H11857

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. H11857

LOCALITY

State Oregon

General Locality Columbia River

Sublocality Sandy Island to Bachelor Island

2008 - 2009

CHIEF OF PARTY

Jonathan L. Dasler, PE (OR), PLS (OR, CA)
David Evans and Associates, Inc.

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NOAA FORM 77-28 (11-72)

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

REGISTER NO.

H11857

HYDROGRAPHIC TITLE SHEET

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: Oregon

General Locality: Columbia River

Sublocality: Sandy Island to Bachelor Island

Scale: 1:10,000

Date of Survey: September 12, 2008 - February 24, 2009

Instructions Dated: 4/1/2008

Project No.: OPR-N338-KR-08

Vessel: R/V Theory, R/V Preston

Chief of Party: Jonathan L. Dasler, PE (OR), PLS (OR, CA)

Surveyed by: David Evans and Associates, Inc.

Soundings taken by echo sounder: RESON 7125, RESON 8101, Odom CV100

Graphic record scaled by: N/A

Graphic record checked by: N/A

Evaluation by: A. Raymond

Automated plot by: N/A

Verification by: A. Raymond, K. Reser

Soundings in: Feet at Columbia River Datum (CRD)

REMARKS: Time in UTC. UTM Projection Zone 10

Revisions and annotations appearing as endnotes were generated during office processing.

As a result, page numbering may be interrupted or non-sequential

All separates are filed with the hydrographic data.

Subconsultants: Zephyr Marine, P.O. Box 1575, Petersburg, AK 99833

Descriptive Report to Accompany Hydrographic Survey H11857
Project *OPR-N338-KR-08*
Columbia River, Oregon
Sandy Island to Bachelor Island
Scale 1:10,000
September 2008 – February 2009
David Evans and Associates, Inc.
Lead Hydrographers: Jonathan L. Dasler, Jason C. Creech

A. AREA SURVEYED

David Evans and Associates, Inc. (DEA) conducted hydrographic survey operations on the Columbia River, Oregon. The survey area (Figure 1) extends from Columbia River Mile (CRM) 74 to 89.

Survey H11857 was conducted in accordance with the *Statement of Work* for *OPR-N338-KR-08*; dated April 1, 2008 with the exception of tides and water levels requirements. Due to the Columbia River Datum (CRD), the project chart datum, being a non-tidal gradient datum and the complex hydrodynamics of the Columbia River, *OPR-N338-KR-08* was approved as a pilot project for the use of Global Positioning System (GPS) water levels acquired directly at the survey vessel. This change was approved after the receipt of the Statement of Work.[1]

The project instructions required three categories of multibeam coverage: Complete, Object Detection, and Set Line Spacing. In water depths greater than four meters, complete multibeam coverage was required. Automated Wreck and Obstruction Information System (AWOIS) items and the main shipping channel were acquired to meet object detection coverage requirements. Twenty-five (25) meter set line spaced multibeam bathymetry was required from the four meter water depths to the "inshore limit of hydrography". The inshore limit of hydrography was defined as the seaward most extent of either the two meter contour or the equivalent to 0.8 millimeters at the scale of the largest scale nautical chart from the mean high water (MHW) line. Though not required by contract, multibeam side scan data was acquired but not processed.

Seventeen (17) bottom samples were acquired for H11857. No AWOIS item investigations were assigned to this survey.

Data acquisition was conducted from September 12, 2008 (DN256) to February 24, 2009 (DN055). Table 1 lists specific dates of acquisition.

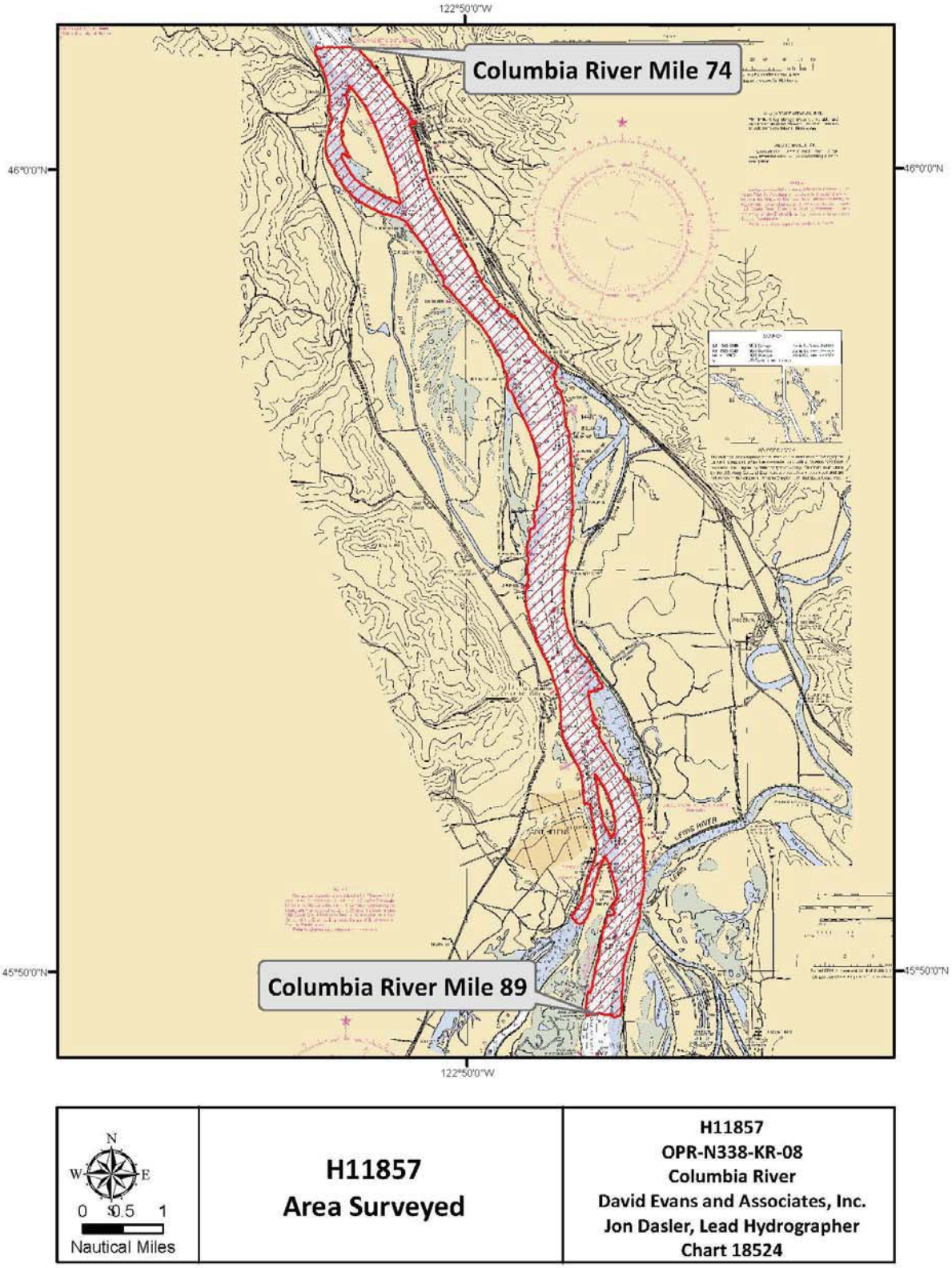

Figure 1. H11857 Survey Area

Table 1. H11857 Days of Acquisition

Dates of Acquisition	
Month	**Dates**
September 2008	12-15, 17-19, 22-30
October 2008	1-2, 17-18
February 2009	16-19, 23-24

Detailed survey statistics of H11857 are provided in Table 2.

Table 2. H11857 Survey Statistics

Survey Statistics	***Research Vessels (R/V) THEORY and PRESTON***
MBES (mainscheme nm)	528.87
Crosslines (MBES nm)	29.20
Number of Item Investigations that required additional survey effort	13
Total number of square nautical miles	6.20

B. DATA ACQUISITION AND PROCESSING

B1. Equipment

Equipment and vessel used for data acquisition and survey operations during this survey are listed in Table 3 and Table 4.

Table 3. R/V Theory Equipment and Vessel Specifications

R/V THEORY	
	
Hull Registration Number	IAR34CATA808
Official Number (O/N)	1217549
Builder	Armstrong Marine
Design	Catamaran
Year Built	2008
Length Overall	36’
Beam	13’
Draft, Maximum	3’
Cruising Speed	26 knots
Max Survey Speed	9 knots
Primary Echosounder	RESON 7125-B
Sound Velocity Equipment	Brooke Ocean MVP-30 with AML Smart SV & P Reson SVP-70 Sea-Bird SEACAT SB-19 CTD Profiler
Positioning & Attitude	Applanix POS/MV 320 v4 RTK compatible

Table 4. R/V Preston Equipment and Vessel Specifications

R/V Preston	
	
Hull Registration Number	ABTJOHNB3090
Official Number (O/N)	WN0437NX
Builder	Action Boats Inc.
Design	Custom Monohull Jet
Year Built	1990
Length Overall	31’
Beam	8.5’
Draft, Maximum	16”
Cruising Speed	24 knots
Max Survey Speed	7 knots
Primary Echosounder	RESON 8101
Sound Velocity Equipment	Sea-Bird SEACAT SB-19 CTD Profiler AML SV Plus
Positioning & Attitude	Applanix POS/MV 320 v4 RTK compatible

There were no vessel or equipment configurations used during data acquisition that deviated from those described in the *OPR-N338-KR-08 Data Acquisition and Processing Report* (DAPR).[2]

B2. Quality Control

Quality control is discussed in detail in Section B of the DAPR. The results from the positioning system comparison and bar check comparison are included in Separate I *Acquisition and Processing Logs* and the sound velocity profile sensor weekly evaluation table can be found in Separate II *Sound Speed Data* section of this report.[3] Data were reviewed at multiple levels of data processing including CARIS Hydrographic Information Processing System (HIPS) conversion, subset editing, and analysis of anomalies revealed in combined uncertainty and bathymetry estimator (CUBE) surfaces. Both baring and submerged significant features identified during survey were noted in the acquisition logs and saved to Hypack target files or Isis Cursor log files and then displayed during HIPS editing to aid in the interpretation of data and act as a check during feature compilation

B2.a Crosslines

A total of 29.20 nautical miles of crosslines, or 5.52% of mainscheme lines, were run for analysis of survey accuracy. Crosslines were run in a direction perpendicular to mainscheme lines across the entire surveyed area providing a good representation for analysis of consistency.

Crossline analysis was performed using the Caris HIPS QC Report tool, which compares crossline data to a gridded surface and reports results by beam number. Crosslines were compared to a 50 centimeter CUBE surface that encompassed the entire survey area. This surface was not included with the deliverables due to its large file size. The QC Report tabular output and plots are included in Separate IV *Crossline Comparisons*.[4] The results of the analysis exceed the requirements as stated in the National Ocean Service (NOS) *Hydrographic Surveys Specifications and Deliverables* (April 2007).[5]

B2.b Uncertainty

The calculated uncertainty values of all nodes within the unfinalized CUBE surfaces range from 0.116 meters to 0.303 meters.

During HIPS processing, the "greater of the two" option was selected, where the calculated uncertainty from total propagated uncertainty (TPU) is compared to the standard deviation of the soundings influencing the node, and the greater value is assigned as the final uncertainty of the node. As a result, the uncertainty of the finalized surface and associated Bathymetric Attributed Grids (BAGs) increased for nodes, where the standard deviation of the node was greater than the calculated uncertainty. No area within the survey exceeds International Hydrographic Organization (IHO) Order 1 specifications for depth accuracy.[6]

B2.c Junctions

H11857 junctions with survey H11858 to the south and H11856 to the north. The H11858 junction was visually reviewed in Caris HIPS subset mode and a difference analysis was performed using Caris Bathy DataBASE. The H11856 junction analysis is referenced in the *H11856 Descriptive Report.*[7]

In general, the surveyed depths at junction H11857 and H11858 are within 10cm in the main navigation channel. Larger differences occur at the steep cliff face on the west bank of the Columbia River and in the area of naturally migrating sand waves on the east bank.[8] Table 5 lists survey lines that were not used in the junction analysis due to their later acquisition date creating significant discrepancies with the original data.

Table 5. Lines Excluded from Junction Analysis

Lines Excluded from Junction Analysis
2009PR0471905
2009PR0471908
2009PR0471909
2009PR0471910
2009PR0471911
2009PR0472121
2009PR0472131

B2.d Unusual Conditions or Data Degradation

Artifacts in Reson 7125 Bottom Tracking Algorithm

There is an error in the Reson 7125 bottom tracking algorithm that causes bottom detection (beams 86-115 and 140-168) to lock on to stronger sonar returns bleeding over from more nadir returns (Figure 2). This may be related to the amplitude bottom detection used near nadir and the bottom detection locking on to the strong nadir return signal, rather than the actual bottom return for that designated beam area. These artifacts occur in two areas near nadir and are more prevalent on a hard bottom, such as a dredged channel, when the amplitude of the nadir return is the strongest. The artifacts run along track and can exceed 20 cm in the raw soundings, but are reduced to 5 cm to 10 cm in the CUBE surface.[9] Attempts to remove these artifacts during survey operations with changes in sonar settings were unsuccessful. Reson is aware of this issue and is working towards a resolution with a different bottom tracking algorithm.

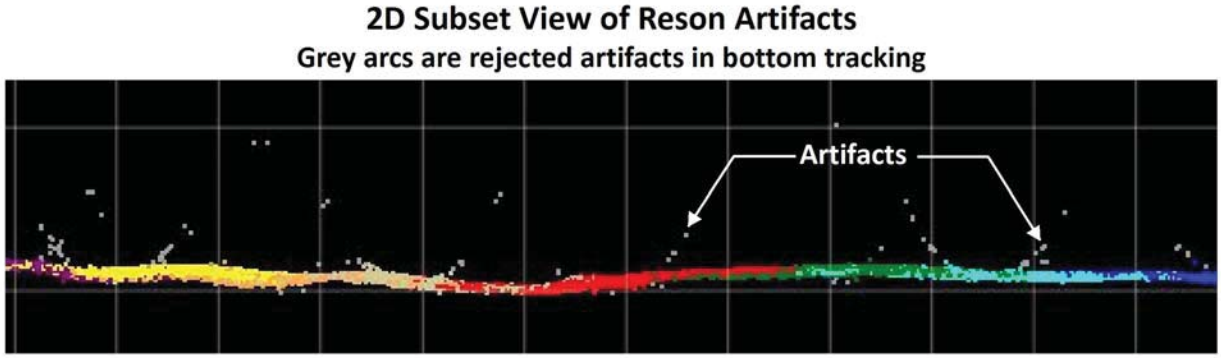

Figure 2. Artifacts in Reson 7125 bottom tracking algorithm

Snags and Deadheads
Snags and deadheads are common along the Columbia River. Any feature, submerged or baring that was determined to be seasonal or transient in nature was removed from the data.

B2.e Object Detection and Coverage Requirements

Survey speeds were maintained at less than 9 knots, so that object detection requirements were exceeded throughout the survey.[10]

High resolution, 50-centimeter CUBE surfaces were created over the entire survey area. The disambiguation method selected to create all 50-centimeter CUBE surfaces was "Shoal," which corresponds to the NOS *Hydrographic Surveys Specifications and Deliverables* (April 2007) Object Detection Coverage requirements. Survey coverage was reviewed to ensure that no data gaps (more than 3 connected open nodes) were present within AWOIS radii and maintained navigation channels.

Outside maintained navigation channels Complete Coverage requirements were demonstrated by creating one meter CUBE surfaces with "Deep" disambiguation method selected, which corresponds to the NOS *Hydrographic Surveys Specifications and Deliverables* (April 2007) Complete Coverage requirements. Survey coverage was reviewed to ensure that no data holidays (more than 3 connected open nodes) were present. In a telephone conversation on January 7, 2009 between the Pacific Hydrographic Branch (PHB) and DEA it was agreed that the one meter surfaces would be created and reviewed by DEA hydrographers, but not submitted with the delivered dataset in order to reduce data storage needs.

B3. Corrections to Echo Soundings

Data reduction procedures for survey H11857 are detailed in the *OPR-N338-KR-08* DAPR, submitted under separate cover. The multibeam swath angle filter that was applied to each survey day varied depending on location, conditions, and sonar type. In general, Reson 7125 survey lines were unfiltered and used the entire 128-degree swath. Reson 8101 survey lines were filtered at a 60/60-degree angle from nadir for mainscheme hydrography and 60/90 or 60/75 for survey lines along the shoreline. For detailed information pertaining to applied filters please refer to the multibeam processing logs in Separate I *Acquisition and Processing Logs.*[11]

The survey area for H11857 contained numerous bearing features. The least depths of baring features were marked as "Examined" and the rest of the structure was flagged as "Rejected" to the mudline. The use of the examined sounding flag to track baring items aided hydrographers during the feature management compilation process. Baring features are not included in the finalized bathymetric sounding set. This was done to ensure that the generated surface represented the true river bottom and submerged features.

B3.a Deviations from DAPR

The post-survey calibration report for Applied Microsystems AML SV Plus (serial number 3591) has not yet been received from the manufacturer. The AML3591 was compared to another AML SV Plus (serial number 3592) as well as both AML Smart SV&Ps (serial numbers 5110 and

5111) as part of a weekly confidence check for sound speed determination. All comparisons passed within the National Oceanic and Atmospheric Administration (NOAA) specifications.[12]

Multibeam swath coverage images of sun illuminated depth and uncertainty layers have not been submitted as this requirement has been dropped from recent versions of NOS *Hydrographic Surveys Specifications and Deliverables.* These layers have been submitted in both BAG and CUBE format.[13]

There are no other deviations from the *OPR-N338-KR-08* DAPR.

B3.b Additional Calibration Tests

The initial system calibration tests for the *R/V Theory* and *R/V Preston* were performed on August 15, 2008 (DN228) and August 29, 2008 (DN242), respectively. Additional tests were performed periodically to verify the adequacy of the known system biases and document changes in alignment offsets due to sensor remounting and sonar strikes on submerged objects. Additional discussion on calibration tests can be found in the *OPR-N338-KR-08* DAPR.

B4. Data Processing (Data Representation)

CUBE surface resolutions and depth ranges were set in accordance with the NOS *Hydrographic Surveys Specifications and Deliverables* (April 2007). Final CUBE surfaces were created at a 50-centimeter resolution to meet Object Detection requirements. Some data gaps exist in the 50-centimeter grids; however, the grids still meet coverage requirements for the survey. Near shore coverage, in some areas less than 4 meters used, Set Line spacing and gaps are present between survey lines. Additionally, coverage outside of the maintained channel only required a one meter resolution and small data gaps may be visible in the 50-centimeter surfaces, but still meet requirements in these areas.[14] Complete Coverage requirements were met and all data gaps, three nodes or greater, were filled prior to ceasing survey operations.

In order to keep CUBE surfaces at a manageable size, the main survey area was broken up into six Field Sheets organized by corresponding Columbia River mile (H11857_CRM_75-77, etc.). When combined, the Fields Sheets encompass the entire area of acquired multibeam bathymetry. A BAG was created for each finalized CUBE surface and both the CUBE and BAG surfaces have been included with the digital data.

C. HORIZONTAL AND VERTICAL CONTROL

Due to the CRD, the project chart datum, being a non-tidal gradient datum and the complex hydrodynamics of the Columbia River, the project chart datum, *OPR-N338-KR-08* was approved as a pilot project for the use of GPS water levels acquired directly at the survey vessel. With the exception of tide reduction of baring features, traditional zoning from water level stations was not used for this project though zoning provided by Center for Operational Oceanographic Products and Services (CO-OPS) and verified water level files for the survey have been included with the digital deliverables

Prior to survey acquisition, two GPS base stations with a dual frequency (L1/L2) receiver were established in Washington at Kalama and in Oregon at the CO-OPS water level station in St. Helens. The base stations logged raw dual frequency (L1/L2) GPS observables at one second epochs as well as broadcast real-time kinematic (RTK) corrections to the survey vessels. The base station closest to the area surveyed broadcast the RTK correctors. This base station was later used to post-process the navigation data. Base station positions relative to the North American Datum of 1983 (NAD83) (CORS96) (Epic 2002) were derived from the NGS (National Geodetic Survey) On-line Positioning User Service (OPUS) and were based on a 24-hour data file, with one second-epoch logging prior to commencement of survey operations.

A separation model of CRD relative to NAD83 was created and formatted to allow for direct integration with Hypack and Caris HIPS. The model input used a river profile of CRD relative to North American Vertical Datum of 1988 (NAVD88) provided by the U.S. Army Corps of Engineers (USACE), Portland District (the designated stewards of CRD). GEOID 03 was used to transfer the NAVD88 to CRD relationship directly to the NAD83 ellipsoid, which allowed direct computation of GPS water levels from ellipsoid heights recorded at the survey vessel. The model file (.bin) used to compute GPS water levels in HIPS, has been included with the digital deliverables.

RTK navigation was logged during acquisition and applied during preliminary data processing, but ultimately overwritten with a post-processed Inertially-Aided Kinematic Ambiguity Resolution (IAKAR) navigation solution. The HIPS Load Attitude and Navigation tool was used to load position, GPS height, and attitude data from a smoothed best estimate trajectory (SBET) file create from Applanix POSPac.

A complete description of horizontal and vertical control for survey H11857 can be found in the *OPR-N338-KR-08 Horizontal and Vertical Control Report*, submitted under separate cover.[15] A summary of horizontal and vertical control for this survey follows.

C1. Vertical Control

The vertical datum for this project is the CRD, an adopted low-water gradient datum relative to NAVD88. There are known problems in the NGS level lines between Oregon and Washington due to the long level runs without the ability to run tie lines across the Columbia River. GPS observations have documented large vertical differences in published bench mark elevations across the Columbia River. Whereas CO-OPS water level gauges are located in Oregon and Washington and are directly referenced to NGS published bench mark elevations, and the known issue with the level lines between Oregon and Washington, a decision was jointly made by the USACE and NOAA to use NGS OPUS solutions to establish vertical consistency in the relationship of CRD relative to NAVD88. The USACE, Portland District (designated stewards of CRD) conducted surveys that established OPUS derived NAVD88 elevations on historic bench marks referencing CRD. A result of these surveys was a profile of CRD relative to OPUS derived NAVD88 elevations which were consistent across the Columbia River. The profile defined CRD relative to NAVD88 for each River Mile (RM) from RM 23 to RM 145 on the Columbia River and RM 0 to RM 26 on the Willamette River. This profile is used by the USACE, Portland District for hydrographic surveys and dredging operations to maintain the Federal Channel on the Columbia and Willamette rivers.

To improve vertical accuracy of this survey, soundings were reduced to CRD using GPS water levels measured at the survey vessel. Water levels were derived from post processed GPS heights and application of a separation model of the CRD to NAD83 ellipsoid relationship. Data reduction procedures, including detailed discussions of the CRD model generation and GPS water levels computations, for survey H11857 are detailed in the *OPR-N338-KR-08* DAPR.

To verify GPS water levels, a comparison was made by vessel static observations adjacent to the CO-OPS water level stations 9440422 located in Longview, Washington and 9439201 located in St Helens, Oregon. To obtain water levels relative to the CO-OPS defined CRD, the Hydrographer selected Station Datum when downloading data from the CO-OPS web site. This is consistent with obtaining CRD values for any CO-OPS station on the Columbia River above RM 23. Adjustments were required to correct CO-OPS water level data to CRD based on the updated USACE CRD profile used to maintain the Columbia and Willamette rivers.

An additional adjustment was applied to correct local tidal bench marks with orthometric heights based on NGS level lines to OPUS derived NAVD88 elevations to match the USACE profile and eliminate errors from distorted level lines. As a result of these comparisons, the Hydrographer discovered a large deviation from the CO-OPS data reported from station 9440422 in Longview, WA. After running digital levels from CO-OPS tidal bench marks and recording a 1-hour series of 6-minute water level observations with an optical level, it has been determined that the CO-OPS water level station in Longview, WA (9440422) is incorrectly reporting water levels relative to the station tidal bench marks and should be corrected by -0.071 meters to match CO-OPS tidal bench marks. CO-OPS is aware of this issue and is working toward resolving the problem.

It should be noted that these adjustments were applied to CO-OPS water level data for comparison purposes of water level data relative to the revised USACE profile relative to OPUS derived NAVD88 elevations. Application of the USACE CRD profile and use of GPS water levels was approved for project OPR-N388-KR-08 by the Office of Coast Survey, Hydrographic Surveys Division Chief as it is consistent with the USACE, Portland District, methods for maintaining the Federal Channel in the Columbia and Willamette rivers. Further, CO-OPS should adjust water level stations on CRD and part of the Columbia PORTS® system to be consistent with the defined CRD profile by the USACE, Portland District. Tables 6 and 7 list corrections to be applied to CO-OPS data to be consistent with the Portland District CRD profile.

Table 6. Corrections Applied to 9440422 Longview, Washington

Description of Adjustment	Adjustment (m)
Revised CRD Value to 0.804m NAVD88 from CO-OPS 0.764m NAVD88	-0.040
Adjustment to OPUS elevation for Tidal Bench Mark SA 89 MON 4	-0.052
CO-OPS Gauge Correction Based on Optical Level Water Surface Observations	-0.071
Total Adjustment to CO-OPS Data in Longview, WA	**-0.163**

Table 7. Corrections Applied to 9439201 Saint Helens, Oregon

Description of Adjustment	Adjustment (m)
Revised CRD value to 1.291m from 1.286m NAVD88	-0.005
Total Adjustment to CO-OPS Data in St Helens, Oregon	**-0.005**

Water level observations, OPUS position results and gauge comparison data may be found in Appendix IV. No configurations used during data acquisition deviated from those described in the *OPR-N338-KR-08* DAPR.

C2. Discussion of GPS Tides

The coordinates of the GPS base stations used during acquisition and processing of H11857 are included in Table 8. The reference base stations used for both RTK and post processing are listed in the survey acquisition logs and POSPac processing logs included in Separate I *Acquisition and Processing Logs*.

Table 8. H11857 NAD83 Base Stations Positions

RTK Base Station	Latitude (N)	Longitude (W)	Ellipsoid Height
STHL	45 51 47.95572	122 47 46.32988	-7.715 m
KLMA	46 00 20.45579	122 50 50.13183	-11.153 m

As discussed in the *OPR-N338-KR-08* DAPR, the use of GPS water levels eliminated large errors associated with discrete zoning and significantly reduced vertical uncertainty for this survey. Typical tide zoning artifacts for the survey area could exceed 30 centimeters, but as a result of using GPS water levels there are no visual tidal artifacts present in this survey.

C3. Horizontal Control

The horizontal datum for this project is the NAD83. Differential GPS (DGPS) and RTK positioning were used simultaneously throughout acquisition with DGPS positions only used for a real-time confidence check. DGPS corrections were received from the U.S. Coast Guard (USCG) beacon at Fort Stevens, Washington (287 kHz) or from the secondary beacon at Appleton, Washington (300 kHz). Some DGPS outages from the primary beacon occurred during survey operations. The system was set up to automatically switch to the secondary beacon when the primary signal was lost, so all of the secondary navigation data were collected in DGPS mode.

Navigation and attitude data were post-processed using Applanix POSPac MMS software, which produced an IAKAR navigation solution relative to NAD83. The GPS reference station and position used during post-processing were identical to those used for RTK broadcast during acquisition.

The real-time navigation and attitude logged during acquisition was overwritten with post-processed data during HIPS processing. Post-processed navigation, attitude and GPS heights were applied to all HIPS data unless POSPac processing errors created data outages in the SBET files, which prevented application to some survey lines. These survey lines, which use real-time sensor data, including RTK navigation and GPS heights, are listed in Table 9.

Table 9. Survey Lines Using Real-time Sensor Data

Survey Vessel (S/V)	Day Number (DN)	Survey Line
Theory	262	2008TH2621942
Theory	269	2008TH2691623 2008TH2692049 2008TH2692052
Theory	270	2008TH2702317 2008TH2702318
Preston	273	2008PR2732228
Preston	274	2008PR2741447

Quality checks of RTK navigation procedures and comparison to post processed data discussed in the *OPR-N338-KR-08* DAPR and *OPR-N338-KR-08 Horizontal and Vertical Control Report* demonstrate that the use of RTK is also a reliable method to obtain GPS water levels. Survey lines using RTK have been thoroughly reviewed and exceed accuracy requirements for the survey.

D. RESULTS AND RECOMMENDATIONS

D1. Chart Comparison

D1.a Survey Agreement with Chart

During the course of data acquisition and processing, H11857 was compared to the largest scale raster and electronic navigation charts (RNC and ENC). The results of these comparisons are described below, as well as in Sections D1.b through D1.f of this report.

Contours and soundings used during the chart comparison were generated from combined HIPS product surfaces. Soundings and contours were generated from a 5-meter HIPS product surface (1:10,000) of the entire survey area, which was compiled from all finalized CUBE surfaces for the survey. The product surfaces, contours, and soundings were created solely for quality assurance and chart comparison and have not been submitted as a final deliverable.

H11857 contours and soundings were compared in Caris HIPS to the depths and contours on the charts listed in Table 10.

Table 10. Charts compared to H11857

Chart	Scale	Edition	Edition Date	Issue Date	Latest LNM	Cleared Through Date
18524	1:40,000	36	12/01/2006	5/23/2009	18/09	05/02/2009
18525	1:40,000	36	04/01/2009	5/23/2009	18/09	05/02/2009
US5OR13M	---	33	---	04/28/2009	---	---
US5OR14M	---	25	---	05/01/2009	---	---

Survey H11857 depths were compared to the charted soundings on inset chart 18524 and chart 18525 and the corresponding ENC US5OR13M and US5OR14M. In general there is good agreement between depths from survey H11857 and the charts. Based on the distribution of the differences, the hydrographer believes that the changes are the result of natural shoaling.[16]

Chart 18524 incorrectly reads “Multinomah Channel.” This should be revised to spelling of Multnomah.[17]

The latest electronic and raster versions of the relevant charts were reviewed to ensure that all USCG Local Notice to Mariners (LNM) issued during survey acquisition, impacting the survey area, were applied and addressed by this survey.

D1.b Comparison to Significant Shoals

South of Elder Rock on the west side of Sandy Island significant shoaling has occurred (CRM 75). Current bathymetry reduces depths to 2-feet (0.7 m) where the chart shows a depth range of 8 to 11-feet. Numerous stumps, snags, and an uncharted rock were located in this area (Figure 3) and are included in the S-57 feature file.[18]

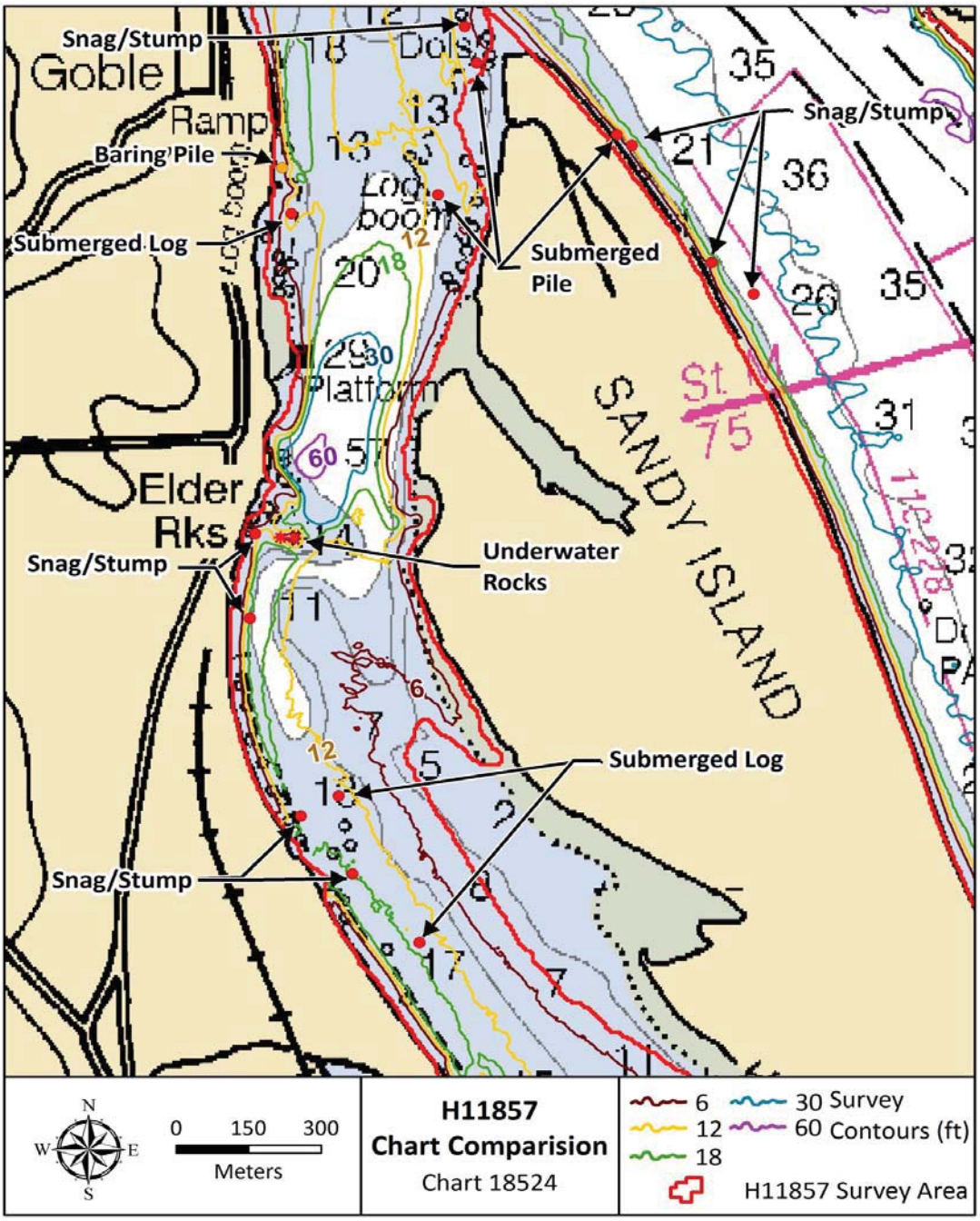

Figure 3. Shoaling and Obstructions at Elder Rocks behind Sandy Island

There is a general deepening trend near charted Bachelor Shoal at CRM89. Bachelor Shoal was surveyed to be 3 to 6 feet (0.9 to 1.8 m) deeper than charted (Figure 4).[19]

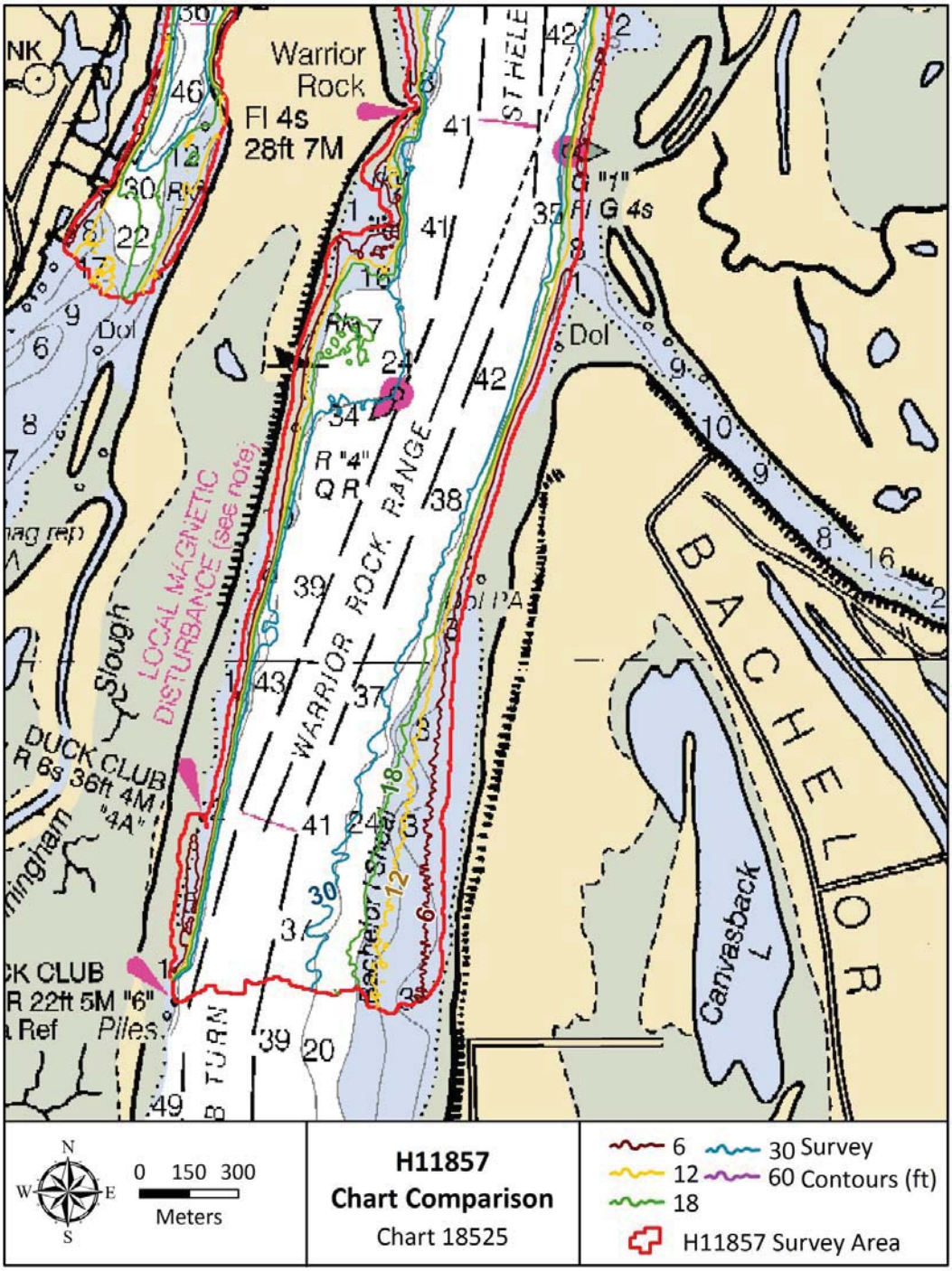

Figure 4. Bachelor Shoal

D1.c Comparison to Charted Features

No assigned AWOIS items were located within the limits of survey H11857.[20] A complete description of features verified or disproved by H11857 is available in Appendix II *Survey Feature Report*.[21]

D1.d Comparison of Soundings in Designated Anchorages and Along Channels

There are two designated anchorages within survey H11857. Surveyed depths within Anchorage Area 110.228, located at CRM 84, generally agrees except for minor shoaling in the southeast corner. Surveyed depths within Anchorage Area 110.228, located at CRM 75, generally agree with charted depths; however, there H11857 located depths 1-3 feet shoaler than charted.[22]

There are ten named Columbia River channel sections within survey H11857. The charted project depth is 40 feet for all ten channels. The most recent channel survey report for charts 18524 and 18525 was February 2009 and September 2008 (respectively) at which time a minimum depth of 35 feet was found in the right outside quarter of the Kalama Lower Range. Table 11 lists the Columbia River channels affected by survey H11857.

Table 11. Columbia River Channels and Minimum Depths

Name of Channel	Project Depth (ft)	Controlling Depth (ft)	H11857 Minimum Survey Depth (ft)
Kalama Lower Range (partial)	40	35	37
Kalama Upper Range	40	43	39
Bybee Ledge Channel	40	43	41
Martin Island Channel	40	43	41
Martin Island Range	40	41	39
Columbia City Channel	40	41	39
St. Helens Range	40	39	36
St. Helens Turn	40	39	39
Warrior Rock Range	40	36	35
Duck Club Turn (partial)	40	41	43

Seven of the ten channels, though generally deeper than the project depth, had shoaler soundings than 40 feet. The following is a list of representative controlling depths for H11857 for those channels:[23]

- Surveyed depth of 36.9 feet (11.25 m) was found in the right outside quarter of Kalama Lower Range at 46/01/21.671N, 122/52/08.982W.
- Surveyed depth of 39.2 feet (11.95 m) was found in the right outside quarter of Kalama Upper Range at 46/00/07.229N, 122/51/02.904W.
- Surveyed depth of 39.7 feet (12.10 m) was found in the left outside quarter of Martin Island Range at 45/55/22.015N, 122/48/20.940W.

- Surveyed depth of 39.0 feet (11.89 m) was found in the left outside quarter of Columbia City Channel at 45/54/08.789N, 122/48/22.124W.
- Surveyed depth of 36.2 feet (11.03 m) was found in the right outside quarter of St. Helens Range at 45/52/17.056N, 122/47/20.820W.
- Surveyed depth of 39.7 feet (12.10 m) was found in the right outside quarter of St. Helens Turn at 45/51/18.544N, 122/47/06.899W.
- Surveyed depth of 35.3 feet (10.76 m) was found in the right outside quarter of Warrior Rock Range at 45/50/10.056N, 122/47/29.644W.

In addition to the main Columbia River channels, Multnomah Channel branches off of St. Helens Range, just south of Columbia City, OR. The Multnomah Channel was last surveyed April 2000-2004 and has a charted controlling depth of 25 feet. The minimum surveyed depth of 23.6 feet (7.19 m) was found at 45/52/16.944N, 122/47/48.188W.[24]

D1.e New Submerged Features

New submerged features are listed in tabular format in Appendix II *Survey Feature Report*.[25]

D1.f Dangers to Navigation

One (1) DtoN was located during survey H11857 and was submitted to PHB. This DtoN was not deemed worthy of charting by PHB; however, the obstruction is included in the S-57 feature file.[26]

D.2 Additional Results

D2.a Shoreline Investigations

There is a new gravel conveyor loading facility (Figure 5) constructed with six new dolphins at approximately CRM 82.7.[27]

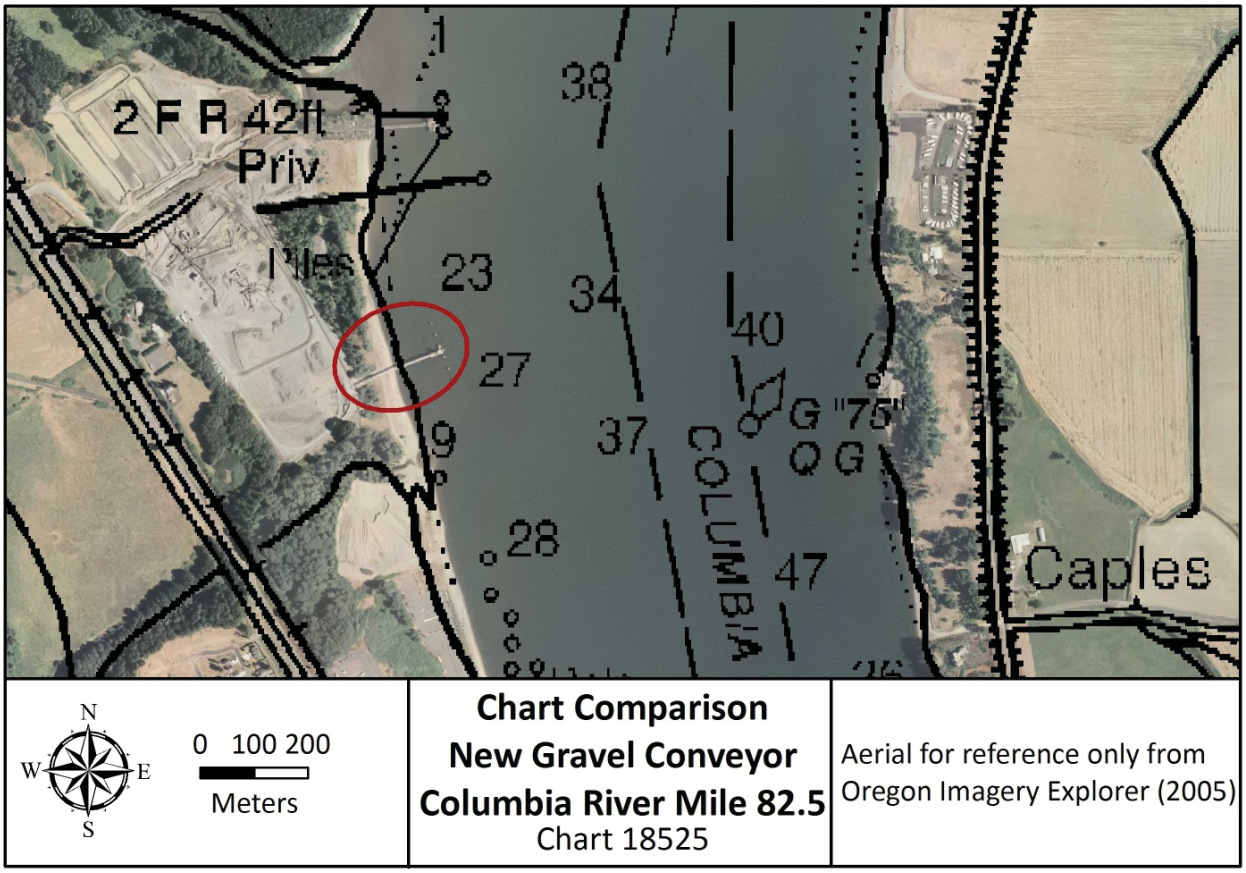

Figure 5. New Gravel Conveyor

D2.b Comparison with Prior Surveys

Comparison with prior surveys was not required under this task order.

D2.c Aids to Navigation (AtoN)

All USCG aids to navigation (AtoN) within the survey limits were found to be correctly charted and serving their intended purpose.[28]

D2.d Overhead Clearance

There are no overhead obstructions impacting survey H11857.

D2.e Cables, Pipelines and Offshore Structures

The charted pipeline area at CRM 77 was not observed in multibeam data.[29]

A sewer pipeline was located in Multnomah Channel, continuing through the northern tip of Sauvie Island, and terminating at the western boundary of the charted shipping channel at CRM 87. The pipeline is visible for a length of 151 feet (46 m) in the Multnomah Channel just north of the charted pipeline. The pipeline is also visible for a length of 150 feet (45 m) in the Columbia River off of Warrior Point, Sauvie Island slightly north of the charted pipeline.[30]

An uncharted, elevated pipe that is approximately 66 feet (20 m) in length was located south of the Kalama Marina adjacent to a charted dolphin at approximately CRM75.4 (Figure 6).[31]

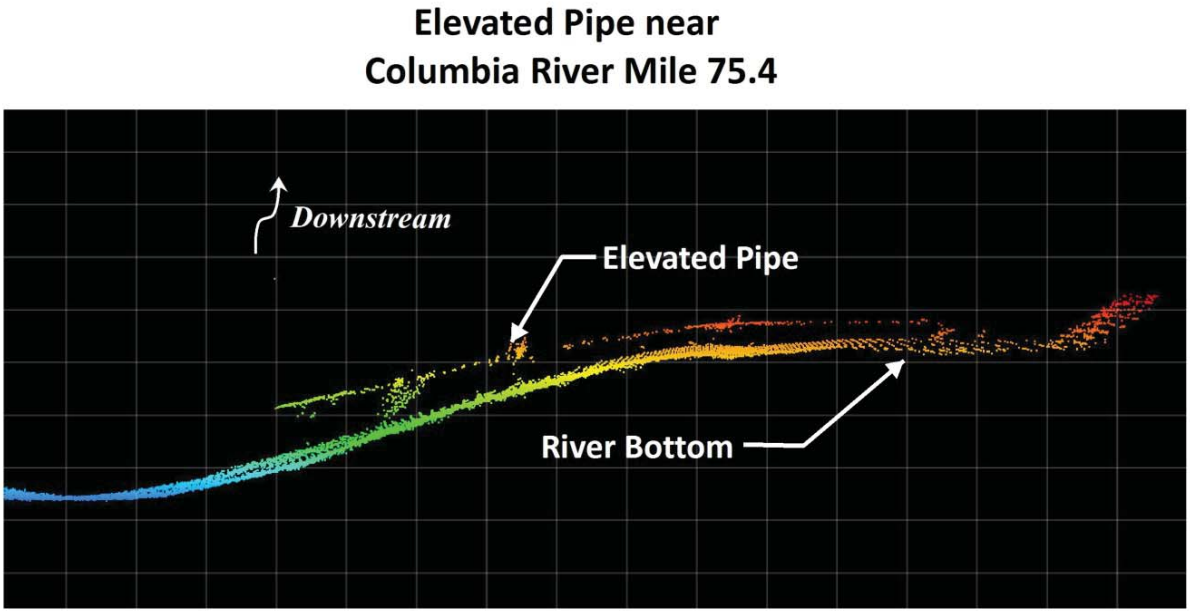

Figure 6. Elevated Pipe

A charted cable area was located within the survey area and did not affect survey operations. No evidence of the cables was observed within the charted cable area at CRM 87.[32]

D2.f Environmental Conditions Impacting the Quality of the Survey

Although the survey exceeds IHO Order 1 accuracy requirements, environmental conditions degraded the quality of the survey data. Due to the dynamic nature of the Columbia River with its heavy sediment transport, sand wave migration (up to one meter of downstream migration per

day), has altered the river bottom over time, creating an offset between fill and mainscheme data.[33]

The difference in offset varies over the survey, depending upon the local sand wave formation and the time between fill and mainscheme data collection. Figure 7 shows an example of downstream sand wave migration impacting agreement between mainscheme and fill data.

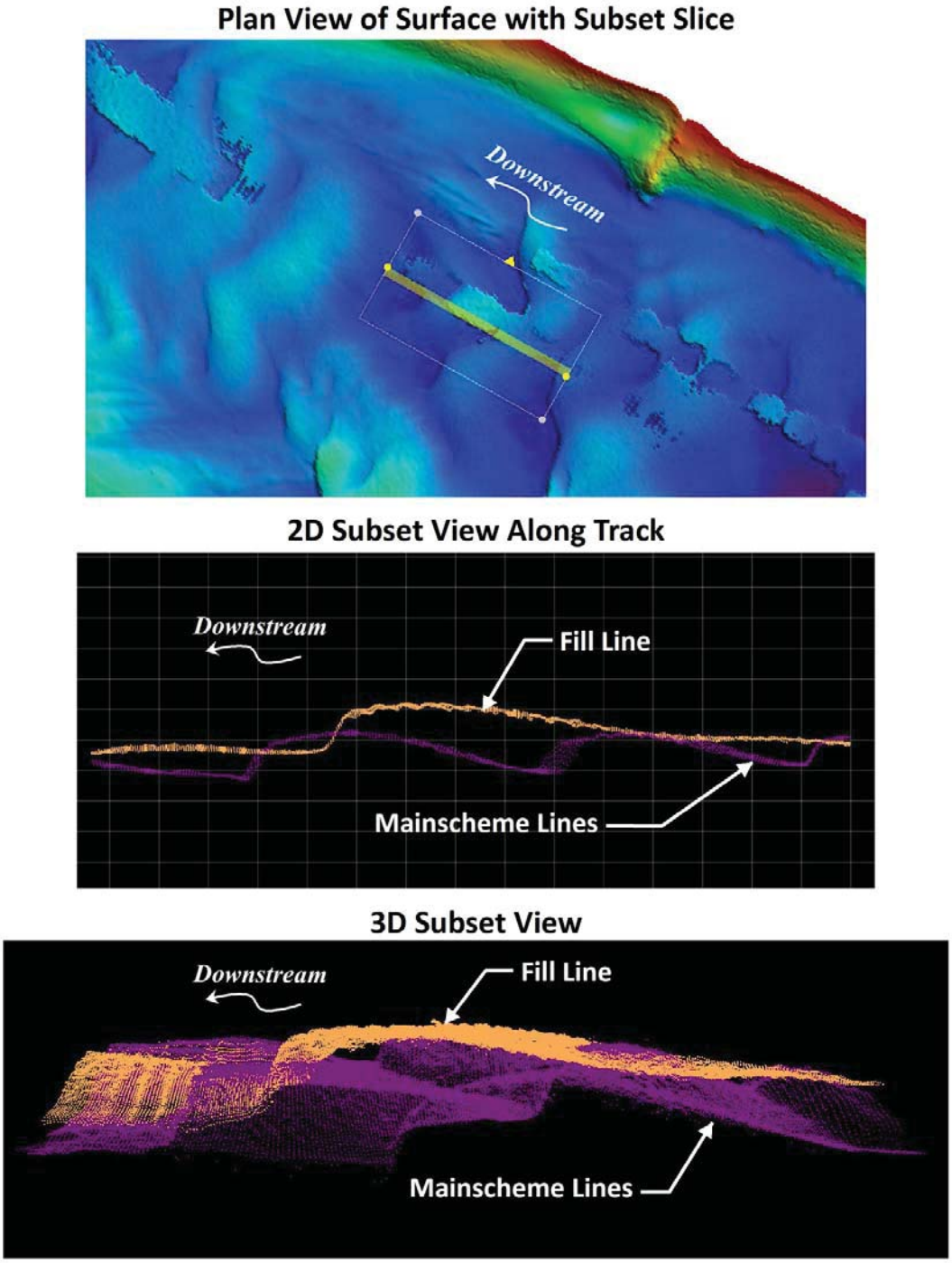

Figure 7. Example of Sand Wave Migration

D2.g Construction Projects

Dredging activities were observed on September 12, 2008 (DN256) between CRM 83-86. Survey operations were not affected, but river bed changes from dredging operations did impact fill agreement with main scheme lines when run after dredging.

During survey operations on sheet H11857 a ship grounded, outside of the Federal channel, in the vicinity of the Port of Kalama Harvest States terminal. A peak of one of the sand waves was surveyed at 36 feet. Dredging operations commenced to deepen the approach to the terminal. Data acquisition in this area occurred before dredging operation commenced. This area contains 15-foot high sand waves that have been determined to migrate 3 feet per day based on periodic surveys of this area.

D2.h Bottom Characteristics

Seventeen (17) bottom samples were obtained on September 27 & 29, 2008 (DNs 271 and 273) and are included in the S-57 attributed feature file in the *Supporting Data* folder.[34] A table listing the position and description of each bottom sample is included in Appendix V *Supplemental Survey Records and Correspondence*, along with photographs of each sample.[35]

E. LETTER OF APPROVAL

The letter of approval for this report and accompanying data follows on the next page.

DAVID EVANS AND ASSOCIATES INC.

LETTER OF APPROVAL

OPR-N338-KR-08
REGISTRY NO. H11857

This report and the accompanying data are respectfully submitted.

Field operations contributing to the accomplishment of survey H11857 were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and associated data have been closely reviewed and are considered complete and adequate as per the *OPR-N338-KR-08 Statement of Work*, dated April 1, 2008.

Digitally signed by Jon Dasler
DN: cn=Jon Dasler, email=jld@deainc.com, o=David Evans and Associates, Inc., c=US
Date: 2009.07.09 10:33:29 -07'00'

Jonathan L. Dasler, PE (OR), PLS (OR, CA)
Lead Hydrographer

Digitally signed by Jason Creech
DN: cn=Jason Creech, email=jasc@deainc.com, o=David Evans and Associates, Inc., c=US
Date: 2009.07.09 10:34:08 -07'00'

Jason Creech
Lead Hydrographer

David Evans and Associates, Inc.
February 2009

F. SUPPLEMENTAL REPORTS

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

Title	**Submittal Date**
OPR-N338-KR-08 Data Acquisition and Processing Report	June 17, 2009
OPR-N338-KR-08 Horizontal and Vertical Control Report	TBD[36]

Revisions and Corrections Compiled During Office Processing and Certification

[1] See the Horizontal and Vertical Control Report filed with project records.
[2] Filed with project records.
[3] Separates are filed with hydrographic records.
[4] Filed with hydrographic records.
[5] Concur.
[6] Concur. These data are adequate to supersede charted data in the common area.
[7] Concur with clarification. The junction comparison in the H11856 Descriptive Report states that "In general, the depth differences between H11856 and H11857 are within 15 centimeters, with the largest differences correlating to the natural migration of sand waves mid-channel and along the steep east bank of the Columbia River." Compiler recommends a note be added to the charts stating that mariners use caution when navigating outside the maintained channels.
[8] Concur. Compiler recommends a note be added to the charts stating that mariners use caution when navigating outside the maintained channels.
[9] Despite the artifacts from the bottom tracking algorithm, the data meets specification.
[10] Concur.
[11] Filed with hydrographic records.
[12] Concur.
[13] Concur.
[14] Concur.
[15] Filed with project records.
[16] Concur. Updated soundings are included in HCell H11857.
[17] Concur. A blue note is included in the HCell to fix the spelling of Multnomah.
[18] Concur. The updated soundings and new features are included in HCell H11857.
[19] Concur. Updated soundings are included in the HCell.
[20] Concur with clarification. There are four AWOIS items within the limits of survey H11857, however, none were assigned for investigation. A new wreck was identified 123m to the southeast of a charted wreck at 45-50-25.350N, 122-47-34.160W. The new wreck is included in the HCell and it is recommended that it be added to the AWOIS database.
[21] See attached feature report.
[22] Concur. Updated soundings are included in the HCell.
[23] The US Army Corps of Engineers Portland District has been contacted and have been made aware of the survey results. Given the fact that the Columbia River Channels are continually being dredged, it is recommended that the tabulated depths for each channel be updated with the latest survey information.
[24] Recommend updating controlling depth in Multnomah Channel with the latest survey information. See endnote 23.
[25] See attached feature report.
[26] Concur with clarification. The DTON was not considered dangerous and therefore not forwarded to MCD, however, it is included in the HCell as an obstruction feature at 49-59-56.324N, 122-52-11.881W. See attached feature report.
[27] The new gravel conveyor and dolphins are included in the HCell.
[28] Chart ATONs using latest ATONIS information.
[29] Recommend retaining the pipeline as charted.

[30] The pipeline is located inside a charted pipeline area. It is recommended that the area be retained as charted.
[31] Due to scale constraints, it is recommended that the charted dolphin be retained and the new pipeline not be charted.
[32] Recommend retaining cable area as charted.
[33] These data are adequate to supersede charted data in the common area despite the shifting nature of the sandwaves. Compiler recommends a note be added to the chart stating that mariners use caution when navigating outside the maintained channels.
[34] Seventeen bottom samples were collected during H11857 and all are included in the HCell. One charted bottom sample was blue noted to be retained.
[35] Filed with hydrographic records.
[36] The Horizontal and Vertical Control Report was submitted July 22, 2009.

APPENDIX II
SURVEY FEATURE REPORT

NO AWOIS ITEMS WERE ASSIGNED TO H11857

Appendix II
S-57 Features

OPR-N338-KR-08
H11857
Survey Features
PILPNT

Disproved:

ENC Latitude (N)	ENC Longitude (W)	Surveyed Latitude (N)	Surveyed Longitude (W)	Remarks
45-50-22.988N	122-47-35.708W	--	--	Disproved
45-51-31.616N	122-47-40.273W	--	--	Disproved
45-51-43.421N	122-47-42.651W	--	--	Disproved
45-53-38.334N	122-48-24.577W	--	--	Disproved
45-53-54.686N	122-48-32.138W	--	--	Disproved
45-54-02.984N	122-48-37.867W	--	--	Disproved
45-54-19.716N	122-48-48.832W	--	--	Disproved
45-54-21.892N	122-48-48.925W	--	--	Disproved
45-55-45.479N	122-48-08.655W	--	--	Disproved
45-57-13.138N	122-48-24.112W	--	--	Disproved
45-57-12.677N	122-48-21.564W	--	--	Disproved
45-57-13.638N	122-48-22.447W	--	--	Disproved
45-57-14.773N	122-48-22.094W	--	--	Disproved
45-57-15.979N	122-48-25.246W	--	--	Disproved
45-57-17.465N	122-48-25.981W	--	--	Disproved
45-57-15.661N	122-48-22.977W	--	--	Disproved
45-57-31.372N	122-49-14.650W	--	--	Disproved
45-59-10.376N	122-50-10.768W	--	--	Disproved
45-59-11.782N	122-50-11.874W	--	--	Disproved
46-00-56.328N	122-51-17.218W	--	--	Disproved
46-00-57.008N	122-51-17.916W	--	--	Disproved
46-00-51.005N	122-51-50.400W	--	--	Disproved
46-01-07.110N	122-51-28.742W	--	--	Disproved
46-01-04.608N	122-51-25.682W	--	--	Disproved
46-00-43.685N	122-52-09.263W	--	--	Disproved
46-00-52.581N	122-52-12.830W	--	--	Disproved
46-00-42.778N	122-52-24.590W	--	--	Disproved
46-00-44.891N	122-52-24.497W	--	--	Disproved

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H11857
Survey Features
PILPNT

Disproved:

ENC Latitude (N)	ENC Longitude (W)	Surveyed Latitude (N)	Surveyed Longitude (W)	Remarks
46-00-26.635N	122-52-25.911W	--	--	Disproved
46-00-09.014N	122-52-27.008W	--	--	Disproved
46-00-02.584N	122-52-20.321W	--	--	Disproved
46-00-04.574N	122-52-19.131W	--	--	Disproved
46-00-03.122N	122-52-18.601W	--	--	Disproved
45-59-55.604N	122-52-15.159W	--	--	Disproved
45-59-45.777N	122-52-05.106W	--	--	Disproved
45-59-43.431N	122-52-03.032W	--	--	Disproved
45-50-52.543N	122-47-48.452W	--	--	Disproved
45-51-18.562N	122-47-26.875W	--	--	Disproved

New:

ENC Latitude (N)	ENC Longitude (W)	Surveyed Latitude (N)	Surveyed Longitude (W)	Remarks
--	--	45-50-44.078N	122-48-04.957W	Pile
--	--	45-50-49.318N	122-47-23.841W	Pile
--	--	45-50-55.606N	122-47-47.062W	Pile
--	--	45-51-05.429N	122-47-52.103W	Pile
--	--	45-51-08.110N	122-47-51.602W	Pile
--	--	45-51-09.846N	122-47-50.085W	Pile
--	--	45-51-09.943N	122-47-48.841W	Pile
--	--	45-51-10.009N	122-47-49.935W	Pile
--	--	45-51-19.857N	122-47-37.573W	Pile chart to ENC US5OR13M, correctly charted on RNC 18524
--	--	45-51-22.078N	122-47-43.340W	Pile
--	--	45-51-24.498N	122-46-52.591W	Pile
--	--	45-51-35.294N	122-47-40.700W	Pile
--	--	45-51-44.532N	122-47-43.481W	Pile chart to ENC US5OR13M, correctly charted on RNC 18524
--	--	45-51-44.856N	122-47-43.171W	Pile chart to ENC US5OR13M, correctly charted on RNC 18524
--	--	45-51-45.195N	122-47-42.870W	Pile chart to ENC US5OR13M, correctly charted on RNC 18524
--	--	45-51-45.516N	122-47-42.578W	Pile chart to ENC US5OR13M, correctly charted on RNC 18524
--	--	45-51-45.800N	122-47-42.304W	Pile chart to ENC US5OR13M, correctly charted on RNC 18524
--	--	45-52-07.383N	122-47-52.039W	Pile

OPR-N338-KR-08
H11857
Survey Features
PILPNT

New:

ENC Latitude (N)	ENC Longitude (W)	Surveyed Latitude (N)	Surveyed Longitude (W)	Remarks
--	--	45-52-20.592N	122-47-55.028W	Pile
--	--	45-52-21.860N	122-47-54.270W	Pile
--	--	45-52-27.054N	122-47-56.564W	Pile
--	--	45-52-27.272N	122-47-56.165W	Pile
--	--	45-52-27.524N	122-47-56.485W	Pile
--	--	45-52-56.896N	122-48-16.512W	Pile
--	--	45-53-36.982N	122-48-25.006W	Pile
--	--	45-53-37.378N	122-48-25.158W	Pile
--	--	45-53-45.892N	122-48-29.558W	Pile
--	--	45-53-47.291N	122-48-30.498W	Pile
--	--	45-53-53.789N	122-48-34.604W	Pile
--	--	45-53-54.115N	122-48-34.833W	Pile
--	--	45-53-54.514N	122-48-35.082W	Pile
--	--	45-53-55.224N	122-48-35.561W	Pile
--	--	45-53-56.303N	122-48-36.310W	Pile
--	--	45-54-33.904N	122-48-55.290W	Pile, support for gravel conveyor
--	--	45-54-34.131N	122-48-55.397W	Pile, support for gravel conveyor
--	--	45-54-34.271N	122-48-54.145W	Pile, support for gravel conveyor
--	--	45-54-34.305N	122-48-54.023W	Pile, support for gravel conveyor
--	--	45-54-34.361N	122-48-54.197W	Pile, support for gravel conveyor
--	--	45-54-34.405N	122-48-54.080W	Pile, support for gravel conveyor
--	--	45-54-34.465N	122-48-53.380W	Pile, support for gravel conveyor
--	--	45-54-34.488N	122-48-53.233W	Pile, support for gravel conveyor
--	--	45-54-34.581N	122-48-53.443W	Pile, support for gravel conveyor
--	--	45-54-34.630N	122-48-53.307W	Pile, support for gravel conveyor
--	--	45-58-02.357N	122-49-00.586W	Pile
--	--	45-58-02.874N	122-49-01.123W	Pile
--	--	45-58-03.344N	122-49-01.691W	Pile

OPR-N338-KR-08
H11857
Survey Features
PILPNT

New:

ENC Latitude (N)	ENC Longitude (W)	Surveyed Latitude (N)	Surveyed Longitude (W)	Remarks
--	--	45-58-38.466N	122-49-45.304W	Pile
--	--	45-58-53.907N	122-49-56.842W	Pile
--	--	45-58-56.872N	122-49-59.423W	Pile
--	--	45-58-59.194N	122-50-01.401W	Pile
--	--	45-58-59.482N	122-50-01.893W	Pile
--	--	45-58-59.754N	122-50-02.430W	Pile
--	--	45-59-00.044N	122-50-02.892W	Pile
--	--	45-59-00.309N	122-50-03.437W	Pile
--	--	45-59-00.607N	122-50-03.910W	Pile
--	--	45-59-00.874N	122-50-04.389W	Pile
--	--	45-59-30.415N	122-51-36.295W	Pile
--	--	45-59-32.089N	122-51-41.530W	Pile
--	--	45-59-33.021N	122-51-44.065W	Pile
--	--	45-59-34.001N	122-51-46.600W	Pile
--	--	45-59-35.907N	122-51-51.613W	Pile
--	--	46-00-11.048N	122-50-51.438W	Pile chart to ENC US5OR13M, correctly charted on RNC 18524
--	--	46-00-49.718N	122-51-10.919W	Pile
--	--	46-00-50.044N	122-51-11.175W	Pile
--	--	46-00-50.286N	122-51-11.565W	Pile
--	--	46-00-51.700N	122-52-24.954W	Pile

OPR-N338-KR-08
H11857
Survey Features
PIPSOL

New:

Surveyed SOL Latitude	Surveyed SOL Longitude	Surveyed EOL Latitude	Surveyed EOL Longitude	Remarks
46-00-19.980N	122-50-54.312W	46-00-20.160N	122-50-53.412W	Elevated pipe
45-51-15.336N	122-47-24.756W	45-51-14.814N	122-47-22.776W	Pipe in charted pipeline area
45-51-19.350N	122-47-40.092W	45-51-19.854N	122-47-42.108W	Pipe in charted pipeline area

OPR-N338-KR-08
H11857
Survey Features
OBSTRN

Disproved:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
45-57-07.987N	122-49-05.814W	--	--	Disproved
45-57-17.069N	122-49-09.841W	--	--	Disproved
45-58-35.022N	122-49-43.312W	--	--	Disproved

New:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
--	--	45-49-34.261N	122-47-16.738W	snag/stump
--	--	45-49-44.040N	122-47-49.271W	snag/stump
--	--	45-50-31.913N	122-47-25.107W	update charted rocky area with known attributes
--	--	45-50-48.333N	122-47-50.781W	submerged log
--	--	45-50-50.956N	122-47-50.763W	snag/stump
--	--	45-50-51.674N	122-47-50.401W	snag/stump
--	--	45-50-51.801N	122-47-50.455W	snag/stump
--	--	45-51-16.421N	122-47-44.924W	submerged logs
--	--	45-52-56.696N	122-48-16.203W	corrugated structure
--	--	45-52-56.771N	122-48-15.847W	corrugated structure
--	--	45-52-57.561N	122-48-16.458W	corrugated structure
--	--	45-52-57.586N	122-48-16.157W	corrugated structure
--	--	45-55-09.473N	122-48-52.632W	snag/stump
--	--	45-56-48.091N	122-48-53.416W	snag/stump
--	--	45-57-07.881N	122-49-04.222W	submerged pile
--	--	45-57-13.340N	122-49-08.936W	snag/stump
--	--	45-57-22.745N	122-49-12.669W	awash snag/stump
--	--	45-57-24.124N	122-49-13.096W	submerged logs
--	--	45-57-24.961N	122-49-13.090W	submerged logs
--	--	45-57-28.122N	122-48-29.885W	snag/stump
--	--	45-57-40.958N	122-49-20.912W	snag/stump
--	--	45-57-56.085N	122-48-54.670W	snag/stump
--	--	45-58-28.342N	122-50-05.944W	snag/stump
--	--	45-58-52.005N	122-49-55.293W	submerged pile

OPR-N338-KR-08
H11857
Survey Features
OBSTRN

New:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
--	--	45-59-26.432N	122-51-09.444W	submerged log
--	--	45-59-36.366N	122-51-47.702W	submerged log
--	--	45-59-56.324N	122-52-11.881W	submerged logs
--	--	46-00-01.249N	122-52-18.323W	snag/stump
--	--	46-00-05.387N	122-52-23.278W	snag/stump
--	--	46-00-06.811N	122-52-19.624W	submerged logs
--	--	46-00-15.152N	122-50-51.823W	snag/stump
--	--	46-00-16.491N	122-50-52.321W	snag/stump
--	--	46-00-19.534N	122-52-28.124W	snag/stump
--	--	46-00-25.553N	122-52-27.612W	snag/stump
--	--	46-00-37.642N	122-51-00.032W	submerged pile
--	--	46-00-37.798N	122-51-00.271W	submerged pile
--	--	46-00-38.117N	122-51-00.144W	submerged pile
--	--	46-00-38.305N	122-51-00.320W	submerged pile
--	--	46-00-39.418N	122-51-02.231W	submerged logs
--	--	46-00-39.990N	122-51-02.665W	submerged logs
--	--	46-00-40.721N	122-51-02.994W	submerged logs
--	--	46-00-42.640N	122-51-39.639W	snag/stump
--	--	46-00-43.355N	122-51-05.353W	submerged logs
--	--	46-00-44.898N	122-51-43.676W	snag/stump
--	--	46-00-45.218N	122-51-06.534W	submerged logs
--	--	46-00-46.010N	122-51-07.527W	snag/stump
--	--	46-00-48.444N	122-52-24.070W	submerged log
--	--	46-00-49.786N	122-52-09.969W	submerged pile
--	--	46-00-51.912N	122-51-15.489W	7.5m x 3m rectangular object
--	--	46-00-53.283N	122-51-51.311W	snag/stump
--	--	46-00-54.049N	122-51-52.784W	submerged pile
--	--	46-00-59.188N	122-52-06.240W	submerged pile
--	--	46-01-01.799N	122-52-07.379W	snag/stump
--	--	46-01-18.060N	122-51-43.687W	Charted OBSTRN with new least depth

OPR-N338-KR-08
H11857
Survey Features
OBSTRN

New:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
--	--	46-01-20.969N	122-51-45.723W	large square object

OPR-N338-KR-08
H11857
Survey Features
MORFAC

Disproved:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
45-52-26.172N	122-47-39.359W	--	--	Disproved
45-54-15.301N	122-48-44.907W	--	--	Disproved
45-54-16.788N	122-48-47.056W	--	--	Disproved
45-54-18.327N	122-48-47.056W	--	--	Disproved
46-00-20.206N	122-51-23.320W	--	--	Disproved
46-01-02.503N	122-52-07.942W	--	--	Disproved
45-51-12.729N	122-47-47.189W	--	--	Disproved

New:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
--	--	45-51-03.621N	122-47-45.080W	Dolphin chart to ENC US5OR14M, correctly charted on RNC 18525
--	--	45-54-05.607N	122-48-41.837W	Dolphin
--	--	45-54-32.849N	122-48-52.306W	Dolphin
--	--	45-54-33.549N	122-48-52.698W	Dolphin
--	--	45-54-34.246N	122-48-53.079W	Dolphin
--	--	45-54-34.886N	122-48-53.429W	Dolphin
--	--	45-54-35.581N	122-48-53.808W	Dolphin
--	--	45-54-36.282N	122-48-54.173W	Dolphin
--	--	45-54-47.507N	122-48-53.101W	Dolphin
--	--	45-54-47.745N	122-48-53.104W	Dolphin
--	--	45-54-49.221N	122-48-53.189W	Dolphin
--	--	45-54-49.422N	122-48-53.189W	Dolphin
--	--	45-59-01.269N	122-50-05.055W	Dolphin
--	--	45-59-10.040N	122-50-11.838W	Dolphin
--	--	45-59-11.701N	122-50-12.981W	Dolphin
--	--	45-59-13.639N	122-50-14.628W	Dolphin

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H11857
Survey Features
UWTROC

Disproved:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
45-50-43.799N	122-47-51.624W	--	--	Disproved

New:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
--	--	45-50-39.821N	122-47-23.360W	new rock
--	--	45-50-39.973N	122-47-26.523W	new rock
--	--	45-50-42.372N	122-47-21.407W	update charted rock with known attributes
--	--	45-57-37.529N	122-48-31.798W	new rock
--	--	45-57-38.259N	122-48-32.991W	new rock
--	--	45-57-39.894N	122-48-34.652W	new rock
--	--	45-57-43.196N	122-48-40.571W	new rock
--	--	45-57-43.564N	122-48-40.808W	new rock
--	--	45-58-03.828N	122-49-02.617W	new rock
--	--	45-58-05.118N	122-49-03.989W	new rock
--	--	45-58-06.395N	122-49-05.571W	new rock
--	--	45-58-13.307N	122-49-16.778W	new rock
--	--	45-58-17.546N	122-49-26.034W	new rock
--	--	45-58-17.992N	122-49-25.637W	new rock
--	--	45-59-19.061N	122-50-18.012W	new rock
--	--	46-00-25.250N	122-52-23.867W	update charted rock with known attributes
--	--	46-00-25.287N	122-52-25.144W	new rock

OPR-N338-KR-08
H11857
Survey Features
WRECKS

Disproved:

ENC Latitude	ENC Longitude	Surveyed Latitude	Surveyed Longitude	Remarks
45-50-28.727N	122-47-35.888W	--	--	Disproved

H11857 HCell Report

Katie Reser, Physical Scientist
Pacific Hydrographic Branch

Introduction

The primary purpose of the HCell is to provide new survey information in International Hydrographic Organization (IHO) format S-57 to update the largest scale ENC and RNC in the region: NOAA ENCs US5OR13M and US5OR14M, and NOAA RNCs 18524 and 18525.

HCell compilation of survey H11857 used Pacific Hydrographic Branch HCell Reference Guide Version 2.0-Draft.

1. Compilation Scale

Depths for HCell H11857 were compiled to the largest scale charts in the region, 18524 (36th Ed., December 2006, 1:40,000) and 18525 (36th Ed., April 2009, 1:40,000). The density and distribution of soundings from H11857 were selected to emulate the distribution on the charts. Non-bathymetric features have been generalized to chart scale.

2. Soundings

A survey-scale sounding (SOUNDG) feature object layer was built from the 0.5-meter combined surface, **H11857_Office_50cm_Combined**, in CARIS BASE Editor. A shoal-biased selection was made at 1:10,000 scale for the main chart area using a Radius Table file with values shown in the table, below.

Upper limit (m)	Lower limit (m)	Radius (mm)
0 10		3
10 20		4
20 50		4.5
50	500	5

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

3. Depth Contours

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

Chart Contours in Feet	Metric Equivalent of Chart Contours	Metric Equivalent of Chart Contours NOAA Rounded	Actual Value of Chart Contours
0 0.00		NA	0.00
6 1.829		2.0574	6.75
12 3.658		3.8862	12.75
18 5.486		5.715	18.75
30 9.144		9.3726	30.75
60 18.288		18.5166	60.75

Contours delivered in the *_SS file have not been de-conflicted against shoreline features, soundings and hydrography as all other features in the *_CS file and soundings in the *_SS have been. This results in conflicts between the *_SS file contours and HCell features at or near the survey limits. HCell features should be honored over *_SS.000 file contours in all cases where conflicts are found.

4. Meta Areas

The following Meta object areas are included in HCell 11857:

M_QUAL

Meta area objects were constructed on the basis of the limits of the hydrography. Due to the complexity of the extents generated during contour creation from the **H11857_Office_50cm_Combined** surface, the limits of the coverage area were derived from a combination of auto-generating from the surface and extensive node filtering.

5. Features

Shoreline features for H11857 were delivered from the field in one S-57 file defining new features and modification to GC or charted features. The features included in the HCell were de-conflicted against the chart and hydrography during office processing.

There was one DTON identified during H11857, however it was deemed insignificant by the Pacific Hydrographic Branch and was not forwarded to MCD.

There are four AWOIS items in the limits of H11857, however, none were assigned to be investigated.

Seventeen bottom samples were collected during H11857 and all are included in the HCell. One charted bottom sample was blue noted to be retained.

The source of all features included in the H11857 HCell can be determined by the SORIND field.

6. S-57 Objects and Attributes

The *_CS HCell contains the following Objects:

SOUNDG	Chart scale soundings
UWTROC	Rock features
OBSTRN	Foul ground and obstructions
WRECKS	Wreck
PILPNT	Piles
MORFAC	Dolphins
SLCONS	Lines of piles and gravel conveyor
SBDARE Bottom	samples
M_QUAL	Data quality Meta object
$CSYMB	Blue notes

The *_SS HCell contains the following Objects:

SOUNDG	Soundings at the survey scale density
DEPCNT	NOAA rounded contours at chart scale intervals

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

7. Blue Notes

Notes to the RNC and ENC chart compilers are included in the HCell as $CSYMB features with the blue note information and charting disposition located in the NINFOM field.

8. Spatial Framework

8.1 Coordinate System

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

8.2 Horizontal and Vertical Units

DUNI, HUNI and PUNI are used to define units for depth, height and horizontal position in the chart units HCell, as shown below.
Chart Unit Base Cell Units:

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

During creation of the HCell in CARIS BASE Editor and CARIS S-57 Composer, all soundings and features are maintained in metric units with as high precision as possible. Depth units for soundings measured with sonar maintain millimeter precision. Depths on rocks above CRD and heights on islets above MHW are typically measured with range finder, and therefore have lower precision. Units and precision are shown below.

BASE Editor and S-57 Composer Units:

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

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

Conversion to feet charting units with NOAA rounding ensures that:

- All depths display as whole feet.
- All height units (HUNI) which have been converted to charting units, and that are 2.0 feet above MHW and greater, are shown in feet.

9. Data Processing Notes

9.1 Junctions

H11857 junctions with surveys H11856 and H11858. H11856 has already been compiled and a junction was made between the surveys. A common junction will be made with survey H11858 when it is compiled.

9.2 Conflicts between Shoreline and Hydrography

There are instances of charted shoreline in conflict with hydrography. These were examined using the highest resolution Surfaces. Conflicts were given a blue note with a recommendation to adjust the charted shoreline using the new survey data.

10. QA/QC and ENC Validation Checks

H11857 was subjected to QA checks in S-57 Composer prior to exporting to the HCell base cell (000) file. The millimeter precision metric S-57 HCell was converted to a chart units and NOAA rounding applied. dKart Inspector was then used to further check the data set for conformity with the S-58 ver. 2 standard (formerly Appendix B.1 Annex C of the S-57 standard). All tests were run and warnings and errors investigated and corrected unless they have been approved by MCD as inherent to and acceptable for HCells.

11. Products

11.1 HSD, MCD and CGTP Deliverables

- H11857 Base Cell File, Chart Units, Soundings compiled to 1:40,000
- H11857 Base Cell File, Chart Units, Soundings compiled to 1:10,000
- H11857 Base Cell File, Metric Units, Features compiled to 1:10,000
- H11857 Descriptive Report including end notes compiled during office processing and certification, the HCell Report, and supplemental items
- H11857 Survey Outline to populate SURDEX

11.2 File Naming Conventions

- Chart units base cell file, chart scale soundings H11857_CS.000
- Chart units base cell file, survey scale soundings H11857_SS.000
- Metric base cell file, survey scale features H11857_Features.000
- Descriptive Report package H11857_DR.pdf
- Survey outline H11857_Outlin e.gml & *xsd

11.3 Software

CARIS HIPS Ver. 6.1	Inspection of Combined BASE Surfaces
CARIS BASE Editor Ver. 2.2	Creation of soundings and bathy-derived features, creation of the depth area, meta area objects, and Blue Notes; Survey evaluation and verification; Initial HCell assembly.
CARIS S-57 Composer Ver. 2.0	Final compilation of the HCell, correct geometry and build topology, apply final attributes, export the HCell, and QA.
CARIS GIS 4.4a	Setting the sounding rounding variable for conversion of the metric HCell to NOAA charting units with NOAA rounding.
CARIS HOM Ver. 3.3	Perform conversion of the metric HCell to NOAA charting units with NOAA rounding.
HydroService AS, dKart Inspector Ver. 5.1	Validation of the base cell file.
Newport Systems, Inc., Fugawi View ENC Ver.1.0.0.3	Independent inspection of final HCells using a COTS viewer.

12. Contacts

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

Katie Reser, Physical Scientist, PHB, Seattle, WA; 206-526-6864;
Katie.Reser@noaa.gov.

APPROVAL SHEET
H11857

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

Katie Reser
2010.05.04
09:22:51
-07'00'

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

Digitally signed
by Russ Davies
Date: 2010.05.04
12:54:28 -07'00'

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

Gary C. Nelson
2010.05.04
09:55:00 -07'00'