

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

## ***PROJECT CT0401C***

### ***Long Island Sound, Hatchett Point to Point Judith, Connecticut and Rhode Island***

#### **Introduction**

Coastal Mapping Program (CMP) Project CT0401C provides new digital shoreline data along the north shore of Long Island Sound and Block Island Sound, from Hatchett Point, Connecticut in the west to Point Judith, Rhode Island in the east. Project CT0401C is a sub-project of a larger project, CT0401, which includes the entire coast of Connecticut, and parts of New York and Rhode Island.

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 files of the coastal zone which meet the requirements of the CMP. The GC may be utilized in support of NOAA's Nautical Charting Program (NCP) and coastal zone management activities.

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 UTM Zone18, North American Datum of 1983 (NAD 83).

#### **Project Design**

The design of project CT0401C was based on a comparison of image analysis to cartographic detail depicted on the pertinent NOAA nautical charts of the project site. The Requirements Branch (RB) of the Remote Sensing Division (RSD) formulated the CT0401 project instructions for this project. The instructions discussed the project's purpose, geographic area of coverage, scope and priority; photographic requirements; flight line priority; GPS data collection procedures and guidelines for both kinematic and static surveys; data recording and handling instructions; and contact and communication information.

RSD created a Project Layout Diagram, and flight maps. NOVA Digital Systems, Inc. created the input files for the aircraft's flight management system, and provided copies of the descriptions of potential geodetic control stations at the bases of operation.

#### **Field Operations**

All field operations were in support of the larger CT0401 project which includes this sub-project along with sub-projects CT0401A, CT0401B, and CT0401D. Sanborn mapping

Company, a consultant of NOVA, conducted the airborne survey operations on the following dates:

Natural Color photography – September 6, 2005,

IR - MHW photography – September 5 & September 7, 2005,

IR - MLLW photography – May 22, June 18, June 21 and August 12, 2006,

All airborne collections were accomplished within the calculated MHW and MLLW tides. A Cessna T206 aircraft was used to acquire the Natural color photographs and the coordinated MHW black and white (B+W) infrared (IR) photographs. A Piper PA31 was used to acquire the coordinated MLLW B+W IR photographs. Both aircraft used the same Wild RC-30 camera (NOAA contract camera designator # 26). All aerial photographs were acquired at the nominal scale of 1:30,000 with Airborne-GPS (ABGPS). Two ground-based static GPS datasets (NGS station GON-A, CORS station RVDI) were collected, during each photographic mission, as reference position data for the differential correction of the ABGPS data.

Prior to the collection of photography, twenty-six (26) GPS ground control points were set up and paneled for photo identification. Twenty-two (22) of these points were used to supplement the Airborne GPS controlled imagery and four were used as check points not used in the aero-triangulation (AT) adjustment.

Additional information concerning the Field operations and results can be found in the Ground Control Report and the Final Photo Mission Report on file with the National Geodetic Survey (NGS), RSD.

### **GPS Data Reduction**

Global Positioning System (GPS) data was collected and processed to provide precise positions of camera centers for application as photogrammetric control in the aero-triangulation phase of the project. Acquisition, of the reference GPS stations and the ABGPS data, was executed in compliance with the NGS Shoreline Mapping Statement of Work (SOW). The GPS ground survey data were processed using Trimble® Office Geomatics software. The ABGPS data were processed using GrafNav v.7.50 software. Precise satellite ephemerides and standard meteorological data were applied during the data reduction process. GPS data reduction was completed by NOVA Digital Systems, Inc.

### **Aerotriangulation**

A multi-block AT strategy was implemented based on emulsion/data type (Color, MHW B+W IR, MLLW B+W IR) and completed in February 2007. All photographs of the project were “bridged” using a softcopy 3D stereo photogrammetric system to establish the network of control required for the compilation phase. All image point measurements, for the AT phase, were accomplished using the Multi-Sensor Triangulation (MST) module within SOCET SET, v. 4.4. The image points, per block, were then imported into the AeroSys v.7 software for processing the analytical bundle adjustment and computing the Root Mean Square (RMS) of the Standard Deviations (SD) of all the sub-

block adjusted image points. These values were then used to compute the 95% confidence circle (R) for each of the individual blocks. The table below provides information on the image point RMS, per sub-block, for the X and Y components along with the associated R. All values are in meters.

<b>Sub-Block</b>	<b>RMS (x)</b>	<b>RMS (y)</b>	<b>R</b>
NATURAL COLOR Photographs	0.234	0.260	0.6
MHW B+W IR Photographs	0.341	0.380	0.9
MLLW B+W IR Photographs	0.317	0.359	0.8

Additional information concerning the AT process and results can be found in the AT Report on file with the NGS/RSD.

## Compilation

The Compilation phase of the project was completed by NOVA Digital Systems, Inc. in August, 2007. Digital mapping was accomplished using the SOCET SET version 4.4, Feature Extraction software. Feature identifications were based on information extracted from image analysis of all photographs as well as the appropriate NOAA Nautical Charts. Cartographic feature attribution was assigned in compliance with the Coastal Cartographic Object Attribute Source Table (C-COAST) as well as the NGS Shoreline Mapping SOW13A, Attachment K (Feature Compilation).

Cartographic features were compiled to meet a horizontal accuracy of 1.8 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is derived by doubling the circular error computed from aerotriangulation statistics. See the AT report for additional information. The table below provides information on aerial photographs used in the CT0401C project:

<b>Date</b>	<b>Film Emulsion</b>	<b>Time (UTC)</b>	<b>Roll Number</b>	<b>Photo Numbers</b>	<b>Scale (nominal)</b>	<b>Stage of Tide</b>
09-06-05	Color	14:28-14:42	0526CN02	135-156	1:30,000	NA
09-06-05	Color	14:47-15:21	0526CN02	160-210	1:30,000	NA
09-06-05	Color	15:41-15:42	0526CN02	233-236	1:30,000	NA
09-05-05	B&W IR	13:42-13:51	0526R03	264-283	1:30,000	0.7 m
09-05-05	B&W IR	14:19-14:58	0526R03	312-366	1:30,000	0.8 m
09-05-05	B&W IR	16:02-16:03	0526R04	549-552	1:30,000	0.6 m
05-22-06	B&W IR	15:32-15:58	0626R01	29-79	1:30,000	-0.0 m
05-22-06	B&W IR	16:29-16:40	0626R01	87-107	1:30,000	0.0 m
05-22-06	B&W IR	18:43-18:46	0626R01	115-118	1:30,000	0.2 m

\*NOTE: Tide levels were based on actual observations at the following substations: Newport, Montauk, Bridgeport, New London. See the Tabulation of Aerial photographs on file with the NGS/RSD for further information.

## **Quality Control / Final Review**

Quality Control (QC) operations of all the project phases were conducted by NOVA personnel. After completion of the compilation phase, the process included review of the identification and attribution of cartographic features based on image analysis and criteria defined in C-COAST. The quality control process concluded with an inspection of topological connectivity within the GC using ArcGIS software. The project data were evaluated for compliance to CMP requirements and all QC operations were completed in September 2007.

Comparisons of the largest scale NOAA nautical charts with imagery and compiled data resulted in creation of the Chart Evaluation File (CEF). The following NOAA nautical charts and their insets were used for chart comparison:

Chart 12375, Scale 1:20,000 Connecticut River, 21st Ed., Feb. 2001.  
Chart 13211, Scale 1:20,000 North Shore of Long Island Sound, 14th Ed., Sep. 2004.  
Chart 13212, Scale 1:20,000 Approaches to New London Harbor, 37th Ed., Nov. 2005.  
Chart 13213, Scale 1:10,000 New London Harbor, 41st Ed., Mar. 2004.  
Chart 13214, Scale 1:20,000 Fishers Island Sound, 28th Ed., Apr. 2006.  
Chart 13215, Scale 1:40,000 Block Island Sound, 18th Ed., Aug. 2004.  
Chart 13219, Scale 1:15,000 Point Judith Harbor, 12th Ed., Oct. 2001.

## **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 GC10641 file contents, attached to PCR

### **Remote Sensing Division Electronic Data Library**

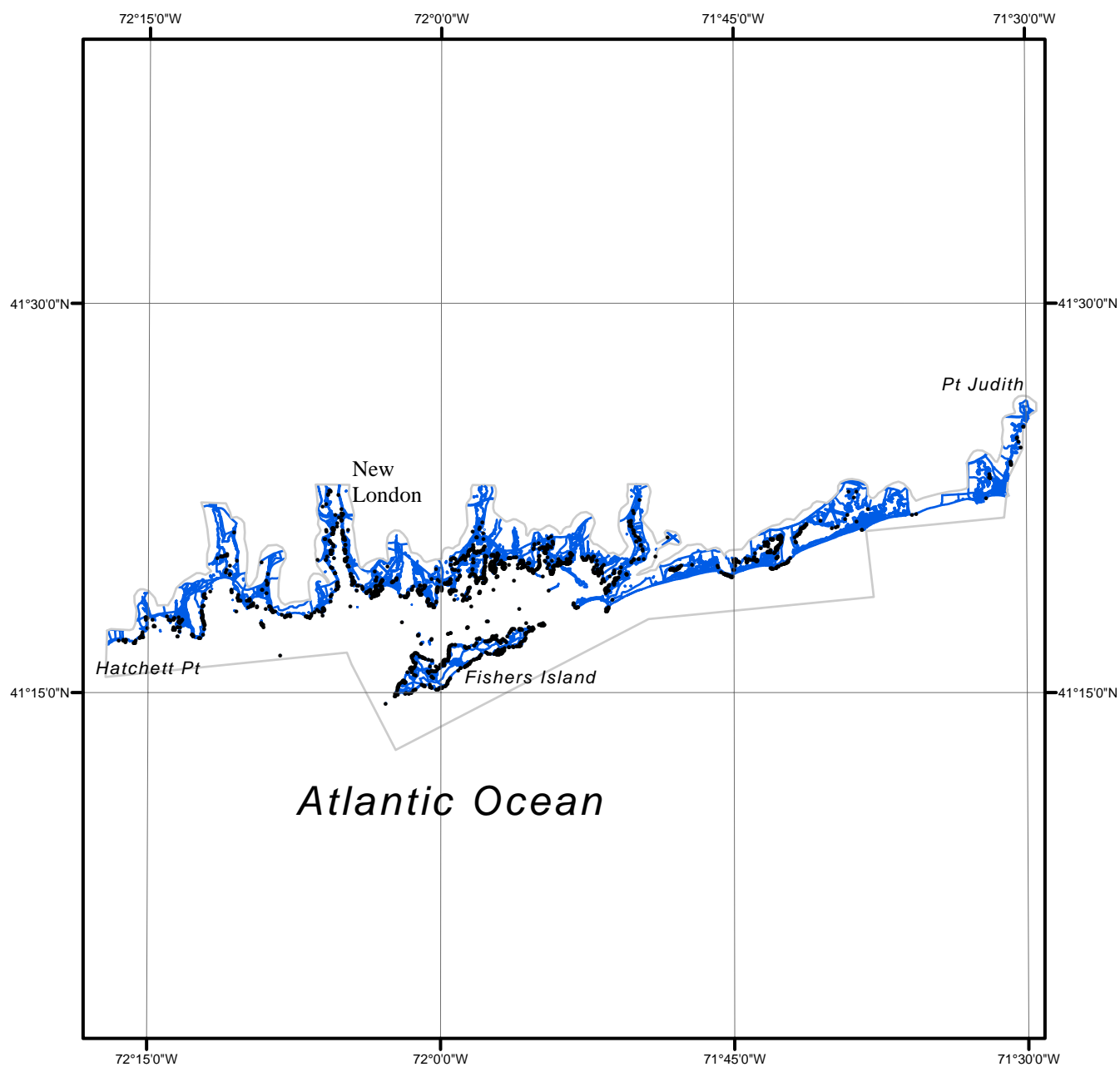
- Project database
- GC10641 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

### **NOAA Shoreline Data Explorer**

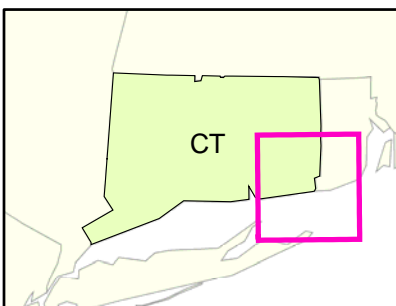
- GC10641 in shapefile format
- Metadata file for GC10641
- Digital copy of the PCR in Adobe PDF format

## **End of Report**

# LONG ISLAND SOUND, HATCHETT POINT TO POINT JUDITH CONNECTICUT AND RHODE ISLAND



Overview



CT0401C

GC10641