H11604

NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

DESCRIPTIVE REPORT

Type of Survey HYDROGRAPHIC

Field No.

Registry No. H11604

LOCALITY

State Alaska

General Locality Bristol Bay

Sublocality

2006

CHIEF OF PARTY

Commander Andrew L. Beaver, NOAA

LIBRARY & ARCHIVES

DATE

NOAA FORM 77-28 (11-72)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REGISTER NO.

HYDROGRAPHIC TITLE SHEET

H11604

INSTRUCTIONS - The hydrographic sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the office.

FIELD NO.

State: Alaska

General Locality: Bering Sea

Sublocality: Bristol Bay

Scale: 1:500,000

Date of Survey: Aug 06 - Aug 20, 2006

Instructions Dated: 7/11/2006

Project No.: M-R908-FA-06

Vessel: NOAA Ship FAIRWEATHER

Chief of Party: Commander Andrew L. Beaver, NOAA

Surveyed by: Fairweather Personnel

Soundings taken by echo sounder: RESON 8111

Graphic record scaled by: Fairweather Personnel

Graphic record checked by: Fairweather Personnel

Evaluation by: M. Andring

Automated plot by: n/a

Verification by: M. Andring

Soundings in: Fathoms and feet at MLLW

REMARKS: Time in UTC. UTM Projection Zone 4

Revisions and annotations appearing as endnotes were generated during office processing. As a result, page numbering may be interrupted or non-sequential.

All depths listed in this report are referenced to mean lower low water unless otherwise noted

All separates are filed with the project or hydrographic data.

Descriptive Report to Accompany Hydrographic Survey H11604

Project M-R908-FA-06
Bristol Bay, AK
Scale 1:500,000
July – August 2006
NOAA Ship FAIRWEATHER
Chief of Party: Commander Andrew L. Beaver, NOAA

A. AREA SURVEYED

This hydrographic survey was completed as specified by Hydrographic Survey Letter Instructions M-R908-FA-06, dated 11 July 2006, Standing Instructions for Hydrographic Surveys (SI) dated May 2006, NOS Hydrographic Surveys Specifications and Deliverables Manual (HSSDM) dated March 2003 and NOS Field Procedures Manual for Hydrographic Surveying (FPM) dated May 2006 with the exception of deviations noted in this report. The survey area is located in Bristol Bay, AK, in the Eastern Bering Sea (EBS). These data were collected as part of the NOAA/NMFS Alaska Fisheries Science Center's (AFSC) Resource Assessment and Conservation Engineering (RACE) Division's FISHPAC project. FISHPAC is a collaborative effort designed to assess the feasibility of utilizing acoustics for Essential Fish Habitat (EFH) modeling. This survey corresponds to sheet A in the sheet layout provided with the Letter Instructions.

Three discreet tracklines (broken into five survey lines for FISHPAC purposes) were completed within the limits of hydrography (Fig. 1). Each of the five survey lines is approximately 140 nm long, with 20 nm spacing between adjacent lines. 100% multibeam coverage was not required by the Hydrographic Survey Letter Instructions. Three passes were completed over each line. Data from all three passes have been submitted with H11604; however, only the second pass was originally intended for submission to PHB for charting use. See the section entitled "Sound Speed Errors" within "B2. Quality Control" for further discussion.

Hydrographic data acquisition was conducted from August 06 to August 20, 2006 (DN 218 to DN 232).

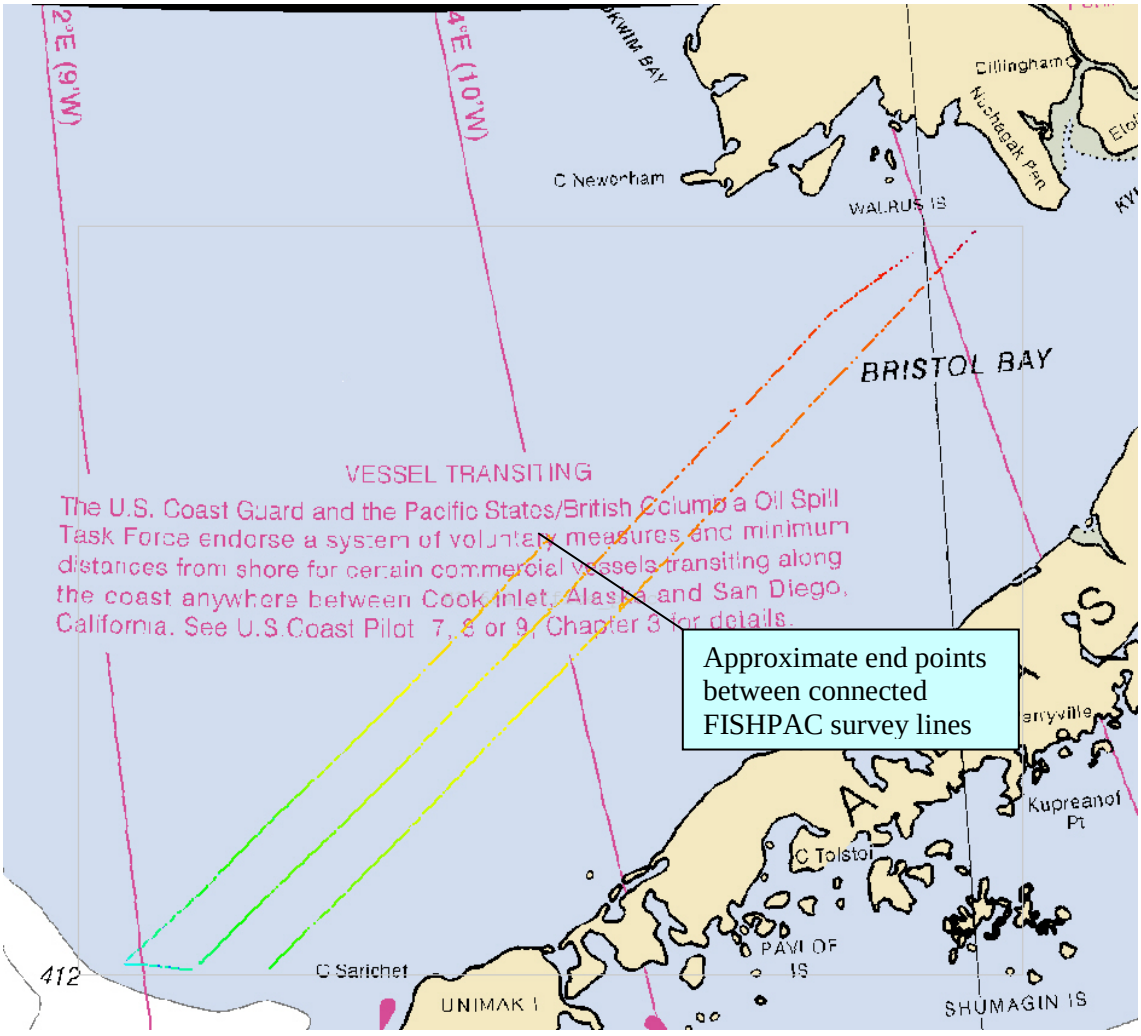


Figure 1. H11604 FISHPAC survey tracklines

B. DATA ACQUISITION AND PROCESSING

A complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods can be found in the *M-R908-FA-06 Data Acquisition and Processing Report* (DAPR)[1], to be submitted by FAIRWEATHER under a separate cover. Items specific to this survey, and any deviations from the aforementioned report are discussed in the following sections.

B1. Equipment and Vessels

All data were acquired by FAIRWEATHER utilizing its Reson 8111. Due to errors in positioning, sound speed and tides (discussed below), several TPE values were adjusted as follows:

Position Nav (m) error in HVF increased to 4.0 m, based on the following correspondence with Peter Stewart from Applanix. "Typical positional accuracy from POS MV while out of

range of DGPS corrections will be 4-6m rms in horizontal and 5-8m rms in vertical, with the precise value dependant on, amongst other things, satellite constellation (i.e. DOP)."

Tide measured value increased to 0.05 m and **tide zoning** value increased to 0.4 m when computing TPE, based on HSTD 2007-2 dated 09FEB2007. **Sound speed measured** value increased to 4.0 m/s when computing TPE, also based on HSTD 2007-2.

Acquisition system control settings (e.g. gain control, range scale) were configured for the optimization of backscatter, at the expense of bathymetry, in accordance with FISHPAC project requirements.

The Brooke Ocean Technology Free Fall Cone Penetrometer (FFCPT) was the primary instrument for collecting sound speed data after a quality assurance comparison with an SBE CTD was conducted by FA crewmembers (undocumented).

B2. Quality Control

Crosslines

No crosslines were completed during acquisition.[2] Where main scheme lines overlap, there are differences up to 3 m due to the lack of accurate tidal zoning. A statistical quality control report has not been generated.

Junctions

Not applicable, in accordance with Letter Instructions.

Data Quality Factors

Data for survey H11604 exhibit the following deficiencies:

Sound Speed Errors:

Of the three passes on each transect, only the second pass included sound speed casts every four hours. Sound speed casts were only conducted at the beginning and end of the line for the first and third passes. The time between these casts was approximately 20-22 hours. This configuration was designed to maximize the time spent acquiring backscatter data for habitat mapping, which does not require frequent sound speed correctors. Under the original guidelines, only the second pass would be profiled every four hours and only the second pass would be submitted for hydrographic purposes. All three lines have been submitted with H11604.[3]

Sound speed errors are present throughout H11604, including the second pass where sound speed was profiled every four hours. The bathymetry exhibits the characteristic "frowns" and "smiles" indicative of inaccurate sound speed corrections (Fig. 2 & 3). A well documented "cold pool" of Arctic water exists in the subsurface summer waters of Bristol Bay. The sound speed effects of this layering were pronounced and varied greatly over very small temporal and spatial changes (Fig. 4). Due to the constraints of the FISHPAC project, increasing the

frequency of SV casts was unfortunately not feasible. Outer beams were filtered to 10 degrees from nadir on both sides to help reduce erroneous outer beam data.[4]

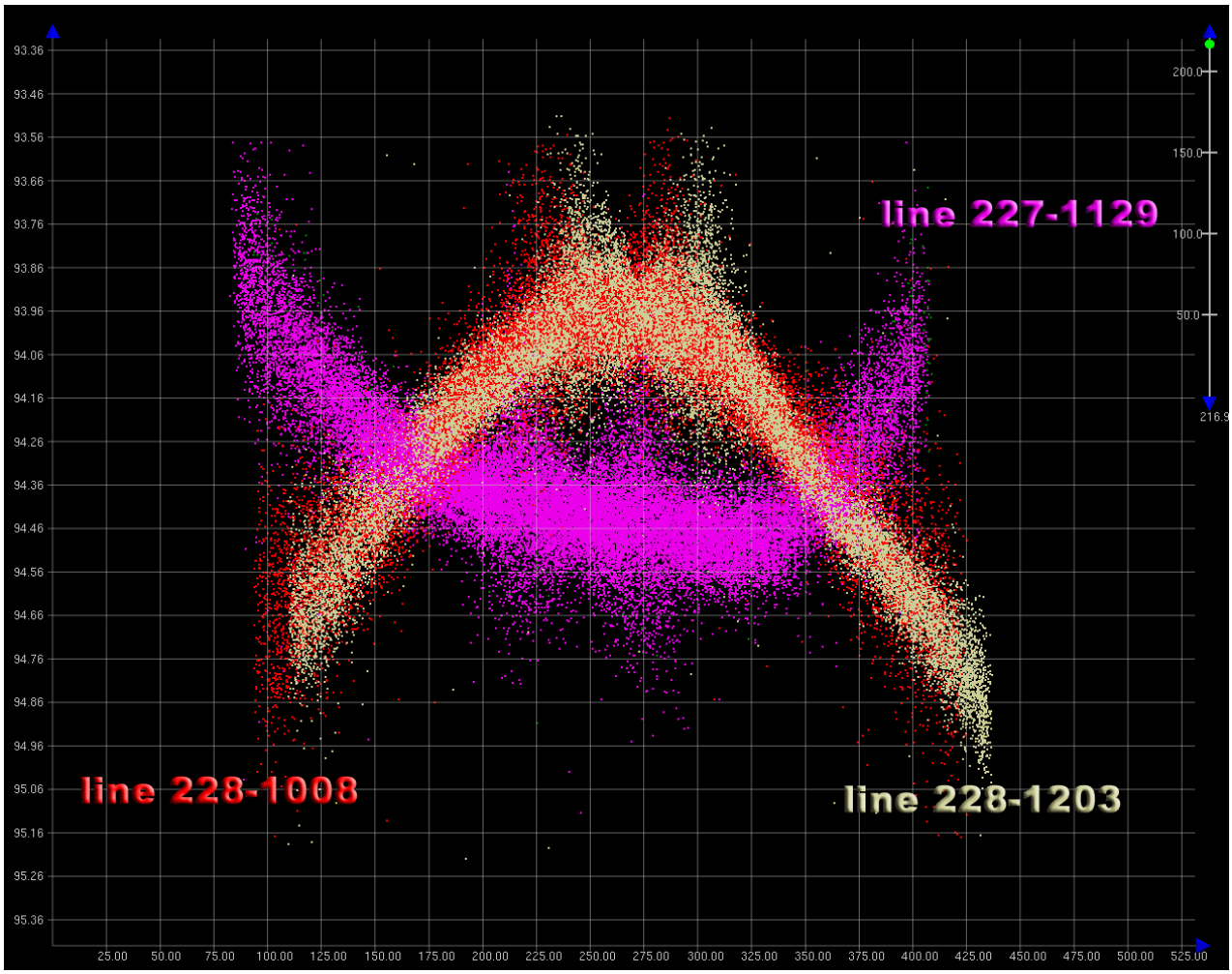


Figure2. Representative sound speed errors (before outer beam were filtered)

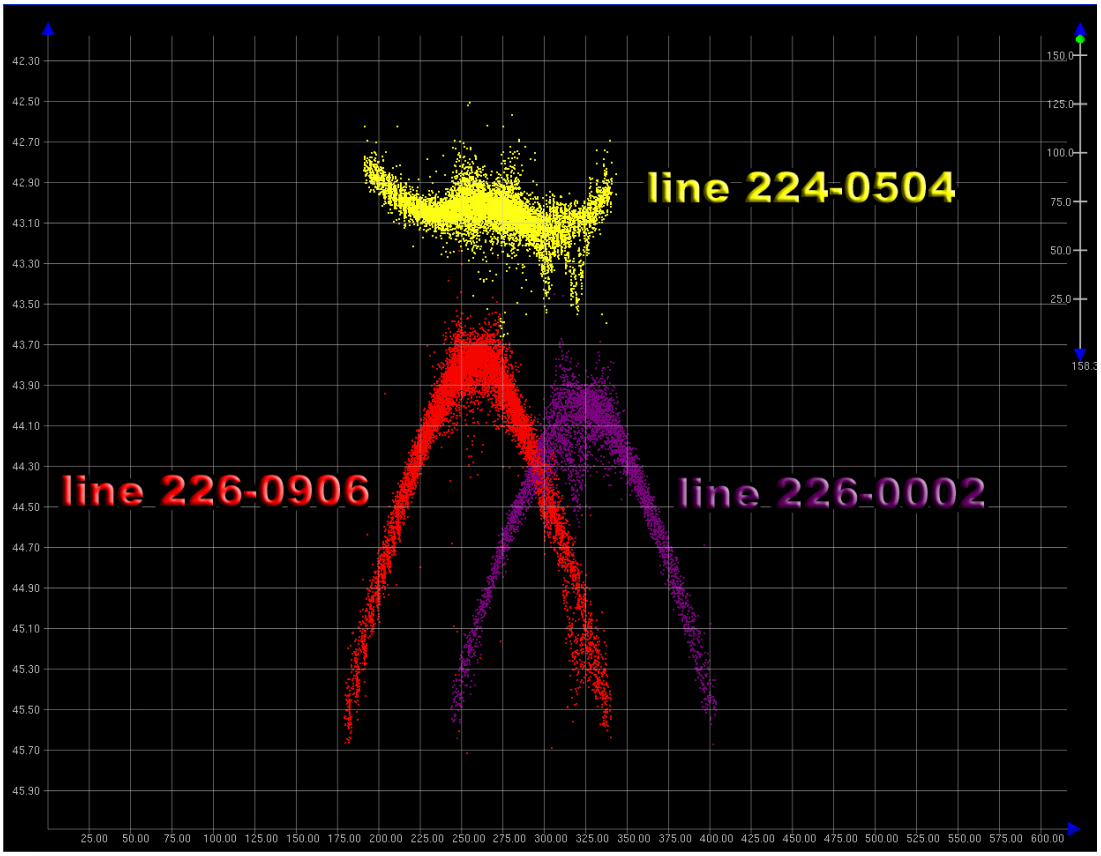


Figure 3. Sound speed & vertical errors (before outer beams were filtered)

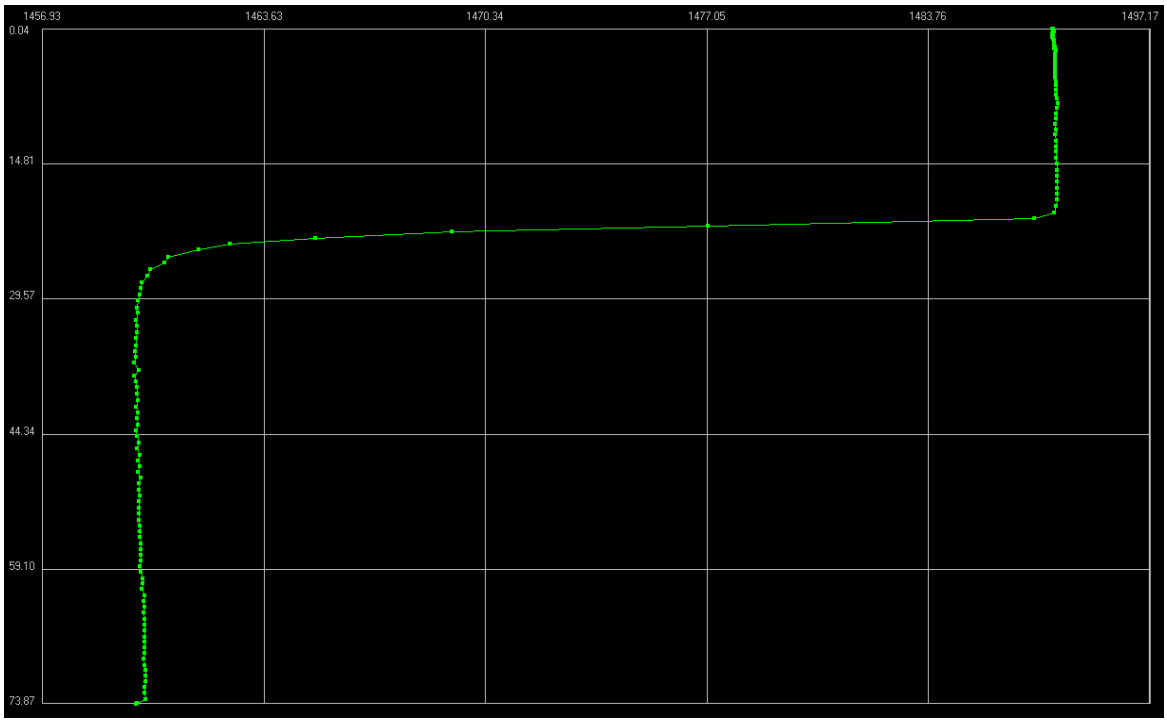


Figure 4. Sample sound speed profile (~25m/s change)

Positioning:

H11604 surveyed areas outside of DGPS coverage (Fig. 5). C-NAV satellite positioning system was inconsistent and unreliable for areas outside of DGPS coverage, perhaps due to antennae location (unverified). The majority of the survey was completed using standard, non-corrected GPS. TPE positioning error estimates were adjusted as discussed above to compensate for the increase in positional error.[5]

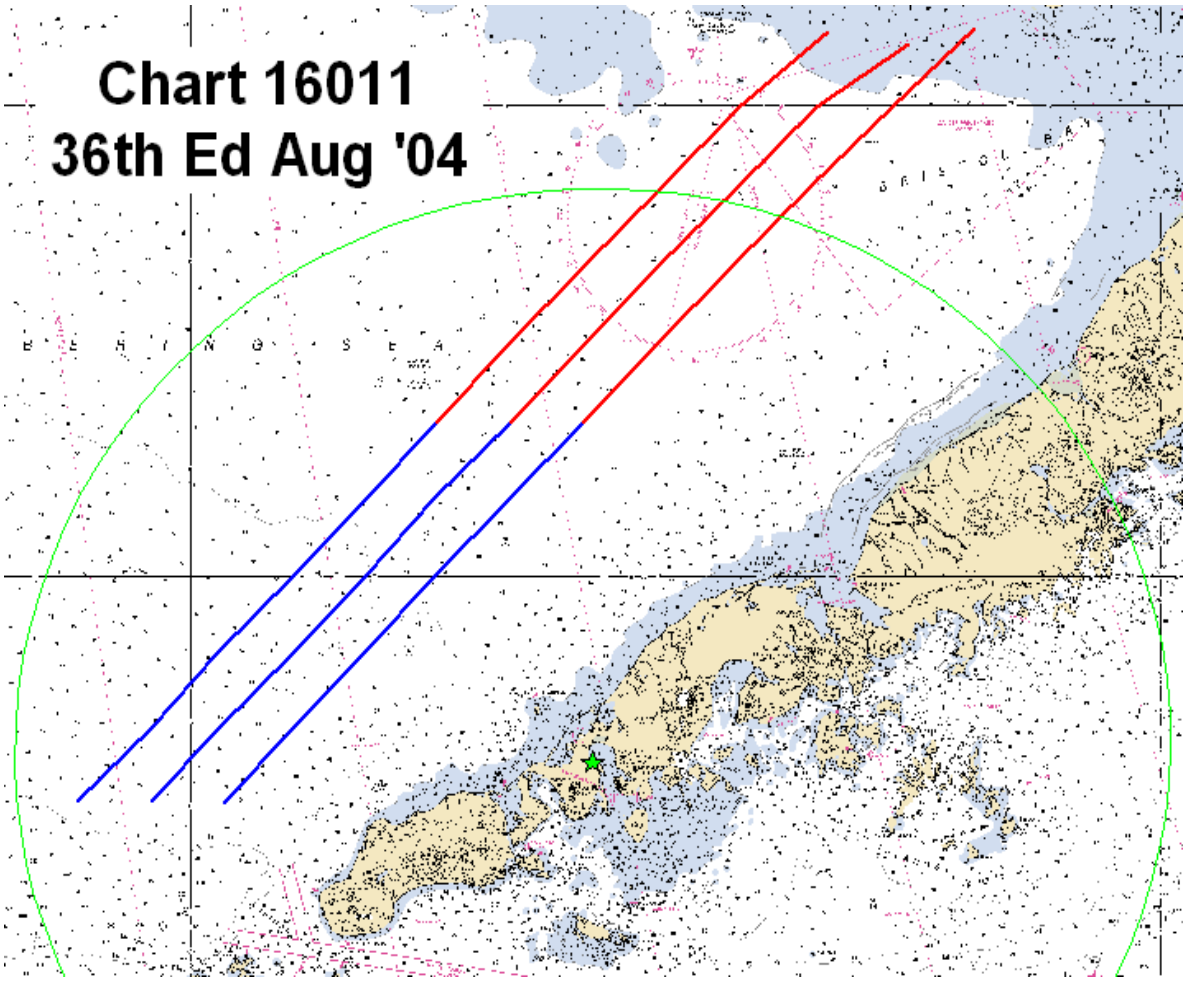


Figure 5. Cold Bay, AK DGPS station (green star) and approximate DGPS coverage (green curve)

Tides:

Tidal zoning in Bristol Bay is notoriously difficult to construct. The only operational gauge for this survey was in Unalaska, AK (946-2620), nearly 355 nm from the northernmost surveyed area. CO-OPS could only provide reliable zoning for a small portion of the surveyed area (Fig. 6). Vertical offsets up to 3 m exist over much of the survey, including the shoalest areas surveyed (< 20 m). The effect of this offset, combined with the above mentioned sound speed errors, result in grossly erroneous surfaces where the seafloor is known to be relatively flat and featureless (Fig 7, 8). Where two lines are horizontally

aligned but vertically offset, the calculated BASE surface is, as expected, created between the lines, resulting in a potentially dangerous situation where vast amounts of shoal soundings are not carried through to the chart (Fig. 9).[6]

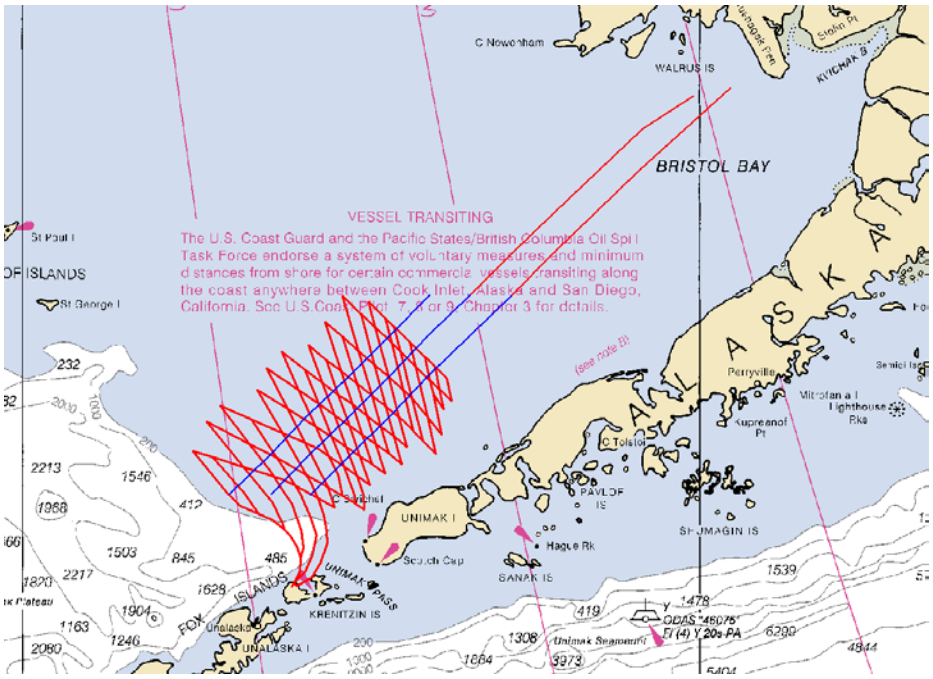


Figure 6. CO-OPS provided tide zones and FISHPAC survey lines

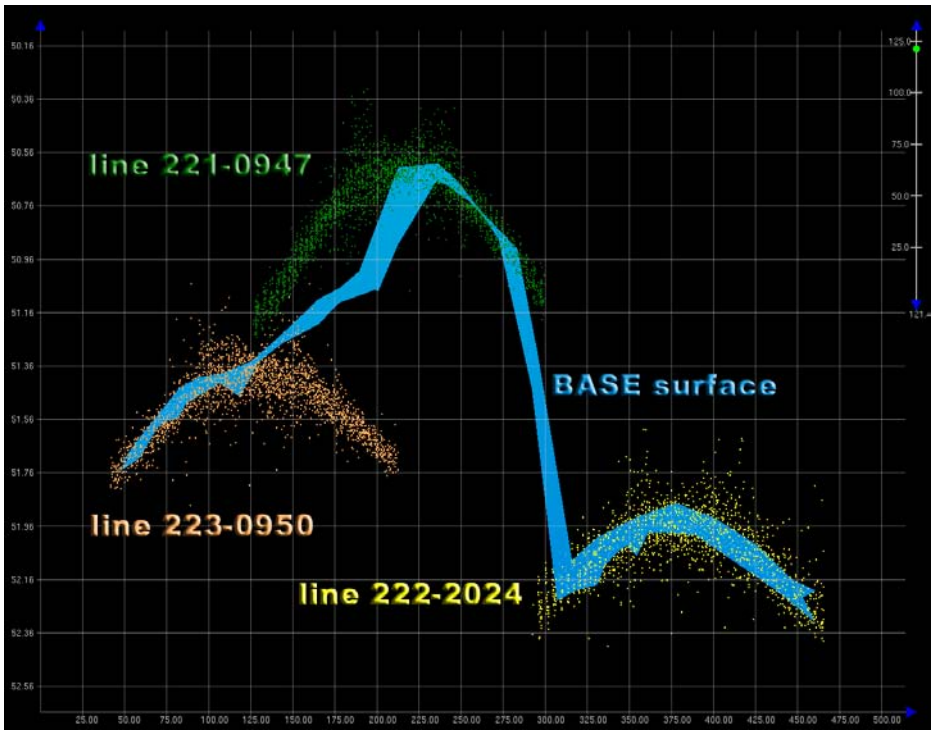


Figure 7. Vertical offset due to inaccurate tides (sound speed errors also present; before outer beam filtering)

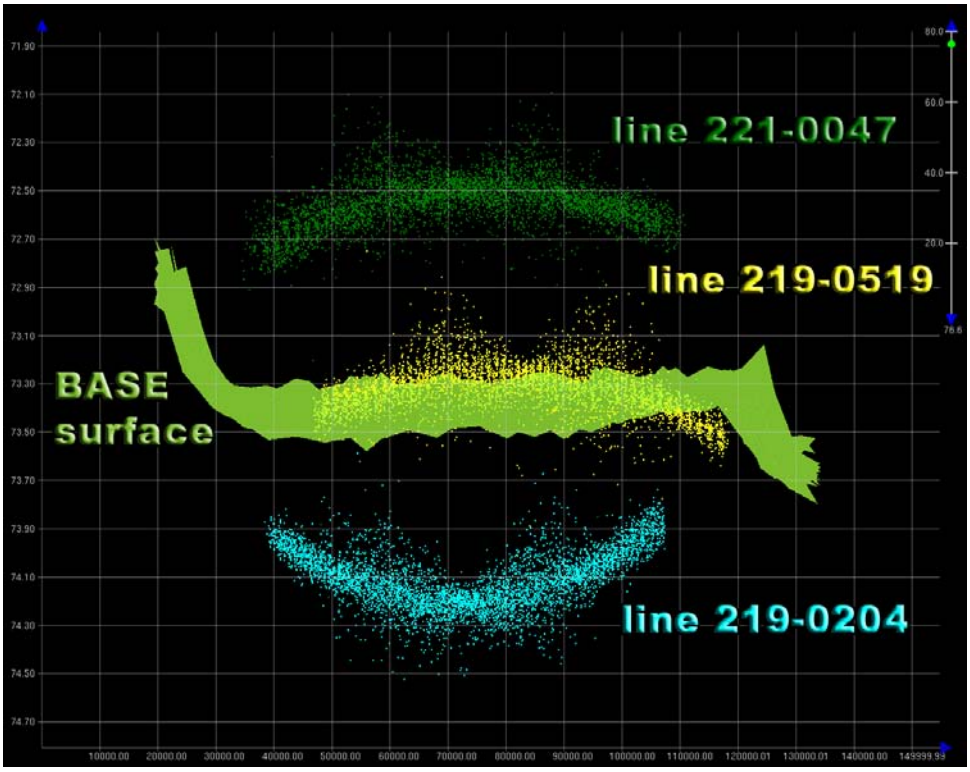


Figure 8. Vertical offset due to inaccurate tides
(sound speed errors also present; before outer beam filtering)

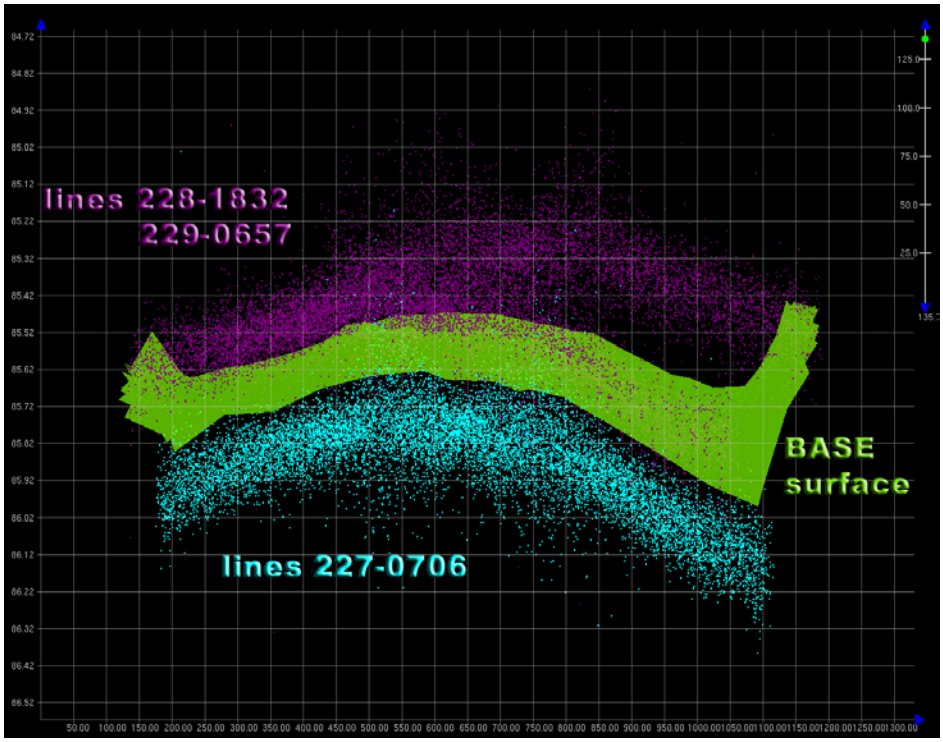


Figure 9. Vertical offset with BASE surface (note that two lines of data are shoaler than computed surface; before outer beam filtering)

Acoustic Interference:

At any give time, several acoustic systems, including both of FAIRWEATHER's Reson systems, one of two Klein side scan sonars (models 5410 or 7180, with its own suite of individual sonars), and a Sonardyne Fusion USBL, were operational. Data from H11604 periodically exhibit interference from one or more of these systems (Figs. 10 & 11). BASE surfaces were not greatly affected by this interference, though they add a significant amount of cyclic noise to the data.

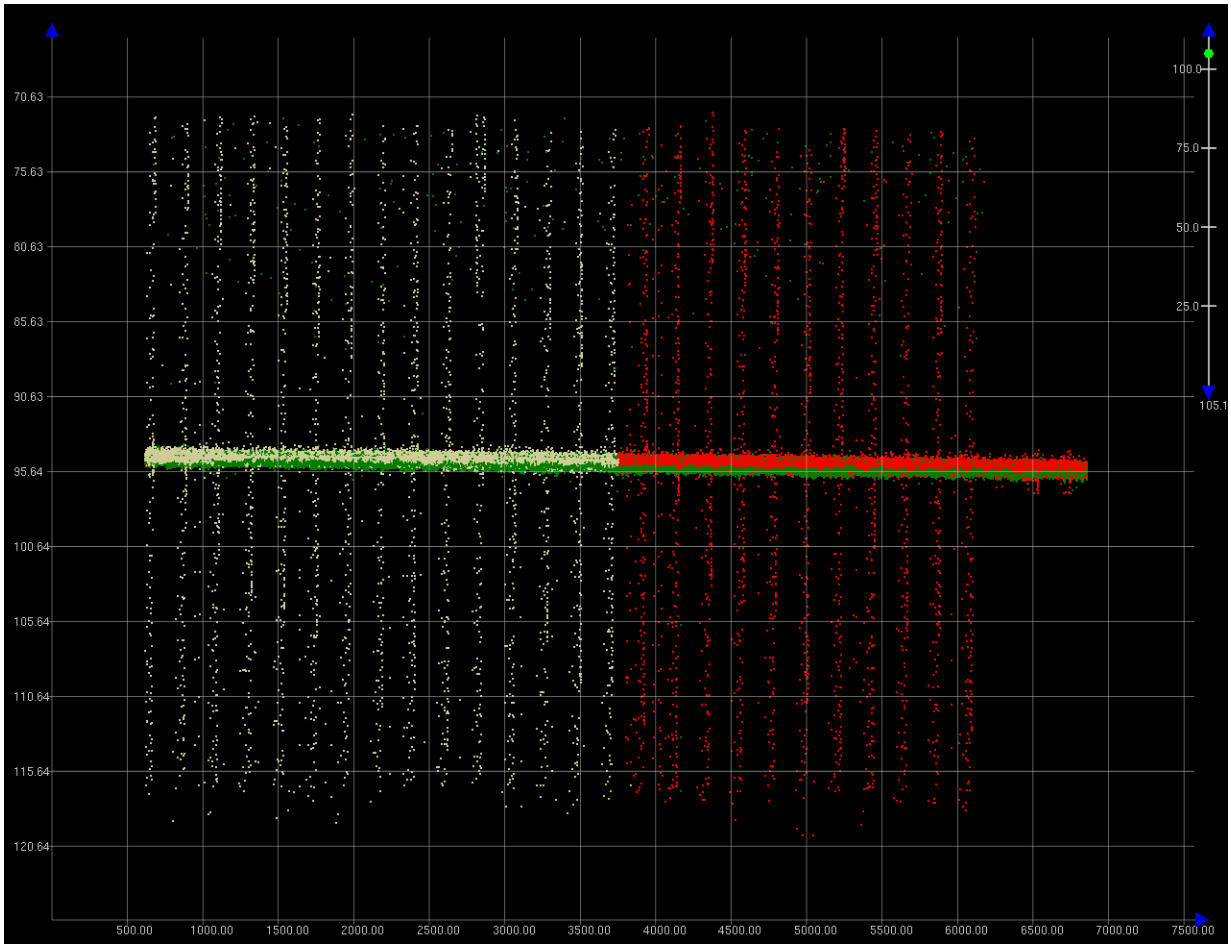


Figure 10. Side view of acoustic interference (vertical bars)

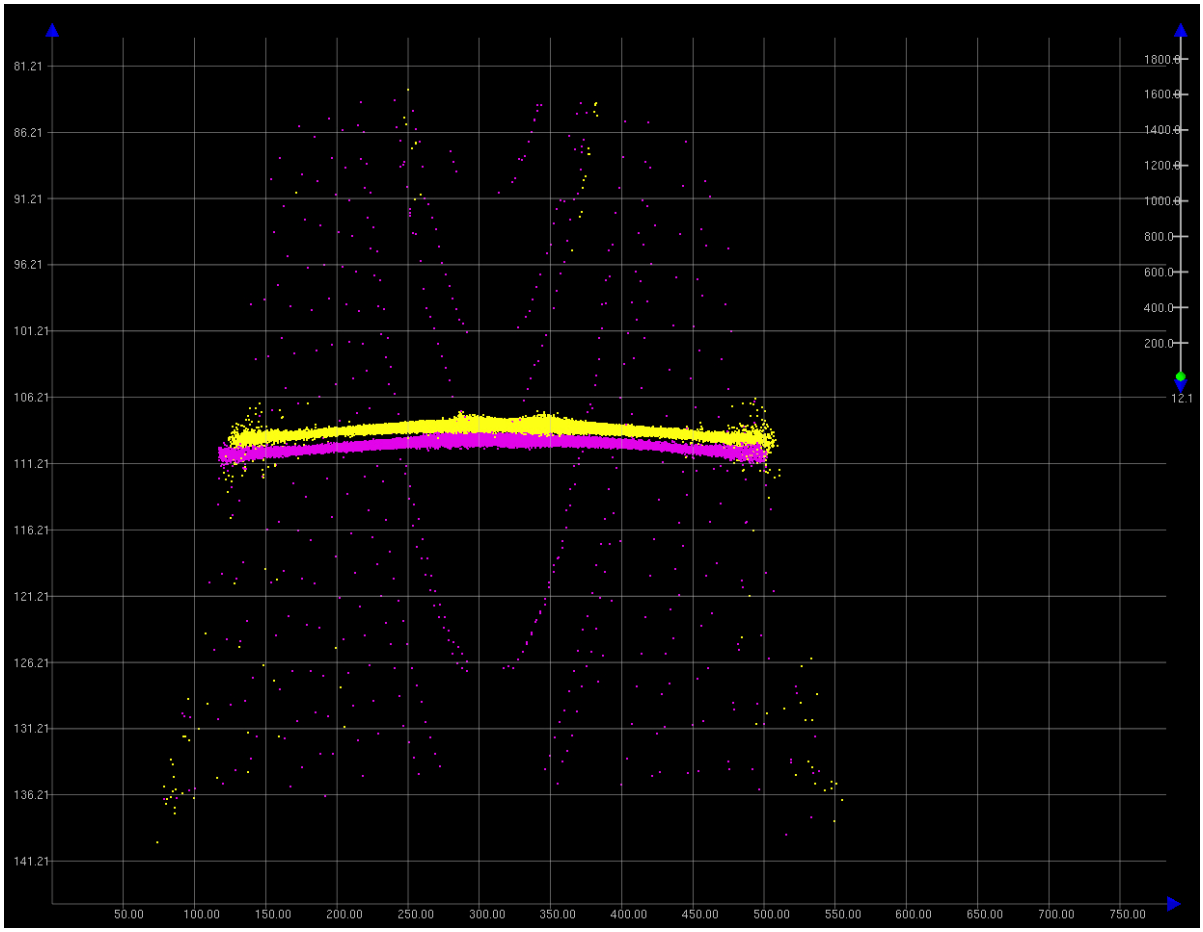


Figure 11. Acoustic interference (parabolic patterns)

B3. Data Reduction

An IHO Order 2 CUBE surface (H11604_5m) was created at 5 meter resolution.

B4. Data Representation

A single Caris Field Sheet (H11640_8111) has been created and an IHO Order 2 CUBE surface (H11604_5m) was created at 5 meter resolution for data processing and comparison. Due to the extreme vertical offsets in the data, only soundings from the shoalest lines in a given area should be used for charting. The large area of the survey precludes the creation of finer resolution surfaces, due to computer memory limitations. Due to the data quality issues discussed above, finer resolution surfaces do not provide more accurate or detailed representations of the seafloor.

C. VERTICAL AND HORIZONTAL CONTROL

Project M-R908-FA-06 did not require static GPS observations or other horizontal control work, and all tide corrections were generated from the CO-OPS maintained tide station in

Unalaska, AK. Thus, a "null" Horizontal and Vertical Control Report will be submitted.[7] A summary of horizontal and vertical control for this survey follows.

C1. Horizontal Control

The horizontal datum for this project is the North American Datum of 1983 (NAD83). Differential GPS (DGPS) was utilized when with range of the signal. The differential corrector beacon utilized for this survey is the U.S. Coast Guard beacon at Cold Bay, AK, transmitting on 289 kHz. This site is approximately 66 nm from the nearest approach to H11604 survey area (Fig. 5, above). C-NAV was installed to compensate for the lack of DGPS correctors, but proved unreliable, possibly due to antennae shadowing (unverified). Uncorrected GPS was applied for the majority of the data. Positioning error estimates were adjusted as discussed above to compensate for the increase in positional error.

C2. Vertical Control

Verified zoned tides have been applied in those areas where CO-OPS was able to provide zones. Verified tides have been applied to all areas outside of the provided zones.

The vertical datum for this project is Mean Lower-Low Water (MLLW). The operating National Water Level Observation Network (NWLON) primary water level station at Unalaska, AK (946-2620) served as control for datum determination and as the primary source for water level reducers for survey H11604.

No additional water level stations were installed.

D. RESULTS AND RECOMMENDATIONS

D.1 Automated Wreck and Obstruction Information System (AWOIS) Investigations

No AWOIS items were located within the limits of H11604.[8]

D.2 Chart Comparisons

Because reliable tides could not be applied, an adequate chart comparison cannot be completed. However, no significant discrepancies which would result in DToNs were found.[9]

D.3 Shoreline

There was no shoreline work for H11604.[10]

Charted Features

No charted features were investigated during H11604 acquisition.[11]

Recommendations

Despite the limitations of the data documented above, the hydrographer recommends that data from H11604 supersede that charted data, in areas where this survey provides shoaler soundings than currently charted soundings.[12] H11604 should not be used to create deeper soundings than what is already charted, with the possible exception in the areas of CO-OPS provided tide zoning. Although the data does not meet IHO Order 1 specifications in shallow waters, the shoalest soundings from the nadir beams are cromulent, given the depth of water (>20 m), the vintage of charted soundings (much of the charted sounding are from a 1910 leadline survey) and the low sounding density over much of the surveyed area (Fig. 12). The quality of this data, while not meeting NOS criteria for charting, is likely more accurate than the currently charted soundings and in an area unlikely to be resurveyed within the foreseeable future. To ensure safety, soundings should be taken from the shoalest line where vertical offsets occur.[13] For example, sounding for the chart only should be taken from line 221-0047 in Figure 8.

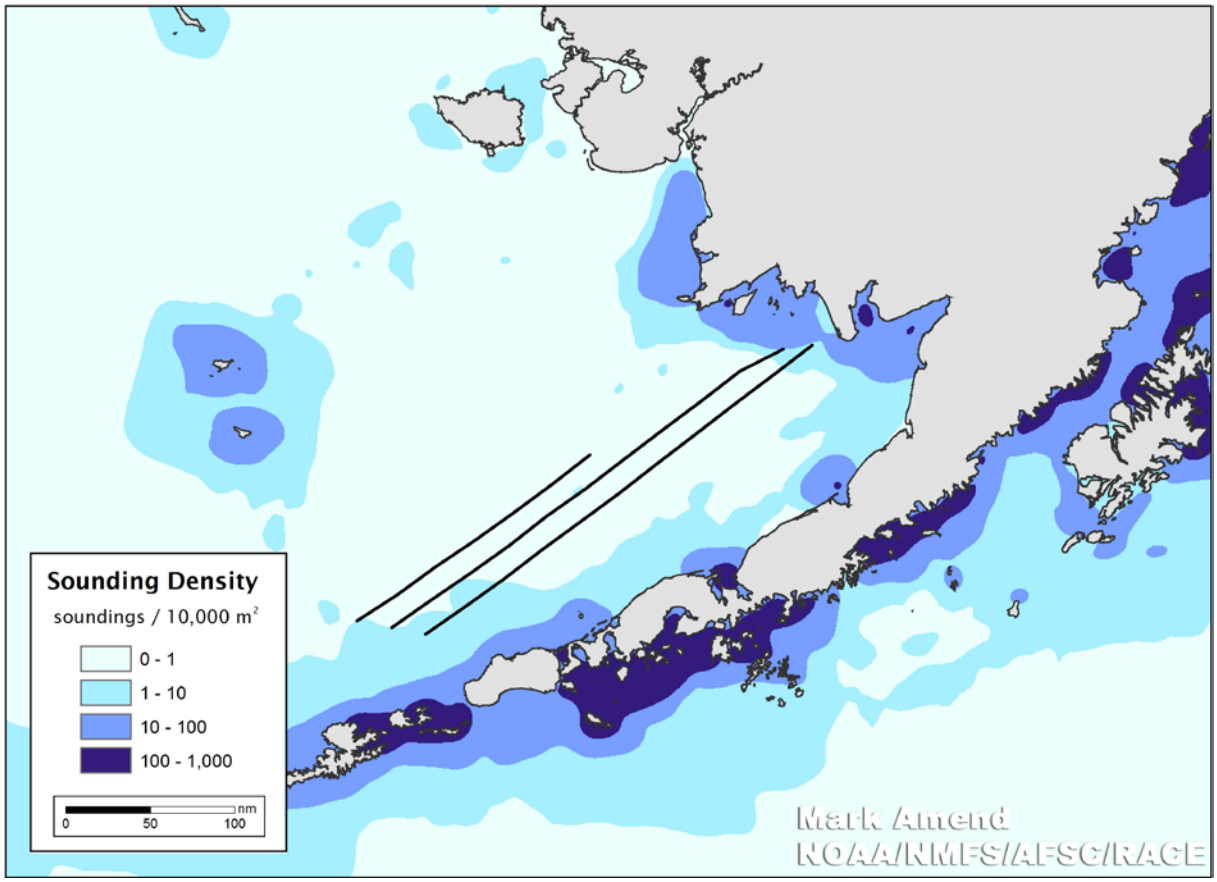


Figure 12. NOAA/NIMA charted sounding density in the vicinity of the FISHPAC survey lines

Close coordination between RACE and HSD on subsequent FISHPAC cruises could dramatically increase data accuracy. C-NAV antennae should be repositioned and tested to ensure more reliable position data. Sound speed measurements should be taken at more

frequent intervals, dictated by data quality (necessitates near real-time data processing). If possible, FAIRWEATHER should test the Brooke Ocean MVP with a dummy weight and the Klein 7180 mock-up, to determine if both systems can be safely operated simultaneously, as is done on THOMAS JEFFERSON. CO-OPS should be consulted to determine how to best solve errors associated with tidal modeling and a tide gauge(s) installed as necessary. RACE and UNH should determine if any acoustic systems can be eliminated, which may reduce the noise in the data. If these criteria cannot be met, future FISHPAC survey should be assigned a "W" registry number, as opposed to an "H" number, to signify that data acquisition procedures may not meet NOS standards.

D.4 Dangers to Navigation

No Dangers to Navigation (DToNs) were found in H11604.[14]

D.5 Aids to Navigation

No Aids to Navigation (ATONs) are located within the limits of H11604.[15]

D.6 Miscellaneous

Bottom samples collected by RACE are undergoing laboratory classification and are unavailable for inclusion in this report at the time of writing.[16]

E. ADDITIONAL DOCUMENTATION

Listed below are supplemental reports submitted separately that contain additional information relevant to this survey:

Title	Date Sent	Office
Data Acquisition and Processing Report for M-R908-FA-06	October 25, 2006	N/CS3
Horizontal and Vertical Control Report (null report)	November 21, 2006	???

Revisions Compiled During Office Processing and Certification:

[1] Filed with Project Records
[2] Concur with Clarification. No crosslines were required by the letter instructions.
[3] Concur with Clarification. Only lines from the second pass within a 4 hour window of a sound velocity cast were used for surfaces and sounding selection.
[4] Concur with Clarification. The survey reviewer re-cleaned the data to be in within Order 1 specifications.
[5] Concur with Clarification. Due to the scale of the chart and age of current soundings, uncorrected GPS is sufficient.
[6] Concur with Clarification. Due to the lack of tides over much of the survey area only the shoalest soundings between surveyed and charted were retained.
[7] Filed with Project Records as M-R908-FA_HVCR_Memo.pdf
[8] Concur.
[9] Concur.
[10] Concur.
[11] Concur.
[12] Concur with Clarification. No official signature page was submitted with the survey.
[13] Concur.
[14] Concur.
[15] Concur.
[16] No bottom samples are included in the HCell

H11604 HCell Report

Matt Andring, ERT Hydrographic Intern
Pacific Hydrographic Branch

Introduction

The primary purpose of the HCell is to provide new survey information in International Hydrographic Organization (IHO) format S-57 to update the largest ENC and RNC in the region: NOAA ENC, US3AK61M and NOAA RNC, 16520 and 16011.

HCell compilation of survey H11604 utilized Office of Coast Survey HCell Specifications Version 3.1, with approved modifications to better align with PHB's HCell process and to meet MCD needs.

1. Compilation Scale

Depths for HCell H11604 were compiled to the largest scale chart in the region, 16520, 1:300,000 and 16011, 1:1,023,188. Some of the surveyed data from H11604 was under the title block of 16520, so density and distribution of soundings are based upon chart 16011 in this area.

2. Soundings

A survey-scale sounding (SOUNDG) feature object layer was built from the 5-meter Finalized Surface in CARIS BASE Editor. A shoal-biased selection was made at 1:50,000 survey scale using a Radius Table file with values shown in the table, below. The resultant sounding layer contains 5,188 depths ranging from 21.9 to 159.1 meters.

Upper limit (m)	Lower limit (m)	Radius (mm)
0	10	3
10	20	4
20	50	4.5
50	200	5

In CARIS BASE Editor soundings were manually selected from the high density sounding layers and imported into a new layer created to accommodate chart density depths. Manual selection was used to accomplish a density and distribution that closely represents the seafloor morphology.

3. Depth Areas and Depth Contours

3.1 Depth Areas

Due to the extreme size and nature of the trackline survey H11604, the extents of the highest resolution BASE surface together with the extents of the soundings layer were not used to compute the hydrographic extents. The depth area (DEPARE) was hand-digitized using the area of the soundings as a guide.

3.2 Depth Contours

Depth contours at the intervals on the largest scale chart are included in the *_SS HCell for MCD raster charting division to use for guidance in creating chart contours. The generalized metric and fathom equivalent contour values are shown in the table below.

Chart Contours in Fathoms	Metric Equivalent of Chart Contours	Metric Equivalent of Chart Contours Generalized	Actual Value of Chart Contours
20	36.576	37.9476	20.750
50	91.44	92.8116	50.750

4. Meta Areas

The following Meta object areas are included in HCell H11604:

M_QUAL
M_COVR
M_CSCL

Meta area objects were constructed on the basis of the limits of the hydrography. (See 3.1 *Depth Areas*.)

5. Features

Due to the off-shore nature of the survey no shoreline features were collected or verified. Additionally, no bottom samples were collected or verified.

6. S-57 Objects and Attributes

The *_CS HCell contains the following Objects:

$CSYMB	Blue Notes
DEPARE	The all-encompassing depth area
M_COVR	Data coverage Meta object
M_QUAL	Data quality Meta object
M_CSCL	Data Scale Meta object
SOUNDG	Soundings at the chart scale density

The *_SS HCell contains the following Objects:

DEPCNT	Generalized contours at chart scale intervals
SOUNDG	Soundings at the survey scale density

All S-57 Feature Objects in the *_CS HCell have been attributed as fully as possible based on information provided by the Hydrographer and in accordance with current guidance and the OCS HCell Specifications.

7. Blue Notes

Notes to the RNC and ENC chart compilers are included in the HCell as $CSYMB features with the Blue Note information located in the INFORM field. By agreement with MCD, the NINFOM field is populated with an abbreviated version of the Blue Note (30 characters or less), describing the chart disposition, to be used by MCD in generating their Chart History spreadsheet.

8. Spatial Framework

8.1 Coordinate System

All spatial map and base cell file deliverables are in an LLDG geographic coordinate system, with WGS84 horizontal, MHW vertical, and MLLW (1983-2001 NTDE) sounding datums.

8.2 Horizontal and Vertical Units

DUNI, HUNI and PUNI are used to define units for depth, height and horizontal position in the chart units HCell, as shown below.

Chart Unit Base Cell Units:

Depth Units (DUNI):	Fathoms and feet
Height Units (HUNI):	Feet
Positional Units (PUNI):	Meters

During creation of the HCell in CARIS BASE Editor and CARIS S-57 Composer, all soundings and features are maintained in metric units with as high precision as possible. Depth units for soundings measured with sonar maintain millimeter precision. Units and precision are shown below.

BASE Editor and S-57 Composer Units:

Sounding Units:	Meters rounded to the nearest millimeter
Spot Height Units:	Meters rounded to the nearest decimeter

Conversion to charting units and application of NOAA rounding is completed in the same step, at the end of the HCell compilation process.

Conversion to fathoms and feet charting units with NOAA rounding ensures that:

- All depths deeper or equal to 11 fathoms display as whole fathoms.
- All depth units between 0 fathoms (MLLW) and 11 fathoms display as fathoms and whole feet.
- All depth units skyward of 0 fathoms (MLLW) to 2.0 feet above MHW display in feet for values that round to 5 feet or less, and in fathoms and feet skyward of that.
- All height units (HUNI) which have been converted to charting units, and that are 2.00 feet above MHW and greater, are shown in feet.

In an ENC viewer fathoms and feet depth units (DUNI) display in the format X.YZZZ, where X is fathoms, Y is feet, and ZZZ is decimals of the foot. In an ENC viewer, heights (HUNI) display as whole feet.

9. Data Processing Notes

9.1 Junction with H11604

H11604 does not junction with any other surveys.

9.2 Conflicts between Shoreline and Hydrography

H11604 does not meet the shoreline in any area.

10. QA/QC and ENC Validation Checks

H11604 was subjected to QA checks in S-57 Composer prior to exporting to the HCell base cell (000) file. The millimeter precision metric S-57 HCell was converted to a chart units and NOAA rounding applied. dKart Inspector was then used to further check the data set for conformity with the S-58 ver. 2 standard (formerly Appendix B.1 Annex C of the S-57 standard). All tests were run and warnings and errors investigated and corrected unless they are MCD approved as inherent to and acceptable for HCells.

11. Products

11.1 HSD, MCD and CGTP Deliverables

- H11604 Base Cell File, Chart Units, Soundings and features compiled to 1:300,000 and 1:1,023,188.
- H11604 Base Cell File, Chart Units, Soundings compiled to 1:50,000.
- H11604 Descriptive Report including end notes compiled during office processing and certification, the HCell Report, and supplemental items.
- H11604 Survey outline to populate the SURDEX.

11.2 File Naming Conventions

- Chart units base cell file, chart scale soundings — 11604 _CS.000
- Chart units base cell file, survey scale sounding set — 11604_SS.000
- Descriptive Report package — H11604 _DR.pdf
- Survey outline — H11604_Outline.gml & *.xsd

11.3 Software

CARIS HIPS Ver. 6.1	Inspection of Combined BASE Surfaces
CARIS BASE Editor Ver. 2.2	Creation of soundings and bathy-derived features, creation of the depth area, meta area objects, and Blue Notes; Survey evaluation and verification; Initial HCell assembly.

CARIS S-57 Composer Ver. 2.0	Final compilation of the HCell, correct geometry and build topology, apply final attributes, export the HCell, and QA.
CARIS GIS 4.4a	Setting the sounding rounding variable for conversion of the metric HCell to NOAA charting units with NOAA rounding.
CARIS HOM Ver. 3.3	Perform conversion of the metric HCell to NOAA charting units with NOAA rounding.
HydroService AS, dKart Inspector Ver. 5.1	Validation of the base cell file.
Newport Systems, Inc., Fugawi View ENC Ver.1.0.0.3	Independent inspection of final HCells using a COTS viewer.

12. Contacts

Inquiries regarding this HCell content or construction should be directed to:

Matt Andring, ERT Hydrographic Intern, PHB, Seattle, WA; 206-526-6845;
Matt.Andring@noaa.gov.

APPROVAL SHEET
H-11604

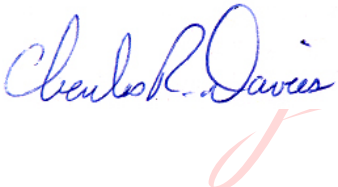
Initial Approvals:

The survey evaluation and verification has been conducted according to branch processing procedures and the H-Cell compiled per the latest OCS H-Cell Specifications.

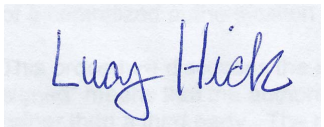
Matt Andring
2009.10.01
15:09:44 -07'00'

The survey and associated records have been inspected with regard to survey coverage, delineation of the depth curves, development of critical depths, S-57 classification and attribution of soundings and features, cartographic characterization, and verification or disproval of charted data within the survey limits. The survey records and digital data comply with OCS requirements except where noted in the Descriptive Report and are adequate to supersede prior surveys and nautical charts in the common area.

I have reviewed the H-Cell, accompanying data, and reports. This survey and accompanying digital data meet or exceed OCS requirements and standards for products in support of nautical charting except where noted in the Descriptive Report.



Digitally signed by Charles R. Davies
DN: cn=Charles R. Davies, o=Pacific Hydrographic Branch, ou=NOAA,NOS,OCS, email=Russ.Davies@NOAA.GOV, c=US
Date: 2009.10.01 15:32:12 -07'00'



Lucy Hick
AWOIS & SURF
Check Completed
2009.10.05
13:29:03 -04'00'