

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT CA1213E-CM-N

San Francisco Bay, Sierra Point to Foster City, California

Introduction

NOAA Coastal Mapping Program (CMP) Project CA1213E-CM-N provides a highly accurate database of new digital shoreline data for a portion of the coastline from Sierra Point to Foster City, California. Project CA1213E-CM-N is a subproject of a larger project, CA1213-CM-N, which covers the eastern and southern portions of San Francisco Bay. The Geographic Cell (GC) may be used in support of the NOAA Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

Project Design

Photographic mission instructions for CA1213-CM-N were formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) following the guidelines of RSD's Photo Mission Standard Operating Procedures. The instructions discussed the project's purpose, geographic area of coverage, scope and priority, image requirements, Global Positioning System (GPS) data collection procedures and guidelines, instructions for data recording and handling, and mission communication protocols. RB created a Project Layout Diagram, flight maps and input files for the aircraft flight management system.

Field Operations

Field operations for CA1213-CM-N consisted of the collection of static and kinematic GPS data and Inertial Measurement Unit (IMU) data, and the acquisition of digital aerial imagery. Aerial survey operations were conducted in April, May, and August 2013, and in February 2014, with the NOAA King Air aircraft (N68RF). Project imagery included 34 flight lines of natural color and near-infrared (NIR) imagery acquired concurrently using an Applanix DSS-439 dual head digital camera system (two 60 mm lenses), in coordination with both MLLW and MHW tide levels. All imagery was acquired at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters.

Direct Georeferencing Data Processing

GPS/IMU data was collected and processed by RSD personnel to yield precise camera positions and orientations for direct georeferencing (DG) of the imagery. A local GPS base station was established for use as a reference station for kinematic GPS processing operations. The position of the base station was determined using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. The airborne kinematic data was processed using Applanix POSPAC (ver. 6.1 and 6.2) software in April, May and August of 2013 and in March 2014. For further information refer to the Airborne Positioning and Orientation Report (APOR) that is on file with other project data within the RSD Electronic Data Library.

The processed GPS/IMU data was used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. The predicted horizontal accuracy of the imagery was determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using an Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 1.5 meters.

Compilation

RSD AB personnel accomplished the data compilation phase of this project in June 2018. Digital mapping was performed using the Feature Extraction software module within SOCET SET (ver. 5.6). Feature identification and attribution within the Geographic Cell (GC) are based on image analysis of the aerial imagery and information extracted from the largest scale NOAA nautical chart 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 CA1213E-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 3.0 meters at the 95% confidence level. This predicted accuracy of well-defined points measured during the compilation phase was derived by doubling the imagery accuracy computed from the EO-TPU tool.

The following table provides information on the imagery used to complete this project:

Date	Time (UTC)	Roll # Color / NIR	Photo #s Color / NIR	Tide Level*
4/17/2013	19:34 – 19:37	13NC13 / 13NR09	2653 – 2672 / 1883 – 1902	0.1 m
4/17/2013	19:43 – 19:45	13NC13 / 13NR09	2673 – 2691 / 1903 – 1921	0.1 m
4/17/2013	19:56 – 19:57	13NC13 / 13NR09	2723 – 2733 / 1953 – 1963	0.1 m
4/17/2013	20:06 – 20:08	13NC13 / 13NR09	2734 – 2749 / 1964 – 1979	0.1 m
4/17/2013	20:15 – 20:17	13NC13 / 13NR09	2763 – 2777 / 1993 – 2007	0.1 m
4/23/2013	18:36 – 18:37	13NC16 / 13NR13	3697 – 3702 / 2916 – 2921	1.8 – 1.7 m
4/23/2013	18:46 – 18:47	13NC16 / 13NR13	3732 – 3737 / 2951 – 2956	1.7 – 1.8 m
4/26/2013	20:49 – 20:51	13NC20 / 13NR16	4472 – 4489 / 3696 – 3713	1.9 m
4/26/2013	20:56 – 20:58	13NC20 / 13NR16	4490 – 4509 / 3714 – 3733	1.9 – 2.0 m
4/26/2013	21:07 – 21:10	13NC20 / 13NR16	4542 – 4560 / 3766 – 3784	2.0 – 1.8 m
4/26/2013	21:16 – 21:17	13NC20 / 13NR16	4561 – 4571 / 3785 – 3795	1.9 – 2.0 m
4/26/2013	21:27 – 21:29	13NC20 / 13NR16	4587 – 4606 / 3811 – 3830	2.0 – 1.7 m

5/1/2013	20:07 – 20:10	13NC27 / 13NR22	5377 – 5394 / 4532 – 4549	-0.1 m
8/26/2013	23:15 – 23:17	13NC58 / 13NR53	12825 – 12839 / 11464 – 11478	2.1 – 2.2 m
8/26/2013	23:21 – 23:23	13NC58 / 13NR53	12840 – 12855 / 11479 – 11494	2.2 – 2.1 m
2/24/2014	21:13 – 21:16	14NC22 / 14NR17	5613 – 5632 / 2772 – 2791	0.2 m
2/24/2014	21:37 – 21:38	14NC22 / 14NR17	5639 – 5644 / 2798 – 2803	0.1 m
2/24/2014	21:56 – 21:57	14NC22 / 14NR17	5686 – 5691 / 2845 – 2850	0.0 m

* Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at the time of photography from various NOS gauges near the project. The elevation of the MHW tidal datum in the project area varies between 1.70 – 2.19 m. above MLLW.

Quality Control / Final Review

A member of the Applications Branch performed quality control during all phases of project completion. The final QC review was completed in June 2018. The review process included analysis of the DG 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 10.5.1 software. All project data comply with CMP requirements.

Comparisons of the largest scale NOAA nautical charts with source imagery and compiled project data resulted in creation of the Chart Evaluation File (CEF). The nautical chart used in the comparison process was:

- 18651 San Francisco Bay – Southern Part, 45th Ed., Dec. 2013

End Products and Deliverables

The following specifies the location and identification of the products generated during the completion of this project:

Remote Sensing Division Electronic Data Library

- Airborne Positioning and Orientation Report (APOR)
- Project Completion Report (PCR)
- Project database
- GC11406 in shapefile format
- Chart Evaluation File in shapefile format

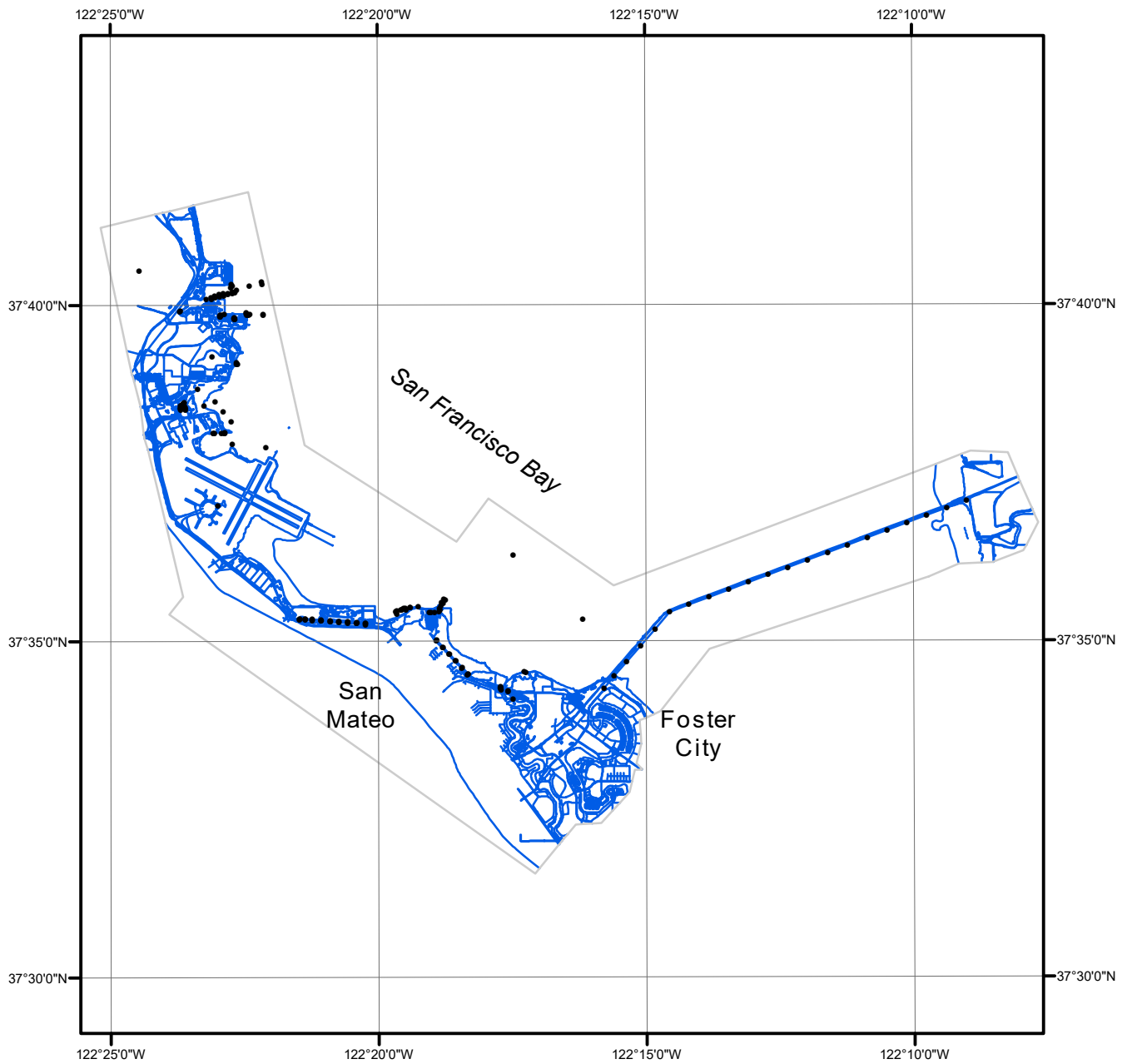
NOAA Shoreline Data Explorer

- GC11406 in shapefile format
- Metadata file for GC11406
- Digital copy of the PCR

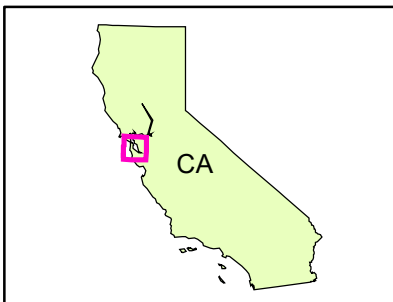
End of Report

SAN FRANCISCO BAY, SIERRA POINT TO FOSTER CITY

CALIFORNIA



Overview



CA1213E-CM-N

GC11406