

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

## ***PROJECT WA1401B-CM-N***

### ***Hood Canal, Dabob Bay to Lynch Cove, Washington***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project WA1401B-CM-N provides highly accurate digital shoreline for Hood Canal, from Dabob Bay to Lynch Cove, Washington. This project is a subproject of a larger project, WA1401-CM-N, which covers Hood Canal from Port Townsend to Annas Bay, Washington. 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**

Photographic mission instructions for WA1401-CM-N were formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) following the guidelines of RSD's 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) 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 Global Positioning System (GPS) data, Inertial Measurement Unit (IMU) data, and the acquisition of aerial imagery. The tide coordinated photographic mission operations were conducted in July and August 2014 for the Mean High Water (MHW) imagery, and in June and July 2014 for the Mean Lower Low Water (MLLW) imagery, with the NOAA King Air (N68RF) aircraft. Nineteen strips each of color (RGB) and infrared (IR) digital images, at both the MHW and MLLW tide stages, were acquired concurrently with an Applanix Digital Sensor System (DSS) 439 dual camera system at a nominal altitude of 10,500 feet, resulting in an approximate ground sample distance (GSD) of 0.37 meters.

#### **GPS Data Reduction**

The GPS/IMU data was collected and processed by RSD personnel to yield precise positions and orientations of camera centers for direct georeferencing (DG) of the imagery as well as to provide a control network necessary for aerotriangulation. 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 kinematic GPS data was processed using Applanix POSPAC (ver. 6.2) software in July, 2014 for MLLW imagery and August and September, 2014 for MHW imagery. For further information refer to the

Airborne Positioning and Orientation Reports (APOR) on file with other project data within the RSD Electronic Data Library.

## Direct Georeferencing Data Processing

The processed GPS/IMU data were used to derive precise exterior orientation (EO) values of the camera centers suitable 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 the Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level for all project imagery was calculated to be 1.5 meters. NGS third-order geodetic control was used to verify the horizontal integrity of the DG data. All stereo models were examined and found to have acceptable levels of parallax for mapping purposes. All positional data is referenced to the North American Datum of 1983 (NAD 83).

## Compilation

The data compilation phase of this project was accomplished by a member of AB in March 2017. The Feature Extraction module was used within SOCET SET (v 5.6.0) photogrammetric software. 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), 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 WA1401B-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 3.0 meters at the 95% confidence level. This predicted accuracy of compiled well-defined points was derived by doubling the horizontal uncertainty of the imagery calculated from the EO-TPU tool.

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

Date	Time (UTC)	Strip No.	Color Imagery		Infrared Imagery		Tide Level*
			Roll	Images	Roll	Images	
6-30-2014	19:14 – 19:20	53-020	14NC57	12038 – 12078	14NR48	08789 – 08829	0.0 m
6-30-2014	19:29 – 19:33	53-022	14NC57	12079 – 12123	14NR48	08830 – 08874	0.0 to -0.1 m
6-30-2014	19:38 – 19:45	53-021	14NC57	12124 – 12167	14NR48	08875 – 08918	-0.1 m
6-30-2014	19:50 – 19:56	53-024	14NC57	12168 – 12205	14NR48	08919 – 08956	-0.1 m
6-30-2014	20:00 – 20:05	53-023	14NC57	12206 – 12241	14NR48	08957 – 08992	-0.1 m
6-30-2014	20:10 – 20:11	53-025	14NC57	12242 – 12247	14NR48	08993 – 08998	-0.1 m
6-30-2014	20:16 – 20:18	53-016	14NC57	12248 – 12264	14NR48	08999 – 09015	-0.2 m

6-30-2014	20:24 – 20:26	53-014	14NC57	12272 – 12287	14NR48	09023 – 09038	-0.2 m
6-30-2014	20:31 – 20:33	53-013	14NC57	12288 – 12302	14NR48	09039 – 09053	-0.2 m
8-09-2014	22:21 – 22:27	53-020	14NC68	16061 – 16101	14NR59	12809 – 12849	2.9 – 3.1 m
8-09-2014	22:32 – 22:37	53-023	14NC68	16102 – 16137	14NR59	12850 – 12885	3.2 m
8-09-2014	22:42 – 22:48	53-024	14NC68	16138 – 16175	14NR59	12886 – 12923	3.3 m
8-09-2014	22:54 – 23:00	53-021	14NC68	16176 – 16219	14NR59	12924 – 12967	3.4 – 3.2 m
8-09-2014	23:05 – 23:12	53-022	14NC68	16220 – 16264	14NR59	12968 – 13012	3.2 – 3.5 m
8-09-2014	23:17 – 23:18	53-025	14NC68	16265 – 16270	14NR59	13013 – 13018	3.5 m
8-09-2014	23:23 – 23:25	53-014	14NC68	16271 – 16286	14NR59	13019 – 13034	3.3 m
8-09-2014	23:32 – 23:34	53-016	14NC68	16294 – 16310	14NR59	13042 – 13058	3.3 – 3.4 m
8-09-2014	23:40 – 23:42	53-013	14NC68	16311 – 16325	14NR59	13059 – 13073	3.3 m

\*Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at NOS gauges. The height of the MHW tidal datum in the project area varies between 3.13 – 3.31 meters above MLLW.

## 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 April 2017. The review process included analysis of DG 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 10.4.1 software. All project data was evaluated for compliance to CMP requirements.

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

- 18441, Puget Sound, Northern Part, 1:80,000 scale, 47th Ed., Jun. 2011
- 18448, Puget Sound, Southern Part, 1:80,000 scale, 36th Ed., Dec. 2015
- 18458, Hood Canal, South Point to Quatsap Point, 1:25,000 scale, 17th Ed., Oct. 2010
- 18476, Puget Sound, Hood Canal and Dabob Bay, 1:40,000 scale, 6th Ed., Sep. 2011

## 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

- Project database
- Airborne Positioning and Orientation Report (APOR)
- GC11274 in shapefile format
- Project Completion Report (PCR)
- Chart Evaluation File in shapefile format

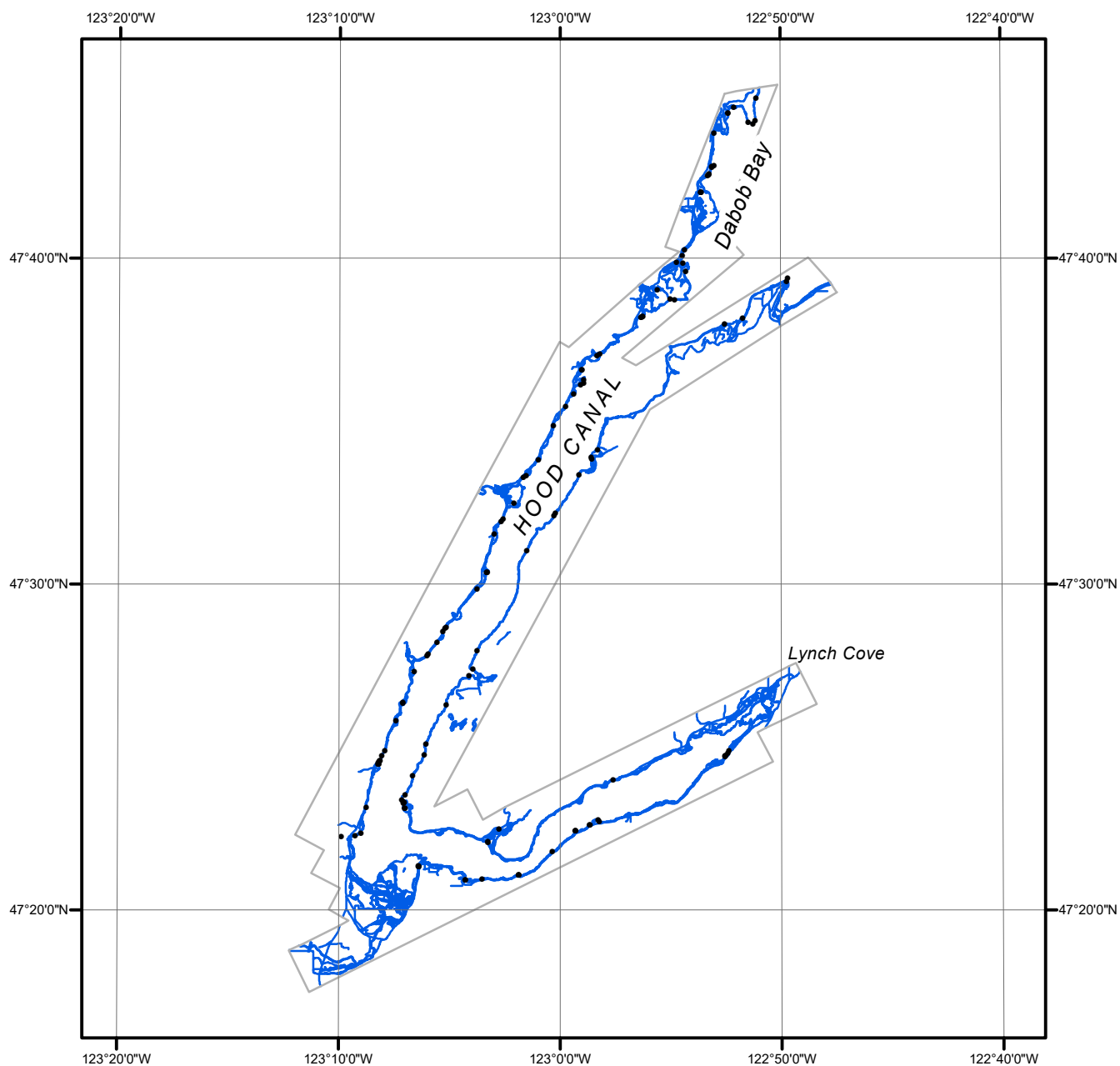
### **NOAA Shoreline Data Explorer**

- GC11274 in shapefile format
- Metadata file for GC11274
- Digital copy of the PCR in Adobe PDF format

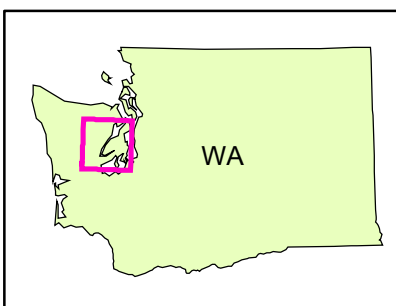
**End of Report**

# HOOD CANAL, DABOB BAY TO LYNCH COVE

## WASHINGTON



Overview



WA1401B-CM-N

GC11274