

# **NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT**

## ***PROJECT VI0801***

### ***St. Thomas Harbor, U.S. Virgin Islands***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project VI0801 provides a highly accurate database of new digital shoreline data for St. Thomas Harbor, U.S. Virgin Islands, and surrounding coastal areas. The project extends from Green Cay westward to Brewers Bay and includes both East and West Gregerie Channel.

Successful completion of this project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric-quality digital aerial images, and digital feature data of the coastal zone which complements the Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

The project database consists of information measured and extracted from digital aerial images and metadata related to photogrammetric compilation. Base mapping was conducted in a digital environment using stereo softcopy photogrammetry and associated cartographic practices.

#### **Project Design**

The design of Project VI0801 was accomplished by the Requirements Branch (RB) of the Remote Sensing Division (RSD) in response to the need for timely updates to the NOAA Electronic Navigational Chart (ENC) series. Project requirements were originally formulated as a result of analysis conducted within the Coast and Shoreline Change Analysis Program (CSCAP), in which NOAA nautical chart products are compared to contemporary high resolution imagery in order to ascertain the need for more current shoreline data. Subsequent to the change analysis, RSD received a request from the Office of Coast Survey (OCS) Navigation Manager in the region for updated shoreline of St. Thomas Harbor to support the application of a new hydrographic survey. Given the special request, as well as the availability of stereo color and IR imagery, the Applications Branch (AB) of RSD elected to provide full compilation of the entire project area.

#### **Field Operations**

The field operations consisted of the collection of kinematic Global Positioning System (GPS) and Inertial Measurement Unit (IMU) data and the acquisition of digital aerial imagery. The photographic mission operations were conducted on April 9th, 2009 with the NOAA Cessna Citation II (N52RF) aircraft. Two strips of natural color digital images and two strips of black & white infrared (IR) for a total of forty-six (46) images

were acquired simultaneously through the use of an Applanix DSS-439 digital camera with dual 60 mm lenses at an approximate ground sample distance (GSD) of 0.35 meters.

Instead of establishing a GPS base station for this project, static GPS data was collected from the CORS station (ZSU1) at Luis Munoz Marin Intl. Airport (San Juan, PR). Airborne kinematic GPS/IMU data was collected to determine precise camera positions and orientations in order to establish control network necessary for aerotriangulation. Data collection operations were conducted in accordance with the GPS Controlled Photogrammetry Field Operations Manual. No ground control survey operations were required for this project.

## **GPS Data Reduction**

GPS and IMU data was processed by RSD personnel to provide precise positions of camera centers for application as photogrammetric control in the aerotriangulation phase of project completion. The airborne kinematic data was processed using Applanix POSPAC (ver. 4.4) software also in May 2008. For further information refer to the Airborne Positioning and Orientation Report (APOR) on file with other project data within the RSD Applications Branch (AB) Project Archive.

## **Aerotriangulation**

Routine softcopy aerotriangulation methods were applied to establish a network of precise camera positions and other control for mapping, and to provide model parameters and orientation elements required for digital compilation. This work was initiated by RSD personnel in December 2009 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components and other associated peripheral devices. BAE Systems SOCET SET® v. 5.4.1 softcopy photogrammetry suite was used for both project setup and aerotriangulation, using the Multi-Sensor Triangulation (MST) module.

The color digital images were bridged first as a single block. The B&W IR images were then tied together with the color images using photo control points measured from the aerotriangulated color imagery. Upon successful completion of the aerotriangulation process, the MST software provided the standard deviations of the residuals for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 0.3 meters based on a 95% confidence level for the final adjusted block of all images. An Aerotriangulation Report was written and is on file with other project data within the RSD Project Archive.

The project database consists of project parameters and options, camera calibration data, ground control parameters, adjusted exterior orientation parameters, and positional listing of all measured points. Positional data is referenced to the North American Datum of 1983 (NAD 83).

## **Compilation**

The data compilation phase of the project was initiated by RSD personnel in January 2010. Digital mapping was performed using a DPW in conjunction with the SOCET

SET Feature Extraction module. Feature identification and attribution within the Geographic Cell (GC) were based on image analysis of the digital aerial imagery and information extracted from the appropriate NOAA nautical charts, US Coast Guard Light List and other ancillary sources. Feature attribution was assigned in compliance with the Coastal Cartographic Object Attribute Source Table (C-COAST), which provided the definition and attribution scheme for the full range of cartographic features pertinent to the CMP. Selected features were further modified with additional descriptive information to refine general classification.

Spatial data accuracies for Project VI0801 were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 0.6 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is derived by doubling the circular error computed from the aerotriangulation statistics.

The following table provides information on the digital imagery used in the project completion:

Date	Time (UTC)	Roll Number	Photo Numbers	GSD (nominal)	Tide Level*
4-09-08	17:50-17:51	08NC03	150001_0489 - 150001_0499	0.35 m	-0.1 m
4-09-08	17:56-17:58	08NC03	150002_0500 - 150002_0511	0.35 m	-0.1 m
4-09-08	17:50-17:51	08NR02	350001_0120 - 350001_0130	0.35 m	-0.1 m
4-09-08	17:56-17:58	08NR02	350002_0131 - 350002_0142	0.35 m	-0.1 m

\* Tide levels are given in meters above MLLW and are based on actual observations recorded by the NOS gauge at Charlotte Amalie, St. Thomas reference station at the time of photography. The elevation of MHW at Charlotte Amalie is equal to 0.7 meters above MLLW.

## Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of AB. The final QC review was completed in February 2010. The review process included analysis of aerotriangulation results and assessment of the identification and attribution of digital feature data within the GC according to image analysis and criteria defined in C-COAST. The quality control process concluded with an inspection of topological connectivity within the GC using ArcGIS 9.3 software. All project data was evaluated for compliance to CMP requirements.

Comparisons of the largest scale NOAA nautical charts with the imagery and compiled project data resulted in creation of the Chart Evaluation File (CEF). The following nautical chart was used in the comparison process:

25649, St. Thomas Harbor, West Indies, 1:10,000 scale, 19<sup>th</sup> Ed.

## **End Products and Deliverables**

The following specifies the location and identification of the products generated during the completion of this project:

### **RSD Applications Branch Archive**

- Hardcopy of the Airborne Positioning and Orientation Report (APOR)
- Hardcopy of the Aerotriangulation Report
- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of GC10799 file contents, attached to PCR

### **Remote Sensing Division Electronic Data Library**

- Project database
- GC10799 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File in shapefile format

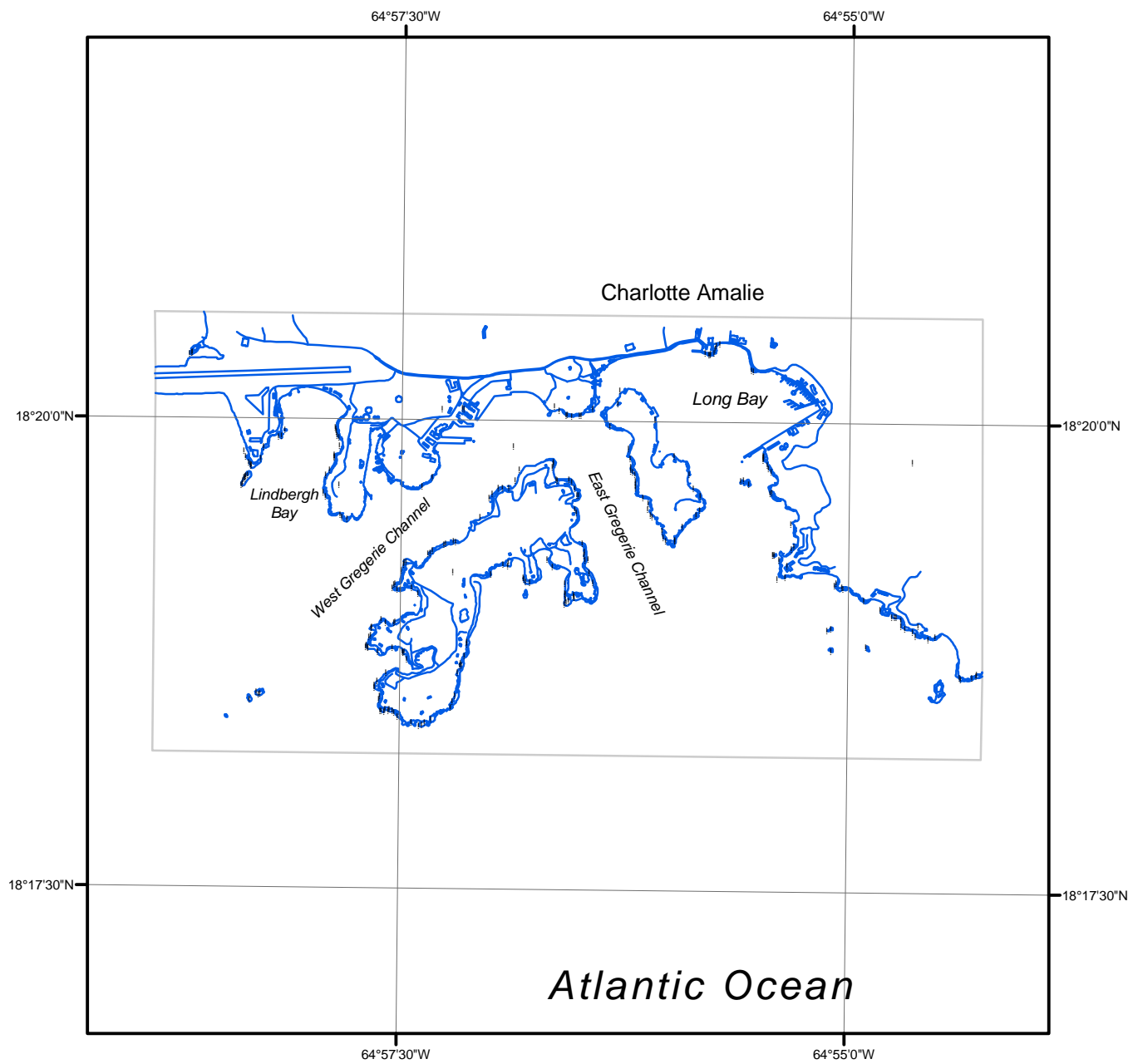
### **NOAA Shoreline Data Explorer**

- GC10799 in shapefile format
- Metadata file for GC10799
- Digital copy of the PCR in Adobe PDF format

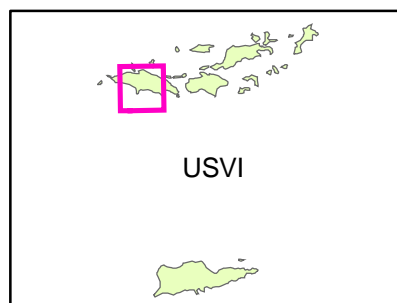
## **End of Report**

# ST. THOMAS HARBOR

## U.S. VIRGIN ISLANDS



Overview



VI0801

GC10799