

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

## ***PROJECT MI0713***

### ***Sebewaing Harbor, Michigan***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project MI0713 provides a highly accurate database of new digital shoreline data for Sebewaing Harbor, MI and surrounding coastal areas within the Saginaw Bay of Lake Huron. The project extends east of the Kilmanagh Road westward to Myers Road, and includes Sebewaing River to the Columbia River.

Successful completion of this project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric-quality aerial photographs, and digital feature data of the coastal zone which compliments the Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

The project database consists of information measured and extracted from aerial photographs and metadata related to photogrammetric compilation. Base mapping was conducted in a digital environment using stereo softcopy photogrammetry and associated cartographic practices.

#### **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 Procedure Version II (7/1/93). The instructions discussed the project's purpose, geographic area of coverage, scope and priority; photographic requirements; flight line priority; Global Positioning System (GPS) data collection procedures and guidelines for both kinematic and static surveys; data recording and handling 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 consisted of the collection of static and kinematic Global Positioning System (GPS) data and the acquisition of aerial imagery. The photographic mission operations were conducted on May 28, 2007, with the NOAA Cessna Citation II aircraft. Two strips of natural color photographs were acquired through use of a Wild RC-30 camera with the NOS "A" lens cone at the nominal scale of 1:30,000.

Airborne GPS data collection operations were conducted in accordance with the GPS Controlled Photogrammetry Field Operations Manual (10/25/99). A base station was established atop a PK-nail at the MBS International Airport – Saginaw, and airborne



kinematic GPS data was collected in conjunction with an Inertial Measurement Unit (IMU) to determine precise camera positions and orientations to establish a control network necessary for aerotriangulation.

## **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 May 2007 using the NGS Online Processing User Service (OPUS) software to compute fixed baseline solutions from three CORS stations. The final NAD83 position reported by OPUS was the average of these three baseline solutions. The airborne kinematic data was processed using Applanix POSGPS (ver. 4.4) software in December 2007. Refer to the 07MBS148 Airborne Positioning and Orientation Report (APOR) for further details.

## **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 2008 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components and other associated peripheral devices. The two color photograph strips were measured and adjusted as a single block using BAE Systems SOCET SET (version 5.3) photogrammetric software in conjunction with the Multi-Sensor Triangulation (MST) module of aerotriangulation software. Upon successful completion of the aerotriangulation process, the MST software provided the RMS of the standard deviations of the residuals for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 1.0 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, 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 (NAD 83).

## **Compilation**

The data compilation phase of the project was initiated by RSD personnel in May 2008. The work was accomplished using a DPW in conjunction with the SOCET SET (version 5.2) Feature Extraction software module. Feature identification and attribution within the Geographic Cell (GC) 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), 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 MI0713 were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 2.0 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is calculated by doubling the circular error derived from aerotriangulation statistics.

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

Date	Time (UTC)	Roll Number	Photo Numbers	Scale (nominal)	Lake Level*
05-28-07	15:03-15:04	07ACN09	1357-1359	1:30,000	176.1 m
05-28-07	15:09-15:10	07ACN09	1360-1362	1:30,000	176.1 m

\*Lake levels are given in meters above IGLD 1985 and are based on actual observations recorded by the NOS gauge at Essexville, Michigan at the time of photography.

### **Quality Control / Final Review**

Quality control tasks were conducted during all phases of project completion by a senior member of the RSD Applications Branch (AB). The final QC review was completed in June 2008. The review process included analysis of the 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 9.1 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:

14863, Saginaw Bay, Michigan, 1:120,000 scale, 31<sup>st</sup> edition, October 2005  
and Sebewaing Harbor inset, 1:20,000

### **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 GC10705 file contents, attached to PCR



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

- Project database
- GC10705 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File in shapefile format

### **NOAA Shoreline Data Explorer**

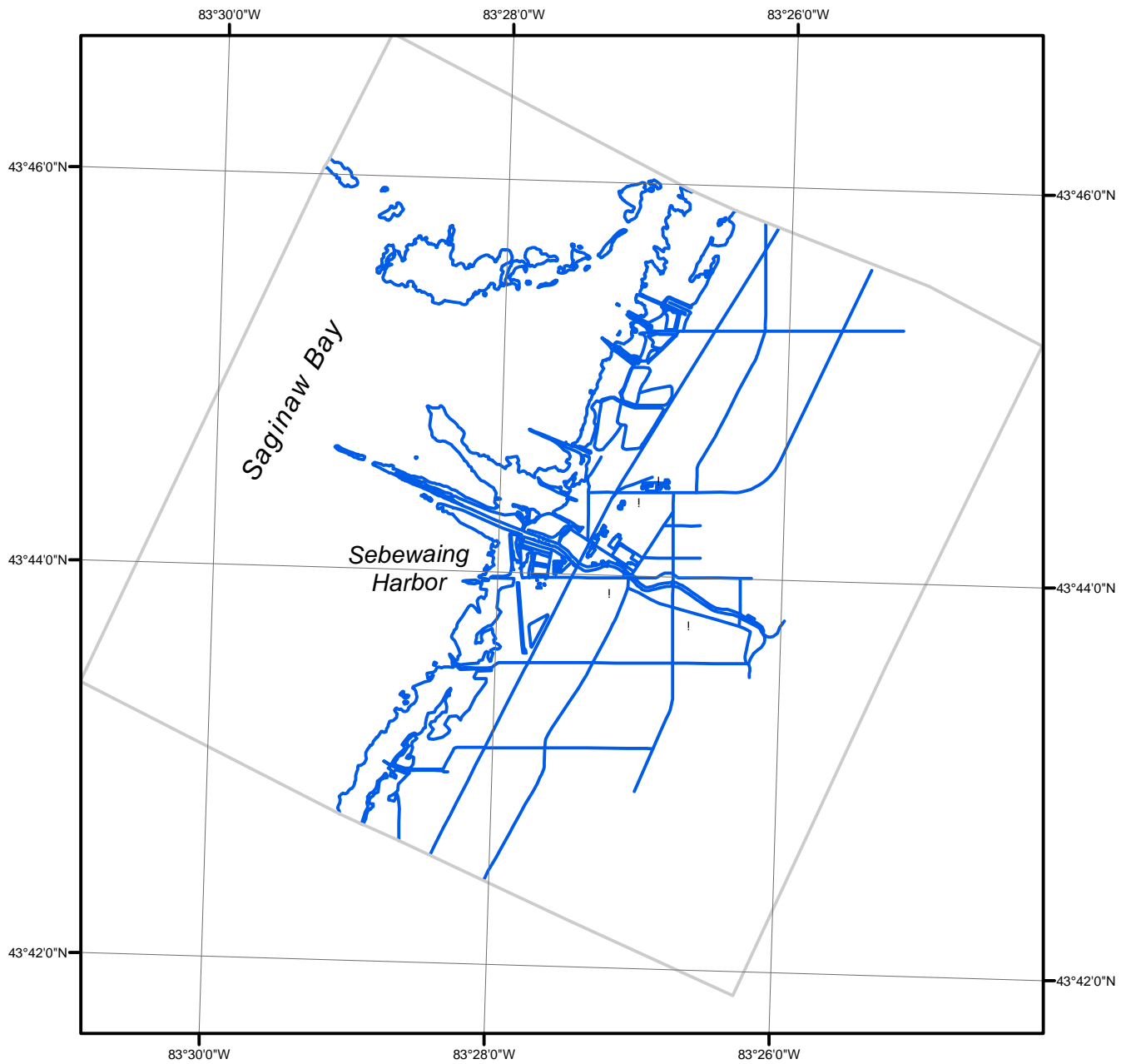
- GC10705 in shapefile format
- Metadata file for GC10705
- Digital copy of the PCR in Adobe PDF format

**End of Report**

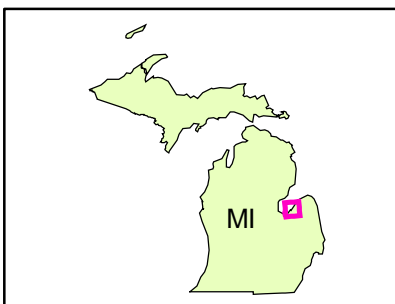


# SEBEWAING HARBOR

## MICHIGAN



Overview



MI0713

GC10705