	6.18	17° 57' 6.9394"	67° 0' 52.0495"	Rk	N	Replace	

Shoal Categories

1-New Shoal Found

2-Charted Shoal Disproved / Not Found

Sequence No	Shoal No	Category	CHARTED			SURVEYED			Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks
			Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)				
18	K25	1				2.70	17° 57' 0.0652"	66° 59' 50.0672"	Rk	N	Insert	All items covered by 4x4m laser spot spacing at 200% lidar coverage.
19	K26	1				3.26	17° 57' 7.2907"	66° 59' 14.7768"	Rk	N	Insert	
20	K27	1					17° 56' 51.2228"	66° 58' 14.0538"	Islet	N	Insert	
21	K28	1					17° 56' 31.7904"	66° 57' 50.1077"	Islet	N	Insert	Charted coastline surveyed as islet.
22	K30	2	3.60	17° 56' 2"	66° 57' 32"	1.91	17° 56' 1.4348"	66° 57' 28.427"	Rk	N	Replace	
23	K32	2	11.30	17° 56' 14"	67° 1' 26"	9.26	17° 56' 13.159"	67° 1' 26.288"	Rk	N	Replace	
24	K33	2	16.40	17° 55' 49"	67° 0' 56"	13.48	17° 55' 50.7508"	67° 0' 53.4017"	Rk	N	Replace	
25	K35	2	14.60	17° 55' 37"	66° 57' 38"	12.99	17° 55' 37.4066"	66° 57' 36.1451"	Rk	N	Replace	
26	K37	2	16.40	17° 55' 14"	66° 58' 17"	13.96	17° 55' 11.5036"	66° 58' 19.4963"	Rk	N	Replace	
27	K38	2	9.10	17° 55' 17"	66° 59' 1"	7.51	17° 55' 17.0591"	66° 59' 3.2698"	Rk	N	Replace	
28	K40	2	14.60	17° 55' 31"	66° 59' 31"	13.08	17° 55' 33.3242"	66° 59' 29.9648"	Rk	N	Replace	
29	K41	2	18.20	17° 55' 17"	66° 59' 57"	16.05	17° 55' 15.4067"	66° 59' 57.264"	Rk	N	Replace	
30	K42	2	16.40	17° 55' 14"	67° 0' 6"	14.38	17° 55' 15.5482"	67° 0' 2.9369"	Rk	N	Replace	
31	K43	2	9.50	17° 55' 17"	67° 0' 26"	8.65	17° 55' 18.3698"	67° 0' 26.3124"	Rk	N	Replace	
32	K45	2	14.60	17° 54' 59"	66° 59' 50"	13.54	17° 55' 3.031"	66° 59' 50.9561"	Rk	N	Replace	
33	K46	2	20.10	17° 55' 7"	66° 59' 42"	12.93	17° 55' 1.9978"	66° 59' 40.69"	Rk	N	Replace	See Danger to Navigation Item 1.
34	K47	2	20.10	17° 55' 7"	66° 59' 27"	15.25	17° 55' 5.0581"	66° 59' 26.4437"	Rk	N	Replace	
35	K49	2	14.60	17° 54' 46"	66° 59' 14"	12.01	17° 54' 43.8566"	66° 59' 10.9324"	Rk	N	Replace	
36	K51	2	14.60	17° 55' 1"	66° 57' 56"	12.98	17° 55' 1.0049"	66° 57' 58.9439"	Rk	N	Replace	

Shoal Categories

1-New Shoal Found

2-Charted Shoal Disproved / Not Found

Sequence No	Shoal No	Category	CHARTED			SURVEYED			Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks	
			Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)					
37	K52	2	13.30	17° 54' 57"	66° 57' 26"	12.29	17° 54' 54.8334"	66° 57' 23.2765"	Rk	N	Replace	All items covered by 4x4m laser spot spacing at 200% lidar coverage.	
38	K53	2	20.10	17° 54' 30"	66° 59' 60"	17.97	17° 54' 27.684"	67° 0' 1.6337"	Rk	N	Replace		
39	K55	2	20.10	17° 53' 55"	67° 1' 32"	18.99	17° 53' 56.4623"	67° 1' 27.8252"	Rk	N	Replace		
40	K56	2	16.40	17° 53' 50"	67° 1' 19"	15.90	17° 53' 47.7197"	67° 1' 22.2913"	Rk	N	Replace		
41	K60	2	14.60	17° 53' 34"	67° 0' 38"	13.28	17° 53' 33.1084"	67° 0' 36.5962"	Rk	N	Replace		
42	K62	2	11.50	17° 56' 1"	66° 59' 20"	10.89	17° 56' 1.2624"	66° 59' 19.2203"	Rk	N	Replace		
43	K63	1				-0.64	17° 56' 5.9651"	66° 57' 23.7906"	Islet	N	Insert		
44	K64	2	Islet	17° 55' 48"	66° 58' 22"		17° 55' 49.249"	66° 58' 25.9536"	Islet	N	Remove		Not detected by lidar, not observed in downward looking video.
45	K65	2	Islet	17° 58' 12"	66° 59' 35"		17° 58' 11.5532"	66° 59' 35.0671"	Coast	N	Remove		Charted islet surveyed as coast.
46	K66	2	Islet	17° 58' 15"	66° 59' 52"		17° 58' 14.5344"	66° 59' 51.846"	Islet	N	Remove		Two charted islets surveyed as one.
47	K67	1				0.62	17° 57' 51.408"	66° 59' 35.8346"	Rk	Y	N/A		
48	K68	2	Drying Rk	17° 57' 48"	66° 59' 35"	0.39	17° 57' 48.2209"	66° 59' 33.1994"	Rk	Y	N/A		
49	K69	2	Drying Rk	17° 56' 36"	66° 58' 11"	-1.00	17° 56' 36.9028"	66° 58' 11.1407"	Islet	N	Replace		
50	K70	2	Drying Rk	17° 56' 36"	66° 58' 11"					N	Remove	Not detected by lidar, not observed in downward looking video.	
51	K71	2	Drying Rk	17° 56' 35"	66° 58' 6"					N	Remove	Not detected by lidar, not observed in downward looking video.	
52	K72	2	Drying Rk	17° 56' 35"	66° 58' 6"					N	Remove	Not detected by lidar, not observed in downward looking video.	
53	K73	1				-0.18	17° 56' 28.8805"	66° 57' 50.4378"	Drying Rk	N	Insert		
54	K74	2	Drying Rk	17° 56' 24"	66° 57' 53"					N	Remove	Not detected by lidar, not observed in downward looking video.	

Shoal Categories

1-New Shoal Found

2-Charted Shoal Disproved / Not Found

Sequence No	Shoal No	Category	CHARTED			SURVEYED			Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks
			Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)				
55	K75	2	Drying Rk	17° 56' 21"	66° 57' 47"				N	Remove	Not detected by lidar, not observed in downward looking video.	
56	K76	1				-0.03	17° 56' 26.28"	66° 57' 44.3516"	Drying Rk	N	Insert	
57	K77	2	Drying Rk	17° 56' 16"	66° 57' 41"				N	Remove	Not detected by lidar, not observed in downward looking video.	
58	K78	2	Islets	17° 56' 9"	67° 1' 12"	-1.70	17° 56' 10.3848"	67° 1' 3.1976"	Islet	N	Replace	Three charted islets surveyed as one islet.
59	K79	2	Drying Rk	17° 56' 12"	67° 1' 15"				N	Remove	Not detected by lidar, not observed in downward looking video.	
60	K81	1				-0.24	17° 56' 43.895"	67° 0' 57.9312"	Drying Rk	N	Insert	
61	K82	1				-0.50	17° 56' 42.027"	67° 0' 56.525"	Islet	N	Insert	
62	K83	1				-0.30	17° 56' 41.4312"	67° 0' 55.512"	Drying Rk	N	Insert	
63	K84	1				-0.27	17° 56' 36.6058"	67° 0' 32.1206"	Drying Rk	N	Insert	
64	K85	1					17° 56' 36.456"	67° 0' 30.5935"	Islet	N	Insert	
65	K87	1				-0.21	17° 56' 36.9197"	67° 0' 24.6758"	Drying Rk	N	Insert	
66	K88	2	Islet	17° 56' 41"	67° 0' 15"				Y	N/A	Not detected by lidar, not observed in downward looking video.	
67	K89	2	Drying Rk	17° 56' 35"	67° 0' 17"	-0.41	17° 56' 36.6368"	67° 0' 16.1162"	Islet	N	Replace	
68	K90	1				-0.80	17° 56' 38.4004"	67° 0' 7.33"	Islet	N	Insert	
69	K91	1				-0.50	17° 56' 42.1087"	67° 0' 7.3901"	Islet	N	Insert	
70	K92	1				-0.21	17° 56' 40.7543"	67° 0' 8.5267"	Drying Rk	N	Insert	
71	K93	1				-0.01	17° 56' 40.5899"	67° 0' 10.5865"	Drying Rk	N	Insert	

Shoal Categories

1-New Shoal Found

2-Charted Shoal Disproved / Not Found

Sequence No	Shoal No	Category	CHARTED			SURVEYED			Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks
			Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)				
									Rk			All items covered by 4x4m laser spot spacing at 200% lidar coverage.
72	K94	2	Islet	17° 56' 51"	66° 59' 52"					Y	N/A	Not detected by lidar, not observed in downward looking video.
73	K95	2	Islets	17° 57' 2"	66° 59' 39"					N	Remove	Not detected by lidar, not observed in downward looking video.
74	K96	2	Drying Rk	17° 56' 52"	66° 59' 38"	-0.90	17° 56' 52.7323"	66° 59' 37.9126"	Islet	N	Replace	
75	K97	1				-0.23	17° 56' 53.988"	66° 59' 36.6752"	Drying Rk	N	Insert	
76	K98	1					17° 56' 55.7815"	66° 59' 33.9709"	Islets	N	Insert	
77	K99	1					17° 56' 59.0662"	66° 59' 17.7511"	Islets		Insert	
78	K101	1					17° 56' 59.3858"	66° 59' 10.1742"	Islets	N	Insert	Charted islet surveyed as several islets.
79	K102	1				-0.21	17° 56' 57.5007"	66° 58' 59.0202"	Drying Rk	N	Insert	
80	K103	1					17° 56' 54.9276"	66° 58' 57.1505"	Islets	N	Insert	
81	K104	2	Drying Rk	17° 57' 1"	66° 58' 50"					N	Remove	Not detected by lidar, not observed in downward looking video.
82	K105	1					17° 56' 52.8"	66° 58' 49.6092"	Islet	N	Insert	
83	K107	1					17° 56' 51.2539"	66° 58' 49.407"	Islet	N	Insert	
84	K108	1					17° 57' 3.4168"	66° 58' 49.2719"	Islets	N	Insert	
85	K109	1				13.25	17° 54' 31.2282"	66° 59' 43.2938"	Rk	N	Insert	

Shoal Categories

1-New Shoal Found

2-Charted Shoal Disproved / Not Found

D.1.5 Additional Boatwork inside the Lidar Area

Additional boatwork may be required to supplement the gaps in the lidar coverage.

D.1.5.1 Features Requiring Investigation

No features requiring further investigation.

D.1.5.2 Gaps in the Data *see also the Evaluation Report.*

Areas where no lidar coverage exist are provided in the S-57 feature file (US511567.000).

- Turbidity. Areas of turbidity exist offshore in channels, which have resulted in no lidar coverage. These areas are considered significant due to their location. The significant areas are listed below:

Area	Latitude (N)	Longitude (W)	Dimension (m)	Water Depth (m)	Remark
1	17° 57' 22"	67° 00' 31"	300x100	15	500m S of Isla Matel
2	17° 57' 29"	67° 00' 18"	200x50	15	300m S of Isla Matel
3	17° 56' 35"	67° 01' 05"	100x100	13-18	250m SW of Arrecife Enmedio

In addition to the areas mentioned above, the largest areas of turbidity where no lidar coverage exists, is located in the channel between Arrecife Romero and the coast of Punta Montalva. The approximate position is 17° 57' 14" N, 67° 01' 05" W, in water depths of 7-10m. These gaps have been created as unsurveyed areas (UNSARE) and attributed as INFORM = Turbidity in the S-57 feature file (US511567.000).

- Secondary Exclusion Zone. A gap due to the Secondary Exclusion Zone occurs in very shallow areas near the land / sea interface. The depth or height cannot be accurately determined from the waveform when the bottom and sea surface returns merge. There are 125 areas where no data exists due to the Secondary Exclusion Zone. Many of these areas exist around off-lying reefs, around mangrove areas and along the coast. These gaps have been created as unsurveyed areas (UNSARE) and attributed as INFORM = Secondary Exclusion Zone in the S-57 feature file (US511567.000). It is possible that depths are shoaler within these gaps than the surrounding data, and least depth for these areas has not been determined. The gaps have not been recommended for further investigation as all the gaps exist within charted foul areas or in close proximity to charted drying rocks or islets.

D.1.6 Aid To Navigation

No aids to navigation exist within the H11567 survey area.

D.1.7 Recommended Overlap With Lidar Data

The recommended overlap by surface vessels for survey H11567 is to seaward of the data coverage polygon defined by S-57 object M_COVR, CATCOV=1.

E. APPROVAL SHEET**LETTER OF APPROVAL – OPR-I305-KRL-06**

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

ReportSubmission Date

Descriptive Report – H11567

May 9, 2007



Mark Sinclair
Hydrographer
Tenix LADS Incorporated

Date May 9, 2007

APPENDIX I – DANGERS TO NAVIGATION

DTONS Submitted to AHB

1.1. Danger to Navigation Report

Hydrographic Survey Registry Number:	H11567
State:	Puerto Rico
Locality:	Southwest Puerto Rico
Sub-locality:	Vicinity of Bahia Montalva
Project Number:	OPR-I305-KRL-06
Survey Dates:	April 2 to May 15, 2006

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
25671	18th Ed	March, 2003	1:100,000

The following items were found during hydrographic survey operations:

No.	Feature	Depth	Latitude (N)	Longitude (W)	Time and Date	Investigate
1	Shoal	12.9	17° 55' 2.00"	66° 59' 40.69"	13:58:32, Apr 17	No

DTONS Submitted to MCD

1.2. Danger to Navigation Report

No DTON's were submitted to MCD.

Subject: Re: Poster/Sheet K DTON/Raster chart
From: gene_parker <castle.e.parker@noaa.gov>
Date: Tue, 08 May 2007 09:26:10 -0400
To: GUILFORD James <James.GUILFORD@Tenix.com>
CC: David Scharff <David.Scharff@noaa.gov>

Good Morning,

I'm sorry about not replying with Danger submission sooner; I got side tracked by some guy and something about a poster...

For now keep H11567 DtoN #1 in Appendix 1. (Might want to change the submission Branch... it's listed as PHB) After reviewing the charted depths and locations, I am not going to process and submit to MCD. Related to DtoN submission with Debris Mapping Project, AHB has been CYA and submitting features that MCD decides not to chart and publish to LNM. Their response was "Why waste my time processing this Danger when I don't think it deserves special charting attention!" (paraphrased from my perspective, with attitude!) So, in the normal survey processing we will update.

Reviewing the chart 6.5 fm SGSL exists to the east, 7 fm to the ESE, and 7.5 to the SSW, 7fm to the west. So, based upon my previous submissions to MCD and feedback, I'm using different judgment criteria and put on the MCD hat, and make assumptions. For now, keep the Danger in Appendix 1. I have discussed with AHB Chief and he concurs with my analysis and judgment not to submit to MCD. I feel that from Tenix point of view, it should remain in the DR, but will annotate that AHB review decided not to submit. At least by keeping in the DR, it documents that it was submitted, and Tenix did the right thing (CYA) and submit to AHB.

Reviewing Chart 25671, I found what you reference with same name, two islands. Your comments and observation should be included in the DR, section D. Make comment about the two islands named the same name and give exact locations. We will concur with your observation and recommend MCD reference source information (US Chief Geographer); MCD will have to investigate the source and name duplication on the chart. Basically, we defer final charting disposition to MCD, but the fact will have been brought to their attention.

On another note, can you send me a pdf copy of the final poster after last semantic BS. I am going to plot a smaller version one for AHB and have it framed on the wall. Thanks. Don't you think ya could trade the poster for at least one beer in AK? Just one! Yeah, if you don't want to take it with you, we'll keep it here at AHB or maybe send to HQ for their walls. I printed a full size version and it's HUGE!

That's all for now, see ya next week! Gene

GUILFORD James wrote:

> Hey Gene,

>

> How are you? Hope you had a good weekend. Jazzfest was on in New Orleans all weekend so I hit up some shows saturday and sunday. Needless to say, I'm moving a little slow today. I have a few things for you.

>

> First, the poster is finished and is out getting printed and laminated. I know you asked to laminate it but it happened without my knowing this morning. If you want, you can keep it afterwards as I don't really feel like carrying it up to alaska with me after the conference (although I'm sure it would be a big hit if I brought it with me to the bars in Ketchikan).

>

> Second, we have identified two islands on raster chart 25671 that have the same name. It's Turrumote Island, approximate position: 17.946523294N 67.124772576W OR 17.946347606N 67.123624929W Should we write this up in the DR report for Sheet K (H11567) or is this something that can be fixed from your end? This is a situation we haven't dealt with before.

>

> Third, any word on the DTON I submitted for Sheet K (H11567)?

>

> Alright...thats about all from me. Have a good afternoon.

>

> Thanks

> James

>

> -----

> James Guilford

> Deputy Survey Manager

> Tenix LADS, Inc.

> 925 Tommy Munro Dr Suite J

> Biloxi, MS 39532

> (O) 228-594-6800 (M) 228-342-3028

> (F) 228-594-6887

Subject: Baselines for PR
From: Shepard Smith Shep.Smith@noaa.gov
Date: Mon, 12 Jan 2009 17:58:56 -0500
To: Bryan Chauveau <Bryan.Chaudeau@noaa.gov>
CC: Meredith Westington <Meredith.Westington@noaa.gov>, Jeffrey Ferguson
<Jeffrey.Ferguson@noaa.gov>

Bryan,

I just remembered that we need to consider the baselines for the PR surveys, esp on those offshore reefs. They may be relevant to the widest boundaries. Lets discuss tomorrow.

Shep
Chief, Atlantic Hydrographic Branch
Hydrographic Surveys Division, Office of Coast Survey
National Oceanic and Atmospheric Administration

Subject: Re: Puerto Rico Baselines
From: "meredith.westington" <Meredith.Westington@noaa.gov>
Date: Tue, 13 Jan 2009 10:10:31 -0500
To: Bryan Chauveau <Bryan.Chaudeau@noaa.gov>

Hi Bryan,

Can you send me a polygon of the survey area in SHP format? I was out of the office yesterday, but can check into the overlap with baselines today and possibly into tomorrow, if needed.
Meredith

Bryan Chauveau wrote:

Hi Meredith,

I am compiling the 2nd of a set of surveys along the southwestern side of Puerto Rico. Today, Shep reminded me we need to take the baselines for PR into consideration. I know he cc'd you on that email. I don't recall previously how we obtained the baselines from you, so can you remind me and send me the information? Thank you. I have a survey review today and am hoping to have this survey compilation finalized this week. However, I can easily place this survey on the back burner and begin compilation on the next survey to accomodate time necessary to receive the baselines for Puerto Rico from you.

Bryan Chauveau
Atlantic Hydrographic Branch

Subject: Re: Puerto Rico Baselines
From: "meredith.westington" <Meredith.Westington@noaa.gov>
Date: Wed, 14 Jan 2009 11:29:56 -0500
To: Bryan Chauveau <Bryan.Chauveau@noaa.gov>
CC: James M Crocker <James.M.Crocker@noaa.gov>, Shepard Smith
<Shep.Smith@noaa.gov>

Hi Bryan,

Please see attached for baseline info on the 8 survey areas you requested-- H11560, H11561, H11562, H11563, H11564, H11565, H11566, and H11567. You should find 3 shapefiles in the attached zip file-- 3nm basepoints, 1 closing line, and rock research (including rocks that could have incorporated into the baseline had we been able to find out more information and/or if the research results yielded evidence of rocks bare at MLLW). I put this together rather quickly, so if you have any questions or problems loading the data, please let me know.

Thanks,
Meredith
Chief Geographer
NOAA/NOS/Office of Coast Survey

On January 13, 2009, the Atlantic Hydrographic Branch (AHB) requested baseline information for the following surveys: H11560, H11561, H11562, H11563, H11564, H11565, H11566, and H11567.

Baseline points and one closing line that overlap this area of interest were derived from charts 25675 (9th edition, March 2003) and 25671 (18th edition, March 2003). The following 3 shapefiles (in NAD83) reflect the baseline approvals as well as research for AHB's area of interest.

The file *PR_USVI_3nmbasepts_Intersect.shp* contains all of the contributing baseline points (41 in total) within the 8 survey areas requested by AHB.

The file *PR_USVI_closinglines_Intersect.shp* contains the one closing line (bay closing line across Bahia de Boquerón) within the AHB request area.

The file *WestPR_rockresearch_Intersect1.shp* contains the rocks referenced in the rock research spreadsheet on the next page. The number listed under "Source" in the shapefile references the row number on the spreadsheet. Several rocks were investigated by checking the source surveys (typically hydrographic surveys) for additional height information to see if they could be incorporated into the baseline. Two of these rocks were incorporated into the approved baseline (see *PR_USVI_3nmbasepts_Intersect.shp*); however, if any of the other rocks were to bare at MLLW, they could be incorporated into future revisions of the baseline. It should be noted that the relevant hydrographic surveys were not available to us for the first 4 rocks in the list.

WESTPR: 25671 ASTERISK ROCKS LIST (The rocks listed contribute to the 3nm line. The rocks were researched against hydrosurveys and flagged as to whether or not they are drying features.)

			Charted latitude/longitude DMS (NAD83)						NAD83 to PRD vals		Hydrographic Survey Coordinates (PRD)									
	Area	Chart	Clat deg	Clat min	Clat sec	Clong deg	Clong min	Clong sec	Hlat diff	Hlong diff	Hlat deg	Hlat min	Hlat sec	Hlong deg	Hlong min	Hlong sec	Hsurvey	symbology	drying?	scan avail?
9	Pta. Arenas	25671	18	8	21.348	67	11	19.525	7.167	1.354	18	8	28.515	67	11	20.879	H02537	*	NO	NO
10	Pta. Guaniquilla	25671	18	2	6.018	67	12	38.532	7.167	1.354	18	2	13.185	67	12	39.886	H02686	NF	NO	NO
11	Cabo Rojo	25671	17	56	3.434	67	11	51.426	7.167	1.354	17	56	10.601	67	11	52.78	H02690	NF	NO	NO
12	Cabo Rojo	25671	17	55	51.806	67	11	41.321	7.167	1.354	17	55	58.973	67	11	42.675	H02690	NF	NO	NO
13	Arrecife Margarita	25671	17	55	2.864	67	7	33.492	7.167	1.354	17	55	10.031	67	7	34.846	H08985	marsh (0)	NO	YES
14	Arrecife Margarita	25671	17	55	1.888	67	7	10.654	7.167	1.354	17	55	9.055	67	7	12.008	H08985	marsh (0)	NO	YES
15	Arrecife Margarita	25671	17	55	1.566	67	7	2.321	7.167	1.354	17	55	8.733	67	7	3.675	H08985	marsh (0)	NO	YES
16	Arrecife Margarita	25671	17	54	59.609	67	6	39.199	7.167	1.354	17	55	6.776	67	6	40.553	H08985	marsh (0)	NO	YES
17	Arrecife Margarita	25671	17	55	0.411	67	6	30.16	7.167	1.354	17	55	7.578	67	6	31.514	H08985	marsh (0)	NO	YES
18	Arrecife Margarita	25671	17	55	3.177	67	6	24.205	7.167	1.354	17	55	10.344	67	6	25.559	H08985	marsh (0)	NO	YES
19	Arrecife Margarita	25671	17	55	6.8	67	6	16.391	7.167	1.354	17	55	13.967	67	6	17.745	H08985	marsh (0)	NO	YES
20	Arrecife Margarita	25671	17	55	17.232	67	5	55.254	7.167	1.354	17	55	24.399	67	5	56.608	H08985	marsh (0)	NO	YES
21	Arrecife Media Luna	25671	17	56	12.761	67	2	52.858	7.167	1.354	17	56	19.928	67	2	54.212	H08984	marsh	YES	YES
22	Turumote Isl.	25671	17	56	7.553	67	1	7.058	7.167	1.354	17	56	14.72	67	1	8.412	H08984	marsh	YES	YES

**ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT to Accompany
Survey H11567**

This Evaluation Report has been written to supplement and/or clarify the original Descriptive Report. Sections in this report refer to the corresponding sections of the Descriptive Report.

B. DATA ACQUISITION AND PROCESSING

B.1 DATA PROCESSING

The following software was used to process and review data at the Atlantic Hydrographic Branch (AHB):

CARIS HIPS/SIPS version 6.1 SP2 hotfix 7
CARIS BASE Manager 2.1 SP1 hotfix 10
CARIS S-57 Composer 2.0 hotfix 2
Dkart Inspector V. 5.0 Build 732 (SP1)

B.2 QUALITY CONTROL

H-Cells

The AHB source depth grid was a 3m resolution shoal biased BASE surface extracted from the field submitted surface for survey H11567. Survey scale soundings were extracted from the 3m shoal biased BASE Surface generated at a 1:10000 scale using a radius of 5m. Because the survey was conducted entirely by LIDAR, depth curves were created by hand at the 3 fathom, 5 fathom and 10 fathoms depth intervals. Soundings were selected for charting by hand using the latest raster chart (25671) and depth contours used as background for sounding placement. Soundings were then checked for conflicts, corrected to remove conflicts, and edited to allow for proper sounding compilation placement with respect to existing charted depths outside the survey area.

The compilation products and Stand Alone HOB Files (SAHOB) are detailed in the Compilation Process Log of this document. All individual SAHOB files were assembled in BASE Editor during H-Cell compilation.

The completed H-Cell was exported as a Base Cell File (ENC.000) in S-57 format with all values in metric units. The metric equivalent ENC.000 file was then converted to

NOAA chart units (ENC_CU.000) with all values measured in fathoms following NOAA sounding rounding rules.

Chart compilation was performed by Atlantic Hydrographic Branch personnel in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland.

The H11567 CARIS H-Cell final deliverables include the following products:

H11567_CU.000	1:10,000 Scale	H11567 H-Cell with Chart Scale Selected Soundings
H11567_SS.000	1:10,000 Scale	H11567 Survey Scale Soundings

C. VERTICAL AND HORIZONTAL CONTROL

Final vertical correction processing was completed by field personnel. Sounding datum is Mean Lower Low Water (MLLW). Vertical datum is Mean High Water (MHW). Horizontal control used for this survey during data acquisition is based upon the North American Datum of 1983 (NAD83), UTM projection zone 19.

D. RESULTS AND RECOMMENDATIONS

D.1 Chart Comparison

25671 (18th Edition, Mar./03)
Corrected through NM Mar. 22/03
Corrected through LNM Mar. 04/03
1:100,000 Scale

ENC Comparison

US4PR60M
West Coast of Puerto Rico
Edition 6
Update Application Date 2007-10-22
Issue Date 2007-10-22
References: Chart 25671

Hydrography

The charted hydrography originates with prior surveys and requires no further consideration. The hydrographer makes adequate chart comparisons in Section D. of the Descriptive Report.

Shoreline, Islands, Mangrove and Islets

The charted shoreline, islets, jetties and mangrove areas were surveyed and updated by Tenix as detailed in the Descriptive Report. Office personnel digitized the depth area of the survey to include the detailed shoreline provided by Tenix. Two sets of Orthoimages were downloaded from the US Geological Survey website (<http://seamless.usgs.gov>) for shoreline comparison with the Tenix Photomosaics. The USGS Orthoimages were taken by the US Geological Survey in October of 2004 at 1.0 meter resolution and in November 2006 at 0.3 meter resolution. Using the Tenix survey photomosaic and updated shoreline orthophotos from the USGS the shoreline was updated and generalized to the 1:100,000 chart scale, incorporating islets and exposed rocks close to shore into the generalized shoreline (COALNE). Using the same resources, the mangrove limits were updated and generalized to chart scale (COALNE – CATCOA 7: mangrove). The shoreline of the charted islands, Isla Matei and Cayo Don Luis, were also updated and generalized to chart scale using these resources.

The Tenix areas defined as Secondary Exclusion Zones (either due to shallow depths or turbidity) were considered insignificant at chart scale and were not used in compilation of the shoreline, mangrove areas, reef areas, or rocks across the survey area. Thus, no Secondary Exclusion Zones (UNSARE) from Tenix were included in the survey H-Cell.

Charted Features

In the survey area are two islands both named Turrumote Island. One is located in the western section of the survey area in the vicinity of Latitude 17°55'33.88"N, Longitude 66°57'05.59"W and the other is located in the eastern section of the survey area in the vicinity of Latitude 17°55'33.88"N, Longitude 66°57'05.59"W. It is recommended the names of these islands be reviewed for accuracy, or, if the names are accurate, then the Islands should be appended as Turrumote Is. (west) and Turrumote Is. (east). Defer all charting recommendations for geographic names to Marine Chart Division, Source Data Branch.

In the southeast section of the survey area, offshore of Punta Jorobado, is a reef named Arrecife Baul, in the vicinity of Latitude 17°55'33.88"N, Longitude 66°57'05.59"W. The western end of the reef falls within the survey area, however, based on the orthoimagery used to update all shoreline, mangrove, and reef limits across the Puerto Rico surveys, it is recommended Arrecife Baul be updated using the latest orthoimagery available. As you can see in the following image, Arrecife Baul reef limits as currently charted are approximately 60 meters south of their actual location, significant at chart scale.

Arrecife Baul as currently charted with available USGS Orthoimagery



Baselines

The existing Baseline points around southwestern Puerto Rico require revision based upon the MLLW limits as documented from this survey. Defer all Baseline updates to Marine Chart Division, Source Data Branch. Refer to included correspondence for a description of the Baseline points and their usage.

Per email conversation with Meredith Westington, Chief Geographer NOAA/NOS/Office of Coast Survey (Meredith.Westington@noaa.gov), the National Baseline is defined as follows:

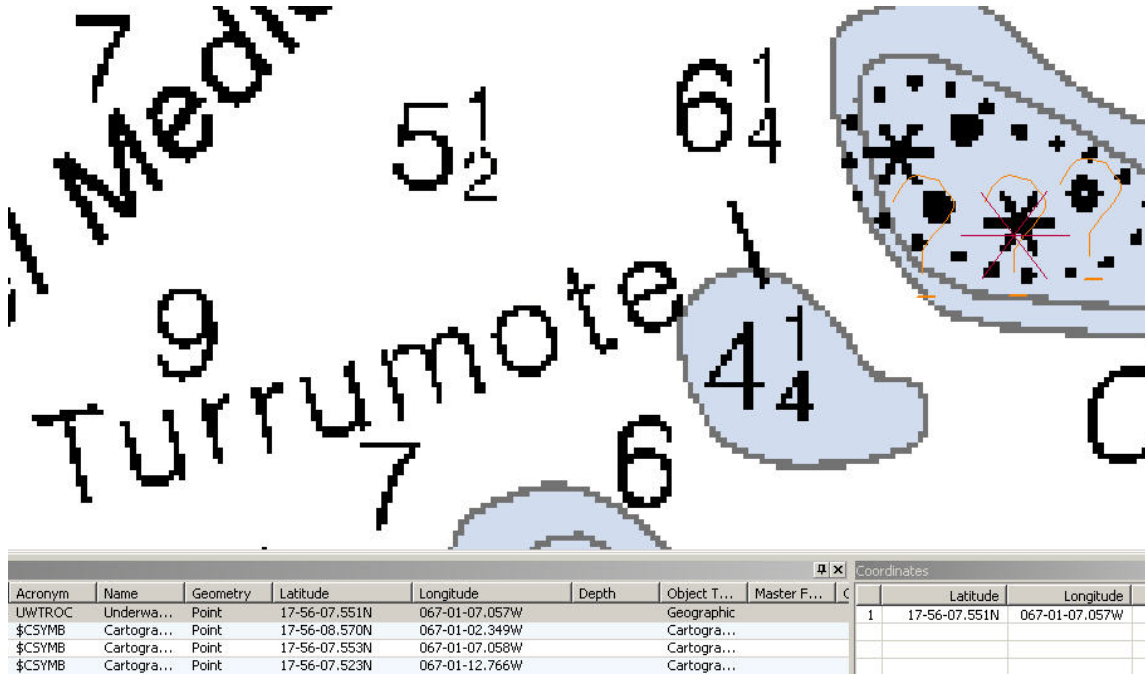
The charted, offshore limits of U.S. jurisdiction-- Three Nautical Mile Line, 9 nautical mile (nm) Natural Resources Boundary, 12nm territorial sea, 24nm contiguous zone, and 200nm Exclusive Economic Zone (EEZ)—are measured from what is referred to as the “baseline.” A “normal baseline,” as defined in the Convention on the Law of the Sea, refers to the low-water line as marked on officially recognized, large-scale nautical charts. Since low water is not an official tidal datum, the U.S. applies the term to reference the lowest charted datum, which is mean lower low water (MLLW) in the U.S. As the charts are updated, so does the baseline and the related maritime zones. Examples of features that typically meet international baseline criteria are naturally-formed islands, islets, and rocks awash that bare at MLLW. Additionally, groins, breakwaters, jetties, and entrances to legally-defined bays, harbors, or rivers may also be included. Subsequent to the application of this survey, the following baseline features may be impacted by updates to the relevant nautical charts:

In the survey limits for H11567 there are five Baseline Points, four at Turrumote Island (west) and one at Turrumote Island (east), that will need adjustment based on the

new survey data. The five Baseline Points are located at:

Turumote Island (west)

- Latitude: 17-56-08.570N Longitude: 67-01-02.349W
- Latitude: 17-56-07.553N Longitude: 67-01-07.058W
- Latitude: 17-56-07.523N Longitude: 67-01-12.766W
- Latitude: 17-56-07.551N Longitude: 67-01-07.057W



Turrumote Island (east)

Latitude: 17-55-44.721N Longitude: 66-58-26.529W

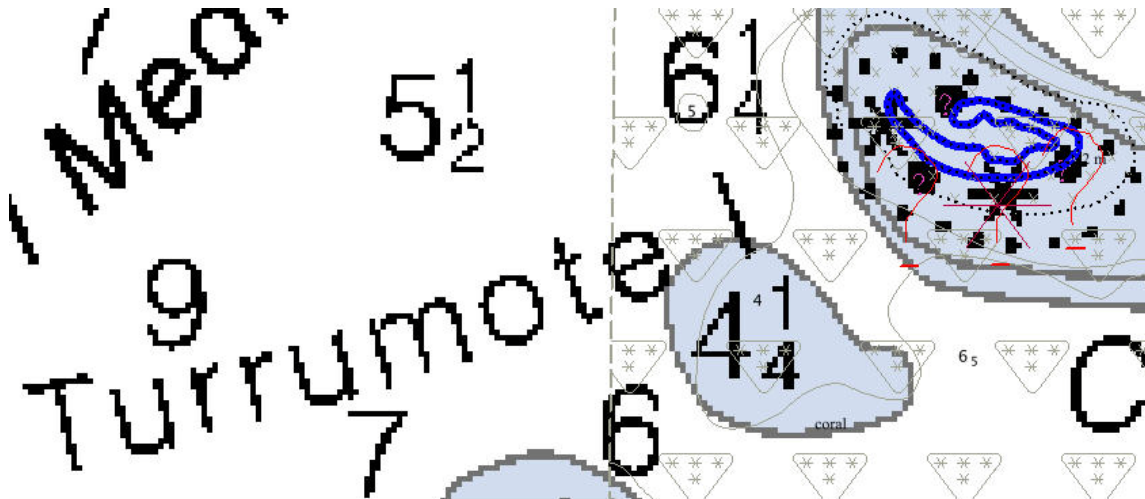


Acronym	Name	Geometry	Latitude	Longitude	Depth	Object T...	Master F...
\$CSYMB	Cartogra...	Point	17-55-44.721N	066-58-26.529W		Cartogra...	

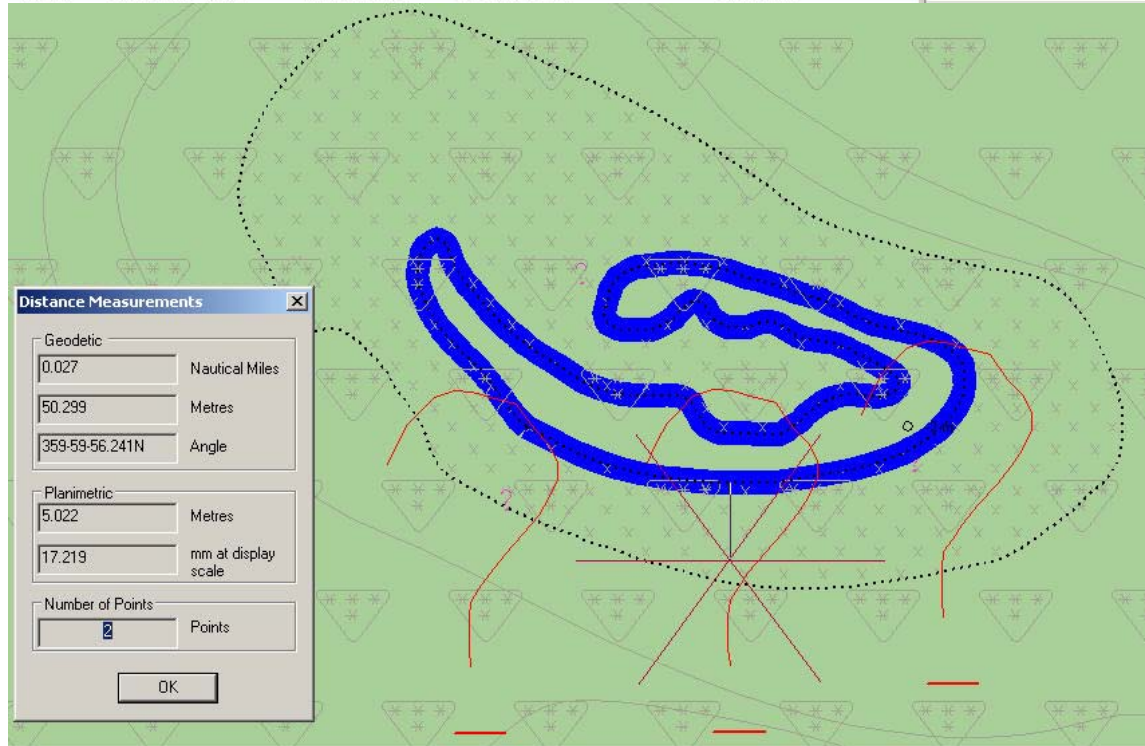
Based on the new survey MLLW lines, and referencing the correspondence with Meredith Westington where she states “if any of the other rocks were to bare at MLLW, they could be incorporated into future revisions of the baseline,” there are numerous new exposed (above MLLW limits) “reefs” around the existing Baseline Points that should be considered for inclusion as new Baselines. It is recommended these new MLLW limits supersede the current Baseline Points and the appropriate offshore limits of US jurisdiction be adjusted accordingly.

The following images demonstrate the new MLLW limits and the current Baseline Points. New MLLW limits are blue, current Baseline Points are red question marks.

The Baseline point south of Turrumote Island (west) should either be moved shoreward 50 meters to the new MLLW limits as depicted below.



Acronym	Name	Geometry	Latitude	Longitude	Depth	Object T...	Master F...	Coordinates
UWTROC	Underwa...	Point	17-56-07.551N	067-01-07.057W		Geographic		
\$CSYMB	Cartogra...	Point	17-56-08.570N	067-01-02.349W		Cartogra...		
\$CSYMB	Cartogra...	Point	17-56-07.553N	067-01-07.058W		Cartogra...		
\$CSYMB	Cartogra...	Point	17-56-07.523N	067-01-12.766W		Cartogra...		



Acronym	Name	Geometry	Latitude	Longitude	Depth	Object T...	Master F...	Coordinates
UWTROC	Underwa...	Point	17-56-07.551N	067-01-07.057W		Geographic		
\$CSYMB	Cartogra...	Point	17-56-08.570N	067-01-02.349W		Cartogra...		
\$CSYMB	Cartogra...	Point	17-56-07.553N	067-01-07.058W		Cartogra...		
\$CSYMB	Cartogra...	Point	17-56-07.523N	067-01-12.766W		Cartogra...		

The Baselines at Turrumote island (east) needs to be moved shoreward to the north and east 107 meters to the new MLLW limits:



Comparison with Prior Surveys

A comparison with prior surveys was not done during office processing in accordance with section 4. of the memorandum titled "Changes to Hydrographic Survey Processing", dated May 24, 1995.

Adequacy of Survey

The present survey is adequate to supersede the charted bathymetry within the common area. Any features not specifically addressed either in the H-Cell BASE Cell File or the Blue Notes should be retained as charted. Due to the dramatic shoreline changes, mangrove limits, and nearshore and offshore reef limits that were updated by the Tenix Puerto Rico surveys, it is recommended the remaining sections of Puerto Rico be scheduled for updated hydrographic and shoreline surveying as well.

Bryan Chauveau

Bryan Chauveau
Physical Scientist
Verification of Data
Evaluation and Analysis Report

H11567 COMPILATION RECORD

Registry No. H11567
 Project No. OPR-I305-KRL-06
 Field Unit Tenix LADS Aircraft, VH – LC
 Compilers Bryan Chauveau

25671 (18th Edition, Mar./03)
 Corrected through NM Mar. 22/03
 Corrected through LNM Mar. 04/03
 1:100,000 Scale

Largest Scale Chart **US4PR60M**
 West Coast of Puerto Rico
 Edition 6
 Update Application Date 2007-10-22
 Issue Date 2007-10-22
 References: Chart 25671

Survey Scale 1:10000
 Date Of Survey 4-2 to 5-15-2006

Milestones	File Name
<i>Contours Layer</i>	H11567_Contours.hob
<i>Survey Scale Soundings</i>	H11567_SS_Soundings.hob
<i>Chart Scale Soundings</i>	H11567_CS_Soundings.hob
<i>Feature Layers</i>	H11567_DepAre.hob H11567_Mangrove_Limits.hob H11567_Smooth_Shoreline.hob H11567_Features.hob H11567_Seabed_Area.hob
<i>Meta-objects Layers</i>	H11567_MCovr.hob H11567_MQual.hob
<i>Blue Notes</i>	H11567_BlueNotes.hob

META-OBJECTS:

M_COVR attributes

Acronym	Value
CATCOV	1 - coverage available
SORDAT	20060515
SORIND	US,US,survey,H11567

M_QUAL attributes

Acronym	Value
CATZOC	zone of confidence B
INFORM	H11566,OPR-I304-KRL-06, Tenix LADS Aircraft, VH LCL
TECSOU	Laser
SURSTA	20060402
SUREND	20060515
POSACC	10
SORDAT	20060515
SORIND	US,US,survey,H11567

Final Grids Listing –

H11567_3m_Shoal_Extracted.hns

H11567_3m_Shoal_Extracted.xml

H11567_3m_Shoal_Extracted Depth.bel

APPROVAL SHEET
H11567

The completed survey has been inspected with regard to survey coverage, delineation of depth curves, development of critical depths, cartographic symbolization, and verification or disproof of charted data. All revisions and additions made to the H-Cell files during survey processing have been entered in the digital data for this survey. The survey records and digital data comply with NOS requirements except where noted in the Evaluation Report.

Bryan Chauveau
Physical Scientist,
Atlantic Hydrographic Branch

All final products have undergone a comprehensive review as per the Atlantic Hydrographic Branch Processing Manual and are verified to be accurate and complete except where noted in the Evaluation Report.

I have reviewed the Base Cell files, accompanying data, and reports. This survey and accompanying Marine Chart Division deliverables meet or exceed NOS requirements and standards for products in support of nautical charting except where noted in the Evaluation Report.

Approved:

Commander Shepard M. Smith, NOAA
Chief, Atlantic Hydrographic Branch