Cover Sheet (NOAA Form 76-35A)

NOAA FORM 76-35A

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

Data Acquisition and Processing Report

Type of Survey HYDROGRAPHIC

Field No M-L906-KR-08

Registry No. H11980, H11981,& H11982

LOCALITY

State CALIFORNIA

General Locality Pacific Ocean – Northern California

Sublocality Areas Extending from Conical Rock to Split Rock

2009

CHIEF OF PARTY

DEAN MOYLES

LIBRARY & ARCHIVES

DATE

☆U.S. GOV. PRINTING OFFICE: 1985—566-054

Title Sheet (NOAA Form 77-28)

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION **HYDROGRAPHIC TITLE SHEET**	REGISTER NO. H11980, H11981, & H11982
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 CALIFORNIA

General Locality Pacific Ocean – Northern California

Locality Areas Extending from Conical Rock to Split Rock

Scale NA Date of Survey 09/08/08 – 11/25/08, 04/29/09 - 06/05/09

Instructions dated July 7, 2008 Project No. M-L906-KR-08

Vessel F/V PACIFIC STAR (556510), R/V R2 (623241), R/V D2 (647782), R/V QUICKSILVER (947419)

Chief of party DEAN MOYLES

Surveyed by MOYLES, REYNOLDS, GILL, MOUNT, FARLEY, ZURITA, BARROW, TODD, TIDEY, TIXIER, STEWART, CAMERON, et al.

Soundings taken by echo sounder, hand lead, pole RESON SEABAT 7125 (R2, D2, PACIFIC STAR, QUICKSILVER, HULL MOUNT), RESON SEABAT 8125 (D2, HULL MOUNT)

Graphic record scaled by FUGRO PELAGOS, INC. PERSONNEL

Graphic record checked by FUGRO PELAGOS, INC. PERSONNEL

Protracted by N/A Automated plot by N/A

Verification by

Soundings in METERS at MLLW

REMARKS: The purpose of this work is to provide NOAA with modern and accurate hydrographic survey data for the area in Northern California in the vicinity of Conical Rock to Split Rock.

ALL TIMES ARE RECORDED IN UTC.

FUGRO PELAGOS INC.

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A – Equipment

The F/Vs Pacific Star (with launches R2 and D2) and Quicksilver acquired all sounding data for this project. The equipment list and vessel descriptions are included in Appendices I and II.

SOUNDING EQUIPMENT

The F/V Pacific Star was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at two user-selectable frequencies of 400 and 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in the 400 kHz mode, and 256 beams at a spacing of 1° (across-track) in the 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. For this project both the 400 kHz and 200 kHz systems were configured for 256 equi-angle beams. The selection of these frequencies as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1).

The F/V Pacific Star was also equipped with a hull mounted Reson SeaBat 8111 multibeam echosounder system for surveying the deeper portions of the survey area. The Reson 8111 system operates at a frequency of 100 kHz and forms 101 beams at a spacing of 1.5° (across-track), with a maximum swath coverage of 150°. Sonar settings such as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1).

The R/V R2 (a Pacific Star launch) was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at two user-selectable frequencies of 400 and 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in the 400 kHz mode and 256 beams at a spacing of 1° (across-track) in the 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. Various combinations of these modes of operation were used during this project. The selection of these modes as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1).

The R/V D2 (a Pacific Star launch) was equipped with a hull mounted Reson SeaBat 7125 single-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at a frequency of 400 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. For this project the system operated in 256 beam equi-distant mode. Operating modes as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1).

The R/V D2 (a Pacific Star launch) was also equipped with a hull mounted Reson SeaBat 8125 multibeam echosounder. The Reson 8125 system operates at a frequency of 455 kHz and forms

240 beams at spacing of 0.5° (across-track), with maximum swath coverage of 120°. Sonar settings such as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1).

The R/V Quicksilver was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at two user-selectable frequencies of 400 and 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in the 400 kHz mode and 256 beams at a spacing of 1° (across-track) in the 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. For this project both the 400 kHz and 200 kHz systems were configured for 256 equi-angle beams. The selection of these frequencies as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1).

The line orientation for the all vessels was generally parallel to the coastline and bathymetric contours in the area. The line spacing depended on the water depth and data quality, with an average spacing of two to three times water depth.

The following table summarizes the sonar models and configurations used on each survey vessel.

Table 1 – Vessel Sonar Summary

Vessel Sonar Summary				
Vessel	**Pacific Star**	**R2**	**D2**	**Quicksilver**
Mount Type	Hull	Hull	Hull	Hull
Sonar System(s)	Reson 7125 dual frequency Reson 8111	Reson 7125 dual frequency	Reson 7125 single frequency (400 kHz) Reson 8125	Reson 7125 dual frequency
Operated in dual-head mode	No	No	No	No

SIDE SCAN SONAR

Towed Side Scan Sonar (SSS) operations were not required by this contract. Backscatter and beam imagery snippet data from all multibeam systems were logged and processed separately for the State of California but were not required by NOAA.

POSITIONING EQUIPMENT

All vessels were equipped with an Applanix Position and Orientation System for Marine Vessels (POS MV) 320 V4 to calculate positions. Position was determined in real time using a Trimble Zephyr L1/L2 GPS antenna, which was connected to a Trimble BD950 L1/L2 GPS card residing in the POS MV. An Inertial Measurement Unit (IMU) provided velocity values to the POS MV allowing it to compute an inertial position based on DGPS, heading, and motion.

The POS MV was configured to accept differential corrections which were output from a CSI MBX-3 DGPS receiver that was tuned to the closest or strongest USCG DGPS station.

The POS MV controller software's real-time QC displays were monitored throughout the survey to ensure that the positional accuracies specified in the NOS Hydrographic Surveys Specifications and Deliverables were achieved. These include, but are not limited to the following: GPS Status, Position Accuracy, Receiver Status (which included HDOP), and Satellite Status.

SOFTWARE

Acquisition

All raw multibeam data for all vessels were collected with WinFrog Multibeam v3.08.44.04 (WFMB). WFMB ran on Windows XP Pro PCs with a dual-core Intel processor. Data from the Reson 8111 and 8125 sonars were logged in the XTF file format while data from the Reson 7125 sonars were logged in the S7K format. These XTF and S7K files contain all multibeam bathymetry, position, attitude, heading, and UTC time stamp data required by CARIS to process the soundings. A separate WFMB module (PosMVLogger) on the same PC logged all raw POS MV data for post-processing of vessel positions in Applanix POSPac software. WFMB also provided a coverage display for real time QC and coverage estimation of the acquired data.

WFMB offers the following display windows for operators to monitor data quality:

1. Devices: The Devices window shows the operator which hardware is attached to the PC. It also allows the operator to configure the devices, determine whether they are functioning properly, and to view received data.
2. Graphic: The Graphic window shows navigation information in plain view. This includes vessel position, survey lines, background vector plots, and raster charts.
3. Vehicle: The Vehicle window can be configured to show any tabular navigation information required. Typically, this window displays position, time, line name, heading, HDOP, speed over ground, distance to start of line, distance to end of line, and distance off line. Many other data items are selectable.
4. Calculation: The Calculation window is used to look at specific data items in tabular or graphical format. Operators look here to view the status of the GPS satellite constellation and position solutions.

Applanix POS MV V4 controller software was used to monitor the POS MV system. The software has various displays that allow the operator to check real time position, attitude and heading accuracies, and GPS status. POS MV configuration and calibration, when necessary, was also done using this program.

Fugro Pelagos' MB Survey Tools v2.00.20.0 was used to aid in file administration and reporting during data acquisition. This program created a daily file that contained survey line, SVP, and static draft records. These logs were stored digitally in a database format and later used to create the log sheets in PDF format located in Separate 1.

Processing

All Soundings were processed using CARIS (Computer Aided Resource Information System) HIPS (Hydrographic Information Processing System) v6.1. HIPS converted the XTF and S7K files to HIPS format, corrected soundings for sound velocity, motion, tide, and vessel offsets, and were used to examine and reject noisy soundings. HIPS produced the final BASE surfaces as well.

CARIS Notebook v3.1 was used to generate the S57 Feature Files.

ESRI ArcMap 9.3 was utilized for survey planning, reviewing coverage plots, creating fill-in and crosslines, and producing progress sketches.

Applanix POSPac MMS v5.2 was utilized for post-processing the vessel dual frequency GPS data with simultaneous base station data to calculate higher accuracy positions than those calculated in real time.

MB Survey Tools v2.00.20.0 was used to extract True Heave from POS files and put data into a text format acceptable to the CARIS Generic Data Parser. This was only utilized when the CARIS Load True Heave routine in HIPS failed to import.

MB Survey Tools allowed processors reviewing the data to track changes and add comments while processing. MB Survey Tools was also used to process all sound velocity profiles and put them into CARIS format.

A complete list of software and versions used on this project is included in Appendix I. Refer to the "2009-MBES_Processing_Procedures_R0" document for a detailed processing routine with procedures used.

B – Quality Control

In the CARIS Hips Vessel File (HVF), error estimates for all survey sensors were entered. These error estimates were used in CARIS to calculate the Total Propagated Error (TPE) at the 95% confidence interval for the horizontal and vertical components for each individual sounding. The values that were entered in the CARIS HVF file for the survey sensors are the specified manufacturer accuracy values and were downloaded from the CARIS website **http://www.caris.com/tpe/**. The following is a breakdown and explanation on the manufacturer and Fugro Pelagos derived values used in the error model:

- Navigation – A value of 0.10 m was entered for the positional accuracy. This value was selected since all positions were post processed, with all X, Y, and standard deviation values better than 0.10m.
- Gyro/Heading – All vessels were equipped with a POS MV 320 V4 and had a baseline < 4m, so therefore a value of 0.020 was entered in the HVF as per manufacturer specs.
- Heave – The heave percentage of amplitude was set to 5% and the Heave was set to 0.05m, as per manufacturer specs.
- Pitch and Roll - As per the manufacturer accuracy values, both were set to 0.02 degrees.
- Timing – All data were time stamped when created (not when logged) using a single clock/epoch (Pelagos Precise Timing method). Position, attitude (including TrueHeave), and heading were all time stamped in the POS MV on the UTC epoch. This UTC string was also sent to the Reson processor, via a serial string (ZDA+1 PPS on 7125 systems), to sync the Reson with the POS MV, yielding timing accuracies on the order of 1 ms. Therefore a timing error of 0.001 seconds was entered for all sensors on all vessels.
- All vessel and sensor offsets were derived via conventional surveying techniques (total station), while the vessels were dry docked. The results yielded standard deviations of 0.005m to 0.010m, vessel and survey dependent.
- Vessel speed – set to 0.10 m/s since a POS MV with 100 Hz output rate was in use.
- Loading – estimated vessel loading error set to 0.05m. This was the best estimate of how the measured static draft changed through the survey day.
- Draft – it was estimated that draft could be measured to within 0.01m to 0.05m, therefore values in this range were entered, vessel dependent.
- Tide error was set to 0.10 m. This value was selected since RMS for GPS altitude was typically better than this.
- Sound Speed Values were set to 1 m/s, surface velocity set to 2.5 m/s.
- MRU Align StdDev for the Gyro and Roll/Pitch were set to 0.10° since this is the estimated misalignment between the IMU and the vessel reference frame.

The calculated vertical and horizontal error or TPE values were then used to create finalized CUBE (Combined Uncertainty Bathymetry Estimator) surfaces that used only soundings meeting or exceeding project accuracy specifications.

An overview of the data processing flow follows:

In order for the XTF and S7K files collected by WFMB to be used by CARIS, they must be converted to HDCS format using the CARIS XTF or ResonPDS converter routine. Prior to the files being converted, vessel offsets, patch test calibration values, TPE values, delta draft, and static draft were entered into the HVF.

Once converted, the SVP and TrueHeave data were loaded into each line and the line was SVP corrected in CARIS HIPS. The TPE was then computed for each sounding and the attitude, navigation, and bathymetry data for each individual line were examined for noise, as well as to ensure the completeness and correctness of the data set.

A filter settings file was formalized and named "60-012.hff". This filter rejected all soundings falling greater than 60° from nadir, and soundings flagged as low quality by the Reson multibeam system. Note that "rejected" does not mean the sounding was deleted – it was instead flagged as bad so that it would not be used in subsequent processing, such as surface creation. Data flagged as rejected due to the angle from nadir parameters did often contain valid data but were flagged to remove noise and speed the processing flow. Valid data were manually reaccepted into the data set occasionally during line and subset editing to fill data gaps.

Filter settings were often modified based upon data quality and sonar used, but all filter settings used were noted on each corresponding line log (refer to Separate 1).

Raw POS MV data logged in to a POS file were processed in conjunction with base station data in Applanix POSPac to produce an SBET (Smoothed Best Estimated Trajectory) file containing positioning data that was more accurate than the real time positioning data. These SBETs were loaded into each line in CARIS HIPS which replaced the real time navigation and GPS altitude data.

The CARIS HIPS GPSTide function was then run to compute a MLLW tide that utilized the GPS altitude, vessel heave, vessel waterline offsets, and VDatum NAD83 to MLLW grids.

The lines were then merged, using the GPSTide option. CUBE surfaces were then created at varying resolutions depending on the depth range. The following depth thresholds were used on this project.

- Depth Threshold: 0 to 22 meters resolution = 0.5 m
- Depth Threshold: 20 to 33 meters resolution = 1 m
- Depth Threshold: 30 to 45 meters resolution = 1.5 m
- Depth Threshold: 40 to 84 meters resolution = 2 m
- Depth Threshold: 80 to 100 meters resolution = 4 m
- Depth Threshold: 90 to 250 meters resolution = 5 m
- Depth Threshold: 230 to 1000 meters resolution = 10 m

Deviations from these thresholds, if any, are detailed in the appropriate DR.

Subsets Tiles (to track areas examined) were then created in CARIS HIPS. Adjacent lines of data were examined to identify tidal busts, sound velocity and roll errors, as well as to reject any remaining noise in the data set that adversely affected the CUBE surface.

While examining the data in subset mode, soundings were designated wherever the CUBE surface did not adequately depict the shoalest point of a feature or were issued as a danger to navigation. Soundings were designated when they met or exceeded the criteria for designation set forth in the Specifications and Deliverables. Designation ensured soundings were carried through to the finalized BASE surfaces.

A statistical analysis of the sounding data was conducted via the CARIS Quality Control Report (QCR) routine. Crosslines were run in each sheet and were compared with lines acquired from the main-scheme lines where applicable. The Quality Control Reports are located in Separate 4.

Sounding data that passed the required quality assurance checks were used in the final BASE surfaces. During final BASE surface creation in CARIS, the S-44 order option "User Defined" was selected, and the values set so that a=0.20 and b=0.01. This constrained the area of influence of soundings to those that passed project specifications.

CARIS Notebook 3.1 was utilized to produce the S57 feature file. Seabed Area (SBDARE) polygon objects were picked from areas with obvious rocky bottom topography from the BASE surfaces. Meta-Coverage (M_COV) and Meta-Quality (M_QUAL) objects were defined as required using the extents of the multibeam BASE surfaces.

C - Corrections to Soundings

SOUND VELOCITY PROFILES

Sound velocity casts were normally performed every two hours. The AML Smart Probes used to determine sound velocities sampled at a rate of ten velocity and pressure observation pairs a second. For each cast, the probes were held at the surface for one to two minutes to achieve temperature equilibrium. The probes were then lowered and raised at a rate of 1 m/s. Between casts, the sound velocity sensors were stored in fresh water to minimize salt-water corrosion and to hold them at ambient water temperature.

A Brooks Ocean MVP-30 system was used on this project on the F/V Pacific Star. The system was used to collect a set of between three to five sound velocity profiles on a single line, then two hours later another set of profiles, to build a grid of sound velocity profiles. The MVP towfish (which utilized an AML Smart Probe) would free-fall rapidly to a set distance above the

seafloor and then retrieved at a slow rate (about 0.5 m / second), producing most of its data on the up-cast. When not deployed, the towfish with sound velocity sensor was stored in fresh water to minimize salt-water corrosion and to maintain the sensor at ambient water temperature.

Fugro Pelagos' MB Survey Tools was used to check the profiles graphically for spikes or other anomalies and to produce an SVP file compatible with CARIS HIPS.

Refer to Appendix III for SVP Calibration Reports.

SETTLEMENT CURVE

Squat-settlement tests were performed on all vessels to obtain dynamic draft correctors. Note that in the GPSTide method of tidal corrections used on this project, dynamic draft correctors are not necessary since the computed altitudes include the dynamic draft component of sonar change in depth.

The squat-settlement tests were performed by first establishing a 1000 meter line in the direction of the current. The survey vessel sat static at one end of the line for three minutes logging L1/L2 GPS data. The line was first run heading into the current at lowest possible engine RPM, then re-run moving with the current at the same RPM, stopping at the original starting point to obtain an additional three minutes of static L1/L2 GPS data. This pattern was repeated for additional lines at incrementing vessel RPMs.

All measurements were corrected for heave, pitch, roll, and reduced to the vessel's common reference point (CRP). Static measurements observed at the end of each line set were used to compute a tide curve for tidal corrections. After post-processing with base station data in Applanix POSPac, a settlement curve of dynamic draft correctors was computed.

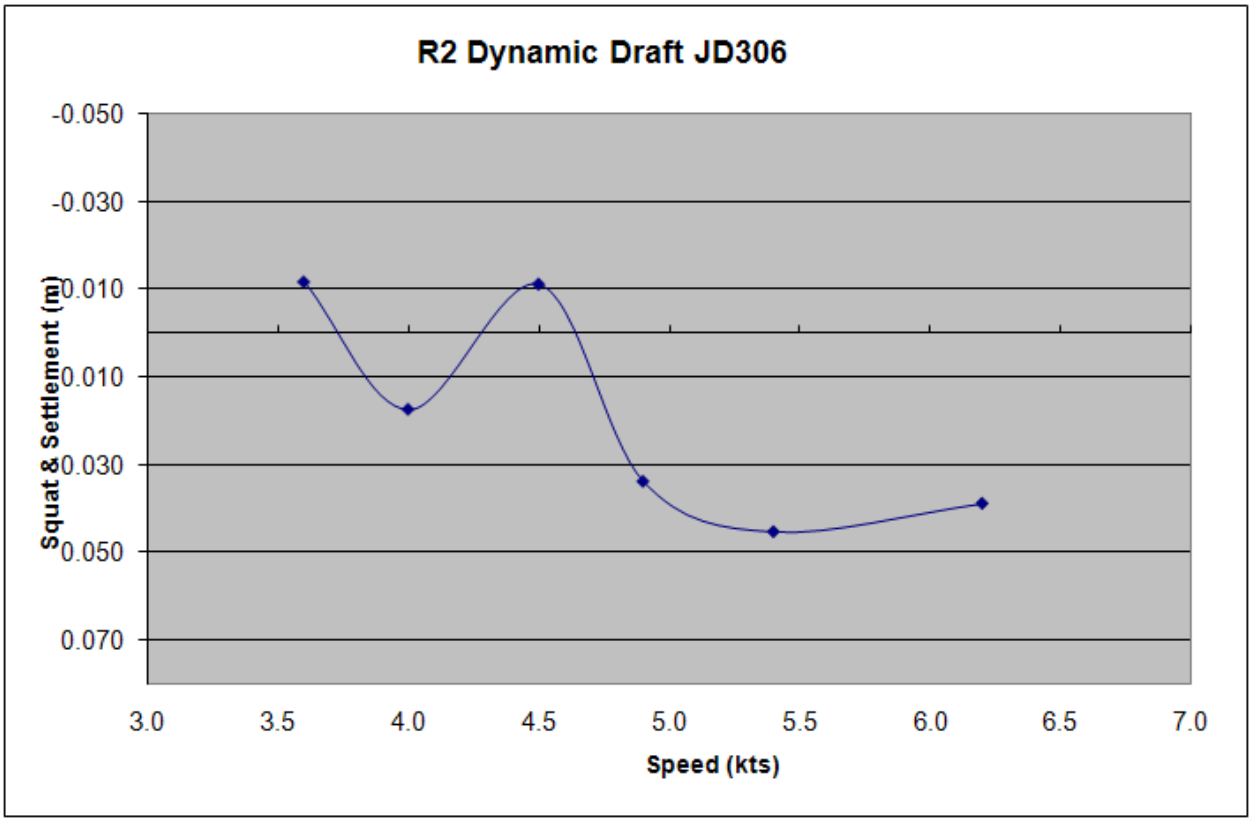


Figure 1 – R2 Dynamic Draft

Table 2 – R2 Squat Settlement Results

R2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.6	400	-0.012
4.0	525	0.017
4.5	750	-0.011
4.9	1000	0.034
5.4	1200	0.045
6.2	1300	0.039

The squat settlement test for the R/V R2 was conducted near Eureka, CA. on November 1, 2008 (Julian Day 306).

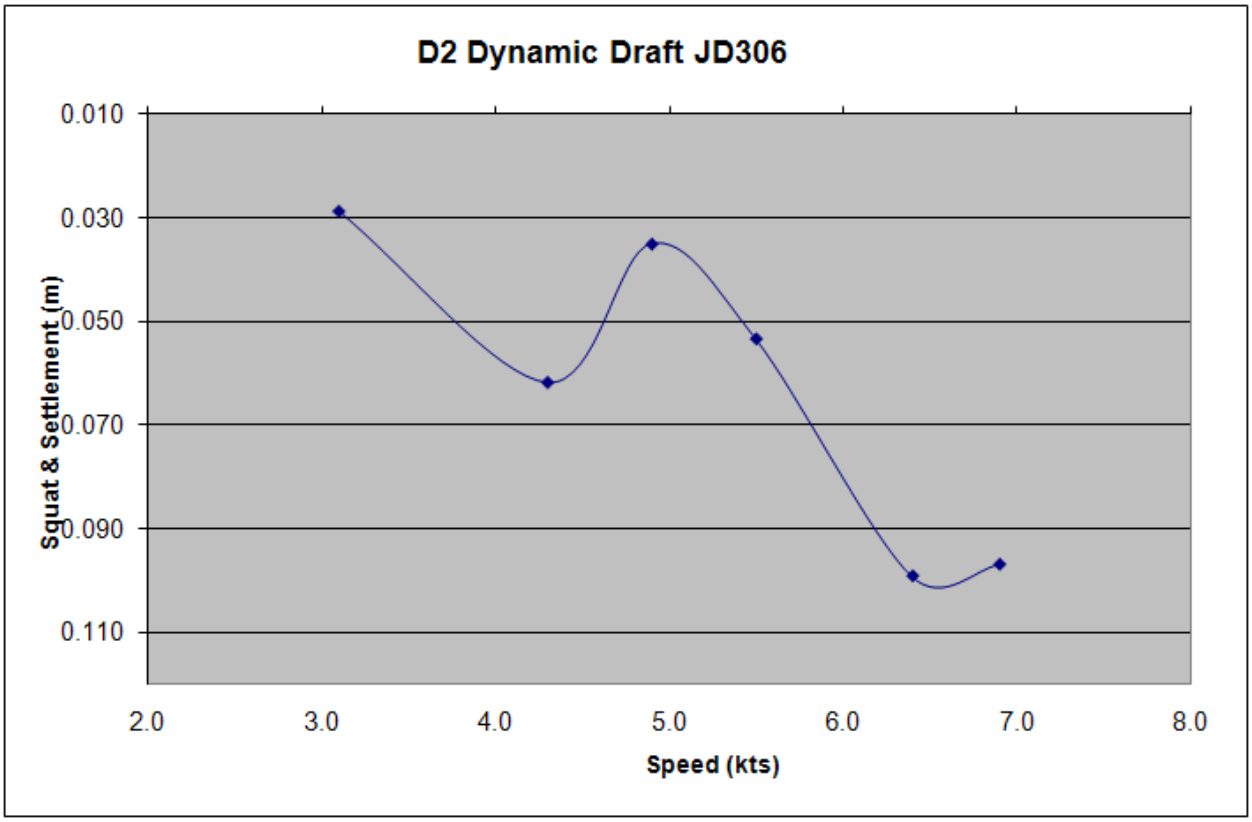


Figure 2 – D2 Dynamic Draft

Table 3 – D2 Squat Settlement Results

D2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.1	600	0.029
4.3	800	0.062
4.9	1000	0.035
5.5	1200	0.053
6.4	1400	0.099
6.9	1600	0.097

The squat settlement test for the R/V D2 was conducted near Eureka, CA. on November 1, 2008 (Julian Day 306).

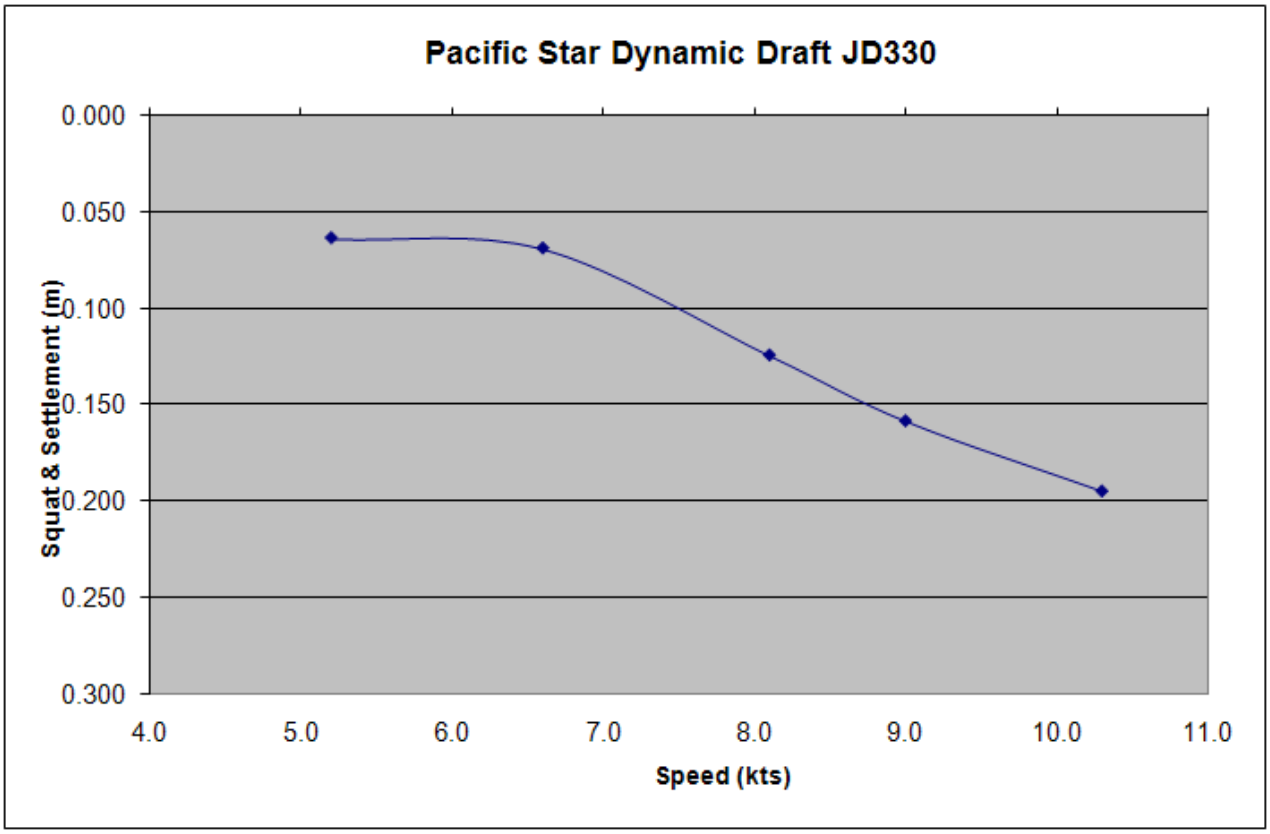


Figure 3 – Pacific Star Dynamic Draft

Table 4 – Pacific Star Squat Settlement Results

Pacific Star DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
5.2	350	0.064
6.6	450	0.069
8.1	550	0.124
9.0	600	0.158
9.7	650	0.176
10.3	700	0.195

The squat settlement test for the F/V Pacific Star was conducted near Eureka, CA. on November 25, 2008 (Julian Day 330).

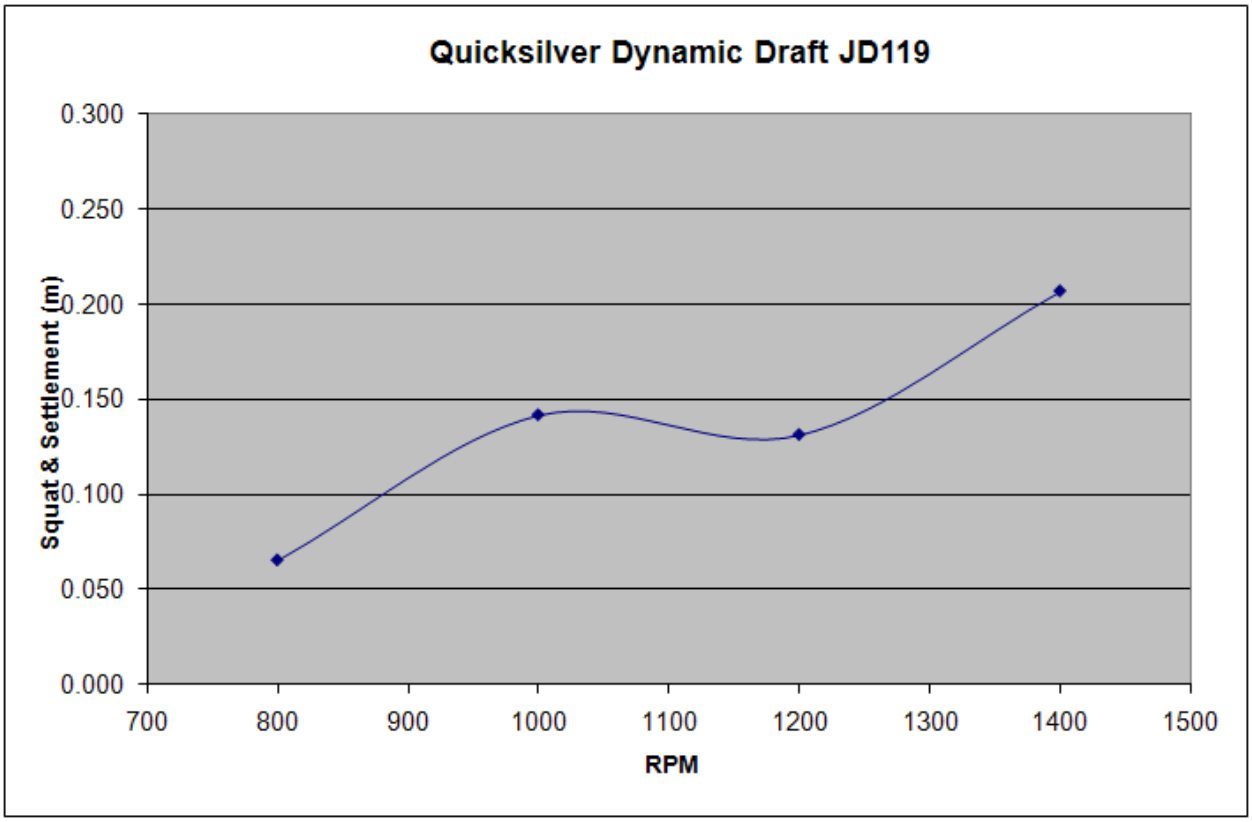


Figure 4 – Quicksilver Dynamic Draft

Table 5 – Quicksilver Squat Settlement Results

Quicksilver DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
5.9	800	0.065
6.5	900	0.103
7.1	1000	0.142
7.5	1100	0.136
7.9	1200	0.131
8.4	1300	0.169
8.8	1400	0.207

The squat settlement test for the R/V Quicksilver was conducted near Crescent City, CA. on April 29, 2009 (Julian Day 119).

STATIC DRAFT

Static draft was measured from tabs on both sides of the vessel, the average was taken, and then the correction to the common reference point was applied. The tables below show the static draft values measured for all vessels.

Table 6 - Draft Measurements for the F/V Pacific Star

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	252	9/8/2008	17:19	-1.76
2	253	9/9/2008	14:30	-1.80
3	255	9/11/2008	22:54	-1.88
4	258	9/14/2008	02:03	-1.94
5	259	9/15/2008	15:26	-1.73
6	259	9/15/2008	02:28	-1.99
7	260	9/16/2008	14:45	-1.79
8	260	9/16/2008	01:47	-1.77
9	261	9/17/2008	17:01	-1.74
10	262	9/18/2008	14:38	-1.77
11	263	9/19/2008	14:43	-1.85
12	263	9/19/2008	02:30	-1.79
13	264	9/20/2008	18:37	-2.08
14	265	9/21/2008	16:54	-2.08
15	265	9/21/2008	03:52	-2.08
16	266	9/22/2008	02:05	-2.09
17	267	9/23/2008	14:27	-2.08
18	268	9/24/2008	01:40	-2.11
19	270	9/26/2008	14:18	-2.07
20	271	9/27/2008	00:03	-1.99
21	272	9/28/2008	14:06	-2.13
22	275	10/1/2008	19:38	-2.08
23	278	10/4/2008	01:34	-2.08
24	280	10/6/2008	22:51	-2.04
25	280	10/6/2008	15:46	-2.09
26	281	10/7/2008	14:38	-1.96
27	282	10/8/2008	05:44	-2.02
28	286	10/12/2008	14:46	-1.88
29	287	10/13/2008	14:13	-1.99
31	288	10/14/2008	14:30	-1.87
32	289	10/15/2008	15:51	-1.93

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
33	289	10/15/2008	06:03	-1.90
34	290	10/16/2008	14:15	-1.81
35	291	10/17/2008	18:17	-1.82
36	292	10/18/2008	14:32	-1.82
37	293	10/19/2008	14:36	-1.78
38	294	10/20/2008	14:45	-1.87
39	298	10/24/2008	01:09	-1.92
40	298	10/24/2008	03:19	-2.09
41	299	10/25/2008	01:48	-2.04
42	301	10/27/2008	00:35	-1.90
43	302	10/28/2008	14:46	-1.91
44	303	10/29/2008	22:24	-1.89
45	303	10/29/2008	21:07	-1.86
46	308	11/3/2008	15:10	-1.83
47	309	11/4/2008	22:50	-1.87
48	310	11/5/2008	20:09	-1.87
49	312	11/7/2008	15:02	-1.89
50	313	11/8/2008	00:46	-1.89
51	315	11/10/2008	15:58	-1.86
52	316	11/11/2008	17:10	-1.88
53	317	11/12/2008	02:11	-2.04
54	322	11/17/2008	00:00	-2.00
55	324	11/19/2008	08:00	-1.93
56	325	11/20/2008	05:15	-1.90
57	357	12/21/2008	01:00	-1.96

Table 7 - Draft Measurements for the R/V R2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	254	9/10/2008	17:17	-0.28
2	255	9/11/2008	16:03	-0.24
3	256	9/12/2008	14:20	-0.25
4	257	9/13/2008	18:21	-0.24
5	258	9/14/2008	14:22	-0.27
6	259	9/15/2008	14:32	-0.25
7	261	9/17/2008	16:51	-0.26
8	262	9/18/2008	14:05	-0.28

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
9	263	9/19/2008	14:37	-0.28
10	264	9/20/2008	14:10	-0.27
11	265	9/21/2008	14:13	-0.3
12	266	9/22/2008	14:13	-0.27
13	267	9/23/2008	14:23	-0.28
14	268	9/24/2008	16:18	-0.23
15	270	9/26/2008	14:17	-0.26
16	271	9/27/2008	14:35	-0.26
17	272	9/28/2008	14:11	-0.27
18	272	9/28/2008	14:11	-0.27
19	273	9/29/2008	14:28	-0.27
20	275	10/1/2008	14:49	-0.21
21	275	10/1/2008	14:49	-0.21
22	279	10/5/2008	19:45	-0.22
23	279	10/5/2008	19:45	-0.22
24	280	10/6/2008	16:00	-0.22
25	280	10/6/2008	16:00	-0.22
26	281	10/7/2008	14:44	-0.23
27	281	10/7/2008	14:44	-0.23
28	287	10/13/2008	14:24	-0.22
29	288	10/14/2008	14:38	-0.22
30	289	10/15/2008	15:55	-0.23
31	290	10/16/2008	14:19	-0.24
32	291	10/17/2008	18:39	-0.23
33	292	10/18/2008	14:30	-0.25
34	293	10/19/2008	14:34	-0.24
35	294	10/20/2008	14:32	-0.23
36	295	10/21/2008	14:18	-0.21
37	297	10/23/2008	16:29	-0.23
38	298	10/24/2008	14:44	-0.29
39	300	10/26/2008	22:55	-0.22
40	302	10/28/2008	14:49	-0.23
41	302	10/28/2008	1:27	-0.24
42	303	10/29/2008	14:59	-0.22
43	304	10/30/2008	16:21	-0.23
44	312	11/7/2008	15:45	-0.23

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
45	318	11/13/2008	15:05	-0.21
46	319	11/14/2008	14:48	-0.21
47	320	11/15/2008	14:42	-0.2
48	321	11/16/2008	14:44	-0.21
49	322	11/17/2008	14:38	-0.21
50	323	11/18/2008	15:14	-0.23
51	324	11/19/2008	15:21	-0.19
52	326	11/21/2008	14:44	-0.2
53	327	11/22/2008	14:37	-0.2
54	328	11/23/2008	14:43	-0.2
55	329	11/24/2008	16:47	-0.2
56	337	12/2/2008	15:52	-0.19

Table 8 - Draft Measurements for the R/V D2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	253	9/9/2008	14:44	-0.21
2	258	9/14/2008	14:52	-0.13
3	259	9/15/2008	15:09	-0.19
4	260	9/16/2008	14:39	-0.19
5	261	9/17/2008	14:44	-0.17
6	262	9/18/2008	15:02	-0.18
7	263	9/19/2008	16:03	-0.18
8	264	9/20/2008	14:29	-0.19
9	265	9/21/2008	14:17	-0.17
10	266	9/22/2008	14:14	-0.18
12	268	9/24/2008	19:00	-0.21
13	270	9/26/2008	20:46	-0.21
14	271	9/27/2008	16:43	-0.21
15	272	9/28/2008	14:18	-0.19
16	275	10/1/2008	16:45	-0.19
17	279	10/5/2008	19:33	-0.18
18	280	10/6/2008	15:51	-0.20
19	281	10/7/2008	14:39	-0.18
20	286	10/12/2008	15:00	-0.18
22	288	10/14/2008	14:40	-0.18

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
23	289	10/15/2008	15:51	2.70
24	289	10/15/2008	06:03	2.73
25	289	10/15/2008	15:49	-0.19
26	290	10/16/2008	14:13	-0.19
27	291	10/17/2008	18:15	-0.18
28	292	10/18/2008	14:30	-0.19
29	293	10/19/2008	14:33	-0.18
30	294	10/20/2008	14:19	-0.19
31	295	10/21/2008	14:18	-0.19
32	296	10/22/2008	14:05	-0.20
33	297	10/23/2008	14:55	-0.20
34	298	10/24/2008	14:34	-0.20
35	300	10/26/2008	19:12	-0.22
36	301	10/27/2008	14:48	-0.21
37	302	10/28/2008	14:33	-0.23
38	303	10/29/2008	21:11	-0.22
39	304	10/30/2008	15:17	-0.22
40	312	11/7/2008	15:00	-0.22
41	315	11/10/2008	16:10	-0.22
42	316	11/11/2008	18:16	-0.22
43	318	11/13/2008	15:05	-0.23
44	319	11/14/2008	14:54	-0.23
45	320	11/15/2008	14:45	-0.23
46	321	11/16/2008	14:45	-0.23
47	322	11/17/2008	14:55	-0.21
48	323	11/18/2008	14:58	-0.23
49	324	11/19/2008	15:18	-0.19
51	326	11/21/2008	14:46	-0.22
52	327	11/22/2008	14:46	-0.20
53	328	11/23/2008	14:45	-0.19
54	329	11/24/2008	16:47	-0.15
55	329	11/24/2008	15:26	-0.24
56	337	12/2/2008	15:25	-0.20
57	342	12/7/2008	16:36	-0.20

Table 9 - Draft Measurements for the R/V Quicksilver

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	119	4/29/2009	14:04	-0.42
2	120	4/30/2009	15:02	-0.48
3	120	4/30/2009	2:48	-0.4
4	121	5/1/2009	14:41	-0.45
5	122	5/2/2009	14:22	-0.44
6	123	5/3/2009	14:15	-0.43
7	124	5/4/2009	14:10	-0.42
8	125	5/5/2009	14:00	-0.42
9	126	5/6/2009	15:29	-0.46
10	127	5/7/2009	14:15	-0.46
11	128	5/8/2009	14:17	-0.44
12	129	5/9/2009	14:01	-0.44
13	130	5/10/2009	13:50	-0.42
14	131	5/11/2009	14:01	-0.43
15	132	5/12/2009	15:32	-0.47
16	133	5/13/2009	14:25	-0.44
17	134	5/14/2009	14:03	-0.44
18	135	5/15/2009	13:56	-0.43
19	136	5/16/2009	14:01	-0.42
20	137	5/17/2009	15:37	-0.45
21	138	5/18/2009	14:00	-0.44
22	139	5/19/2009	14:02	-0.44
23	141	5/21/2009	14:16	-0.46
24	142	5/22/2009	14:15	-0.45
25	143	5/23/2009	14:56	-0.46
26	144	5/24/2009	14:33	-0.44
27	145	5/25/2009	14:26	-0.44
28	146	5/26/2009	14:35	-0.43
29	147	5/27/2009	14:37	-0.42
30	148	5/28/2009	14:22	-0.41
31	149	5/29/2009	14:18	-0.41
32	150	5/30/2009	14:12	-0.45
33	151	5/31/2009	14:35	-0.43
34	152	6/1/2009	16:20	-0.43
35	153	6/2/2009	14:00	-0.43
36	154	6/3/2009	14:28	-0.43
37	155	6/4/2009	14:00	-0.41

TIDES

All sounding data were initially reduced to MLLW using preliminary tidal data. Preliminary tides were used for preliminary processing only.

Final tidal corrections for this project were GPS-derived. POS files logged continuously during data acquisition on each vessel were post-processed using Applanix POSPac software with concurrent onshore dual-frequency base station data and/or precise timing and ephemeris files to create a smoothed best estimate of trajectory (SBET) file. The SBET was then loaded into each line in CARIS HIPS, replacing the real time GPS altitude with a post-processed GPS altitude. See the Horizontal and Vertical Control Report more for details concerning SBET generation.

The CARIS GPSTide function was then run on each line, computing tidal corrections by utilizing the GPS altitude, corrected for waterline offsets as well as vessel heave. This reduced the altitude to MLLW by use of NAD83 to MLLW offset grids produced by NOAA's VDatum software.

The CARIS GPSTide function works as follows:

GPSTide = GPS Height – Datum Height – Heave – Waterline Offset.

Where "GPS Height" is the altitude of the vessel reference point (RP) above NAD83 that has been loaded into each line from the SBET, "Datum Height" is the offset between NAD83 and MLLW as calculated by VDatum, "Heave" is the TrueHeave that has been loaded into each line, and "Waterline Offset" is the applicable offset between the RP and the waterline from the vessel configuration file.

Although heave and waterline offset measurements are not necessary to compute GPS Tide since altitudes of the sonar relative to a "fixed" surface (the NAD83 ellipsoid) are being calculated, they do need to be removed from the computed GPSTide as shown above since CARIS HIPS applied those corrections during sound velocity correction. Note that GPS Tide corrects for changes in sonar depth as a result of dynamic draft as well.

After GPS Tide was computed, all lines were then re-merged, selecting the merge option "Apply GPS Tide".

Tide station data were used only for comparison with the GPSTides. See each survey's Descriptive Report for specific results of the tide – GPSTide comparisons.

For more detail concerning the GPSTide method of tidal reduction see the Horizontal and Vertical Control Report.

VESSEL ATTITUDE: HEADING, HEAVE, PITCH, AND ROLL

Vessel heading and dynamic motion were measured by the Applanix POS MV 320 V4 on all vessels. The system calculated heading by inversing between two Trimble GPS generated antenna positions. An accelerometer block (the IMU), which measured vessel attitude, was mounted directly above the multibeam transducer. The operational accuracy specifications for this system, as documented by the manufacturer, are as follows:

Table 10 - POS MV Specifications

POS MV Accuracy	
Pitch and Roll	0.02°
Heading	0.02°
Heave	5% or 5-cm over 20 seconds

CALIBRATIONS

Multibeam

For all vessel and sonar configurations, patch tests were conducted to identify alignment errors (timing, pitch, heading, and roll) between the motion sensor and the multibeam transducer(s). Patch test calibration values used to correct all soundings for the survey are shown in Table 11.

Table 11 - Patch Test Results Summary

Vessel	Patch Test Day[1]	MB Sonar	Timing Error	Pitch Offset	Roll Offset	Azimuth Offset
Pacific Star	2008-234	7125 400 kHz (256 mode)	0.000	-1.300	-0.540	-0.640
	2008-282	7125 400 kHz (256 mode)	0.000	-1.250	-0.560	-3.00
	2008-234	7125 200 kHz (256 mode)	0.000	-1.310	-0.430	-0.970
	2008-282	7125 200 kHz (256 mode)	0.000	-1.280	-0.470	-3.20
	2008-235	8111	0.000	-0.700	-0.080	0.600
	2008-282	8111	0.000	-1.200	-0.080	-2.200
Pacific Star	2008-282	7125 400 kHz (256 mode)	0.000	-1.250	-0.560	-3.000
	2008-282	7125 200 kHz (256 mode)	0.000	-1.280	-0.470	-3.200
	2008-282	8111	0.000	-1.200	-0.080	-2.200
R2	2008-245	7125 400 kHz (256 mode)	0.000	0.910	0.490	-1.590
	2008-245	7125 200 kHz (256 mode)	0.000	2.050	0.580	-0.800
R2	2008-301	7125 400 kHz (256 mode)	0.000	0.910	0.340	-1.590
R2	2008-323	7125 400 kHz (256 mode)	0.000	1.350	0.890	-1.600
	2008-323	7125 200 kHz (256 mode)	0.000	0.900	0.970	-0.700
D2	2008-236	7125 400 kHz (256 mode)	0.000	1.990	1.090	1.850
D2	2008-244[2]	7125 400 kHz (256 mode)	0.000	0.990	1.430	0.850
D2	2008-257	8125	0.000	0.800	1.440	0.200
Quicksilver	2009-118	7125 400 kHz (256 mode)	0.000	-0.900	1.010	1.200
Quicksilver	2009-118	7125 200 kHz (256 mode)	0.000	-0.800	1.250	1.900

[1] Julian day the actual test was done is listed. May be pre-dated in CARIS HVF to cover lines run before patch test.
[2] D2 7125 sonar head was removed for troubleshooting, necessitating this re-patch.

Additional Sounding Techniques

None used.

D - Approval Sheet

Approval Sheet

For

H11980, H11981, & H11982

Standard field surveying and processing procedures were followed in producing this survey in accordance with the following documents:

M-L906-KR-08 Statement of Work
NOS Hydrographic Surveys Specifications and Deliverables, April 2008 Edition
Fugro Pelagos, Inc. Acquisition Procedures (2009-MBES_Acquisition_Procedures_R0);
Fugro Pelagos, Inc. Processing Procedures (2009-MBES_Processing_Procedures_R0)

The data were reviewed daily during acquisition and processing, and the survey is complete and adequate for its intended purpose.

This report has been reviewed and approved. All records are forwarded for final review and processing to the Chief, Pacific Hydrographic Branch.

Approved and forwarded,

Dean Moyles (ACSM Certificate N0. 226),
Lead Hydrographer
Fugro Pelagos, Inc. Survey Party
November 16, 2009

X Dean Moyles

Digitally signed by Dean Moyles
DN: cn=Dean Moyles, email=dmoyles@fugro.com, o=Fugro Pelagos, Inc., l=San Diego, CA
Date: 2009.11.16 14:56:53 -08'00'

Dean Moyles
ACSM Certified

Appendix I – Equipment List and Software Versions

Equipment

Table 12 - Equipment List (Pacific Star, R2 & D2)

Description	Ast_SerialNumber
AML SV PLUS VELOCITY PROBE (MVP)	7522
AML SV PLUS VELOCITY PROBE (MVP)	7523
AML SV PLUS VELOCITY PROBE 1000DBAR	4656
AML SV PLUS VELOCITY PROBE 1000DBAR	4703
AML SV PLUS VELOCITY PROBE 1000DBAR	4820
AML SV PLUS VELOCITY PROBE 1000DBAR	4966
AML SV PLUS VELOCITY PROBE 1000DBAR	5282
AML SV PLUS VELOCITY PROBE 1000DBAR	5283
AML SV PLUS VELOCITY PROBE 1000DBAR	5284
AML SV PLUS VELOCITY PROBE 1000DBAR	5353
AML SV PLUS VELOCITY PROBE 1000DBAR	5354
APPLANIX IMU 200	231
APPLANIX IMU 200	241
APPLANIX IMU 200	49
APPLANIX IMU 200	730
APPLANIX IMU 200	778
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2148
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2151
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2161
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2355
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2640
BROOKE OCEAN MVP-30 CONTROL I/O DECK UNIT	10597
BROOKE OCEAN MVP-30 SSFF (FISH)	10598
BROOKE OCEAN MVP-30 SSFF (FISH)	10599
BROOKE OCEAN MVP-30 TOW BLOCK	10596
BROOKE OCEAN MVP-30 WINCH	10595
COMPUTER DELL PC (PROCESSING)	1454KC1
COMPUTER DELL PC (PROCESSING)	21DFQB1
COMPUTER DELL PC (PROCESSING)	2454KC1
COMPUTER DELL PC (PROCESSING)	2FS5ZC1
COMPUTER DELL PC (PROCESSING)	4454KC1
COMPUTER DELL PC (PROCESSING)	6FS5ZC1
COMPUTER DELL PC (PROCESSING)	B354KC1
COMPUTER DELL PC (PROCESSING)	C86VP81

Description	Ast_SerialNumber
COMPUTER DELL PC (PROCESSING)	F354KC1
COMPUTER DELL PC (PROCESSING)	G354KC1
COMPUTER DELL PC (PROCESSING)	H354KC1
COMPUTER DELL PC (PROCESSING)	HDS5ZC1
COMPUTER RACKMOUNT (MVP)	874E50040A10050
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602498
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602562
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602564
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602603
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602604
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602606
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602607
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602608
DONGLE ARCGIS ARCVIEW (ESRI)	37114247-VIEW3
DONGLE ARCGIS ARCVIEW (ESRI)	37114247-VIEW4
DONGLE ARCGIS ARCVIEW (ESRI)	37150457
DONGLE ARCGIS ARCVIEW (ESRI)	37152209-VIEW1
DONGLE CARIS - NT (HIPS/SIPS)	CW9604665
DONGLE CARIS - NT (HIPS/SIPS)	CW9604705
DONGLE CARIS - NT (HIPS/SIPS)	CW9604869
DONGLE CARIS - NT (HIPS/SIPS)	CW9604871
DONGLE CARIS - NT (HIPS/SIPS)	CW9604872
DONGLE CARIS - NT (HIPS/SIPS)	CW9604873
DONGLE CARIS - NT (HIPS/SIPS)	CW9604894
DONGLE CARIS - NT (HIPS/SIPS)	CW9605328
DONGLE CARIS - NT (HIPS/SIPS)	CW9605663
DONGLE CARIS - NT (HIPS/SIPS)	CW9605666
DONGLE C-MAP	ET0002
DONGLE POS GPS	4096
DONGLE POS GPS	4375
DONGLE POS GPS	4915
DONGLE POS GPS	5049
DONGLE POS GPS	7346
DONGLE POS GPS	7347
DONGLE POS PAC	2061
DONGLE POS PAC	2110
DONGLE POS PAC	2220-870
DONGLE POS PAC	2257-865
DONGLE POS PAC	495-1740

Description	Ast_SerialNumber
DONGLE POS PAC	496-1734
DONGLE QT-MODELER	SRB10750
DONGLE WFMB	3100369U
DONGLE WFMB	3100375U
DONGLE WFMB	3100429U
DONGLE WFMB	3100433U
DONGLE WFMB	3100442U
ETHENET TELEMETRY , FROGLINK I/O	BGR602410
GENERATOR >3000W	EZGF-1194681
GPS ANTENNA L1/L2	12561426
GPS ANTENNA L1/L2	12561441
GPS ANTENNA L1/L2	12697293
GPS ANTENNA L1/L2	60001982
GPS ANTENNA L1/L2	60008160
GPS ANTENNA L1/L2	60124972
GPS ANTENNA L1/L2	60125052
GPS ANTENNA L1/L2	60125232
GPS ANTENNA L1/L2	60186871
GPS ANTENNA L1/L2	60187495
GPS ANTENNA L1/L2 STARFIX SPOT	189
GPS ANTENNA L1/L2 STARFIX SPOT	190
GPS ANTENNA L1/L2 STARFIX SPOT	191
GPS ANTENNA L1/L2 STARFIX SPOT	30220334
GPS ANTENNA L1/L2 STARFIX SPOT	BGR602321
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200047
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200049
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420009
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420011
GPS BEACON ANTENNA CSI MBL-3	0037-7035-0002
GPS BEACON ANTENNA CSI MBL-3	9827-1866-0004
GPS BEACON ANTENNA CSI MBL-3	9834-2211-0003
GPS BEACON ANTENNA CSI MBL-3	9845-2643-0001
GPS CSI CDA ANTENNA	0634-31116-0022
GPS CSI CDA ANTENNA	0640-31662-0017
GPS CSI CDA ANTENNA	0640-31662-0020
GPS CSI CDA ANTENNA	0748-5628-0078
GPS CSI CDA ANTENNA	0748-5628-0160
GPS CSI CDA ANTENNA	0748-5628-0162
GPS CSI MBX-3 COASTGUARD RECEIVER	0042-7227-0001

Description	Ast_SerialNumber
GPS CSI MBX-3 COASTGUARD RECEIVER	0314-11467-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9827-1866-0002
GPS CSI MBX-3 COASTGUARD RECEIVER	9833-2166-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0002
GPS CSI MBX-3 COASTGUARD RECEIVER	9913-3442-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9920-3754-0001
GPS RECEIVER L1/L2 STARFIX XP/HP	0225108640
GPS RECEIVER L1/L2 STARFIX XP/HP	0225108XXX
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07080024
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120002
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120004
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120016
GPS RECEIVER L1/L2 STARFIX XP/HP	NBVO7080003
LAPTOP PC	BH5GD81
LAPTOP PC	GH4GD81
LAPTOP PC	hb2pbg1
NETWORK ATTACHED STORAGE	30012668
NETWORK ATTACHED STORAGE	30012669
NETWORK ATTACHED STORAGE	NA0000000413215
NETWORK ATTACHED STORAGE	SHU444430019825
NETWORK ATTACHED STORAGE (SMART) NETAPP 3050	JW0000000071173
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1229U620
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1234U1WQ
PLOTTER A0 75X	SG12M2205X
PRINTER COLOR INKJET	sg17k8300pdh
PRINTER LASER	CNJC84X04G
PRISM	BGR602576
PRISM	BGR602578
PRISM	BGR602594
RESON NAVISOUND SVP 70	2007073
RESON NAVISOUND SVP 70	4506001
RESON SEABAT 7125 200KHZ PROJECTOR	0408003
RESON SEABAT 7125 200KHZ PROJECTOR	2506008
RESON SEABAT 7125 200KHZ PROJECTOR	2506015
RESON SEABAT 7125 200KHZ PROJECTOR	4605048
RESON SEABAT 7125 400KHZ PROJECTOR	5006392
RESON SEABAT 7125 400KHZ PROJECTOR	5006396
RESON SEABAT 7125 RECEIVE ARRAY	2507038

Description	Ast_SerialNumber
RESON SEABAT 7125 RECEIVE ARRAY	4107007
RESON SEABAT 71-P LCU	1515004
RESON SEABAT 71-P LCU	1515008
RESON SEABAT 71-P PROCESSOR	4707082
RESON SEABAT 71-P PROCESSOR	4707090
RESON SEABAT 8111 RECEIVER ARRAY	3402015
RESON SEABAT 8111 TRANSCEIVER	23745
RESON SEABAT 8111 TRANSCEIVER	37157
RESON SEABAT 8111 TRANSMIT ARRAY	2104019
RESON SEABAT 8125 TRANSDUCER	0802100
RESON SEABAT OVERSIDE MOUNT (SMALL)	121945
RESON SEABAT PROCESSOR RESON 81-P	23279
RESON SEABAT PROCESSOR RESON 81-P	34545
RESON SEABAT PROCESSOR RESON 81-P	36746
RESON SVP-C TOPSIDE (8125)	74548
SLIP RING IEC	3259-0601
SLIP RING IEC	4101-1297-0702
SLIP RING IEC	4103-0000-0702
SLIP RING IEC	9-25-87-K714
TOTAL STATION SOKKIA	D21828
TRIBRACH	BGR124179
TRIBRACH	BGR124180
TRIBRACH	BGR602073
TRIBRACH	BGR602584
WINCH HYDRAULIC MEDIUM / SMALL TOW	BGR122174

Table 13 - Equipment List (Quicksilver)

Description	Ast_SerialNumber
GPS ANTENNA L1/L2 NOVATEL GPS-702L	NZT070200047
GPS ANTENNA L1/L2 NOVATEL GPS-702L	NZT07420009
GPS ANTENNA L1/L2 NOVATEL GPS-702L	NZT070200049
GPS ANTENNA L1/L2 NOVATEL GPS-702L	NVH06140007
GPS ANTENNA L1/L2 NOVATEL GPS-702L	NZT07420011
GPS RECEIVER L1/L2 STAFIX XP/HP NOVATEL DL-V3-L1L2	NBV07080024
GPS RECEIVER L1/L2 STAFIX XP/HP NOVATEL DL-V3-L1L2	NBV07120016
GPS RECEIVER L1/L2 STAFIX XP/HP NOVATEL DL-V3-L1L2	NBV07120002
GPS RECEIVER L1/L2 STAFIX XP/HP NOVATEL DL-V3-L1L2	NBVO7080003
GPS RECEIVER L1/L2 STAFIX XP/HP NOVATEL DL-V3-L1L2	NBV08200008
GPS COASTGUARD RECEIVER CSI MBX-3	9830-2023-0001

Description	Ast_SerialNumber
GPS COASTGUARD RECEIVER CSI MBX-3	9834-2211-0001
GPS COASTGUARD RECEIVER CSI MBX-3	9827-1866-0002
GPS CSI CDA ANTENNA HEMISPHERE A30	0748-5628-0078
GPS CSI CDA ANTENNA HEMISPHERE A30	0748-5628-0162
INMARSAT PHONE IRIDIUM 9505A	IMEI:30021401020730
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602489
COMPUTER RACKMOUNT PC (FPI-ACQUISITION) XFX nForce 790I	BGR602607
COMPUTER RACKMOUNT PC (FPI-ACQUISITION) XFX nForce 790I	BGR602603
COMPUTER RACKMOUNT PC (FPI-ACQUISITION) XFX nForce 790I	BGR602605
COMPUTER RACKMOUNT PC (FPI-ACQUISITION) XFX nForce 790I	BGR602606
DONGLE WINFROG DESKEY USB	3100369U
MONITOR FLATSCREEN (1600X1200) LCD NEC LCD2070VX 20"	s7y301936ga
MONITOR FLATSCREEN (1600X1200) LCD NEC LCD2070VX 20"	s82303877ga
MONITOR FLATSCREEN (1600X1200) LCD NEC LCD2070VX 20"	s7y301909ga
MONITOR FLATSCREEN (1600X1200) LCD NEC LCD2070VX 20"	s82303874ga
MONITOR FLATSCREEN (1600X1200) LCD NEC LCD2070VX 20"	s7y301969ga
MONITOR FLATSCREEN (1600X1200) LCD NEC LCD2070VX 20"	s82303879ga
MONITOR FLATSCREEN (1920X1200) LCD NEC LCD24WCMX 24"	87106354NA
MONITOR FLATSCREEN (1920X1200) LCD NEC LCD24WCMX 24"	84104171NA
MONITOR FLATSCREEN (1920X1200) LCD NEC LCD24WCMX 24"	S84103940NA
MONITOR FLATSCREEN (1920X1200) LCD NEC LCD24WCMX 24"	S81103186NA
DONGLE ARCINFO RAINBOW SUPERPRO (USB DONGLE) ARCINFO	37150457
DONGLE CARIS - NT HASP USB DONGLE	CW9604873
DONGLE POS GNSS V5.1	7347
DONGLE POS PAC V5.1 MMS	496-1734
LAPTOP PC DELL INSPIRON B120	GH4GD81
LAPTOP PC DELL INSPIRON B120	1G4GD81
LAPTOP PC DELL LATITUDE D800	4WJ4R51
TOOL KIT FPI STANDARD TOOL KIT	
TOOL KIT, FPI STANDARD MOBILIZATION KIT	BGR602766
TOOL KIT, POWER TOOLS, DEWALT POWER TOOLS	BGR602841
TOOL KIT,FPI STANDARD ELECTRICAL KIT	BGR602764
UW COLOUR CAMERA TOWED VIDEO, Lights Camera Action, 7705-CW-25	v08b00647ntsc
UW COLOUR CAMERA TOWED VIDEO, Lights Camera Action, 7705-CW-25	v08b00648ntsc
DATA RADIO CELLULAR GATEWAY GLOBESURFER	gp2992n027
ETHENET TELEMETRY , FROGLINK I/O	
ETHENET TELEMETRY , FROGLINK I/O	
AML SV PLUS VELOCITY PROBE (MVP) AML SV&P 200dbar Applied Microsystems	7523
BROOKE OCEAN MVP-30 BLOCK MVP-30-HOS-2 ODIM BROOKE OCEAN	10596

Description	Ast_SerialNumber
BROOKE OCEAN MVP-30 CONTROL I/O DECK UNIT MVP-CJ-30-1 ODIM	10597
BROOKE OCEAN MVP-30 SSFF (FISH) BROOKE OCEAN MVP-FFF-SS-12-3	10598
BROOKE OCEAN MVP-30 WINCH MVP-3--2 ODIM BROOKE OCEAN	10595
PRISM PEANUT CST	BGR602578
PRISM PEANUT CST	BGR602576
TOTAL STATION SOKKIA SET 600	D21828
TRIBRACH GDF112 LEICA	BGR602584
TRIBRACH LEICA GDF 112	BGR124179
tripod 60-WDW20HV CST SERVCO	BGR602571
tripod 60-WDW20HV CST SERVCO	BGR602566
tripod 60-WDW20HV CST SERVCO	BGR602568
APPLANIX IMU 200 APPLANIX LN200	241
GPS ANTENNA L1/L2 TRIMBLE ZEPHYR GEODETIC ANTENNA 39105-00 DC 4703 LI/L2	60008160
GPS ANTENNA L1/L2 TRIMBLE ZEPHYR GEODETIC ANTENNA 39105-00 DC 4703 LI/L2	60001982
GPS INERTIAL SYSTEM APPLANIX POS MV329 PROCESSOR L1/L2	2161
GPS INERTIAL SYSTEM APPLANIX POS MV329 PROCESSOR L1/L2	2640
GENERATOR >3000W HONDA EU3000	EZGF-1194681
UPS UNIT > 3KVA TRIPP-LITE SMART1500LCD	9721BY0SM678800096
UPS UNIT > 3KVA TRIPP-LITE SMART1500LCD	9721BY0SM678800227
UPS UNIT > 3KVA TRIPPLITE SMART3000RM2U	9642ALCSM653400132
UPS UNIT > 3KVA TRIPPLITE SMART3000RM2U	9642ALCSM653400131
RESON 71-P PROCESSOR RESON 7125	4707082
RESON NAVISOUND SVP 70 RESON EM 7211	4506001
RESON SEABAT 7125 200KHZ PROJECTOR	4408352
RESON SEABAT 7125 400KHZ PROJECTOR RESON TC 2160	5006392
RESON SEABAT 7125 RECEIVE ARRAY RESON EM 7200	4107007
RESON SEABAT 71-P LCU RESON	1515008
AML SV PLUS VELOCITY PROBE 1000DBAR AML SV&P	5385
AML SV PLUS VELOCITY PROBE 1000DBAR AML SV&P	4966
AML SV PLUS VELOCITY PROBE 1000DBAR AML SV&P	5284
SLIP RING IEC (Modified for Impulse Connector)	4101-1297-0702

Software

Fugro Pelagos WFMB v3.08.23
Fugro Pelagos WFMB v3.08.44.04
Fugro Pelagos MBSurvey Tools v2.00.20.00
Fugro Pelagos PosMvLogger v1.0
CARIS HIPS/SIPS v6.1 (w/ Service Pack 2, Hotfixes 1-8)
CARIS HIPS/SIPS v7.0 (w/ Hotfixes 1-5)
CARIS Notebook v3.1 (w/Hotfix 1)
ESRI ArcGIS v9.3
Applanix POS MV V4 Controller v3
Applanix POSPac MMS 5.2 (w/ Service Pack 1)
IVS Fledermaus v6.7.0
NOAA Chart Re-projector v2.0
Nobeltec Tides and Currents v3.5.107
Microsoft Office 2007 Professional
Microsoft Windows XP Professional (w/ Service Pack 3)
Helios Software Solutions TextPad v5.2.0
IrfanView v3.98

Appendix II – Vessel Descriptions

F/V Pacific Star

The F/V Pacific Star (Figure 5), a former Bering Sea crab fishing vessel, was modified to accommodate a survey crew, acquisition hardware, and survey launches. Living quarters and office space containers were installed on the back deck. Davits previously used on the R/V Davidson were installed near the aft end of the vessel to lift and deploy the R2 and D2 survey launches. Access doors and infrastructure were built to facilitate access to the launches.

Reson Seabat 7125 and 8111 multibeam sonars were hull mounted near the best estimate of the vessel's center of gravity, approximately midship. A drop keel was attached to the keel and protected the sonar heads forward by a crescent shaped skid (Figure 8). The inertial measurement unit (IMU) accelerometer package for a POS MV was installed inside the hull almost directly above the Reson 7125.

Table 14 - Vessel Specifications (Pacific Star)

F/V PACIFIC STAR	
Owner	Pacific Star Fisheries, LLC
Official Number	556510
Length	162'
Breadth	38'
Depth	14'
Max Draft	16'
BHP Main Engines	3,000 combined BHP (1500 ea) Two Electromotive Diesels
Gross Tonnage (US)	194
Fresh Water Capacity	24,399 Gallons
Fuel Capacity	90,112 Gallons

Figure 5 – F/V Pacific Star

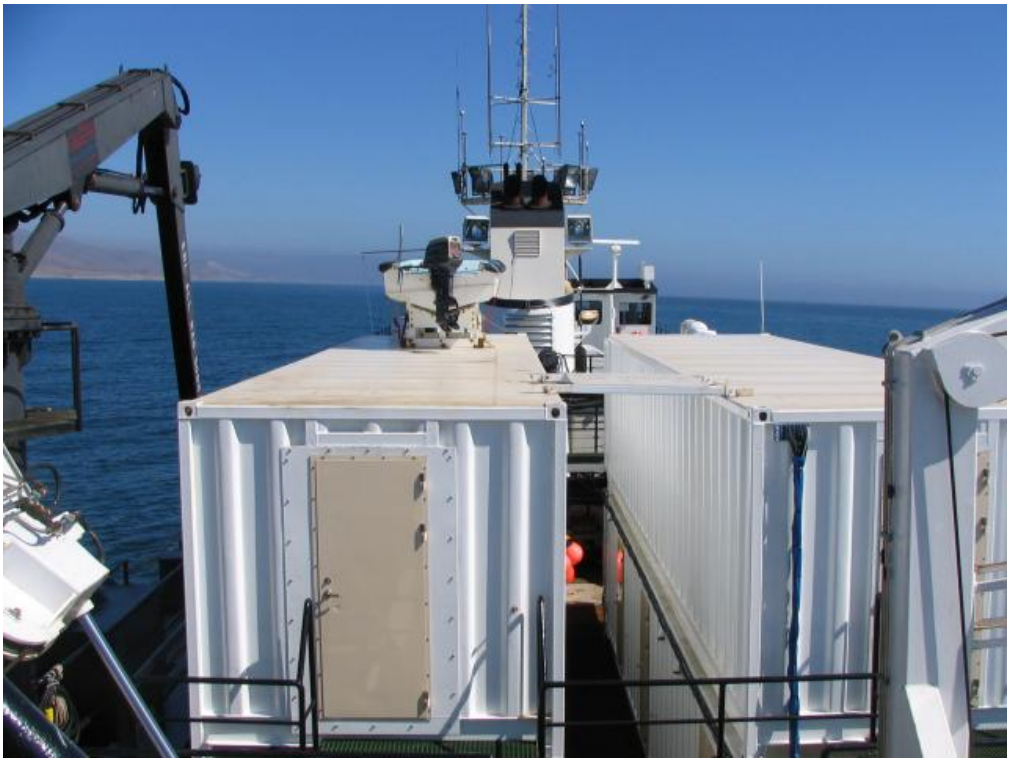


Figure 6 – F/V Pacific Star Office Containers

Figure 7 – F/V Pacific Star Davit Launch System

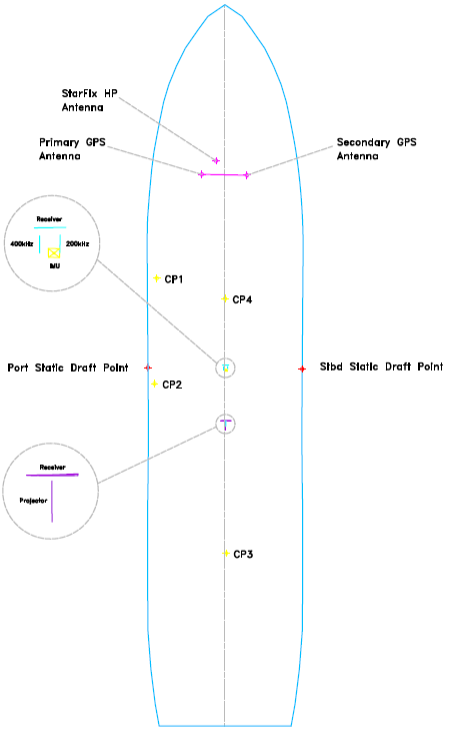
Figure 8 – F/V Pacific Star Drop Keel with 7125 and 8111 Sonar Heads

Two Trimble L1/L2 antennas were mounted above and forward from the sonars on the vessel radio mast. Offset 3.4 meters port-starboard from each other, these provided GPS data to the POS MV for position, attitude, and heading computations. The port side antenna functioned as the POS MV master antenna; the starboard side antenna functioned as the POS MV secondary.

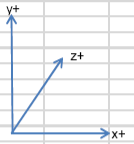
A Brooks Ocean MVP-30 system using an AML Smart Probe was installed and used off the stern to collect sound velocity profiles in shallow water. An AML Smart Probe with a standard winch setup was used off the stern for deeper water and as a backup to the MVP-30.

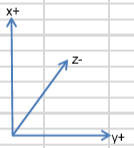
Draft measurement tabs were installed at convenient measurement stations on both the port and starboard sides of the vessel, in line with the CRP and Reson 7125.

Offset values for the CRP to the sonar and waterline were applied to the data in CARIS HIPS as specified in the HIPS vessel file (HVF). Offsets between the GPS antennas and the CRP were applied internally by the POS MV by entering a GPS lever arm offset. Vessel offsets used are shown in the offset diagram (Figure 9).



"Pacific Star" Offsets Table	**Distances in meters		
Cartesian Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-1.813	14.426	14.608
Stbd GPS Antenna (Sec)	1.511	14.367	14.630
StarFix HP Antenna	-0.761	15.429	14.655
Port Static Draft Point	-5.785	0.192	5.941
Stbd Static Draft Point	5.589	0.090	5.939
Control Point 1	-5.132	6.783	5.731
Control Point 2	-5.297	-0.987	5.763
Control Point 3	-0.026	-13.486	3.227
Control Point 4	-0.099	5.275	3.205
Reson 7125			
Acoustic Reference Point (400kHz)	-0.212	0.131	-2.470
Acoustic Reference Point (200kHz)	0.088	0.137	-2.465
Reson 8111			
Acoustic Reference Point	-0.046	-4.114	-2.155
POSMV Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	14.426	-1.813	-14.608
Stbd GPS Antenna (Sec)	14.367	1.511	-14.630
StarFix HP Antenna	15.429	-0.761	-14.655
Port Static Draft Point	0.192	-5.785	-5.941
Stbd Static Draft Point	0.090	5.589	-5.939
Control Point 1	6.783	-5.132	-5.731
Control Point 2	-0.987	-5.297	-5.763
Control Point 3	-13.486	-0.026	-3.227
Control Point 4	5.275	-0.099	-3.205
Reson 7125			
Acoustic Reference Point (400kHz)	0.131	-0.212	2.470
Acoustic Reference Point (200kHz)	0.137	0.088	2.465
Reson 8111			
Acoustic Reference Point	-4.114	-0.046	2.155





2008-08-01

Figure 9 - Pacific Star Offset Diagram

R/V R2

The R/V R2 (Figure 10), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and a Reson 7125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by way of a crescent shaped skid. The accelerometer package for a POS MV was mounted in the hull of the vessel just over the 7125 multibeam transducer head.

Two Trimble L1/L2 antennas were mounted above the 7125 and accelerometer for positioning and heading (Figure 11). The two POS MV antennas were offset 1.0m to the port and starboard. The port side antenna (L1/L2) functioned as the POS MV master antenna; the starboard side antenna functioned as the POS MV secondary.

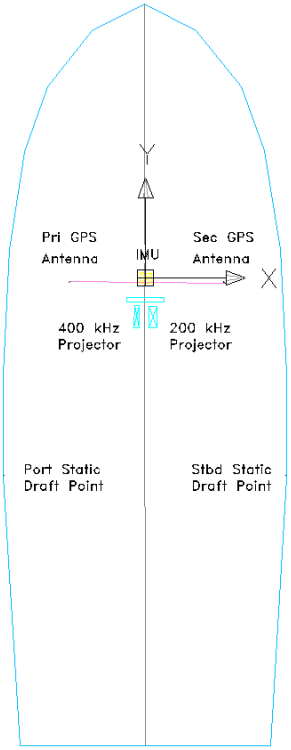
The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

Offset values were applied to the data in CARIS HIPS as specified in the HIPS Vessel File (HVF). Vessel offsets used are shown in the offset diagram (Figure 10). Note that the HVF does not contain navigation offsets because the position provided by the POS MV is already corrected to the CRP.

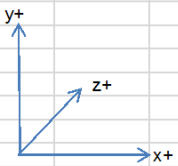
Table 15 - Vessel Specifications (R2)

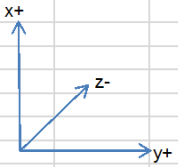
R/V R2	
Owner	Stabbert Maritime Yacht & Ship
Official Number	623241
Year Built	1980/1982
Length	28.9 ’
Breadth	12’
Max Draft	5.7’
Gross Ton	15
Net Ton	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights

Figure 10 - R/V R2



"R2" Offsets Table	**Distances in meters		
Cartesian Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.980	-0.037	3.054
Stbd GPS Antenna (Sec)	1.022	-0.066	3.027
Port Static Draft Point	-1.831	-2.539	1.388
Stbd Static Draft Point	1.802	-2.539	1.341
Acoustic Reference Point (400kHz)	-0.120	-0.495	-0.679
Acoustic Reference Point (200kHz)	0.092	-0.499	-0.683
POSMV Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.037	-0.980	-3.054
Stbd GPS Antenna (Sec)	-0.066	1.022	-3.027
Port Static Draft Point	-2.539	-1.831	-1.388
Stbd Static Draft Point	-2.539	1.802	-1.341
Acoustic Reference Point (400kHz)	-0.495	-0.120	0.679
Acoustic Reference Point (200kHz)	-0.499	0.092	0.683





2008-08-07

Figure 11 - R2 Offset Diagram

R/V D2

The R/V D2 (Figure 12), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and Reson 7125 multibeam sonar was installed A conical cowling protected the sonar head forward and aft by way of a crescent shaped skid. The accelerometer package for a POS MV was mounted in the hull of the vessel just over the 7125 multibeam transducer head.

Note: On JD253 D2 struck a rock near the entrance to Crescent City and the Reson 7125 was replaced with a Reson 8125.

Two Trimble L1/L2 antennas were mounted above the 7125/8125 and accelerometer for positioning and heading (Figure 13). The two POS MV antennas were offset 1.0m to the port and starboard from the IMU. The port side antenna (L1/L2) functioned as the POS MV master antenna; the starboard side antenna functioned as the POS MV secondary.

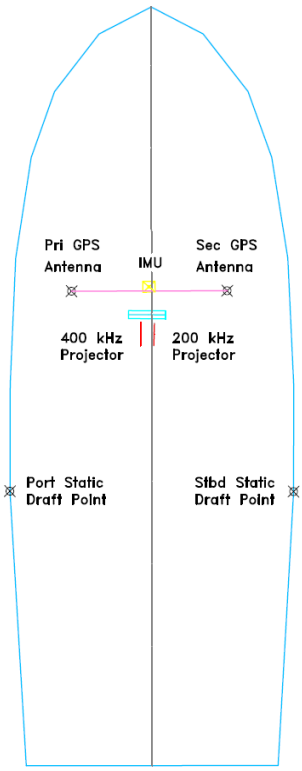
The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

Offset values were applied to the data in CARIS HIPS as specified in the HIPS Vessel File (HVF). Vessel offsets used are shown in the offset diagram (Figure 12). Note that the HVF does not contain navigation offsets because the position provided by the POS MV is already corrected to the CRP.

Figure 12 - R/V D2

Table 16 - Vessel Specifications (D2)

R/V D2	
Owner	Stabbert Maritime Yacht & Ship
Official Number	647782
Year Built	1980/1982
Length	28.9 ’
Breadth	12’
Max Draft	5.7’
Gross Ton	15
Net Ton	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights



"D2" Offsets Table	**Distances in meters		
Cartesian Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.995	-0.055	3.077
Stbd GPS Antenna (Sec)	1.006	-0.049	3.052
Port Static Draft Point	-1.786	-2.570	1.339
Stbd Static Draft Point	1.860	-2.575	1.280
Acoustic Reference Point (400kHz)	-0.105	-0.597	-0.741
Acoustic Reference Point (200kHz)	0.066	-0.601	-0.745
Acoustic Reference Point (8125)*	0.006	-0.765	-0.720
POSMV Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.055	-0.995	-3.077
Stbd GPS Antenna (Sec)	-0.049	1.006	-3.052
Port Static Draft Point	-2.570	-1.786	-1.339
Stbd Static Draft Point	-2.575	1.860	-1.280
Acoustic Reference Point (400kHz)	-0.597	-0.105	0.741
Acoustic Reference Point (200kHz)	-0.601	0.066	0.745
Acoustic Reference Point (8125)*	-0.765	0.006	0.720
* Added Sept. 14/2008			

2008–07–25

Figure 13 - D2 Offset Diagram

R/V Quicksilver

The R/V Quicksilver (Figure 14) was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and Reson 7125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by a crescent shaped skid. The accelerometer package for a POS/MV was mounted in the hull of the vessel just over the 7125 multibeam transducer head.

Two Trimble L1/L 2 antennas were mounted above the 7125 and accelerometer for positioning and heading (Figure 14). The port side antenna (L1/L2) functioned as the POS/MV master antenna; the starboard side antenna functioned as the POS/MV secondary.

A Brooks Ocean MVP-30 system using an AML Smart Probe was installed and used off the stern to collect sound velocity profiles in shallow water, but for safety reasons (crab pots) was never deployed. The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

Offset values were applied to the data in CARIS HIPS as specified in the HIPS Vessel File (HVF). Vessel offsets used are shown in the following table. Note that the HVF does not contain navigation offsets because the position provided by the POS/MV is already corrected to the CRP.

Table 17 - Vessel Specifications (Pacific Star)

R/V QUICKSILVER	
Owner	Marcus Ballweber
Official Number	947419
Year Built	1989
Length	32’
Breadth	15.5’
Max Draft	3’
Gross Ton	28
Net Ton	15
Mechanical Power	860 hp
Electrical	5kW

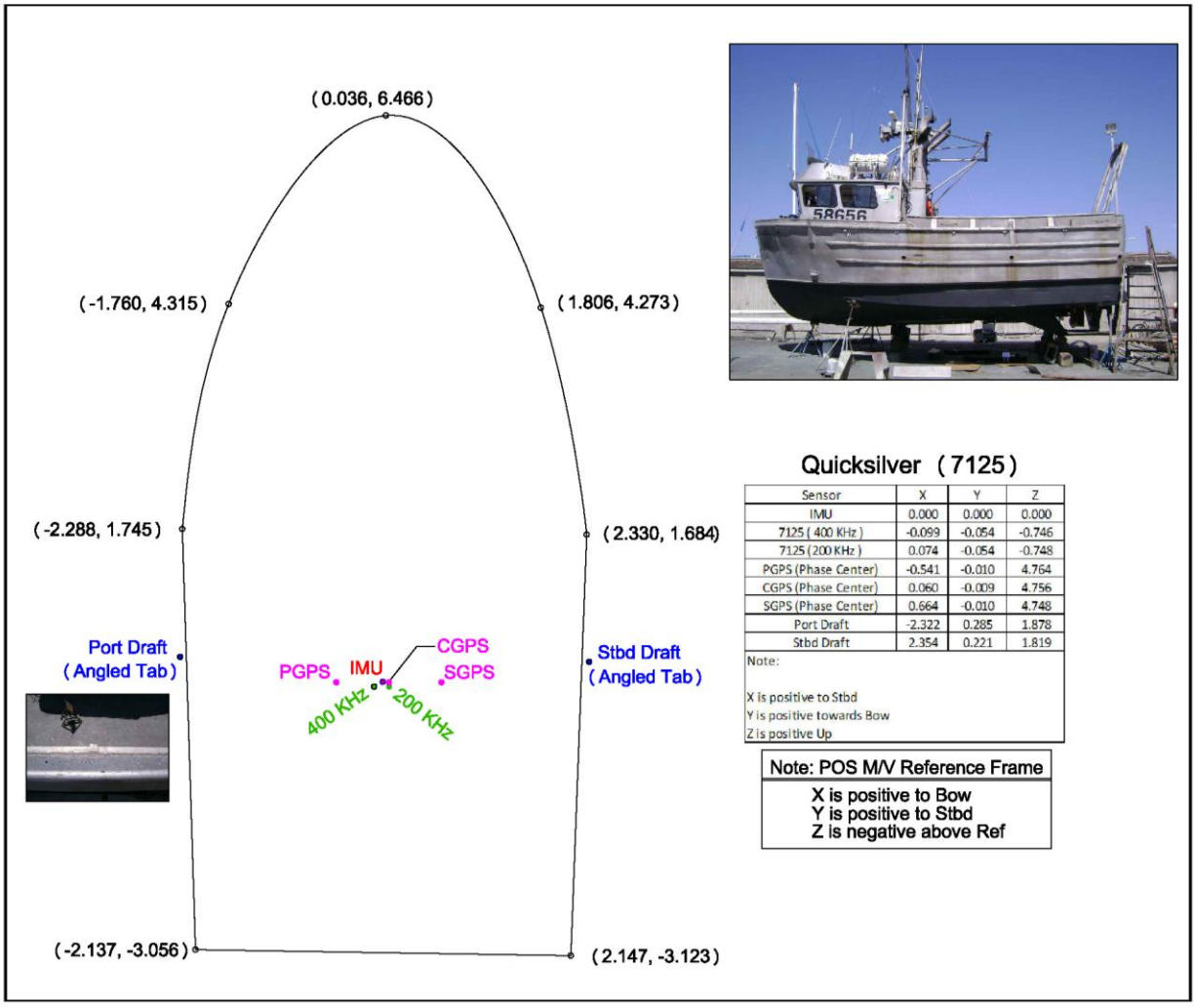


Figure 14 - Quicksilver Offset Diagram

Appendix III – Calibration Reports

All Calibration Reports can be found under the Appendix_III (SVP_Calibrations) directory.