

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

## ***PROJECT WA0301B***

### ***Cathlamet Bay to Puget Island, Columbia River, Washington and Oregon***

#### **Introduction**

Coastal Mapping Program (CMP) Project WA0301B provides a highly accurate database of new digital shoreline data of the Columbia River in the states of Washington and Oregon. The project includes shoreline of the Columbia River from Cathlamet Bay to Puget Island including Clifton Channel and Grove Slough. WA0301B is a sub project of WA0301 which includes the Columbia River from its confluence with the Pacific Ocean up stream to the Bonneville Dam, and includes the Multnomah Channel and the Lewis River.

Successful completion of the project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric-quality aerial photographs, and a Geographic Cell (GC) of the coastal zone which complements 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 photography 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 design of project WA0301 was based on a comparison of image analysis to cartographic detail depicted on the pertinent NOAA nautical charts of the project site. The Remote Sensing Division (RSD) of the National Geodetic Survey, NOAA, formulated the WA0301 Project instructions dated December 20, 2004 which contains the specific field and photo mission operational guidelines. 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.

Nautical charts provided by RSD showed the limits of the compilation. Photo scales for the color and black and white infrared (B&W IR) photography were determined by RSD staff to attain the required mapping accuracies.

## **Field Operations**

SAIC photographic mission operations were conducted between July 14, 2005 and September 11, 2006. The natural color photography was flown on July 14 and 17 and August 24, 2005 for a total of thirty-one (31) strips. The B&W IR MLLW photography was flown on July 23, August 5, September 21 and 23, 2005; April 22-23, and May 2 and 16, 2006 for a total of twenty-nine (29) strips. The B&W IR MHW was flown on July 23-25, August 24 and September 21, 2005; and May 16, August 14 and September 11, 2006 for a total of twenty-nine (29) strips. Aerial photographic coverage of the project site consisted of natural color and black & white infrared photographs at nominal scales of 1:30,000, 1:40,000 and 1:50,000. Black and white infrared tide-coordinated photography was acquired at both the mean high water (MHW) and mean lower low water (MLLW) levels. Natural color photographs were acquired without local tide coordination.

Base station data was collected utilizing a combination of Trimble geodetic receivers and CORS sites. All data was planned to be collected at a 2Hz rate with a 10° horizon mask. The airborne kinematic data was processed using NovAtel Inc.'s GrafNav (version 7.60.2425) software. Data not collected at a 2 Hz rate was re-sampled to 2 Hz. The ground monitoring stations were situated approximately every 75km to ensure that each photo center would be within 100km of two stations. Ground monitoring stations were a combination of four permanent CORS, two NSRS stations and one temporary control point.

Photo-identifiable control on the new ground stations was established by means of fast-static GPS. Each of the new stations was tied directly to at least three stations found on the National Spatial Reference System (NSRS) or the new CORS. The observations at each were made between March 13 and April 14, 2007 utilizing Trimble 4000SSi and 5700 geodetic receivers. Please refer to the Photographic Flight Reports and Ground Control Reports for additional information.

## **GPS Data Reduction**

Global Positioning System (GPS) data was collected and processed to provide precise positions of camera centers for application as photogrammetric control in the aerotriangulation phase of project completion. Data from seven base stations were used in the final solution. They included: CORS 'KELS' (AF9666) and 'P415' (DH093) which are in the national CORS network, 'KLS' is a county run station set on NSRS station 'KLS' (SC2801); CORS 'PDXA' is run by the Port of Portland; NAD 1983[CORS 96 – Epoch 2002] coordinates for 'PDXA' were established by the Washington State Reference Network by running a minimum of ten 24 hour observations through OPUS and deriving the mean value; NAD 1983[98] values for 'AST A', HQM ARP 2' & 'KLS' were shifted to NAD 1983 [CORS – Epoch 2002] with the use of HTDP. Coordinates for temporary point 'BONN' were established by submitting twelve hours of data spread over four days to OPUS. Session initialization required 6 satellites for a minimum of 10 minutes prior to photo collection.

The data was then processed and adjusted in Trimble Geomatics Office (ver. 1.63) software. The 248 non-trivial base lines resulted in network accuracies of 0.018 meters horizontal and 0.050 meters in orthometric elevation at a 95% confidence level, exceeding the 0.1 meter horizontal and 0.2 meter vertical accuracy requirements for the project. No unusual circumstances or equipment malfunction occurred during observations or processing.

See the Airborne GPS Control Report for additional information.

## **Aerotriangulation**

Routine softcopy aerotriangulation methods were applied to extend the network of precise camera positions and other control for mapping, and to provide model parameters and orientation elements required for digital compilation. [j][f][k] Inc. personnel initiated the softcopy aerotriangulation work in March 2007, utilizing Z/I Imaging's ISDM (Image Station Digital Mensuration) version 054.03.00.08 and ISAT (Image Station Automatic Triangulation) software suite. Once the AT data was measured and verified, it was then processed using [j][f][k]'s PC-RABATS/BRATS software package. The softcopy aerotriangulation work was completed in June 2007.

All three emulsions were processed as individual blocks. Upon successful completion of the block adjustment, ISAT provided the RMS of the standard deviations for all aerotriangulated ground points, which were used to compute a predicted horizontal circular error at the 95% confidence level of 0.4 meters for the color photographs and 0.5 meters for the MHW and MLLW IR photographs. The Aerotriangulation Report is on file with other project data within the RSD AB 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 this project was completed by SAIC in April 2009. Digital mapping was performed using Digital Photogrammetric Workstations (DPWs) in conjunction with BAE Systems SOCET SET (ver. 5.3.1) Feature Extraction software. Feature identification and attribution within the Geographic Cell (GC) were based on image analysis of 1:30,000 scale photographs and information extracted from the appropriate 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 WA0301B were determined according to standard Federal Geographic Data Committee (FGDC) practices. Most cartographic features were

compiled to meet a horizontal accuracy of 0.8 meters at the 95% confidence level. The mean lower low water line and the mean high water line 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 derived from aerotriangulation statistics.

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

<b>Date</b>	<b>Time (UTC)</b>	<b>Roll Number</b>	<b>Frames</b>	<b>Scale (nominal)</b>	<b>Tide Level*</b>
7/14/2005	23:15-23:19	0505CN02	347-354	1:30,000	0.5
7/14/2005	23:23-23:27	0505CN02	355-362	1:30,000	0.9
7/14/2005	23:33-23:37	0505CN02	367-375	1:30,000	0.9
8/24/2005	21:35-21:37	0505CN04	485-490	1:30,000	1.6
8/24/2005	21:51-21:54	0505CN04	499-505	1:30,000	1.5
7/24/2005	23:42-23:45	0505R04	132-138	1:30,000	2.3-2.0
7/24/2005	23:56-23:59	0505R04	139-145	1:30,000	2.1-1.8
7/25/2005	00:15-00:19	0505R04	153-159	1:30,000	1.9-2.2
9/21/2005	19:08-19:11	0505R06	396-400	1:30,000	0.0-0.1
9/21/2005	19:16-19:18	0505R06	403-409	1:30,000	0.1-0.0
9/21/2005	22:26-22:28	0505R06	456-461	1:30,000	2.4-2.1
5/2/2006	19:47-19:50	0605R03	007-012	1:30,000	-0.2
5/2/2006	19:55-19:59	0605R03	013-019	1:30,000	-0.2
5/16/2006	20:10-20:11	0605R03	125-126	1:30,000	-0.1

\*Tide levels are in meters above MLLW and are based on verified observations at the Astoria, OR; Skamokawa, WA; and Wauna, OR tide stations, adjusted for CO-OPS tidal zoning. The elevation of the MHW datum varies between 2.0 meters and 2.4 meters throughout the project area.

## Quality Control/Final Review

SAIC completed the final review in April 2009. The GC was evaluated for completeness and accuracy. The review process included analysis of aerotriangulation results and assessment of the identification and attribution of cartographic features 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 GIS software. All project data was evaluated for compliance to CMP requirements.

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

- 18521, Columbia R. Pacific Ocean to Harrington Point, 1:40,000 scale, 73<sup>rd</sup> Ed.
- 18523, Columbia R. Harrington Point to Crims Island, 1:40,000 scale, 56<sup>th</sup> Ed.

## **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 GC10688 file contents, attached to PCR

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

- Project database
- GC10688 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

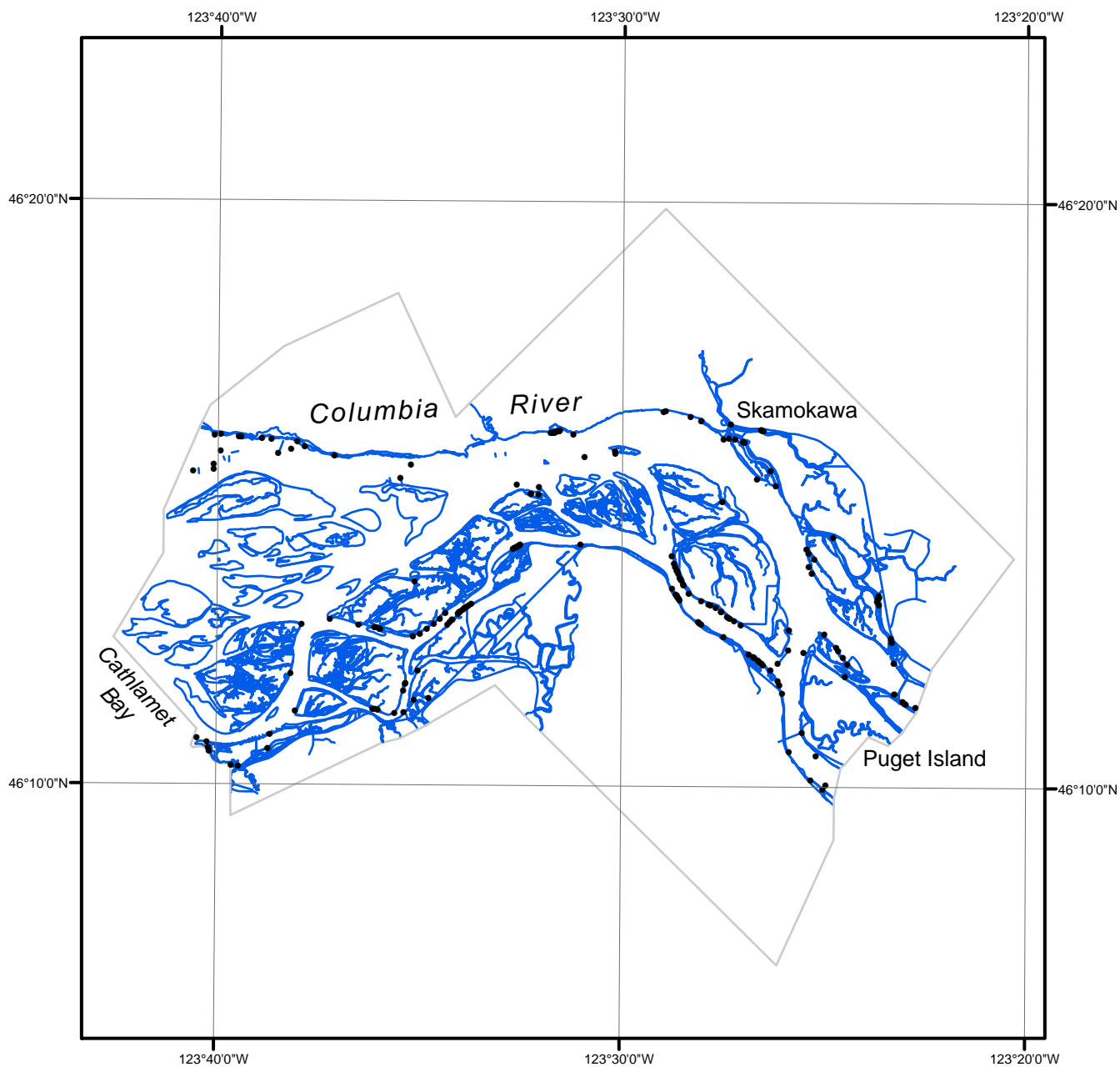
### **NOAA Shoreline Data Explorer**

- GC10688 in shapefile format
- Metadata file for GC10688
- Digital copy of the PCR in Adobe PDF format

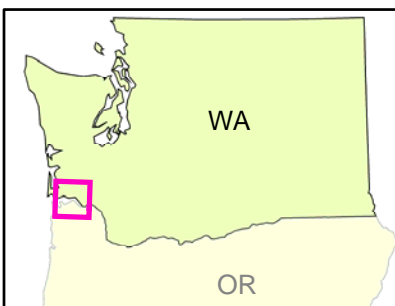
## **End of Report**

# CATHLAMET BAY TO PUGET ISLAND, COLUMBIA RIVER

## WASHINGTON AND OREGON



Overview



WA0301B

GC10688