

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT WI1001G-CM-N

Head of Green Bay to Peshtigo Point, including Fox River to De Pere, Wisconsin

Introduction

NOAA Coastal Mapping Program (CMP) Project WI1001G-CM-N provides highly accurate digital shoreline data for the western shore of Green Bay, Wisconsin, from the head of Green Bay northward to Peshtigo Point, and includes a portion of the Fox River southward from Green Bay to De Pere. WI1001G-CM-N is a subproject of a larger project, WI1001-CM-N, which covers the western shore of Lake Michigan from Burns International Harbor, Indiana to Little Bay De Noc, 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

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, Global Positioning System (GPS) and Inertial Measurement Unit (IMU) 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.

During a latter stage of project completion, a WorldView-2 commercial satellite image (with an acquisition date of September 26, 2015 and resolution of 0.5 meters) was obtained to patch a small gap in the aerial imagery coverage. The vendor reported accuracy was used to calculate a horizontal circular error of 6.8 meters based on a 95% confidence level.

Field Operations

The field operations consisted of the collection of static and kinematic GPS/IMU data and the acquisition of digital aerial imagery. Aerial survey operations were conducted with the NOAA King Air (N68RF) aircraft from August 6th, 2010 through September 30th, 2010. All imagery was flown at a nominal altitude of 10,000 feet resulting in an approximate ground sample distance (GSD) of 0.35 meters. The overall acquisition project included 151 flight lines of natural color (RGB) and near-infrared (NIR) imagery acquired concurrently using an Applanix DSS-439 dual camera system. Of these, a subset of 22 flight lines was used for sub-project WI1001G-CM-N.

Aerometric, Inc. was contracted by RSD to locate new photo control and check points within the project area. The control points and check points were photo-identifiable features located at

well-defined locations. Refer to the Ground Survey Report for a listing of final coordinates, elevations, descriptions and a site map of the points.

GPS Data Reduction

GPS and IMU data were collected and processed by RSD personnel to yield precise positions and orientations of camera centers for application as photogrammetric control in the aerotriangulation phase of project completion. 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 POSPAC version 5.4.0 GPS and IMU processing software. For further information refer to the Airborne Positioning and Orientation Reports (APOR) that are on file with other project data within the RSD Electronic Data Library.

Aerotriangulation

The aerotriangulation phase was completed by Aerometric, Inc. in February, 2012 using a softcopy photogrammetric system. Routine softcopy aerotriangulation methods 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 auto-measured in two separate sub-blocks using the Zeiss Image Station Automatic Triangulation (ISAT) program. Points were measured manually in weak areas and in models with small land area within the water. The sub-blocks were then merged into one block and all ground-surveyed control points and check points were manually measured. A pattern of tie points was manually measured to tie the RGB and NIR images together. The RGB aerotriangulation was used to obtain computed coordinates for the tie points between the RGB and the NIR and used these points as ground control for the NIR. The root mean square (RMS) of the standard deviations of the residuals for each aerotriangulated ground point were used to compute a predicted horizontal circular error of 0.4 meters based on a 95% confidence level. An Aerotriangulation Report was completed and is on file with other project data within the RSD Electronic Data Library.

The project database consists of project parameters and options, camera calibration data, ground control parameters, adjusted exterior orientation parameters, and a positional listing of all measured points. Positional data is referenced to the North American Datum of 1983 (NAD 83).

Compilation

The data compilation phase of the project was initiated by AeroMetric, Inc. in March, 2012. Digital feature extraction was completed in a softcopy stereo environment using DAT/EM Systems International Summit Evolution software (ver. 5.5), and Bentley Systems MicroStation V8. All coding and classification of features occurred within the MicroStation environment as features were collected, and was based on interpretation of the project imagery, and on information extracted from the appropriate 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 WI1001G-CM-N was determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features compiled from the aerial imagery were compiled to meet a horizontal accuracy of 0.8 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is calculated by doubling the circular error derived from the aerotriangulation statistics.

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

Date	Time (UTC)	Strip	Color Imagery		Infrared Imagery		Lake Level*
			Roll	Images	Roll	Images	
9/9/2010	16:59 – 17:02	50-078	10NC18	7657 – 7674	10NR18	8517 – 8534	176.1
9/9/2010	17:41 – 17:44	50-081	10NC18	7744 – 7760	10NR18	8604 – 8620	176.1
9/9/2010	17:48 – 17:51	50-080	10NC18	7761 – 7777	10NR18	8621 – 8637	176.1
9/9/2010	17:57 – 18:00	50-077	10NC18	7778 – 7807	10NR18	8638 – 8667	176.1
9/10/2010	14:47 – 14:49	50-115	10NC19	7882 – 7892	10NR39	16466 – 16476	176.1
9/10/2010	14:54 – 14:55	50-111	10NC19	7893 – 7903	10NR39	16477 – 16487	176.1
9/10/2010	14:59 – 15:01	50-114	10NC19	7904 – 7918	10NR39	16488 – 16502	176.1
9/10/2010	15:06 – 15:09	50-113	10NC19	7919 – 7934	10NR39	16503 – 16518	176.1
9/12/2010	14:22 – 14:26	50-076	10NC20	8025 – 8052	10NR19	8762 – 8790	176.1
9/12/2010	14:31 – 14:35	50-079	10NC20	8053 – 8080	10NR19	8791 – 8818	176.1
9/12/2010	14:43 – 14:49	50-082	10NC20	8102 – 8144	10NR19	8840 – 8882	176.1
9/12/2010	14:54 – 14:56	50-116	10NC20	8145 – 8157	10NR19	8883 – 8895	176.1
9/12/2010	15:01 – 15:11	50-084	10NC20	8158 – 8223	10NR19	8896 – 8961	176.1
9/12/2010	15:16 – 15:30	50-083	10NC20	8224 – 8318	10NR19	8962 – 9056	176.1
9/13/2010	13:52 – 13:55	50-110	10NC26	11008 – 11025	10NR20	10007 – 10024	176.0
9/13/2010	13:58 – 14:01	50-124	10NC26	11026 – 11042	10NR20	10025 – 10040	176.0
9/13/2010	14:14 – 14:16	50-123	10NC26	11091 – 11107	10NR20	10091 – 10106	176.0
9/13/2010	14:20 – 14:24	50-112	10NC26	11108 – 11125	10NR20	10107 – 10124	176.0
9/13/2010	14:28 – 14:31	50-119	10NC26	11126 – 11152	10NR20	10125 – 10151	176.0
9/13/2010	14:36 – 14:41	50-118	10NC26	11153 – 11179	10NR20	10152 – 10178	176.0
9/13/2010	14:53 – 14:55	50-100	10NC26	11180 – 11194	10NR20	10179 – 10193	176.0
9/13/2010	15:10 – 15:12	50-101	10NC26	11209 – 11222	10NR20	10194 – 10221	176.0
9/22/2010	16:03 – 16:05	50-117	10NC22	10011 – 10023	10NR15	6309 – 6321	176.2

* Lake levels are given in meters above IGLD and are based on verified observations at the NOS gauge in Green Bay, WI at the time of imagery. The Low Water Datum (LWD) for the portion of Lake Michigan covered by this project is 176.0 meters above IGLD 1985.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of Aerometric, Inc. The final QC review was completed in September 2013. 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 9.3.1 software. All project data was evaluated for compliance to CMP requirements.

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

- 14909, Upper Green Bay, 1:80,000 scale, 21st Ed., Feb. 2016
- 14910, Lower Green Bay, 1:80,000 scale (w/1:20,000 scale inset), 24th Ed., Jun. 2016
- 14916, Lake Winnebago/Lower Fox R. book chart, 1:15,000 scale, 11th Ed., Mar. 2016
- 14918, Head of Green Bay incl. Fox River, 1:25,000 scale (w/1:10,000 scale inset), 28th Ed., Dec. 2015

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

- Ground Survey Report
- Airborne Positioning and Orientation Reports (APOR)
- Aerotriangulation Report
- Project database
- GC10924 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

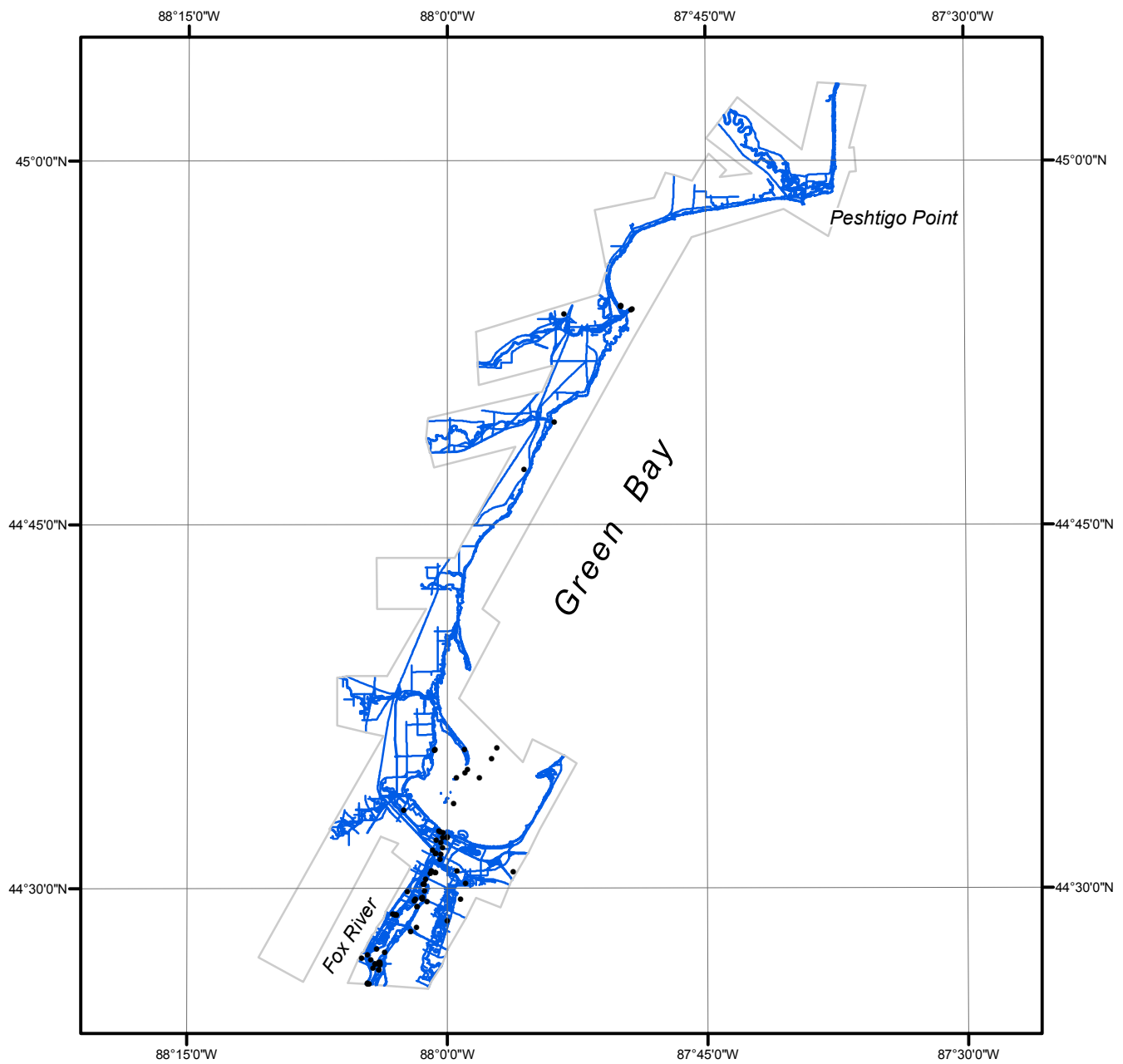
NOAA Shoreline Data Explorer

- GC10924 in shapefile format
- Metadata file for GC10924
- Digital copy of the PCR in Adobe PDF format

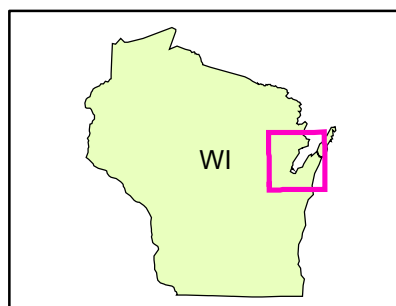
End of Report

HEAD OF GREEN BAY TO PESHTIGO POINT

WISCONSIN



Overview



WI1001G-CM-N

GC10924