

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

## ***PROJECT FL1601B-CM-N***

### ***Caloosahatchee River to Fort Myers, Florida***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project FL1601B-CM-N provides highly accurate digital shoreline data for an area centering on the Caloosahatchee River from its mouth at San Carlos Bay to Fort Myers, in Florida, including the extensive Cape Coral canal system. Project FL1601B-CM-N is a subset of a larger project, FL1601-CU-N, covering a portion of the Gulf of Mexico coastline from South Venice to Marco Island. 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 Requirements Branch (RB) of the Remote Sensing Division (RSD) originally designed Project FL1601-CU-N to support the Continually Updated Shoreline Product (CUSP), a seamless database of high resolution shoreline data. RB formulated the photographic mission instructions for this project following the guidelines of the Photo Mission Standard Operating Procedures, discussing the project's purpose, 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 also created a Project Layout Diagram, flight maps and input files for the aircraft flight management system.

Subsequent to image acquisition for FL1601-CU-N, the project was extended using commercial satellite imagery in response to a request for coverage of the Cape Coral canal system from the Marine Chart Division (MCD) of the Office of Coast Survey, NOAA. Two orthorectified natural color WorldView images from DigitalGlobe, Inc. were obtained for this purpose.

#### **Field Operations**

The field operations for Project FL1601-CU-N consisted of the collection of static and kinematic GPS data, Inertial Measurement Unit (IMU) data, and the acquisition of aerial imagery. The tide coordinated photographic mission operations were conducted on February 11-13, 2016 for Mean High Water (MHW) imagery with the NOAA King Air (N68RF) aircraft. Project imagery for subproject FL1601B-CM-N included five flight lines of natural color imagery acquired using an Applanix DSS-580/560 dual camera system at a nominal altitude of 10,500 feet, resulting in an approximate ground sample distance (GSD) of 0.33 meters. Near-infrared imagery was also collected concurrently with the color images but was not used for this project.

#### **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 (ver. 7.1) software from May-June 2016. For further information refer to the Airborne Positioning and Orientation Reports (APORs) on file with other project data 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 for imagery used in this subproject was calculated to be 0.90 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. Positional data is referenced to the North American Datum of 1983 (NAD 83).

### **Satellite Imagery Georeferencing**

Of the two satellite images obtained, only one of them required additional georeferencing tasks to improve positioning. This work was accomplished by a member of RSD's Applications Branch (AB), using the Georeferencing tool within Esri's ArcGIS (ver. 10.5) desktop GIS software. Control/check points were extracted from the aerial images used for FL1601B-CM-N to perform georeferencing and to assess satellite imagery accuracy. The RMS of the residuals for measured check points was used to compute a horizontal accuracy at the 95% confidence level of 0.7 meters for both images. This value was doubled and added to the accuracy of the source from which check points were obtained in order to conservatively predict the accuracy of well-defined points measured during the compilation process from this imagery.

### **Compilation**

Feature data compilation was accomplished by a member of AB from April to August 2017. Features were extracted from aerial imagery using the Feature Extraction module within BAE's SOCET SET (ver. 5.6) software, and from the satellite imagery using ArcGIS. Feature identification and the assignment of cartographic codes were based on image analysis of the project digital images and information extracted from the appropriate NOAA Nautical Charts, U.S. 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 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 FL1601B-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Features within this project extracted from aerial imagery were compiled to meet a horizontal accuracy of 1.8 meters at the 95% confidence level, a predicted accuracy derived by doubling the horizontal uncertainty calculated from the EO-TPU tool. Features extracted from satellite imagery were tested to have a horizontal

accuracy of 3.2 meters, at the 95% confidence level, by comparing a minimum of twenty (20) check points to an independent source of higher accuracy. The table below provides detailed information on all of the imagery used for feature compilation.

<b>Aerial Images</b>				
<b>Date</b>	<b>Time (GMT)</b>	<b>Roll #</b>	<b>Strip / Photo #s</b>	<b>Tide Level*†</b>
2-11-2016	20:01 – 20:04	16VC15	64-012 / 4193 – 4209	0.7 – 0.5 m
2-11-2016	20:14 – 20:20	16VC15	64-011 / 4210 – 4239	0.6 – 0.4 m
2-11-2016	20:29 – 20:32	16VC15	64-010 / 4257 – 4273	0.5 – 0.6 m
2-12-2016	19:28 – 19:33	16VC16	64-013 / 4677 – 4702	0.2 – 0.6 m
2-12-2016	19:38 – 19:42	16VC16	64-014 / 4704 – 4729	0.6 – 0.2 m
<b>Satellite Images</b>				
<b>Date</b>	<b>Time (GMT)</b>	<b>Resolution</b>	<b>Source File Name (Tile)</b>	<b>Tide Level*‡</b>
1-19-2017	16:34	0.4 m	20170119_1634_WV3_ORI_MOS	0.2 m
1-21-2017	16:32	0.5 m	20170121_1632_WV2_ORI_MOS	0.3 m

\* Tide levels are given in meters above MLLW. The height of the MHW tidal datum in the project area varies from 0.33 to 0.65 meters above MLLW.

† Tide levels were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at NOS gauges in the project area.

‡ Tide levels are based on observations at NOS Tide Station 8725520, Fort Myers, on the Caloosahatchee River.

## 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 September 2017. Reviews included analysis of the georeferencing results and assessment of the identification and attribution of 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. All project data was evaluated for compliance to CMP requirements.

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

- 11426, Estero Bay to Lemon Bay..., 1:80,000 scale, 39<sup>th</sup> Ed., Nov. 2015
- 11427, ICW, Fort Myers to Charlotte Harbor..., 1:40,000 scale, 37<sup>th</sup> Ed., Sep. 2017

## 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

- Project database
- Airborne Positioning and Orientation Report (APOR)

- GC11313 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

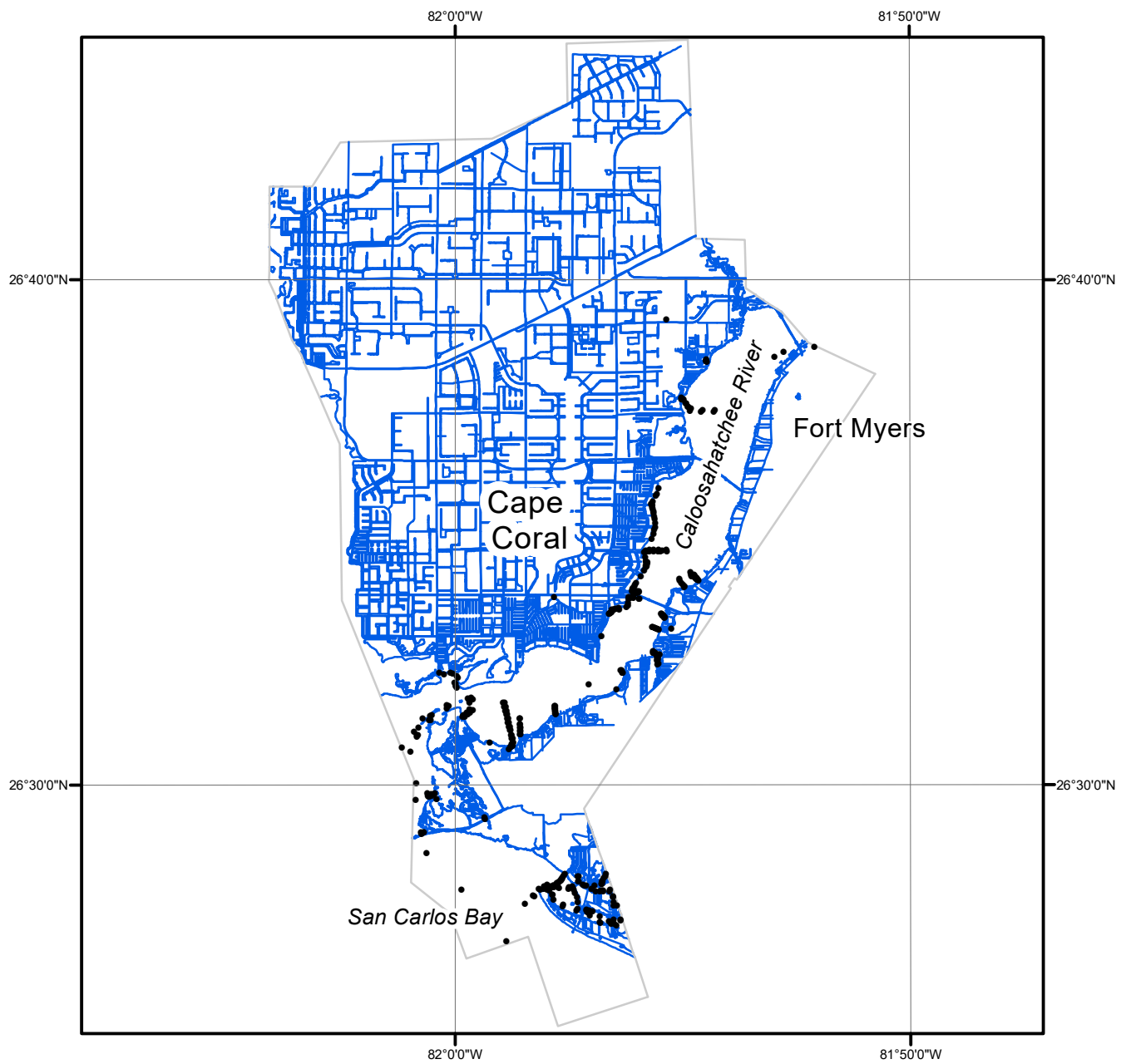
#### **NOAA Shoreline Data Explorer**

- GC11313 in shapefile format
- Metadata file for GC11313
- PCR in Adobe PDF format

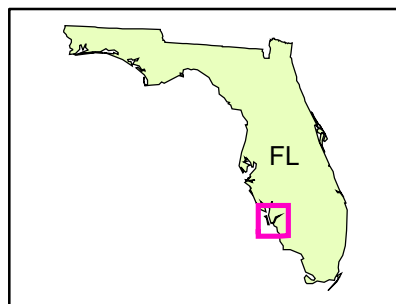
**End of Report**

# CALOOSAHATCHEE RIVER TO FORT MYERS

## FLORIDA



Overview



FL1601B-CM-N

GC11313