

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT CA1213G-CM-N

San Francisco Bay, Alameda Creek to Coyote Creek, California

Introduction

NOAA Coastal Mapping Program (CMP) Project CA1213G-CM-N provides highly accurate coastal feature data of San Francisco Bay from Alameda Creek to Ravenswood Slough including Coyote Creek, in California. Project CA1213G-CM-N is a subproject of a larger project, CA1213-CM-N, which covers the southern and eastern portions of San Francisco Bay from the Golden Gate to Carquinez Strait. 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, Inertial Measurement Unit (IMU) data, and acquisition of digital aerial imagery. Aerial survey operations were conducted in April, May, and August 2013, and February 2014 using an Applanix Digital Sensor System (DSS) dual camera at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters. Thirty-four flight lines each of natural color and near-infrared (NIR) imagery were acquired concurrently in coordination with the Mean Lower Low Water (MLLW) and Mean High Water (MHW) tide levels.

Direct Georeferencing Data Processing

GPS/IMU data were 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 May and November 2013, and in March 2014. For further information refer to the Airborne Positioning and Orientation Reports (APOR) on file with other project data within the RSD Electronic Data Library.

The processed GPS/IMU data were used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. The predicted horizontal accuracy for subproject CA1213G-CM-N was determined by propagating sensor EO and image measurement uncertainties for a subset of 800 images from 10 flight lines 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 1.43 meters.

NGS third order geodetic control points were used to verify the horizontal integrity of the DG data. All stereo-models were examined and found to have acceptable levels of parallax for mapping purposes.

Compilation

The data compilation phase of this project was accomplished by RSD Applications Branch (AB) personnel in May 2020. Digital mapping was performed using the Feature Extraction software module within SOCET SET (ver. 5.6). Feature identification and attribution within the GC were based on image analysis of the aerial imagery and information extracted from the largest scale NOAA nautical charts 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 CA1213G-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 2.9 meters at the 95% confidence level. This predicted accuracy of well-defined points measured during the compilation phase was derived by doubling the circular error computed from the EO-TPU tool. The following table provides information on the imagery used to complete this project:

Date	Time (UTC)	Color Imagery		NIR Imagery		Tide Level*
		Roll	Line / Images	Roll	Line / Images	
04/17/2013	20:22 – 20:25	13NC13	50-021/2778 – 2797	13NR09	50-021/2008 – 2027	0.1 – 0.0
04/17/2013	20:33 – 20:37	13NC13	50-022/2798 – 2823	13NR09	50-022/2028 – 2053	0.0 – 0.1
04/17/2013	20:43 – 20:46	13NC13	50-023/2824 – 2846	13NR09	50-023/2054 – 2076	0.0 – 0.1
04/17/2013	20:50 – 20:54	13NC13	50-024/2847 – 2868	13NR09	50-024/2077 – 2098	0.1
04/17/2013	21:01 – 21:04	13NC13	50-034/2869 – 2890	13NR09	50-034/2099 – 2120	0.1 – 0.2
04/18/2013	20:49 – 20:52	13NC14	50-020/3039 – 3058	13NR10	50-020/2269 – 2288	0.1 – -0.1
04/18/2013	20:56 – 20:58	13NC14	50-016/3059 – 3071	13NR10	50-016/2289 – 2301	0.1 – 0.0
04/23/2013	18:37 – 18:39	13NC16	50-019/3701 – 3716	13NR13	50-019/2920 – 2935	1.7 – 2.3
04/23/2013	18:44 – 18:46	13NC16	50-018/3717 – 3733	13NR13	50-018/2936 – 2952	2.3 – 1.7
04/23/2013	18:52 – 18:54	13NC16	50-017/3744 – 3764	13NR13	50-017/2963 – 2983	1.7 – 2.2
04/23/2013	18:59 – 19:01	13NC16	50-016/3765 – 3777	13NR13	50-016/2984 – 2996	2.3 – 2.0

04/23/2013	19:06 – 19:09	13NC16	50-020/3778 – 3797	13NR13	50-020/2997 – 3016	2.4 – 2.2
04/23/2013	19:13 – 19:16	13NC16	50-023/3798 – 3820	13NR13	50-023/3017 – 3039	2.0 – 2.4
04/23/2013	19:20 – 19:22	13NC16	50-021/3821 – 3840	13NR13	50-021/3040 – 3059	2.4 – 2.1
04/23/2013	19:25 – 19:28	13NC16	50-024/3841 – 3862	13NR13	50-024/3060 – 3081	2.1 – 2.4
04/23/2013	19:32 – 19:36	13NC16	50-022/3863 – 3888	13NR13	50-022/3082 – 3107	2.4 – 2.0
04/23/2013	19:40 – 19:43	13NC16	50-034/3889 – 3910	13NR13	50-034/3108 – 3129	2.1 – 2.4
02/24/2014	21:37 – 21:40	14NC22	50-019/5643 – 5658	14NR17	50-019/2802 – 2817	0.1 – 0.2
02/24/2014	21:45 – 21:48	14NC22	50-017/5659 – 5679	14NR17	50-017/2818 – 2838	0.2 – 0.0
02/24/2014	21:57 – 21:59	14NC22	50-018/5690 – 5706	14NR17	50-018/2849 – 2865	0.0 – 0.2

* Tide levels are given in meters above MLLW and were calculated using Pydro software with a TCARI grid referenced to verified water level observations from NOS gauges in the vicinity of the project. The elevation of the MHW tidal datum in the project area ranges between 1.70 – 2.66 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of AB. The final QC review was completed in July 2020. The review process included analysis of the georeferencing 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 Esri's ArcGIS (ver. 10.8.1) software. All project data was evaluated for compliance to 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 following nautical charts were used in the comparison process:

- 18651, San Francisco Bay Southern Part, 45th Ed., Dec. 2013
- 18680, Point Sur to San Francisco, 32nd Ed., May 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

- Project database
- Airborne Positioning and Orientation Reports (APOR)
- GC11408 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

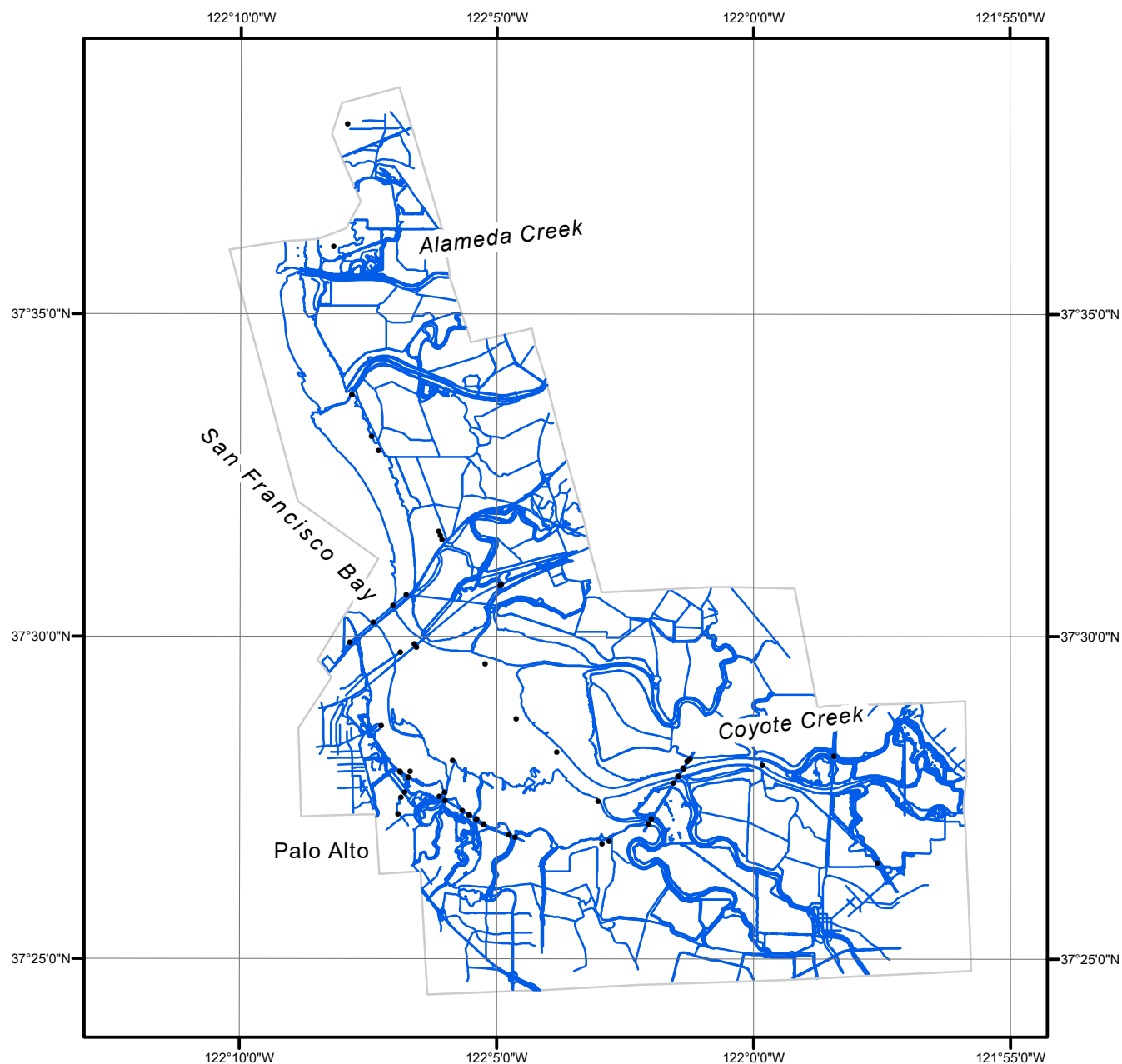
NOAA Shoreline Data Explorer

- GC11408 in shapefile format
- Metadata file for GC11408
- PCR in Adobe PDF format

End of Report

SAN FRANCISCO BAY, ALAMEDA CREEK TO COYOTE CREEK

CALIFORNIA



Overview



CA1213G-CM-N

GC11408