

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

## ***PROJECT MA1101E-CM-N***

### ***Cape Cod Bay, Manomet Point to Scorton Neck, Massachusetts***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project MA1101E-CM-N provides a highly accurate database of new digital shoreline data in Cape Cod Bay, Massachusetts, extending from Manomet Point to Scorton Neck. Project MA1101E-CM-N is a subproject of a larger project, MA1101-CM-N, which covers Cape Cod and Cape Cod Bay. 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**

Photographic mission instructions for MA1101-CM-N were formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) following the guidelines of the Photo Mission Standard Operating Procedures. The instructions discussed the project's purpose, geographic area of coverage, scope and priority, image requirements, Global Positioning System (GPS) data collection procedures and guidelines, instructions for data recording and handling, and mission communication protocols. RB created a Project Layout Diagram, flight maps and input files for the aircraft flight management system.

#### **Field Operations**

The field operations 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 for Project MA1101-CM-N were conducted from June 2011 through October 2014 with the NOAA King Air aircraft (N68RF). Project imagery used for sub-project MA1101E-CM-N included portions of six flight lines of natural color (RGB) and near-infrared (NIR) imagery acquired concurrently using an Applanix DSS-439 dual head digital camera system. The imagery was collected in coordination with both the Mean High Water (MHW) and Mean Lower Low Water (MLLW) tide stages. All imagery was acquired at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 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. Airborne kinematic data for subproject MA1101E-CM-N was processed using Applanix POSPAC (ver. 5.3) software in July 2011, Applanix POSPAC (ver. 5.4) software in October 2011, Applanix POSPAC MMS (ver. 6.1) software in August 2012, and Applanix POSPAC MMS (ver. 6.2) software in August

2013 and October-November 2014. 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 calculated using an Exterior Orientation Total Propagated Uncertainty (EO-TPU ver. 2.1) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 1.4 meters.

## Compilation

The data compilation phase of this project was completed by RSD Applications Branch (AB) personnel in February 2019. 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 MA1101E-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 2.8 meters. This predicted accuracy of well-defined points measured during the compilation phase was derived by doubling the imagery accuracy computed from the EO-TPU tool.

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

Date	Time (UTC)	Flight Line	Color Imagery		Infrared Imagery		Tide Level*
			Roll	Images	Roll	Images	
6/16/2011	18:07 – 18:10	50-007	11NC39	07728 – 07753	11NR21	04697 – 04722	2.8 m
6/16/2011	18:15 – 18:16	50-009	11NC39	07754 – 07765	11NR21	04723 – 04734	2.7 m
9/30/2011	15:53 – 15:56	50-008	11NC67	21608 – 21632	11NR37	12153 – 12177	2.7 m
7/21/2012	18:01 – 18:03	50-033	12NC48	12578 – 12592	12NR34	08015 – 08029	3.0 m
7/21/2012	18:25 – 18:26	50-032	12NC48	12650 – 12658	12NR34	08087 – 08095	2.9 m
7/18/2013	18:14 – 18:16	50-033	13NC42	09694 – 09708	13NR37	08369 – 08383	0.3 – 0.4 m
7/20/2013	19:15 – 19:16	50-032	13NC44	09845 – 09853	13NR39	08520 – 08528	0.1 m
7/20/2013	19:22 – 19:23	50-009	13NC44	09854 – 09865	13NR39	08529 – 08540	0.1 m
4/25/2014	18:16 – 18:20	50-007	14NC38	08597 – 08624	14NR31	05677 – 05704	0.2 – 0.3 m
4/25/2014	18:25 – 18:29	50-008	14NC38	08625 – 08653	14NR31	05705 – 05733	0.2 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 NOS gauges. The height of the MHW tidal datum in the project area varies between 2.94 – 2.99 meters above MLLW.

## **Quality Control / Final Review**

Quality control tasks were conducted during all phases of project completion by a member of AB. The final QC review was completed in February 2019. 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 (ver. 10.5.1) 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:

- 13229, 34<sup>th</sup> Ed., Nov. 2018
- 13236, 32<sup>nd</sup> Ed., Feb. 2017
- 13246, 40<sup>th</sup> Ed., Oct. 2013

## **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 Reports
- GC11462 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

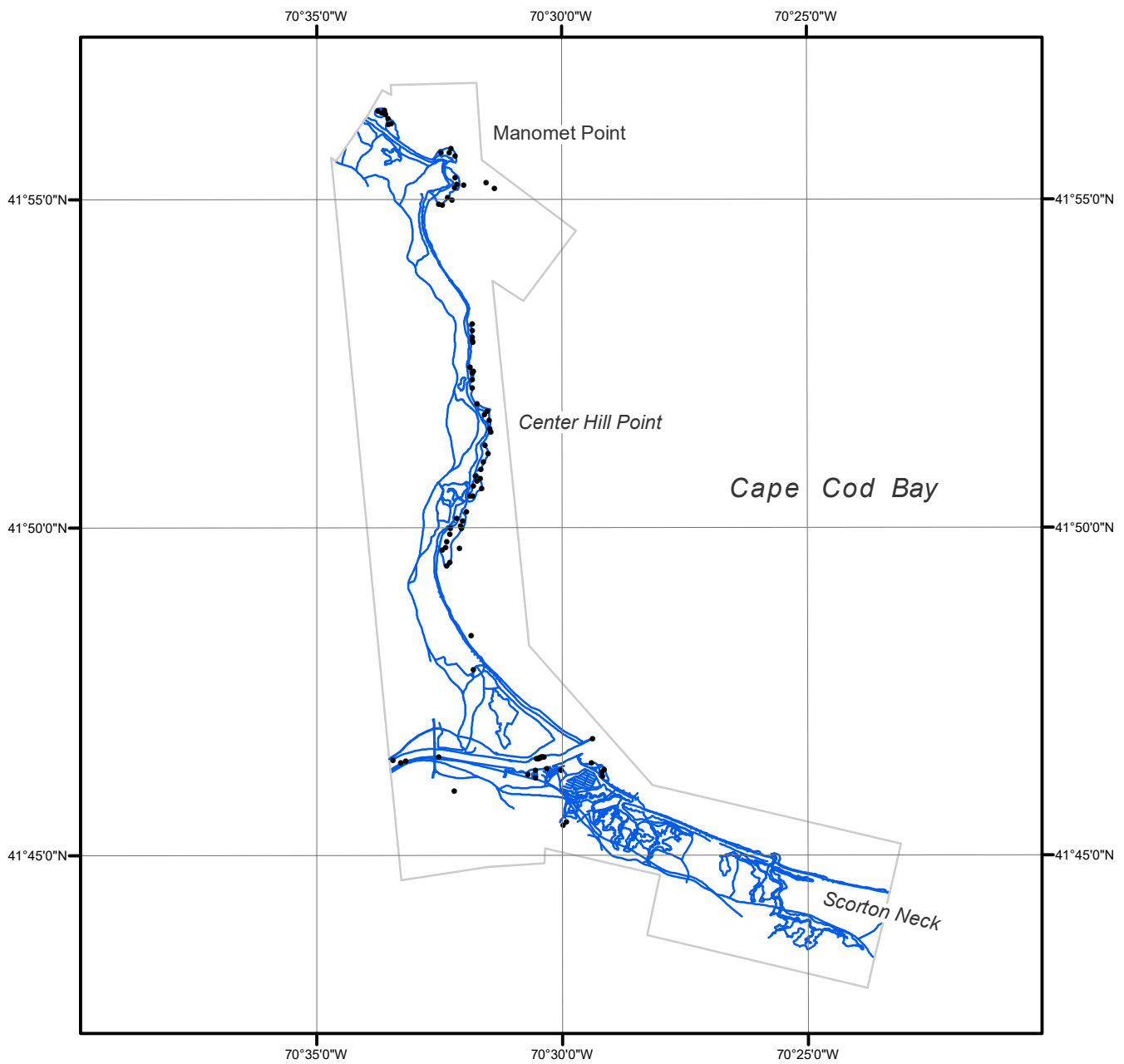
### **NOAA Shoreline Data Explorer**

- GC11462 in shapefile format
- Metadata file for GC11462
- PCR in Adobe PDF format

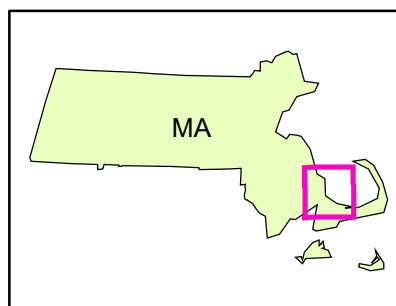
## **End of Report**

# CAPE COD BAY, MANOMET POINT TO SCORTON NECK

## MASSACHUSETTS



Overview



MA1101E-CM-N

GC11462