

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT WI1001E-CM-N

Door Peninsula, Algoma to Point Sable, Wisconsin

Introduction

NOAA Coastal Mapping Program (CMP) Project WI1001E-CM-N provides a highly accurate database of new digital shoreline data for a portion of Lake Michigan in Wisconsin. The project extends from Algoma to Point Sable along the Door Peninsula and includes several tributaries and small islands in the surrounding area. Project WI1001E-CM-N is a subproject of the larger project WI1001-CM-N, which includes shoreline mapping from Burns Waterway Harbor, at the southern end of Lake Michigan, to Little Bay de Noc, including Green Bay and Door Peninsula. 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 Project Instructions for this project following the guidelines of the “Scope of Work, Shoreline Mapping for the Coastal Mapping Program” (SOW), Version 13B, dated January 2008. The instructions discussed the project’s purpose, geographic area of coverage, scope and priority; data acquisition, processing, accuracy, and compilation requirements; product delivery and reporting instructions; and contact and communication information. RB created a Project Layout Diagram, flight maps and input files for the aircraft’s flight management system.

Field Operations

The field operations consisting of the collection of static and kinematic GPS data and the acquisition of digital aerial imagery was performed by RSD personnel. A total of 151 flight lines were planned to cover the entire project. Of these, 30 flight lines consisting of natural color imagery and black and white infrared (BWIR) imagery were acquired concurrently using an Applanix DSS-439 dual-head camera system for subproject WI1001E-CM-N. Aerial survey operations were conducted with the NOAA King Air (N68RF) aircraft during the period of 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.

Photo Science, Inc. (PSI) was contracted by RSD to locate ten new photo control points and four check points. 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 was 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 between October 2010 and May 2011 using POSPAC version 5.3.0 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

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. This work was completed by PSI personnel in March 2012 using a softcopy photogrammetric system. The color and BWIR images were measured and adjusted as a single block using the Multi-Sensor Triangulation (MST) module within BAE Systems' SOCET SET photogrammetric software suite (version 5.6). BINGO aerotriangulation software was used to perform the final bundle block adjustment. 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 0.5 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 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 PSI personnel in April 2012. The work was accomplished using the Feature Extraction module of SOCET SET on a Digital Photogrammetric Workstation (DPW). 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). Selected features were further modified with additional descriptive information to refine general classification.

Spatial data accuracies for Project WI1001E-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 1.0 meters at the 95% confidence level. This predicted accuracy of well-defined points is based on a doubling of the circular error derived from aerotriangulation statistics.

The following table provides information on aerial photographs used in the project completion:

Date	Time (UTC)	Color Imagery		Infrared Imagery		Water Level*
		Roll	Images	Roll	Images	
9-09-2010	17:02 – 17:03	10NC18	7673 – 7681	10NR18	8533 – 8541	176.1 m
9-09-2010	17:06 – 17:10	10NC18	7682 – 7711	10NR18	8542 – 8571	176.1 m
9-09-2010	17:20 – 17:23	10NC18	7712 – 7730	10NR18	8572 – 8590	176.1 m
9-12-2010	15:38 – 15:45	10NC20	8319 – 8363	10NR19	9057 – 9101	176.2 m
9-12-2010	15:54 – 16:11	10NC20	8364 – 8483	10NR19	9102 – 9221	176.2 m
9-12-2010	16:17 – 16:37	10NC20	8484 – 8624	10NR19	9222 – 9362	176.2 m
9-12-2010	16:47 – 16:55	10NC20	8656 – 8711	10NR19	9394 – 9449	176.2 m
9-12-2010	16:58 – 17:09	10NC20	8712 – 8786	10NR19	9450 – 9524	176.2 m
9-12-2010	17:13 – 17:16	10NC20	8787 – 8807	10NR19	9525 – 9545	176.2 m
9-12-2010	17:20 – 17:23	10NC20	8808 – 8829	10NR19	9546 – 9567	176.2 m
9-12-2010	17:28 – 17:38	10NC20	8830 – 8904	10NR19	9568 – 9642	176.2 m
9-12-2010	17:43 – 17:50	10NC20	8905 – 8952	10NR19	9643 – 9690	176.2 m
9-12-2010	17:55 – 18:02	10NC20	8953 – 8999	10NR19	9691 – 9737	176.2 m
9-12-2010	18:07 – 18:14	10NC20	9000 – 9054	10NR19	9738 – 9792	176.2 m
9-12-2010	18:19 – 18:27	10NC20	9055 – 9109	10NR19	9793 – 9847	176.2 m
9-12-2010	18:32 – 18:36	10NC20	9110 – 9139	10NR19	9848 – 9877	176.1 m
9-12-2010	18:51 – 18:55	10NC20	9140 – 9165	10NR19	9878 – 9903	176.1 m
9-12-2010	18:59 – 19:03	10NC20	9166 – 9188	10NR19	9904 – 9926	176.1 m
9-12-2010	19:08 – 19:09	10NC20	9189 – 9199	10NR19	9927 – 9937	176.1 m
9-12-2010	19:14 – 19:17	10NC20	9200 – 9225	10NR19	9938 – 9963	176.1 m
9-12-2010	19:22 – 19:26	10NC20	9226 – 9252	10NR19	9964 – 9990	176.1 m
9-12-2010	19:30 – 19:32	10NC20	9253 – 9268	10NR19	9991 – 10006	176.1 m
9-13-2010	15:35 – 15:37	10NC26	11264 – 11285	10NR20	10263 – 10284	176.1 m
9-13-2010	15:43 – 15:46	10NC26	11286 – 11307	10NR20	10285 – 10306	176.1 m
9-13-2010	15:51 – 15:54	10NC26	11308 – 11329	10NR20	10307 – 10328	176.1 m
9-13-2010	16:00 – 16:03	10NC26	11330 – 11357	10NR20	10329 – 10356	176.1 m
9-13-2010	16:09 – 16:13	10NC26	11358 – 11386	10NR20	10357 – 10385	176.1 m
9-13-2010	16:18 – 16:25	10NC26	11387 – 11436	10NR20	10386 – 10435	176.1 m
9-13-2010	16:32 – 16:36	10NC26	11437 – 11464	10NR20	10436 – 10463	176.1 m

* Lake water levels are given in meters above IGLD 1985 and are based on verified observations at the Menominee and Sturgeon Bay Canal stations. The Low Water Datum (LWD) for Lake Michigan is 176.0 meters above IGLD 1985.

Quality Control / Final Review

Quality control (QC) tasks were conducted during all phases of project completion by a senior member of PSI. The final QC review was completed in September 2012. 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 10.2.2 software. All project data was evaluated for compliance to CMP requirements.

Comparisons of the largest scale NOAA nautical charts with natural color and BWIR images 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, MI/WI, 1:80,000 scale, 21st Ed., Feb. 2016
- 14910, Lower Green Bay, Algoma and Oconto, WI, 1:80,000 scale, 24th Ed., Jun. 2016
- 14918, Head of Green Bay, WI, 1:25,000 scale, 28th Ed., Dec. 2015
- 14919, Sturgeon Bay and Canal, WI, 1:30,000 scale, 29th 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 Report (APOR)
- Aerotriangulation Report
- Project Database
- GC10928 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

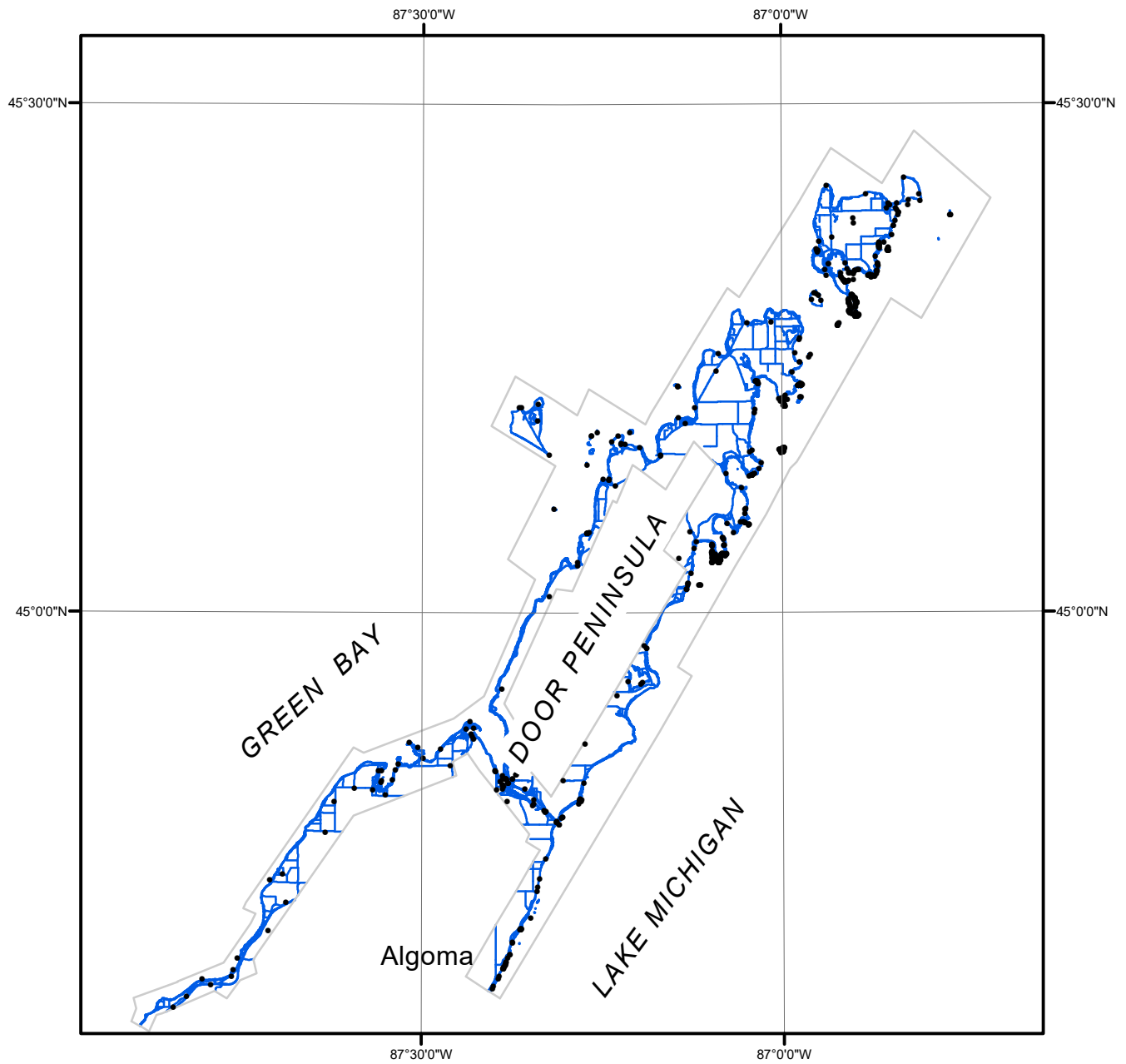
NOAA Shoreline Data Explorer

- GC10928 in shapefile format
- Metadata file for GC10928
- PCR in Adobe PDF format

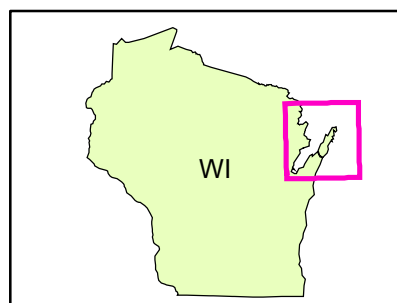
End of Report

DOOR PENINSULA, ALGOMA TO POINT SABLE

WISCONSIN



Overview



WI1001E-CM-N

GC10928