

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

## ***PROJECT MN1502-CS-N***

### ***Port of Two Harbors, Minnesota***

#### **Introduction**

Coastal Mapping Program (CMP) Project MN1502-CS-N provides accurate digital shoreline data for one area of change in the port of Two Harbors, Minnesota. 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 design of Project MN1502-CS-N was accomplished by the Requirements Branch (RB) of the Remote Sensing Division (RSD) in response to the need for timely updates to the NOAA chart suite within key U.S. ports. Project requirements were formulated as a result of analysis conducted within the Coast and Shoreline Change Analysis Program (CSCAP), in which NOAA nautical chart products are compared to contemporary high resolution imagery in order to ascertain the need for more current shoreline data. A Chart Evaluation File (CEF) was forwarded to the Applications Branch (AB) of RSD once the change analysis was complete. Refer to the RB change analysis memorandum of December 15, 2015 for details of the chart comparison process.

#### **Field Operations**

Field operations consisted of the collection of static and kinematic Global Positioning System (GPS) data and Inertial Measurement Unit (IMU) data, and the acquisition of aerial imagery. Aerial survey operations were conducted on September 29, 2015 with the NOAA King Air (N68RF) aircraft. Two strips (13 images) were acquired with an Applanix DSS-580 medium format digital camera at a nominal altitude of 10,500 feet, resulting in an approximate ground sample distance (GSD) of 0.33 meters. Color and near-infrared images were acquired in tandem, although only the color imagery was used.

#### **Direct Georeferencing Data Processing**

GPS/IMU data were processed by RSD personnel to yield precise camera positions and orientations for direct georeferencing (DG) of the imagery. The base station's geodetic position was derived using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. The kinematic GPS data was processed using Applanix POSPac MMS 7.1 software on 10/29/2015. For further information refer to the Airborne Positioning and Orientation Report (APOR) that is on file with other project data within the RSD Electronic Data Library.

The processed GPS/IMU data were used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. The predicted horizontal accuracy of the imagery was determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using an Excel spreadsheet based EO Total Propagated Uncertainty (TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 0.94 meters. NGS third order geodetic control points were used to test the horizontal integrity of the DG data. Image measurements were made within the orthomosaics used in the CSCAP analysis for this project.

## **Compilation**

The data compilation phase of this project was accomplished by a member of AB in February 2016. Digital feature data was compiled in shapefile format from the orthomosaic utilized in the CSCAP analysis, using Esri's ArcGIS 10.2.2 desktop GIS software. Feature attributes were established using 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.

Spatial data accuracies for Project MN1502-CS-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 1.9 meters at the 95% confidence level. This predicted accuracy of compiled, well-defined points is derived by doubling the horizontal uncertainty value derived from the DG data. The following table provides information on the imagery used to complete this project:

<b>Date</b>	<b>Time (UTC)</b>	<b>Roll #</b>	<b>Strip / Frame #s</b>	<b>Lake Level*</b>
9/29/2015	14:53 – 14:54	15VC14	53-002 / 1695-1701	183.7 m
9/29/2015	14:59 – 15:00	15VC14	53-001 / 1702-1707	183.7 m

\* Lake water levels are given in meters above IGLD 1985 and are based on verified observations recorded by the NOS gauges at Grand Marais and Duluth, Minnesota. The Low Water Datum (LWD) for the portion of Lake Superior covered by this project is 183.2 m. above IGLD 1985.

## **Quality Control / Final Review**

The final QC review was completed in April 2016 by a senior member of RSD. The review process included analysis of the direct georeferencing 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. The entire suite of project products was evaluated for compliance to CMP requirements.

## **End Products and Deliverables**

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

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

- Airborne Positioning and Orientation Report (APOR)
- CSCAP evaluation memorandum
- CEF in shapefile format
- Project database
- GC11200 in shapefile format
- Project Completion Report (PCR)

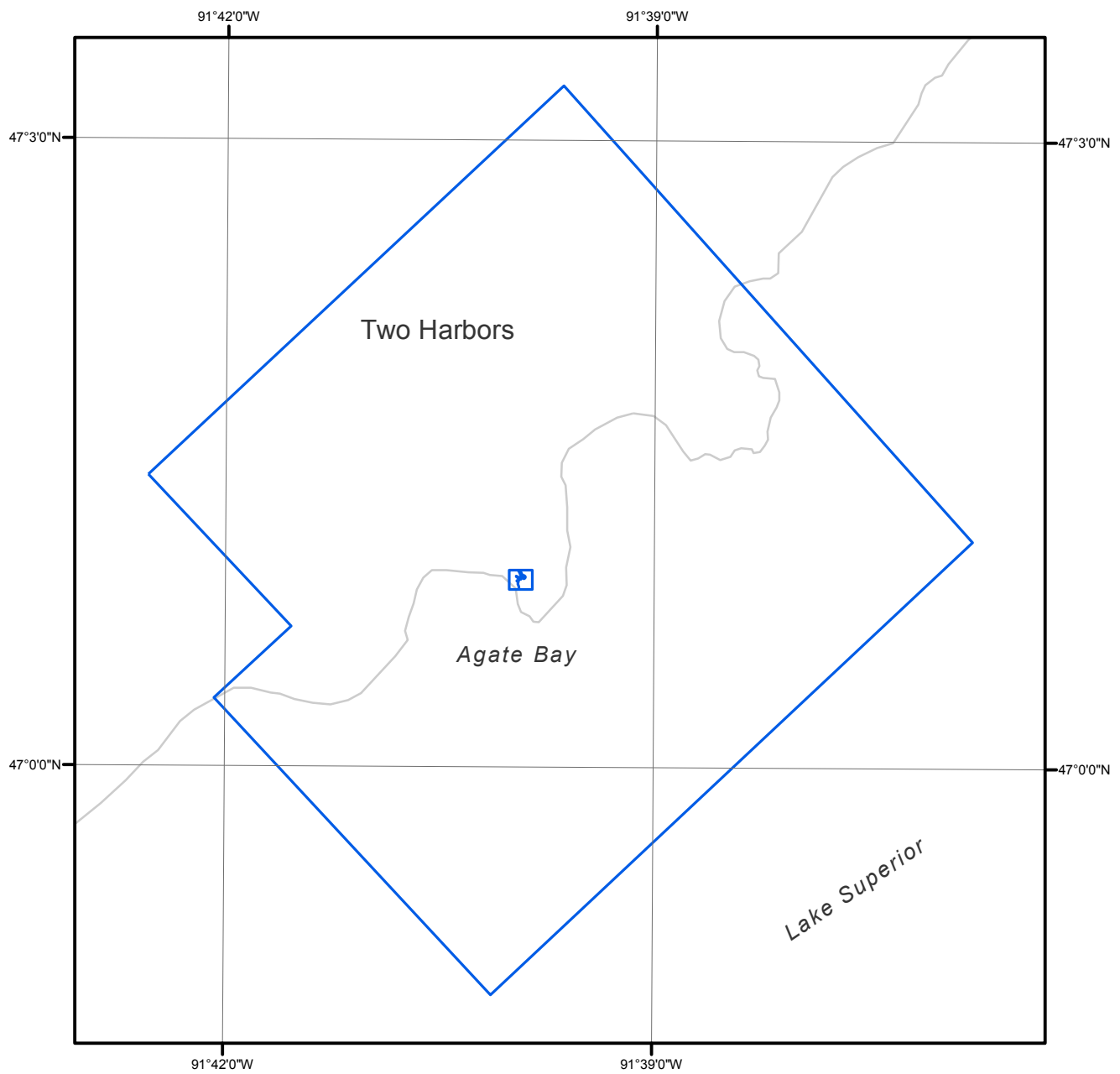
### **NOAA Shoreline Data Explorer**

- GC11200 in shapefile format
- Metadata file for GC11200
- PCR in Adobe PDF format

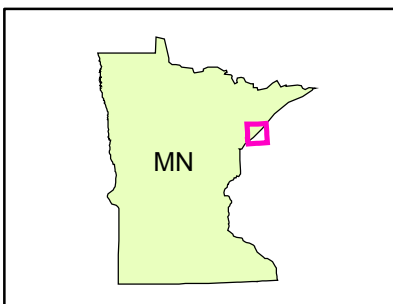
**End of Report**

# PORT OF TWO HARBORS

## MINNESOTA



Overview



MN1502-CS-N

GC11200