H12227

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Survey

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12227

LOCALITY

State(s):	California
General Locality:	San Francisco Bay and Vicinity
Sub-locality:	Pinole Point to Davis Point

2014

CHIEF OF PARTY
Ian Colvert

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H12227**

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

State(s):	**California**
General Locality:	**San Francisco Bay and Vicinity**
Sub-Locality:	**Pinole Point to Davis Point**
Scale:	**5000**
Dates of Survey:	**10/22/2013 to 12/04/2014**
Instructions Dated:	**05/14/2013**
Project Number:	**OPR-L430-NRT6-14**
Field Unit:	**Navigation Response Team 6**
Chief of Party:	**Ian Colvert**
Soundings by:	**Kongsberg EM3002**
Imagery by:	**Kongsberg EM3002 backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold, red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Centers for Environmental Information (NCEI) http://www.ncei.noaa.gov/

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Descriptive Report to Accompany Survey H12227

Project: OPR-L430-NRT6-14

Locality: San Francisco Bay and Vicinity

Sublocality: Pinole Point to Davis Point

Scale: 1:5000

October 2013 - December 2014

Navigation Response Team 6

Chief of Party: Ian Colvert

A. Area Surveyed

Survey Limits were acquired in accordance with the requirements in the Project Instructions and the HSSD.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
38° 4' 5.76" N 122° 24' 27.79" W	38° 0' 9.51" N 122° 16' 0.33" W

Table 1: Survey Limits

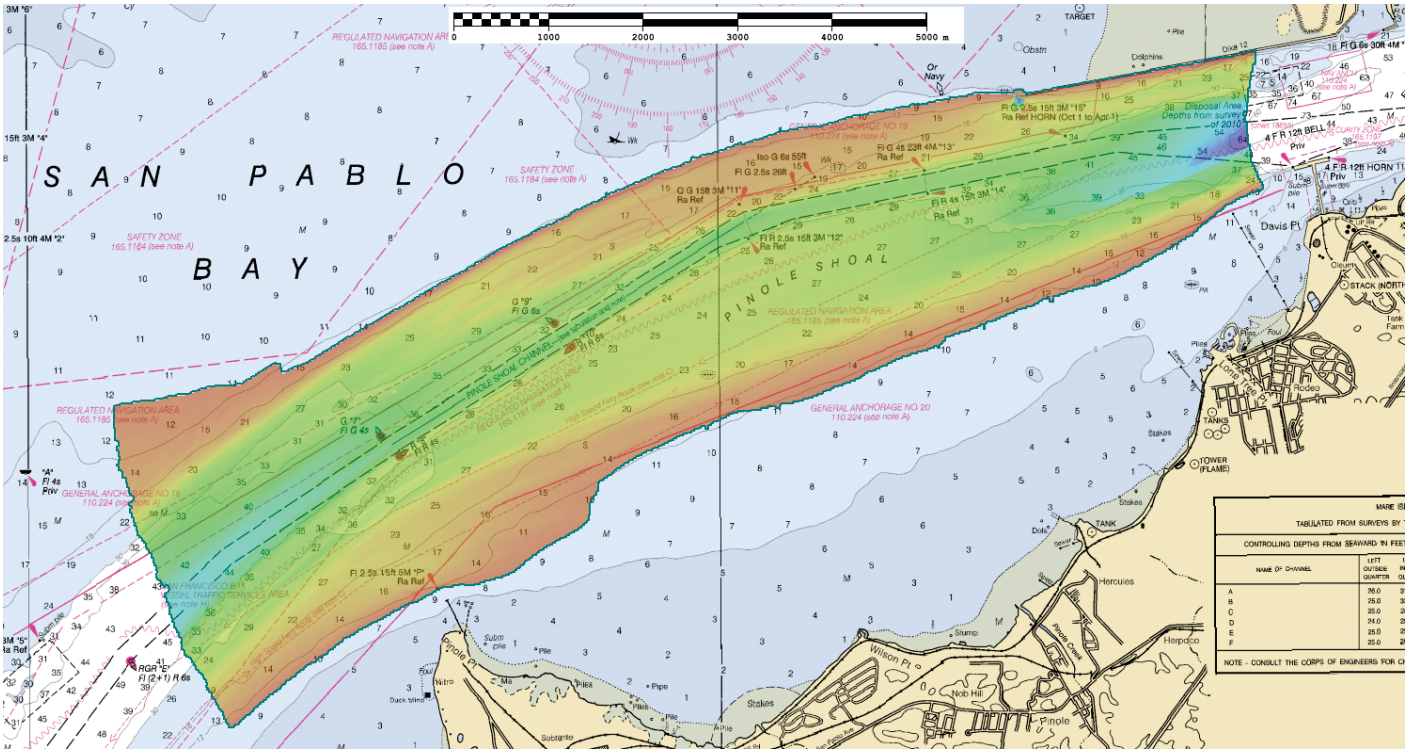


Figure 1: Survey H12227 bathymetry overlaid chart 18655

Survey limits were acquired in accordance with the requirements in the Project Instructions and the HSSD.

A.2 Survey Purpose

The San Francisco Bar Pilots Association identified San Pablo Bay, Pinole Point to Davis Point, as an area of concern with charting discrepancies near Pinole Shoal Channel. A request for hydrographic surveys in San Pablo Bay was a result from meetings in 2004 and 2012. During these meetings, the pilots identified numerous areas of concern and charting discrepancies were discussed. As a result, NRT 6 is assigned to survey and investigate these areas of concern. It is the intent of this survey to supersede all bathymetry, seafloor features and bottom characteristics within the assigned survey area, navigable to the four meter curve.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Survey H12227 encompasses Pinole Point to Davis Point, adhering to the four meter curve and subsequent navigationally significant waters.

A.4 Survey Coverage

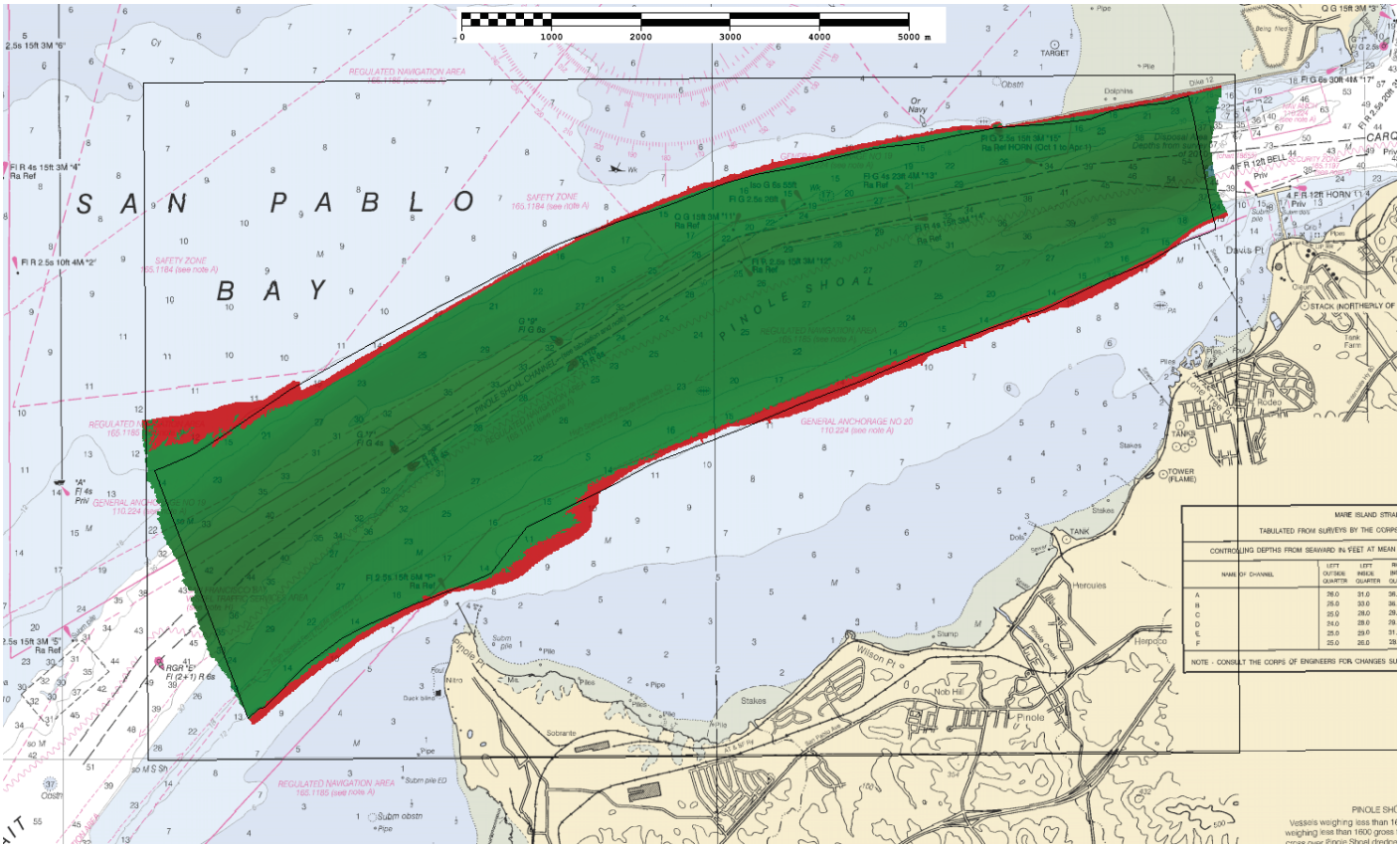


Figure 2: H12227 sheet limits (outer polygon), suggested survey polygon (inner polygon) and bathymetry (red, shoaler than 4 meters) overlaid chart 18655.

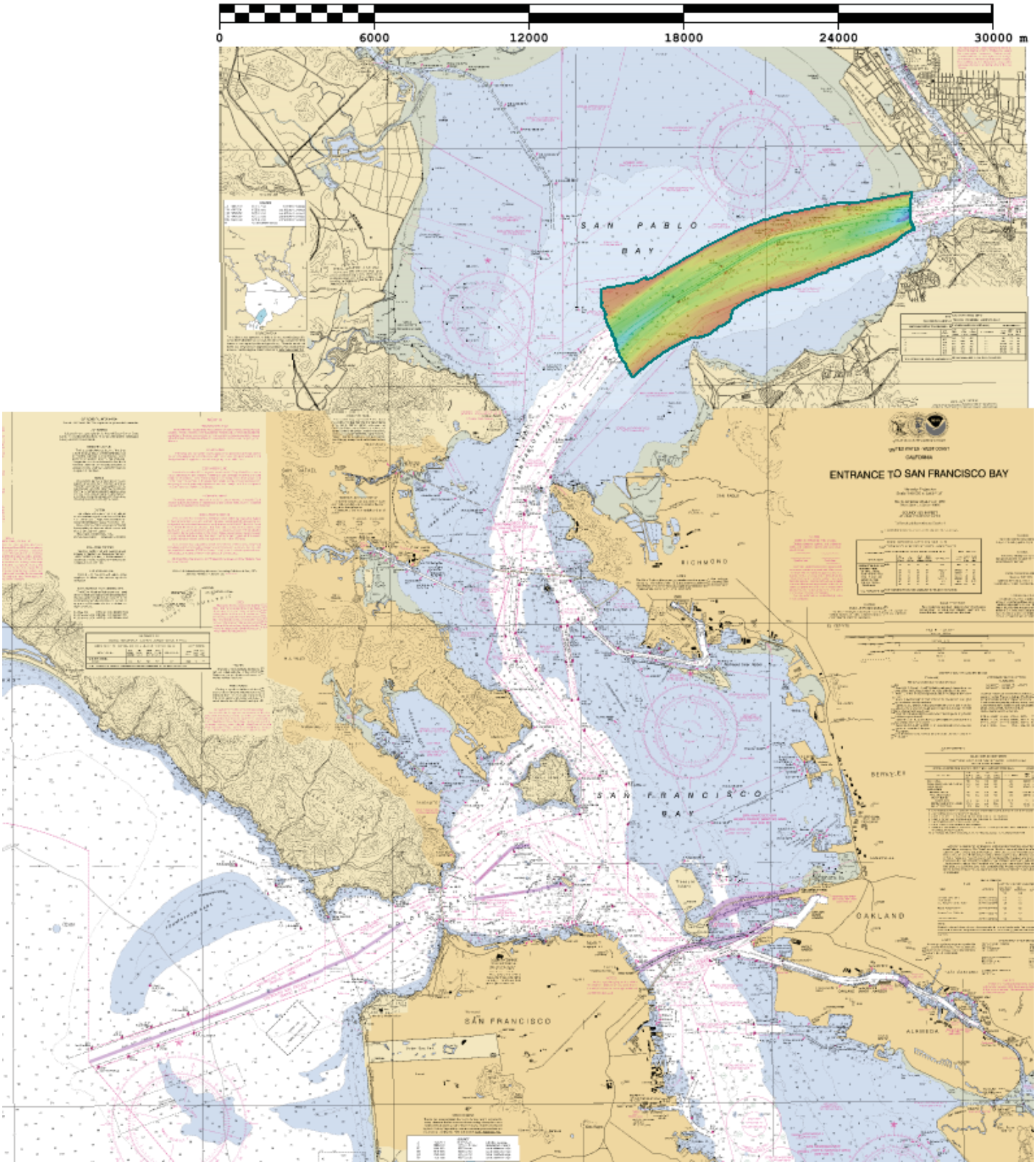


Figure 3: H12227 (bathymetry) resides in San Pablo Bay, north of San Francisco Bay, California.

EGREGIOUS ERROR WITH 2013 PROJECT INSTRUCTION COVERAGE REQUIREMENTS

H12227 Project instructions, signed May 14, 2013, by the Navigation Response Branch Chief, were adhered to for the duration of data acquisition. The coverage requirements stated, "200% SSS with concurrent SBES or MBES, or Complete MBES." Survey crew adhered to the Complete Multibeam requirement, and calculated and employed Government resources and assets to fulfill Complete Multibeam requirements (see Figure 4).

Unfortunately, it was discovered February 6, 2015, as the survey was completely finished and nearly wrapped for submission, that the 2013 survey requirements were in error. A discrepancy was found in the 2014 Project Instructions, dated April 14, 2014, that stated, "200% SSS with concurrent SBES or MBES, or Object Detection MBES." Survey crew failed to catch this discrepancy assuming coverage requirements could not be changed during survey operations (see Figure 5).

After consultation with Navigation Response Branch and Pacific Hydrographic Branch personnel, it was concluded that the 2013 H12227 Project Instructions were issued in error, and that survey H12227 needed to be reworked to Object Detection requirements. This required an entire new iteration of directed editing cleaning to the half meter grid, with 99.54% nodes passing Object Detection coverage , and containing 69 insignificant holidays within mainscheme bathymetry.

MAINSCHEME HOLIDAYS

Sixty-nine holidays of three nodes or greater exist within survey H12227. All holidays are a result of an egregious error of assigned 2014 H12227 Project Instruction coverage requirements. Survey crew acquired bathymetry to Complete Coverage requirements that were later deemed to be Object Detection requirements. However, all 69 holidays are insignificant, with the strong majority within four nodes and the most egregious holiday 23 meters and 1.7 meters wide (38-01-29.93N, 122-21-30.07W). All holidays were examined in subset mode. The Hydrographer did not find any evidence of surrounding scour of a possible hidden feature. The Hydrographer recommends data supersede as charted.

For the Physical Scientist's convenience, The Hydrographer has "tagged" each holiday with an examined sounding in Caris HIPS & SIPS for ease location (see Figure 6).

FOUR METER CURVE HOLIDAY, END OF DIKE 12

One holiday exists in survey H12227, located near the end of the rip-rap Dike 12 (38-03-48.89N, 122-17-47.40W). Survey crew determined the area unsafe due to the close proximity of rip-rap and strong, swirling currents, and were not able to survey to the four meter curve (see Figure 2). The Hydrographer recommends bathymetry supersede as charted (see Figure 7).

Coverage & Limits:

Inshore Limit: The inshore limit of hydrography will be the farthest offshore of the following: (1) the 4-meter depth contour or (2) the line defined by the distance seaward from the MHW line which is equivalent to 0.8 millimeters at the scale of the largest scale nautical chart, with the exception of piers, wharfs and docks. For these specific shoreline features, the navigable waters extend shoreward to the mean high water buffer.

Coverage Type: Complete Coverage
Instructions:

Coverage Water Depth	*Coverage Required*
All waters in survey area	200% SSS with concurrent SBES or MBES, or Complete MBES
AWOIS item search areas	200% SSS with concurrent SBES or MBES, or Object Detection MBES

Figure 4: H12227 2013 Project Instruction coverage requirements

Coverage & Limits:

Inshore Limit: The inshore limit of hydrography will be the farthest offshore of the following: (1) the 4-meter depth contour or (2) the line defined by the distance seaward from the MHW line which is equivalent to 0.8 millimeters at the scale of the largest scale nautical chart, with the exception of piers, wharfs and docks. For these specific shoreline features, the navigable waters extend shoreward to the mean high water buffer.

Coverage Type: Object Detection
Instructions:

Coverage Water Depth	*Coverage Required*
Inshore limit to 20 meters water depth	200% SSS with concurrent SBES or MBES, or Object Detection MBES
Greater than 20 meters water depth	200% SSS with concurrent SBES or MBES, or Complete MBES

Figure 5: H12227 2014 Project Instruction coverage requirements

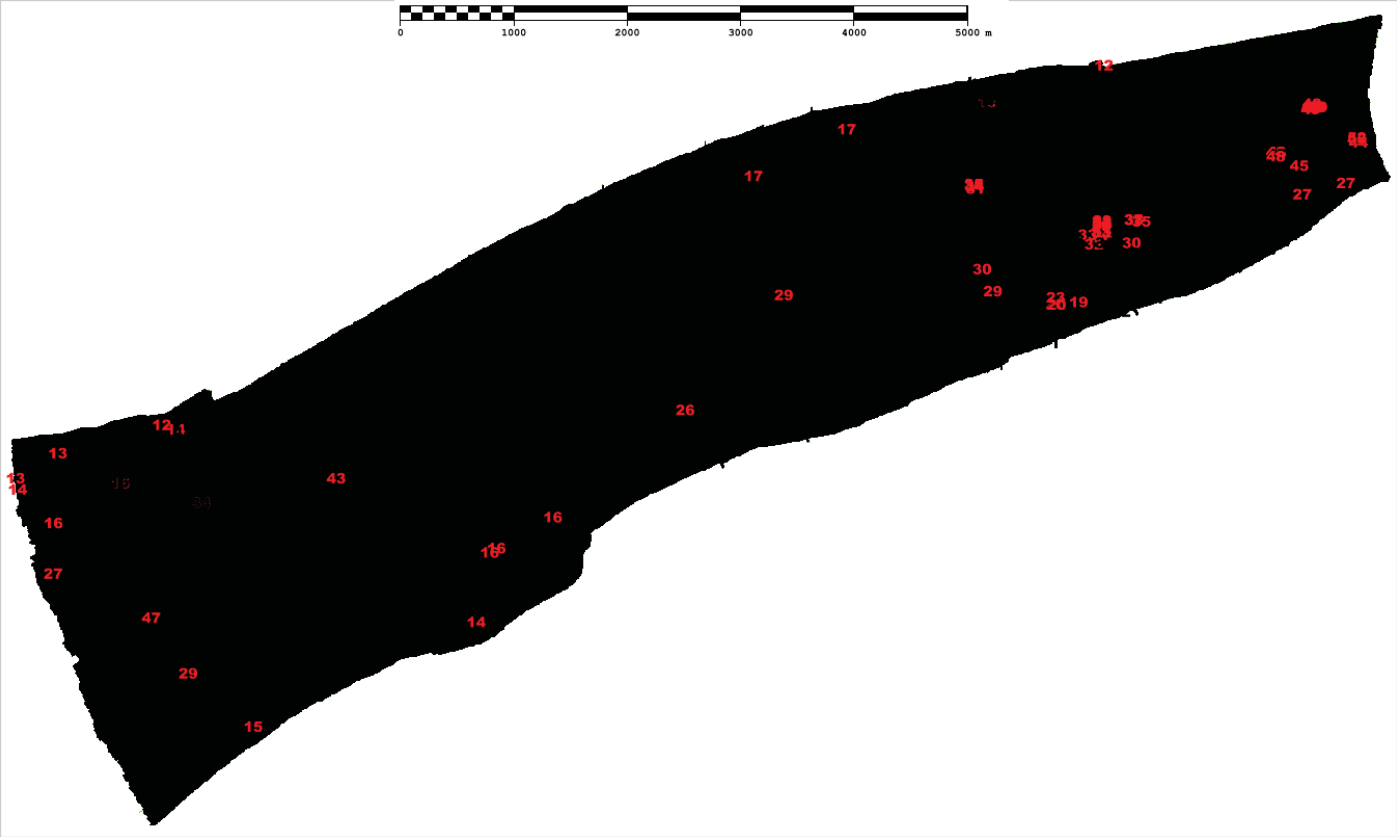


Figure 6: All mainscheme holidays "tagged" as examined soundings (red soundings) overlayed over maincheme bathymetry (black).

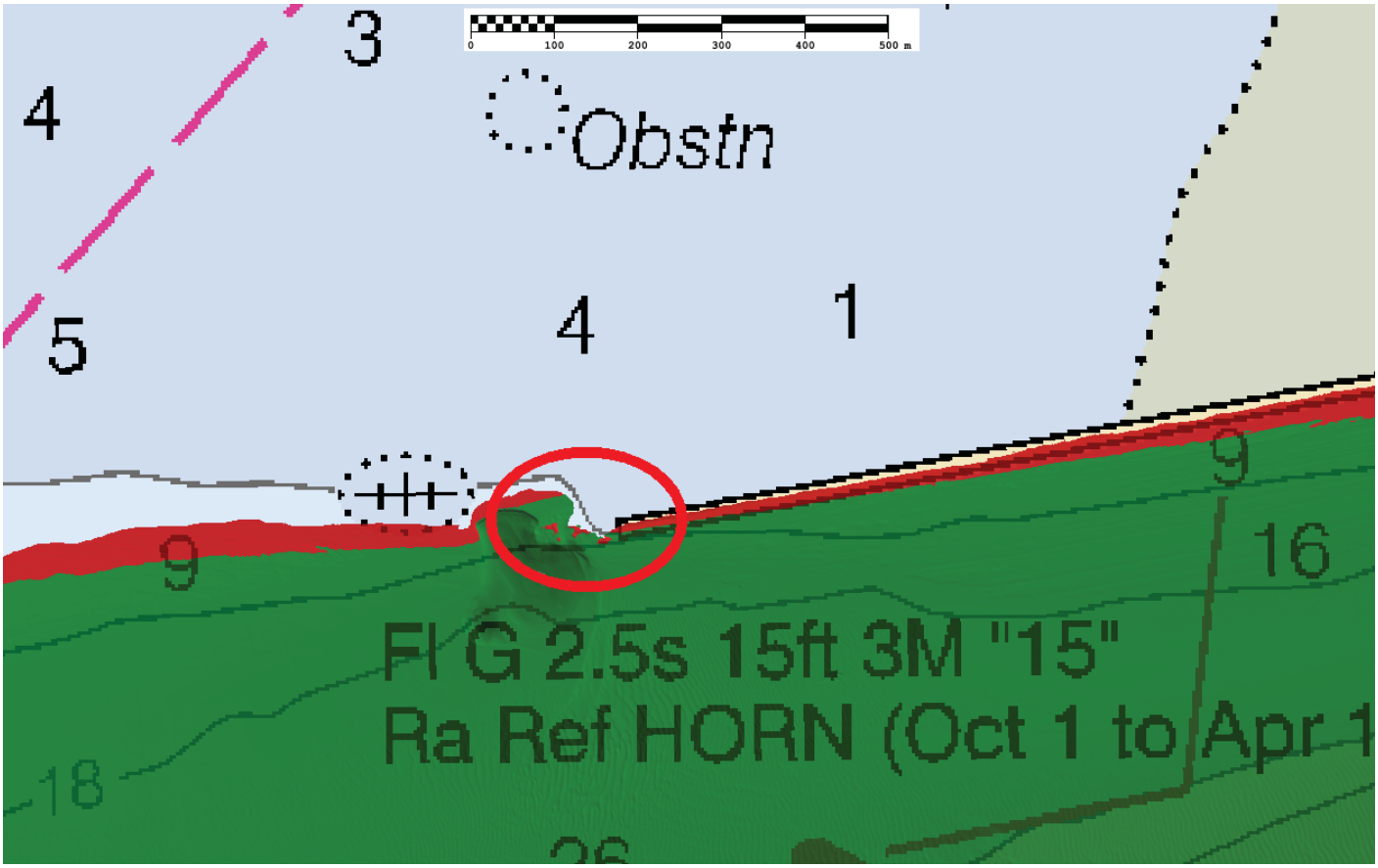


Figure 7: Holiday (circled, red) located at the end of Dike 12 was not surveyed to the four meter curve because of safety concerns.

A.5 Survey Statistics

The following table lists the mainscheme and crossline acquisition mileage for this survey:

	HULL ID	*S3003*	*Total*
LNM	**SBES Mainscheme**	0	0
	MBES Mainscheme	926.48	926.48
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/SSS Mainscheme	0	0
	MBES/SSS Mainscheme	0	0
	SBES/MBES Crosslines	40.76	40.76
	Lidar Crosslines	0	0
Number of Bottom Samples			0
Number of AWOIS Items Investigated			4
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			9.55

Table 2: Hydrographic Survey Statistics

The following table lists the specific dates of data acquisition for this survey:

Survey Dates	Day of the Year
10/22/2013	295
10/24/2013	297
10/25/2013	298
11/05/2013	309
11/06/2013	310
11/07/2013	311
11/08/2013	312
11/14/2013	318
11/25/2013	329
11/26/2013	330
11/27/2013	331
01/17/2014	17
01/22/2014	22
01/27/2014	27
02/04/2014	35
02/05/2014	36
03/27/2014	86
05/14/2014	134
05/15/2014	135
09/16/2014	259
09/17/2014	260
09/23/2014	266
10/01/2014	274
10/06/2014	279
10/07/2014	280
10/08/2014	281
10/15/2014	288
10/16/2014	289
10/20/2014	293
10/21/2014	294
10/22/2014	295
10/23/2014	296
10/28/2014	301
10/29/2014	302
10/30/2014	303

Over a 14 month period (10/22/2013 - 12/04/2014), 39 survey days were employed to collect the entirety of data for survey H12227, with a sizable gap of four months (5/15/2014 - 9/16/2014) when data was not collected. This four month gap was a result of a failing POS V.4 issue with survey launch S3003, and the time between attempting to repair, but ultimately purchasing, upgrading and installing a POS V.5 and new acquisition PC. Also, NRT6 conducted two response operations during this intermediary period.

The bottom section of the Dates of Hydrography table was cut off by the page break. The missing survey dates are 10/30/2014 (DN303), 11/03/2014 (DN307), 11/04/2014 (DN308), 11/06/2014 (DN310), and 12/04/2014 (DN338).

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the Data Acquisition and Processing Reports (DAPR) for a complete description of data acquisition and processing systems, survey vessel, quality control procedures and data processing methods. Additional information to supplement sounding and survey data, and any deviations from the DAPR are discussed in the following sections.

Two DAPRs are included with survey H12227. The NRT6 2013 DAPR is to be referenced for survey dates 10/22/2013 - 05/15/2014. The NRT6 2014 DAPR is to be referenced for survey dates 09/16/2014 - 12/4/2014.

B.1.1 Vessels

The following vessels were used for data acquisition during this survey:

Hull ID	***S3003***
LOA	32 feet
Draft	0.5 feet

Table 4: Vessels Used

B.1.2 Equipment

The following major systems were used for data acquisition during this survey:

Manufacturer	Model	Type
Kongsberg	EM3002	MBES
Applanix	POS/MV 320 V4, V5	Positioning and Attitude System
Sea-Bird Electronics	SBE19Plus	Conductivity, Temperature, and Depth Sensor
Teledyne Odom	Digibar Pro	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines acquired for this survey totaled 4% of mainscheme acquisition.

CROSSLINE OVERVIEW

Multibeam Echosounder (MBES) crosslines totaled 40.76 nautical miles, comprising 4.4% of mainscheme MBES bathymetry, satisfying field procedure requirements. The mainscheme bathymetry was manually compared to the crossline nadir beams in CARIS subset mode. Additionally the Hydrographer created a one meter swath angle BASE surface showing a standard deviation representing areas 0.25 meters greater than the mean surface, representing error greater than IHO Order 1 requirements.

Comparison yielded excellent agreement with no discernible offsets between crossline and mainscheme bathymetry greater than IHO Order 1 error limits, with exceptions due to temporal difference between acquisition of mainscheme and crossline data.

Ten areas where crossline and mainscheme bathymetry exhibit error greater than IHO Order 1 requirements exist. All areas are located where crossline data was acquired more than six months -- and up to 13 months -- from the time mainscheme bathymetry was acquired. Five areas are located at the western end of the survey (see Figure 8), and five areas are located at the eastern end of the survey (see Figure 9).

The most egregious difference between crossline and mainscheme bathymetry, 1.2 meters, is located at the eastern end of the survey, within the Carquinez Strait fairway (38-03-30.96N, 122-16-15.02W) (see Figure 10). The Hydrographer recommends shoalest soundings supersede as charted.

After examination in CARIS subset mode, the Hydrographer concluded that this error is a result of migrating, shifting sedimentation and is not a result of a systematic error in survey systems or processing.

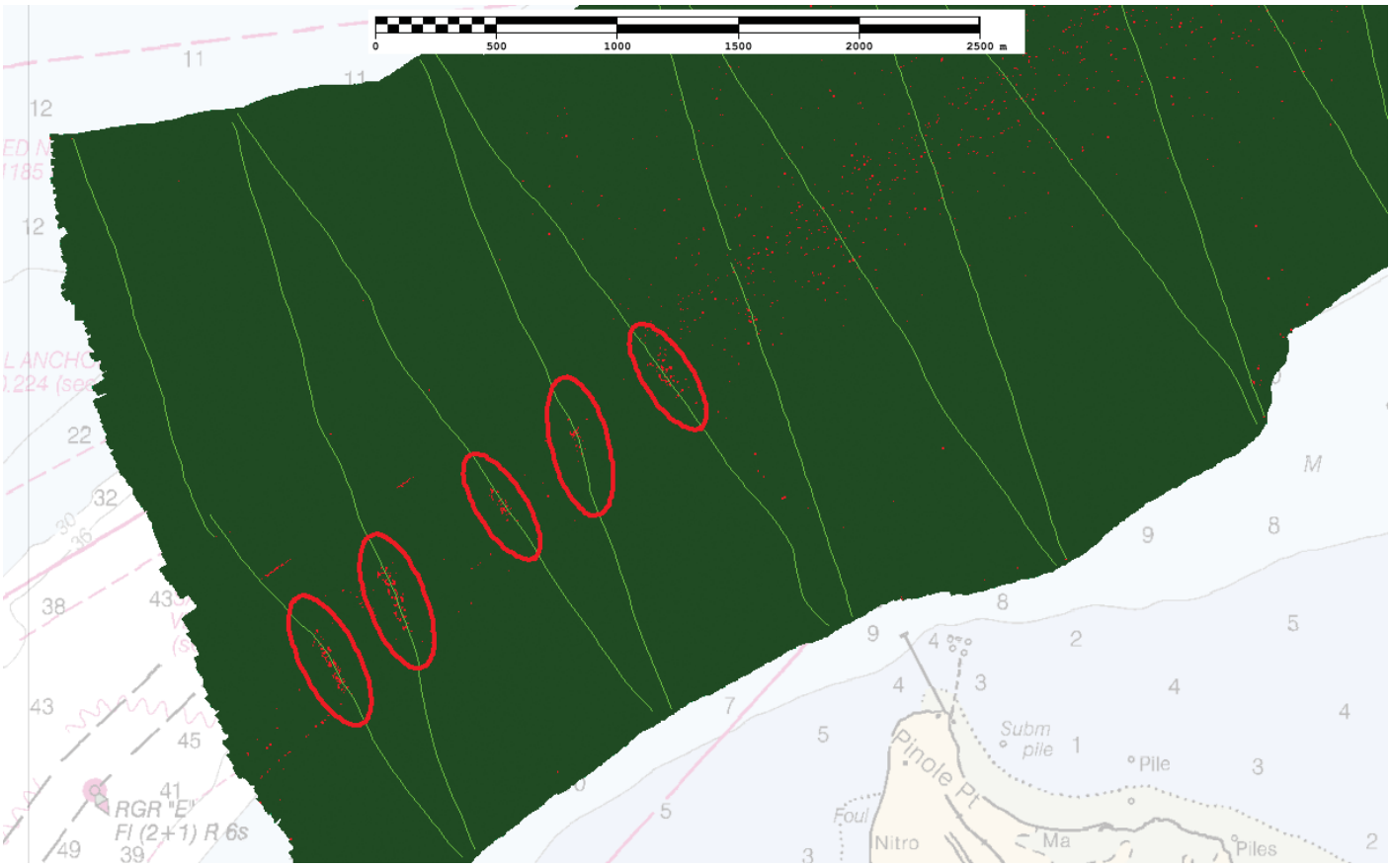


Figure 8: Areas at the western end of survey H12227, circled red, where crossline data and mainscheme bathymetry differ greater than IHO Order 1 specifications due to temporal difference between data collection resulting in observed shifting of sedimentation over time.

Figure 9: Areas at the eastern end of survey H12227, circled red, where crossline data and mainscheme bathymetry differ greater than IHO Order 1 specifications due to temporal difference between data collection resulting in observed shifting of sedimentation over time.

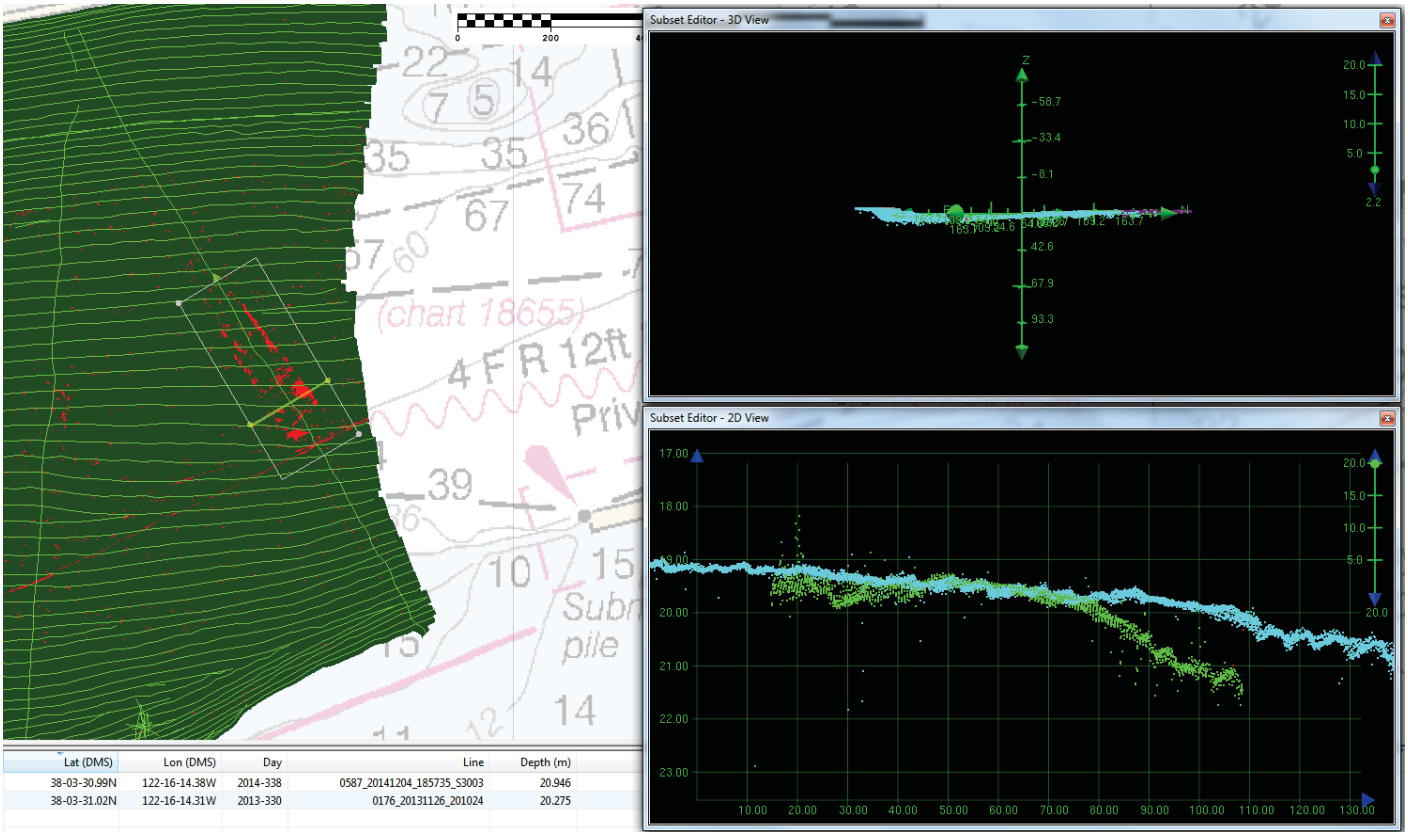


Figure 10: The most egregious difference between crossline and mainscheme bathymetry observed is 1.2 meters, due to migrating sedimentation.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning
0 meters	0.12 meters

Table 6: Survey Specific Tide TPU Values

Hull ID	Measured - CTD	Measured - MVP	Surface
S3003	4 meters/second	NA meters/second	0.5 meters/second

Table 7: Survey Specific Sound Speed TPU Values

Uncertainty values of submitted, finalized grids are calculated in CARIS HIPS & SIPS using the "Greater of the Two" of total propagated uncertainty and standard deviation (scaled to 95%). An "IHO-ness" attribute layers were created for H12227 finalized surface in CARIS HIPS & SIPS for analysis. Uncertainty values

throughout the survey meet IHO Order 1 specifications with exceptions of those areas shown in green (4 soundings per node), blue (three soundings per node), yellow (two soundings per node) and red (one sounding per node) (see Figure 11).

Uncertainty values that do not meet IHO Order 1 specifications are a result of an egregious mistake in the 2013 Project Instruction's coverage requirements signed off as being Complete Coverage. It was later determined that the coverage requirements were actually Object Detection, requiring a half meter surface. Survey data reflects data gathered for one meter Complete Coverage requirements, however, the data density was found that 99.54% of nodes passed Object Detection requirements (see Figure 12).

The Hydrographer recommends data supersede as charted for Object Detection requirements; the strong majority of nodes that did not meet minimum requirements of total propagated uncertainty had at least four soundings contributing, enough to warrant The Hydrographer's recommendation, after review of each area by Caris subset mode.

Figure 11: All data colored black meets IHO Order 1 specifications. Green is four soundings per node. Blue is three soundings per node. Yellow is two soundings per node. Red is one sounding per node.

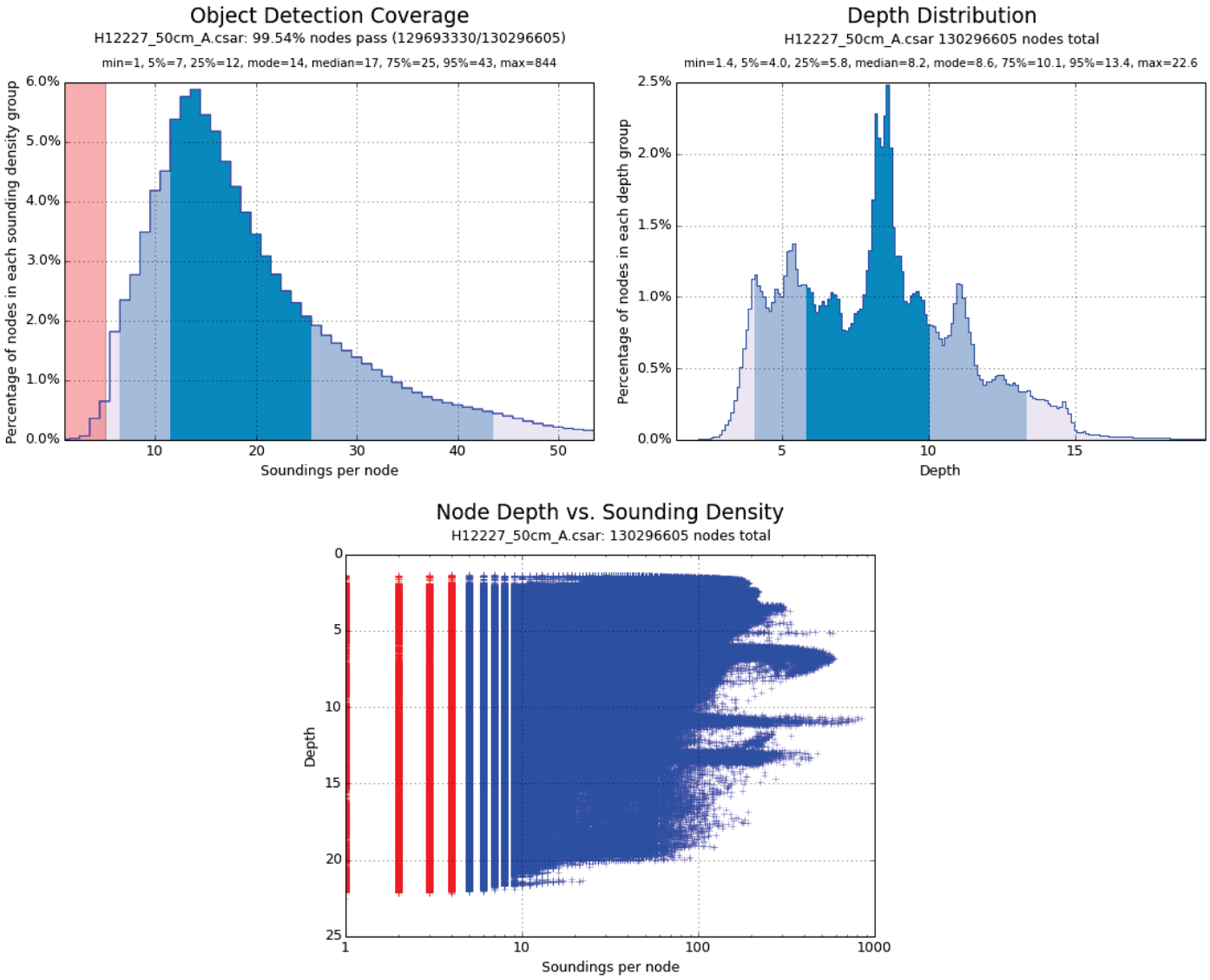


Figure 12: H12227 Object Detection Coverage, Depth Distribution, and Node Depth vs. Sounding Density.

B.2.3 Junctions

One contemporary survey junctions with survey H12227.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H11747	1:10000	2009	Navigation Response Team 6	SW

Table 8: Junctioning Surveys

H11747

Survey H11747, San Pablo Point to 1.5 Miles West of Pinole Point, survey year 2009, exhibits strong agreement with survey H12227. A difference surface was created in CARIS HIPS & SIPS and depths were compared in subset mode. A figure with a color legend was generated showing differences of depths in meters (see Figure 13).

Chart contour junction between surveys are generally consistent.

Pinole Point Channel depths exhibit a variance of up to 0.3 meters.

Survey H11747 exhibits sandwaves, located 320 meters north of the southern extent of the survey (38-00-23.51N, 122-23-35.30W), that are 1.2 meters shoaler than H12227 bathymetry.

Survey H11747 exhibits sandwaves, located 300 meters south of the Pinole Shoal Channel (38-00-43.60N, 122-23-49.79W), that are 2.4 meters deeper than H12227 bathymetry.

All variance is due to migration of sedimentation.

The Hydrographer recommends survey H12227 bathymetry supersede as charted.

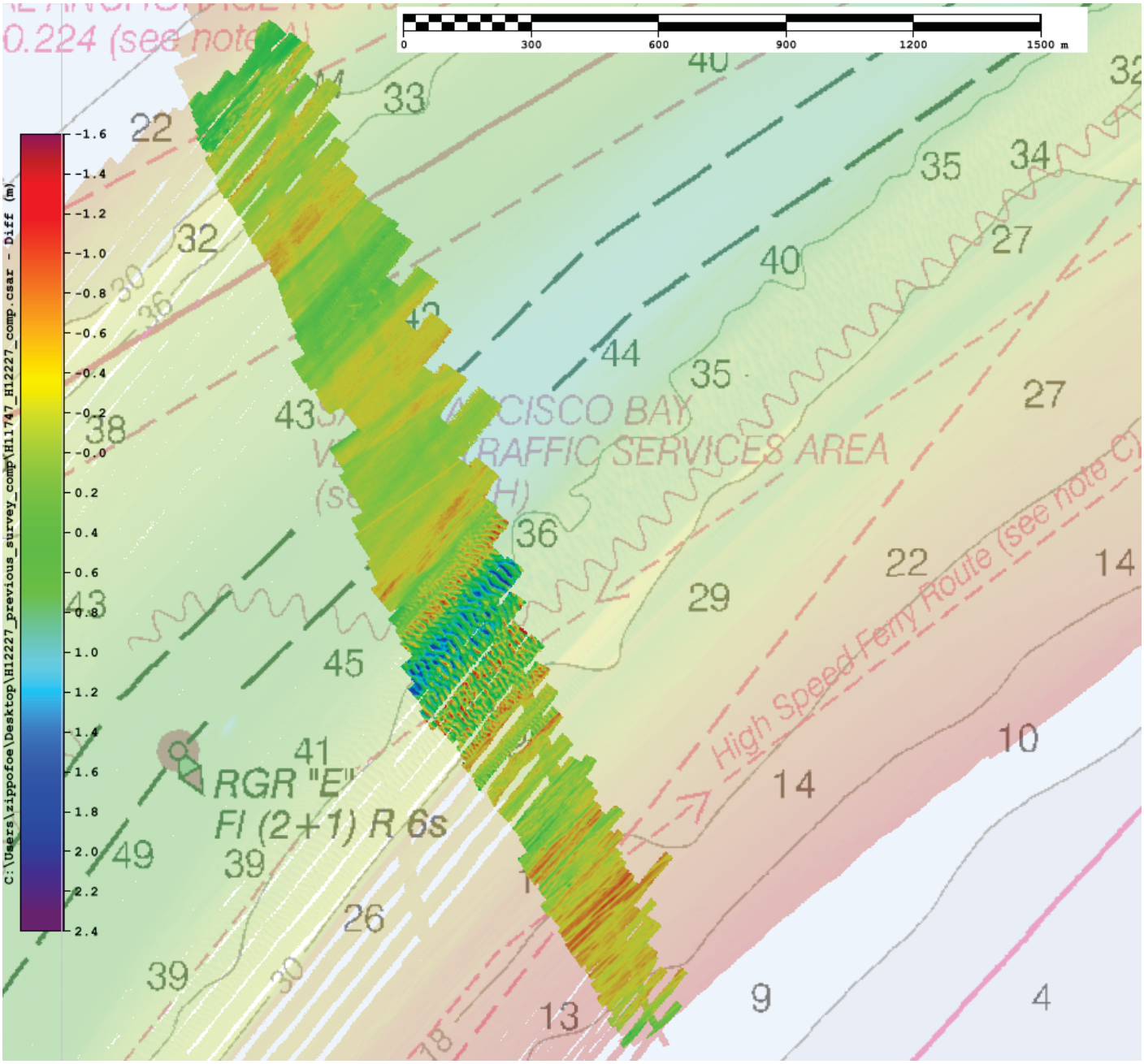


Figure 13: Junction comparison between H11747 and H12227.

B.2.4 Sonar QC Checks

Sonar system quality control checks were conducted as detailed in the quality control section of the DAPR.

B.2.5 Equipment Effectiveness

FAILING POS V.4 ISSUE, "THE SICK POS"

Between survey dates 10/22/2013 (DN295) - 5/15/2014 (DN135) (see Figure 14), a manageable, yet progressively deteriorating systematic roll offset error was observed. Data exhibited a momentary, consistent roll offset, at seemingly random, unpredictable intervals, usually in short duration of a few meters. However, as time went on, the error became more significant, exhibiting the same roll offset in lengths of up to 400 meters.

The error never exceeded IHO standards (see Figure 15).

NRT6, with the outstanding expertise of the Pacific Hydrographic Branch, determined the error as a result of a failing POS V.4 unit and a differential antenna. POS data was examined and results show that one of the gyros in the IMU was "sticking," and that one of the differential correction GPS antennas was intermittently failing (see Figures 16, 17, and 18).

Fifty-six instances of "The Sick POS" issue were noted and manually cleaned in subset editor. An outstanding sounding was placed in each location by the Hydrographer, memorializing each location of "The Sick POS" issue (see Figure 19). The Physical Scientist may use these outstanding designated soundings to locate each "The Sick POS" instance.

Due to the expense of repairing / replacing the IMU, NRT6 surveyed on, managing the error until ultimately an upgrade POS V.5 unit was installed 7/17/2014. Survey operations resumed 9/16/2014, after NRT6 completed a historical wrecks discovery operation and a navigationally significant response operation.

The Hydrographer recommends bathymetry supersede as charted.

Correspondence may be found in the submittal file structure: Project Reports / Project Correspondence / B2_EQUIP_ISSUE_sick_POS_correspondence.txt

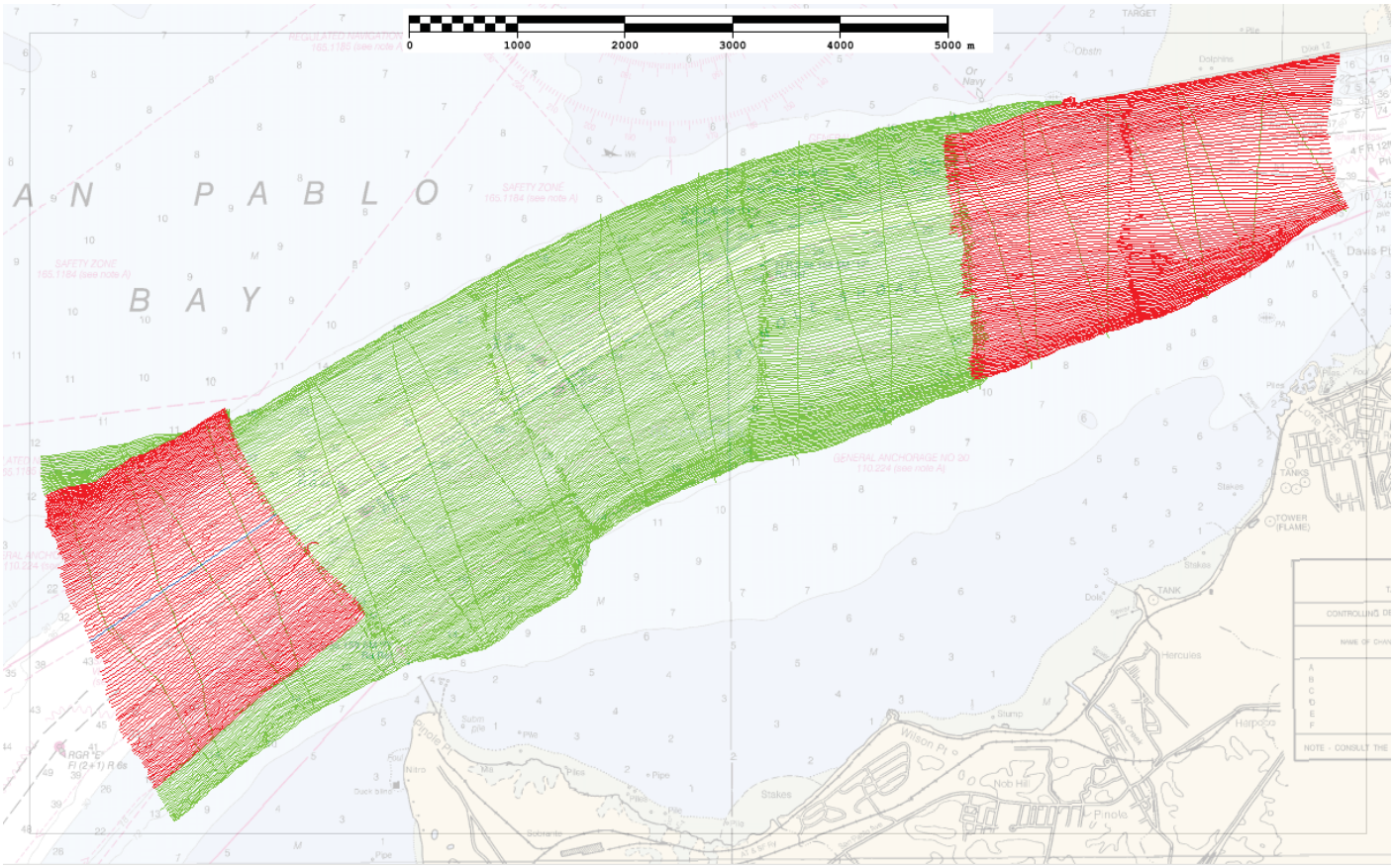


Figure 14: Survey days, red, that are affected by "The Sick POS" issue.

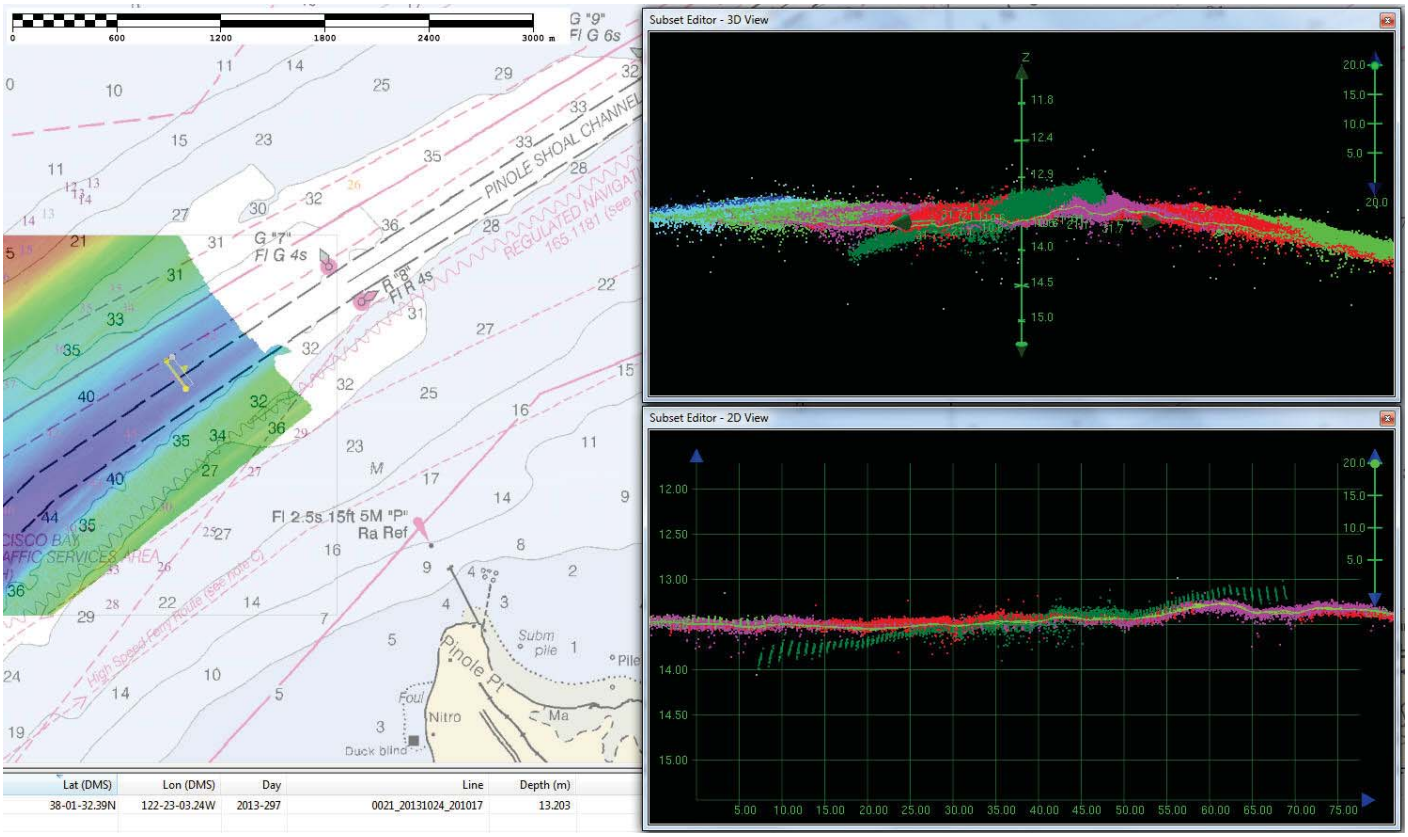


Figure 15: Example of systematic error roll offset as a result of a failing gyro and differential GPS antenna in POS V.4.

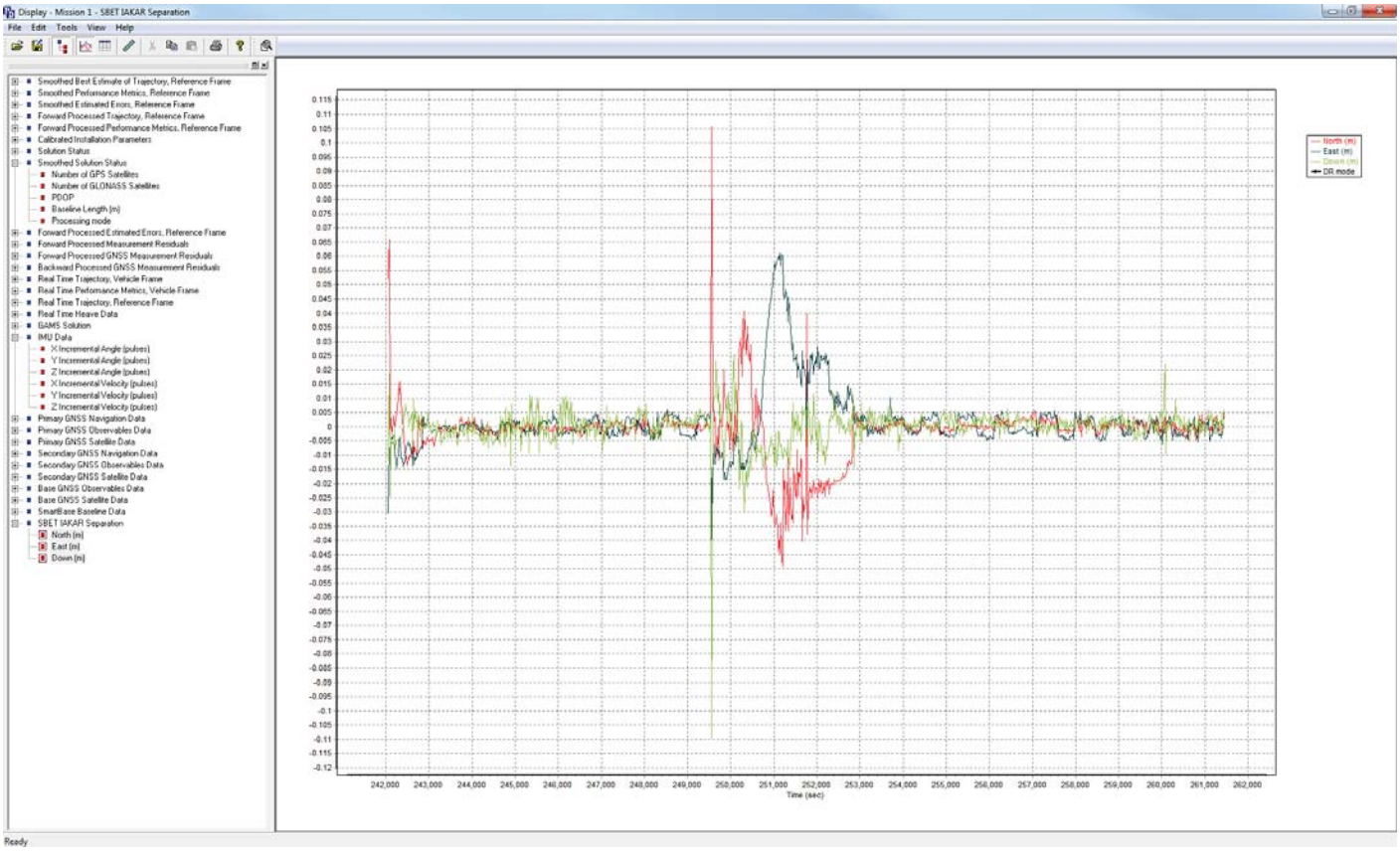


Figure 16: SBET IKAR Separation shows time frames of an intermittent IMU and differential antenna failure.

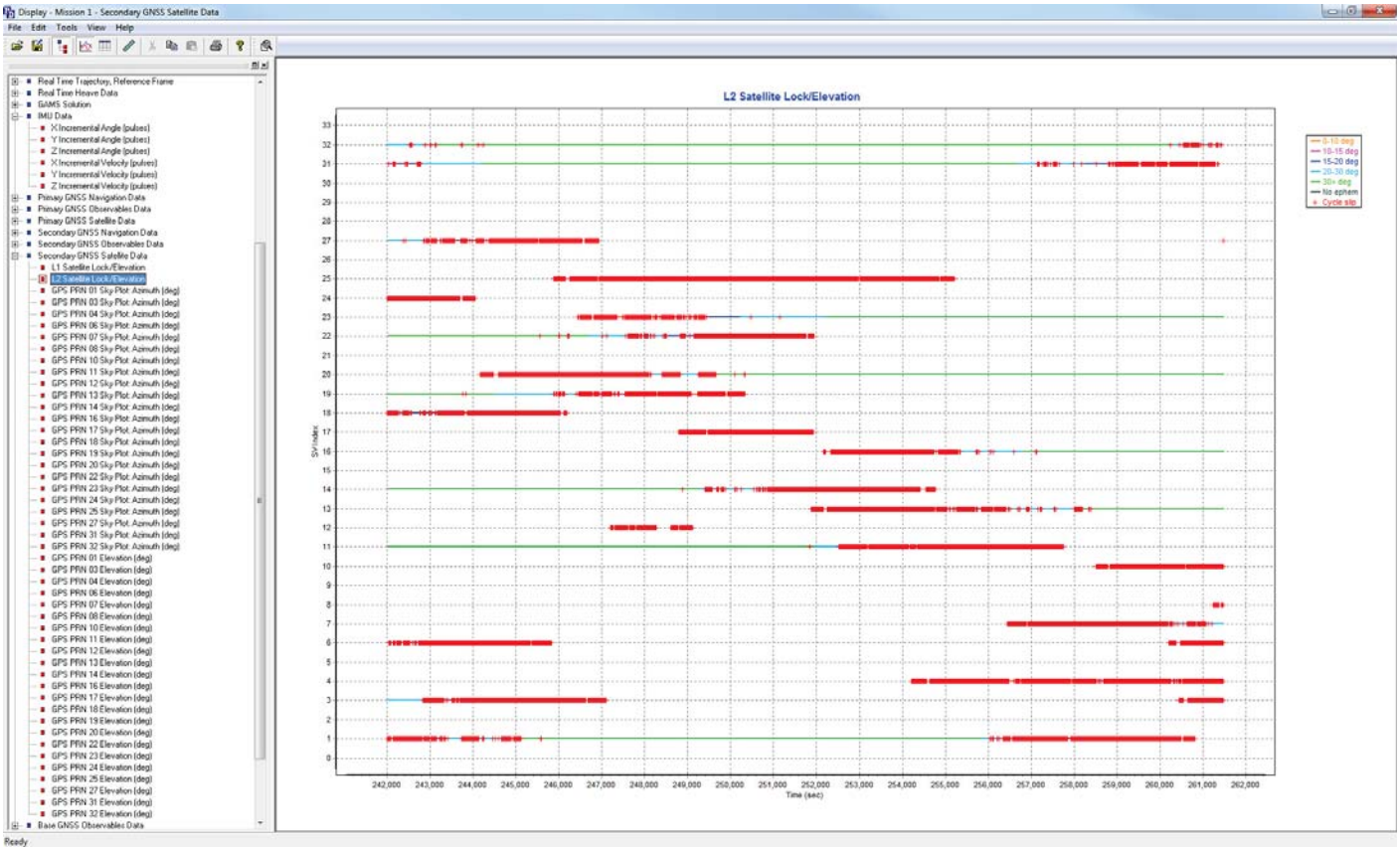


Figure 17: Secondary GNSS satellite data shows time frames as red, where the L2 Satellite Lock/Elevation of the differential GPS antenna failed.

Figure 18: Forward Processed Estimated Errors, Reference Frame shows time frames where one of the IMU's gyros failed.

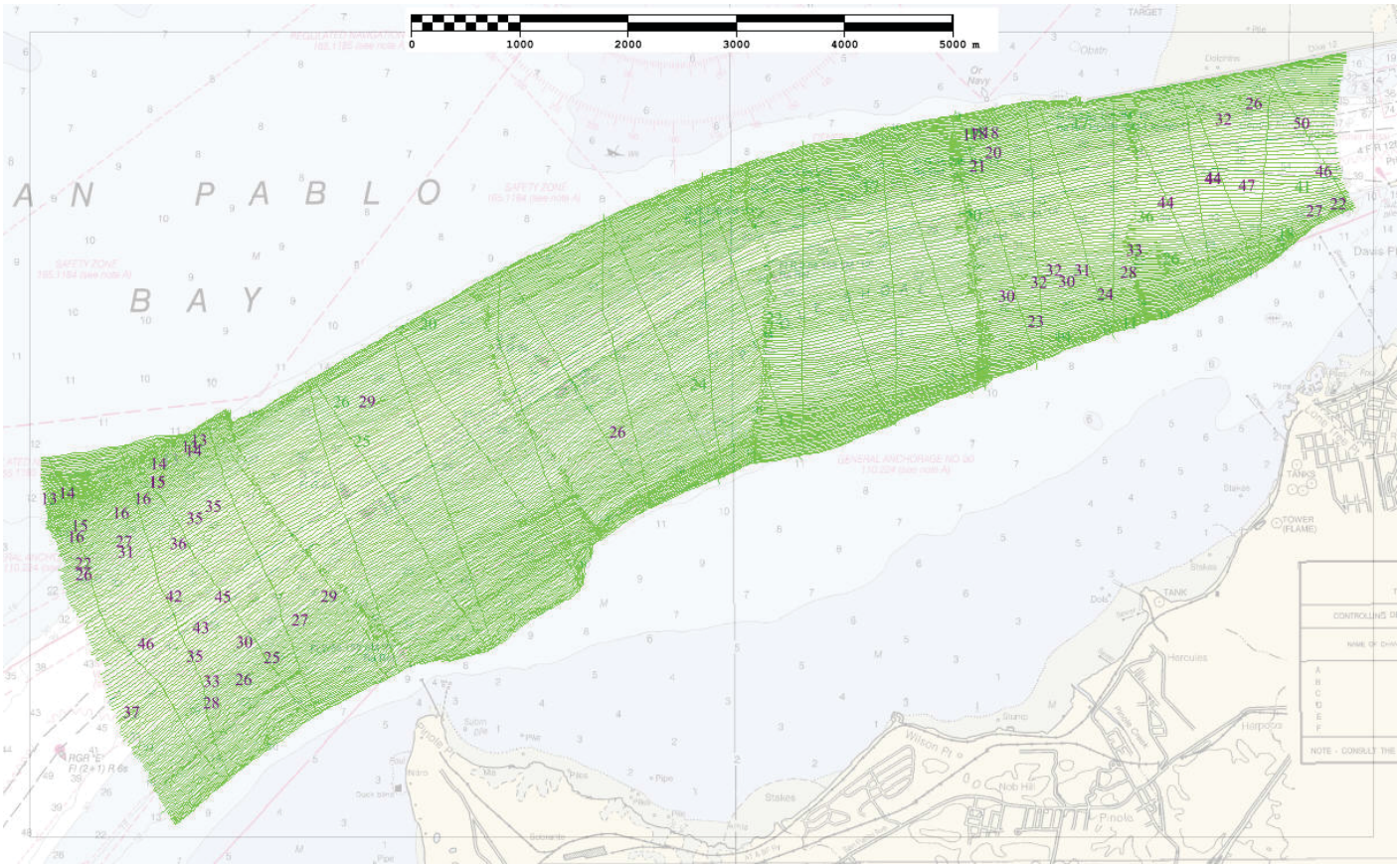


Figure 19: Soundings, purple, represent areas where "The Sick POS" issue was noted.

KONGSBERG EM3002 SYSTEMATIC ISSUE, "DEVIL'S HORNS"

The Kongsberg Simrad EM3002 sonar exhibited a systematic error: two downward along-track spikes consistently evident near 9-12 degrees either side of nadir.

This error is more prevelant in softer bottom types and at shoaler depths (see Figure 20).

However, the one meter CUBE surface negated the error to within 0.1-0.2 meters, well within IHO Order 1 and Special Order standards.

The Hydrographer recommends bathymetry supersede as charted.

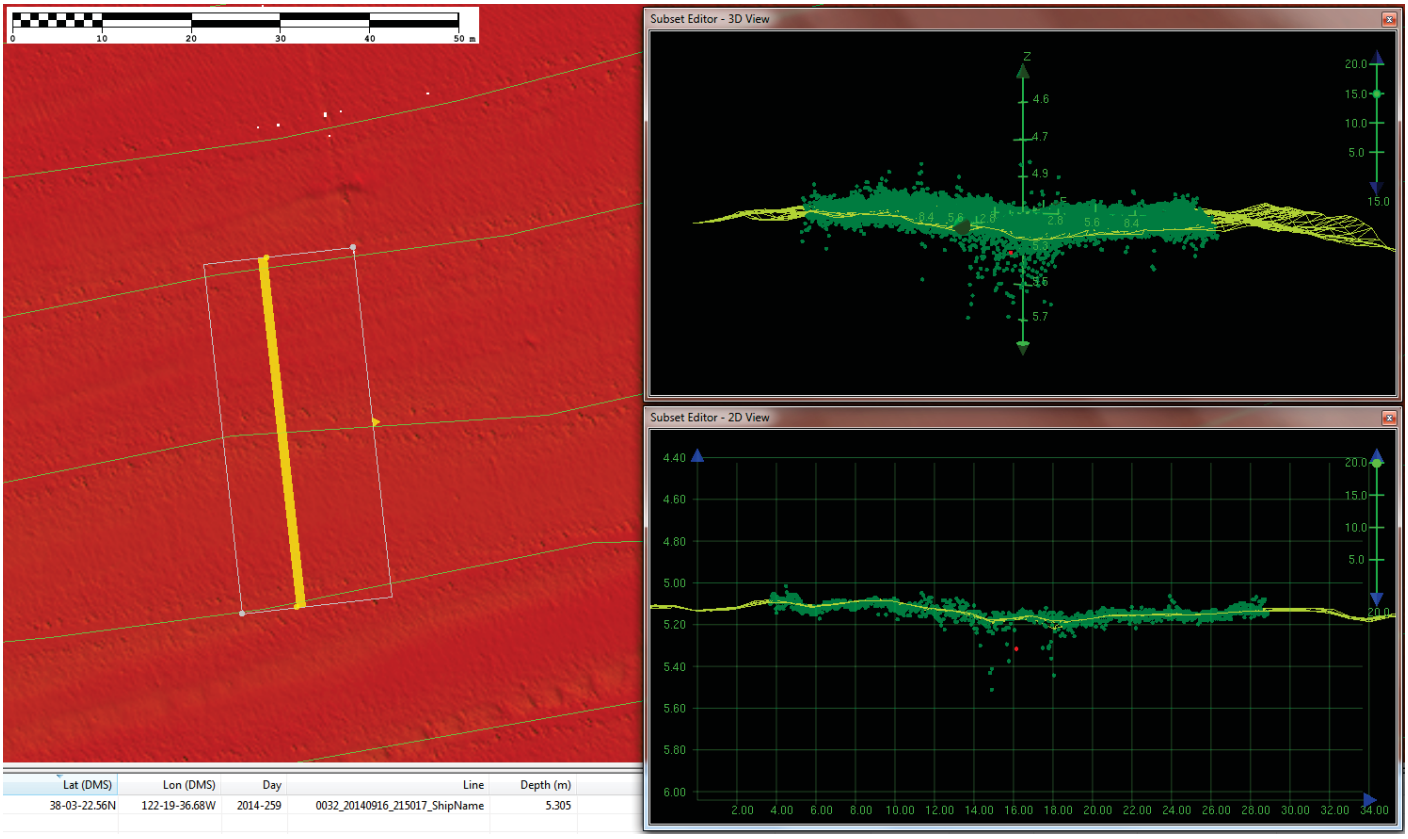


Figure 20: Example of Kongsberg EM3002 systematic error, "Devil's Horns" in shallow depths near six meters in soft sticky gray mud bottom type. Note that the wireframe 1 meter CUBE algorithm does not include erroneous "Devil's Horn" data. Quarter meter swath angle surface shown.

DATA TEMPORAL DIFFERENCE, MIGRATING SEDIMENTATION

There is a difference of nearly seven months between overlapping survey data located roughly 200 meters east of Pinole Shoal, extending from the maintained channel south to the four meter curve (38-02-57.36N, 122-18-27.92W). This difference of time is due to "The Sick POS" issue and subsequent time to resolve the issue and intermediary response operations. Data collected 1/27/2014 (2014_DN027) overlaps with data collected 9/17/2014 (2014_DN260). Due to the seasonal migration of sedimentation, perhaps spurned by California's drought and lack of fresh water runoff, a noticeable difference of up to a half meter was observed in CARIS subset mode between data sets. Data collected in January was shoaler than data collected in September. The Hydrographer removed the deeper data, where applicable, and recommends that the shoaler data supersede as charted (see Figure 21).

Overlapping data on the northern side of the Pinole Shoal Channel, exhibited differences generally 0.2 meters with shoalest points oscillating between temporal differenced data, collected 1/22/2014 (2014_DN022) and 9/16/2014 (2014_DN259). A crossline over the same data collected 12/4/2014 (2014_DN338) exhibits an additional shoaling of 0.1 meters (see Figure 22). CUBE surface honors shoalest depths within IHO Order 1 specifications. The Hydrographer recommends data supersede as charted.

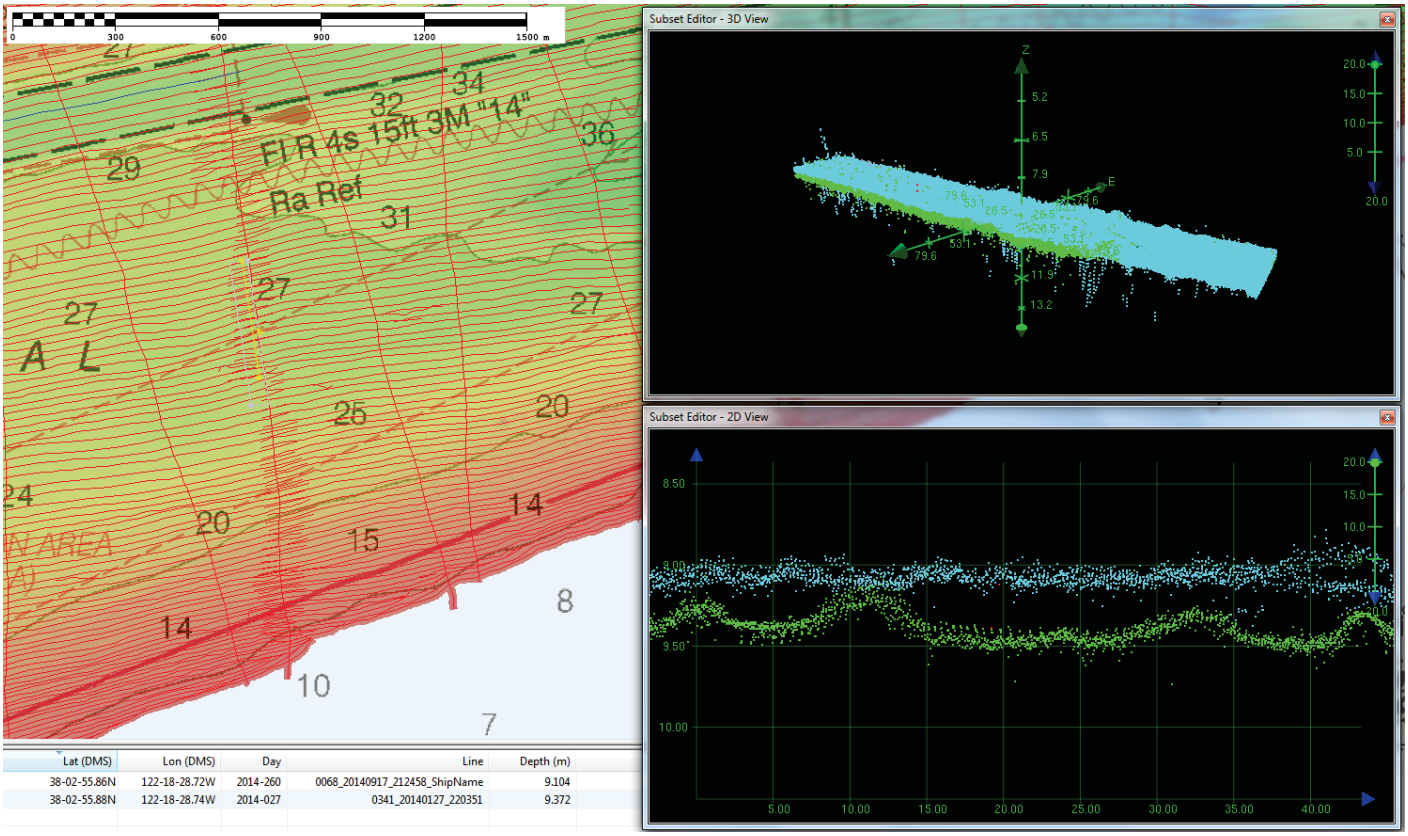


Figure 21: Temporal difference between overlapping data collected seven months apart south of the maintained channel show differences as great as 0.5 meters.

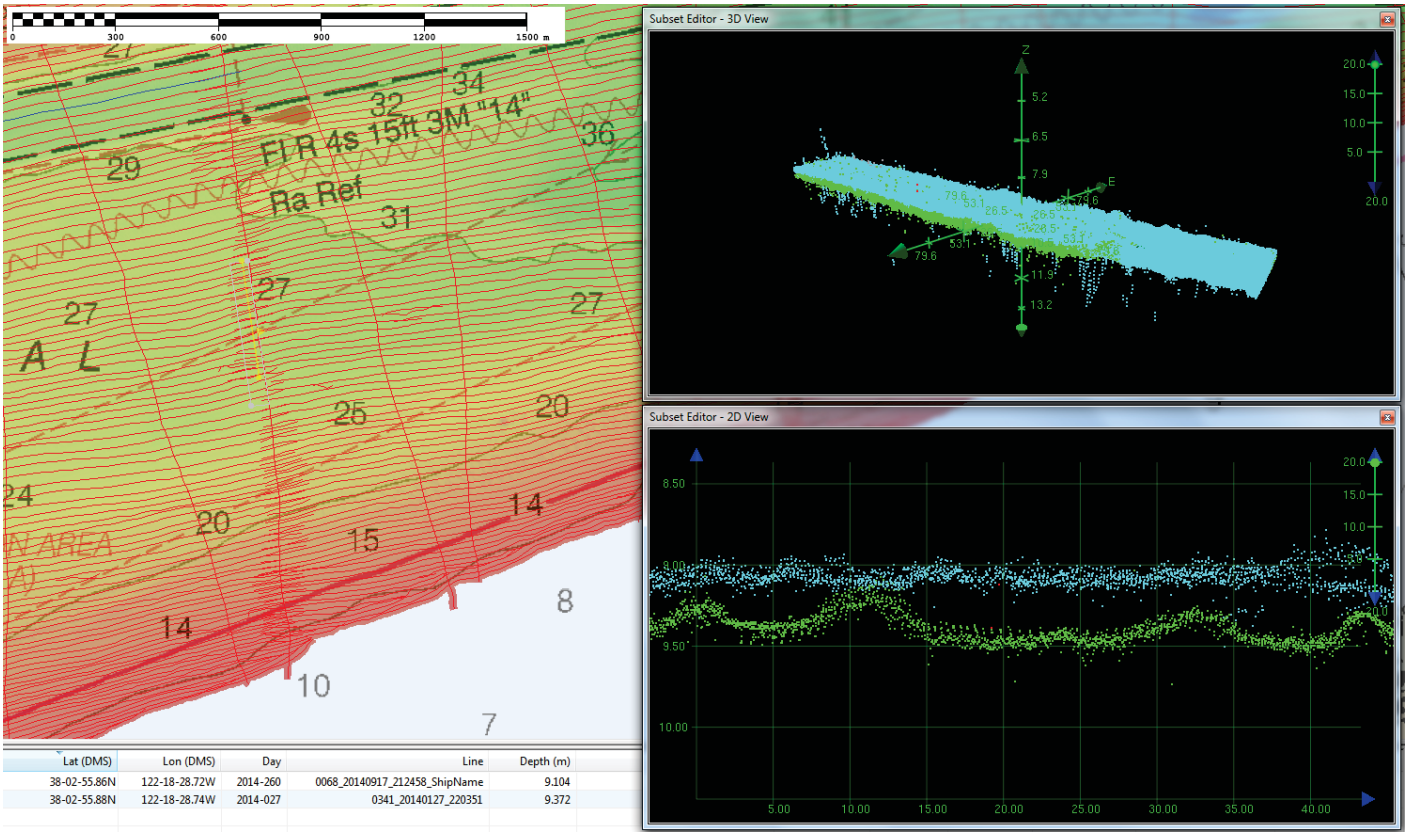


Figure 22: Temporal difference between overlapping data collected seven months apart north of the maintained channel show differences generally 0.2 meters.

B.2.6 Factors Affecting Soundings

ROUGH SEAS: 2013 DN310, 2013 DN318, 2014 DN017

Despite better judgment, survey crew trudged on through stacking 1-2 foot sharp, windswept, white capped swell on days 11/6/2013 (DN310), 11/14/2013 (DN318), and 1/17/2014 (DN017).

The error was sporadic and noticeable in the 1 meter CUBE surface. The Hydrographer cleaned the offending data where able. None of the residual erroneous data contributed to error greater than 0.08 meters to the CUBE 1 meter surface. The resulting surface is well within IHO specifications (see Figure 23).

The Hydrographer recommends bathymetry supersede as charted.

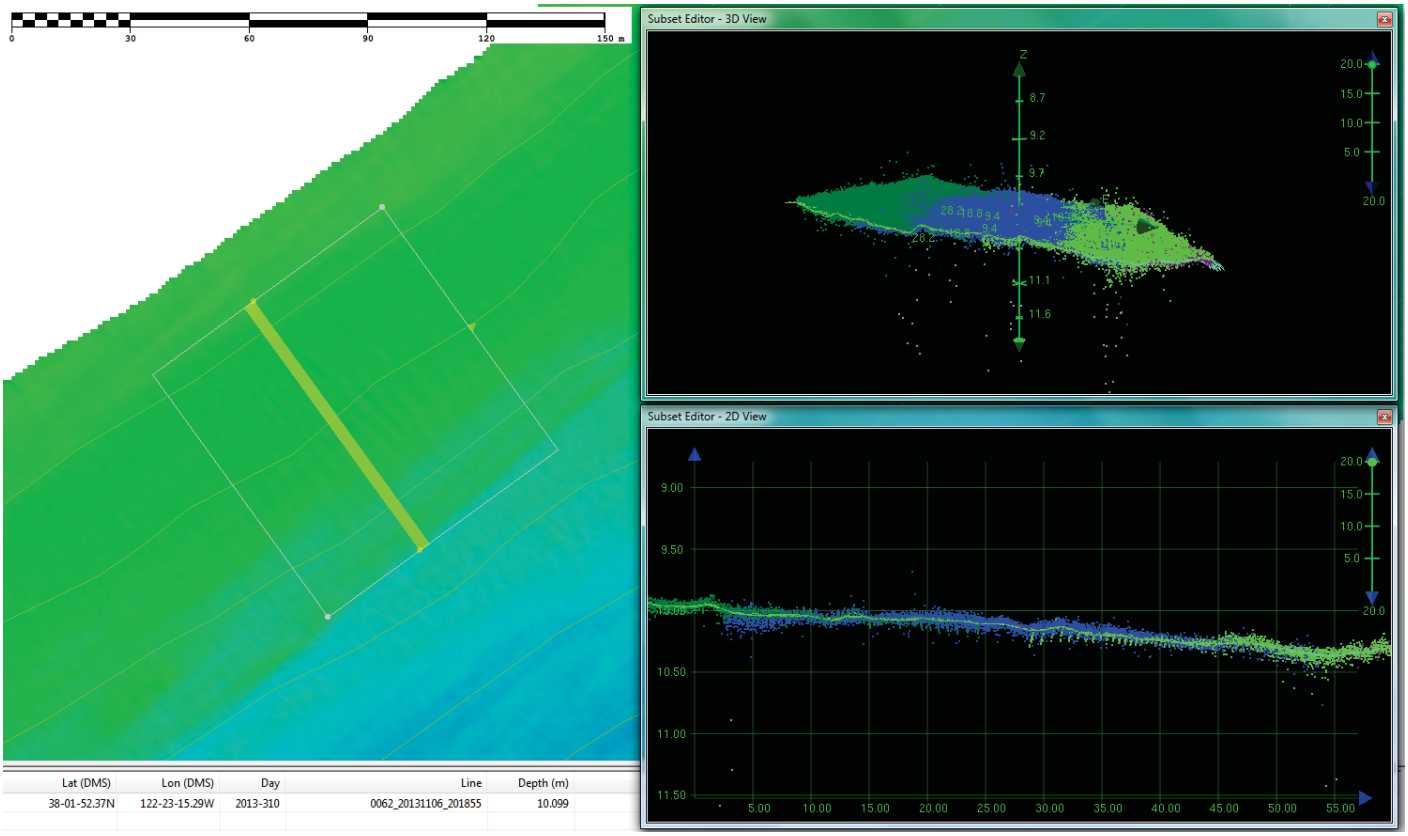


Figure 23: Example of data affected by rough seas: 1-2 foot stacking, windswept swell evident in the CUBE 1 meter surface.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Within four hours or more frequently when observed surface sound speed values varied greater than 5 meters per second, or as hydrodynamic conditions observed by the Hydrographer warranted.

CTD casts were performed and data loaded into Kongsberg EM3002 multibeam using SIS acquisition software prior to logging of data. The Hydrographer employed proactive sound speed methodology using a Seacat Profiler CTD SBE 19plus. Over the duration of survey operations the Hydrographer studied surface velocity trends throughout the survey area. During acquisition the Hydrographer 'blocked' his daily survey area in accordance to surface sound velocity zones that were established. Sound velocity casts were taken within four hours, but were only taken in areas that exhibited stable surface velocity within the daily defined survey area.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods were used as detailed in the DAPR.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

All data reduction procedures conform to those detailed in the DAPR.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.3.3 "THE TWO DAPRS" FOR SURVEY H12227

Two Data Acquisition and Processing Reports are included with survey H12227, NRT6_DAPR_2013.pdf and NRT6_DAPR_2014.pdf.

NRT6_DAPR_2013.pdf applies to data collected 10/22/2013 - 5/15/2014.

NRT6_DAPR_2014.pdf applies to data collected 9/16/2014 - 12/4/2014.

This unique situation was caused by equipment issues requiring upgrading of survey equipment mid-survey. See section B.2, Equipment Issues Affecting Sounding, for explanation.

B.4 Backscatter

Backscatter was not collected for this survey.

Do not concur: Backscatter was collected by the hydrographer, and processed into a mosaic by the processing branch.

B.5 Data Processing

B.5.1 Software Updates

The following software updates occurred after the submission of the DAPR:

Manufacturer	Name	Version	Service Pack	Hotfix	Installation Date	Use
Caris	HIPS/SIPS	7.1	2	6	01/01/2013	Processing

Table 9: Software Updates

The following Feature Object Catalog was used: S-57 ENC 3.1

Caris HIPS & SIPS 7.1, service pack 2, was used for the entirety of this survey. This is because the survey began in 2013 and that over the 13 month duration the Hydrographer chose to stick to the stable, reliable and pertinant Caris 7.1 installation.

B.5.2 Surfaces

The following surfaces and/or BAGs were submitted to the Processing Branch:

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12227_50cm_A	CUBE	0.5 meters	1.35 meters - 22.57 meters	NOAA_0.5m	Complete MBES
H12227_50cm_A_FINAL	CUBE	0.5 meters	1.35 meters - 22.57 meters	NOAA_0.5m	Complete MBES

Table 10: Submitted Surfaces

At the eastern most extent of survey H12227, there is a small area approximately 150 meters by 150 meters, that has depths greater than 20 meters (38-03-30.08N, 122-16-10.58W). Although per guidance these depths require a 1 meter surface, the Hydrographer determined that because of the outstanding data quality and data density -- and to maintain efficiency of time and processing -- that this data is represented by the half meter surface.

C. Vertical and Horizontal Control

Additional information discussing the vertical or horizontal control for this survey can be found in the accompanying HVCR.

C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

Standard Vertical Control Methods Used:

Discrete Zoning

The following National Water Level Observation Network (NWLON) stations served as datum control for this survey:

Station Name	Station ID
Richmond	9414863

Table 11: NWLON Tide Stations

File Name	Status
9414863.tid	Final Approved

Table 12: Water Level Files (.tid)

File Name	Status
L430NRT62014CORP_REV.zdf	Final

Table 13: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 12/23/2014. The final tide note was received on 01/16/2015.

All data, including data collected 2013, was tide corrected using a revised 2014 tide corrector, L430NRT62014CORP_REV.zdf.

Vertical and Horizontal Control Report (HVCR) was not required, and therefore was not submitted with this survey.
See attached Tide Note dated January 12th, 2015

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD83).

The projection used for this project is UTM 10 North.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Pigeon Point, CA (287 kHz)

Table 14: USCG DGPS Stations

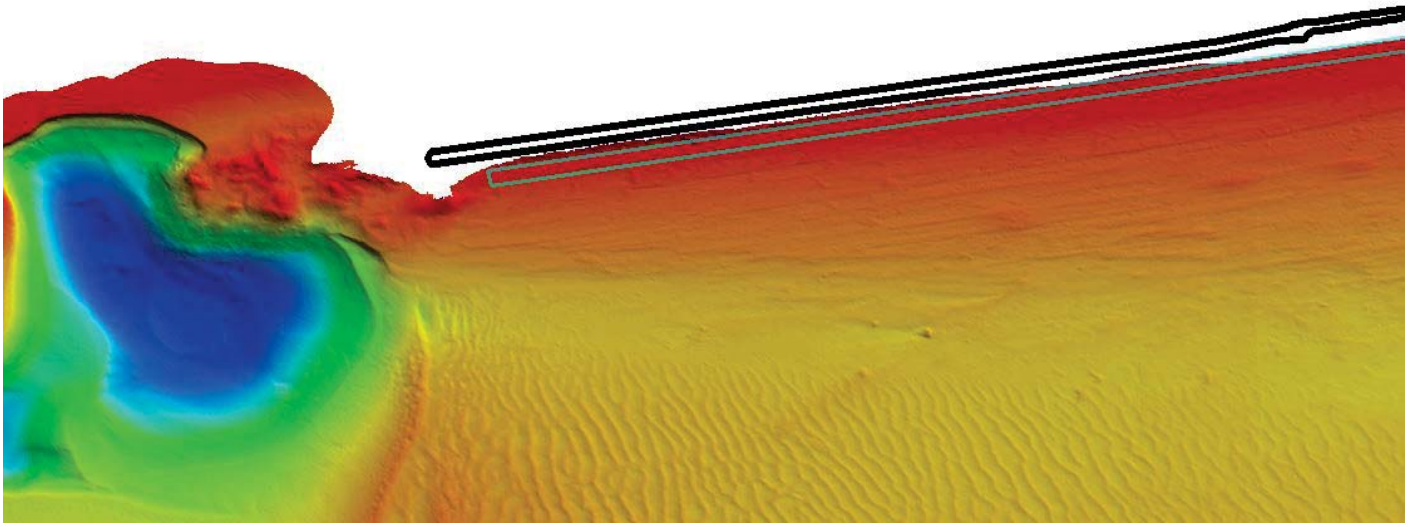
D. Results and Recommendations

D.1 Chart Comparison

CHART COMPARISON 18654, 18655, US5CA31M, US5CA32M, US3CA14M

Due to the navigationally significant nature of Pinole Shoal Channel -- used by a wide array of deep draft, tanker, and container ships -- chart comparison for soundings is treated as such where bathymetry shoaler or deeper than one foot is noted. The method for comparison was accomplished between soundings generated from the survey data manually compared to the charted depths of the appropriate raster or ENC chart. Isoplethic contours were manually compared between the survey data's digital surfaces color coded to match chart and ENC contour line depth intervals.

In all of the following chart comparisons, it should be noted that the northern jetty, named Dike no. 12, was surveyed northward of the charted position resulting in bathymetric coverage overlapping the charted dike. The hydrographer has not surveyed the extents of Dike no. 12, but a blue note within the HCell draws attention to where overlapping bathymetry occurs.



Dike Number 12 charted (blue), bathymetry coverage, and LIDAR derived position (black)

D.1.1 Raster Charts

The following are the largest scale raster charts, which cover the survey area:

Chart	Scale	Edition	Edition Date	LNM Date	NM Date
18654	1:40000	45	01/2011	12/16/2014	12/27/2014
18655	1:10000	59	10/2006	12/16/2014	12/27/2014

Table 15: Largest Scale Raster Charts

18654

CHART 18654 COMPARISON, SOUNDINGS

Generally, bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits a general deepening of a half meter as compared to chart 18654.

However, bathymetric depths directly north and to the west of Pinole Point (38-01-15.81N, 122-22-43.15W), extending roughly three kilometers to the survey's edge, exhibited a general shoaling, no greater than a half meter. This difference may be attributed to the noticeable eddy survey crew experienced during survey operations, a result of the hydrodynamics imparted by Pinole Point (see Figure 24).

CHART 18654 COMPARISON, ISOPLETHIC

Generally, bathymetric soundings agreed with charted isoplethic contours, aside from three broad, discernible areas (see Figure 25):

1) Shoaling west of Pinole Point. Bathymetric depths directly north and to the west of Pinole Point (38-01-15.81N, 122-22-43.15W), extending roughly three kilometers to the survey's edge, exhibited a general shoaling, no greater than a half meter. This difference may be attributed to the noticeable eddy survey crew experienced during survey operations, a result of the hydrodynamics imparted by Pinole Point.

2) Deepening trending east of Pinole Shoal. Bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits a general deepening of a half meter as compared to chart 18654.

3) Deepening against Dike 12. Dike 12, located and extending at the north west extent of survey H12227 (38-03-49.74N, 122-17-29.91W), exhibited bathymetric soundings deeper than charted depths, with differences as great as 9 feet. This is attributed to the hydrodynamic trends of the area.

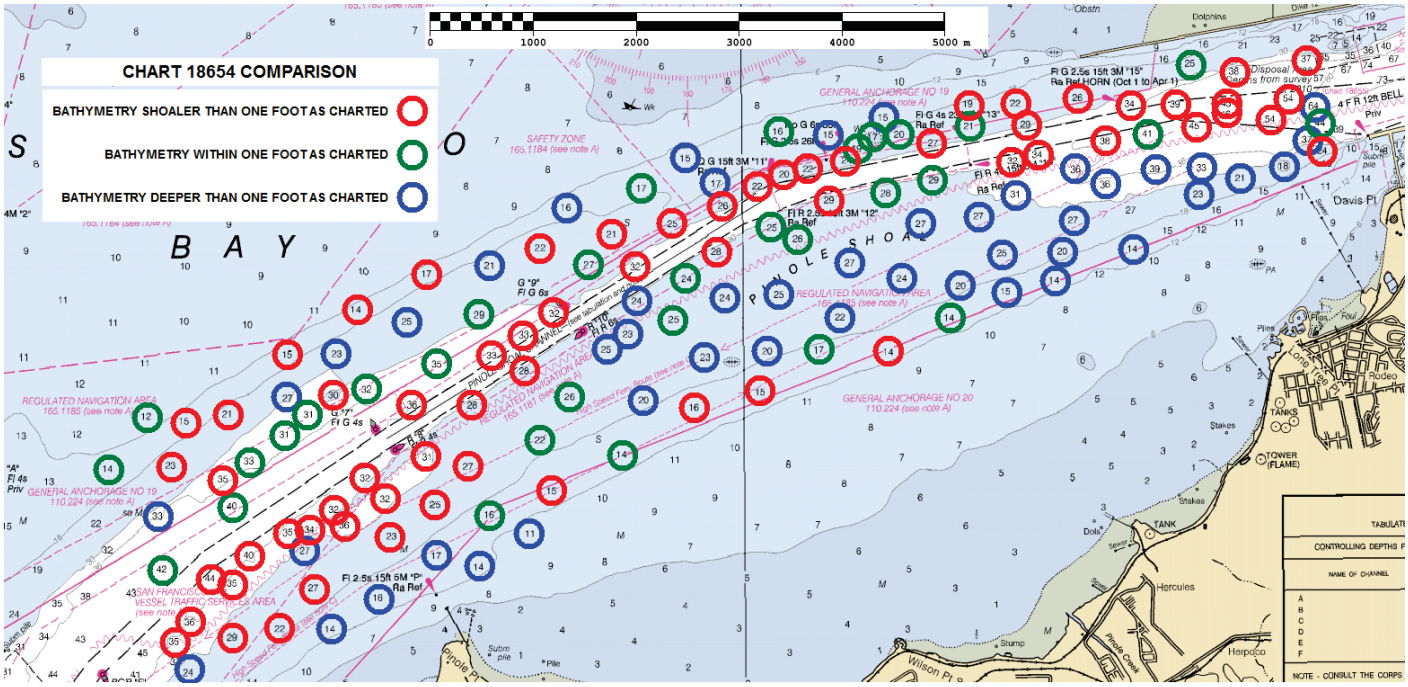


Figure 24: Chart 18654 soundings comparison

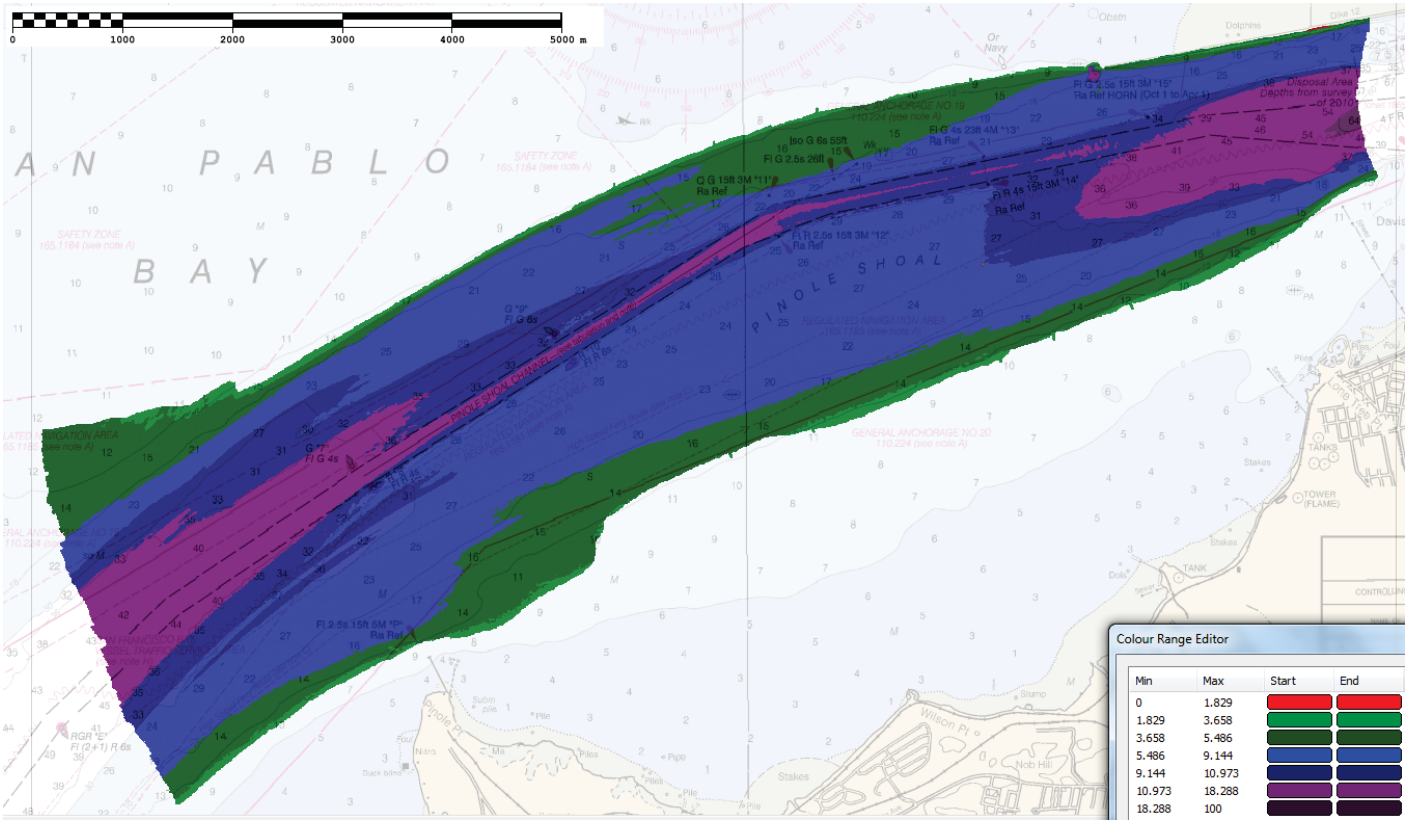


Figure 25: Chart 18654 isoplethic comparison

18655

CHART 18655 COMPARISON, SOUNDINGS

Generally, bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits deepening of generally a half meter as compared to chart 18654.

Bathymetric soundings adjacent to the southern extent of Dike 12 are deeper than as charted, with difference as great as 9 feet (38-03-50.49N, 122-17-14.47W) (See Figure 26).

CHART 18655 COMPARISON, ISOPLETHIC

Generally, bathymetric soundings agreed with charted isoplethic contours, aside from three broad, discernible areas (see Figure 27):

1) Deepening trending east of Pinole Shoal. Bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits a general deepening of a half meter as compared to chart 18655.

2) Deepening against Dike 12. Dike 12, located and extending at the north west extent of survey H12227 (38-03-49.74N, 122-17-29.91W), exhibited bathymetric soundings deeper than charted depths. This is attributed to the hydrodynamic trends of the area.

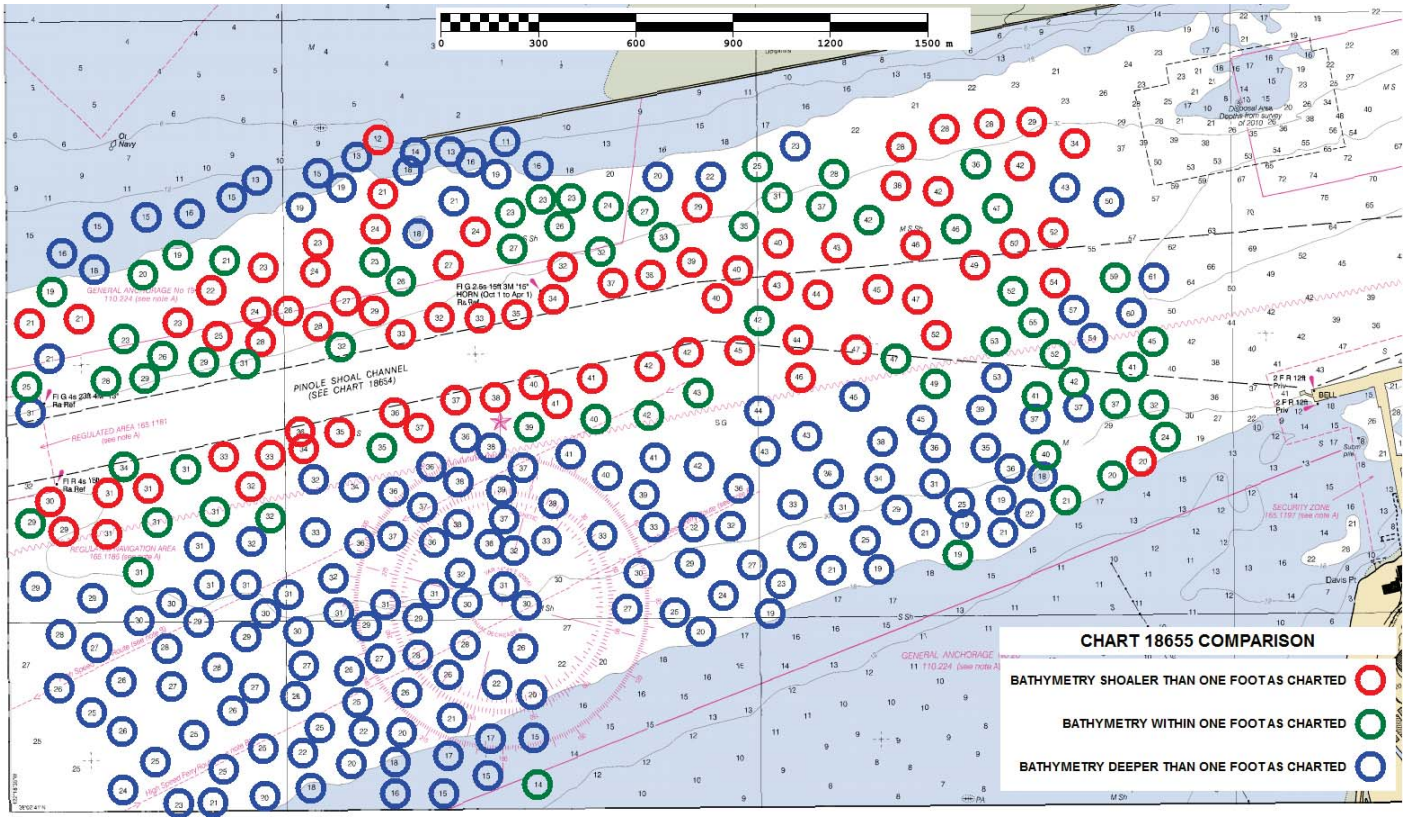


Figure 26: Chart 18655 soundings comparison

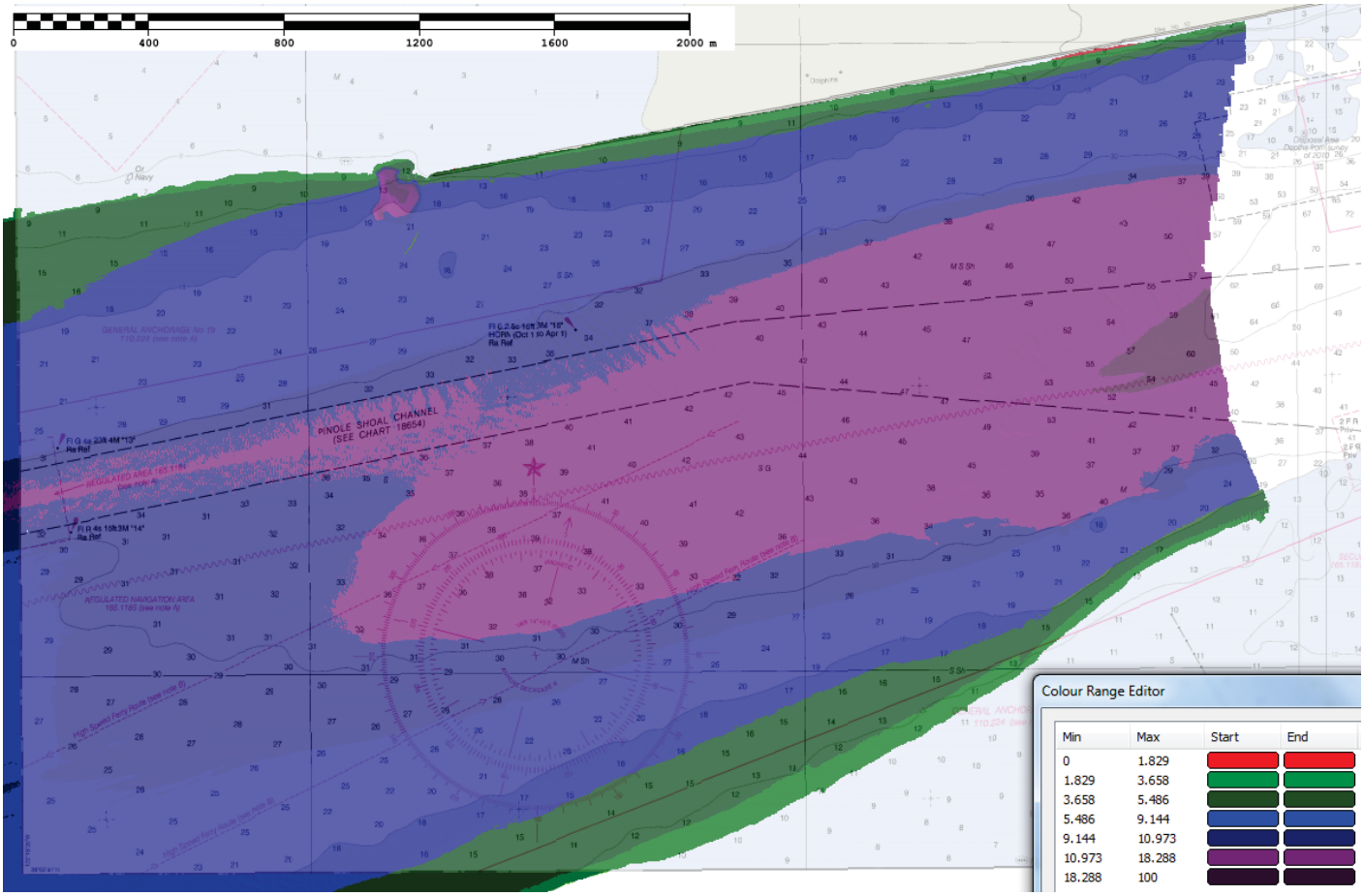


Figure 27: Chart 18655 isoplethic comparison

D.1.2 Electronic Navigational Charts

The following are the largest scale ENCs, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US3CA14M	1:600000	17	05/06/2014	12/10/2014	NO
US5CA32M	1:10000	19	02/26/2014	12/01/2014	NO
US5CA31M	1:40000	23	12/03/2014	12/03/2014	NO

Table 16: Largest Scale ENCs

US3CA14M

Survey H12227 exhibits no difference with ENC US3CA14M (see Figure 28).

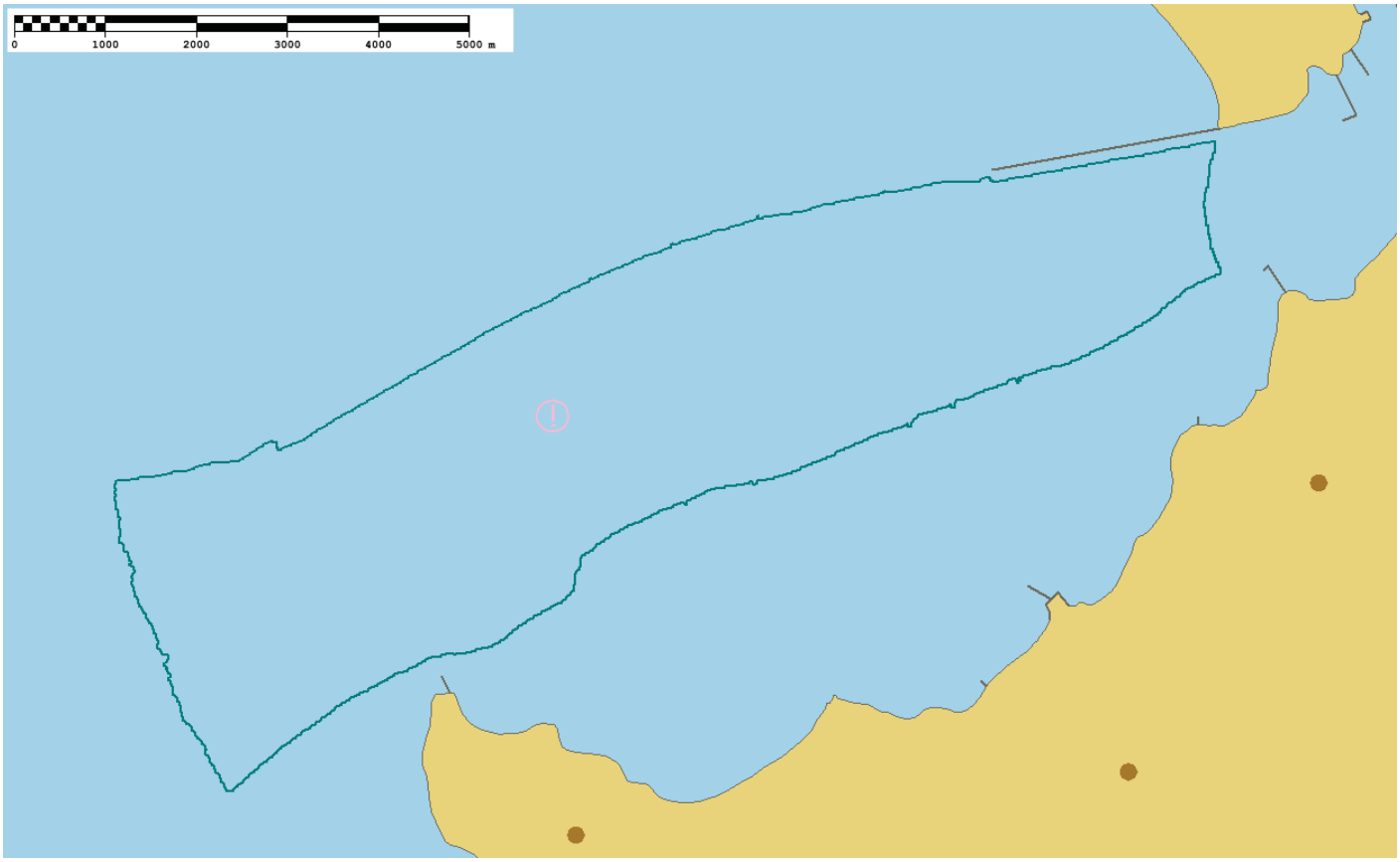


Figure 28: Survey H12227 survey area polygon (color: aqua) overlayed over ENC US3CA14M.

US5CA32M

ENC US5CA32M COMPARISON, SOUNDINGS

Generally, bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits deepening of generally a half meter as compared to US5CA32M.

Bathymetric soundings adjacent to the southern extent of Dike 12 are deeper than as charted, with difference as great as 9 feet (38-03-50.49N, 122-17-14.47W) (See Figure 29).

ENC US5CA32M COMPARISON, ISPOPLETHIC

Generally, bathymetric soundings agreed with charted isoplethic contours, aside from three broad, discernible areas (see Figure 30):

1) Deepening trending east of Pinole Shoal. Bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits a general deepening of a half meter as compared to US5CA32M.

2) Deepening against southern riprap, Dike 12. Dike 12, located and extending at the north west extent of survey H12227 (38-03-49.74N, 122-17-29.91W), exhibited bathymetric soundings deeper than charted depths. This is attributed to the hydrodynamic trends of the area.

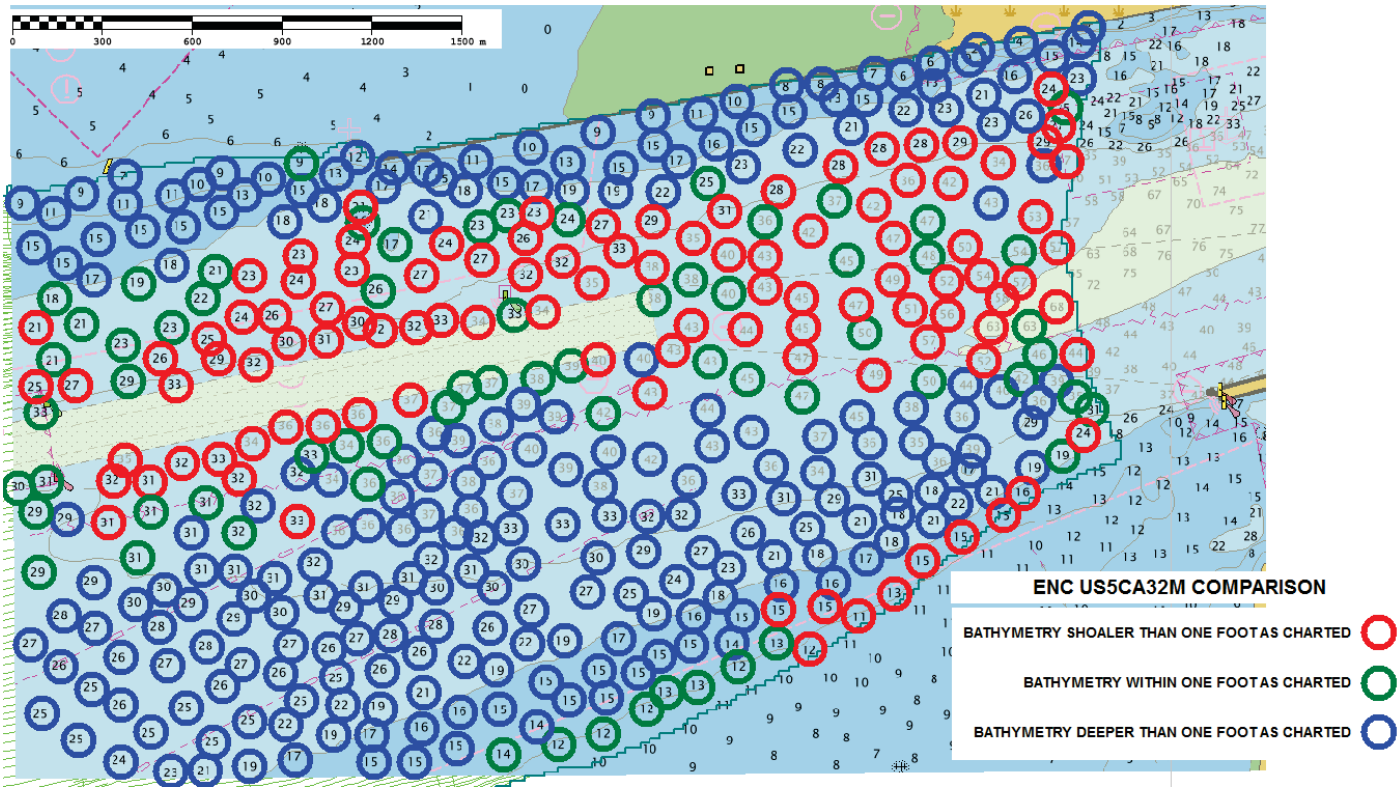


Figure 29: ENC US5CA32M comparison, soundings

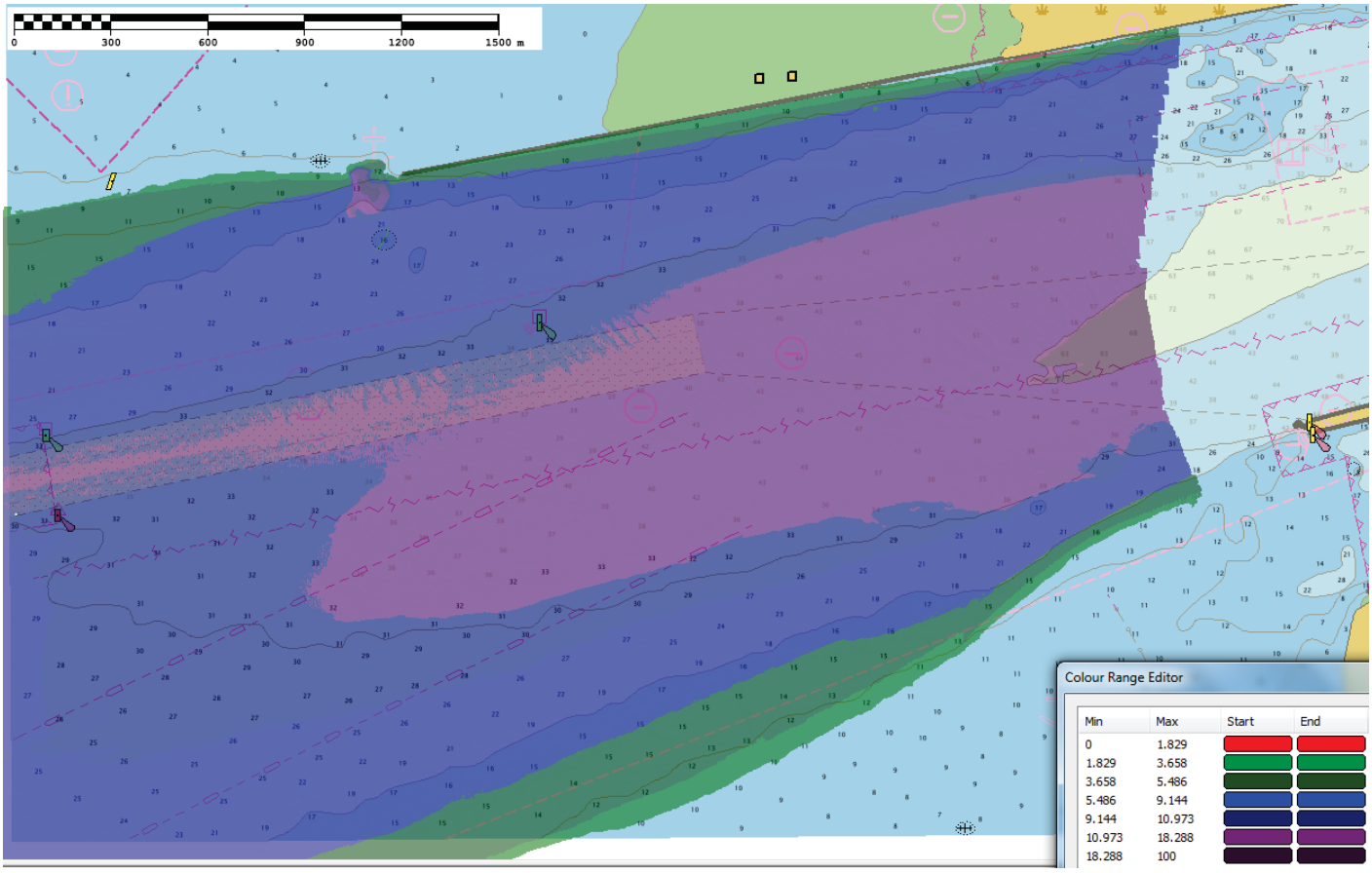


Figure 30: ENC US5CA32M comparison, isoplethic

US5CA31M

ENC US5CA31M COMPARISON, SOUNDINGS

Generally, bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits a general deepening of a half meter as compared to US5CA31M.

However, bathymetric depths directly north and to the west of Pinole Point (38-01-15.81N, 122-22-43.15W), extending roughly three kilometers to the survey's edge, exhibited a general shoaling, no greater than a half meter. This difference may be attributed to the noticeable eddy survey crew experienced during survey, a result of the hydrodynamics imparted by Pinole Point (see Figure 31).

ENC US5CA31M COMPARISON, ISOPLETHIC

Generally, bathymetric soundings agreed with charted isoplethic contours, aside from two broad, discernible areas (see Figure 32):

1) Shoaling west of Pinole Point. Bathymetric depths directly north and to the west of Pinole Point (38-01-15.81N, 122-22-43.15W), extending roughly three kilometers to the survey's edge, exhibited a general shoaling, no greater than a half meter. This difference may be attributed to the noticeable eddy survey crew experienced during survey, a result of the hydrodynamics imparted by Pinole Point.

2) Deepening trending west of Davis Point. Bathymetric soundings agreed with charted depths within a half meter, exhibiting broad, trending areas of sedimentation migration, perhaps due to seasonal shifting of freshwater runoff (or lack thereof due to the record drought that occurred during survey operations). The area at the south eastern extent of survey H12227 (38-03-09.14N, 122-16-51.55W), south of the maintained channel extending from Pinole Shoal to Davis Point, roughly four kilometers, exhibits a general deepening of a half meter as compared to US5CA31M.

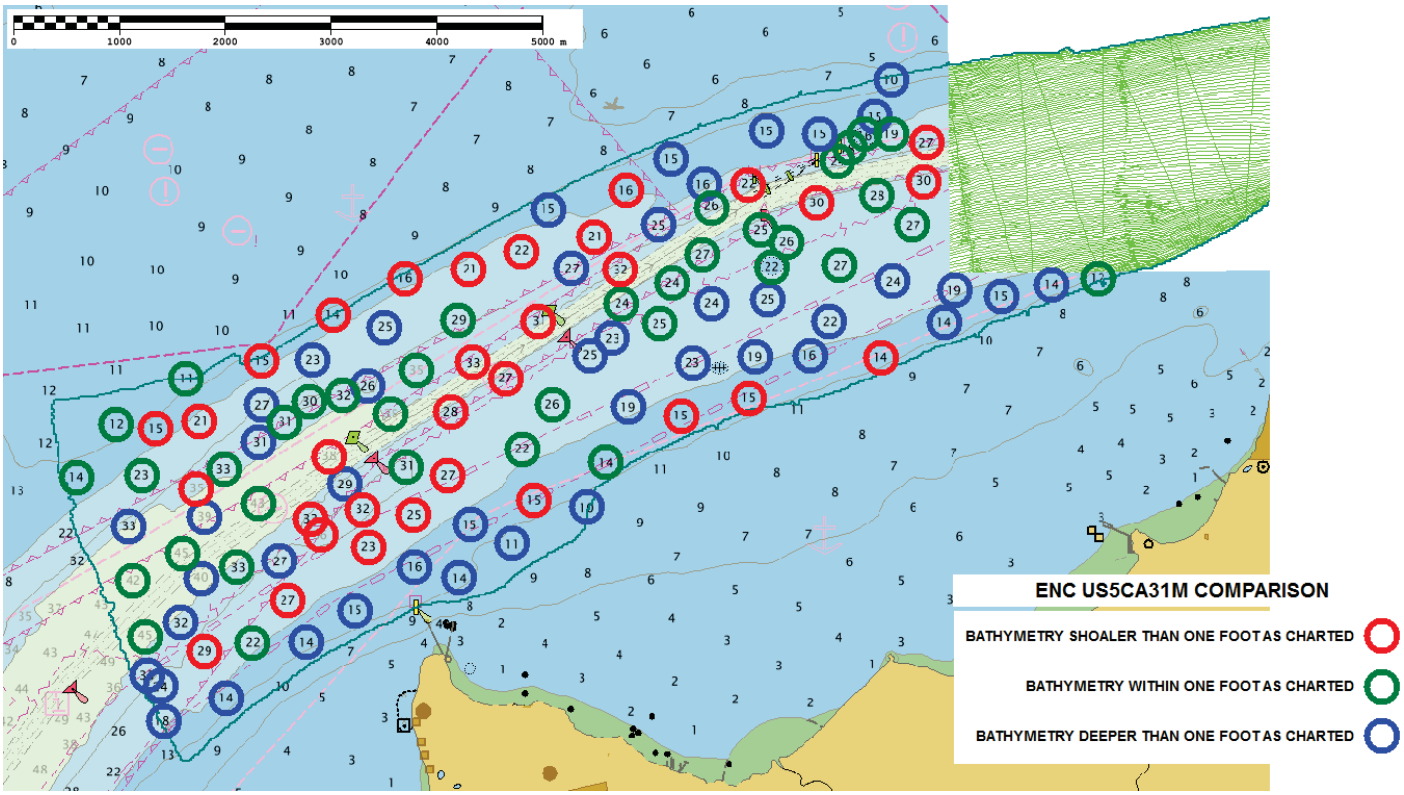


Figure 31: ENC US5CA31M comparison, soundings

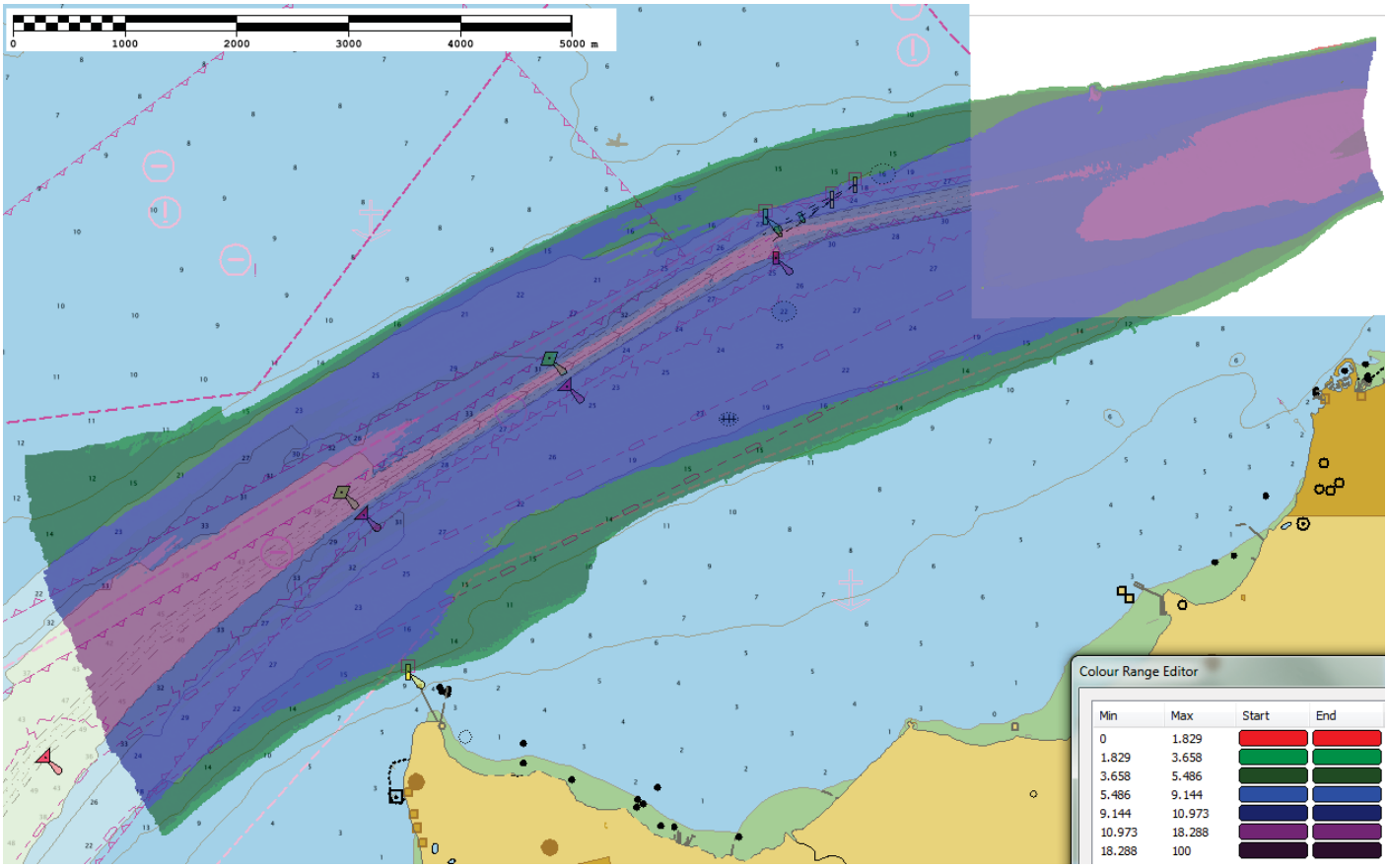


Figure 32: ENC US5CA31M comparison, isoplethic

D.1.3 AWOIS Items

No AWOIS items were assigned for this survey.

D.1.4 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.5 Charted Features

No charted features exist for this survey.

Do not concur, there are two charted wrecks within the survey area.

D.1.6 Uncharted Features

Eleven uncharted features were discovered during survey operations for survey H12227.

Ten of these features are included in the H12227_final_features_file.000 included within this submission. One of these features, however -- Uncharted Feature 2014_10_21 -- could not be included due to IT Security settings preventing proper operation of Caris Bathy database on NRT6's processing computer. The Hydrographer has included a complete Pydro .pss of the project as a backup, H12227_pss.pss., which includes all eleven features. The Hydrographer apologizes for this inconvenience.

UNCHARTED FEATURE 2013_11_26
A small feature, length 0.8 meters, width 0.8 meters, shoalest depth 7.13 meters, height above bottom is 0.1 meters, located 1200 meters northwest of Davis Point (38-03-21.70N, 122-16-23.51W). The Hydrographer recommends charting as obstruction, least depth known (see Figure 33).

UNCHARTED FEATURE 2013_11_26
A small boat, length 13 meters, width 5 meters, shoalest depth 10.97 meters, height above bottom is 1.9 meters, located 400 meters south of Pinole Shoal Channel (38-03-13.02N, 122-17-22.95W). The Hydrographer recommends charting as wreck, least depth known (see Figure 34)

UNCHARTED FEATURE 2014_01_17_A
An uncharted feature with a 11 meters length, 3.6 meters width, 0.4 meters height above bottom, and 5.640 meters shoalest depth was located 38-03-07.54N and 122-16-29.50W. The Hydrographer recommends charting the feature as a wreck (see Figure 35).

UNCHARTED FEATURE 2014_01_22
An uncharted feature with a 4.9 meters length, 3.0 meters width, 1.5 meters height above bottom, and 4.707 meters shoalest depth was located 38-03-38.25N and 122-18-26.94W. The Hydrographer recommends charting the feature as an obstruction (see Figure 36).

UNCHARTED FEATURE 2014_02_04
An uncharted feature with a 3 meters length, 3 meters width, 0.5 meters height above bottom, and 3.346 m shoalest depth was located 38-02-41.22N and 122-17- 29.25W. The Hydrographer recommends charting the feature since it is an obstruction (see Figure 37).

UNCHARTED FEATURE 2014_10_01
An uncharted feature with a 4.7 meters length, 2 meters width, 0.6 meters height above bottom, and 5.195 m shoalest depth was located 38-02-12.76N and 122-19-39.94W. The Hydrographer recommends charting the feature since it is an obstruction (see Figure 38).

UNCHARTED FEATURE 2014_10_22
An obstruction, length 12.4 meters, width 6.5 meters, shoalest depth 7.92 meters, height above bottom is 0.9 meters, located approximately 800 meters north of Pinole Shoal Channel (38-02-19.33N, 122-22-28.54W). The Hydrographer recommends charting as sounding (see Figure 39).

UNCHARTED FEATURE 2014_10_29
A unique feature, length 7.8 meters, width 1.0 meters, shoalest depth 12.472 meters, height above bottom is 1.1 meters, located near Pinole Shoal, (38-02-23.79N, 122-20-13.04W). The Hydrographer recommends charting as obstruction, least depth known (see Figure 40).

UNCHARTED FEATURE 2014_11_04
An obstruction, length 4.7 meters, width 2.9 meters, shoalest depth 6.26 meters, height above bottom is 0.4 meters, located approximately 1000 meters north of Pinole Shoal Channel (38-02-42.37N, 122-21-55.30W). The Hydrographer recommends charting as obstruction, least depth known (see Figure 41).

UNCHARTED FEATURE 2014_10_21
An uncharted feature, length 5 meters, width 5 meters, no height above bottom, shoalest depth 12.7 meters was located within the Pinole Shoal Channel 280 meters west of navigation buoy 7. The shoalest depth of the feature is deeper than maintained channel depths: left outside quarter 29 feet, middle half of channel 36 feet, right outside quarter 35 feet. The Hydrographer recommends charting as obstruction, least depth known (see Figure 42).

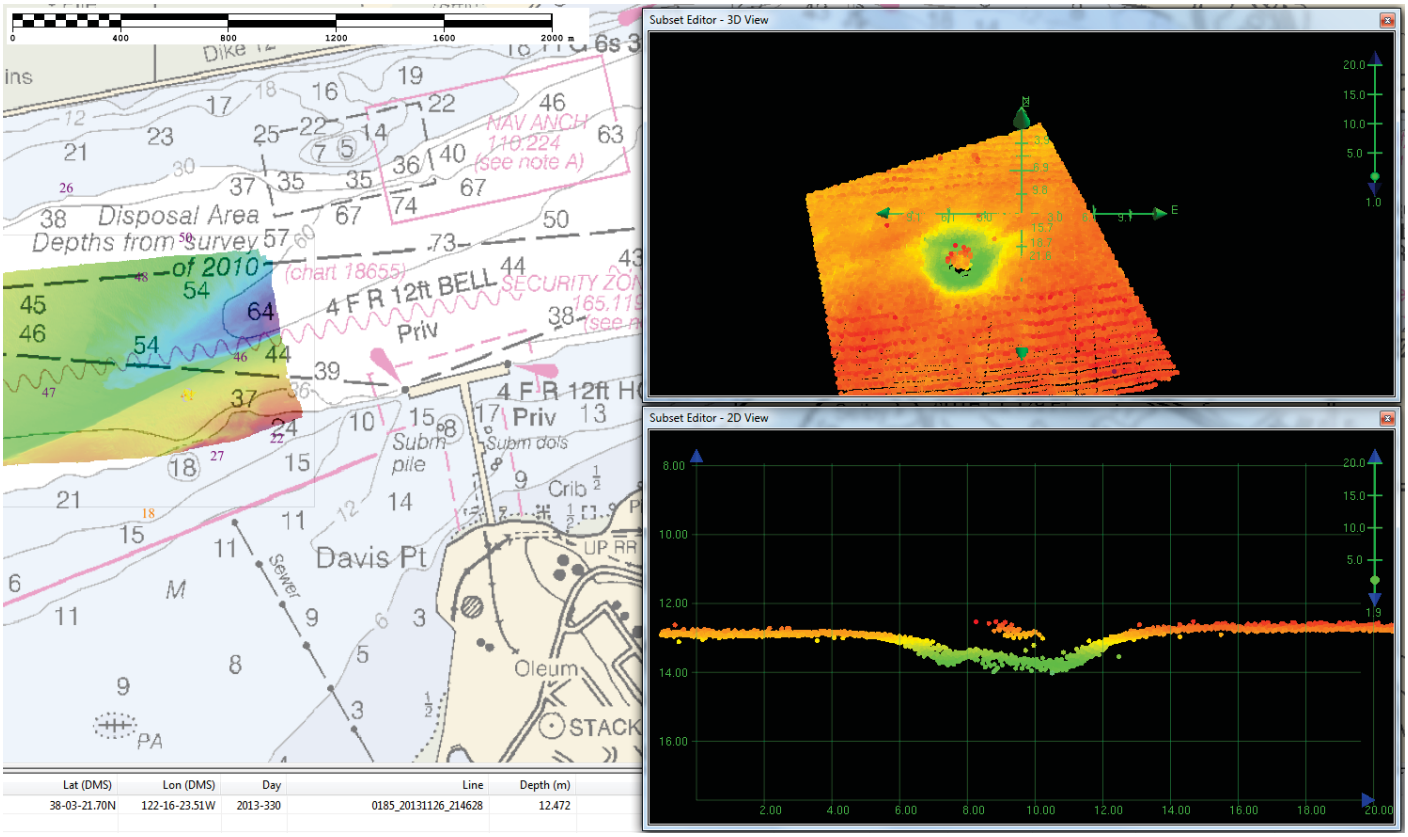


Figure 33: Uncharted feature 2013_11_26

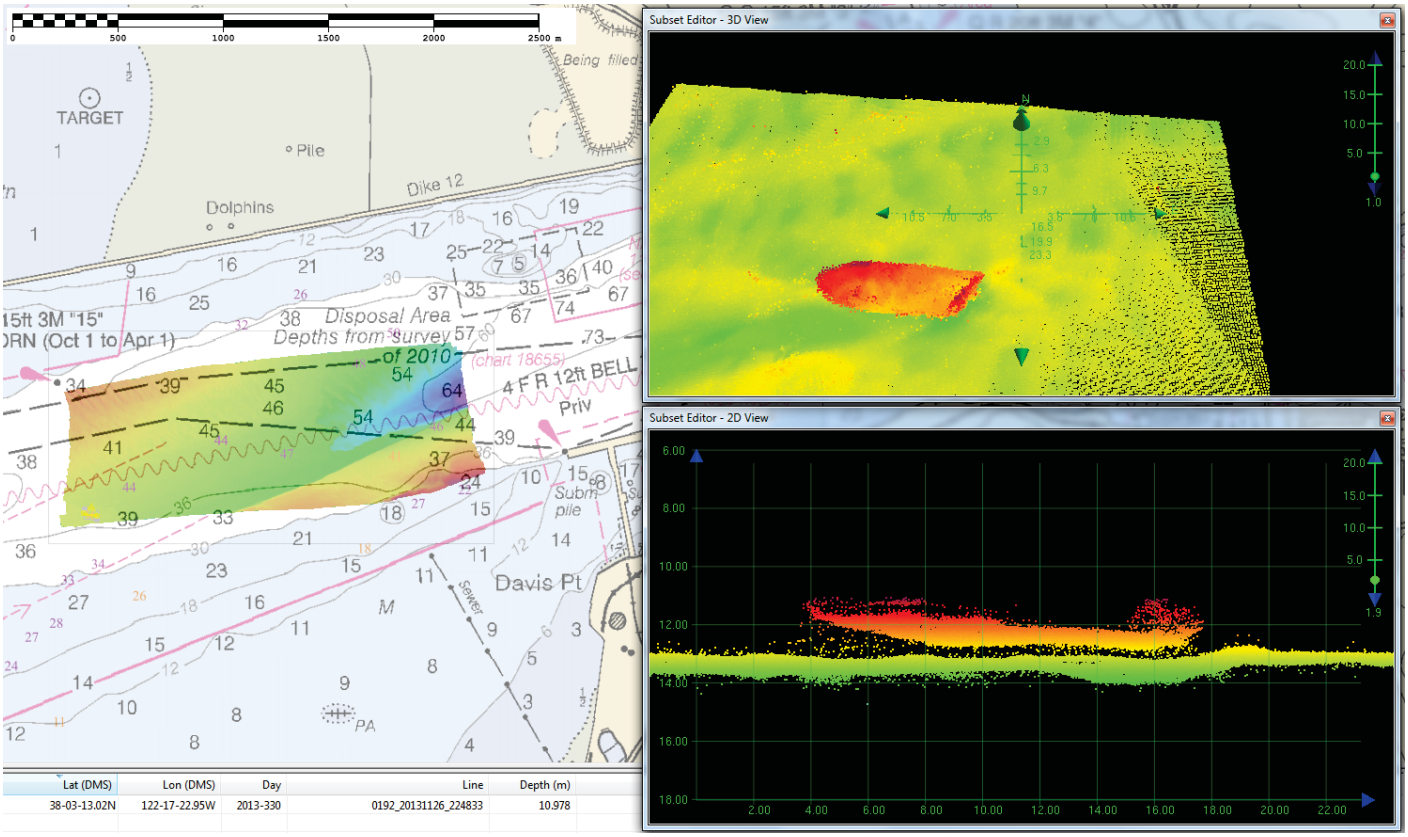


Figure 34: Uncharted feature 2013_11_26

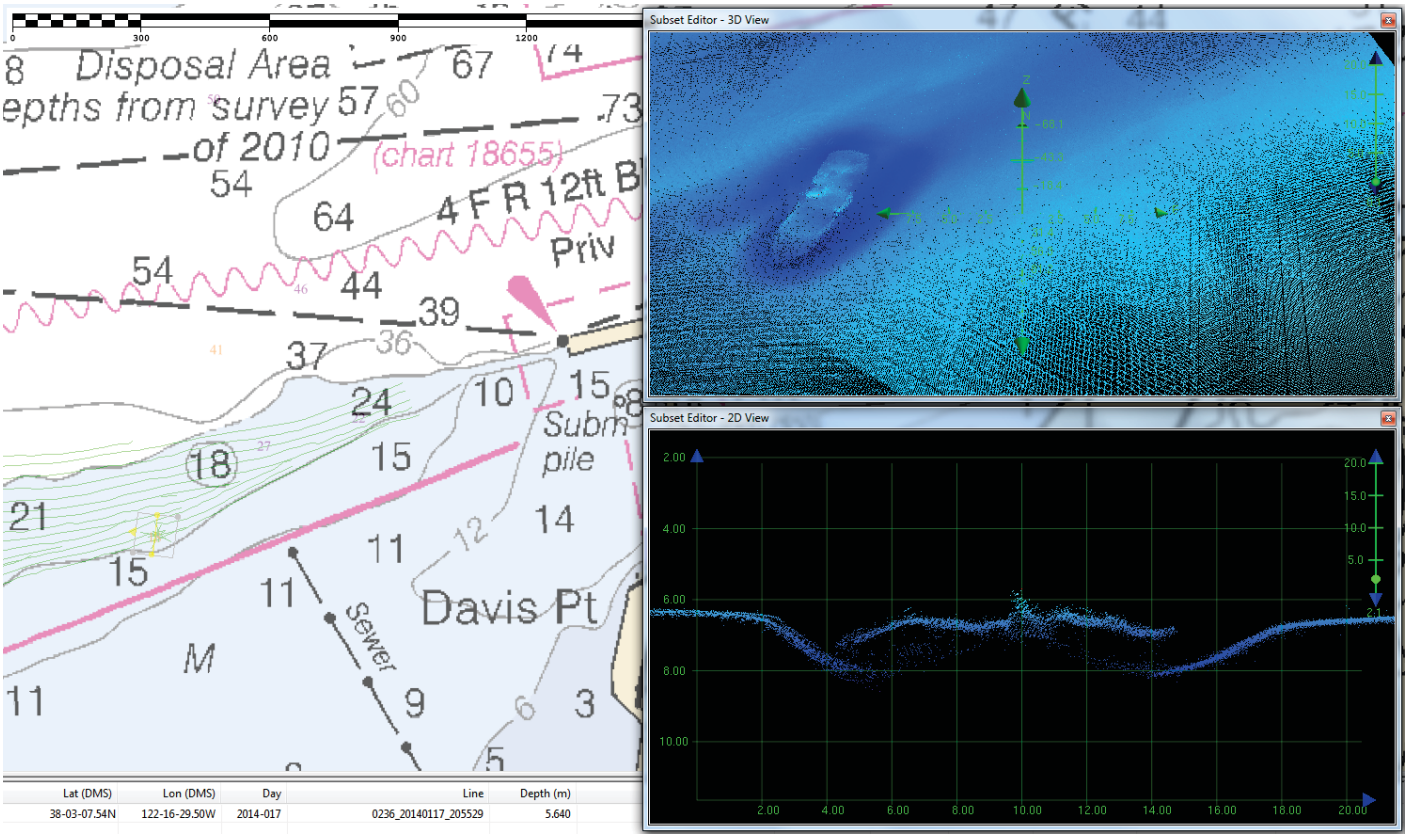


Figure 35: Uncharted feature 2014_01_17_A

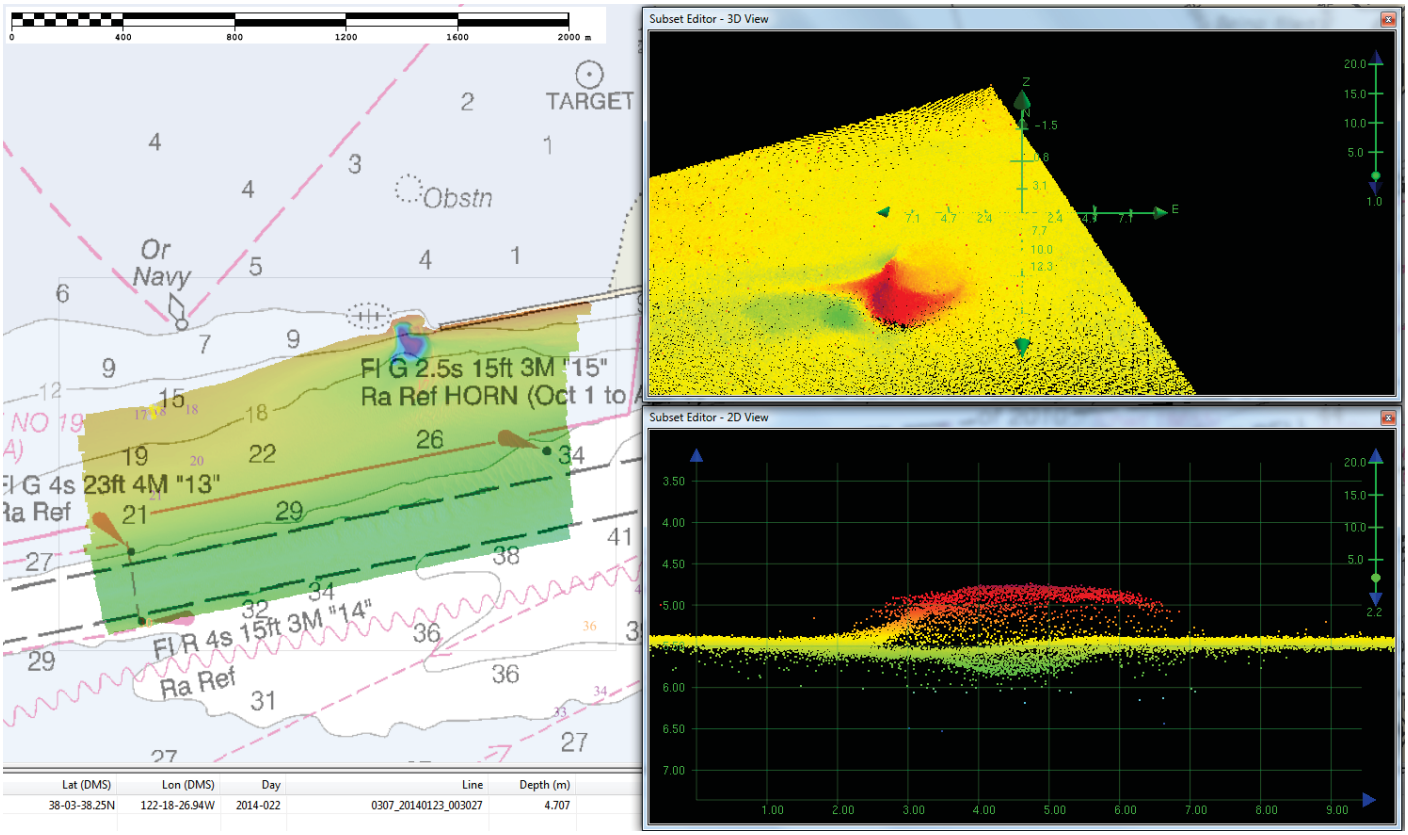


Figure 36: Uncharted feature 2014_01_22

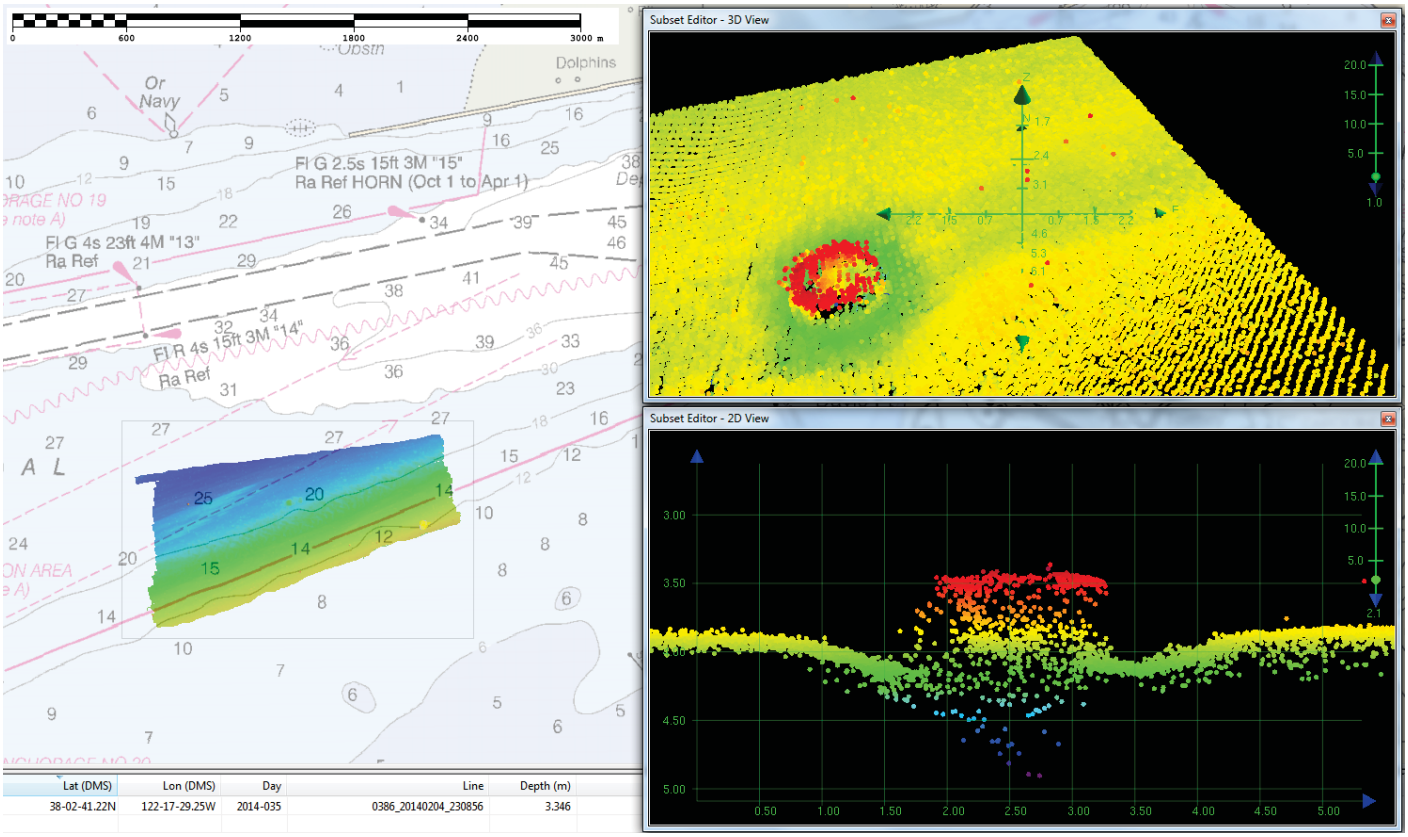


Figure 37: Uncharted feature 2014_02_04

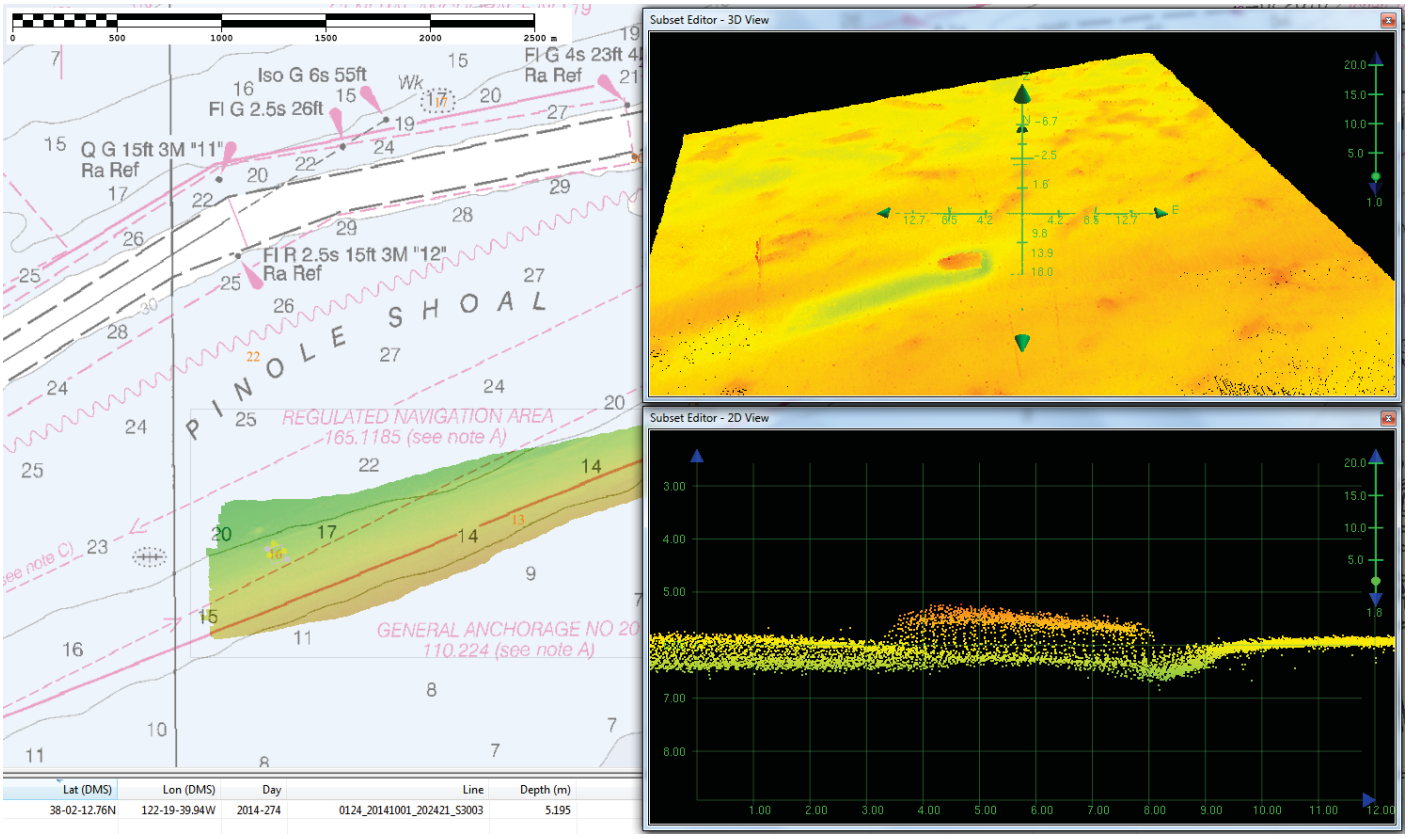


Figure 38: Uncharted feature 2014_10_01

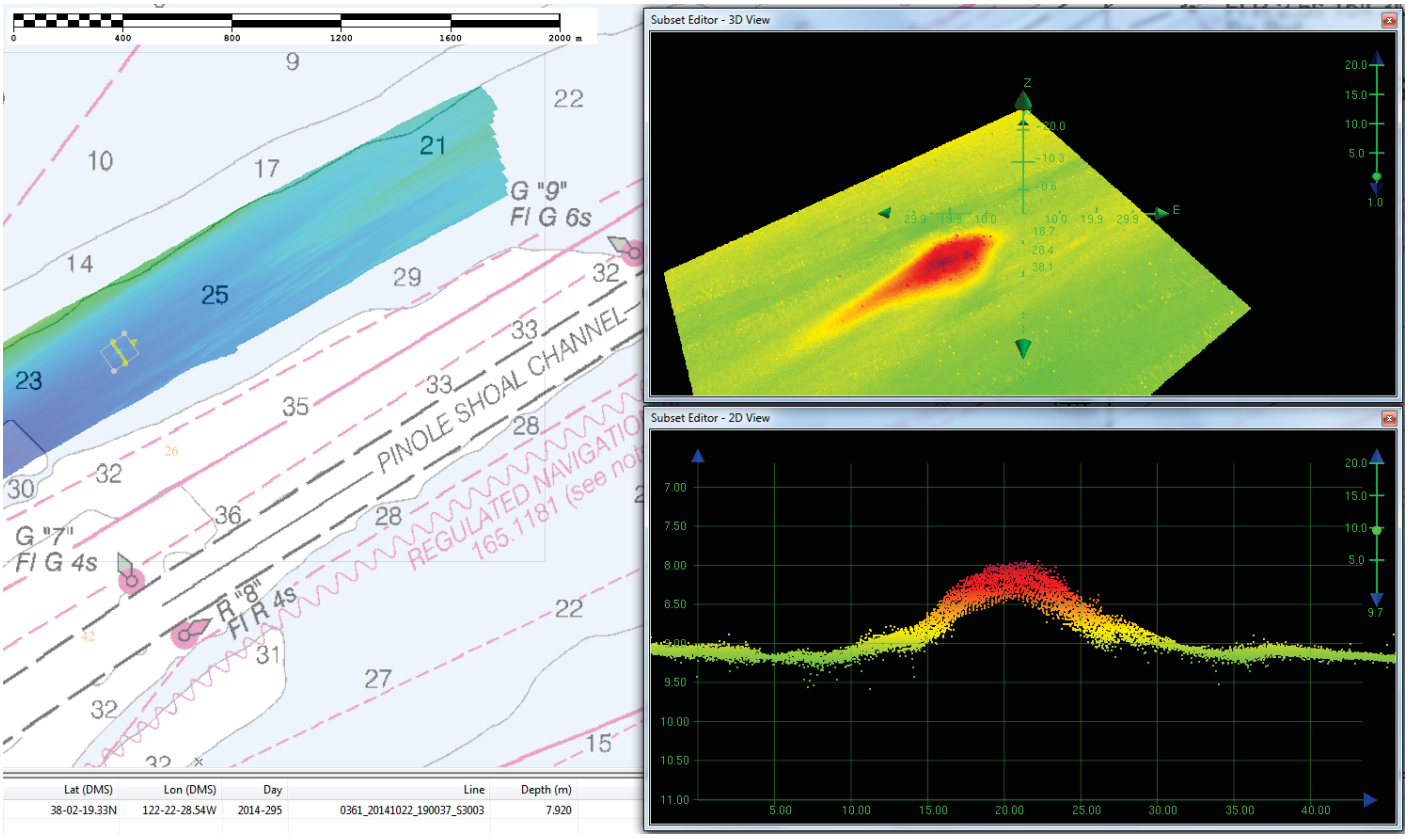


Figure 39: Uncharted feature 2014_10_22

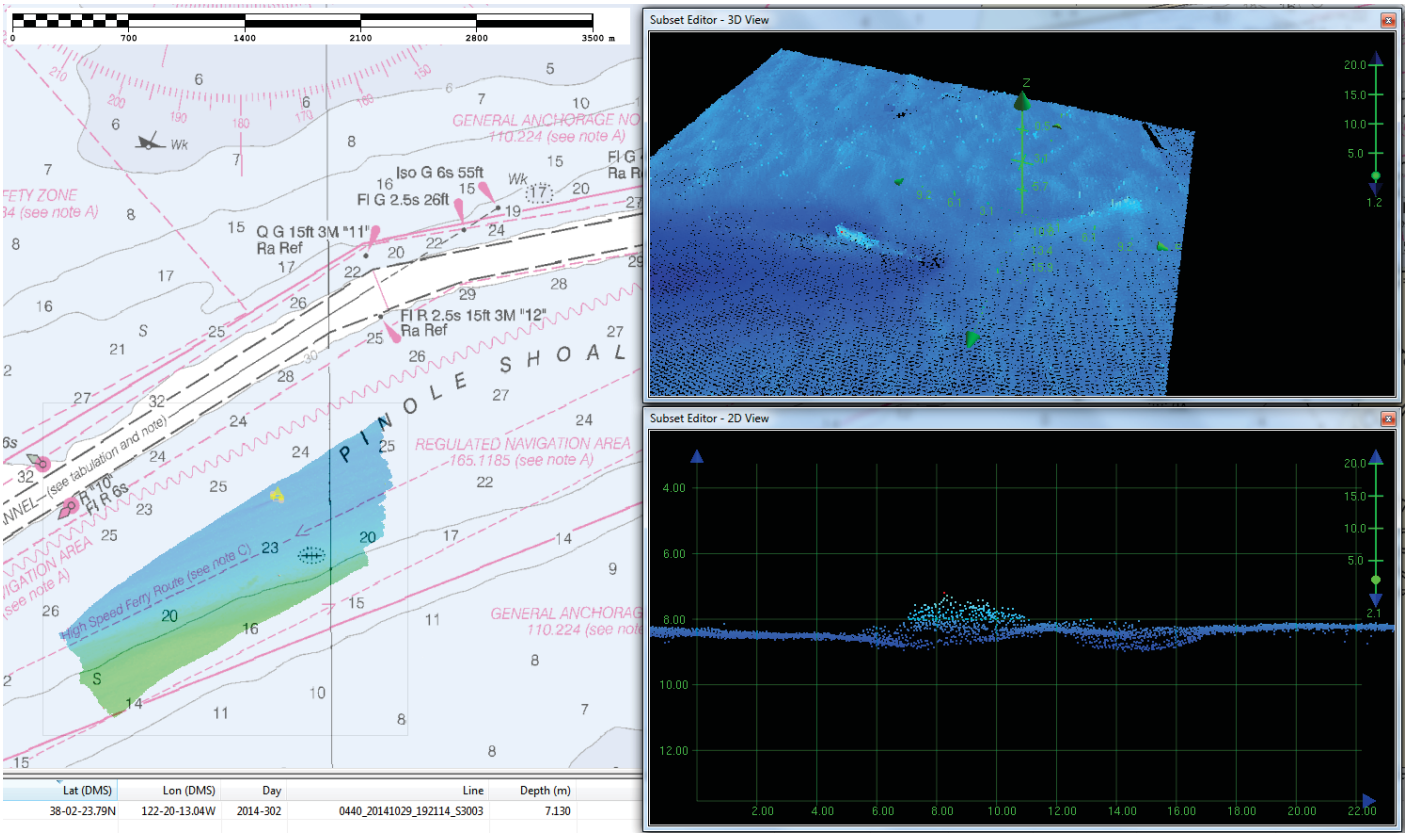


Figure 40: Uncharted feature 2014_10_29

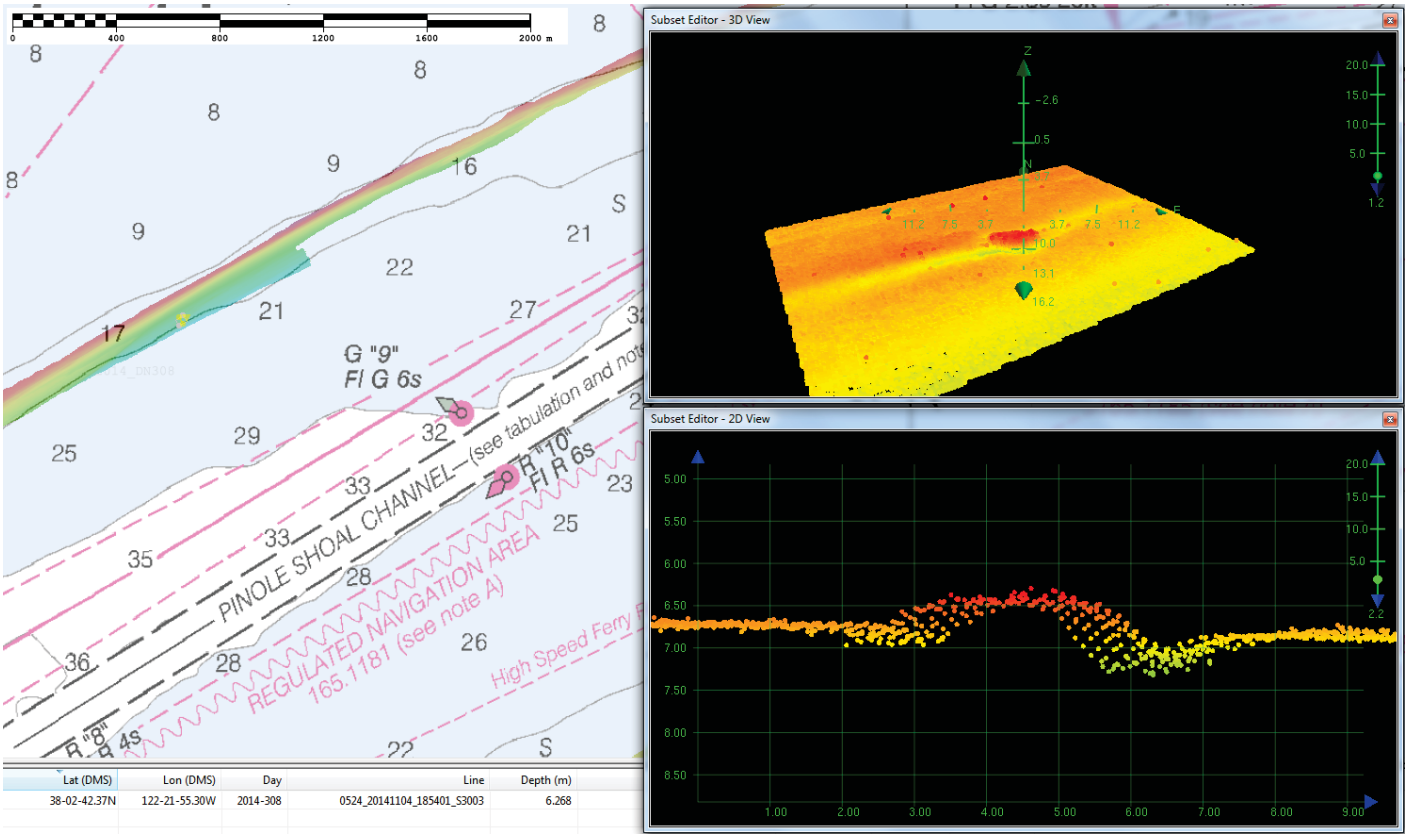


Figure 41: Uncharted feature 2014_11_04

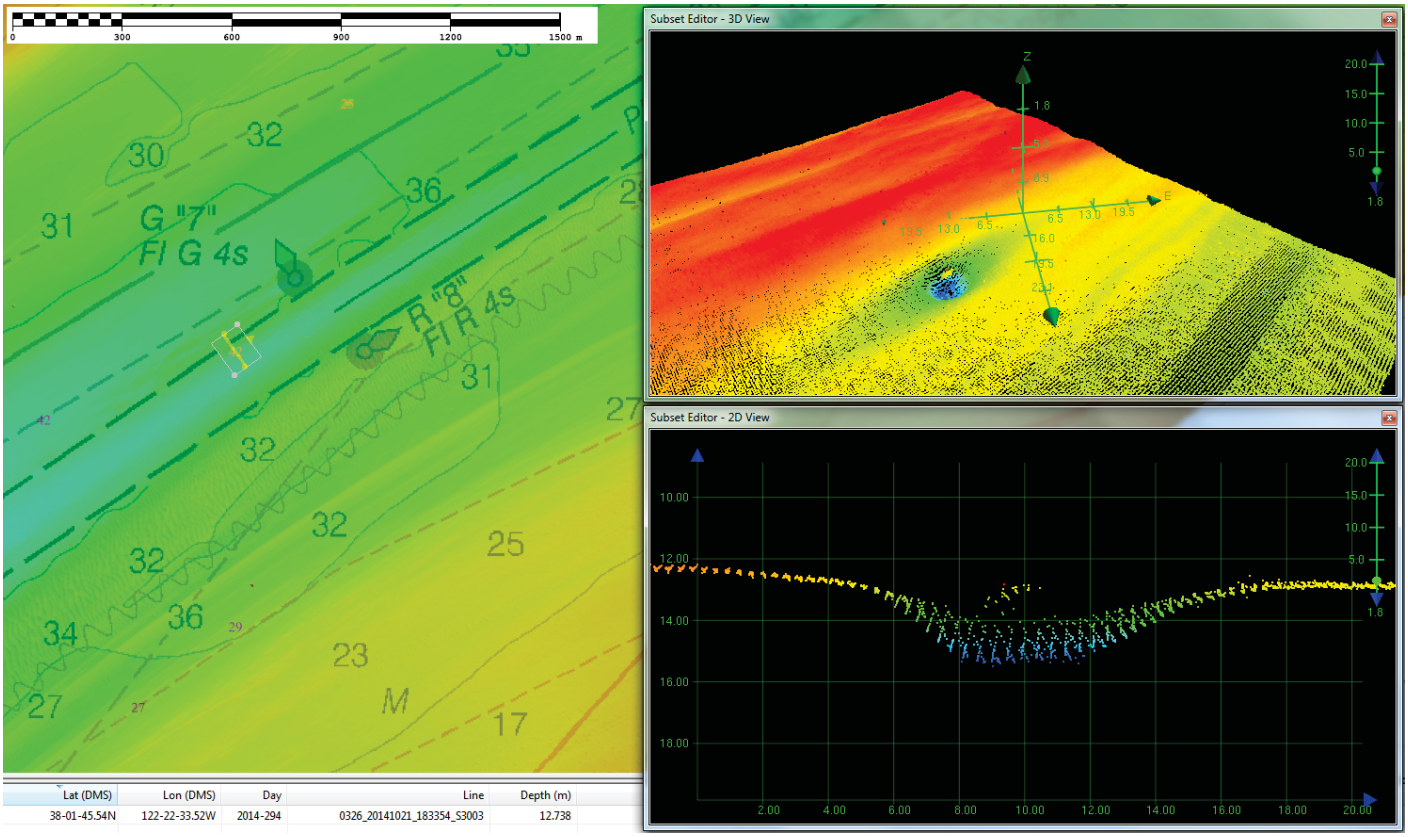


Figure 42: Uncharted feature 2014_10_21

The following discrepancies were found during office review: The least depth of uncharted feature 2013_11_26 (Fig. 33) is 12.472 m. The least depth of uncharted feature 2014_10_22 (Fig. 39) is 7.856 m. The least depth of uncharted feature 2014_10_29 (Fig. 40) is 7.266 m. The least depth of uncharted feature 2014_11_04 (Fig. 41) is 6.042 m.

D.1.7 Dangers to Navigation

Danger to Navigation Reports are included in Appendix II of this report (see Figures 43, 44, and 45).

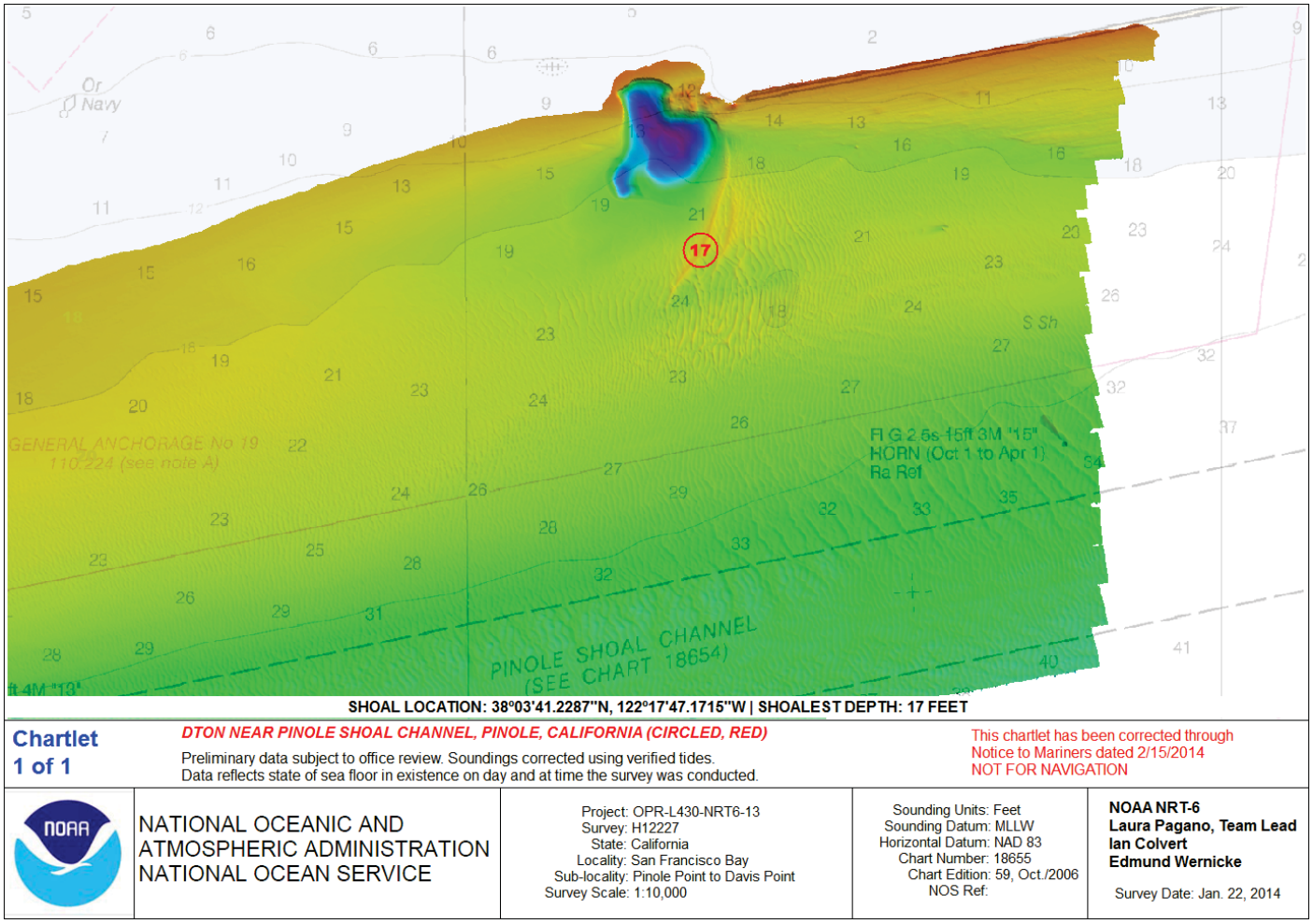


Figure 43: DTON 2014_01_22

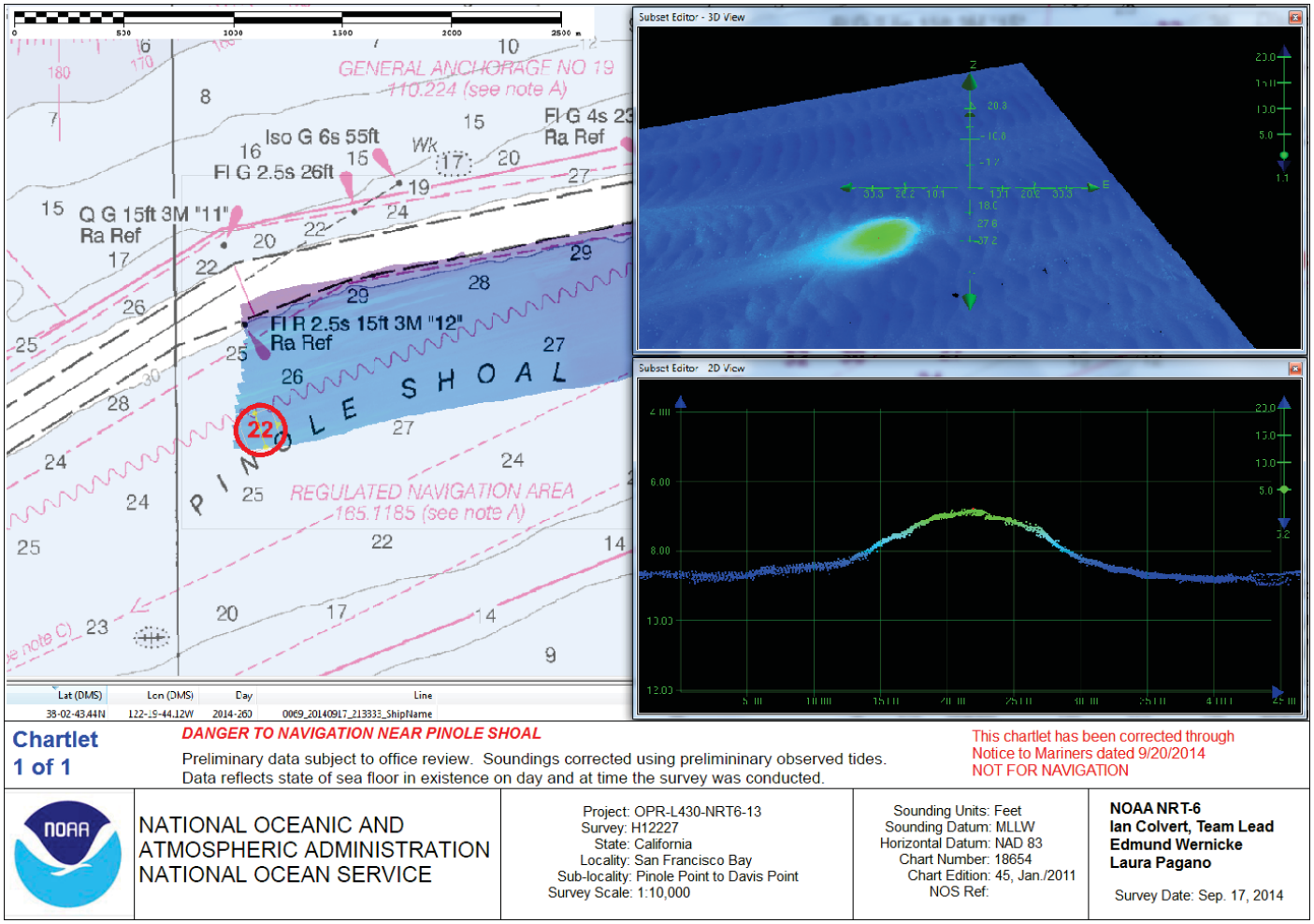


Figure 44: DTON 2014_09_17

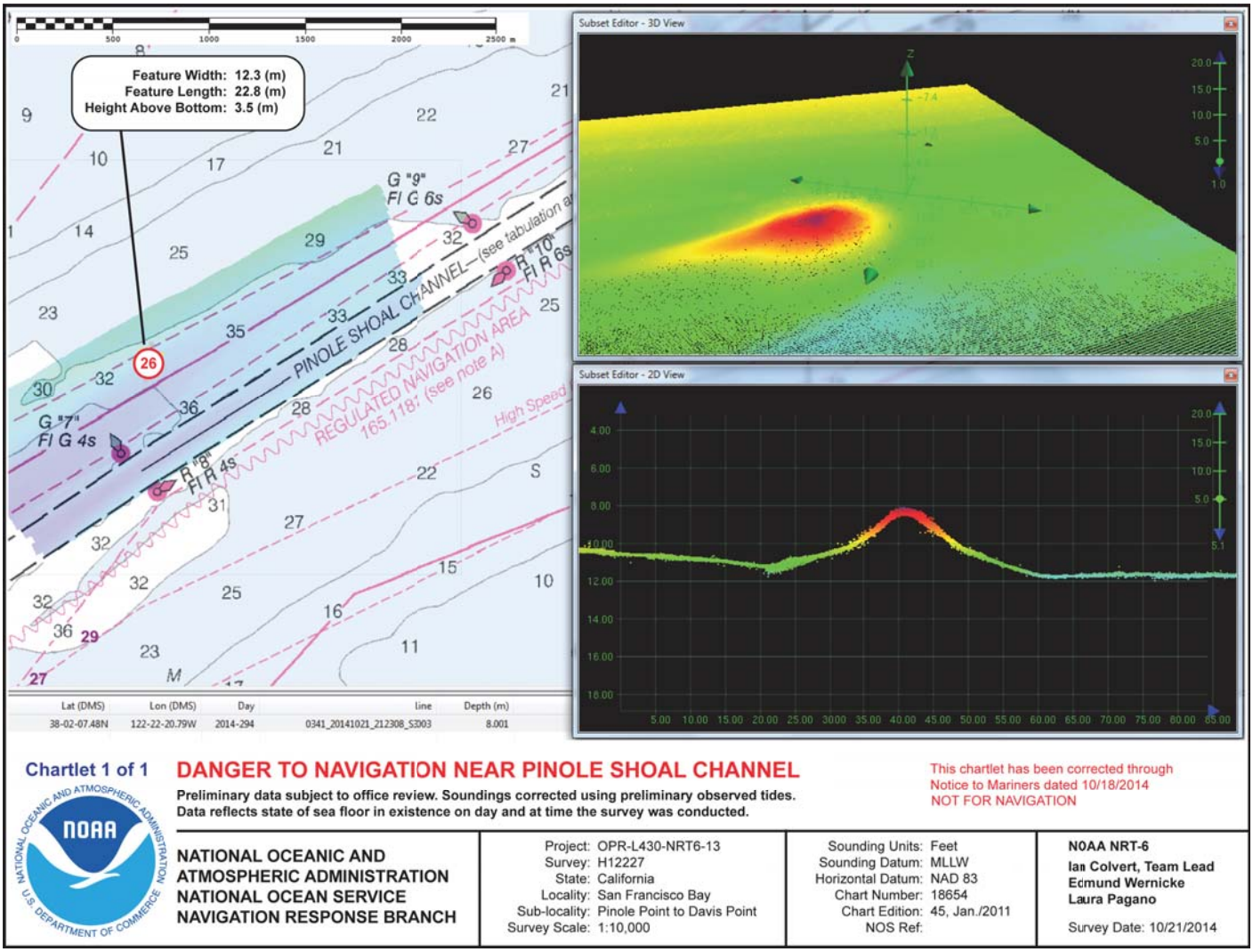


Figure 45: DTON 2014_10_21

D.1.8 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

Potentially hazardous shoals and obstructions found in this survey have been submitted as Danger to Navigation.
All three listed DTONs have been applied to the most up to date nautical charts.

D.1.9 Channels

PINOLE SHOAL CHANNEL

One channel exists within survey H12227, Pinole Shoal Channel.

In Caris HIPS & SIPS a color filter was made from depth bathymetry for comparison to Pinole Shoal Channel's channel depths: channel entrance to Light 11, controlling depths: left outside quarter: 29.0, middle half of channel: 36.0, right outside quarter 35.0. Thence to 38-03-31N, 122-17-08W, controlling depths: left ouside channel: 26.0, middle half of channel: 35.0, right outside quarter: 35.0.

All bathymetry soundings are deeper than charted channel depths.

The channel controlling depths listed above do not match the controlling depths currently charted on 18654. Surveyed channel depths were compared to the channel depths listed on chart 18654 (below) with all surveyed depths meeting or exceeding listed controlling depths. The most recent channel depth survey was conducted in September 2014.

PINOLE SHOAL CHANNEL DEPTHS

TABULATED FROM SURVEYS BY THE CORPS OF ENGINEERS - SURVEYS TO SEP 2014

NAME OF CHANNEL	CONTROLLING DEPTHS FROM SEAWARD IN FEET AT MEAN LOWER LOW WATER (MLLW)				PROJECT DIMENSIONS		
	LEFT OUTSIDE QUARTER	MIDDLE HALF OF CHANNEL	RIGHT OUTSIDE QUARTER	DATE OF SURVEY	WIDTH (FEET)	LENGTH (NAUT. MILES)	DEPTH MLLW (FEET)
CHANNEL ENTRANCE TO LT. 11	34.0	35.0	33.0	8,9-14	600	5.1	35
THENCE TO 38°03'31"N, 122°17'08"W	34.0	35.0	35.0	9-14	600	2.2	35

NOTE - CONSULT THE CORPS OF ENGINEERS FOR CHANGES SUBSEQUENT TO THE ABOVE INFORMATION

Controlling depths currently charted on 18654

D.1.10 Bottom Samples

Although bottom samples were assigned for survey H12227, it was later determined that they were not required. Bottom samples were collected within the survey area of H12227 during the mid to late 1980's, satisfying temporal requirements. See D1_bottom_samples_CORRESPONDENCE.txt in the project correspondence folder submitted in this survey.

D.2 Additional Results

D.2.1 Shoreline

NRT6 conducted a limited shoreline verification using the composite source (CSF). All features with the attribute populated with 'Assigned' were addressed even if they were inshore of NALL. The assigned features are included and attributed in the submitted Final Feature Final.

All other visible cultural features inside of the survey that were not a part of the assigned CSF were verified as charted (see Figure 46).

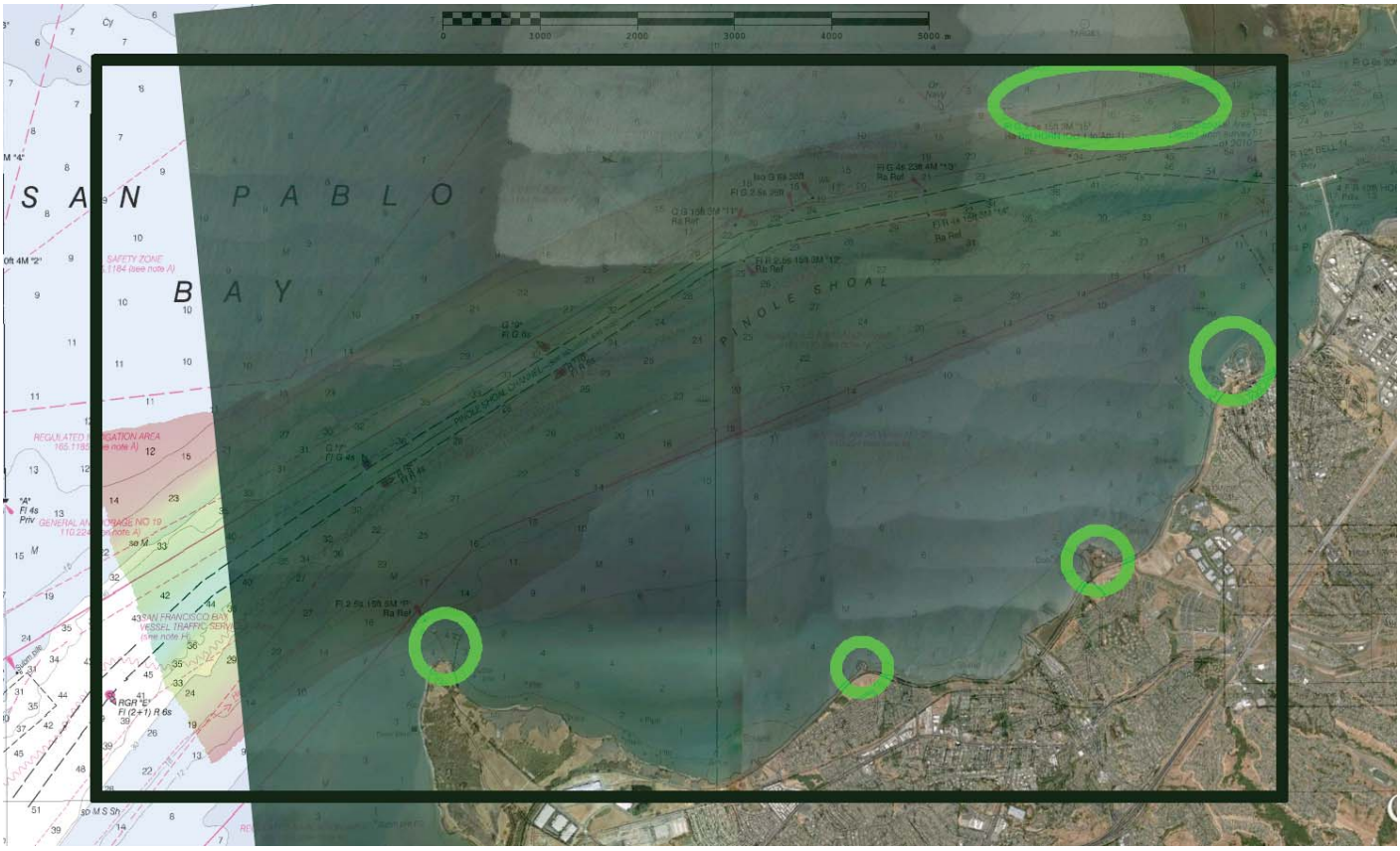


Figure 46: All visible cultural features, not part of the assigned features file, were verified in the field (circled, light green) within H12227 survey limits (dark green polygon).

D.2.2 Prior Surveys

Prior survey comparisons exist for this survey, but were not investigated.

D.2.3 Aids to Navigation

Aids to navigation (ATONs) exist for this survey, but were not assigned for investigation. However, survey crew observed that all ATONs within survey H12227 were properly located and functioning at time of survey.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

SUBMERGED PRODUCTION WELL

A charted submerged production well meanders south of Pinole Shoal Channel the entire extent of survey H12227, beginning 38-00-45.50N, 122-23-52.90W and ending 38-03-29.73N, 122-16-10.77W. No evidence of any physical feature was discerned in bathymetry. The Hydrographer recommends bathymetry supersede as charted.

Do not concur, the coordinates given above point to a charted submarine cable and not a submerged production well. No evidence of the submarine cable can be seen in multibeam, but the feature should be retained as charted.

D.2.6 Ferry Routes and Terminals

Two high speed ferry routes are located within survey H12227. Ferry routes were observed as charted.

D.2.7 Platforms

No platforms exist for this survey.

D.2.8 Significant Features

No significant features exist for this survey.

D.2.9 Construction and Dredging

Present and/or planned construction or dredging exists within the survey limits, but was not investigated. United States Army Corps of Engineers maintains the Pinole Shoal Channel, and dredging operations were discussed for the area fall of 2013.

D.2.10 New Survey Recommendation

No new surveys or further investigations are recommended for this area.

D.2.11 Inset Recommendation

No new insets are recommended for this area.

E. Approval Sheet

As Chief of Party, field operations for this hydrographic survey were conducted under my direct supervision, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports.

All field sheets, this Descriptive Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys and Specifications Deliverables Manual, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Approver Name	Approver Title	Approval Date	Signature
			Digitally signed by Ian Colvert DN: cn=Ian Colvert, c=US, o=NOAA, ou=NRT, email=ian.colvert@noaa.gov Date: 2015.03.21 16:48:48 -07'00'

F. Table of Acronyms

Acronym	Definition
AHB	Atlantic Hydrographic Branch
AST	Assistant Survey Technician
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BAG	Bathymetric Attributed Grid
BASE	Bathymetry Associated with Statistical Error
CO	Commanding Officer
CO-OPS	Center for Operational Products and Services
CORS	Continually Operating Reference Staiton
CTD	Conductivity Temperature Depth
CEF	Chart Evaluation File
CSF	Composite Source File
CST	Chief Survey Technician
CUBE	Combined Uncertainty and Bathymetry Estimator
DAPR	Data Acquisition and Processing Report
DGPS	Differential Global Positioning System
DP	Detached Position
DR	Descriptive Report
DTON	Danger to Navigation
ENC	Electronic Navigational Chart
ERS	Ellipsoidal Referenced Survey
ERZT	Ellipsoidally Referenced Zoned Tides
FFF	Final Feature File
FOO	Field Operations Officer
FPM	Field Procedures Manual
GAMS	GPS Azimuth Measurement Subsystem
GC	Geographic Cell
GPS	Global Positioning System
HIPS	Hydrographic Information Processing System
HSD	Hydrographic Surveys Division
HSSD	Hydrographic Survey Specifications and Deliverables

Acronym	Definition
HSTP	Hydrographic Systems Technology Programs
HSX	Hypack Hysweep File Format
HTD	Hydrographic Surveys Technical Directive
HVCR	Horizontal and Vertical Control Report
HVF	HIPS Vessel File
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LNM	Local Notice to Mariners
LNM	Linear Nautical Miles
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NAIP	National Agriculture and Imagery Program
NALL	Navigable Area Limit Line
NM	Notice to Mariners
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRT	Navigation Response Team
NSD	Navigation Services Division
OCS	Office of Coast Survey
OMAO	Office of Marine and Aviation Operations (NOAA)
OPS	Operations Branch
MBES	Multibeam Echosounder
NWLON	National Water Level Observation Network
PDBS	Phase Differencing Bathymetric Sonar
PHB	Pacific Hydrographic Branch
POS/MV	Position and Orientation System for Marine Vessels
PPK	Post Processed Kinematic
PPP	Precise Point Positioning
PPS	Pulse per second

Acronym	Definition
PRF	Project Reference File
PS	Physical Scientist
PST	Physical Science Technician
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPE	Total Porpagated Error
TPU	Topside Processing Unit
USACE	United States Army Corps of Engineers
USCG	United Stated Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDA	Global Positiong System timing message
ZDF	Zone Definition File

UNITED STATES DEPARMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Silver Spring, Maryland 20910

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : January 12, 2015

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-L430-NRT6-2013
HYDROGRAPHIC SHEET: H12227
LOCALITY: Pinole Point to Davis Point, San Francisco Bay, CA
TIME PERIOD: October 22, 2013 - December 04, 2014

TIDE STATION USED: 941-4863 Richmond, CA
Lat. 37° 55.4'N Long. 122° 24.6' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 1.661 meters

REMARKS: RECOMMENDED ZONING Preliminary zoning is accepted as the final zoning for project OPR-L430-NRT6-2013, H12227, during the time period between October 22, 2013 - December 04, 2014.

Please use the zoning file L430NRT62013CORP submitted with the project instructions for OPR-L430-NRT6-2013. Zones SFB64, SFB65 and SFB66 are the applicable zones for H12227.

Refer to attachments for zoning information.

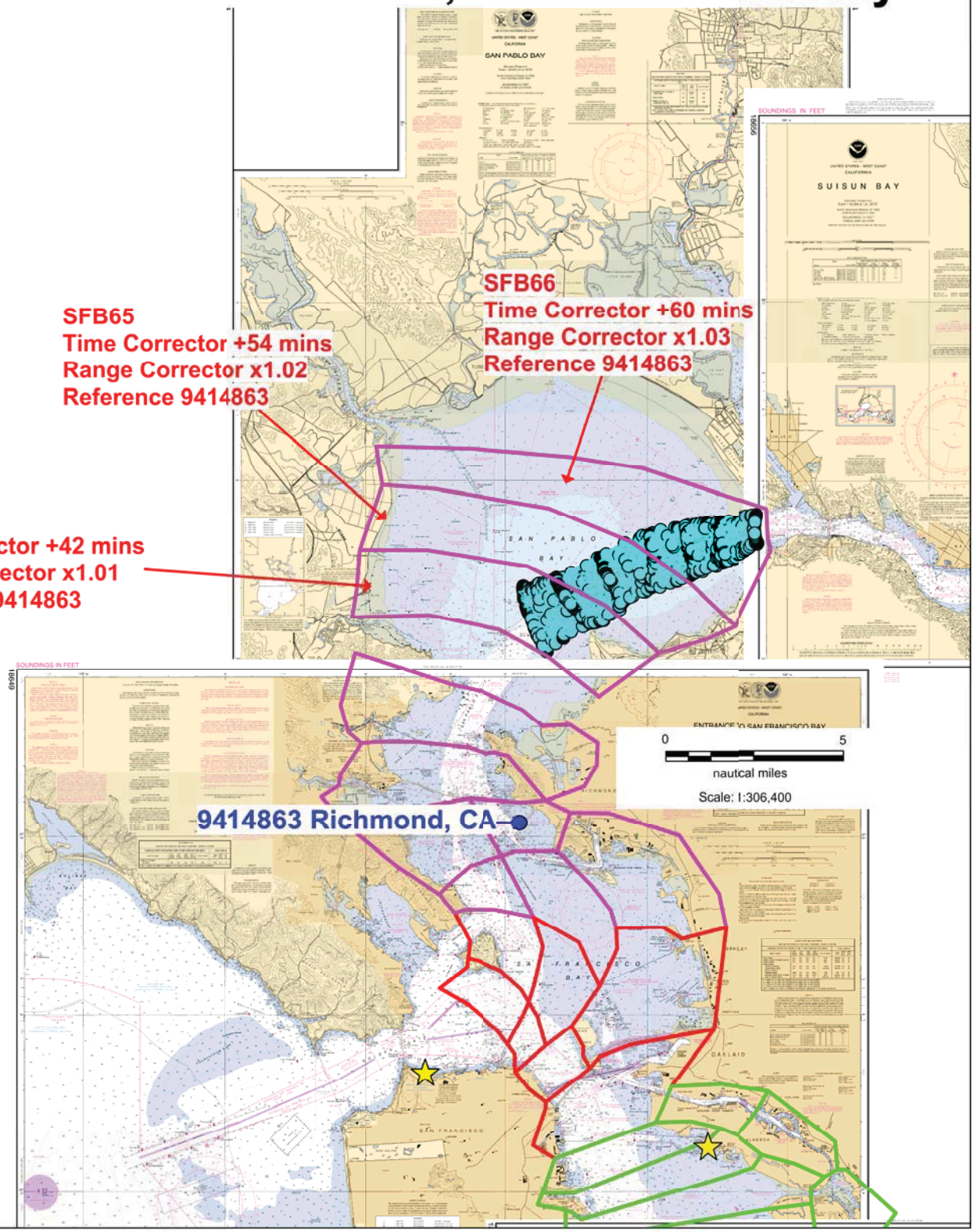
Note 1: Provided time series data are tabulated in metric units (meters), relative to MLLW and on Greenwich Mean Time on the 1983-2001 National Tidal Datum Epoch (NTDE).

HOVIS.GERALD.THOMAS.JR.1365860250

Digitally signed by HOVIS.GERALD.THOMAS.JR.1365860250
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.JR.1365860250
Date: 2015.01.15 16:45:06 -05'00'

CHIEF, PRODUCTS AND SERVICES BRANCH

Preliminary as Final Tidal Zoning for OPR-L430-NRT6-2013, H12227
Pinole Point to Davis Point, San Francisco Bay



Ian and Ed,

After reexamining the bottom samples requirement for H12227, I found that the area was covered by prior surveys from the mid to late 1980s. So, the requirement for bottom sample is not assigned for H12227. Please add this email to the correspondence section of the DR and use as the amendment to the project instructions.

Let me know if you have any questions.

Thanks,
Chris Hare

--
Chris Hare
Physical Scientist
Navigation Response Branch
Navigation Services Division
NOAA's Office of Coast Survey
301-713-2729 x172

from: Ian Colvert - NOAA Federal ian.colvert@noaa.gov
to: Vitad Pradith - NOAA Federal <vitad.pradith@noaa.gov>,
Grant Froelich - NOAA Federal <grant.froelich@noaa.gov>,
Laura Pagano - NOAA Federal <laura.pagano@noaa.gov>,
Edmund Wernicke - NOAA Federal <edmund.wernicke@noaa.gov>
date: Sun, Feb 9, 2014 at 10:39 PM
subject: NRT6 Systematic Error bugs me to no end.
mailed-by: noaa.gov

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 9

to Vitad, Grant, Laura, Edmund
Hey Grant, V,

OK. I'm calling out the Big Guns for this one (that's you two Hydro Goons).

Please admire the attached screenshot. Have you guys seen anything like this before?

S3003's EM3002 install setup is encountering a lingering systematic error that is becoming more pronounced over time. For some weird reason, at random, unpredictable intervals, our data "stutters" over itself and produces a roll offset.

The error is manageable, within IHO Order 1 specifications, but it irritates the hell out of me.

We noticed this happening during our last survey, F00612, but it was very few and far between, and the erroneous roll offset applied to only very short distances (within a meter or so).

Now, the error happens more often, and at times, applies itself to long distances of data, up to 300 meters.

I believe this is happening in SIS, as realtime heave and surface SV is being applied to the data as we collect it. We can see this error occurring on the matrix as we survey.

My hunch tells me this is some sort of latency issue.

However, Hips & Sips' attitude editor shows nothing obviously foul -- there's no stark gaps in roll data. In fact, it appears just fine.

The only glaring thing that stands out on S3003 is the new AML install. The AML documentation recommends a baud rate setting of 36000 bps. Unfortunately, SIS only has the option of 9600 bps for the AML to stream in (due to our multiple COM port cards on the Acquisition PC and resulting convoluted COM port setup). I doubt THAT could be it -- we did get the error BEFORE the AML install.

Also, I suspect the .all file convention we are using. I just don't trust those dang encrypted .all files -- .hsx files were far more user friendly.

If you guys can wave your magic wands and make this error go away, it would be most appreciated. Ideas?

Cheers,
Ian, NRT6

PS. The screen shot has two examples of this error occurring. The northern error (with the cheese slice) is 60 meters long; the southern error about 45 meters long. The surface is a tenth of a meter swath angle surface. The 2D view vertical scale is set to 20.
Image
NRT6_systmatic_error.png

Grant Froelich
Feb 9

to me, Vitad, Laura, Edmund
How old is your pos mv? When was the last time it was tumbled tested? Any chance you logged POSPac data during one of these outings with the roll error?

Sent from my iPad
> <NRT6_systmatic_error.png>

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 9

to Grant, Vitad, Laura, Edmund
Hmmm. POS V4. I know we have a POS V5 coming soon. I'm not sure of a "tumble test" -- should I put the POS in the dryer next time I do laundry? I don't think we are logging POSPac (I'm embarrassed to say I do not know exactly what that is -- something we do for our settlement and squat tests? For our .hvf?). I do know we do not have a POSPac key, as our data was processed somewhere else.

You think our old POS is taking a shitter on us? Has this happened before?

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 9

to Grant, Vitad, Laura, Edmund
Also, during the last two survey outings, we did have a couple of GPS losses on the POS V4. The loss was very brief, maybe a minute tops. I thought maybe it was solar flares messing with the satellites as the sun jettisoned an M3 class flare last week. But maybe our POS is dying?

Grant Froelich
Feb 9

to me, Vitad, Laura, Edmund
Some of the IMUs in the fleet have failed or been right on the edge of failing. The next time you are out if you can log some POSPac data by clicking the POSPac button in the real time logging window (where you log trueheave) it will select all the extra groups needed for POSPac processing. There will be some accelerometer data in there and if it is a failing IMU there will be some tell tail signs once it is processed in POSPac software. Even if it is not a failing accelerometer, if it is a dying pos, then there is other diagnostic information in there to help pinpoint the issue.

A tumble test is not quite as fun as putting the IMU in the dryer unfortunately. They put the IMU on a shaker table with a preset program of movement and then compare what the program is vs what the IMU says the movement is. It is supposed to occur every couple of years but noaa has been pretty awful about doing it.

Sent from my iPad

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 9

to Grant, Vitad, Laura, Edmund
Very cool, Grant. Tomorrow's forecast promises to be a good survey day for us. If the winds stay down we'll log some thick and creamy POSPac. You guys have a POSPac key we can steal? Or better yet, want to our dirty work for us? Because that would be awesome.

Mucho Appreciado.

Laura Pagano - NOAA Federal
Feb 10

to me, Grant, Vitad, Edmund
Yes, we've been tumble tested but its been a couple of years now.

Yes, we always log POSpac data and can/should investigate that more closely. (Thanks for the tip, lets talk about how I can analyze this tomorrow)

Yes, we have a POSPac key or two in the fleet but I'm not sure where they're at these days... (V?)

And yes, we have a POSMV5 purchased for us but I'm not sure when we'll be receiving it... (V?)

Thanks for your help Grant!

Laura

Sent from my iPhone

Grant Froelich
Feb 10

to Laura, me, Vitad, Edmund
Hi Laura,

I have a POSPac key here so if you send me a .000 file, I can process it and then we can have a webex/webinar so you can see my screen as I go over the graphs to show you what to look for. That might be faster than waiting for a POSPac key to be mailed.

grant

Vitad Pradith
Feb 10

to Grant, Laura, me, Edmund
Sorry for the slow reply all. I'm in DC for the ESRI conference this week.

Thank you Grant! This is awesome. I'd like to join in when you do this, would be helpful for the other teams.

On the POS MV note, how old is that POS? I'm staring to see problems from other teams with regards to their BD960 GPS cards and failing IMU's. (Hence the reason why we purchased v5's to replace your units.)

Sent from my rotary phone.

Laura Pagano - NOAA Federal
Feb 10

to Vitad, Grant, me, Edmund
Hey everybody,

Thanks for all the input. Just as a side note, we did get our system tumble tested and it passed without any issues back in August 11'. So it's only been about 2 1/2 years. I can't remember manufacturer specs/recommendations for how often it should be done... Does anyone else know this off hand?

Also, I've been looking for the date that we received our POS MV 320 and I can't find any documentation yet. I think it may have come with the boat 10 years ago. That seems old to me.

Anywho, thanks for offering to process a line for us Grant, that'd be much appreciated. We're trying to find a good .000 file for you as we speak. As soon as we decide on which file to send, I'll start uploading it to The Google Drive. Standby, it'll probably take all day :)

Also, thanks for offering the Webex to show us how the old POSpac works and to point out what we should be looking for. Let's set something up soon.

Thanks!

vitad.pradith@noaa.gov
Feb 10

to Laura, Grant, me, Edmund
See in line

Sent from my Verizon Wireless 4G LTE smartphone

-------- Original message --------
From: Laura Pagano - NOAA Federal
Date:02/10/2014 14:19 (GMT-05:00)
To: Vitad Pradith
Cc: Grant Froelich ,Ian Colvert - NOAA Federal ,Edmund Wernicke - NOAA Federal
Subject: Re: NRTK Systematic Error bugs me to no end.

Hey everybody,

Thanks for all the input. Just as a side note, we did get our system tumble tested and it passed without any issues back in August 11'.
So it's only been about 2 1/2 years. I can't remember manufacturer specs/recommendations for how often it should be done... Does anyone
else know this off hand?
++++++ approximately every 3 years.

Also, I've been looking for the date that we received our POS MV 320 and I can't find any documentation yet. I think it may have come
with the boat 10 years ago. That seems old to me.
+++++++ look at the serial number trash on the topside. It should be on their.   Sadly 10 years sounds about right.   Definitely time for
a refresh.

Anywho, thanks for offering to process a line for us Grant, that'd be much appreciated. We're trying to find a good .000 file for you as
we speak. As soon as we decide on which file to send, I'll start uploading it to The Google Drive. Standby, it'll probably take all day
:)
++++ yeah. Thanks grant!

Also, thanks for offering the Webex to show us how the old POSpac works and to point out what we should be looking for. Let's set
something up soon
+++++ count me in

thanks!
Laura

from: Grant Froelich grant.froelich@noaa.gov
to: "ian.colvert@noaa.gov (Google Drive)" <ian.colvert@noaa.gov>
cc: edmund.wernicke@noaa.gov,
 laura.pagano@noaa.gov,
 vitad.pradith@noaa.gov
date: Mon, Feb 10, 2014 at 3:35 PM
subject: Re: 2014_DN035_POS.000 (grant.froelich@noaa.gov)

Grant Froelich
Feb 10

to me, edmund.wernicke, laura.pagano, vitad.pradith
I'm gonna say that it is between time 21:18:20 and 22:00:00.

I'm also gonna say that you've got something wrong with the secondary antenna setup: either the antenna or the card is on the fritz. That
shouldn't be affecting anything other than GAMS but something to watch out for.

On 2/10/2014 1:53 PM, ian.colvert@noaa.gov (Google Drive) wrote:
I've shared an item with you.
OK, folks -- here's our POS file, containing POS pac data, for survey day 2014_DN035.

On this survey day there is a section of line with discussed error 460 meters long.

Can you find it in this POS file?
 Item   2014_DN035_POS.000
Google Drive: create, share, and keep all your stuff in one place.   Logo for Google Drive

Binary File
2014_DN035_POS.000
Not virus scanned

Grant Froelich
Feb 10

to me, edmund.wernicke, laura.pagano, vitad.pradith
I'd also that based on specification information that Applanix has provided in the past, this IMU is probably going bad and in need of
service.

vitad.pradith@noaa.gov
Feb 10

to Grant, me, edmund.wernicke, laura.pagano
Hey grant, got any screen shots?

Sent from my Verizon Wireless 4G LTE smartphone

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 10

to Grant, Edmund, Laura, Vitad
Hey Grant,

Nope. The offending data rests between 19:42:19 - 19:44:10. I had a prize ready to give out to you, but now you can't have it.

BTW, we've got a second set of antennas, backup primary and secondary GPS antennas. Should we be throwing those on? Hmm. Seems like our
only option.

IMUs are expensive.

Hopefully we can limp this survey in before great expense and time is needed to refurbish our system.

Thanks for your time, Grant!

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 10

to Grant, Edmund, Laura, Vitad
ALTHOUGH we do have two segments of error-ed lines at 21:32 and 21:52, which I suppose fits within your predicted 21:18:20 and 22:00:00.

Therefor, you win your prize (attached).

Image
Sketch10115057.png

vitad.pradith@noaa.gov
Feb 10

to me, Grant, Edmund, Laura
Hey Ian, are they new Zephyr 2's?

vitad.pradith@noaa.gov
Feb 10

to me, Grant, Edmund, Laura
Ps: still could be the gps cards on the pcs

Grant Froelich
Feb 10

to vitad.pradith, me, edmund.wernicke, laura.pagano
That would spoil the webex. But I guess I can share some...

#1 is what led me to the 21:18:20 to 22:00:00 time zone. It is a plot of the processed, smoothed data vs the original inertial data.
Something clearly happened around that time that indicates that either the smoothed data is wonky or the intertial data is wonky. But one
of them is problematic.

#2 a&& are what lead me to believe something is wrong with your secondary antenna or card. 2a shows L2 cycle slips for that antenna. 2b
shows the same for the primary. They should be the same-ish. The secondary antenna is almost all red which means there was almost no L2
data for that antenna. Which as I said, should only affect GAMS. It's probably not a cable issue because the L1 for the secondary
antenna looked fine, so I suspect either card or antenna itself.

#3 a&b are what lead me to believe that your IMU is on it's way out. Not totally dead yet. But not within Applanix's specifications.
These are plots of the some of the raw gyro data. Applanix has said that they should be a fairly straight line and within +/- 200ppm.
The raw (3 a) is all over the place (solid red line is what I am looking at) and often exceeds the +/- 200ppm value that Applanix has
given. The processed, smoothed (3 b) is better but still wonders above +200ppm beginning around time 243,600, which actually matches up
with your 19:42:19 time.

5 Attachments

Image
#1.jpg

Image
#2_a.jpg

Image
#2_b.jpg

Image
#3_a.jpg

Image
#3_b.jpg

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 10

to vitad.pradith, Grant, Edmund, Laura
Here's what we got. Are they Zephyrs or MSKs?

Image
trimby3.jpg

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 10

to vitad.pradith, Grant, Edmund, Laura
Hmm. So when's the webex going to be? tomorrow?

thanks a ton guys!

also, we're uploading a second .000 from DN036 -- just because more data is merrier. so head's up.

NRT6 is standing by for more awesome.

vitad.pradith@noaa.gov
Feb 10

to me, Grant, Edmund, Laura
That's a gas30. L1 with beacon only for your sps361. Trimble's way of sticking it to the man...

Those won't give you an L2. Do you want to try swapping out antennae first? Or do you want to do a complete upgrade to a v5. I'll defer this question to Laura.

vitad.pradith@noaa.gov
Feb 10

to me, Grant, Edmund, Laura
Can we do it on Thursday or Friday? Just open up a help desk ticket to setup a webex.

from: Grant Froelich grant.froelich@noaa.gov
to: "laura.pagano@noaa.gov (Google Drive)" <laura.pagano@noaa.gov>
cc: Edmund Wernicke <Edmund.Wernicke@noaa.gov>,
Ian Colvert <Ian.Colvert@noaa.gov>,
"vitad.pradith@noaa.gov" <vitad.Pradith@noaa.gov>
date: Tue, Feb 11, 2014 at 12:25 PM
subject: Re: 2014_DN036_POS.000 (grant.froelich@noaa.gov)

Grant Froelich
Feb 11

to laura.pagano, Edmund, me, vitad.Pradith
Yeah I see the same sort of things I saw in the other dataset with the secondary antenna L2 and the over +200ppm gyro data.

I do see in the POS Data Import message log (attached) that things were clicking along fine until 337195.397 (21:39:55) and then for some unknown reason it went into Coarse leveling mode and basically restarted itself. I suspect this is when you had your complete loss but there isn't any indication I can see as to why it happened.

On 2/11/2014 10:45 AM, laura.pagano@noaa.gov (Google Drive) wrote:
I've shared an item with you.
Another day of data collection to examine. This day contains both the funky artifact that Ian originally pointed out, it also contains a complete loss of our POS for a short time. Thanks!
Item 2014_DN036_POS.000
Google Drive: create, share, and keep all your stuff in one place. Logo for Google Drive

2 Attachments

Text
extract_Mission 1.log

Binary File
2014_DN036_POS.000
Not virus scanned

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 11

to Grant, laura.pagano, Edmund, Vitad.Pradith
Of course, Grant, I can safely assume these symptoms are similar to the other POS failings throughout the fleet? This IS a case of our POS dying?

Ian, documenting this in our DR.

Grant Froelich
Feb 11

to laura.pagano, edmund.wernicke, me, vitad.pradith
Sorry, the restart looks like it started closer to 337194.397.

Grant Froelich
Feb 11

to me, laura.pagano, Edmund, Vitad.Pradith
Well it's not healthy, but I wouldn't say dying. I would say it needs servicing, but with a v5 PCS and IMU on their way to you shortly I suspect that having it serviced will be put on the back burner.

Ian Colvert - NOAA Federal ian.colvert@noaa.gov
Feb 11

to Grant, laura.pagano, Edmund, Vitad.Pradith
OK, then. In our DR I will refer to this issue as our "Unhealthy POS," and cite you as a source of expertise. Thanks!

H12227 Feature Report

Registry Number:

State:

Locality:

Sub-locality:

Project Number:

Survey Date: 12/04/2014

Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
18655	59th	10/01/2006	1:10,000 (18655_1)	[L]NTM: ?
18654	44th	01/01/2008	1:40,000 (18654_1)	[L]NTM: ?
18652	34th	09/01/2007	1:80,000 (18652_6)	[L]NTM: ?
18640	25th	08/01/2005	1:207,840 (18640_1)	[L]NTM: ?
18010	21st	03/01/2007	1:811,980 (18010_1)	[L]NTM: ?
18022	35th	08/01/2005	1:868,003 (18022_1)	[L]NTM: ?
18007	33rd	02/01/2009	1:1,200,000 (18007_1)	[L]NTM: ?
18020	38th	10/01/2007	1:1,444,000 (18020_1)	[L]NTM: ?
501	12th	11/01/2002	1:3,500,000 (501_1)	[L]NTM: ?
530	32nd	06/01/2007	1:4,860,700 (530_1)	[L]NTM: ?
50	6th	06/01/2003	1:10,000,000 (50_1)	[L]NTM: ?

* Correction(s) - *source: last correction applied (last correction reviewed--"cleared date")*

Features

No.	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	Wreck	5.20 m	38° 02' 12.8" N	122° 19' 39.9" W	---
1.2	Wreck	10.98 m	38° 03' 13.0" N	122° 17' 23.0" W	---
1.3	Wreck	5.64 m	38° 03' 07.5" N	122° 16' 29.5" W	---

1 - Wreck Features

1.1) US 0000636136 00001 / HCell_Wrecks.000

Survey Summary

Survey Position:	38° 02' 12.8" N, 122° 19' 39.9" W
Least Depth:	5.20 m (= 17.04 ft = 2.841 fm = 2 fm 5.04 ft)
TPU (±1.96σ):	**THU (TPEh)** [None] ; **TVU (TPEv)** [None]
Timestamp:	2014-338.00:00:00.000 (12/04/2014)
Dataset:	HCell_Wrecks.000
FOID:	US 0000636136 00001(02260009B4E80001)
Charts Affected:	18654_1, 18652_6, 18640_1, 18010_1, 18022_1, 18007_1, 18020_1, 501_1, 530_1, 50_1

Remarks:

[None]

Feature Correlation

Source	Feature	Range	Azimuth	Status
HCell_Wrecks.000	US 0000636136 00001	0.00	000.0	Primary

Hydrographer Recommendations

[None]

Cartographically-Rounded Depth (Affected Charts):

17ft (18654_1, 18652_6)

2 ¾fm (18640_1, 18010_1, 18022_1, 18007_1, 18020_1, 530_1)

5.2m (501_1, 50_1)

S-57 Data

Geo object 1:	Wreck (WRECKS)
Attributes:	CATWRK - 2:dangerous wreck
	QUASOU - 6:least depth known
	SORDAT - 20141204
	SORIND - US,US,graph,H12227
	VALSOU - 5.195 m

WATLEV - 3:always under water/submerged

1.2) US 0000636137 00001 / HCell_Wrecks.000

Survey Summary

Survey Position: 38° 03' 13.0" N, 122° 17' 23.0" W

Least Depth: 10.98 m (= 36.02 ft = 6.003 fm = 6 fm 0.02 ft)

TPU (±1.96σ): **THU (TPEh)** [None] ; **TVU (TPEv)** [None]

Timestamp: 2014-338.00:00:00.000 (12/04/2014)

Dataset: HCell_Wrecks.000

FOID: US 0000636137 00001(02260009B4E90001)

Charts Affected: 18655_1, 18654_1, 18652_6, 18640_1, 18010_1, 18022_1, 18007_1, 18020_1, 501_1, 530_1, 50_1

Remarks:

[None]

Feature Correlation

Source	Feature	Range	Azimuth	Status
HCell_Wrecks.000	US 0000636137 00001	0.00	000.0	Primary

Hydrographer Recommendations

[None]

Cartographically-Rounded Depth (Affected Charts):

36ft (18655_1, 18654_1, 18652_6)

6fm (18640_1, 18010_1, 18022_1, 18007_1, 18020_1, 530_1)

11.0m (501_1, 50_1)

S-57 Data

Geo object 1: Wreck (WRECKS)

Attributes: CATWRK - 2:dangerous wreck

QUASOU - 6:least depth known

SORDAT - 20141204

SORIND - US,US,graph,H12227

VALSOU - 10.978 m

WATLEV - 3:always under water/submerged

1.3) US 0000636139 00001 / HCell_Wrecks.000

Survey Summary

Survey Position: 38° 03' 07.5" N, 122° 16' 29.5" W

Least Depth: 5.64 m (= 18.50 ft = 3.084 fm = 3 fm 0.50 ft)

TPU (±1.96σ): **THU (TPEh)** [None] ; **TVU (TPEv)** [None]

Timestamp: 2014-338.00:00:00.000 (12/04/2014)

Dataset: HCell_Wrecks.000

FOID: US 0000636139 00001(02260009B4EB0001)

Charts Affected: 18655_1, 18654_1, 18652_6, 18640_1, 18010_1, 18022_1, 18007_1, 18020_1, 501_1, 530_1, 50_1

Remarks:

[None]

Feature Correlation

Source	Feature	Range	Azimuth	Status
HCell_Wrecks.000	US 0000636139 00001	0.00	000.0	Primary

Hydrographer Recommendations

[None]

Cartographically-Rounded Depth (Affected Charts):

18ft (18655_1, 18654_1, 18652_6)

3fm (18640_1, 18010_1, 18022_1, 18007_1, 18020_1, 530_1)

5.6m (501_1, 50_1)

S-57 Data

Geo object 1: Wreck (WRECKS)

Attributes: CATWRK - 2:dangerous wreck
QUASOU - 6:least depth known
SORDAT - 20141204
SORIND - US,US,graph,H12227
VALSOU - 5.640 m

WATLEV - 3:always under water/submerged

APPROVAL PAGE

H12227

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive

- H12227_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12227_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications.

Digitally signed by HOLMBERG.PETER.SCOTT.1365886101
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOLMBERG.PETER.SCOTT.1365886101
Date: 2016.03.15 08:21:52 -07'00'

Approved: _____

Peter Holmberg
Cartographic Team Lead, Pacific Hydrographic Branch

The survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Digitally signed by RAYMOND.ANNEMIEKE.S.1365883048
Date: 2016.03.15 10:12:27 -07'00'

Approved: _____

Annemieke Raymond, NOAA
Physical Scientist, Pacific Hydrographic Branch