

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT VA0402B

Pungoteague Creek to Chesapeake Bay Bridge-Tunnel, Virginia

Introduction

NOAA Coastal Mapping Program (CMP) Project VA0402B provides a highly accurate database of new digital shoreline data for a portion of the Chesapeake Bay in Virginia. The project extends from the mouth of Pungoteague Creek southward to the southern end of the Chesapeake Bay Bridge-Tunnel, Virginia, and includes creeks along the western shore of the Delmarva Peninsula. VA0402B 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, September 26th, 2006, May 29th, 2008, January 31st, 2009 and March 21st, 2009. Tide coordinated B&W IR MHW photography was successfully acquired on March 4th, 2006, September 21st and 26th, 2006, October 02nd, 2006, November 03rd, 2006, August 19th, 2008, October 3rd and 5th, 2008, January 31st, 2009, February 07th, 2009, March 21st, 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, which contained ephemeris data from these 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 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 aerotriangulation 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 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 initiated by Western Air Maps/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 VA0402B 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 information on the aerial photographs used in the project completion:

Date	Time (UTC)	Roll Number	Photo Numbers	Scale (nominal)	Tide Level*
9-03-05	1508-1515	0528CN03	342-356	1:30,000	0.5
9-03-05	1527-1535	0528CN03	357-374	1:30,000	0.4
9-12-05	1730-1736	0528CN04	1-13	1:30,000	1.5
9-12-05	1741-1752	0528CN04	14-37	1:30,000	0.2
9-12-05	1759-1801	0528CN04	38-48	1:30,000	0.5
9-12-05	1801-1813	0528CN04	49-60	1:30,000	0.9
9-12-05	1817-1823	0528CN04	61--72	1:30,000	0.9
9-12-05	1830-1841	0528CN04	73-87	1:30,000	0.9
3-04-06	1500-1515	0627R03	243-253	1:30,000	0.6-0.9
3-04-06	1717-1722	0627R03	254-264	1:30,000	0.7
5-23-06	1531-1536	0627R07	684-695	1:30,000	0.1
5-23-06	1542-1548	0627R07	696-707	1:30,000	0.1
5-23-06	1555-1601	0627R07	708-718	1:30,000	0.1-0.0
5-23-06	1604-1610	0627R07	719-730	1:30,000	0.0

5-23-06	1619-1627	0627R07	731-748	1:30,000	0-0.1
5-23-06	1640-1655	0627R07	749-779	1:30,000	0.5-0.0
5-23-06	1828-1835	0627R07	780-792	1:30,000	0.0
5-23-06	1847-1859	0627R07	793-806	1:30,000	0.2-0.0
5-23-06	1902-1910	0627R07	807-820	1:30,000	0.0-0.1
5-23-06	1949-1956	0627R07	821-833	1:30,000	0.0
9-21-06	1923-1929	0627R10	991-1003	1:30,000	0.6-0.3
9-21-06	1937-1942	0627R10	1004-1013	1:30,000	0.2-0.4
9-21-06	1942-1948	0627R10	1014-1025	1:30,000	0.4-0.5
9-21-06	1953-2000	0627R10	1026-1040	1:30,000	0.5-0.2
9-21-06	2003-2006	0627R10	1041-1046	1:30,000	0.2-0.1
9-26-06	1731-1735	0627R10	1047-1055	1:30,000	1.0-0.7
9-26-06	1745-1748	0627R10	1056-1061	1:30,000	0.7-0.9
9-26-06	1754-1758	0627R10	1062-1068	1:30,000	0.7
9-26-06	1806-1809	0627R10	1069-1074	1:30,000	0.8-1.2
9-26-06	1906-1908	0627R10	1075-1080	1:30,000	0.5-0.7
11-03-06	1658-1702	0627R12	1282-1292	1:30,000	0.3-0.7
5-29-08	1632-1641	0827R05	393-412	1:30,000	0.1
5-29-08	1647-1652	0827R05	413-425	1:30,000	0.0-0.1
5-29-08	2025-2026	0827R05	455-458	1:30,000	0.8
5-29-08	2031-2034	0827R05	459-464	1:30,000	0.8
5-29-08	2039-2041	0827R05	465-469	1:30,000	0.7
5-29-08	2043-2046	0827R05	470-473	1:30,000	0.7
8-19-08	1608-1617	0827R09	801-818	1:30,000	0.6-0.7
10-03-08	1719-1721	0827R03	204-213	1:30,000	0.5
10-03-08	1733-1739	0827R03	214-226	1:30,000	0.5
10-03-08	1746-1751	0827R03	227-233	1:30,000	0.4-0.6
10-03-08	1800-1807	0827R03	234-242	1:30,000	0.6
10-05-08	1856-1906	0827R03	272-289	1:30,000	0.6-0.5
10-05-08	1954-2004	0827R03	303-318	1:30,000	0.4-0.5
10-05-08	2008-2016	0827R03	319-331	1:30,000	0.5

10-05-08	2028-2030	0827R03	332-335	1:30,000	0.5
1-31-09	1600-1605	0927R01	6-16	1:30,000	0.5
1-31-09	1611-1617	0927R01	17-31	1:30,000	0.1-0.0
1-31-09	1623-1627	0927R01	32-40	1:30,000	0.1-0.0
1-31-09	1645-1646	0927R01	41-44	1:30,000	0.6-1.1
1-31-09	1653-1655	0927R01	45-48	1:30,000	0.9
2-07-09	1525-1531	0927R01	49-61	1:30,000	0.4-0.2
2-07-09	1536-1543	0927R01	62-79	1:30,000	0.2-0.5
2-07-09	1544-1549	0927R01	80-91	1:30,000	0.6
3-09-09	1949-1950	0927R03	210-211	1:30,000	0.1-0.0
3-09-09	1955-1956	0927R03	212-214	1:30,000	0.0
3-09-09	2003-2006	0927R03	215-218	1:30,000	0.1-0.0
3-09-09	2007-2009	0927R03	219-222	1:30,000	0.0
3-21-09	1401-1407	0927R03	223-234	1:30,000	0.3
3-21-09	1413-1414	0927R03	235-238	1:30,000	0.3
3-21-09	1420-1426	0927R03	239-251	1:30,000	0.2-0.3
3-24-09	1527-1534	0927R04	541-553	1:30,000	0.5-0.6
3-24-09	1539-1545	0927R04	554-565	1:30,000	0.5
4-08-09	1407-1408	0927R04	644-647	1:30,000	0.6
4-08-09	1415-1420	0927R04	648-660	1:30,000	0.6-0.8
4-08-09	1421-1430	0927R04	661-670	1:30,000	0.7-0.6
4-08-09	1438-1442	0927R04	671-683	1:30,000	0.7
5-10-09	1604-1611	0927R07	954-971	1:30,000	0.5

* Tide levels are given in meters above MLLW and are based on actual observations at the Chesapeake Bay Bridge-Tunnel, VA and Kiptopeke, VA tide stations, with corrections applied to various CO-OPS tide zones throughout the project area. The mean tide range in the project area was 0.8 m.

Quality Control/Final Review

Wilson & Company personnel conducted quality control (QC) tasks during all phases of project completion. The final QC review was completed in November 2010. 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:

12222, Cape Charles to Norfolk Harbor, VA, 1:40,000 scale, 52nd edition
12224, Cape Charles to Wolf Trap, VA, 1:40,000 scale, 24th edition
12226, Wolf Trap to Pungoteague Creek, VA, 1:40,000 scale, 18th edition
12254, Cape Henry to Thimble Shoal Light, VA, 1:20,000 scale, 48th 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

- 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 GC10761 file contents, attached to PCR

Remote Sensing Division Electronic Data Library

- Project database
- GC10761 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

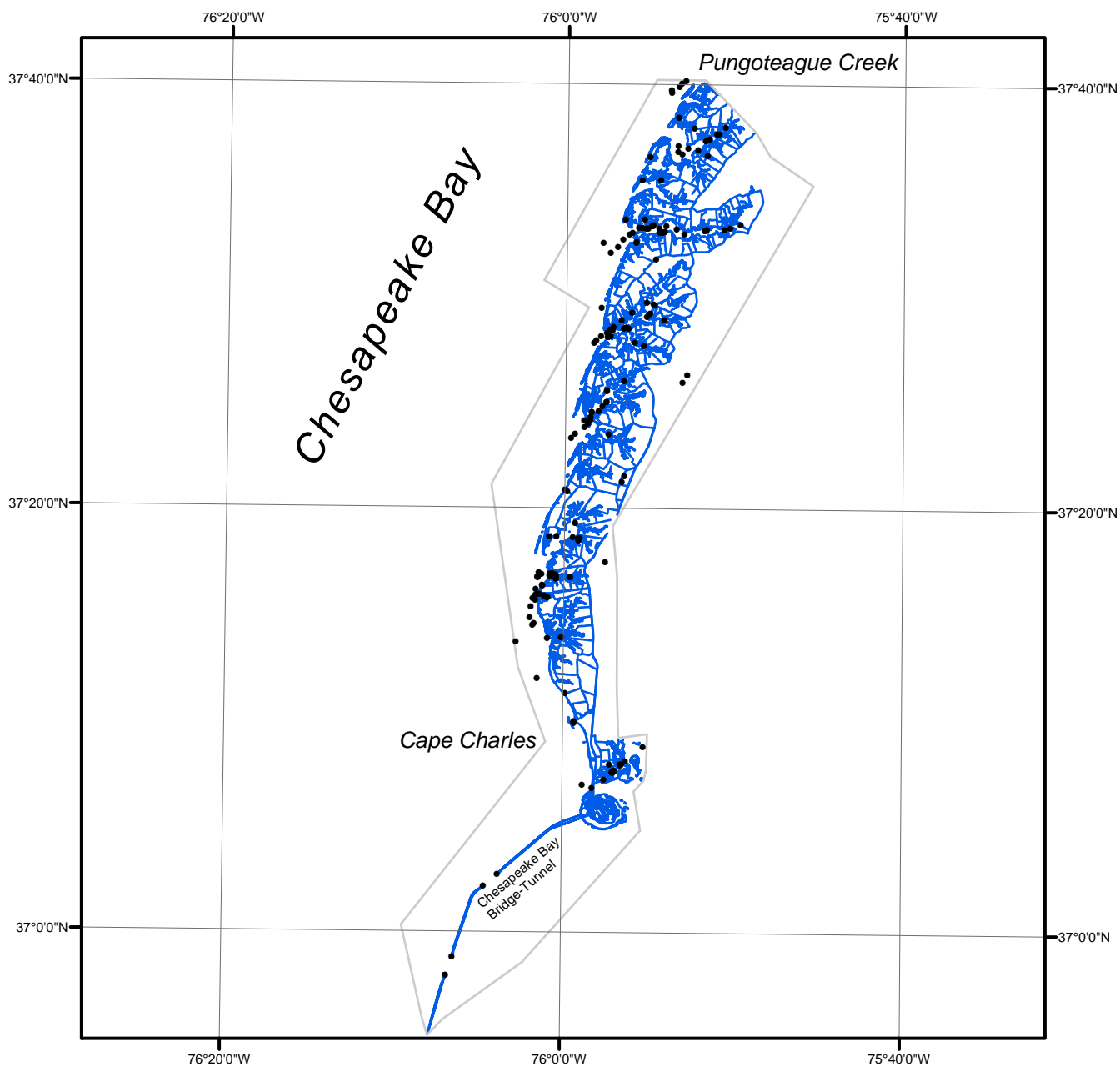
NOAA Shoreline Data Explorer

- GC10761 in shapefile format
- Metadata file GC10761
- Digital copy of the PCR in Adobe PDF format

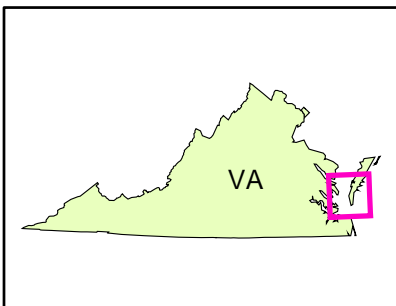
End of Report

PUNGOTEAGUE CREEK TO CHESAPEAKE BAY BRIDGE-TUNNEL

VIRGINIA



Overview



VA0402B

GC10761