

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

## ***PROJECT WI1001J***

### ***Milwaukee Harbor, Wisconsin***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project WI1001J provides a highly accurate database of new digital shoreline data for Milwaukee Harbor, Lake Michigan, Wisconsin. Project WI1001J is a sub project of a larger project, WI1001, which extends from Escanaba, Michigan in the north to Gary, Indiana in the south and includes Green Bay and the 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**

Project WI1001J was designed per a request for the Marine Chart Division (MCD) of the Office of Coast Survey, NOAA for shoreline data to update the existing nautical charts for the area.

#### **Field Operations**

The field operations consisted of the collection of static and kinematic Global Positioning System (GPS) data and the acquisition of aerial imagery. Several photographic mission operations were conducted on August 6<sup>th</sup>, September 22<sup>nd</sup>, and September 29<sup>th</sup>, 2010, with the NOAA King Air 350ER (N68RF) aircraft. Six strips each of natural color digital imagery and black and white infrared imagery were acquired, with an approximate ground sample distance of 45 cm, through use of an Applanix Digital Sensor System (DSS) 439 Dual Cam digital camera. The B&W IR imagery was used as a reference only for this project.

A base station was established for each photographic mission using static GPS. Airborne kinematic GPS data was collected in conjunction with Inertial Measurement Unit (IMU) data to determine precise camera positions and orientations.

#### **GPS Data Reduction**

GPS and IMU data was collected and processed by Remote Sensing Division (RSD) personnel to yield precise positions and orientations of camera centers as a means of rendering accurately georeferenced digital images. The static GPS base station data was processed in October 2010 using the NGS Online Processing User Service (OPUS) software to compute fixed baseline solutions from CORS stations. The airborne kinematic data was processed using Applanix POSGPS (ver. 5.1) software in October 2010. Airborne Positioning and Orientation Reports were written for each mission and are on file with other project data within the Applications Branch (AB) Project Archive.

## Aerotriangulation

Routine softcopy aerotriangulation methods were applied to establish a 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 initiated by RSD personnel in April 2011 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components, and other associated peripheral devices. The digital images were measured and adjusted as a single block using BAE Systems SOCET SET (version 5.5.0) photogrammetric suite including the Multi-Sensor Triangulation (MST) module and in conjunction with the Bingo (version 5.6) aerotriangulation software. Upon successful completion of the aerotriangulation process, the Bingo software provided the standard deviations for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 0.5 meters based on a 95% confidence level. An Aerotriangulation Report was written and is on file with other project data within the RSD Project Archive.

The project database consists of project parameters and options, camera calibration data, adjusted exterior orientation parameters, and positional listing of all measured points. Positional data is referenced to the North American Datum of 1983 (NAD83).

## Compilation

The data compilation phase of the project was initiated by RSD personnel in April 2011. Digital mapping was performed using a DPW in conjunction with the SOCET SET Feature Extraction software module. Feature identification and attribution within the Geographic Cell (GC) were based on image analysis of the digital photographs 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 WI1001J 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. The predicted accuracy of compiled, well defined points is derived by doubling the circular error computed from aerotriangulation statistics.

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

Date	Time (UTC)	Roll Number	Photo Numbers	GSD (nominal)	Tide Level*
08-06-10	15:37-15:39	10NC28	12052-12065	0.45 m	176.3 m
08-06-10	15:43-15:45	10NC28	12066-12079	0.45 m	176.3 m
09-22-10	17:22-17:23	10NC28	10145-10148	0.45 m	176.1 m
09-22-10	17:42-17:44	10NC28	10238-10254	0.45 m	176.1 m

09-29-10	17:00-17:03	10NC28	10675-10691	0.45 m	176.2 m
09-29-10	17:45-17:47	10NC28	10849-10865	0.45 m	176.2 m

\* Lake water levels are given in meters above IGLD 1985 and are based on verified observations at the Milwaukee station in Wisconsin. The Low Water Datum (LWD) for the portion of Lake Michigan covered by this project is 176.0 m. above IGLD 1985.

## **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 August 2011. 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 software. 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 chart was used in the comparison process:

14924, Milwaukee Harbor, WI, 1:10,000 scale, 28<sup>th</sup> Ed., Feb./08

## **End Products and Deliverables**

The following specifies the location and identification of the products generated during the completion of this project:

### **RSD Applications Branch Archive**

- Hardcopy of the Airborne Positioning and Orientation Report (APOR)
- Hardcopy of the Aerotriangulation Report
- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of GC10875 file contents, attached to PCR

### **Remote Sensing Division Electronic Data Library**

- Project database
- GC10875 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File in shapefile format

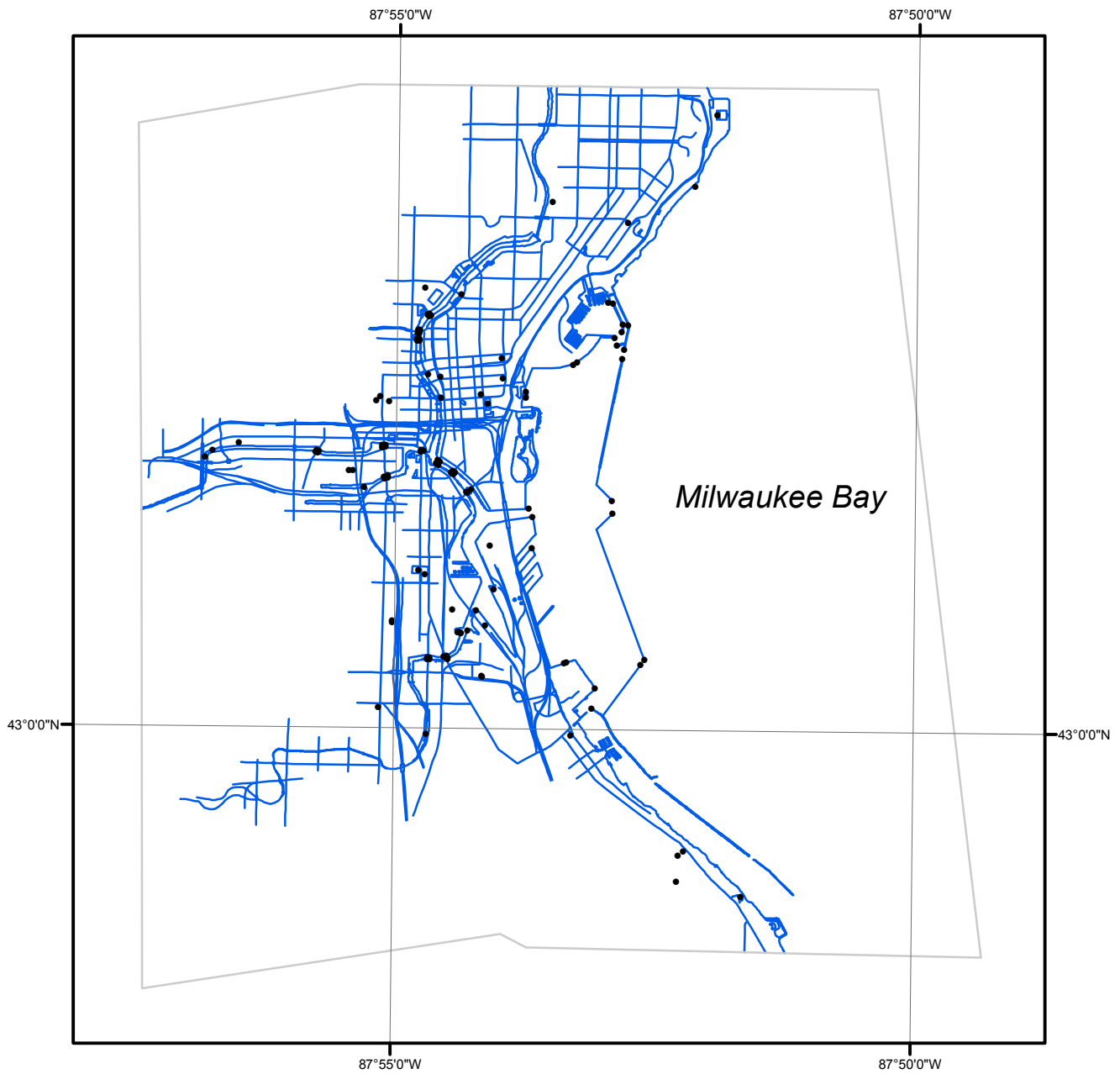
### **NOAA Shoreline Data Explorer**

- GC10875 in shapefile format
- Metadata file for GC10875
- Digital copy of the PCR in Adobe PDF format

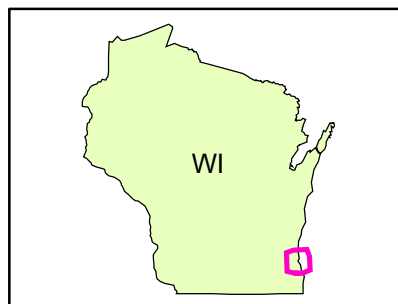
## **End of Report**

# MILWAUKEE HARBOR

## WISCONSIN



Overview



WI1001J

GC10875