C. HORIZONTAL AND VERTICAL CONTROL

A complete description of horizontal and vertical control for survey H12125 can be found in the *M-N928-KR-09 Horizontal and Vertical Control Report*, submitted under separate cover. A summary of horizontal and vertical control for this survey follows.

Real-time navigation logged during acquisition was overwritten with a post-processed navigation solution created from Applanix POSPac MMS using the SmartBase option. GPS reference stations from the National Geodetic Survey (NGS) National and Cooperative Continuously Operating Reference Stations (CORS) or the UNAVCO (University NAVSTAR Consortium) Plate Boundary Observatory (PBO) were used during each post-processing session. Table 7 lists the reference stations used in the network subdivided by data provider. North American Datum of 1983 (NAD83) coordinates of the base stations are included in the *M-N928-KR-09 Horizontal and Vertical Control Report*.

Table 7. GPS Base Stations Used During SmartBase Processing

NGS	UNAVCO	UNAVCO
CHZZ	P395	P411
FTS5	P396	P402
LFLO	P397	P375
P367	P398	P374
P415	P404	
PABH	P405	
FTS6	P407	
CORV	P408	
CABL	P365	

Post-processed uncertainty estimates for position, attitude, and heading were applied using the HIPS Load Error Tool and used during the calculation of TPU.

C1. Vertical Control

The vertical datum for this project is Mean Lower-Low Water (MLLW). To improve vertical accuracy of this survey, soundings were reduced to MLLW using post-processed GPS water levels.[20] The VDatum derived separation model, *NOrgGRS.bin*, was used to reduce soundings from NAD83 ellipsoid heights to MLLW as described in the *M-N928-KR-09* DAPR. The separation model has been included with the digital deliverables.

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.

C2. Discussion of GPS Tides

The decision to use GPS Tides in lieu of discrete zoning was made for the entire project rather than on a sheet by sheet basis. As shown in the example for H12124 (Figure 5), the use of GPS Tides considerably improved swath to swath agreement of adjacent survey lines. In many cases, the use of GPS tides removed 50- to 60-centimeter offsets between adjacent survey lines reduced with discrete zoning.

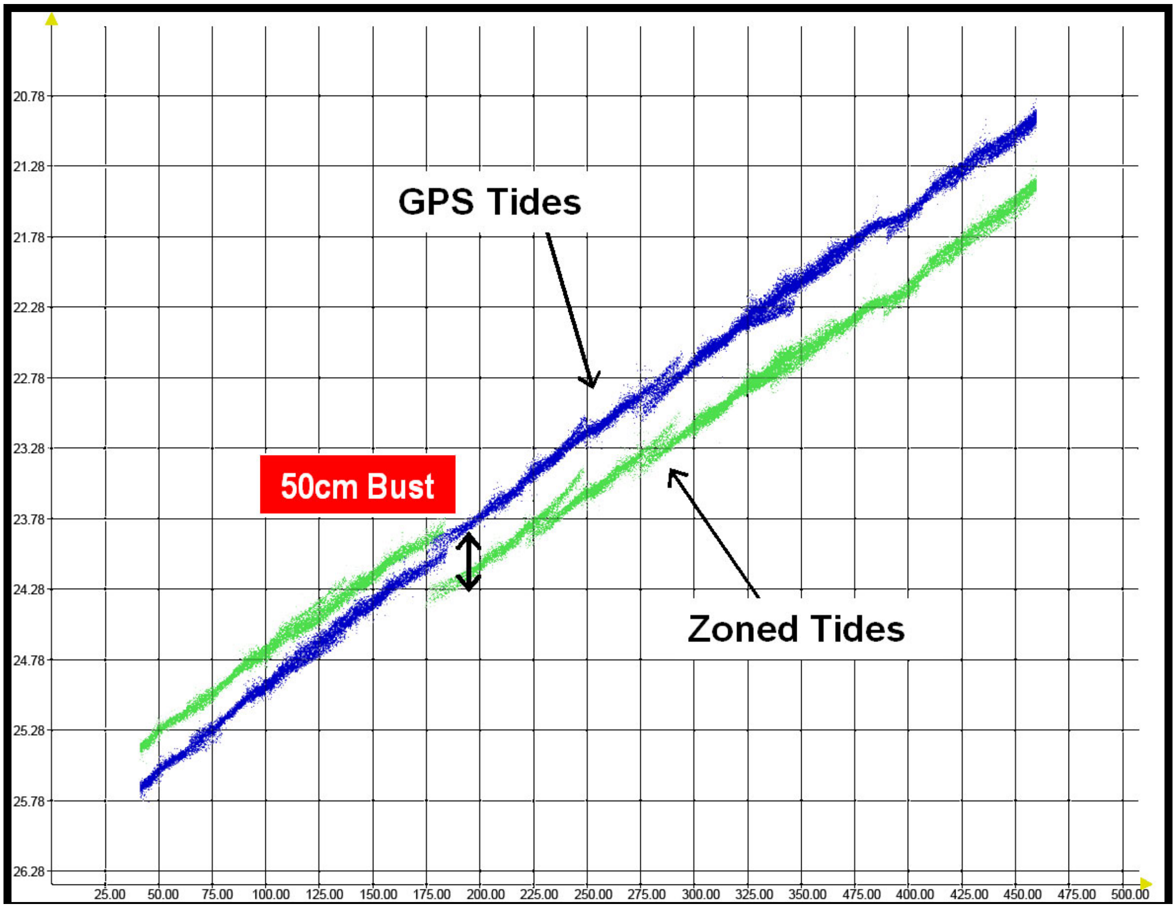

Figure 5. Depth Discrepancies Between Tides Derived from GPS and Tidal Zoning

C3. Horizontal Control

The horizontal datum for this project is NAD83. Differential GPS (DGPS) and Starfire Global Navigation Satellite System (GNSS) 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 Ft. Stevens, OR (287 kHz) or from the secondary beacon at Appleton, WA (300 kHz). All of the primary real-time navigation data were collected using the Starfire Real Time GIPSY (RTG) corrections and are referenced to the International Terrestrial Reference Frame (ITRF) 2005. Real-time navigation data were overwritten by post-processed Smoothed Best Estimate Trajectory (SBET) data referenced to NAD83.