

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT NJ0301A

Chesapeake and Delaware Canal, Maryland/Delaware

Introduction

NOAA Coastal Mapping Program (CMP) Project NJ0301A provides a highly accurate database of new digital shoreline data for the Chesapeake and Delaware Canal and Elk River. The project extends from Oldfield Point to Perch Creek on the Elk River in Maryland, and a portion of the Chesapeake and Delaware Canal from Welch Point, MD to St. George's, DE. Project NJ0301A is a subproject of the larger project NJ0301, which spans the Delaware River from Liston Point northward to Trenton, NJ.

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 cartographic feature data of the coastal zone which compliments 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

Tuck Mapping Solutions, Inc. (TMSI) formulated the design of project NJ0301 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 NJ0301 Project Instructions (September 23, 2003 - revised) which contains the specific field and photo mission operational guidelines. The instructions, as provided to Tuck Mapping Solutions, Inc. (TMSI), discussed the project's purpose, geographic area of coverage, scope and priority; photographic and ground control requirements; flight line priority; tide and sun angle coordination; Global Positioning Systems (GPS) data collection procedures and guidelines for both kinematic and static surveys; data recording and handling instructions; and contact communication information.

Nautical charts provided by RSD showed the limits of the project area. Photo scales for the photography were determined by RSD staff to attain the required mapping accuracies. Tuck Mapping Solutions, Inc. (TMSI) created the Project Layout Diagram, flight maps and input files for the aircraft's flight management system and provided copies of the descriptions of selected geodetic control stations at airports that may have been used as bases of operation.

Field Operations

In compliance with the Project Instructions (Section 3.1), Keystone Aerial Survey, Inc. (KASI) located at the North Philadelphia Airport and a subcontractor to TMSI was tasked with acquiring kinematic airborne GPS controlled imagery. Tide coordinated flight times were provided to KASI by TMSI. The natural color (NC) photographic mission conducted on November 9-10, 2003 with a Cessna 310 aircraft acquired thirteen (13) strips of 1:24,000 and two (2) strips of 1:30,000 scale photography.

KASI used two base stations, KASPK and KAS. KASPK, the primary station, was a TRIMBLE dual frequency GPS receiver with an antenna mounted on the top of one of their hangers. KAS has the same configuration arrangement and is a backup for KASPK. There was one data failure on May 10, 2005, for KASPK that required the use of the backup station data. GPS data was submitted for OPUS solutions to verify the stations. KASI recommended James M. Stewart (JMS), Inc. to perform the necessary GPS surveys to locate aerial control and check points. CORS data was combined with the multiple two hour sessions observed by JMS to produce a network adjustment that verified the data previously submitted. See the Photographic Flight Reports and Ground Control Reports for additional information.

GPS Data Reduction

GPS data was collected and processed to provide precise positions of camera centers for application as photogrammetric control in the aerotriangulation phase of the project completion. KASI acquired static GPS datasets of stations KASPK and KAS during all photography missions. After the flight missions the project data was downloaded and processed using GrafNav software Versions 6.03, 7.01, or 7.50.2117. Forward and reverse trajectories were compared during the processing phase to ensure accuracy. Camera event file data was then applied to the final trajectory to obtain coordinates for the photo centers. A GPS Data Processing Report was written and is on file with other project data within the RSD Applications Branch (AB) Project Archive.

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. The softcopy aerotriangulation work was initiated by John F. Kenefick (JFK), Inc. personnel in the summer of 2004 utilizing a digital photogrammetric workstation (DPW), which is a configuration of a computer processor and monitor and ZI ImageStation Photogrammetry Manager (ISPM) software equipment and associated peripheral devices.

Upon completion of the measurement process the data was exported and processed in JFK, Inc's PC-RABATS/BRATS Aerotriangulation software. The natural color 1:30,000 photography flown November 9-10, 2003 and used for the subproject NJ0301A was processed as one block. Upon successful completion of the block adjustment, PC-RABATS/BRATS software provided the RMS of the standard deviations for all aerotriangulated ground points, which were used to compute a predicted horizontal circular error of 0.5 meters for all adjusted photographs. The Aerotriangulation Report is

on file with other project data within the RSD AB Project Archive.

The project database consists of camera calibration data, interior orientation parameters for each frame, airborne GPS antenna position and offset data, adjusted exterior orientation parameters for each frame, and a positional listing of all measured points, the control file and refined image coordinates as in the Project Database section of the Aerotriangulation Report. Positional data is based on the North American Datum of 1983 (NAD 83), and is referenced to the New Jersey State Plane Coordinate System.

Compilation

The data compilation phase of this subproject was initiated by RSD in January of 2006. Digital mapping was performed using a DPW in conjunction with the SOCET SET Feature Extraction software module (version 5.2). 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 cartographic features were further modified with additional descriptive information to refine general classification.

Cartographic features 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.

See Table 1 for information on all aerial photographs used for subproject NJ0301A.

Table 1 - Compilation Sources

Date	Time (UTC)	Roll Number	Film	Frames	Scale (nominal)	Tide Level*
11/9/2003	1725-1730	0319CN01	NC	0138-0147	1:30,000	0.7 - 1.3
11/10/2003	1640-1646	0319CN02	NC	0245-0254	1:30,000	0.9 - 1.4

* Tide levels are given in meters above MLLW and are based on actual observations recorded by NOS gauges at Chesapeake City, MD and Reedy Point, DE (with time and height offsets applied to the St Georges, DE substation) at the time of photography. The mean tide range for the project area varies between 0.9 and 1.3 meters.

Final Review

TMSI performed quality control on the project design, field operations, GPS data processing and aerotriangulation phases of the project. RSD personnel performed quality control of the compilation phase for subproject NJ0301A. The final review was completed in November 2006. The review process included an 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 ArcGIS 9.1 software. All

project data was evaluated for compliance to CMP requirements.

Comparisons of the largest scale NOAA nautical charts with natural color photographs and compiled project data resulted in the creation of the Chart Evaluation File (CEF).

The following nautical charts were used in the comparison process:

12274, Head of Chesapeake, 1:40,000 scale, 34th edition

12277, Chesapeake and Delaware Canal, 1:20,000 scale, 32nd 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 Project Archive

- Hard copy of Airborne Positioning and Orientation Report
- Hardcopy of the Aerotriangulation Report
- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of GC10593 file contents, attached to PCR

RSD Electronic Data Library

- Project database
- GC10593 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

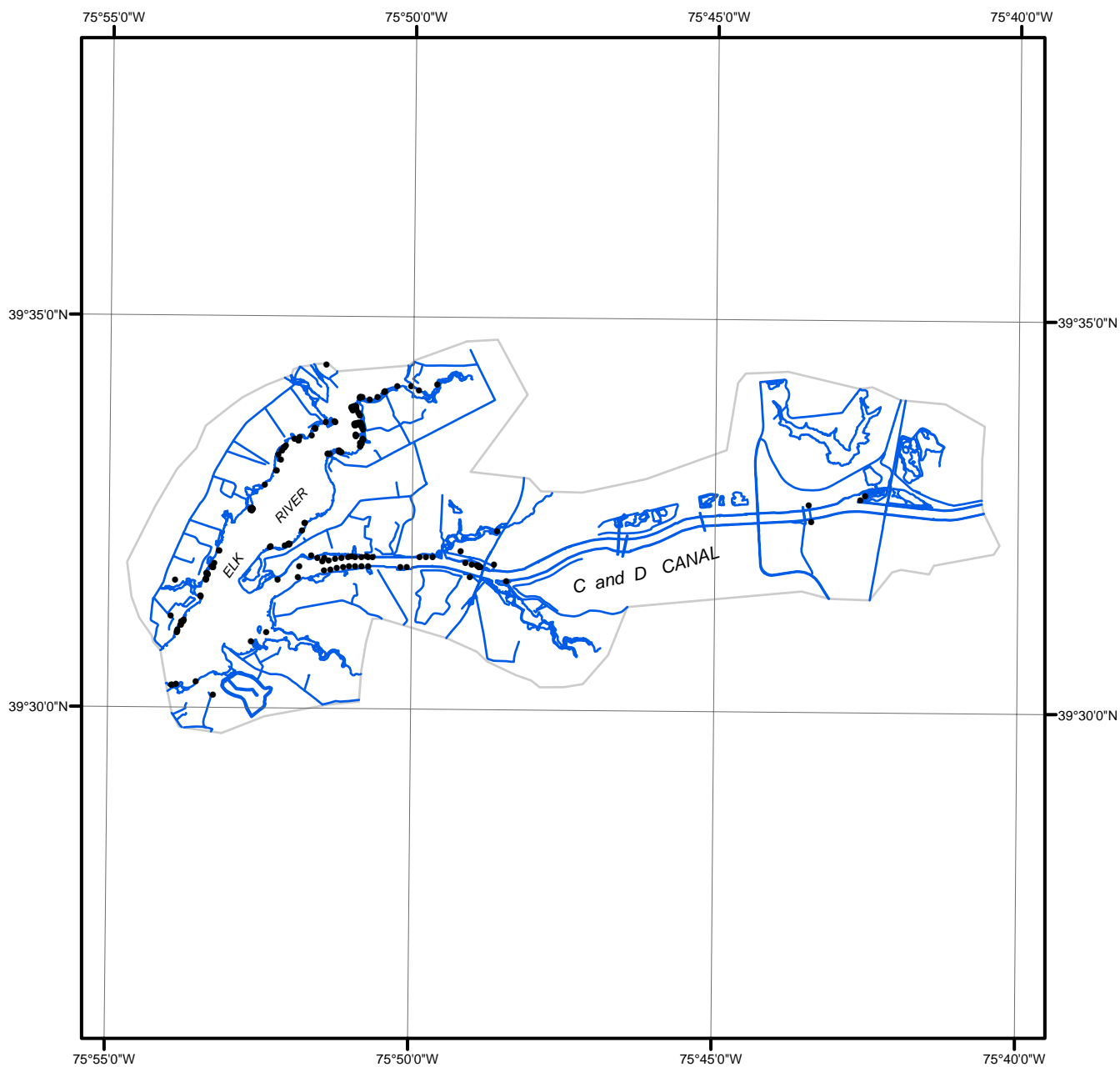
NOAA Shoreline Data Explorer

- GC10593 in shapefile format
- Metadata file for GC10593
- Digital copy of the PCR in Adobe PDF format

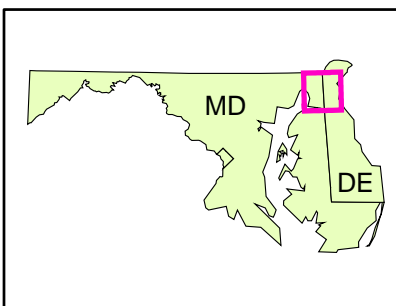
End of Report

CHESAPEAKE AND DELAWARE CANAL

MARYLAND AND DELAWARE



Overview



NJ0301A

GC10593