

NOAA COASTAL MAPPING PROGRAM

PROJECT COMPLETION REPORT

PROJECT CM9304

SAN JUAN ISLANDS, WASHINGTON

Introduction

Project CM9304 provides a highly accurate database of new digital shoreline data of the San Juan Islands in the state of Washington, from Haro Strait in the west to Padilla Bay in the east, and from Deception Pass in the south to Drayton Harbor in the north, including the port of Anacortes. See the project diagram attached to this report for a depiction of the area covered.

Completion of this project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric quality aerial photographs and a digital cartographic feature file (DCFF) of the coastal zone which compliment the Nautical Charting Program (NCP) and other geographic information systems.

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 survey data is referenced to the North American Datum of 1983 (NAD 83).

Project Design

The Requirements Branch (RB) of the Remote Sensing Division (formerly the Coastal Planning Section of the Photogrammetry Branch) formulated and coordinated field and photographic requirements for this project. Planning operations included developing the network design for pre-marked and photo identified control points, preparing project diagrams, flight maps, and input files for the aircraft's flight management system, and coordinating tide level requirements and photographic operations schedules. Field instructions were issued which discussed the project's purpose, geographic area of coverage, scope and priority; photographic requirements; flight line priority; data recording and handling instructions; and contact and communication information.

Field Operations

Field operations consisted of aerial photography, and the establishment of paneled photogrammetric control points prior to the photo mission and supplemental control points by photoidentification methods after the photo mission. Geodetic survey and photoidentification operations were performed in July 1993 and March 1994. There were eleven paneled marks and three photoidentified marks established for use as photogrammetric control.

Aerial photographic survey operations were conducted with the NOAA Cessna Citation II aircraft. Eight strips of natural color photographs were acquired on July 26, 1993 and eight strips of B&W infrared photographs were acquired on August 1, 1993, both using a Wild RC-30 camera with the NOS "A" lens cone at the nominal scale of 1:50,000. The infrared photography was acquired during the predicted MLLW tide stage.

The photographs were reviewed to ensure proper overlap, resolution, and coverage, and were further evaluated for overall image and metric quality to ensure compliance to uniform specifications.

Aerotriangulation

Initial aerotriangulation was completed for this project in February 1995 using a PWS Analytical Plotter employing traditional photogrammetric techniques. An aerotriangulation report was written and is on file, along with other project data, in the RSD Applications Branch (AB) Project Archive. The project was then forwarded to the Atlantic Marine Center Compilation Section, but when that office was shut down, the project was shipped back to headquarters and was set aside, never having been carried through to the compilation phase. In August 2003 RSD received a request for shoreline to support a hydrographic survey in the Anacortes and Billingham, WA areas. Though unable to provide shoreline for all of the requested area in time for the hydrographic survey operations, the decision was made to resurrect this project and complete the compilation using the current softcopy photogrammetry system, SOCET SET.

High resolution scans were created from the original film for use in the softcopy system. An attempt was made to export the original General Integrated ANalytical Triangulation (GIANT) solution results from the legacy system, reformat the data, and import it into SOCET SET for direct rectification of the images. But the attempt failed, and the aerotriangulation had to be redone using SOCET SET and the associated ORIMA triangulation software. The computed photo center coordinates from the original GIANT solution were able to be used in ORIMA as pseudo-GPS airborne control to help constrain the adjustment along with the surveyed ground control points. The color and IR photographs were measured and adjusted as two separate blocks, both using the pseudo-GPS coordinates for control. Since most of the ground control could not be accurately measured in the IR images, after an acceptable triangulation of the color photo block was attained, selected points were measured in the color images and transferred to the IR for use as ground control.

This second aerotriangulation of the project was completed in December 2004. The ORIMA software provided the RMS of the standard deviations of the residuals for each triangulated ground point. These values were used to compute a predicted horizontal circular error (at the 95% confidence level) of 1.4 meters for the color block and 3.0 meters for the IR block. An Aerotriangulation Report was written and is on file with other project data in the RSD AB Project Archive.

The project database consists of project parameters and options, camera calibration data, interior orientation parameters, pseudo-GPS airborne camera station position data, adjusted exterior orientation parameters, and positional listing of all measured points. Positional data is based on the North American Datum 1983, and is referenced to the UTM Coordinate System, zone 10.

Compilation

The data compilation phase of the project was completed by the RSD AB in August 2005. At the end of the original analytical aerotriangulation phase, a set of ten cartographic data files (DM10261 – DM10270) were designated for use in the compilation phase of this project. In order to maintain consistency with existing reports and project listings, these DM designations were preserved and used in place of the current GC standard. The digital mapping was performed using a SOCET SET workstation in conjunction with the Feature Extraction module. Feature identification and the assignment of cartographic codes were based on image analysis of 1:50,000 scale natural color and infrared photographs, and information extracted from the appropriate NOAA Nautical Charts, US Coast Guard Light List and other ancillary sources. Cartographic feature attribution was assigned in compliance with the Coastal Cartographic Object Attribute Source Table (C-COAST).

Cartographic features were compiled to meet a horizontal accuracy (at the 95% confidence level) of 2.8 meters for features measured in the color photographs, and 6.0 meters for features measured in the IR photographs. This predicted accuracy of compiled, well defined points is derived by doubling the circular error computed from aerotriangulation statistics.

The following table provides information on aerial photographs used in the compilation phase:

Date	Time (UTC)	Roll Number	Photo Numbers	Scale (nominal)	Tide Stage (m. above mllw)
7-26-1993	20:10 – 20:12	93ACN22	3484 – 3486	1:50,000	2.1
7-26-1993	20:20 – 20:26	93ACN22	3493 – 3506	1:50,000	1.8 – 1.5
7-26-1993	20:33 – 20:40	93ACN22	3508 – 3517	1:50,000	1.3 – 1.8
7-26-1993	20:47 – 20:52	93ACN22	3521 – 3530	1:50,000	1.8 – 1.7
7-26-1993	20:58 – 21:08	93ACN22	3532 – 3547	1:50,000	1.7 – 2.0
7-26-1993	21:33 – 21:39	93ACN22	3551 – 3561	1:50,000	1.3 – 1.8
7-26-1993	21:42 – 21:47	93ACN22	3562 – 3569	1:50,000	1.7 – 1.3
7-26-1993	21:54 – 22:01	93ACN22	3571 – 3584	1:50,000	1.4 – 1.7
8-01-1993	15:58 – 16:03	93AR01	3588 – 3596	1:50,000	MLLW
8-01-1993	16:07 – 16:12	93AR01	3597 – 3606	1:50,000	MLLW
8-01-1993	16:19 – 16:26	93AR01	3610 – 3620	1:50,000	MLLW
8-01-1993	16:29 – 16:35	93AR01	3621 – 3645	1:50,000	MLLW
8-01-1993	16:40 – 16:47	93AR01	3646 – 3673	1:50,000	MLLW
8-01-1993	16:52 – 16:57	93AR01	3677 – 3697	1:50,000	MLLW
8-01-1993	17:02 – 17:10	93AR01	3698 – 3728	1:50,000	MLLW
8-01-1993	17:19 – 17:20	93AR01	3741 – 3745	1:50,000	MLLW

Note: Tide stages for the color photographs (3484 – 3584) are based on estimates provided by the Tidal Datums Branch on October 7, 1994. The estimates were computed from zoning corrections referenced to an operating gauge at Friday Harbor, WA. The infrared photographs (3588 – 3748) were flown based on a predicted tide stage of MLLW. The actual tide stage for the IR photographs could not be verified, but examination of the imagery indicates that they were captured within the accepted range of MLLW for tide-controlled photogrammetric mapping.

Quality Control / Final Review

The final review was initiated by a senior AB CMP team member in September 2005. The digital cartographic feature file (DCFF) was evaluated for completeness and accuracy. Data review consisted of an on-line evaluation of digital compilation and associated products including the review of stereo models on a SOCET SET workstation for positional accuracies of features, correct cartographic feature codes selection, and other attributes. The cartographic feature attribution was judged to conform to C-COAST specification. The compilation data was further evaluated in its final shapefile format using ArcGIS tools to ensure topologic continuity, proper attribution, suitability for use in a GIS environment, and to compare the compiled features with the largest scale NOAA digital raster nautical charts available. The following nautical charts were used in the comparison process:

- 18421, Strait of Juan De Fuca to Strait of Georgia, 1:80,000 scale, 46th edition
- 18424, Bellingham Bay, 1:40,000 scale, 25th edition
- 18427, Anacortes to Skagit Bay, WA, 1:25,000 scale, 22nd edition
- 18429, Rosario Strait, Southern Part, 1:25,000 scale, 9th edition
- 18430, Rosario Strait, Northern Part, 1:25,000 scale, 8th edition
- 18431, Rosario Strait to Cherry Point, 1:25,000 scale, 6th edition
- 18432, Boundary Pass, 1:25,000 scale, 5th edition
- 18433, Haro Strait, Middle Bank to Stuart Island, 1:25,000 scale, 5th edition
- 18434, San Juan Channel, 1:25,000 scale, 5th edition

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

- Hardcopies of both Aerotriangulation Reports
- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of DCFF file contents, attached to PCR

Remote Sensing Division Electronic Data Library

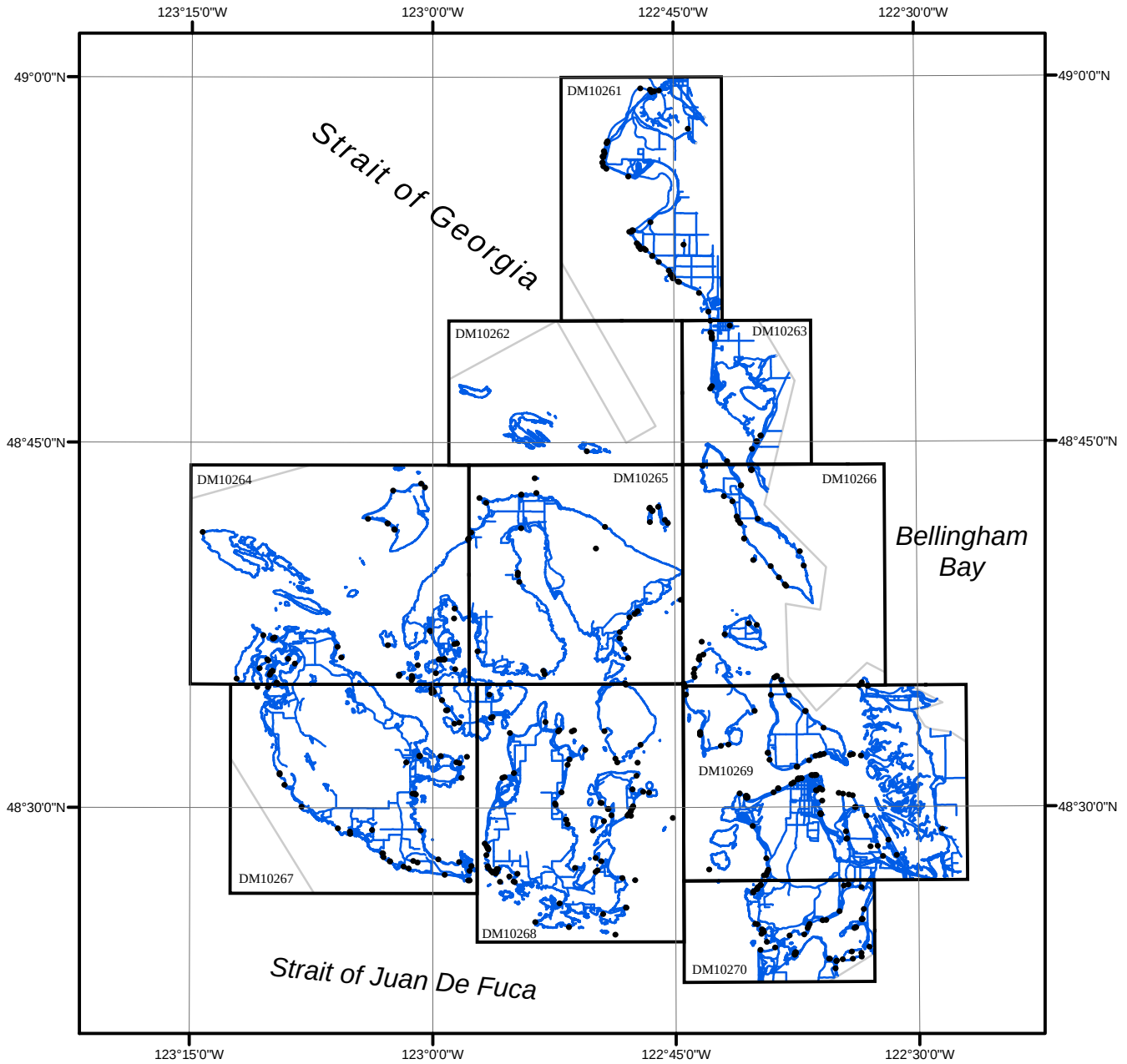
- Project Database
- Digital copy of DCFF in shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File in shapefile format

NOAA Shoreline Data Explorer

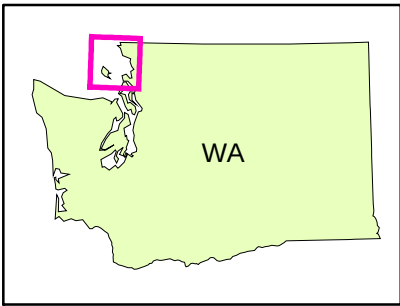
- DCFF for DM10261 – DM10270
- Metadata files for DM10261 – DM10270
- Digital copy of the PCR in Adobe PDF format

End of Report

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Overview



CM9304

DM10261-70