NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT PR1503-CS-N

Roosevelt Roads, Puerto Rico

Introduction

NOAA Coastal Mapping Program (CMP) Project PR1503-CS-N provides highly accurate digital shoreline data for Roosevelt Roads, in Puerto Rico. The Geographic Cell (GC) may be used in support of the NOAA Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

Project Design

The design of Project PR1503-CS-N was accomplished by the Requirements Branch (RB) of the Remote Sensing Division (RSD) in response to the need for timely updates to the NOAA nautical chart suite within key U.S. port areas. Project requirements were 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 to ascertain the need for more current shoreline data. Aerial photography was utilized for the CSCAP analysis, and a recommendation for full recompilation was made. Refer to the CSCAP memorandum of July 14, 2016 for details of the chart comparison process.

Field Operations

Field operations for PR1503-CS-N consisted of the collection of static and kinematic GPS data and Inertial Measurement Unit (IMU) data, and the acquisition of digital aerial imagery. Aerial survey operations, conducted in March 2016 with the NOAA King Air aircraft (N68RF), consisted of the acquisition of three flight lines of natural color and near-infrared (NIR) imagery using an Applanix DSS dual camera system. All imagery was acquired at a nominal altitude of 7,500 feet, resulting in an approximate ground sample distance (GSD) of 0.24 meters. Imagery was not acquired in strict coordination with local tides, though the goal was to collect all imagery below the Mean High Water (MHW) tide stage. The NIR imagery was not used for this project.

Direct Georeferencing Data Processing

The GPS/IMU data were processed by RSD personnel to yield precise camera positions and orientations for direct geo-referencing (DG) of the imagery. A local GPS base station was established for use as a reference station for kinematic GPS processing operations. The position of the base station was determined using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. Airborne kinematic data was processed using Applanix POSPac (ver. 7.1) software in April 2016. For further information refer to the Airborne Positioning and Orientation Reports (APOR) on file with other project data within the RSD Electronic Data Library.

The processed GPS/IMU data were used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. The predicted horizontal accuracy of the imagery was determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using the Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level for all project imagery was calculated to be 0.6 meters. NGS third order geodetic control points were used to verify the horizontal integrity of the DG data. All stereo models were examined and found to have acceptable levels of parallax for mapping purposes.

Compilation

The data compilation phase of this project was accomplished by RSD Applications Branch (AB) personnel in April 2017. Digital mapping was performed using the Feature Extraction software module within SOCET SET (ver. 5.6). Feature identification and attribution within the GC were based on image analysis of the aerial imagery and information extracted from the largest scale NOAA nautical charts and other ancillary sources. Feature attribution was assigned in compliance with the Coastal Cartographic Object Attribute Source Table (C-COAST), which provides 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 PR1503-CS-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 1.2 meters. This predicted accuracy of compiled well-defined points is derived by doubling the horizontal uncertainty calculated from the EO-TPU tool.

The following table provides information on the imagery used to complete this project:

Date	Time (UTC)	Roll	Strip / Images	Tide Level*
03/05/2016	13:16 – 13:18	16VC26	38-001 / 07090 – 07100	0.3 m
03/05/2016	13:22 – 13:24	16VC26	38-002 / 07101 – 07112	0.3 m
03/05/2016	13:28 – 13:30	16VC26	38-003 / 07113 – 07123	0.3 m

* Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at the time of photography from various NOS gauges in the vicinity of the project. The elevation of the MHW tidal datum in the project area varies between 0.26 – 0.34 m. above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of RSD. The final QC review was completed in April 2017. The review process included analysis of the DG 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 10.4 software. All project data was evaluated for compliance to CMP requirements.

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

- 25666, Ensenada Honda, 1:10,000, 18th Ed., Jul. 2006
- 25664, Pasaje de Vieques and Radas Roosevelt, 1:25,000, 18th Ed., Mar. 2014

End Products and Deliverables

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

Remote Sensing Division Electronic Data Library

- Project database
- Airborne Positioning and Orientation Report (APOR)
- GC11310 in shapefile format
- Project Completion Report (PCR)
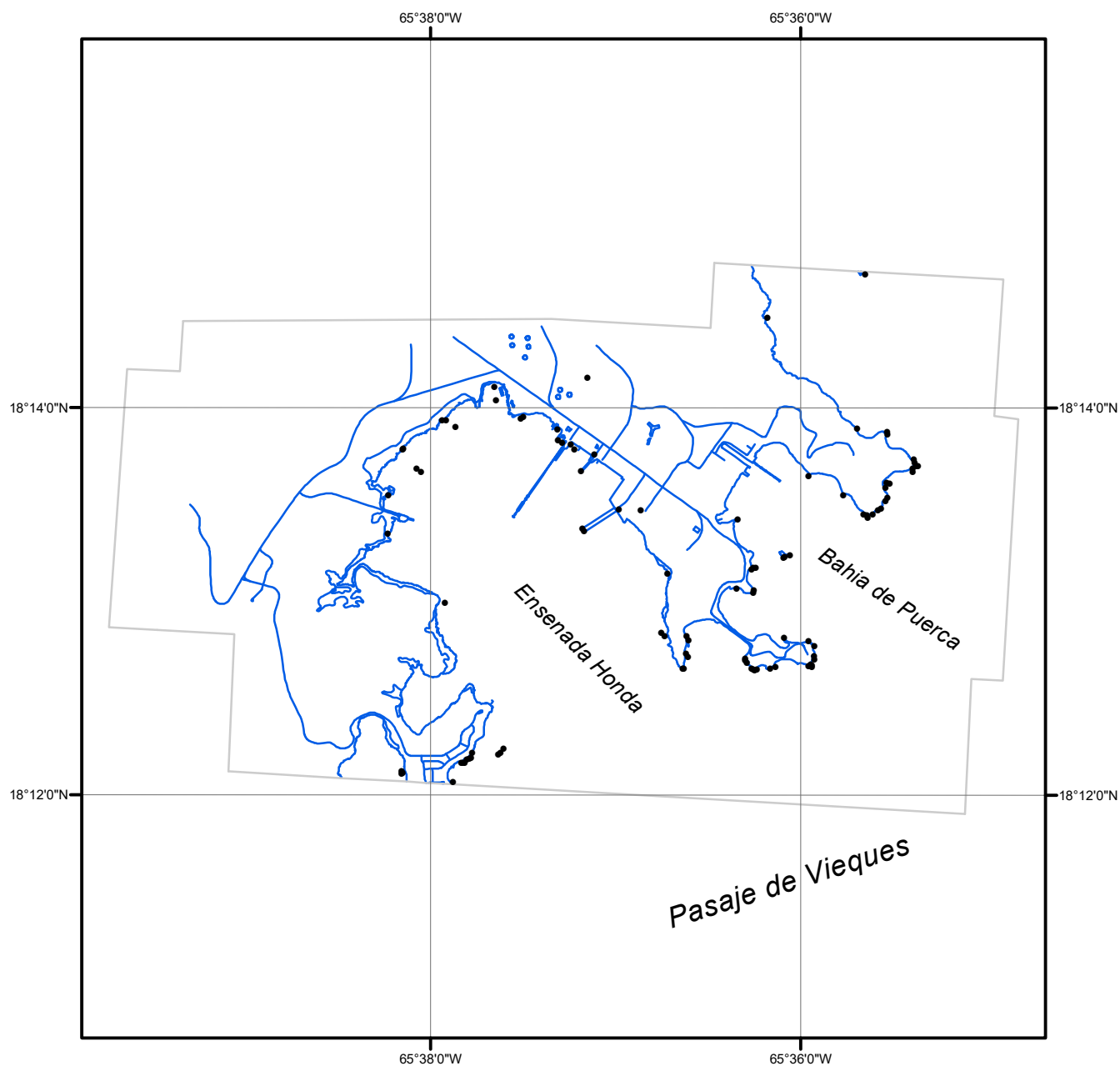- CEF in shapefile format

NOAA Shoreline Data Explorer

- GC11310 in shapefile format
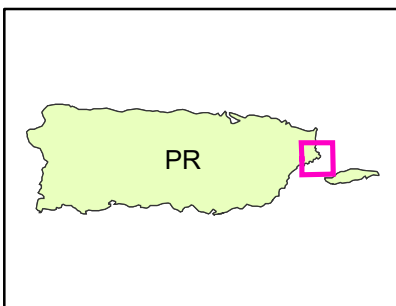- Metadata file for GC11310
- PCR in Adobe PDF format

End of Report

ROOSEVELT ROADS

PUERTO RICO

65°38'0"W 65°36'0"W

18°14'0"N 18°14'0"N

Ensenada Honda

Bahia de Puerca

18°12'0"N 18°12'0"N

Pasaje de Vieques

65°38'0"W 65°36'0"W

Overview

PR

PR1503-CS-N

GC11310