

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT WI1001A-CM-N

Burns International Harbor to Calumet Harbor, Lake Michigan, Indiana and Illinois

Introduction

NOAA Coastal Mapping Program (CMP) Project WI1001A-CM-N provides highly accurate digital shoreline data for a portion of the southern shore of Lake Michigan, from Burns International Harbor, Indiana northwards to Calumet Harbor, Illinois. Also included within the project area are Indiana Harbor and Buffington Harbor. WI1001A-CM-N is a subproject of a larger project, WI1001-CM-N, which extends from Burns International Harbor, Indiana to Little Bay De Noc on the Upper Peninsula in 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.

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 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. The overall acquisition project included 151 flight lines of natural-color imagery and black-and-white infrared (B&W IR) imagery, acquired concurrently using an Applanix DSS-439 dual-head digital camera system. Of these, 14 flight lines (50-008 through 50-020, 50-108) were acquired on September 5 and 7, 2010 and used for sub-project WI1001A-CM-N.

Wilson & Company, 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 Remote Sensing Division Electronic Data Library.

Aerotriangulation

The aerotriangulation of the imagery covering the southern third of project WI1001 (sub-projects A, B, and C) was completed by Wilson & Company, Inc. personnel in March 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 color and B&W IR images were measured and adjusted as a single block using the Multi-Sensor Triangulation (MST) module within BAE SOCET SET (version 5.6.0) software. 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 0.74 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 this project was initiated by Wilson & Company, Inc. in May, 2012. Digital mapping was performed using SOCET for ArcGIS (ver. 9.3) and SOCET SET (ver. 5.5.0) software. Feature identification and attribution within the GC were based on image analysis of the aerial imagery and information extracted from the largest scale 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.

Spatial data accuracies for project WI1001A-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 1.5 meters at the 95% confidence level. This predicted accuracy of compiled well-defined points is derived by doubling the horizontal circular error calculated 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	
9/5/2010	15:10 – 15:14	50-020	10NC16	6117 – 6141	10NR17	7616 – 7640	176.1
9/5/2010	15:19 – 15:23	50-011	10NC16	6142 – 6166	10NR17	7641 – 7665	176.1
9/5/2010	16:30 – 16:33	50-013	10NC16	6294 – 6310	10NR17	7793 – 7809	176.1
9/5/2010	16:37 – 16:40	50-014	10NC16	6311 – 6328	10NR17	7810 – 7827	176.1
9/5/2010	16:45 – 16:48	50-015	10NC16	6329 – 6346	10NR17	7828 – 7845	176.1
9/5/2010	16:53 – 16:58	50-019	10NC16	6348 – 6379	10NR17	7847 – 7878	176.1
9/5/2010	17:02 – 17:06	50-108	10NC16	6380 – 6403	10NR17	7879 – 7902	176.1
9/5/2010	17:34 – 17:39	50-017	10NC16	6456 – 6482	10NR17	7955 – 7981	176.1
9/7/2010	15:04 – 15:09	50-018	10NC17	6526 – 6552	10NR16	6662 – 6688	176.0 – 176.1
9/7/2010	15:13 – 15:17	50-016	10NC17	6553 – 6575	10NR16	6689 – 6711	176.0
9/7/2010	17:04 – 17:07	50-012	10NC17	6827 – 6846	10NR16	6963 – 6982	176.1
9/7/2010	17:14 – 17:17	50-010	10NC17	6847 – 6865	10NR16	6983 – 7001	176.1
9/7/2010	17:23 – 17:31	50-009	10NC17	6866 – 6917	10NR16	7002 – 7053	176.0
9/7/2010	17:41 – 17:49	50-008	10NC17	6918 – 6969	10NR16	7054 – 7105	176.0

* Lake levels are given in meters above IGLD and are based on verified observations at the NOS gauge in Calumet Harbor, IL 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 (QC) tasks were conducted during all phases of project completion by a senior member of Wilson & Company, Inc. The final QC review was completed in July 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 9.3.1 software. All project data was evaluated for compliance to CMP requirements.

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

- 14905, Waukegan to South Haven, 1:120,000 scale (w/1:15,000 scale inset), 31st Ed., Jan/07
- 14926, Chicago & South Shore of Lk Michigan (book chart/various scales), 12th Ed., Oct/10
- 14927, Chicago Lake Front, 1:60,000 scale (w/1:15,000 inset), 25th Ed., Aug/06
- 14929, Calumet and Indiana Harbors, 1:15,000 scale, 25th Ed., Dec/10

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
- GC10911 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

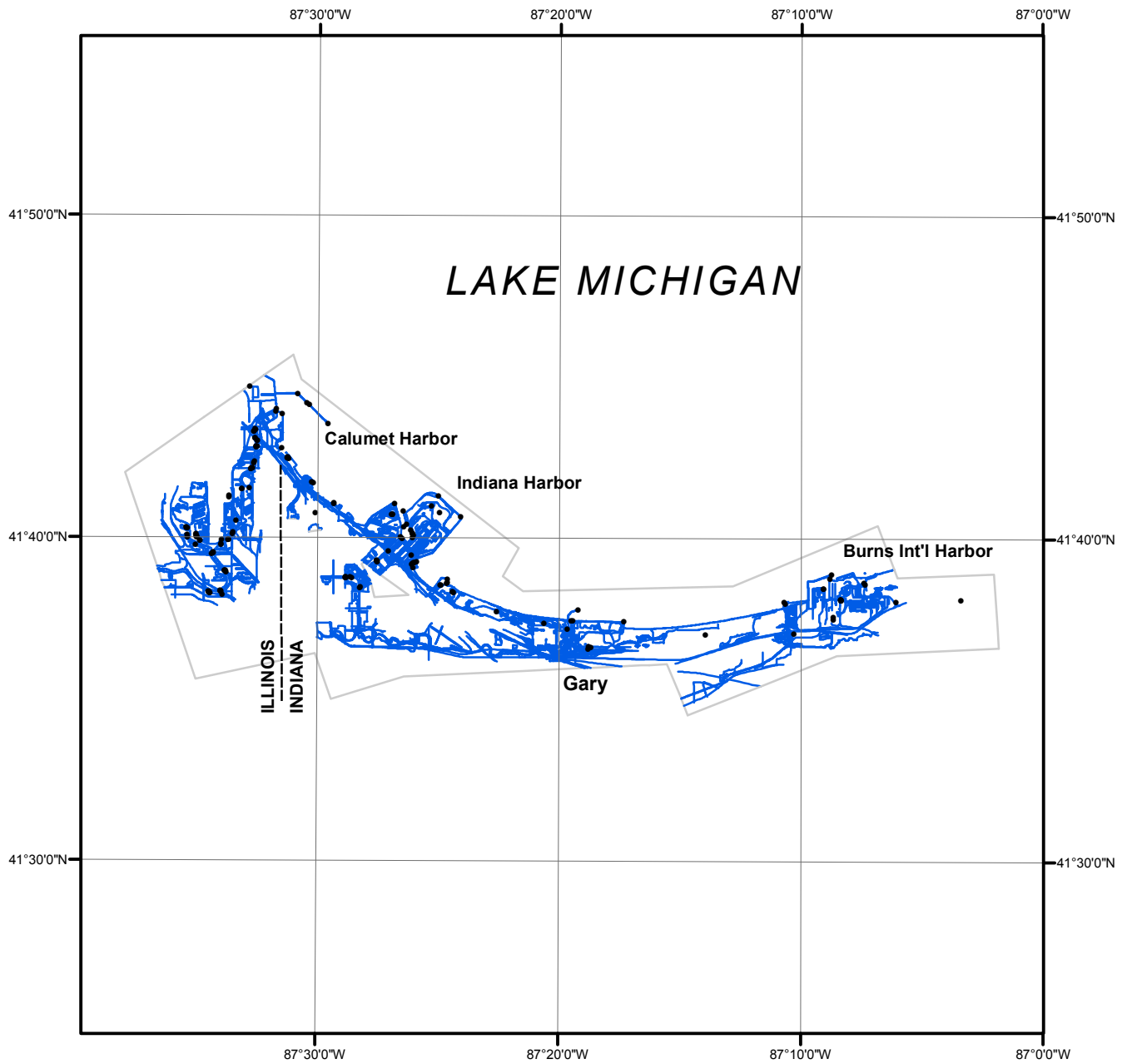
NOAA Shoreline Data Explorer

- GC10911 in shapefile format
- Metadata file for GC10911
- PCR in Adobe PDF format

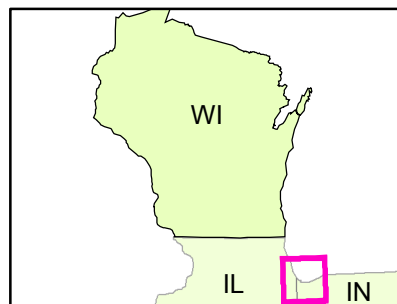
End of Report

BURNS INTERNATIONAL HARBOR TO CALUMET HARBOR

INDIANA AND ILLINOIS



Overview



WI1001A-CM-N

GC10911