

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT MA1101F-CM-N

Hyannis Harbor, Massachusetts

Introduction

NOAA Coastal Mapping Program (CMP) Project MA1101F-CM-N provides highly accurate digital shoreline data for Hyannis Harbor, Massachusetts. Project MA1101F-CM-N is a sub-project of a larger project MA1101-CM-N, 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

Project MA1101F-CM-N was designed in response to multiple requests for shoreline data from NOAA's Office of Coast Survey (OCS). Photographic mission instructions formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) followed the guidelines of the Photo Mission Standard Operating Procedures, and included the project's purpose, geographic coverage, image requirements, Global Positioning System (GPS) data collection procedures, data recording/handling instructions, and mission communication protocols. Flight maps and input files for the aircraft flight management system were also created by RB.

As a result of the requests from OCS, newer commercial satellite imagery was obtained to supplement the aerial imagery. One pan-sharpened color GeoEye-1 image from Digital Globe, Inc. was obtained in order to ensure the latest possible delineations of harbor infrastructure.

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, and included color and near-infrared (NIR) imagery flown concurrently with an Applanix DSS-439 dual camera system in coordination with both MHW and MLLW tide levels. A subset of sixteen images were used in sub-project MA1101F-CM-N. All imagery was flown 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 MA1101F-CM-N was processed in July 2011 and October 2014 using POSPac

GPS/IMU processing software. For further details, refer to the Airborne Positioning and Orientation Reports (APORs) on file in 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 was calculated to be 1.2 meters. NGS third order geodetic control was used to test the horizontal integrity of the DG data.

Compilation

Data compilation was accomplished by RSD Applications Branch (AB) personnel in May 2019. Digital mapping was conducted using the Feature Extraction module within the SOCET SET (ver. 5.6) photogrammetric software suite. Feature identification and attribution were based on image analysis of the aerial imagery and information 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 given additional descriptive information in order to refine general classification.

Upon completion of feature compilation from the aerial imagery, the GeoEye satellite image was spatially adjusted to align with the newly compiled GC using the Georeferencing tool with Esri's ArcGIS desktop software (ver. 10.6.1). The satellite image was then used to verify that all features in the GC were current to the later imagery, with a very limited number of features compiled in addition.

Spatial data accuracies for project MA1101F-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 2.4 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:

Aerial Imagery						
Date	Time (UTC)	Color Imagery		NIR Imagery		Tide Level*
		Roll	Strip/Images	Roll	Strip/Images	
06/16/2011	15:33 – 15:34	11NC38	50-022/7531-7534	11NR20	50-022/4500-4503	1.0
09/05/2014	18:52 – 18:53	14NC77	50-022/18268-18271	14NR67	50-022/14951-14954	0.1
Satellite Imagery						
Date	Time (GMT)	Source File ID (Tile)			Resolution	Tide Level
05-11-2018	15:29	20180511_GE01_ORI_R1C1_NAD83.jp2			0.45 m	n/a

* 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 is 1.05 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted by senior AB personnel. The final QC review was completed in May 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 software. All project data was evaluated for compliance to CMP requirements.

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

- 13229, South Coast of Cape Cod and Buzzards Bay, 34th Ed., Nov. 2018

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
- GC11509 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

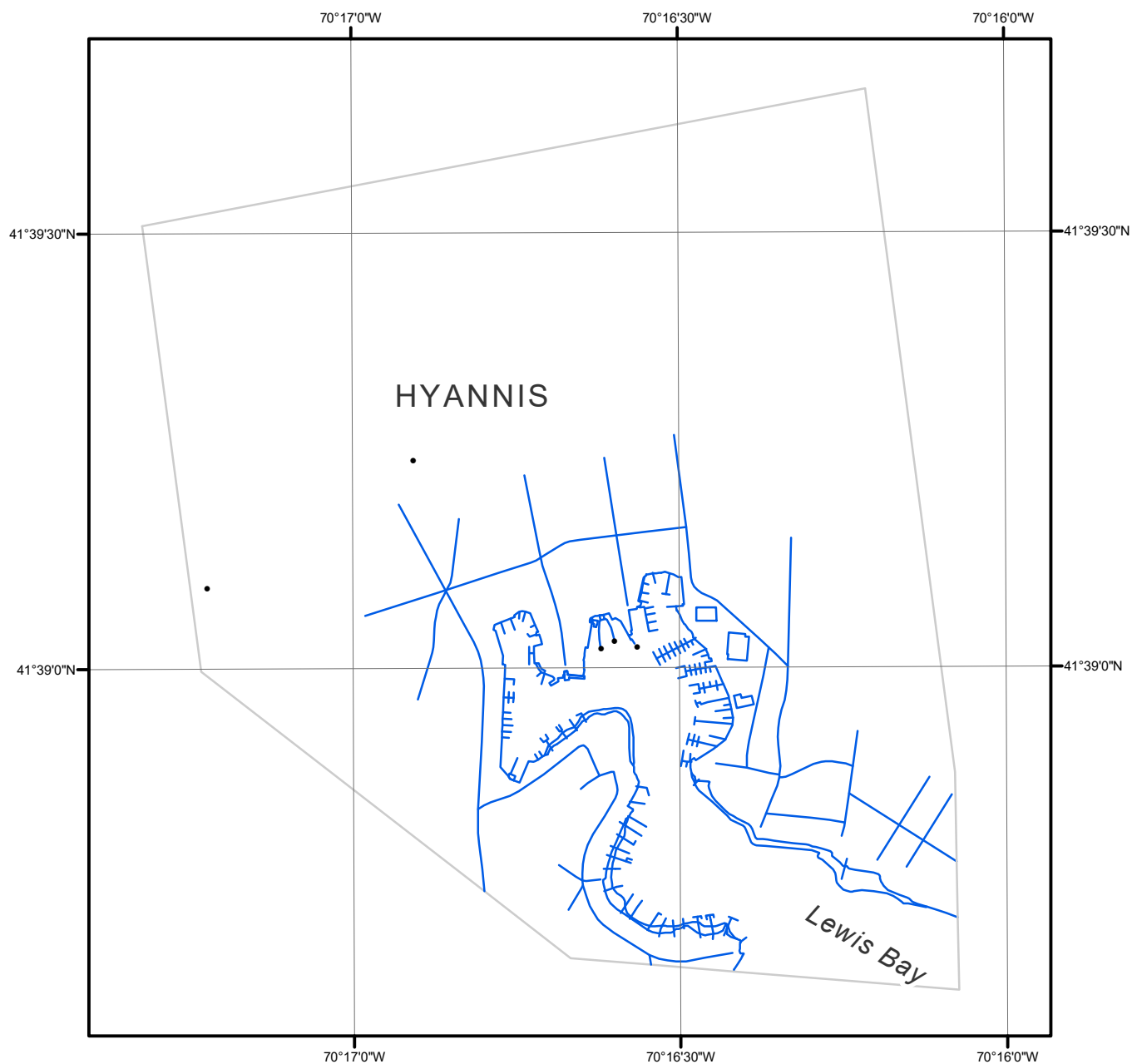
NOAA Shoreline Data Explorer

- GC11509 in shapefile format
- Metadata file for GC11509
- PCR in Adobe PDF format

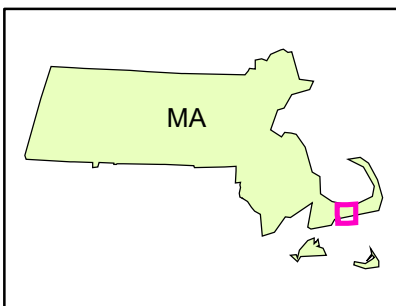
End of Report

HYANNIS HARBOR

MASSACHUSETTS



Overview



MA1101F-CM-N

GC11509