

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

## **PROJECT CA0202 SAN FRANCISCO, CALIFORNIA**

### **Introduction**

Project CA0202 provides a highly accurate database of new digital shoreline data of San Francisco from Edgemar, CA to the Bay Bridge in San Francisco.

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 files (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 (RSD) formulated the photographic mission instructions for this project following the guidelines of the Photo Mission Standard Operating Procedure Version II (7/1/93). 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.

The RB created a Project Layout Diagram, flight maps and input files for the aircraft's flight management system. The RB provided copies of the descriptions of selected geodetic control stations at airports that may have been used as bases of operation. A briefing was held to review the photographic mission instructions and to distribute the data to photographic mission personnel.

Additional project requirements were submitted by the Office of Coast Survey (OCS) regarding Electronic Navigational Chart (ENC) production which had the effect of increasing the compilation scale and level of feature inclusion.

## **Field Operations**

The field operations consisted of the collection of static and kinematic GPS data and the acquisition of aerial photographs. The photographic mission operations were conducted on October 3, 2002, with the NOAA Cessna Citation II aircraft. Five strips of natural color photographs were acquired through use of a Wild RC-30 camera with the NOS "A" lens cone at the nominal scale of 1:15,000.

A base station was established at the airport using static GPS. Airborne kinematic GPS data was collected to determine precise camera positions in order to establish a control network necessary for aerotriangulation. GPS data collection operations were conducted in accordance with the GPS Controlled Photogrammetry Field Operations Manual (10/25/99). No ground control (panels) were established prior to aerial photographic operations.

## **GPS Data Reduction**

GPS data was processed to provide precise and accurate positions of camera centers for application as photogrammetric control in the aerotriangulation phase of the project. Static GPS data collected over the airport base station was processed using the Online Positioning User Service (OPUS), available through the NGS web site, to provide a reference position for differential processing of the kinematic data. The kinematic GPS data was processed using Applanix POSGPS software by RSD personnel in December 2002. A GPS 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 establish the network of precise GPS camera positions and other control for mapping, and to provide model parameters and orientation elements required for digital compilation. This work was initiated by the RSD AB CMP personnel in December 2002 utilizing a digital photogrammetric workstation (DPW) which is a configuration of a computer processor and monitors, softcopy photogrammetry software (SocetSet), stereographic viewing equipment and associated peripheral devices. A copy of the SocetSet ORIMA software module was utilized for the aerotriangulation process where the five strips of aerial photographs were measured and adjusted as one block. Upon successful completion of the aerotriangulation process, the ORIMA 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 0.5 meters based on a 95% confidence level. An Aerotriangulation Report was written and 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, airborne GPS antenna position and offset 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, in which approximately 122 nautical miles of the shoreline along with an additional 100 nautical miles of piers and other alongshore features were compiled, was accomplished by the RSD AB in November 2002. The digital mapping was performed using a DPW in conjunction with the SocetSet Feature Extraction module. Feature identification and the assignment of cartographic codes were based on image analysis of 1:15,000 scale natural color 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). Nomenclature was assigned to selected cartographic features to refine general classification.

Cartographic features were compiled to meet a horizontal accuracy of 1.0 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is derived by doubling the circular error derived from aerotriangulation statistics.

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

<b>Date</b>	<b>Time (UTC)</b>	<b>Roll Number</b>	<b>Photo Numbers</b>	<b>Scale (nominal)</b>	<b>Tidal Stage (m) (MLLW)</b>
10-3-02	1832-1834	02ACN07	2382-2391	1:15,000	1.565-1.551
10-3-02	1843-1845	02ACN07	2392-2401	1:15,000	1.538-1.525
10-3-02	1851-1854	02ACN07	2402-2407	1:15,000	1.515-1.504
10-3-02	1900-1901	02ACN07	2408-2412	1:15,000	1.482-1.478
10-3-02	1907-1908	02ACN07	2413-2418	1:15,000	1.460-1.455

## Final Review

The final review was initiated by a senior AB CMP team member in July 2004. The digital cartographic feature file (DCFF) was evaluated for completeness and accuracy. Data review consisted of an on-line and off-line evaluation of digital compilation and hard copy products. The on-line review comprised of reviewing stereo models on a DPW for cartographic feature codes selection, positional accuracies of features, and nomenclature. The cartographic feature attribution was judged to conform to C-COAST specification. The offline evaluation compared hard copy plots of the project data with the largest scale NOAA nautical charts available and the natural color photographs. The following nautical charts were used in the comparison process:

18649, Entrance to San Francisco Bay, CA, 1:40,000 scale, 63<sup>rd</sup> edition

18650, San Francisco Bay, Candlestick Point to Angel Island, 1:20,000 scale, 52<sup>nd</sup> edition

## **Project Final Data and Products**

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 GPS Processing Report
- Hard copy of Aerotriangulation Report
- Page size graphic plot of DCFF contents
- Hard copy of the Project Completion Report

### **RSD Electronic Data Library:**

- Project Database
- DCFF: GC-10532
- Digital copy of DCFF in Shapefile format
- Chart Evaluation File in Shapefile format
- Digital Copy of Project Completion Report

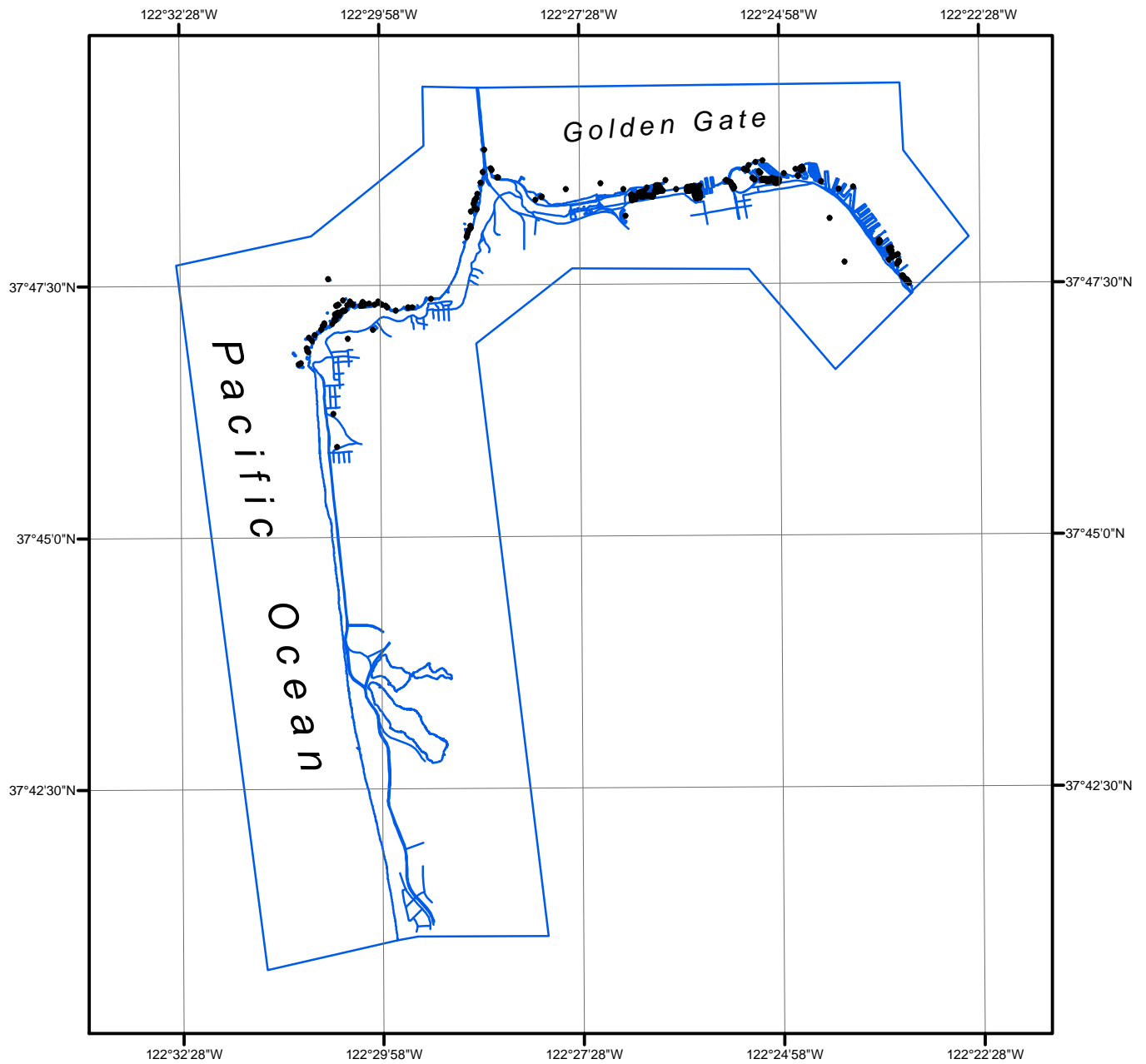
### **NOAA Shoreline Data Explorer**

- DCFF: GC-10532
- Metadata file for GC-10532
- Digital Copy of the Project Completion Report

End of Report

# SAN FRANCISCO

## CALIFORNIA



Overview



CA0202

GC10532