

# The Coast and Shoreline Change Analysis Program (CSCAP)

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Remote Sensing Division



National Oceanic and Atmospheric Administration

# Our Focus

- **NOAA**
  - **National Ocean Service**
    - **National Geodetic Survey**
      - **Remote Sensing Division**
  - **Primary programs**
    - **Coastal Mapping Program**
    - **Aeronautical Survey Program**

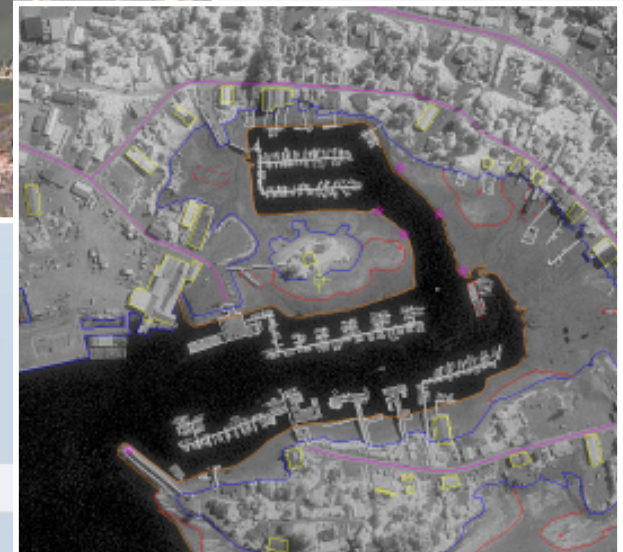


# Coastal Mapping Program

- NOAA's National Geodetic Survey (NGS) has the mandate to survey coastal regions within the U.S. and territories.
- NGS delineates the shoreline through stereo photogrammetry, using tide-coordinated aerial photography controlled by kinematic Global Positioning System (GPS) techniques.
- CSCAP utilizes high resolution satellite imagery and NOAA's Electronic Navigational Charts (ENC) to look for shoreline change within major port cities.
- The Coast and Shoreline Change Analysis Program (CSCAP) is a sub-component within the CMP and is the first step in the Electronic Navigational Chart Validation Initiative.



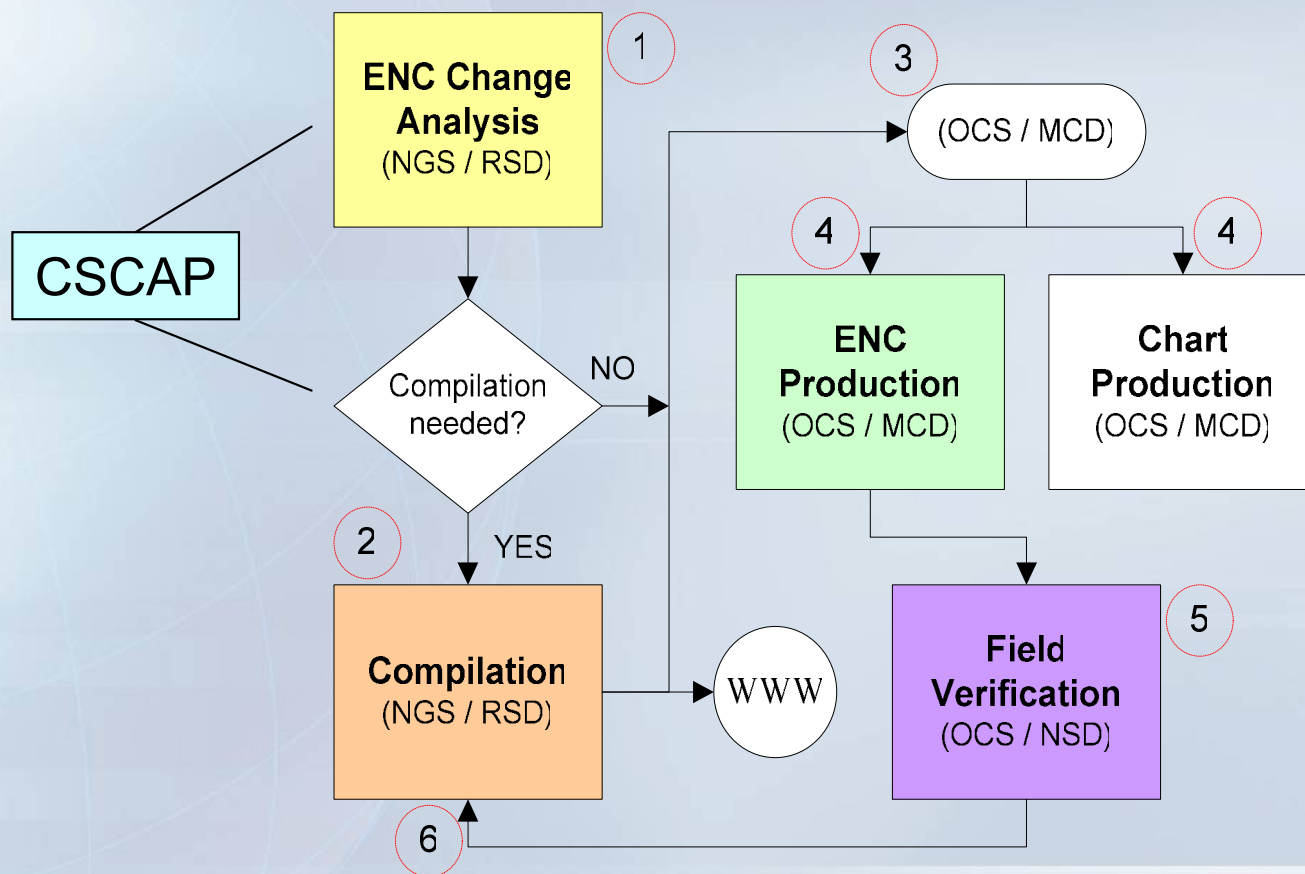
# Digital Photogrammetric Workstation used for aerotriangulation and feature extraction



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# ENC VI: A Multi-Organizational Process

## Life Cycle of the Chart Evaluation File



# Evaluated Imagery

- SPOT – 10 m spatial resolution
- IRS – 5 m spatial resolution
- SPIN2 – 2 m spatial resolution
- IKONOS – 1 m spatial resolution
- Quickbird – 0.60 m spatial resolution



# Charleston, SC IRS Image

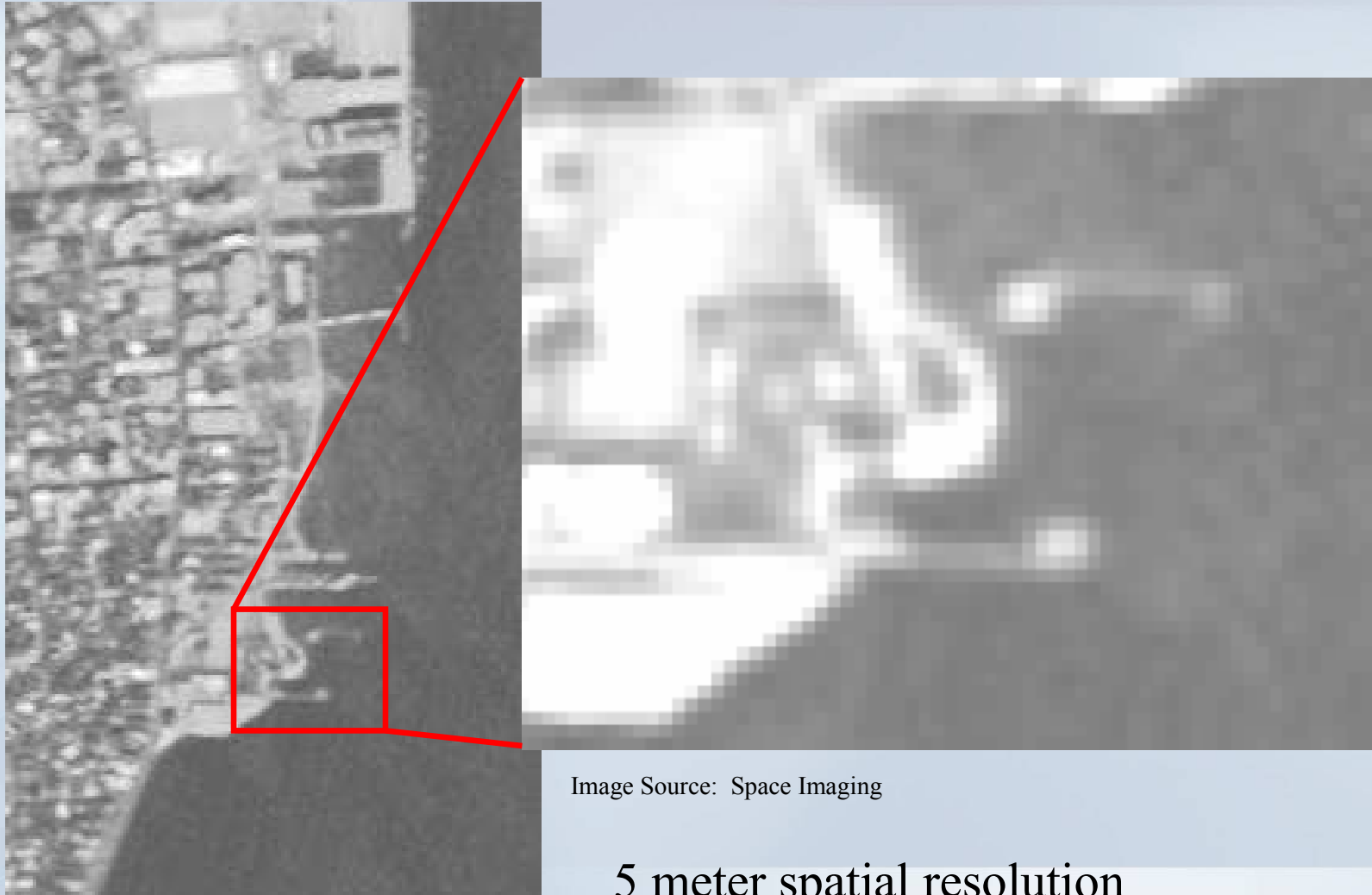


Image Source: Space Imaging

5 meter spatial resolution



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# Charleston, SC SPIN2 Image



Image Source: Aerial Images

2 meter spatial resolution



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# Portland, OR IKONOS Image

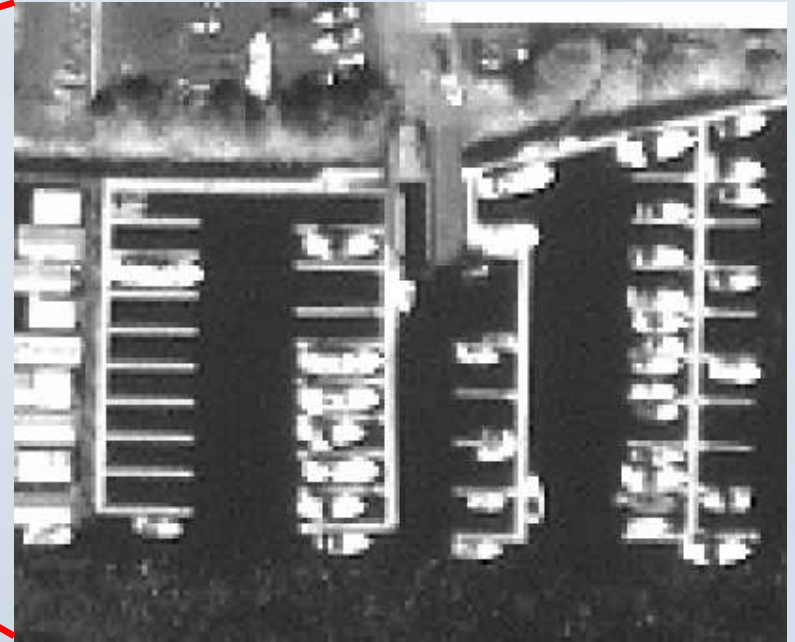
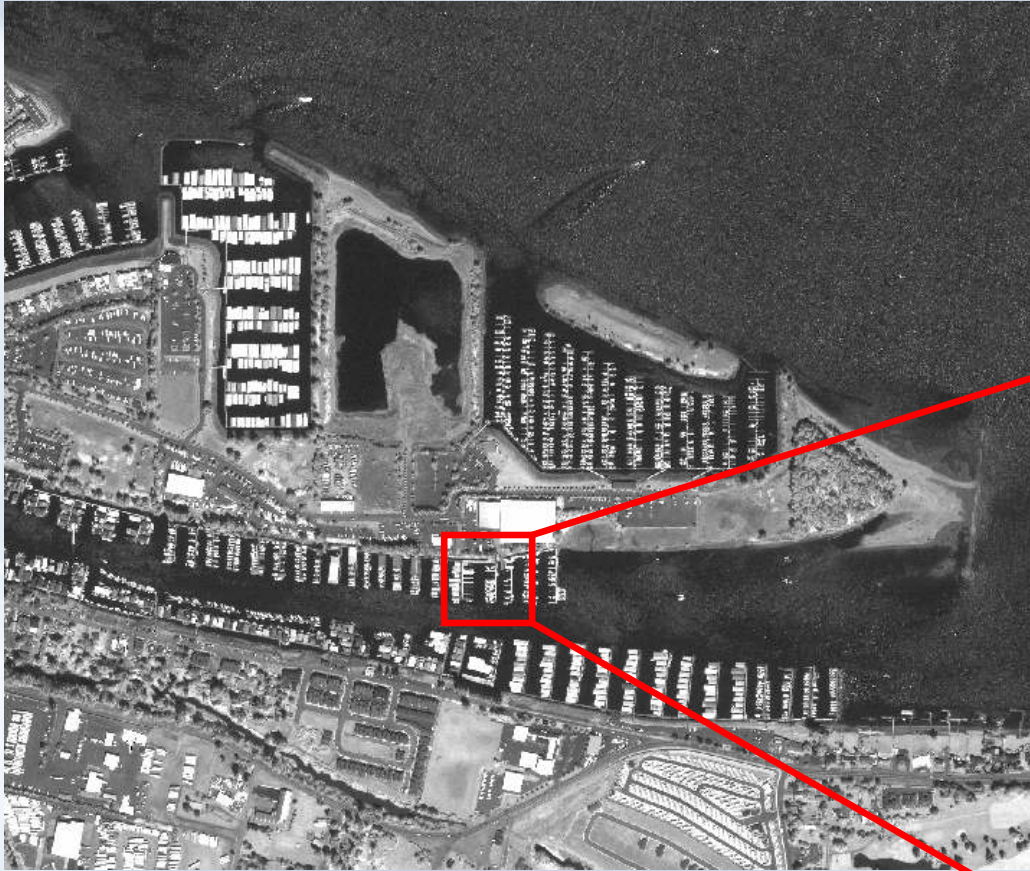


Image Source: Space Imaging

1 meter spatial resolution



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# Ponce, PR Quickbird Image



Image Source: Digital Globe



60 centimeter spatial resolution



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# Future Satellites

## GeoEye-1 (GeoEye)

- Anticipated launch in early 2007
- 0.41 m panchromatic spatial resolution
- 1.64 m multispectral spatial resolution
- 1.2 million sq. KM of imagery/day
- 1.5 day revisit period

## WorldView 1 (Digital Globe)

- Anticipated launch in mid-2007
- 0.50 m panchromatic spatial resolution
- 500,000 sq. km of imagery/day
- 1.7 day average revisit time.



# CSCAP Processing Steps

- Improve relative positioning
- Change Analysis
  - NOAA Electronic Navigational Chart and NOAA Raster Nautical Chart compared with High Resolution Satellite Imagery.
- Georeference Imagery using ground control
- Accuracy Assessment
- Shoreline Compilation
  - Field Verification



# Relative vs Absolute Georeferencing

## Relative

- Uses image coordinates to align shoreline with image.
- User defined links between features on image and shoreline
- Utilizes a first order polynomial transformation
- **NO ACCURACY INFORMATION**

## Absolute

- Utilizes best available control
- Register imagery to reference data
- Uses a first- order polynomial transformation
- **IMAGE ACCURACY IS KNOWN**



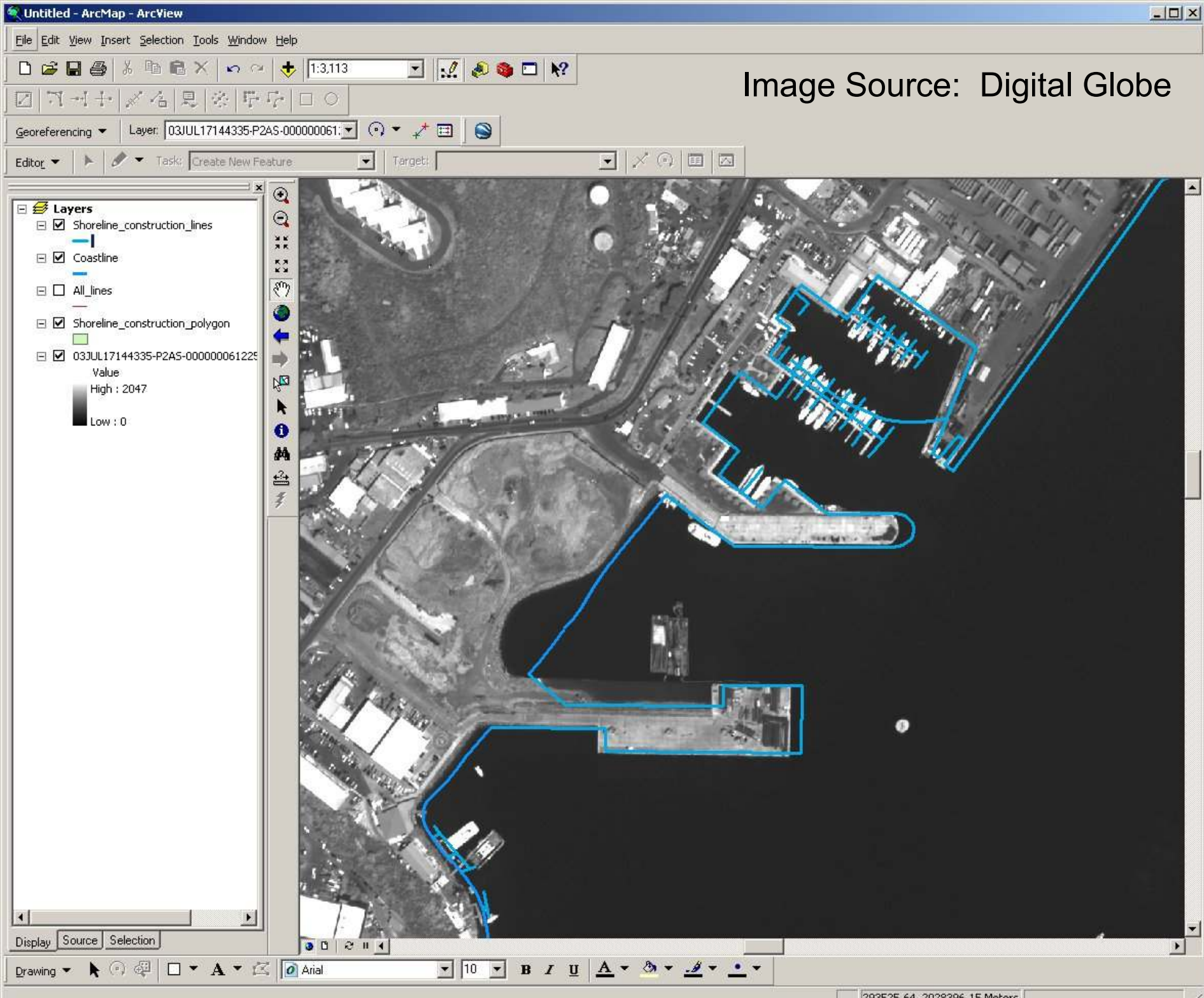


Image Source: Digital Globe

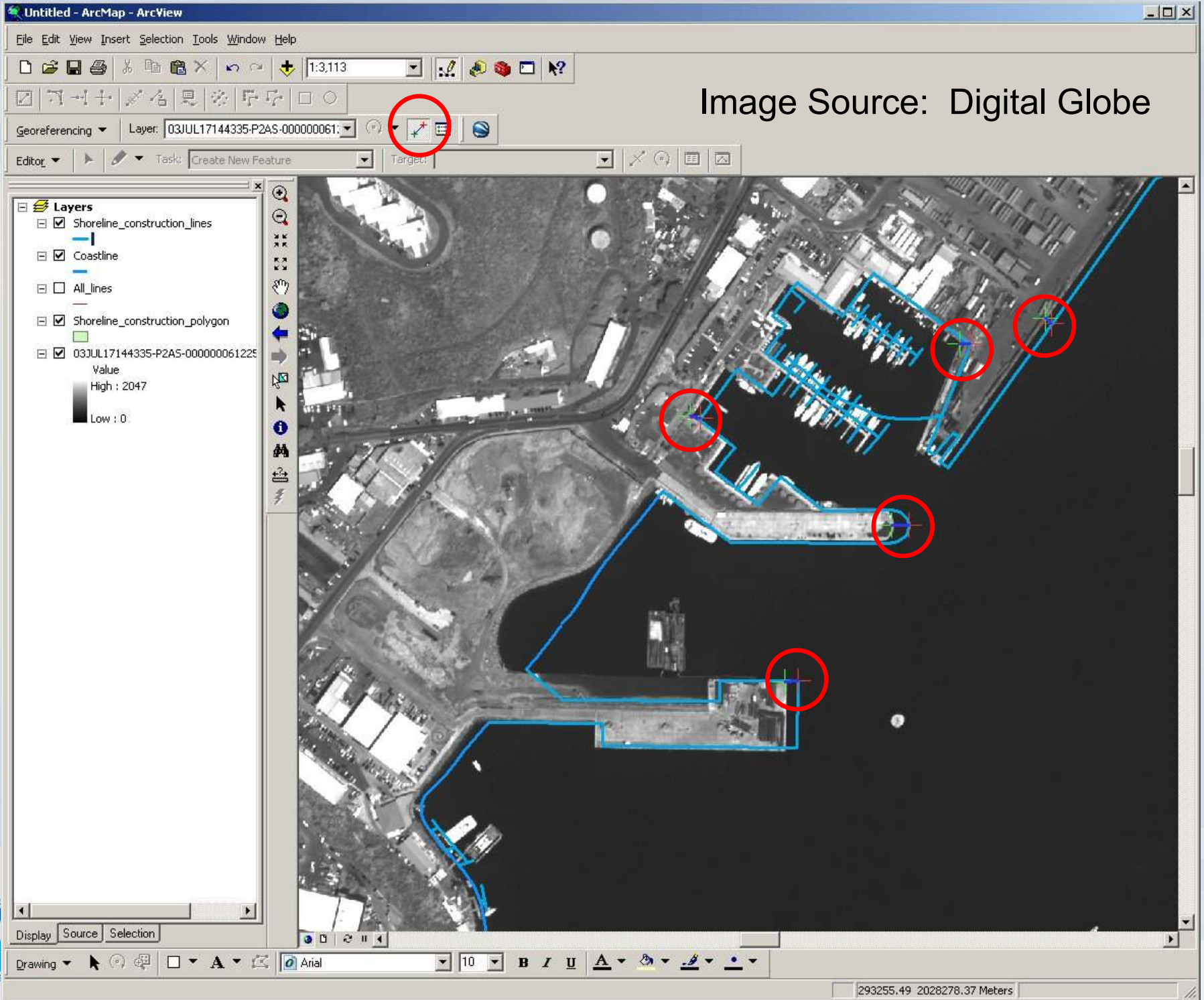


Image Source: Digital Globe

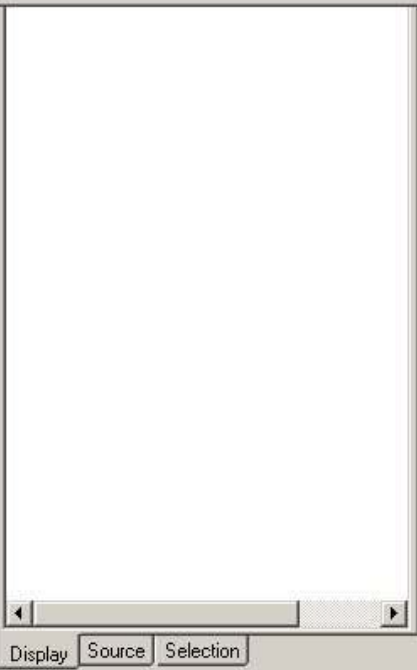
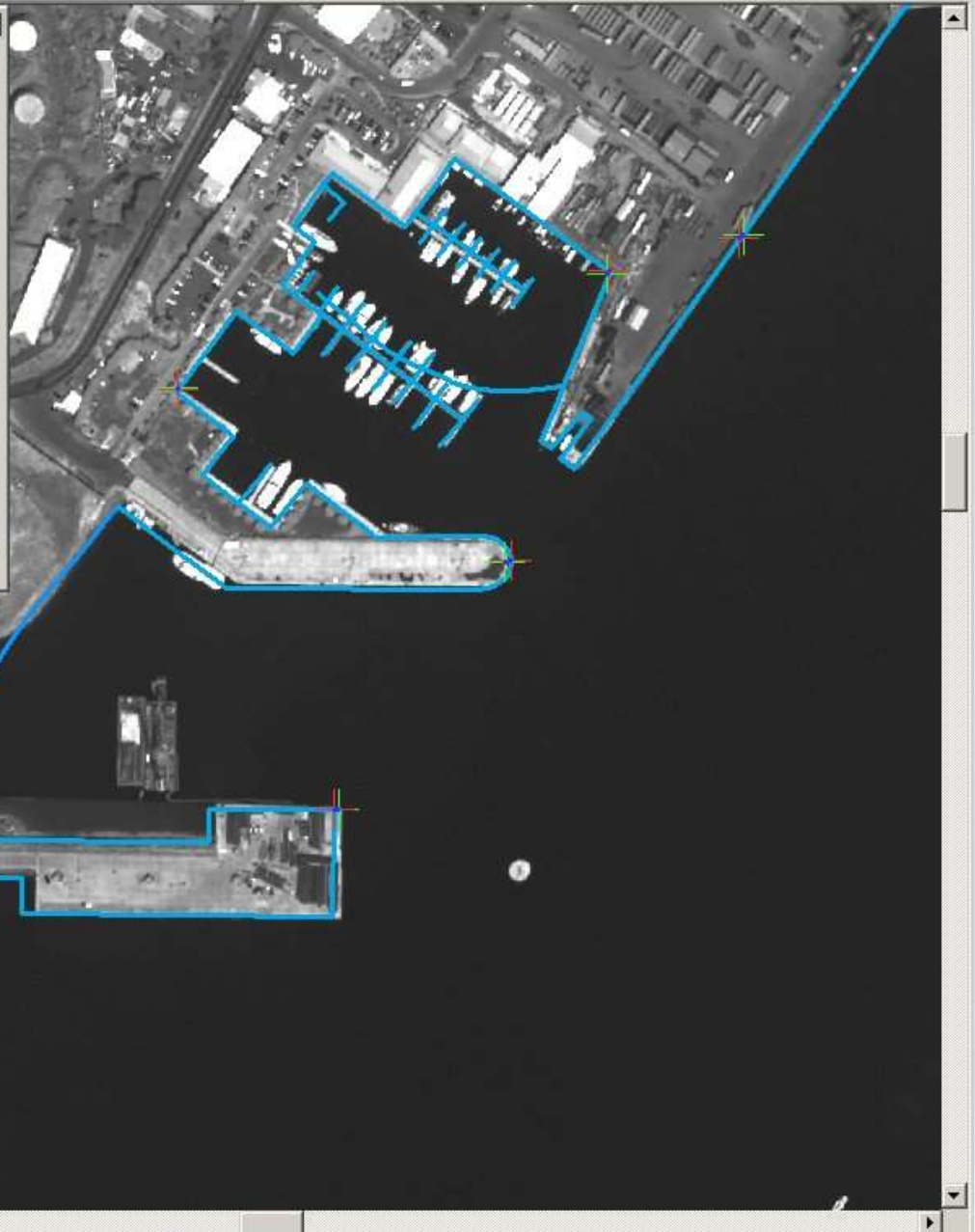
Image Source: Digital Globe

Link Table

Link	X Source	Y Source	X Map	Y Map	Residual
1	293648.361868	2027992.568952	293659.069138	2027993.392588	2.07768
2	293734.843665	2028119.408921	293748.845480	2028119.408921	3.68993
3	293571.763705	2028207.537991	293580.000066	2028205.890718	0.51394
4	293790.027288	2028266.016158	293798.263650	2028266.016158	2.19057
5	293859.212726	2028286.607063	293864.154543	2028282.488882	2.81155

Auto Adjust Transformation: 1st Order Polynomial (Affine) Total RMS Error: 2.48596

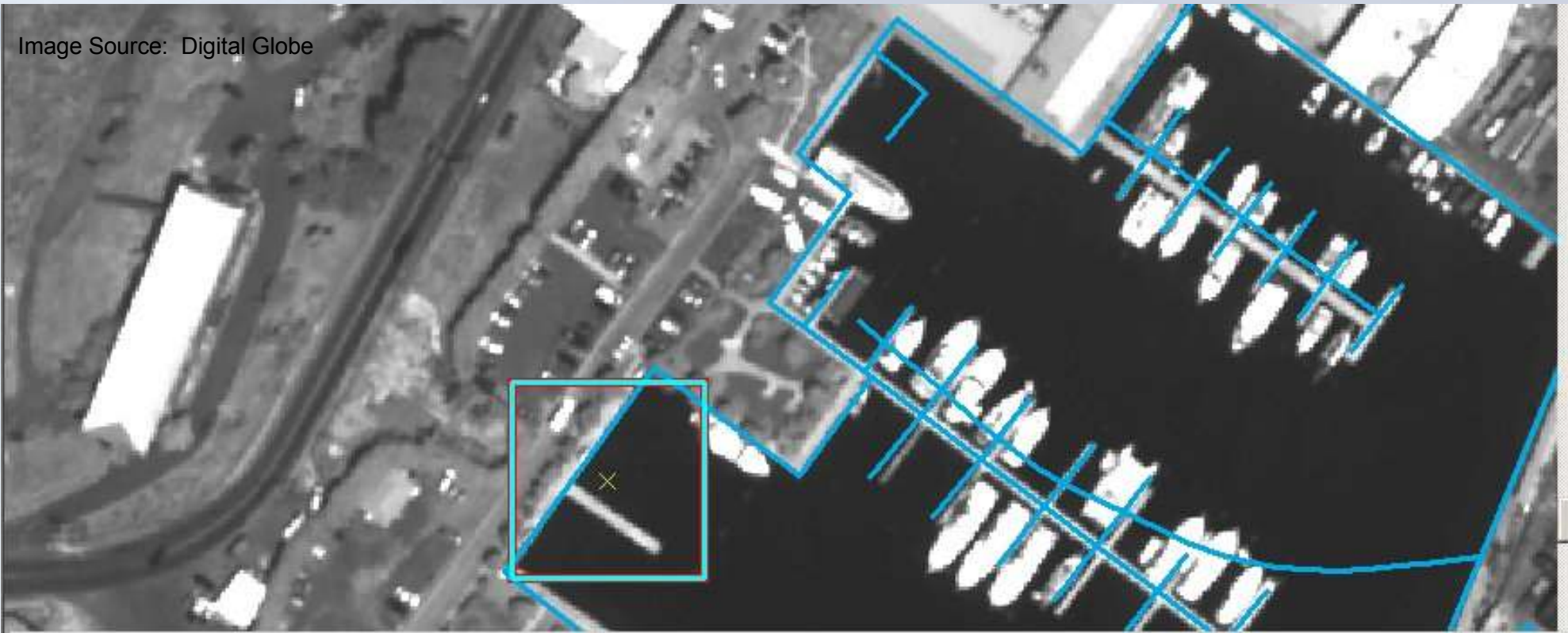
Load... Save... OK





# Chart Evaluation File (CEF)

Image Source: Digital Globe



**Compile CEF Features**

Select Class	Select Attribute	Select Attribute Extension	ENC vs RAS
SHORELINE ALONGSHORE FEATURE OBSTRUCTION POINT OBSTRUCTION LINEAR FREESTANDING MARINE FE. LANDMARK AID TO NAVIGATION	Fender Gate Groin Jetty Marine Railway Pier Training Wall	no extension .Fixed .Floating .Ruins	(no conflict) CONFLICT

Current Class, Attribute and Extension: **ALONGSHORE FEATURE Pier**

Change Note:

Verifiable: YES NO DOUBTFUL

Priority: LOW MEDIUM HIGH

# Identify Results

Layers: <Top-most layer>

[-] XX9999X\_CEF

[+] Quick Bird

Location: (293479.315663 2028084.121221)

Field	Value
FID	0
Shape	Polygon
Id	0
IMG_SOURCE	Quick Bird
IMG_DATE	20030717
LAT_DD	18.332084
LON_DD	-64.954206
FEATURE	10
ATTRIBUTE	SHORELINE Man-made.Rip Rap
S57_CODE	SLCONS;catslc 8
CHG_NOTE	Significant shoreline change
ENC_vs_RAS	
VERIFIABLE	YES
PRIORITY	HIGH
RSD_REC	
RSD_NOTE	
ENC_NOTE	
FIELD_NOTE	
FIELD_REC	
CARTO_REC	
DATASRC_ID	



# Charlotte Amalie 2003 Quickbird Image



# Christiansted 2003 Quickbird Image



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# Christiansted 2003 Quickbird Image



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# Absolute Georeferencing

- Obtain ~ 30 GPS ground control points
  - 10 – Re-georeferencing
  - 20 – Accuracy Assessment
- Provide approximate locations for field crew
- Use a first-order polynomial



# Accuracy Assessment Procedures

- Procedures are based on the *Geospatial Positioning Accuracy Standards Part 3: National Standard for Spatial Data Accuracy* document provided by the Federal Geographic Data Committee (FGDC)
- Root mean square error is used to estimate positional accuracy.
- An independent source of higher accuracy control must be used.
- A minimum of 20 check points shall be used.
- Check points must be distributed to reflect the geographic area of interest.



# Image Georeferencing Accuracy

<b>Location</b>	<b>Image georeferencing source</b>	<b>RMSx</b>	<b>RMSy</b>	<b>RMSr</b>	<b>CE at 95% confidence level</b>
<b>Alameda</b>	GPS Data Points	0.57 m	0.55 m	0.79 m	1.36 m
<b>Carquinez</b>	GPS Data Points	0.49 m	0.47 m	0.68 m	1.17 m





# Field Verification



Image Source: Space Imaging, LLC



Image Source: Space Imaging, LLC




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# Limitations

- Ground control and check points must be collected for areas to be compiled
- Factors that limit accuracy of compiled shoreline:
  - Spatial resolution
  - Georeferencing accuracy
  - Possibility of unknown, nonsystematic geometric problems with the imagery
  - Cannot be tide coordinated
  - Attribution is difficult and varies depending on atmospheric conditions




# Data Distribution

High Resolution Medium Resolution NOAA  Shoreline Data Explorer

intro | search | selection | legend | help


Introduction



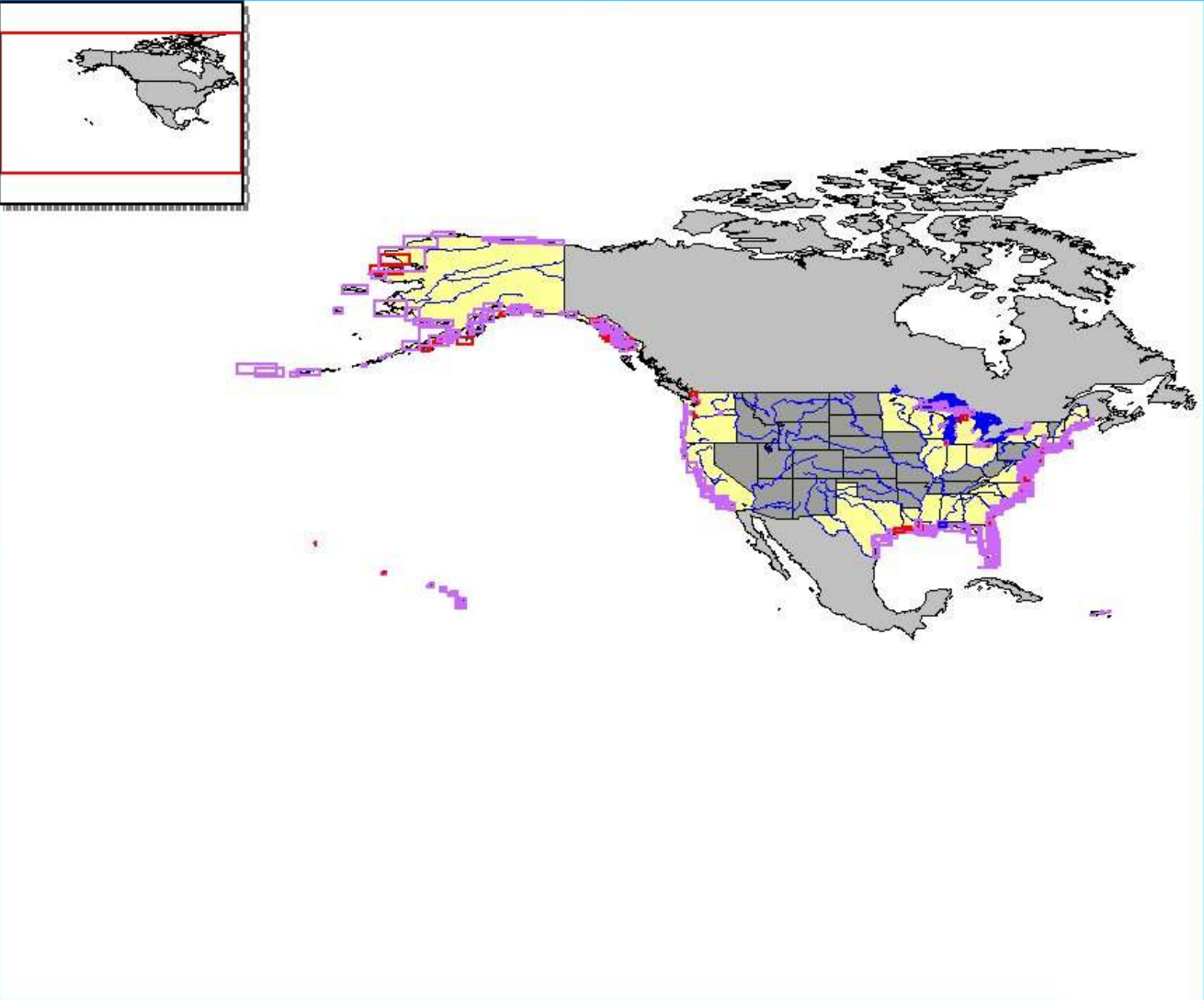
National Geodetic Survey  
NOAA Shoreline Data Explorer

The Data Explorer provides high-resolution digital shoreline from multi-temporal surveys of our nation's coastline. It provides the following capabilities:

- View available shoreline project boundaries
- View vector shoreline data
- View and download FGDC compliant metadata
- Make printable maps
- Download vector shoreline shapefiles

You may locate shoreline project boundaries, outlined in red (post-1990) or purple (pre-1990), by zooming in (left button click) to States highlighted in yellow. Use the cursor tools to zoom in, zoom out, or pan until you have located the project your are interested in. Draw a box around the project(s) of interest using the "Select by Rectangle"  tool. This will highlight the project outline in green and present you with options to view and download the vector shoreline data or the associated FGDC metadata. Other methods to locate vector shoreline data are outlined in the online [tutorial](#).


[Shoreline Update Notice](#)



0 1090.85 Kilometers





Active Layer: Projects

# Data Distribution

**High Resolution** **Medium Resolution** **NOAA**  **Shoreline Data Explorer**

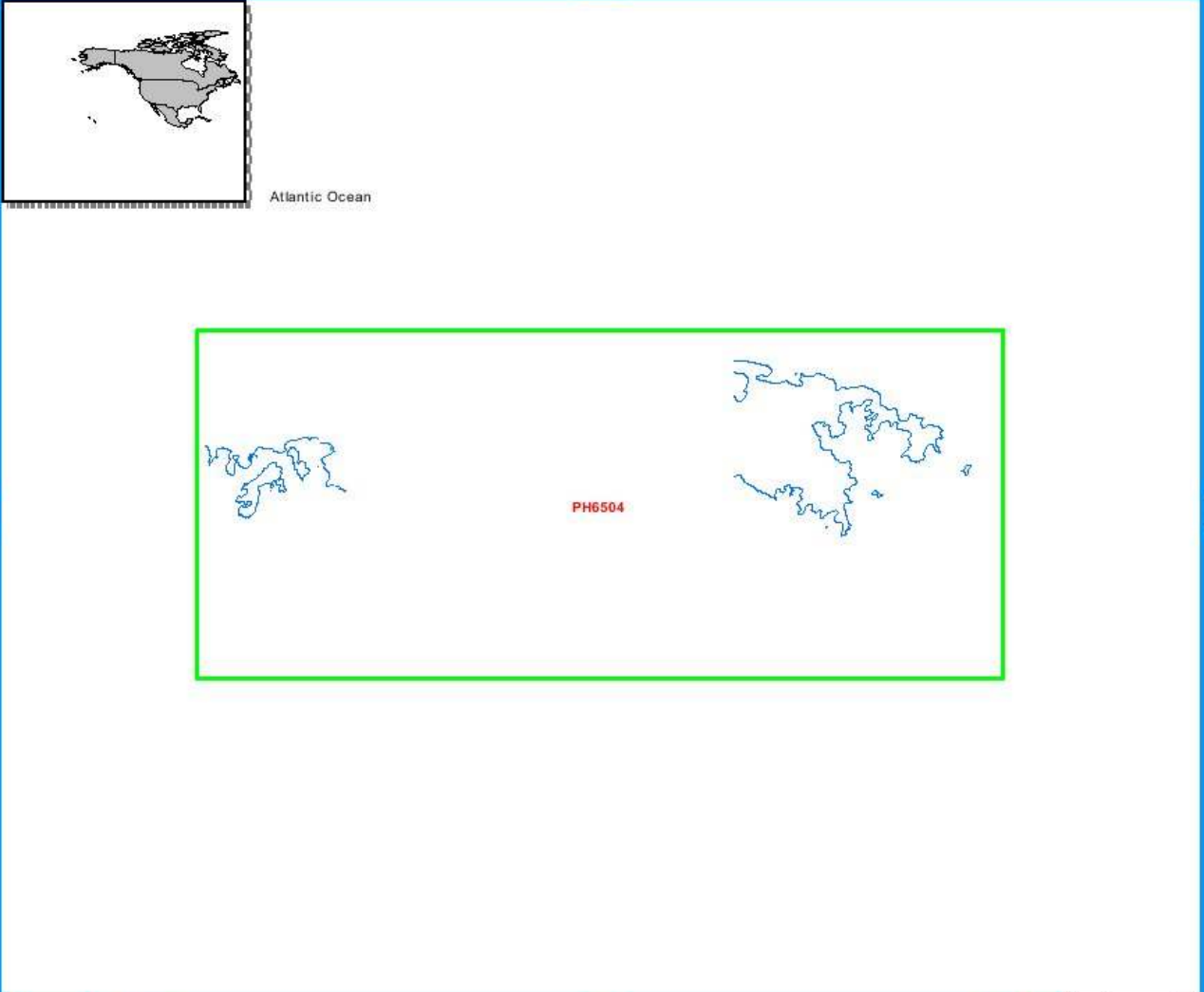
intro | search | **selection** | legend | help

**Selection Set**

Click  to unselect the project from map view.  
Click  to zoom to and view the project outline on the map.  
Click  to download the project data as shapefiles.  
Click  to view project metadata.

Records 1 - 1 of 1

Project ID: PH6504  
Date: 19711101  
Description: St. Thomas and St. John, Virgin Islands



Atlantic Ocean

PH6504

0 3291.94 Meters

Active Layer: Shoreline

# Data Distribution Metadata

[http://www.ngs.noaa.gov/news-ogc-bin/metadata.pl?PRD\\_ID=AL3701&PRD\\_TYPE=SMFC\\_CODE=FC4.FC3](http://www.ngs.noaa.gov/news-ogc-bin/metadata.pl?PRD_ID=AL3701&PRD_TYPE=SMFC_CODE=FC4.FC3) - Microsoft Internet Explorer

Address: [http://www.ngs.noaa.gov/news-ogc-bin/metadata.pl?PRD\\_ID=AL3701&PRD\\_TYPE=SMFC\\_CODE=FC4.FC3&FC13&FC10&FC11&FC16&FC5&FC15&FC11&FC6&FC7&FC14&FC3&FC8&FC12](http://www.ngs.noaa.gov/news-ogc-bin/metadata.pl?PRD_ID=AL3701&PRD_TYPE=SMFC_CODE=FC4.FC3&FC13&FC10&FC11&FC16&FC5&FC15&FC11&FC6&FC7&FC14&FC3&FC8&FC12)

## National Geodetic Survey's Vector Shoreline

**Table of Contents**

- [IDENTIFICATION INFORMATION](#)
- [DATA QUALITY INFORMATION](#)
- [SPATIAL DATA ORGANIZATION INFORMATION](#)
- [SPATIAL REFERENCE INFORMATION](#)
- [ENTITY AND ATTRIBUTE INFORMATION](#)
- [DISTRIBUTION INFORMATION](#)
- [METADATA REFERENCE INFORMATION](#)

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### IDENTIFICATION INFORMATION:

**Citation:**

<p><b>Citation_Information:</b></p> <p><b>Originator:</b> U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Geodetic Survey (NGS)</p> <p><b>Publication Date:</b>20020501</p> <p><b>Title:</b> Shoreline Mapping Program of GRAND BAY TO PENSACOLA MOBILE BAY, AL, AL3701</p> <p><b>Edition:</b> Unknown</p> <p><b>Geospatial Data Presentation Form:</b> Vector digital data</p> <p><b>Publication Information:</b> <b>Publication Place:</b> Silver Spring, MD <b>Publisher:</b> U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Geodetic Survey (NGS)</p> <p><b>Other Citation Details:</b></p>	<p><b>Originator:</b> U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Geodetic Survey (NGS)</p> <p><b>Publication Date:</b>20020501</p> <p><b>Title:</b> Shoreline Mapping Program of GRAND BAY TO PENSACOLA MOBILE BAY, AL, AL3701</p> <p><b>Edition:</b> Unknown</p> <p><b>Geospatial Data Presentation Form:</b> Vector digital data</p> <p><b>Publication Information:</b> <b>Publication Place:</b> Silver Spring, MD <b>Publisher:</b> U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Geodetic Survey (NGS)</p> <p><b>Other Citation Details:</b></p>
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**Online Linkage:** [http://www.nceas.ucsd.edu/metadata/metadata.pl?PRD\\_ID=AL3701&PRD\\_TYPE=SMFC\\_CODE=FC4.FC3&FC13&FC10&FC11&FC16&FC5&FC15&FC11&FC6&FC7&FC14&FC3&FC8&FC12](http://www.nceas.ucsd.edu/metadata/metadata.pl?PRD_ID=AL3701&PRD_TYPE=SMFC_CODE=FC4.FC3&FC13&FC10&FC11&FC16&FC5&FC15&FC11&FC6&FC7&FC14&FC3&FC8&FC12)

**Larger Work Citation:**

**Citation\_Information:**

**Originator:**  
U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Geodetic Survey (NGS)



# Shoreline Applications

NOAA's Shoreline may be used for:

- **Application to Navigational Charts**
- **Historical Shoreline Change Analysis**
- Land and marine geographic information systems (GIS) basemaps
- Property management, real estate
- Coastal disputes
- Natural resource management
- Coastal zone management
- Maritime boundaries



# Shoreline Application to Nautical Charts

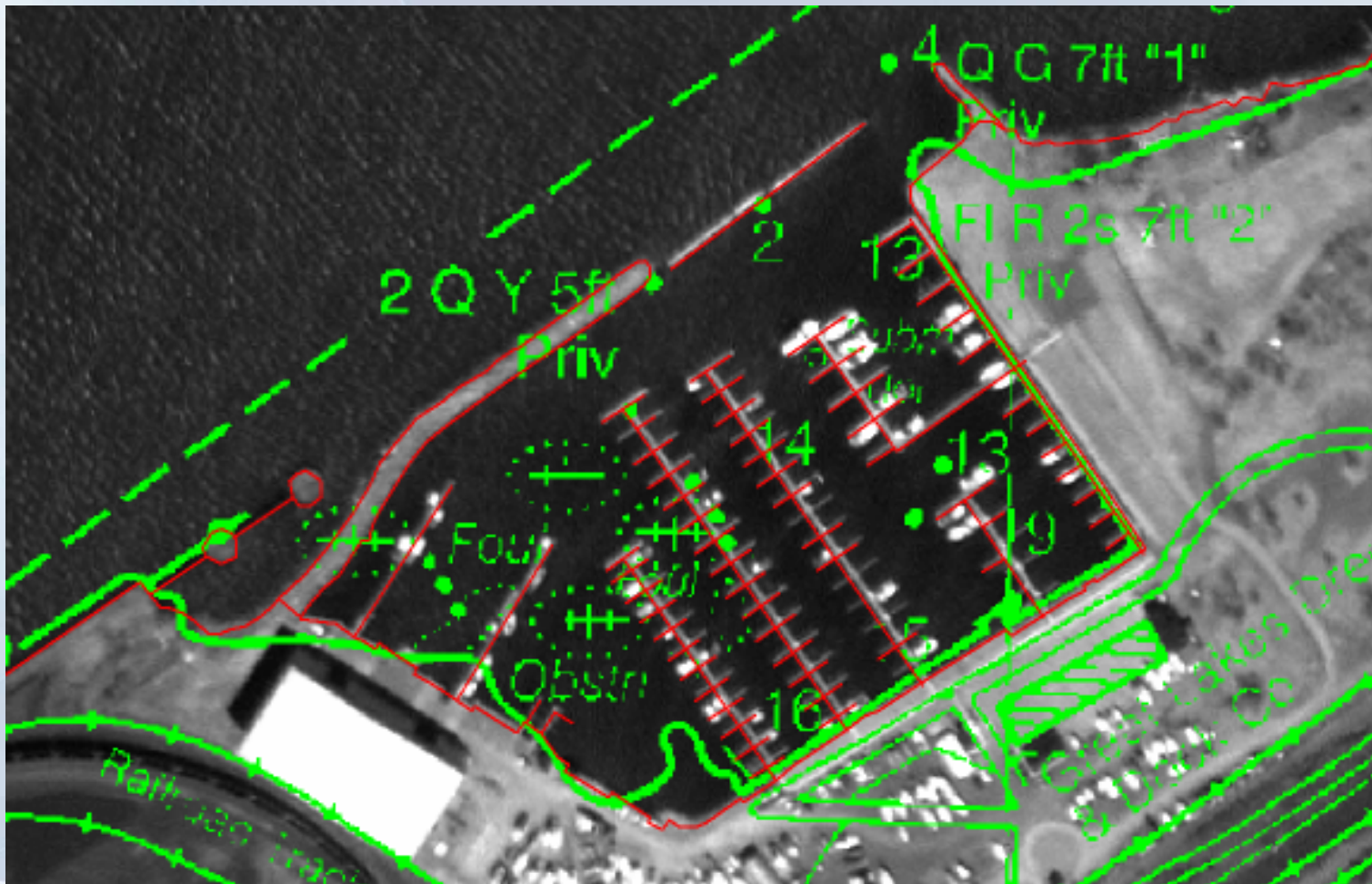


Image Source: Space Imaging, LLC



National Oceanic and Atmospheric Administration

# Historical Shoreline Change

— 1957

— 1976

2004 Aerial photograph  
Fort Desoto Beach, FL



National Oceanic and Atmospheric Administration



# Summary

- High resolution satellite imagery can be a useful tool for shoreline feature change analysis in ports.
- Accurate georeferencing is crucial.
- The Chart Evaluation File (CEF) follows the project through the entire multi-organizational process of the ENC Validation Initiative
- Shoreline is delivered in a GIS friendly format and can be downloaded from [http://www.ngs.noaa.gov/RSD/shoredata/NGS\\_Shoreline\\_Products.htm](http://www.ngs.noaa.gov/RSD/shoredata/NGS_Shoreline_Products.htm)

