

W00126-W00128

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. W00126 - W00128

LOCALITY

State California

General Locality San Francisco Bay

Sublocality From sea buoy east & south to 37°45.48'N

2002

CHIEF OF PARTY

..... David Somers, Mike Q. Smith

LIBRARY & ARCHIVES

DATE

HYDROGRAPHIC TITLE SHEET

W00126-W00128

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 San Francisco Bay

Sublocality From sea buoy east and south to 37°45.48'N

Scale 1:10,000

Date of Survey 4/25/2002 -6/17/2002

Instructions Dated N/A

Project No. _____

Vessel USNS JOHN D. MCDONNELL, Survey Launches HSL013 and HSL014

Chief of Party David Somers, Mike Q. Smith

Surveyed by U.S. Naval Oceanographic Office

Soundings taken by echo sounder, hand lead, pole Simrad 1002, Simrad 3000

Graphic record scaled by Fleet Survey Team

Graphic record checked by Fleet Survey Team

Evaluation by Kurt Brown Automated plot by HP Designjet1050c

Verification by Physical Scientist: K. Brown, Cartographer: B. Taylor

Soundings in meters at MLLW

REMARKS: Revisions and annotations appearing as endnotes were

generated by the cartographer during office processing.

All depths listed in this report are referenced to

mean lower low water unless otherwise noted.

UTM Zone 10



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF COAST SURVEY
Pacific Hydrographic Branch
Seattle, Washington 98115-6349

December 12, 2008

MEMORANDUM TO: Captain David Neander, NOAA
Chief, Pacific Hydrographic Branch

FROM: Kurt Brown, NOAA
Physical Scientist, PHB

SUBJECT: Review of Outside Source Data Survey W00126-W00128
US Naval Oceanographic Office (NAVOCEANO)
San Francisco Bay

I have reviewed outside source hydrographic survey W00126-W00128 with regard to data integrity and completeness of the data submission package, survey field procedures, data processing and quality assurance methods, and overall data accuracy and data quality. Survey W00126-W00128 does not comply with specifications and requirements set forth in the NOS Hydrographic Surveys Specifications and Deliverables Manual (HSSDM), for the following reasons:¹

- Incomplete or inadequate documentation on survey methods, vessels, and data processing does not allow for a full survey Quality Assurance Review.
- SSS data collected with this survey was not submitted and therefore could not be used to verify full bottom coverage.
- Data were supplied to PHB in gridded ASCII .xyz and Fledermaus formats, which cannot be opened in Caris HIPS and SIPS. Data were reviewed in Fledermaus and Mapinfo. Full resolution data, as defined in HSSDM 8.5.3, were not supplied.
- Tidal, sound velocity, metadata and vessel configuration files were not submitted in accordance with HSSDM 8.5.5

Special attention should be given to the following:

- Refer to the Hydrographic Survey Outside Source Data Quality Assurance Checklist² for specific charting recommendations.³
- Bottom Samples are included in an Excel file located in the Ancillary folder.⁴

Final Recommendations:

- The data should only be used to chart soundings and depth curves representing general bathymetric trends, and update shoals that are not adequately depicted on NOAA charts 18640, 18645, 18649, and 18650.⁵
- The data should not be used to supersede near shore features such as wrecks, rocks, obstructions, foul areas or coral reefs.⁶
- The charted shoreline should be retained as charted.⁷



- As full bottom coverage and object detection requirements could not be verified in the office, the survey area should be classified as Category of Zone of Confidence (CATZOC) “B” if used to update ENC survey area classification.⁸

Revisions compiled during office processing by the cartographer

¹ Concur.

² Attached to this report.

³ For charting recommendations, also see W00126_W00128_ChartComparison.doc, attached to this report.

⁴ Attached to this report. Bottom samples were not depicted on the smooth sheet, but are shown on the Hdrawing. Grab 20 did not acquire a sample (see spreadsheet). Grab 16 was too close to Grab 14 for charting at scale. Chart remaining bottom samples as depicted on the Hdrawing.

⁵ Concur.

⁶ Concur with clarification. The survey found shoaler depths than charted for several features. Chart shoaler surveyed depths as shown on the Hdrawing. Do not supersede charted shoal soundings and contours.

⁷ Concur.

⁸ Concur. Do not supersede charted shoal soundings and contours.



UNITED STATES DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

NATIONAL OCEAN SERVICE OFFICE OF COAST SURVEY

Pacific Hydrographic Branch Seattle, Washington

98115-6349

April 2, 2009

MEMORANDUM TO: Captain David O. Neander
Chief, Pacific Hydrographic Branch

FROM: Beth Taylor
Cartographer, Pacific Hydrographic Branch

SUBJECT: Application of Outside Source Data Survey W00126-
W00128
Naval Oceanographic Office
Multibeam Echosounder Survey in San Francisco Bay

I concur with all recommendations by the reviewer Kurt Brown except where noted in this report.

Summary of compilation:

- soundings, curves and features applied
- no rocks, shoals were superseded
- shoreline was retained as charted
- bottom characteristics were retained
- no aids to navigation were positioned in survey area.
- no additional Dangers to Navigation were found during compilation.

It is recommended that OSD survey W00126-W00128 selectively supersede charted information within the common area and that it be applied to charts 18640, 18645, 18649, and 18650.

Record of Application to Charts is attached.

Review and Approved _____

Gary Nelson, Cartographer Team Leader
Pacific Hydrographic Branch



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF COAST SURVEY
Pacific Hydrographic Branch
Seattle, Washington 98115-6349

April 14, 2009

MEMORANDUM TO: Captain John E. Lowell, NOAA
Chief, Marine Chart Division

THROUGH: Jeffrey Ferguson
Chief, Hydrographic Surveys Division

FROM: Captain David O. Neander, NOAA
Chief, Pacific Hydrographic Branch

SUBJECT: Approval Memorandum for W00126-W00128
San Francisco Bay, California

The Pacific Hydrographic Branch has completed an evaluation and chart application of Outside Source Data from the Naval Oceanographic Office (W00126 – W00128). These surveys were conducted as Homeland Defense Surveys, and directly supported a Mine Warfare requirement. The primary mission was to collect side scan sonar imagery, with shallow water multibeam as ancillary data. Side scan data was considered classified and was not submitted for evaluation.

I have reviewed the data, reports and compilation to the chart. Incomplete documentation on survey methods, applied correctors, vessel configurations and data processing procedures does not allow for a comprehensive Quality Assurance Review. Thus, data has only been used to chart soundings and depth curves representing general bathymetric trends and to update charted shoal depths. Data from W00126 - W00128 were not used to supersede shoaler charted soundings and features.

Within the 2008 NOAA Hydrographic Survey Priorities (NHSP), portions of San Francisco Bay which coincide with surveys W00126 – W00128 are listed as “Critical Area”. Except where noted in the Evaluation and Quality Assurance Memorandum and Chart Application Memorandum, surveys W00126 – W00128 provided adequate depth information. However, given the lack of quality control and associated documentation, it cannot be stated definitely that object detection criteria were met and that accurate least depths on all new and charted features were obtained. Additional fieldwork including side-scan and/or multibeam surveys of AWOIS items, approaches to harbors and potential anchorage areas is recommended as resources allow in order to complete bottom search and object detection requirements. Due to the above mentioned issues and the age of the surveys (circa 2002) It is recommended that the area encompassing surveys W00126-W00128 remain classified as “Critical Area”.

As full bottom coverage and object detection requirements could not be verified, the survey area should be classified as Category of Zone of Confidence (CATZOC) “B” if used to update ENC survey area classification (Seafloor Coverage: Full seafloor coverage not achieved; uncharted features, hazardous to surface navigation are not expected but may exist. Typical Survey Characteristics: Controlled, systematic survey to standard accuracy.).

cc: Chief, HSD Operations Branch N/CS31





Quality Review Summary for San Francisco, California

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Document History:

- Cruise Report 510502 generated by the SNR Dave Somers. This report consists of Site Manager Report and Lead ET Report.
- Cruise Report 510602 generated by the SNR Michael Q. Smith. This report consists of N5 Lead Report, Site Manager Report and Lead ET Report.

Cruise Information:

Vessel: USNS JOHN D. MCDONNELL T-AGS 51

Detachment: 124

Dates of Survey: 25 APR 2002 to 17 JUN 2002

Archive Number: 02US05

Country: USA

Area: San Francisco Bay from the sea buoy east and south to approximately 37° 45.48' N, 122° 20.04' W.

SURVOPS	DATES of SURVEY
510502	25 APR – 19 MAY 02
510602	23 MAY – 17 JUN 02

Survey SNRs and System Mangers:

SURVOP	Dates	SNR	System Manger
510502	25 APR - 19 MAY 02	David Somers	Roger M. Meadows
510602	23 MAY - 17 JUN 02	Mike Q. Smith	Stephen A. Farr

General:

This survey was done as a Homeland Defense Survey and directly supported a Mine Warfare requirement. The primary mission was to collect side scan sonar imagery, and bathymetric soundings were collected as ancillary data. During the survey the USNS MCDONNELL used the Klein 5000 side scan sonar and Simrad 1002 multibeam echo sounder, and the Hydrographic Survey Launches (HSLs) used the Simrad 3000 multibeam echo sounder. Three smooth sheets at a scale of 1:10,000 were created using the survey data from areas shoreward of the sea buoy.

Requirements:

Required data collection included side scan sonar imagery, multibeam soundings, Acoustic Doppler Current Profiler (ADCP), bottom samples, optical measurements, CTD and XBT casts.

Side Scan Data Collection:

Side-scan data was collected using the Klein 5000 and Datasonics systems. In accordance with the Technical Specification, SSS was operated in depths to approximately 45 meters. SSS mosaics were produced daily using UNISIPS software and were used to ensure better than 200 per cent coverage.

In-House Side Scan Sonar Target Verification:

Side Scan Data was considered classified and was not used in the creation of these smooth sheets.

Sounding Collection:

Line spacing was done according to Homeland Defense Specification. The specification is considered classified because it pertains to the Mine Warfare Q-routes.

Sounding Verification:

The soundings were first edited in the field and then verified in-house. A second verification was conducted by visually reviewing and editing outlying soundings using the Area Based Editor. Validation included checks for tidal and sound speed corrections, navigation errors and sensor offsets. In general the overall accuracy of the soundings are within required standards.

Calibration:

SURVOP 510502: Calibrations were performed on HSL013 and HSL014 by N6 personnel prior to departure. The ship was not used for any data collection.

SURVOP 510602: A roll check calibration of the Simrad EM1002 was done on 06-03-02. The check calibration indicated the current roll offset was correct. No additional offset was needed.

Extraneous Activities Affecting the Survey:

Strong tidal currents of 3-4 knots caused problems for side scan sonar collection. High seas, strong currents and strong winds affected HSL operations.

Geodetic Control:

No geodetic work was conducted for this survey.

Source of Shorelines:

NOAA high-resolution vector shoreline was used for the smooth sheets. They were obtained from NOAA website: <http://www.csc.noaa.gov/shoreline/index.html>.

Tide Gage Operation:

No NAVOCEANO tide gauge was used for this survey. Two NOAA tide gauges in San Francisco Bay were used. One was in San Francisco (Golden Gate) position: N 37 48 00, W 122 28 00, and a tide gauge at Oakland (Grove Street) position: N 37 48 00, W 122 17 00.

Tides Accuracy:

Tide gauge accuracy is estimated to be within +/-0.02m.

Comparison with Existing Data:

Several charts of the area were used for comparison with the collected data, including NOAA chart numbers 18640, 18649, 18650 and NGA DNC libraries H1316300 and A1316300.

Vertical Accuracy of Soundings:

The vertical accuracy was 0.3 meters at 15 meters depth and 0.8 meters at 100 meters depth. IHO Order 1 Survey accuracy requirement is 0.5 meters at 15 meters depth and 1.4 meters at 100 meters depth.

Horizontal Accuracy of Soundings:

The horizontal accuracy was 4.6 meters at 15 meters depth and 6.9 meters at 100 meters depth. IHO Order 1 Survey accuracy requirements are 5.1 meters at 15 meters depth and 10 meters at 100 meters depth.

Navigational Features:

No navigation aids were positioned during the SURVOPs.

Wrecks and Obstructions:

No wrecks or obstructions were found in this area.

Smooth Sheet Production:

Three Hydrographic Smooth Sheets (00601, 00602 and 00603) were created at a scale of 1:10,000 using CARIS Editor™. Sheet 00601 starts at the Sea Buoy in the Pacific Ocean and

goes through the Golden Gate into the San Francisco Bay. There are two small data gaps; one near the San Francisco Bay side and the other near the sea buoy entrance. Sheet 00602 is in the San Francisco Bay surrounded by Alcatraz Island, Angel Island, Treasure Island and Yerba Buena Island. There are several small data gaps on both sides of the sheet. Sheet 00603 is in the San Francisco Bay surrounded by San Francisco, Yerba Buena Island and the Harbor area east of San Francisco. There is a small data gap near the harbor area. Data gaps are due to weather, currents and the shape of the area established for the survey.

Chart Comparison for W00126-W00128

Chart comparisons were conducted by the Reviewers for Surveys W00126 through W00128 using the largest scale charts that were available for the survey areas.¹ The following charts were compared with the survey smooth sheet soundings:

Chart	Edition	Date	Scale	Units
18650	55 th	Dec. 07	1 : 20,000	Feet
18645	26 th	Sep. 08	1 : 100,000	Fathoms
18680	31 st	Jun. 05	1 : 210,668	Fathoms

In general, smooth sheet depths agreed with charted soundings within 10 feet.² Significant differences have been listed below on a survey specific basis.

W00126

Chart 18650

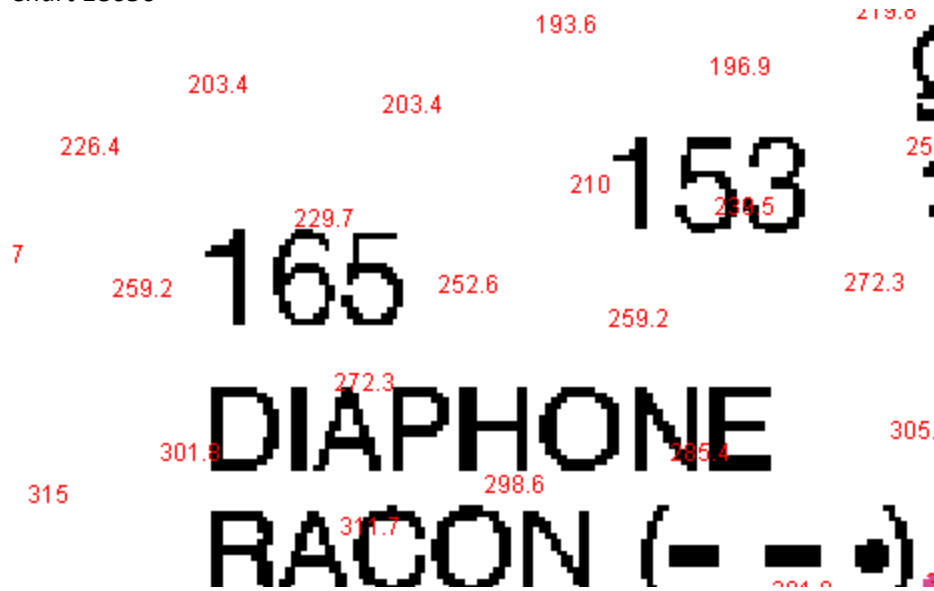


Figure 1: Located at approx. 37-49-16N, 122-28-51W, soundings from the survey are 50-90 feet deeper than charted soundings.³

Revisions compiled during office processing by the cartographer

¹ During cartographic processing, W00126-W00128 were also compared with the following:

✚ Chart 18650, 55th Edition, continuous maintenance raster dated 3/13/09

✚ Chart 18649, 66th Edition, continuous maintenance raster dated 3/31/09

² Concur with clarification. W00126, W00127, and W00128 found depth-curve shoaling trends in several areas. Chart revised contours as shown on the Hdrawings. Do not supersede charted shoal soundings and contours.

³ Concur with clarification. Do not supersede charted shoal soundings.

⁴ Concur with clarification. Do not supersede charted shoal soundings.

⁵ Concur. Chart revised contour as shown on the Hdrawing.



Registry No:
State:
General Locality:
Sub Locality:
Dates of Survey:
OSD Supplier:
OSD Project No:
Reviewer: Review Date:

I. DATA INVENTORY

A. Reports

Table with 4 columns: Report Type, Format, Document Title, Date. Rows include Descriptive Report, Data Acquisition and Processing Report, Horizontal and Vertical Control Report, System Certification Report, and Other.

B. Data

Table with 3 columns: Data Type, Format, Description (Raw, Processed). Rows include Smooth Sheet Sounding Plots, XYZ ASCII Files, Multibeam, Side Scan Sonar, LIDAR, and Single Beam.



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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II. DATA ACQUISITION AND PROCESSING

A. System Calibrations and/or Certifications

_____ A sensor offset and alignment survey was conducted to NOAA HSSDM requirements

_____ Offset values provided

_____ Patch tests were conducted for shallow-water multibeam systems

_____ Alignment bias and latency values provided

_____ Draft measurements were conducted

_____ Static Draft _____ Dynamic Draft _____ Loading

_____ Draft values were provided

_____ Sensors were calibrated in accordance with manufacturer requirements and NOAA specifications

_____ Calibration reports were provided.

B. Sound Velocity Corrections

_____ Sound velocity sampling regimen is in accordance with NOAA HSSDM requirements

_____ Sound velocity profiles were supplied

_____ All profiles appear valid

C. Water Levels

_____ Water level measuring equipment and methods are consistent with NOAA equipment and methods and are capable of meeting specifications

Equipment / method used: _____

_____ Tide corrector files were supplied

_____ All tide correctors appear valid

_____ Water level correctors applied to sounding data

_____ Verified _____ Observed _____ Predicted _____ NOAA Zoning _____ Other zoning

_____ Water level error estimate provided by CO-OPS

Water level / zoning error estimate: _____



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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E. Survey Methodology

_____ The surveyor has conducted adequate quality control of horizontal positioning data

_____ DTM, BASE surface, and/or mosaics indicate that seafloor coverage requirements (per NOAA HSSDM) were met and no significant coverage holidays exist.

_____ All least depths over shoals, wrecks, rocks, obstructions, and other features have been determined

_____ The Hydrographer has conducted the required quantity of cross lines, or acquired sufficient redundant data, in accordance with the HSSDM, to assess internal data consistency.

F. Data Processing and Quality Control

_____ An adequate description of data processing and quality control methods is provided in documentation.

Processing software used: _____

_____ Data processing methodology is robust enough and adequate to provide a dataset suitable for charting.

_____ Data have been reviewed and are cleaned appropriately with no noise, fliers, or systematic errors noted.

_____ Crossline agreement or redundant data overlap has been visually inspected by the hydrographer

_____ Disagreements have been noted

_____ A Chart comparison was conducted by the hydrographer

_____ Disagreements have been noted.



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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III. DATA QUALITY AND RESULTS

A. Internal Data Consistency

- _____ Full resolution data was provided in order to gauge the adequacy of cleaning and/or processing of the data.
- _____ A review of the data reveals no positioning errors exceeding NOAA specifications
- _____ Crossline agreement or redundant data overlap shows no disagreements exceeding NOAA HSSDM tolerances.
- _____ Anomalous data (fliers, noise, etc) were apparent in the BASE surface, DTM, and/or selected sounding set.
- _____ Are there any tide errors exceeding NOAA HSSDM requirements observable in the data
- _____ Are there any observable SV errors exceeding NOAA HSSDM accuracy standards.
- _____ All shoals are valid (no fliers) and the proper least depth has been retained.
- _____ Where multiple systems, platforms, and/or sensors were used, junctioning or overlapping data agree within NOAA HSSDM tolerance between platforms.
- _____ Any statistical assessment of the data (e.g. BASE standard deviation, QC reports, etc) indicate that data agree within NOAA HSSDM tolerances.

B. Error Budget Analysis

- _____ An error budget analysis was provided by the surveyor
 - _____ The error budget analysis indicates that data are capable of meeting NOAA HSSDM standards
 - _____ The evaluator concurs with the provided error budget analysis
- _____ The evaluator has conducted an error budget analysis
 - _____ The error budget analysis indicates that data are capable of meeting NOAA HSSDM standards

D. Automated Wreck and Obstruction Information System (AWOIS) Items

- _____ AWOIS Items are located within the limits of the survey.
 - _____ AWOIS Items can be sufficiently confirmed or disproved using data from this survey (Attach AWOIS pages to the certification memorandum.).



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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E. Dangers to Navigation

- _____ Dangers to Navigation (DTONs) were selected and submitted by the surveyor / data provider
- _____ DTONs have been verified by the office evaluator.
- _____ Additional DTONs were noted during office evaluation and submitted

F. Aids to Navigation

- _____ Aids to Navigation (ATONs) were positioned during this survey
- _____ New ATONS were positioned during this survey
- _____ Survey positions match charted positions
- _____ The surveyor / data provider issued DTONs or notified the USCG for any ATON discrepancies
- _____ ATON discrepancies were noted during office evaluation and submitted as DTONs.

G. Shoreline and Bottom Samples

- _____ The shoreline (MHW and/or MLLW lines) were included as part of this survey
- _____ Surveyed shoreline matches charted shoreline
- _____ Surveyed shoreline compares with NGS/RSD source data
- _____ Surveyed shoreline should be used to revise nautical charts
- _____ Shoreline features were positioned during this survey
- _____ Surveyed features match charted shoreline
- _____ Surveyed features compares with NGS/RSD source data
- _____ Surveyed features should be used to revise nautical charts
- _____ Bottom samples were acquired during this survey
- _____ Bottom sample spacing was in accordance with NOAA HSSDM requirements
- _____ Bottom samples should be used to update NOAA charts



Title:

**HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE
CHECKLIST**

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IV. COMMENTS

		SEDIMENT SIZE AND COMPOSITION DATA					
		for					
		GRAB SAMPLES FROM McDONNELL					
		CRUISE # 510602					
		WEIGHT PERCENT OF SEDIMENT IN EACH PHI CLASS					
		GRAB 1	GRAB 2	GRAB 3	GRAB 4	GRAB 5	GRAB 6
Latitude (N)		37°46.59	37°46.57	37°46.58	37°46.95	37°47.11	37°47.33
Longitude (W)		122° 20.81	122° 21.38	122° 21.89	122° 21.56	122° 21.58	122° 22.07
Depth (m)		13.5	17.0	18.0	18.0	18.0	19.0
< -4	>16	0.000	0.000	0.000	8.284	0.000	0.000
-4 to -3	16.000 to 8.000	0.000	0.000	80.986	1.972	0.000	0.000
-3 to -2	8.000 to 4.000	0.000	2.296	6.338	0.845	0.000	0.000
-2 to -1	4.000 to 2.000	0.000	2.066	0.704	0.733	0.388	0.481
-1 to 0	2.000 to 1.000	0.160	1.331	1.408	1.465	0.259	0.120
0 to 1	1.000 to .500	0.881	13.912	0.704	6.988	1.898	9.988
1 to 2	.500 to .250	5.609	75.298	2.817	71.006	23.296	77.617
2 to 3	.250 to .125	36.779	4.913	5.634	8.594	24.978	11.673
3 to 4	.125 to .063	7.292	0.184	1.408	0.113	7.420	0.120
4 to 5	.063 to .031	5.929	0.000	0.000	0.000	5.047	0.000
5 to 6	.031 to .016	5.689	0.000	0.000	0.000	4.012	0.000
6 to 7	.016 to .008	4.407	0.000	0.000	0.000	3.451	0.000
7 to 8	.008 to .004	4.647	0.000	0.000	0.000	3.494	0.000
8 to 9	.004 to .002	4.567	0.000	0.000	0.000	3.883	0.000
9 to 10	.002 to .001	4.327	0.000	0.000	0.000	3.322	0.000
> 10	< .001	19.712	0.000	0.000	0.000	18.550	0.000
Gravel (>2.0mm)		0.000	4.362	88.028	11.834	0.388	0.481
Sand (2.0 - .063 mm)		50.721	95.638	11.972	88.166	57.852	99.519
Silt (.063 - .004 mm)		20.673	0.000	0.000	0.000	16.005	0.000
Clay (< .004 mm)		28.606	0.000	0.000	0.000	25.755	0.000
Wentworth Size Class (from Mean Phi)		Medium Silt	Medium Sand		Coarse Sand	Coarse Silt	Medium Sand
Shepard Sediment Class		Snd-Slt-Cly	Sand	Gravel	Sand	Clayey Sand	Sand
Mean (mm)		0.025	0.425	6.843	0.560	0.037	0.353
Mean (phi)		5.346	1.233	-2.775	0.838	4.764	1.502
Standard Deviation (in phi units)		3.328	0.855	1.796	1.859	3.497	0.519
Skewness		0.252	-1.284	1.213	-1.092	0.322	-0.411
Kurtosis		-1.356	8.139	4.323	3.393	-1.163	5.893
Calcium Carbonate %		0.0	7.0	Insufficient Sample	2.0	0.0	Insufficient Sample

APPROVAL SHEET
W00126-W00128

Evaluated by:

Kurt Brown
Hydrographic Team Leader
Pacific Hydrographic Branch

Review by:

Kurt Brown
Hydrographic Team Leader
Pacific Hydrographic Branch

Cartography

The evaluated survey has been inspected with regard to delineation of the depth curves, development of critical depths, cartographic symbolization, and verification or disproof of charted data

Compiled by:

Beth Taylor
Cartographer
Pacific Hydrographic Branch

Reviewed by:

Gary Nelson
Cartographic Team Leader
Pacific Hydrographic Branch

Approval

I have reviewed the data, and reports. Data are suitable for nautical charting except where specifically recommended in this report.

David O. Neander
Captain, NOAA
Chief, Pacific Hydrographic Branch

