

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT VA0402A

Pocomoke Sound, Pungoteague Creek to Bullbegger Creek, Virginia

Introduction

NOAA Coastal Mapping Program (CMP) Project VA0402A provides a highly accurate database of new digital shoreline data for a portion of southeast Chesapeake Bay in Virginia. The project extends from the approximate area of the mouth of the Pocomoke River southward to Pungoteague Creek, and includes creeks along the western shore of the Delmarva Peninsula. VA0402A is a sub-project of VA0402 which extends from the Pocomoke River south to the Chesapeake Bay Bridge-Tunnel.

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 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 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 initial project instructions for VA0402 were issued on June 16, 2004. Subsequent to the initial issuance of the instructions, the project was broken into two phases, Phase 1 being the aerial acquisition phase and Phase 2 being the map compilation phase of the task order. These instructions outlined the purpose of the project, the overall geographic area of coverage for the project, and provided all necessary special compilation instructions, reporting and handling instructions, and contact and communication information. Wilson & Company, Inc. proceeded to derive a work plan that would comply with all of NOAA's requirements for shoreline mapping projects.

Wilson & Company, Inc. personnel prepared a comprehensive work plan based on the project requirements specified in NOAA's project instructions, NOAA's standard SOW, NOAA provided charts and ESRI shapefiles. Wilson & Company, Inc. used the color and tide coordinated Black and White Infrared (B&W IR) aerial photography, ground control and aerial triangulation results from VA0402 Phase 1 to conduct the mapping and attribution services necessary to complete Phase 2. Wilson & Company, Inc. was responsible for the initial map compilation and attribution of the interim shape files. In addition, Wilson & Company, Inc. had the responsibility for quality control review and validation of the aerotriangulation results, extraction and attribution of the features into a SOCET SET feature database for NGS review, application of any NGS specified changes to the mapping, consolidation of the shapefiles,

migrating the attribution of the interim feature database to the C-COAST attribution schema, and delivering these final files to NGS. Wilson & Company, Inc. would be responsible for preparing the final Project Completion Report. NOAA approved the tentative work plan in January, 2008. Final project work limits for NOAA/NGS Project VA0402 Phase 2 were received from NOAA's Remote Sensing Division during January, 2009. The revised work limits defined the specific extents of the two project sub-areas that NOAA wanted compiled.

Field Operations

The field operations consisted of the collection of static and kinematic GPS data and the acquisition of aerial photographs. Wilson & Company's subcontractor Metro Engineering & Surveying Co., Inc. (MESC) collected static GPS data. Wilson & Company and its subcontractor, Richard Crouse Associates (RCA), flew tide coordinated black and white infrared (B&W IR) photography at Mean Lower Low Water (MLLW) tide stage, B&W IR aerial photography at Mean High Water (MHW) tide stage and non-tide coordinated natural color photography. Airborne Global Positioning System (ABGPS) data was collected for all photos. The output of post-processing this data with Continuously Operating Reference Station (CORS) data was used in conjunction with ground survey points to control the subsequent Aerial Triangulation (AT).

Eight flight lines of natural color photographs were acquired on September 3rd and September 12th, 2005 using a Wild RC-30 camera (S-N 5282, lens S-N 13328). Tide coordinated B&W IR MLLW photography was successfully acquired May 23rd, 2006, May 29th, 2008, January 31st, 2009, March 9th, 2009, and March 24th, 2009. Tide coordinated B&W IR MHW photography was successfully acquired on March 4th, 2006, September 26th, 2006, October 2nd, 2006, November 3rd, 2006, May 29th, 2008, August 19th, 2008, October 5th, 2008, February 7th, 2009, March 21st, 2009, March 24th, 2009, April 8th, 2009 and May 10th, 2009. The same flight line configuration of eight flight lines used for the natural color aerial acquisition missions was used for the tide coordinated B&W IR missions. RCA used two additional NOAA approved Wild RC-30 cameras (S-N 5324, lens S-N 13365 and S-N 5368, lens S-N 13413) with a 705 nanometer filter to acquire the B&W IR exposures. The collection of the B&W Infrared photographs was coordinated with both the MLLW and MHW tide levels based on predicted tides at the Chesapeake Bay Bridge-Tunnel, VA (#8638863) and at the Kiptopeke, VA (#8632200) gauges. All photographs were acquired at the nominal scale of 1:30,000.

CORS and several Cooperative CORS served as ground stations during flight. Airborne kinematic GPS data was collected to determine precise camera positions in order to establish a control network necessary for aerial triangulation. Photo-identifiable ground control was collected to supplement the airborne kinematic GPS. MESC used two GPS receivers as rovers to observe each of the control points in the project area. MESC ran one 2.5 hour static session on each point. The GPS data was downloaded from the 4000SSE receivers and, through Trimble Geomatics Office software, converted into RINEX files for submittal to NGS for OPUS processing. MESC was responsible for the generation and maintenance of the NGS Station Description-Recovery Form (DR Form), photographs of each photo control point surveyed, NOAA Form 76-53 for each panel, Visibility Obstruction Diagrams, and GPS Observation Logs.

GPS Data Reduction

Ground control survey data files were downloaded from the GPS receivers and converted to a RINEX format. MESC used Trimble Geomatics Office, version 1.01 to perform preliminary processing and review of the collected GPS data by comparing the antenna heights, antenna types and start and end times to the field GPS. MESC performed the final data reduction and computation of final coordinates through the NGS online GPS processing tool, OPUS. Each data file submitted was processed using the three (3) nearest CORS sites as selected by OPUS.

The airborne GPS receiver (Topcon Legacy-E, L1-L2-GLONASS) was employed on all flights and collected time-tagged (dual frequency) satellite carrier phase data simultaneously with the ground station receivers. GPS data from the base stations was downloaded and included in the GPS processing. Novatel's Waypoint Software (GrafNav) was used in the kinematic GPS post processing. This software computed the forward and backward solutions and combined these two solutions to provide an optimal solution, resulting in values that provided accurate photo coordinates in easting, northing and height.

On several occasions, Wilson & Company's photogrammetrists employed Inertial Measurement Unit (IMU) data whenever the equipment was available; however, this data was not collected on every mission.

Aerotriangulation

Routine softcopy aerotriangulation methods were applied to establish the 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 WAM/WCEA personnel in December 2005 utilizing Z/I Imaging's ISAT digital AT software (version 6.0.5.0) operating on an SSK Pro Workstation. This software was used for the automatic tie point generation, manual measurements of additional tie points, ground control point measurements and bundle adjustments. The AT for the color, MHW B&W IR and MLLW B&W IR photography was performed using images scanned at 25 microns, ABGPS control and 11 ground surveyed control points. The photography was aerotriangulated in three separate blocks - one block contained the color aerial photos, one block contained the MHW B&W IR photos and the third block contained the MLLW B&W IR photos. The final bundle adjustment was done with Inpho's PATB-NT AT version 1.2.164 software.

Upon successful completion of the aerial triangulation process, the ISAT 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 0.4 meters for the color photographs, 0.3 meters for the MHW B&W IR photographs and 0.5 meters for the MLLW B&W IR photographs, based on a 95% confidence level. An Aerotriangulation Report was written and is on file with other project data within the RSD Applications Branch (AB) Project Archive.

The project database consists of general project parameters, camera calibration data, interior orientation parameters, ground control locations, Airborne GPS antenna position and offset data, adjusted exterior orientation parameters, and a 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 initiated by WAM/Wilson & Company, Inc. in January, 2006. Digital mapping was performed using SOCET for ArcGIS (Version 9.2 and ArcGIS 9.3.1) and SOCET SET (Versions 5.4.1 and 5.5) 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 VA0402A were determined according to standard Federal Geographic Data Committee (FGDC) practices. Most features were compiled to meet a horizontal accuracy of 0.8 meters at the 95% confidence level. The MLLW line was 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 aerial triangulation statistics.

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

Date	Time (UTC)	Roll Number	Line Number	Photo Numbers	Scale (nominal)	Tide Level*
09/03/2005	15:01 – 15:09	0528CN03	30-003	326 – 343	1:30,000	0.4 – 0.5
09/12/2005	17:30 – 17:36	0528CN04	30-002	001 – 013	1:30,000	0.1 – 0.2
09/12/2005	17:41 – 17:49	0528CN04	30-001	014 – 031	1:30,000	0.2 – 0.1
05/23/2006	18:32 – 18:35	0627R07	30-001	786 – 792	1:30,000	0.0
05/23/2006	19:49 – 19:55	0627R07	30-002	821 – 831	1:30,000	0.0
05/29/2008	16:34 – 16:35	0827R05	30-003	396 – 399	1:30,000	0.0
01/31/2009	16:13 – 16:18	0927R01	30-001	021 – 031	1:30,000	0.1 – 0.0
01/31/2009	16:23 – 16:25	0927R01	30-003	032 – 036	1:30,000	0.1
03/09/2009	20:04 – 20:05	0927R03	30-003	215 – 218	1:30,000	0.1
11/03/2006	17:02	0627R12	30-003	1291	1:30,000	0.6
10/05/2008	20:13	0828R03	30-002	326 – 327	1:30,000	0.6
02/07/2009	15:44	0927R01	30-003	79	1:30,000	0.5
03/21/2009	14:02 – 14:07	0927R03	30-001	224 – 234	1:30,000	0.7 – 0.6
03/21/2009	14:14 – 14:15	0927R03	30-002	235 – 238	1:30,000	0.6 – 0.7
03/24/2009	15:39 – 15:46	0927R04	30-003	554 – 565	1:30,000	0.8 – 0.7

04/08/2009	14:39 – 14:42	0927R04	30-001	671 – 677	1:30,000	0.5
05/10/2009	16:10 – 16:11	0927R07	30-003	967 – 970	1:30,000	0.4 – 0.5

* Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with discrete tidal zones referenced to verified water level observations at the Kiptopeke, VA gauge (8632200). The height of the MHW tidal datum in the project area varies between 0.47 - 0.74 meters above MLLW.

Quality Control / Final Review

WAM/Wilson & Company personnel conducted quality control (QC) tasks during all phases of project completion. The final QC review was completed in April, 2011. The review process included analysis of 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 9.3.1 software. All project data was evaluated for compliance to CMP requirements.

Comparisons of the largest scale NOAA nautical charts with natural color photographs, tide coordinated B&W IR photography and compiled vector data resulted in creation of the Chart Evaluation File (CEF). The following nautical charts were used in the comparison process:

- 12225 Chesapeake Bay, Wolf Trap to Smith Point, 1:80,000 scale, 59th Ed., Dec/09
- 12226 Chesapeake Bay, Wolf Trap to Pungoteague Cr, 1:40,000 scale, 18th Ed., Jul/09
- 12228 Chesapeake Bay, Pocomoke & Tangier Sounds, 1:40,000 scale, 32nd Ed., Mar/08
- 12230 Chesapeake Bay, Smith Point to Cove Point, 1:80,000 scale, 63rd Ed., Dec/06

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 GC10760 file contents, attached to PCR

Remote Sensing Division Electronic Data Library

- Project database
- GC10760 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

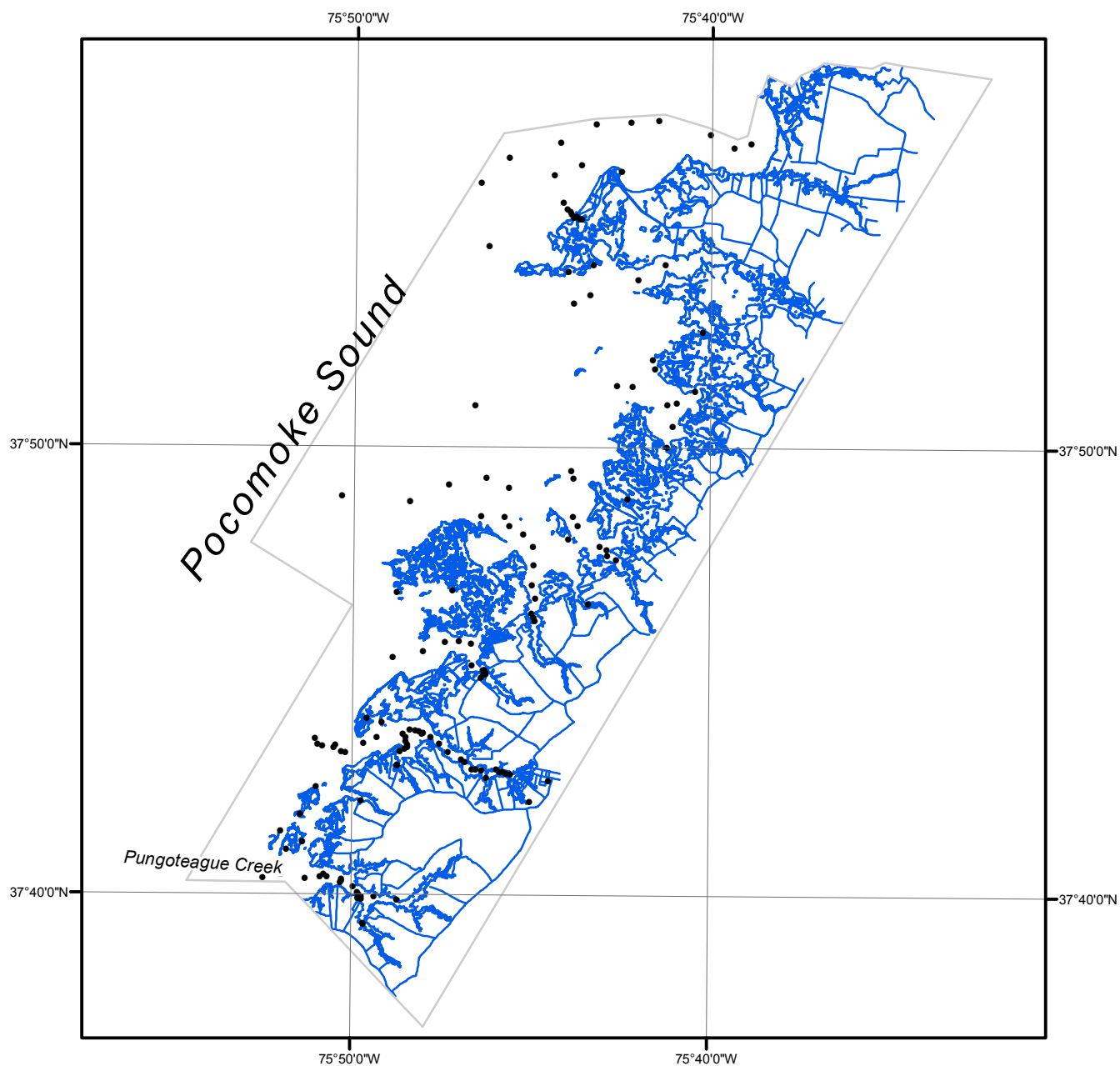
NOAA Shoreline Data Explorer

- GC10760 in shapefile format
- Metadata file GC10760
- Digital copy of the PCR in Adobe PDF format

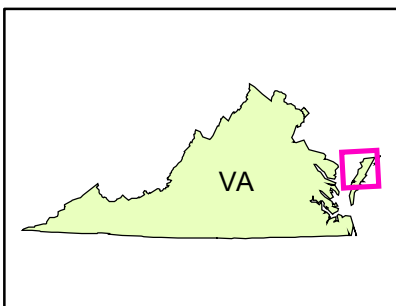
End of Report

POCOMOKE SOUND, PUNGOTEAGUE TO BULLBEGGER CREEK

VIRGINIA



Overview



VA0402A

GC10760