

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

## ***PROJECT UM0501***

### ***Palmyra Atoll, U.S. Pacific Islands***

#### **Introduction**

Project UM0501 provides an accurate database of new digital shoreline data for the Palmyra Atoll. The project encompasses the islands of the Atoll as well as the surrounding coral reef area. The project database consists of information measured and extracted from satellite imagery and metadata related to metric data compilation. Base mapping was conducted in a digital environment using softcopy photogrammetric procedures and associated cartographic practices. Project survey data is referenced to the North American Datum of 1983 PACP00 (NAD 83, PACP00). Successful completion of this project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric-quality satellite images, and digital cartographic feature data of the coastal zone which compliments the Nautical Charting Program (NCP) and other geographic information systems.

#### **Project Design**

This project was designed per a request from the NOAA Marine Charting Division (MCD) for cartographic data in support of MCD operations, specifically to aid in shifting the chart data to NAD83. Based on an analysis of project requirements and results of a source data search, it was determined that Coastal Mapping Program (CMP) procedures for compilation from commercial satellite imagery would apply for this project.

#### **Field Operations**

GPS field operations were conducted on June 29 and June 30, 2005 by personnel from the National Geodetic Survey and the U.S. Fish and Wildlife Service. Field operations consisted of the collection of the *Palmyra Base Station* and 10 Photo ID points using static GPS positioning procedures. All GPS data was adjusted to the NAD 83, PACP00 reference frame. See “Palmyra\_Atoll\_Field\_GPS\_Report.pdf” for further details on the collection and processing of the GPS data.

#### **Satellite Image Data and Image Processing**

Two IKONOS-2 **Standard Geo**, non-orthorectified, data components were acquired by the NOAA Center for Coastal Monitoring and Assessment’s Biogeography Team (CCMA-BT) from Space Imaging Inc. in support of NOAA’s Coral Reef Conservation Program. Each data component consisted of spatially coincident panchromatic (Pan) and multi-spectral (MS) images with a pixel ground sample distance (GSD) of 1-meter and 4-meter respectively (Table 1). The overlap of these data frames produced an approximate 15% stereographic coverage of the Atoll. The stated horizontal accuracy of the IKONOS-2 Standard Geo product (CE90% = 15 meters), as derived from rational functions and sensor ephemeris data, necessitated the use of the field

derived Photo ID points along with a geo-referencing algorithm to improve the horizontal accuracy of the compiled product. The image processing and geo-referencing was completed by CCMA-BT personnel in December 2005, and provided to the National Geodetic Survey in support of this CMP project.

Table 1. Source images utilized for compilation in coastal mapping project UM0501.

Image #	Image Source	Source ID (Image Component)	Source File Name	Acquisition Date/Time	Data Type
1	IKONOS-2	2001121521165340000011625769	po_86356_pan_000000.ntf	12/15/2001: 21:16GMT	panchromatic, 1-meter GSD
2	IKONOS-2	2001121521165340000011625769	po_86356_ms_000000.ntf	12/15/2001: 21:16GMT	multi-spectral, 4-meter GSD
3	IKONOS-2	2001121521170430000011625768	po_86356_pan_001000.ntf	12/15/2001: 21:17GMT	panchromatic, 1-meter GSD
4	IKONOS-2	2001121521170430000011625768	po_86356_ms_001000.ntf	12/15/2001: 21:17GMT	multi-spectral, 4-meter GSD

The PCI Geomatics image processing software was utilized to: **1)** Pan-sharpen the independent data components, using the coincident Pan and MS image files, to produce two multi-spectral image files with 1-meter GSD, and **2)** Warp the two pan-sharpened images, within the PCI Ortho module environment, using the sensor rational functions enhanced with the supplemental photo ID points. The Photo ID points and tie points (in the overlap area) were measured on the two pan-sharpened images in order to warp and mosaic the two pan-sharpened images. The outcome from this process was a single rectified MS image file, with a 1-meter GSD, that completely encompassed the islands and the surrounding submerged coral reef area.

The horizontal circular error at the 95% confidence interval (CE95%) for all image points measured for the warp solution was computed as 1.56 meters. However, because independent image points outside of the area of stereo coverage are lacking, this level of planimetric accuracy is questionable across the entirety of the image mosaic. Therefore a more independent and conservative method was employed, whereby the photo ID points were utilized as check points and compared against the original source imagery (controlled by the satellite ephemeris data).

**Using this approach the CE95% was predicted to be 17.6 meters. This is the official accuracy of well defined points as measured during compilation for this project.**

## Compilation

Due to the limited stereo coverage, the Atoll was compiled primarily from the mono-scopic, pan-sharpened mosaic imagery. The stereoscopic coverage provided a useful reference for the overlap area, and as a reference for various cartographic features throughout the project (i.e., submerged\_coral, ledge\_covers\_uncovers) that were difficult to assess with the monoscopic mosaic imagery. The compilation of cartographic feature data for this project was accomplished by a member of the Applications Branch (AB) of the Remote Sensing Division (RSD) in February, 2006. Digital feature data was compiled in ESRI shapefile format utilizing SOCET SET (version 5.2) digital photogrammetric workstation (DPW) software. Feature attributes were established using the C-COAST specification file, which provides the definition and attribution scheme for the full range of cartographic features pertinent to the CMP.

## **Quality Control / Final Review**

Quality control tasks were conducted during all phases of project completion by a senior member of the Applications Branch of RSD. The final QC review was completed in February, 2006. The review process included an analysis of the geo-referencing results and assessment of the identification and attribution of cartographic features according to image analysis and criteria defined in C-COAST. The quality control process concluded with an inspection of topological connectivity within the DCFE using ArcGIS 9.1 software. The entire suite of project products was evaluated for compliance to CMP requirements. The following nautical charts were used in the comparison process:

Chart 83157\_1, Palmyra Atoll, 1:10,000 scale, 5th Ed., Mar. 21/98,

Chart 83157\_2, Palmyra Atoll, 1:47,750 scale, 5th Ed., Mar. 21/98,

Note: Due to an approximate 330 meter offset between the Atoll position on the raster nautical chart (RNC) 83157 and the warped IKONOS-2 imagery, it was determined that the chart required a new registration for reference purposes. Using the Raster Geometric Correction module within the IMAGINE image processing environment, ground control was transferred from the IKONOS-2 mosaic imagery and a 1<sup>st</sup> order Polynomial model was applied. This image warp allowed the compiled coastal vectors, as well as the CEF data, to properly overlay on the chart and source imagery for use in the comparison process.

## **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 image warp and mosaic report.
- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of GC10594 file contents, attached to PCR

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

- Project Database
- Digital copy of DCFE GC10594 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File in shapefile format

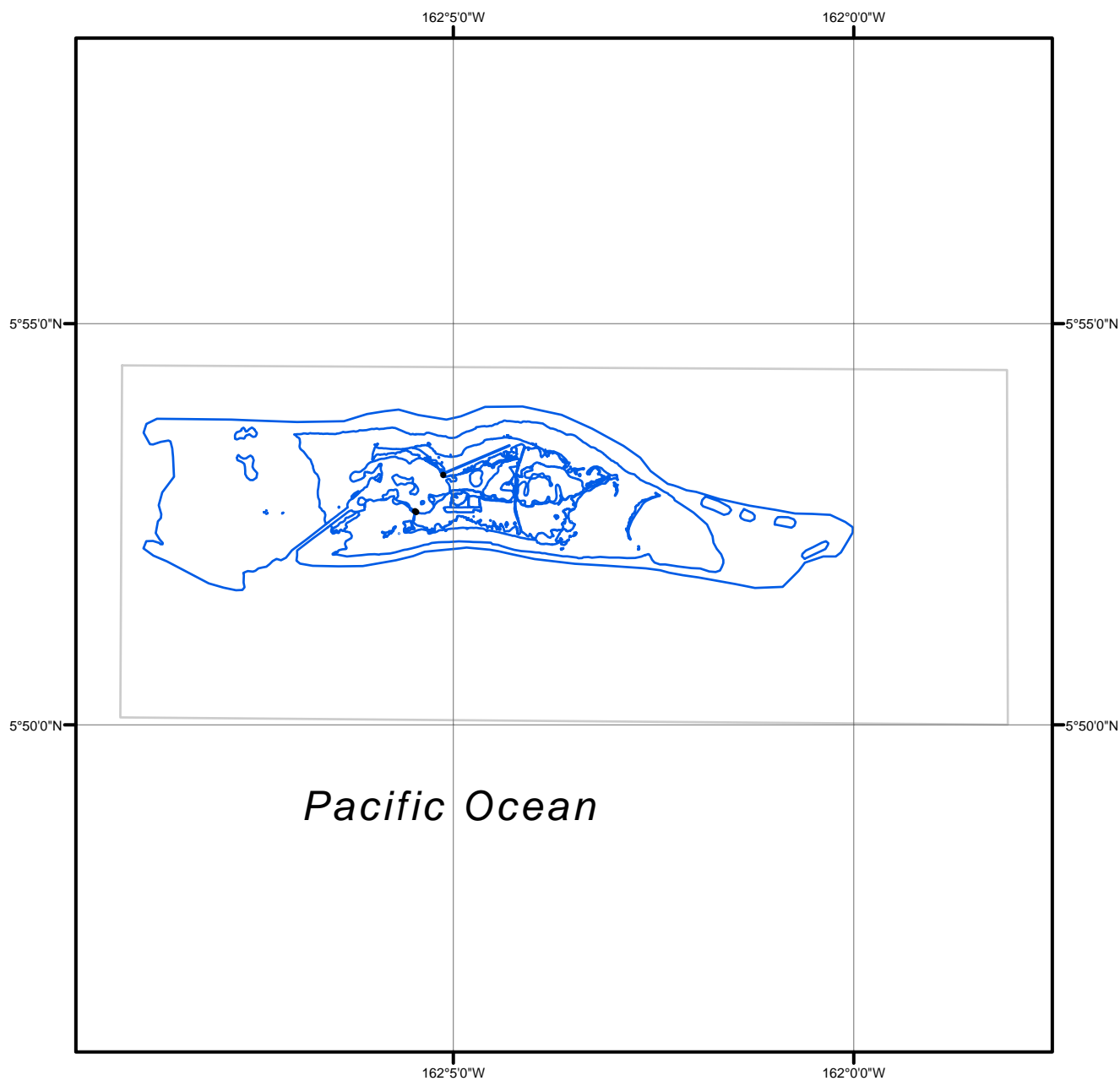
### **NOAA Shoreline Data Explorer**

- DCFE for GC10594
- Metadata file for GC10594
- Digital copy of the PCR in Adobe PDF format

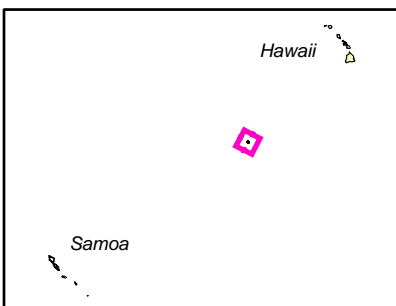
## **End of Report**

# PALMYRA ATOLL

## U.S. PACIFIC ISLANDS



Overview



UM0501

GC10594