

F00479

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. RA-02-01-01

Registry No. F00479

LOCALITY

State Washington

General Locality Puget Sound

Sublocality Shiishole Bay

2001

CHIEF OF PARTY
Lieutenant. Mark A. Wetzler, NOAA

LIBRARY & ARCHIVES

DATE

HYDROGRAPHIC TITLE SHEET

F00479

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.

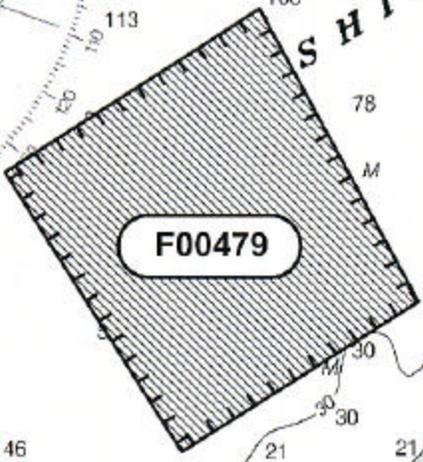
RA-02-01-01

State WashingtonGeneral Locality Puget SoundSublocality Shilshole BayScale 1:2,500Date of Survey February 7, 2001Instructions Date N/A (see DR, Section A)Project No. OPR-N326-RAVessel RA-6 (2126)Chief of Party Lt. M.A. Wetzler, NOAASurveyed by RAINIER PersonnelSoundings taken by echo sounder, hand lead, pole KNUDSEN 320M, RESON 8101Graphic record scaled by RAINIER PersonnelGraphic record checked by RAINIER PersonnelEvaluation by M. Lathrop, R. Shipley Automated plot by HP Design Jet 1050CVerification by E. Domingo, R. ShipleySoundings in Feet at MLLWREMARKS: Time in UTC.

**Revisions and annotations appearing as endnotes were
generated during office**

**All depths listed in this report are referenced to
mean lower low water unless otherwise noted.
UTM Projection (zone 6)**

Progress Sketch
OPR-N326-RA-01
Survey F00479
Puget Sound
Shilshole Bay
February 2001
Chart 18447



Accomplished	February
LNM Multibeam	10.500
SQ NM Multibeam	0.034
SV Casts	2.000
Days at Sea	1.000

UND
 RVICES
 D)

146

Mo (A) BELL 147

PUGET SOUND

SHILSHOLE

F00479

Accomplished	February
LNM Multibeam	10.500
SQ NM Multibeam	0.034
SV Casts	2.000
Days at Sea	1.000

Descriptive Report to Accompany Hydrographic Survey F00479

Project OPR-N326-RA Northern Puget Sound

Scale 1:2500

June 2001

NOAA Ship RAINIER

Chief of Party: LT Mark A. Wetzler, NOAA

A. AREA SURVEYED

This hydrographic survey was completed as specified by the Draft Standing Project Instructions Dated April 6, 1998. The region surveyed is a small 285 m by 255 m rectangle located in Shilshole Bay, Washington. Hydrographic Survey Letter Instructions were not provided for this survey. This project responds to the need for a defined reference surface with which hydrographic survey equipment can be tested and calibrated. The survey was conducted to provide full-bottom multibeam coverage of the reference surface, hereafter known as the Shilshole Reference Surface (SRS).

The survey of the SRS is bounded by a rectangle with its major axis rotated 32° from the north to the west. The northern corner of the SRS is located at latitude 47° 40' 29.61¹'' N, longitude 122° 25' 19.68²'' W; an eastern corner of 47° 40' 21.77³'' N, 122° 25' 12.55⁴'' W; a southern corner of 47° 40' 17.45⁵'' N, 122° 25' 22.81⁶'' W; and a western corner of 47° 40' 25.32⁷'' N, 122° 25' 30.06⁸'' W. The length of the major axis is 285 m and the length of the minor axis is 255 m for a total area of .073 km².

Data acquisition was conducted on February 7, 2001 (DN 038).

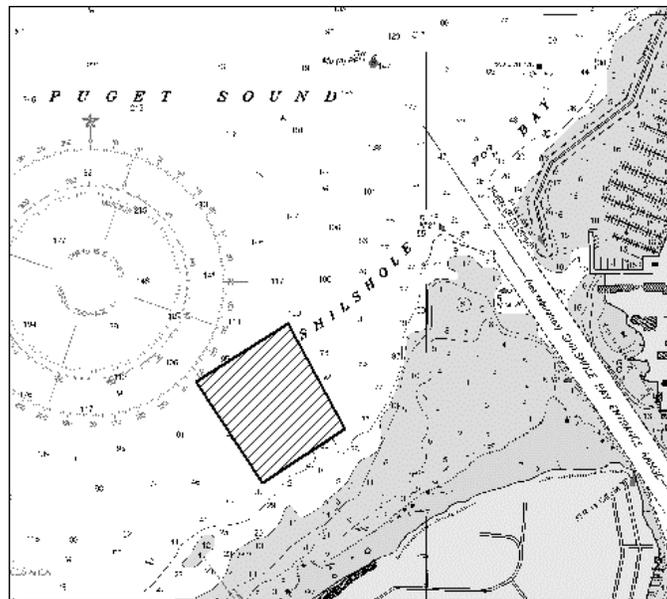


Figure 1: F00479 Survey Limits

B. DATA ACQUISITION AND PROCESSING

A complete description of data acquisition and processing systems, survey vessels, quality control procedures, and data processing methods used during the acquisition of data for F00479 are discussed in the following sections. The software, hardware, vessel configurations and sound velocity calibrations used for this survey are contained in the Data Acquisition and Processing Report (DAPR) for OPR-P139-00, Prince William Sound.⁹ This project was chosen since the data for F00479 were acquired during the RAINIER's winter inport and the processing model used was that of the prior field season.

B1. Equipment and Vessels

Data were acquired by RAINIER's survey launch vessel number 2126. Vessel 2126 was used to acquire shallow-water multibeam soundings and sound velocity profiles. No unusual vessel configurations or problems were encountered on this project.¹⁰

Launch Vertical-Beam Echo Sounder (VBES) - VN 2126

Vessel 2126 is equipped with a Knudsen Engineering Limited 320M, which is a dual frequency (100 kHz, 24 kHz) digital recording vertical-beam echo sounder with an analog paper record. The beamwidths for the high and low frequency are 7° and 25° respectively. Although VBES data were not processed for this project, VBES data were acquired concurrently with launch multibeam data and compared to nadir beams of multibeam in real-time during data acquisition to assure multibeam data quality.¹¹ Digital VBES depth data were also used by Isis to assist the Reson 8101 in filtering depth fliers in real-time.

Launch Shallow-Water Multibeam (SWMB) - VN 2126

Vessel 2126 is equipped with a hull-mounted Reson SeaBat 8101, with option 033, Angle-Independent Imagery, and option 040, Extended Range Projector. The SeaBat 8101 is a 240 kHz multibeam system that measures relative water depths across a 150° swath, consisting of 101 individual 1.5° x 1.5° beams. This system was used to obtain full-bottom coverage in depths generally from 4 meters to 25 meters, with range scale values ranging from 75 meters to 125 meters, depending upon the depth of water and across-track slope.

Side Scan Sonar

Side Scan Sonar (SSS) equipment was not used on this project. However, it should be noted that the Reson Seabat 8101 system provides a low-resolution digital SSS record of the multibeam swath. This SSS imagery is primarily used during processing of the multibeam depth data to aid in determining whether anomalous soundings are true features or noise.¹²

Positioning Equipment

Vessel 2126 is equipped with a TSS POS/MV Position and Orientation Sensor to measure and calculate position. The POS/MV is a GPS-aided inertial navigation system, which provides a blended position solution derived from both an Inertial Motion Unit (IMU) and an integrated GPS receiver. The IMU and GPS receivers are complementary sensors, and data from one are used to filter and constrain errors from the other, resulting in higher position accuracy and fewer errors than either system alone. Position accuracy is displayed in real-time by the POS/MV software and was monitored to ensure that positioning accuracy requirements as outlined in the NOS Hydrographic Surveys Specifications and Deliverables were not exceeded. In addition, the POS/MV software displays HDOP and number of satellites used in

position computation. Data acquisition was generally halted when an HDOP of 2.5 was exceeded or the number of satellites available dropped below four. However, because positional accuracy can be maintained by the POS/MV through short GPS outages with the help of the IMU, data acquisition was not halted during short periods of time when the HDOP was exceeded and/or the number of satellites used fell below stated parameters.¹³

Software

Shallow-water multibeam (SWMB) echo sounder data, along with position and attitude data from the POS/MV, were acquired using Triton-Elics' ISIS software version 4.54, and processed using Universal Systems Limited's CARIS HIPS software version 4.3.2, running on a Silicon Graphics Inc. Origin 2000 with the Irix 6.5.8 operating system.

Coastal Oceanographic's HYPACK MAX was utilized for vessel navigation and line tracking during acquisition of shallow-water multibeam (SWMB) data.

Final soundings were saved in MapInfo format and will be submitted with the digital data.

Raw sound velocity data were processed using VelocWin 5.03 supplied by the NOS Hydrographic Systems and Technology Programs N/CS11 (HSTP). VelocWin 5.03 uses raw salinity, temperature, and pressure measurements to create a sound velocity profile.

A complete list of software and versions is included in Appendix I¹⁴ of the DAPR for OPR-P139-00 project.

B2. Data Processing and Quality Control

Shallow-water Multibeam Data

Shallow-water multibeam data were monitored in real-time using the 2-D and 3-D data display windows in Isis and the on-screen display for the Reson SeaBat 8101 sonar processor. Adjustable user parameters are range scale, power, gain, and pulse width. These parameters were adjusted as necessary to ensure the best data quality. Additionally, vessel speed was adjusted as necessary, and in accordance with the NOS Specifications and Deliverables and Draft Standing Project Instructions to ensure the required along-track coverage for object detection.

Following acquisition, shallow-water multibeam data were initially reviewed with the CARIS Hydrographic Data Cleaning System (HDCS) program SwathEdit. All soundings were reviewed, ping-by-ping, and obvious depth fliers were identified and manually flagged as "rejected". Vessel positioning and attitude data from each system were similarly displayed and manually cleaned. Fliers or gaps in positioning and attitude data were rejected and interpolated for small periods in time and outright rejected for larger periods in time in which the characteristic of the curve was ambiguous. All soundings beyond a maximum angle of 60° off-nadir were rejected in accordance with the Draft Standing Project Instructions to reduce the noise and refraction errors possible in these outer beams.¹⁵

After review and cleaning in SwathEdit, depth, position and attitude data were merged, using the HDCS program HDCSLineMerge, with sound velocity, vessel offset, and dynamic draft correctors to compute the corrected depth and position of each sounding. All soundings were then again reviewed, and spatially referenced in HDCS Subset Mode. Data were compared with adjacent lines and crosslines, for systematic errors such as sound velocity errors. Questionable soundings were also compared with adjacent or overlapping data for confirmation or further rejection. Depth fliers and noisy data, which were not

rejected in SwathEdit, were rejected in Subset Mode.

A 0.5-meter sun-illuminated Digital Terrain Model (DTM) image was created to demonstrate coverage and to further check for systematic errors such as sound velocity, or attitude and/or timing errors.

A statistical analysis of all SWMB data was performed using the CARIS Quality Control Report (QCR) function. SWMB crosslines were compared with mainscheme soundings, beam-by-beam, to statistically determine the accuracy of each beam. Beams not meeting accuracy requirements as described in the NOS Hydrographic Surveys Specifications and Deliverables were further filtered and rejected. Results from the survey's QCR can be found in Appendix V.¹⁶ Crosslines were only run in areas of regular and even bathymetry in order to utilize the lowest variance in the analysis and to eliminate possible skew of the results due to irregular bathymetry.

To produce the final reduced data set represented by the final field sheet, all non-rejected soundings having passed all other quality-assurance checks were imported into a CARIS "workfile" by selecting shoal-biased "line-by-line" binning using a 2-meter cell size. The resultant thinned data were then imported into HPS and combined with heights of point features. The processed soundings were excessed in HPS ZoomEdit using a 3.5-millimeter character size, ensuring that the largest spacing between selected soundings would not exceed 5 millimeters at survey scale. Final selected soundings were saved and plotted in MapInfo at a 2-millimeter character size.

Data processing flow diagrams are included in Appendix II of the DAPR for OPR-P139-00.¹⁷

Crosslines

SWMB crosslines totaled 4.4 nautical miles, comprising 41.9% of SWMB hydrography. The Quality Control Report (CARIS HIPS) indicated a checkline file average of 98.77%, corresponding to a depth tolerance factor of 0.0075 and a constant depth error of 0.25 m, and 99.19 %, with a depth tolerance factor of 0.013 and a constant depth error of 0.50 m. These checkline file averages conform to International Hydrographic Organization (IHO) Special Order and Order 1 specification respectively as detailed in Special Publication S-44, Edition 4.¹⁸ See Appendix V¹⁹ for the detailed reports.

Junctions

There are no contemporary survey junctions with F00479.²⁰

Data Quality Factors

No unusual conditions were encountered during the survey that affected the expected accuracy and quality of survey data.

B3. Corrections to Echo Soundings

Sound Velocity

Sound velocity profiles were acquired with Sea-Bird Electronic's SEACAT SBE19 Conductivity, Temperature, and Depth (CTD) profiler (S/N 2543). Raw conductivity, temperature, and pressure data were processed using the program VelocWin version 5.03, which generates sound velocity profiles for CARIS and sound velocity corrector tables for HPS. Sound velocity correctors were applied to SWMB soundings in CARIS. The calibration report and dates are included in Appendix IV²¹ of the DAPR for the project OPR-P139-00.

The speed of sound through water was determined by a minimum of one cast every four hours of SWMB acquisition in accordance with the Draft Standing Project Instructions and NOS Specifications and Deliverables for Hydrographic Surveys. Casts were conducted more frequently when changing survey areas, or when it was felt that conditions, such as a change in weather, would warrant additional sound velocity profiles.

Vessel Offsets and Dynamic Draft Correctors

The following table shows when the vessel offsets and dynamic draft correctors used for this survey were last determined:

Vessel No.	Date of Static Draft and Transducer Offset Measurements	Method of Settlement and Squat Measurement	Date of Settlement and Squat Measurement	Location of Settlement and Squat Measurement
2126	March 1999	OTF*	March 1999	Port Angeles, WA

*OTF: "On-the-fly" GPS techniques

Sensor offset and dynamic draft values were applied to SWMB data in CARIS during post-processing. These values are stored in CARIS Vessel Configuration Files (VCFs). Vessel offset diagrams and dynamic draft tables are included in Appendix III²² of the DAPR for the project OPR-P139-00. The VCFs themselves are included with the digital HDCS data.²³

Heave, Pitch, Roll and Heading, Including Biases and Navigation Timing Errors

SWMB launch, VN 2126, utilized a TSS POS/MV Model 320 Position and Orientation System – Marine Vessel (POS/MV), which provides accurate navigation and attitude data to correct for the effects of heave, pitch, roll and heading. The POS generates attitude data in three axes (roll, pitch and heading) to an accuracy of 0.05° or better. Heave measurements supplied by the POS/MV maintain an accuracy of 5% of the measured vertical displacement for movements that have a period of up to 10 seconds. The POS/MV delivers heading measurements by two distinct methods. First, the Dynamic Heading Alignment determines the vessels heading by using the data supplied by the Internal Measurement Unit (IMU) and GPS receivers to achieve heading that is, at best, accurate to within 0.25°. This method suffers from drift but is relatively unaffected by noise. Second, the GPS Azimuth Measurement System (GAMS) determines the geographic vector between two GPS antennas fixed to the vessel by comparing the phase of satellite signals they receive. The error from this method is largely due to noise, but exhibits no drift. The POS/MV uses the advantages of each method to compensate for the disadvantages of the other to arrive at an optimal accuracy of 0.05°.

Heave, roll, pitch, and navigation latency biases were determined during Patch Tests conducted off Shilshole Bay, WA on March 6, 2000 for vessels 2121 and 2126. SWMB vessel offsets, dynamic draft correctors, and system bias values are contained in CARIS Vessel Configuration Files (VCFs) and were created using the program "VCFEDIT" in CARIS. These offsets and biases are applied to the sounding data during processing in CARIS. The VCFs and Patch Test data are included with the digital HDCS data.²⁴

C. VERTICAL AND HORIZONTAL CONTROL

Horizontal Control

The horizontal datum for this project is the North American Datum of 1983 (NAD83). Differential GPS (DGPS) was the sole method of positioning. Differential corrections from the U.S. Coast Guard beacon at Whidbey Island, WA (ID# 888) and Robinson Point, WA (ID# 887) were utilized during this survey.²⁵

Vertical Control

The vertical datum for this project is Mean Lower-Low Water (MLLW). The operating National Water Level Observation Network (NWLON) primary tide station at Seattle, WA (944-7130) will serve as control for datum determination. There were no tertiary tide gauges for this field examination.

The Pacific Hydrographic Branch will apply final approved (smooth) tides to the survey data during final processing. A request for delivery of final approved (smooth) tides for survey F00479 was forwarded to N/OPS1 on June 21, 2000 in accordance with FPM 4.8.²⁶

D. RESULTS AND RECOMMENDATIONS

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

There were no AWOIS items assigned to this field examination.²⁷

D.2 Chart Comparison²⁸

One chart is affected by this survey:

Chart	Scale	Edition Number	Date	Datum
18447	1:10,000	26 th	January 25, 1997	NAD83

Depths from chart 18447 agree well with the current survey, generally within one to two feet.²⁹ One notable difference is discussed below. The survey region was covered with 600% shallow-water multibeam using only the beams "40° from the nadir.

In the vicinity of a charted 45-foot sounding, the present survey revealed a depth of 51 feet (Pos. # 180,992) 23 m to the north. The 45-foot sounding is labeled "Rk" and appears to correspond to the 51-foot sounding over a large boulder. The location of the surveyed sounding is 47° 40' 22.32" N, 122° 25' 22.65" W (543,316.2 E, 5,280,102.9 W³⁰). The hydrographer recommends deleting the charted 45-foot "Rk" sounding and adding the surveyed 51-foot "Rk" sounding.³¹

The present survey revealed that the anchor for the charted lighted mooring buoy is at a depth of 63 feet³² (Pos. #184,763) at location 47° 40' 22.26" N, 122° 25' 23.15" W. During analysis of multibeam data in Shilshole Bay it was noted that the anchor moved 19.9 m along a heading of 005° over a period of 180 days (an average of 0.09 m/day).

Final sounding comparisons will be made at Pacific Hydrographic Branch after application of verified smooth tides.

D.3 Shoreline

No remote sensing source shoreline data were supplied for this project.³³

D.4 Dangers to Navigation

No dangers to navigation were found.³⁴

D.5 Aids to Navigation³⁵

There are no aids to navigation within the survey limits.

E. APPROVAL

As Chief of Party, I have ensured that standard field surveying and processing procedures were followed in producing this examination in accordance with the Hydrographic Manual, Fourth Edition; the Hydrographic Survey Guidelines; the Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables, as updated for 2000.

The digital data and supporting records have been reviewed by me, are considered complete and adequate for charting purposes, and are approved. All records are forwarded for final review and processing to N/CS34, Pacific Hydrographic Branch

Survey F00479 is complete and adequate to supersede charted soundings³⁶ in their common areas.³⁷

No supplemental reports have been created relating to this survey.

Approved and Forwarded:



Mark A. Wetzler
Lieutenant, NOAA

Revisions Compiled During Office Processing and Certification

- ¹ PHB Revision--Strikethrough ~~29.61~~ and replace with 30.5
- ² PHB Revision--Strikethrough ~~49.68~~ and replace with 20
- ³ PHB Revision--Strikethrough ~~21.77~~ and replace with 22
- ⁴ PHB Revision--Strikethrough ~~12.55~~ and replace with 12
- ⁵ PHB Revision--Strikethrough ~~17.45~~ and replace with 16.8
- ⁶ PHB Revision--Strikethrough ~~22.81~~ and replace with 23
- ⁷ PHB Revision--Strikethrough ~~25.32~~ and replace with 25
- ⁸ PHB Revision--Strikethrough ~~30.06~~ and replace with 31
- ⁹ PHB revision-Concur
- ¹⁰ PHB revision-Concur
- ¹¹ PHB revision-Concur
- ¹² PHB revision-Concur
- ¹³ PHB revision-This data was analyzed during office processing and found to be consistent with adjacent survey data collected on the same day.
- ¹⁴ PHB revision-Filed with the hydrographic data.
- ¹⁵ PHB revision-Concur
- ¹⁶ PHB revision-Filed with the hydrographic data.
- ¹⁷ PHB revision-Filed with the hydrographic data.
- ¹⁸ PHB revision-Concur
- ¹⁹ PHB revision-Filed with the hydrographic data.
- ²⁰ PHB revision-Concur
- ²¹ PHB revision-Filed with the hydrographic data.
- ²² PHB revision-Filed with the hydrographic data.
- ²³ PHB revision-Concur
- ²⁴ PHB revision-Concur
- ²⁵ PHB revision-Concur
- ²⁶ PHB revision-Approved Tide Note dated July 10, 2001 is attached.
- ²⁷ PHB revision-Concur
- ²⁸ PHB revision- The smooth sheet was compared to prior survey H10665 (1996). A digital comparison was made and registration and legibility was good. The present survey reflects differences of 0-3 feet with the current work being shoaler biased. The use of multibeam collection has provided a better portrayal of the bottom configuration. The following charted wrecks were surveyed using 600% shallow water multibeam but were not specifically addressed by the hydrographer. The charted wrecks should be superceded by the present survey information.

The 70 *Wk* at Lat 47/40/26N, Long 122/25/22W was found on the present survey to be at Lat 47/40/25.8N, Long 122/25/21.4W (543340.45E, 5280211.5N) with a least depth of 68 feet. Chart 68 *Wk* at survey position.

The 54 *Wk* at Lat 47/40/23N, Long 122/25/23W was found on the present survey to be at Lat 47/40/23.6N, Long 122/25/22.9W, (543308.54E, 5280142.1N) with a least depth of 54 feet. Chart 54 *Wk* at survey position.

The 27 *Wk* at Lat 47/40/23N, Long 122/25/19W was found on the present survey to be at

Lat 47/40/22.6 N, Long 122/25/19.1 W (543388.93E, 5280113.4N) with a least depth of 28 feet.
Chart 28 *Wk* at survey position.

Survey F00479 is adequate to supersede the prior survey within the area of common coverage.

²⁹ PHB revision-Concur with clarification. After application of approved tides, the comparison reflects was general differences of 0-3 feet.

³⁰ PHB Revision--Strikethrough ~~W~~ and replace with N

³¹ PHB revision-Concur. The evaluator recommends that the charted 45 Rk (source unknown) at Lat 47/40/21 N, Long 146/25/22 W be superceded based on complete bottom ensonification accomplished during this survey. It should also be noted that the inspection of prior survey H10665 also shows a 51 foot sounding with a rky notation.

³² PHB revision-Concur

³³ PHB revision-Concur

³⁴ PHB revision-Concur

³⁵ PHB revision-Do not concur. A lighted mooring buoy exists within the survey area.

However, it was not positioned during the survey work. The evaluator recommends retaining as charted.

³⁶ PHB revision-add and features

³⁷ PHB revision-Concur

HYDROGRAPHIC SURVEY STATISTICS

F00479

RECORDS ACCOMPANYING SURVEY: To be completed when survey is processed.

RECORD DESCRIPTION	AMOUNT	RECORD DESCRIPTION	AMOUNT
SMOOTH SHEET	1	SMOOTH OVERLAYS: POS., ARC, EXCESS	NA
DESCRIPTIVE REPORT	1	FIELD SHEETS AND OTHER OVERLAYS	NA

DESCRIPTION	DEPTH/POS RECORDS	HORIZ. CONT. RECORDS	SONAR-GRAMS	PRINTOUTS	ABSTRACTS/SOURCE DOCUMENTS
ACCORDION FILES					
ENVELOPES	1				
VOLUMES					
CAHIERS					
BOXES					

SHORELINE DATA

SHORELINE MAPS (List):

PHOTOBATHYMETRIC MAPS (List):

NOTES TO THE HYDROGRAPHER (List):

SPECIAL REPORTS (List):

NAUTICAL CHARTS (List):

OFFICE PROCESSING ACTIVITIES

The following statistics will be submitted with the cartographer's report on the survey

PROCESSING ACTIVITY	AMOUNTS		
	VERIFICATION	EVALUATION	TOTALS
POSITIONS ON SHEET			
POSITIONS REVISED			
FINDINGS REVISED			
CONTROL STATIONS REVISED			

PROCESSING ACTIVITY	TIME-HOURS		
	VERIFICATION	EVALUATION	TOTALS
PRE-PROCESSING EXAMINATION			
VERIFICATION OF CONTROL			
VERIFICATION OF POSITIONS			
VERIFICATION OF SOUNDINGS			
VERIFICATION OF JUNCTIONS			
APPLICATION OF PHOTOBATHYMETRY			
SHORELINE APPLICATION-VERIFICATION			
COMPILATION OF SMOOTH SHEET			82
COMPARISON WITH PRIOR SURVEYS AND CHARTS			
EVALUATION OF SIDE SCAN SONAR RECORDS			
EVALUATION OF WIRE DRAGS AND SWEEPS			
EVALUATION REPORT			31
GEOGRAPHIC NAMES			
OTHER: (Chart Compilation)			23
USE OTHER SIDE OF FORM FOR REMARKS			
TOTALS			136

Pre-processing Examination by	Beginning Date	07/23/2001	Ending Date	
Verification of Field Data by Boles, R. Davies, R. Mayor, M. Lathrop, R. Shipley	Time (Hours)	82	Ending Date	
Verification Check by	Time (Hours)		Ending Date	
Evaluation and Analysis by M. Lathrop, R. Shipley	Time (Hours)	31	Ending Date	07/17/2003
Inspection by B. Olmstead	Time (Hours)	7	Ending Date	07/18/2003

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE: July 10, 2001

HYDROGRAPHIC BRANCH: Pacific

HYDROGRAPHIC PROJECT: OPR-N326-RA-2001

HYDROGRAPHIC SHEET: F00479

LOCALITY: Puget Sound, WA

TIME PERIOD: February 9, 2001

TIDE STATION USED: 944-7130 Seattle, WA

Lat. 47° 36.1'N Lon. 122° 20.4'W

PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters

HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.198 meters

REMARKS: RECOMMENDED ZONING

Use zone(s) identified as: PS161

Refer to attachments for zoning information.

Note 1: Provided time series data are tabulated in metric units (meters), relative to MLLW and on Greenwich Mean Time.

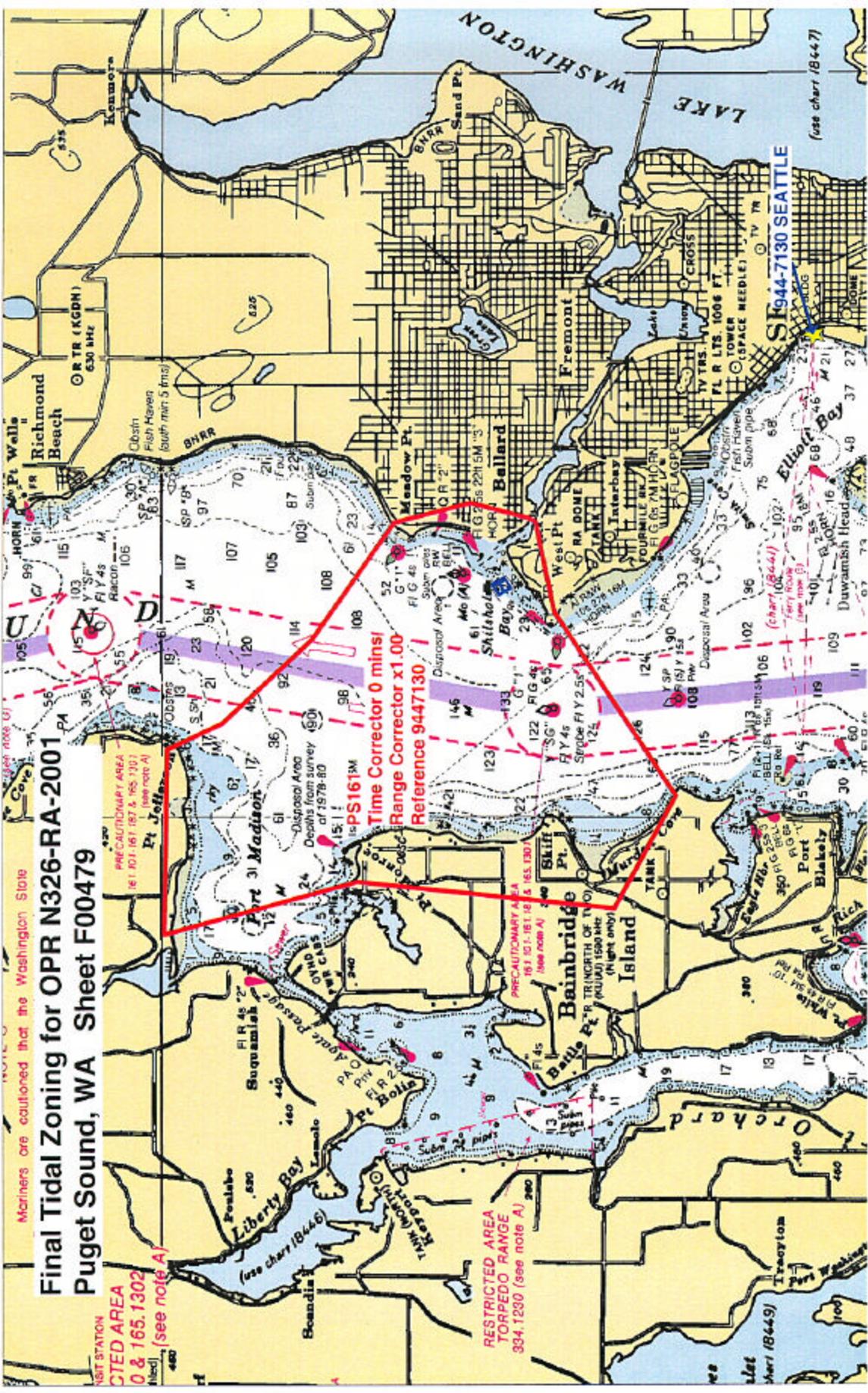
--
CHIEF, REQUIREMENTS AND DEVELOPMENT

DIVISION

Final tide zone node point locations for OPR-N326-RA-2001,
Sheet F00479.

Format: Longitude in decimal degrees (negative value denotes
Longitude West),
Latitude in decimal degrees
Tide Station (in recommended order of use)
Average Time Correction (in minutes)
Range Correction

	Tide Station Order	AVG Time Correction	Range Correction
Zone PS161			
-122.4775 47.748685	944-7130	0	1.00
-122.539751 47.749408			
-122.522043 47.705945			
-122.531028 47.648028			
-122.493204 47.634317			
-122.43138 47.661495			
-122.400999 47.665697			
-122.399705 47.667448			
-122.394633 47.680395			
-122.401293 47.697613			
-122.44047 47.716091			
-122.468913 47.736374			
-122.4775 47.748685			



Mariners are cautioned that the Washington State

**Final Tidal Zoning for OPR N326-RA-2001
Puget Sound, WA Sheet F00479**

**RESTRICTED AREA
0 & 165.1302
(see note A)**

**PRECAUTIONARY AREA
161.101, 167, 167 & 165.7301
(see note A)**

**Time Corrector 0 mins!
Range Corrector x1.00
Reference 9447130**

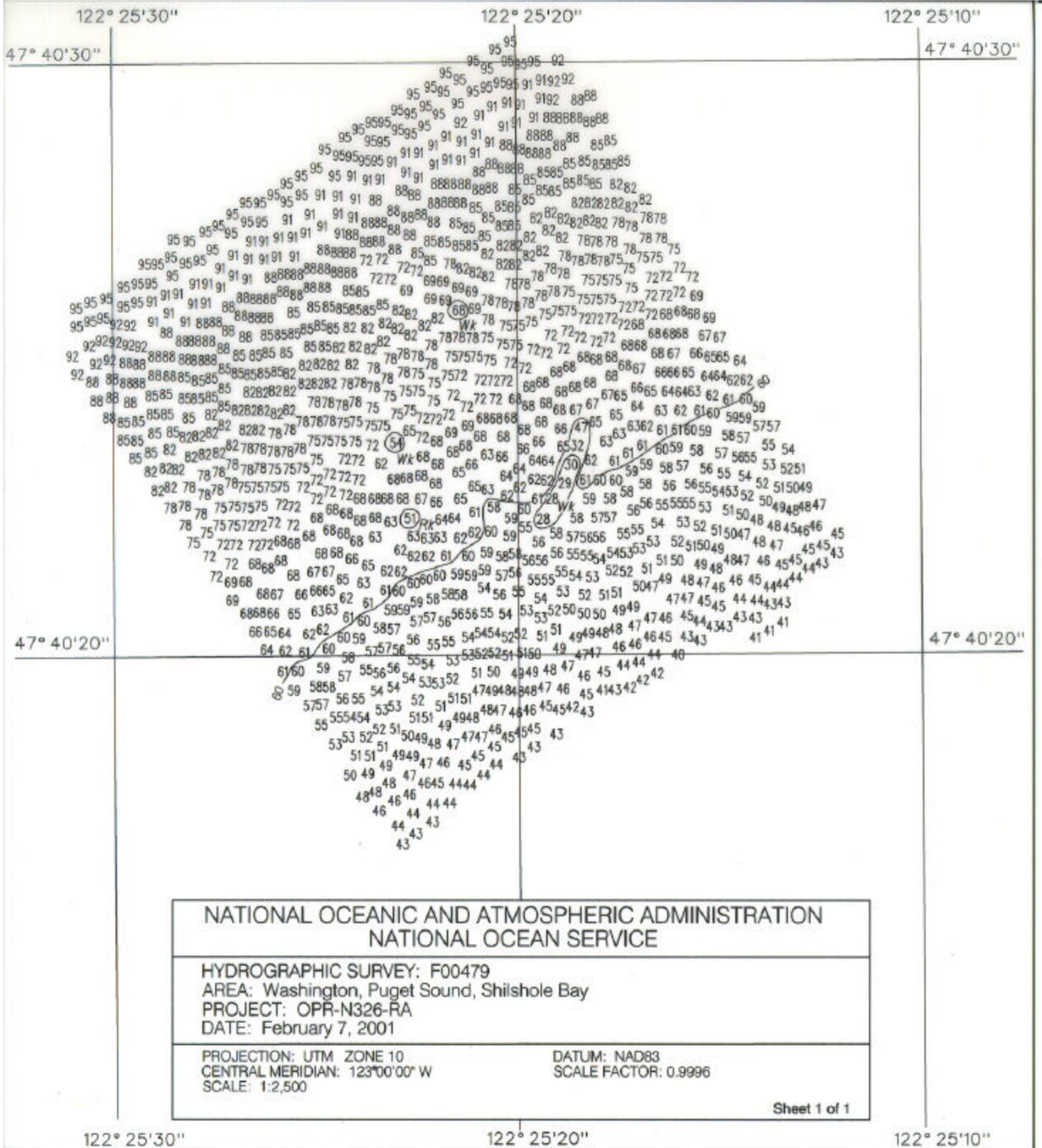
**RESTRICTED AREA
TORPEDO RANGE
334.1230 (see note A)**

SF944-7130 SEATTLE

(see chart 18447)

(see chart 18447)

(see note A)



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

HYDROGRAPHIC SURVEY: F00479
 AREA: Washington, Puget Sound, Shilshole Bay
 PROJECT: OPR-N326-RA
 DATE: February 7, 2001

PROJECTION: UTM ZONE 10 DATUM: NAD83
 CENTRAL MERIDIAN: 123°00'00" W SCALE FACTOR: 0.9996
 SCALE: 1:2,500

APPROVAL SHEET
F00479

Initial Approvals:

The survey and associated records have been inspected with regard to survey coverage, delineation of the depth curves, development of critical depths, cartographic symbolization, and verification or disproval of charted data. The survey records and digital data comply with NOS requirements except where noted in the Descriptive Report and are adequate to supersede prior surveys and nautical charts in the common area.

Bruce A. Oelstrom
Dennis Hill
Chief, Cartographic Team
Pacific Hydrographic Branch

Date: *7/31/2003*

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

J. E. Lowell, Jr.
John E. Lowell, Jr.
Commander, NOAA
Chief, Pacific Hydrographic Branch

Date: *9/11/03*

*Awois check
11/4/03 mcr*

