NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT MI1602-CS-N

Port of Monroe, Michigan

Introduction

NOAA Coastal Mapping Program (CMP) Project MI1602-CS-N provides highly accurate digital shoreline data for key areas of change within the Port of Monroe, Michigan. 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

This project was designed and planned by the Requirements Branch (RB) of the Remote Sensing Division (RSD) in response to the need for timely updates to the NOAA chart suite within key U.S. ports. 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 digital imagery in order to ascertain the need for current shoreline data. A Chart Evaluation File (CEF) was forwarded to the Applications Branch (AB) of RSD once the change analysis was complete. Refer to the CSCAP memorandum of March 10, 2017 for details of the chart comparison process.

Field Operations

The field operations consisted of the collection of static and kinematic Global Positioning System (GPS) data and Inertial Measurement Unit (IMU) data and the acquisition of aerial imagery. Three strips of natural color and near-infrared imagery were acquired concurrently on November 12, 2016 with the NOAA King Air aircraft using an Applanix Digital Sensor System (DSS 580/560) dual camera. Of the 144 images acquired, only 26 color images were used. The imagery was flown at a nominal altitude of 10,500 feet resulting in an approximate ground sample distance (GSD) of 0.33 meters.

Direct Georeferencing Data Processing

GPS/IMU data were processed by RSD personnel to yield precise camera positions and orientations for direct georeferencing (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. The airborne kinematic data was processed using Applanix POSPAC MMS (v. 7.1) software in December 2016. For further information refer to the Airborne Positioning and Orientation Report (APOR) that is 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 an Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 0.9 meters.

Compilation

The data compilation phase of this project was accomplished by a member of RSD in August 2018. Digital feature data was compiled monoscopically using Esri's ArcGIS desktop GIS software (v. 10.5.1) using orthoimages produced from the project imagery. Feature identification and attribution within the GC were based on analysis of the project imagery and information extracted from 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.

Spatial data accuracies for Project MI1602-CS-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 1.8 meters at the 95% confidence level. This predicted accuracy of compiled well-defined points is derived by doubling the horizontal uncertainty calculated using the EO-TPU tool.

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

Date	Time (UTC)	Roll #	Photo #s	Lake Level*
11-12-2016	16:24 – 16:26	16VC90	64-001 / 20937 – 20945	174.3 m
11-12-2016	16:37 – 16:38	16VC90	64-003 / 20960 – 20967	174.3 m
11-12-2016	16:48 – 16:50	16VC90	64-002 / 20994 – 21002	174.3 m

* Lake water levels are given in meters above IGLD 1985 and are based on verified observations at the Fermi Power Plant station, Michigan. The Low Water Datum (LWD) for Lake Erie is 173.5 meters above IGLD 1985.

Quality Control / Final Review

The final review of the project was completed by a senior member of RSD in December 2018, and included analysis of 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 (v. 10.5.1). All project data was evaluated for compliance to CMP requirements.

End Products and Deliverables

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

Remote Sensing Division Electronic Data Library

- CSCAP evaluation memorandum
- Project database
- Airborne Positioning and Orientation Report (APOR)
- Project Completion Report (PCR)
- GC11443 in shapefile format
- CEF in shapefile format

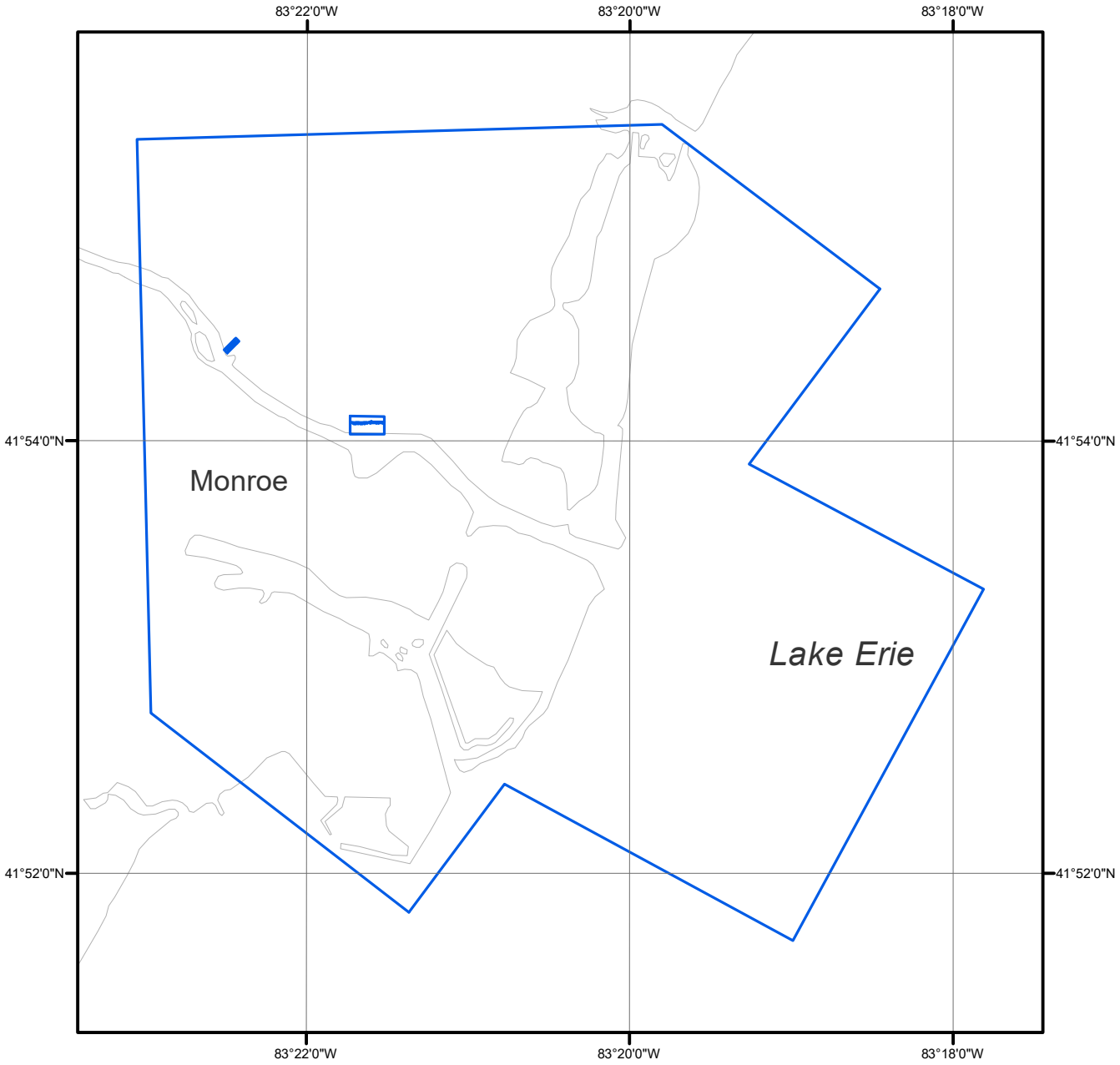
NOAA Shoreline Data Explorer

- GC11443 in shapefile format
- Metadata file for GC11443
- PCR in Adobe PDF format

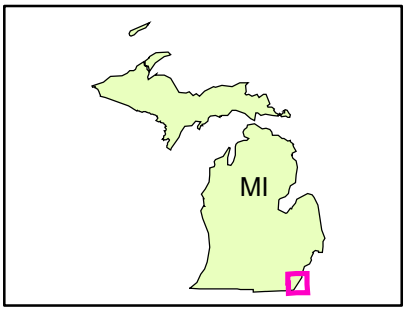
End of Report

PORT OF MONROE

MICHIGAN



Overview



MI1602-CS-N

GC11443