

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

## ***PROJECT NY1802C-CM-N***

### ***Hudson River, West Point to George Washington Bridge, New York***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project NY1802C-CM-N provides a highly accurate database of new digital shoreline data for the Hudson River from West Point to the George Washington Bridge, in New York, and is a subproject of a larger acquisition project, NY1802-CM-N, which extends southward along the Hudson River from Troy to Manhattan in New York City. 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 NY1802-CM-N was designed in response to a request for shoreline data from NOAA's Office of Coast Survey. The Requirements Branch (RB) of the Remote Sensing Division (RSD) formulated the photographic mission instructions for this project 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, flight line priority, Global Positioning System (GPS) data collection procedures and guidelines, instructions for data recording and handling, and contact and communication information. RB created a Project Layout Diagram, flight maps and input files for the aircraft flight management system.

#### **Field Operations**

The field operations for the NY1802-CM-N project consisted of the collection of static and kinematic GPS data and Inertial Measurement Unit (IMU) data, the acquisition of digital aerial imagery, followed by ground surveys performed under contract with Fugro Geospatial, Inc.

Aerial survey operations included the acquisition of seventeen flight lines for RGB and NIR imagery at MHW tidal stage. The images were acquired using an Applanix DSS 580/560 dual camera system in 2018. All aerial imagery acquisition was accomplished with NOAA's King Air aircraft (N68RF) flying at an altitude of 10,500 feet. Refer to the NY1802-CM-N Hudson River Data Acquisition Summary report for additional information and specific dates concerning the aerial survey operations.

Fugro was contracted by NGS to perform field operations limited to the surveying of ground control points (GCPs) and check points (CPs). The National Spatial Reference System (NSRS) was used to provide control for the network. As a subcontractor to Fugro, TerraSurv Inc. established 34 photo identifiable control points. Of the 34 collected control points, 27 were successfully located for the RGB, 28 were successfully located for the NIR, and used as ground control in the final block adjustments TerraSurv Inc. surveyed 4 additional points that were used

as check points for both the RGB and NIR blocks. Refer to Fugro's Aerotriangulation Report, NY1802 (A-C) for more information on ground survey operations.

## **GPS Data Processing**

All GPS/IMU data processing tasks were completed by NGS and the final processed data was supplied to Fugro Geospatial, Inc. GPS and IMU data were collected and processed by RSD personnel to yield precise positions and orientations of camera centers as a means of rendering accurately georeferenced digital images. For further information refer to the multiple Airborne Positioning and Orientation Reports (APOR) on file within the RSD Electronic Data Library.

## **Aerotriangulation**

Fugro Geospatial, Inc. performed routine softcopy aerotriangulation methods that were applied to establish the network of precise camera positions and other control for mapping, and to provide model parameters and orientation elements required for digital compilation. The RGB and NIR images were measured and adjusted as two separate blocks. This work was completed in June 2019 using a softcopy photogrammetric workstation. The softcopy system hardware consisted of a high-end Dell Precision Workstation with stereo viewing capability. SOCET SET (ver. 5.6) was used for project setup and the mensuration phase. The adjustment solution phase was accomplished with the ORIMA (ver. 11.01) module.

Upon successful completion of the aerotriangulation process, the overall RMS data for all of the adjusted ground point's standard deviations (both x & y) were used to compute a predicted horizontal circular error, computed at a 95% confidence level, of 0.7 meters for the RGB adjusted block solution and 0.6 meters for the NIR solution.

The project database consists of project parameters and options, camera calibration data, interior orientation parameters, ground control parameters, adjusted exterior orientation parameters, and positional listing of all measured points. Positional data is referenced to the North American Datum of 1983, (NAD83/2011). An Aerotriangulation Report was completed and is on file with other project data within the RSD Electronic Data Library.

## **Compilation**

The compilation for NY1802C-CM-N was done by Fugro, between September and December 2019. Digital mapping was performed using SOCET SET (ver. 5.6) stereo softcopy workstations with the SOCET for ArcGIS module and ArcGIS (ver. 10.3) desktop GIS software. Feature identification and attribution within the GC were based on image analysis of the project imagery and information extracted from the appropriate NOAA nautical charts, US 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.

During compilation it was noted that at the time of acquisition of the project aerial imagery the Tappan Zee Bridge (Governor Mario M. Cuomo Bridge), a feature of particular navigational significance, was under construction and not yet completed. After compilation tasks were

completed two orthorectified commercial satellite images, a panchromatic WorldView-1 image and a pan-sharpened natural color GeoEye-1 image, were obtained in order to provide the final alignment of the bridge. The images were adjusted to match the positioning of existing features in the GC using the Georeferencing tool within Esri's ArcGIS (ver. 10.7.1) desktop GIS software, and a very small portion of the southern span was added to the GC.

Spatial data accuracies for Project NY1802C-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. The cartographic features were compiled to meet a horizontal accuracy of 1.4 meters at the 95% confidence level for features extracted from the RGB imagery and 1.2 meters for features from NIR images. The predicted accuracy of compiled, well defined points is derived by doubling the circular error derived from aerotriangulation statistics.

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	
5/9/2018	12:09 – 12:11	64-006	18VC30	7872-7886	18VR30	7872-7886	1.2
5/9/2018	12:27 – 12:29	64-007	18VC30	7942-7955	18VR30	7942-7955	1.2 - 1.1
5/9/2018	12:33 – 12:35	64-008	18VC30	7956-7969	18VR30	7956-7969	1.1 - 1.2
5/11/2018	12:16 – 12:23	64-003	18VC31	8148-8186	18VR31	8148-8186	1.3
5/11/2018	12:29 – 12:37	64-004	18VC31	8187-8227	18VR31	8187-8227	1.3
5/11/2018	12:42 – 12:50	64-005	18VC31	8228-8268	18VR31	8228-8268	1.2 - 1.3
8/25/2018	13:23 – 13:27	64-001	18VC46	10059-10082	18VR46	10060-10083	1.2 - 1.3
8/25/2018	13:32 – 13:36	64-002	18VC46	10083-10103	18VR46	10084-10104	1.2 - 1.3
8/26/2018	13:01 – 13:02	64-002	18VC47	10170-10174	18VR47	10171-10175	1.3
<b>Satellite Imagery</b>							
<b>Date</b>	<b>Time (UTC)</b>	<b>Source File (Tile) Name</b>				<b>GSD</b>	<b>Tide Level</b>
7/4/2019	18:46	20190704_WV01_ORI_R1C1.jp2				0.5 m	n/a
9/19/2019	16:03	20190919_GE1_ORI_R1C1.jp2				0.46 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 varies between 1.29 – 1.32 meters above MLLW.

## Quality Control / Final Review

Quality Control tasks were conducted during all phases of project completion by a senior member of the Fugro Geospatial, Inc. compilation team. The final QC review was completed in December 2019. The review process included analysis of aerotriangulation 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 charts with natural color photographs and compiled project data resulted in creation of the Chart Evaluation File (CEF). The following nautical charts were used in the comparison process:

- 12341, Days Point to George Washington Bridge, 28<sup>th</sup> Ed., May 2011
- 12342, Harlem River, 24<sup>th</sup> Ed., May 2013
- 12343, Hudson River to Wappinger Creek, NY, 20<sup>th</sup> Ed., Mar. 2013
- 12345, Hudson River, George Washington Bridge to Yonkers, 11<sup>th</sup> Ed., Dec. 2010
- 12346, Yonkers to Piermont, 12<sup>th</sup> Ed., Aug. 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**

- Airborne Positioning and Orientation Reports (APOR)
- Ground Control Survey Report
- Aerotriangulation Report
- Project database
- GC11496 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

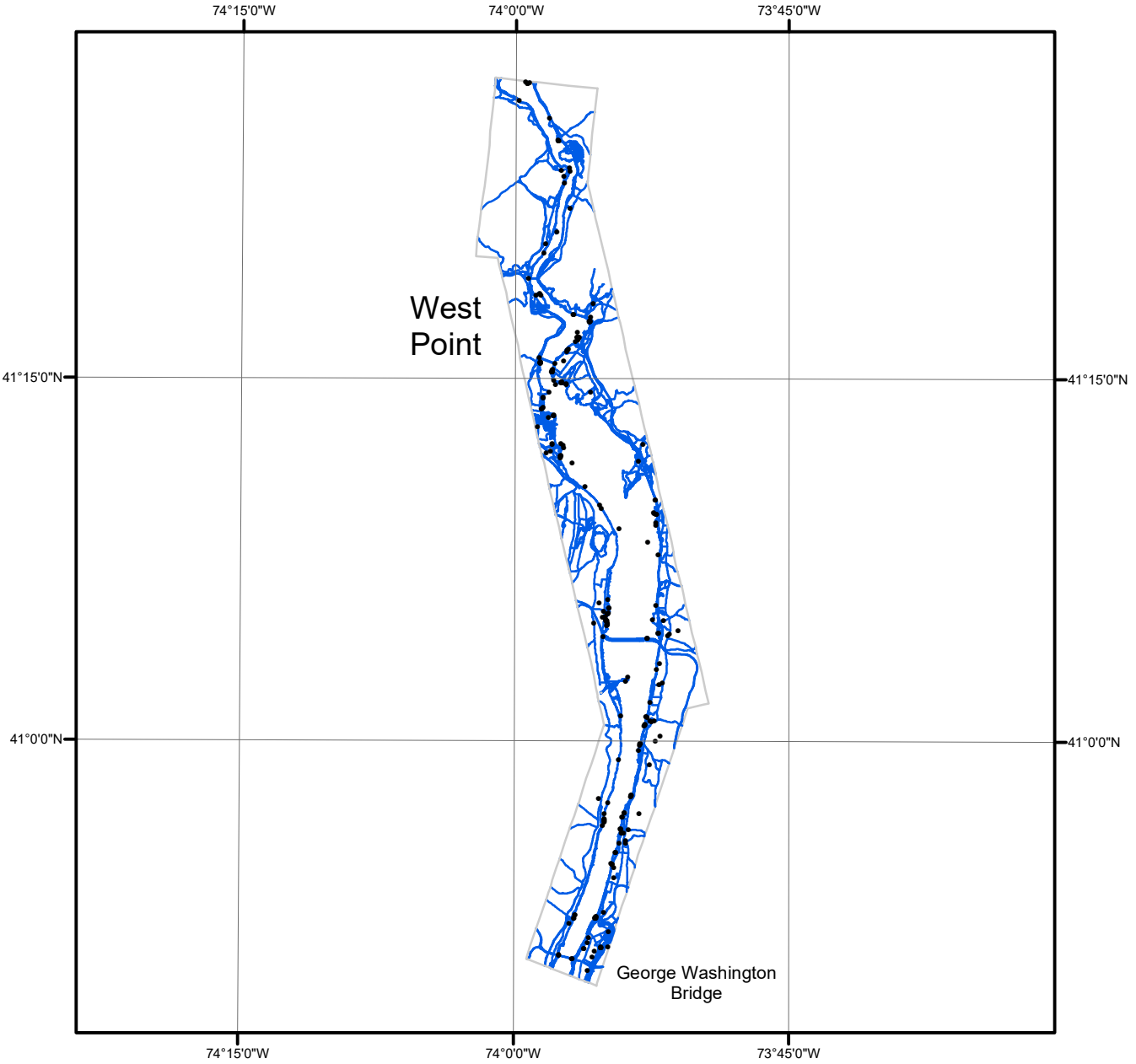
### **NOAA Shoreline Data Explorer**

- GC11496 in shapefile format
- Metadata file for GC11496
- PCR in Adobe PDF format

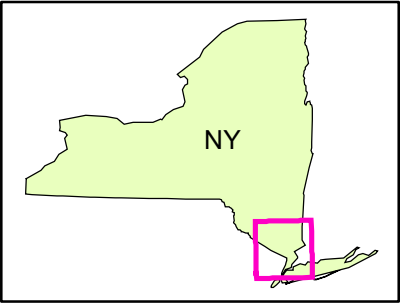
## **End of Report**

# HUDSON RIVER, WEST POINT TO GEORGE WASHINGTON BRIDGE

## NEW YORK



Overview



NY1802C-CM-N

GC11496