Port Townsend Waterfront Eelgrass Survey

July 27-30, 2022

by

Ian Fraser

Submitted To:

Monica Montgomery
Jefferson County Marine Resources Comittee
August 29th, 2022

Marine Resources Consultants

Marine Resources Consultants
PO Box 816
Port Townsend, WA 98368
(360) 385-4486
ifraser@olympus.net

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Introduction

The Jefferson County Marine Resources Committee (JCMRC) requested a videographic survey of eelgrass (*Zostera marina*) resources along a portion of the City of Port Townsend waterfront in Port Townsend Bay. The purpose of the survey was to duplicate the efforts of a similar surveys in 2007, and 2014-2015 in order to conduct comparisons both within and outside the Voluntary No-anchor Zones.

Methods

Personnel

We conducted the survey on July 27-30, 2022. Table 1 lists the personnel on board the vessel during the survey.

Table 1. Personnel list.

Date	Name	Position
Jul. 27, 2022	Ian Fraser	Skipper
	Brittany Grant	Deckhand technician
	Melissa Sanchez	DNR scientist
Jul. 28, 2022	Ian Fraser	Skipper
	Brittany Grant	Deckhand technician
	Melissa Sanchez	DNR scientist
Jul. 29, 2022	Ian Fraser	Skipper
	Brittany Grant	Deckhand technician
	Aki Avelino	Deckhand trainee
	Melissa Sanchez	DNR scientist
Jul. 30, 2022	Ian Fraser	Skipper
	Brittany Grant	Deckhand technician
	Melissa Sanchez	DNR scientist

Site Description

The study area was defined as the areas from approximately midway between the Port Townsend paper mill and the Port of Port Townsend Boat Haven, to Point Hudson. The general description corresponding to the Washington State Department of Natural Resources (DNR) Submerged Vegetation Monitoring Project (SVMP) (Berry et al. 2003; Dowty 2005; Dowty et al. 2005) 1000m (as measured along the -20ft isobaths) "fringe site" units of CPS2598, CPS2597, CPS2595, and CPS2594 as previously surveyed in 2014 and 2015. Note, these sites are contiguously adjacent to one another, and the DNR fringe site unit numbering skips CPS2596.

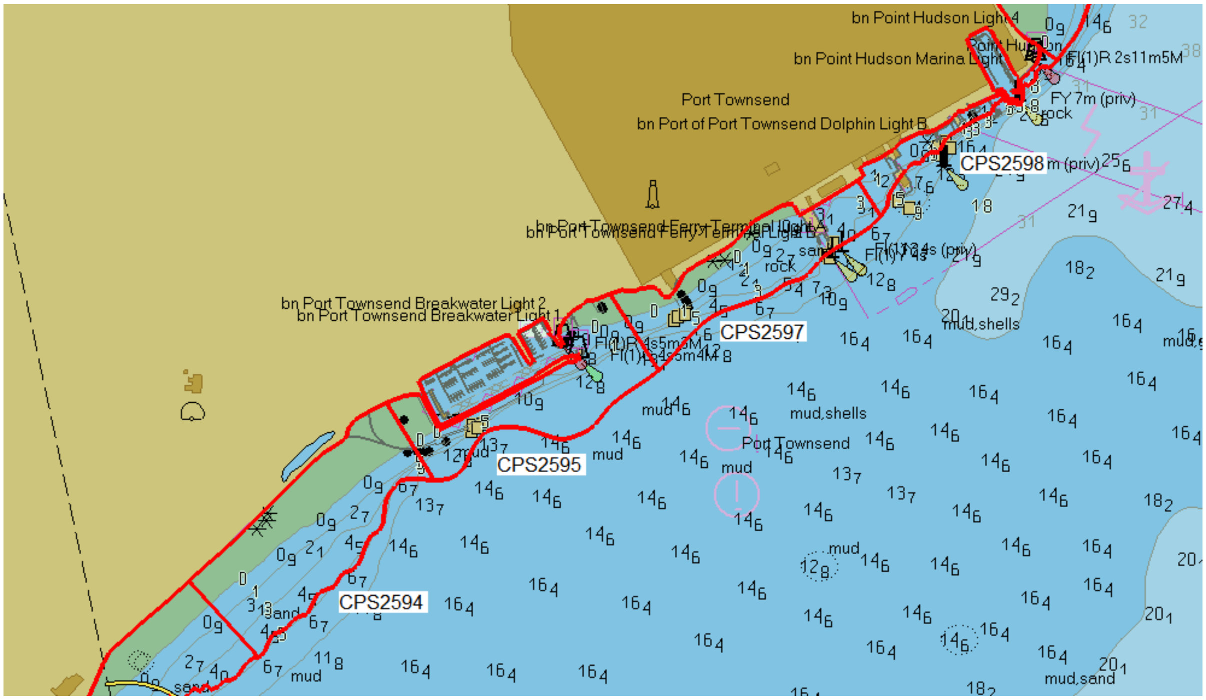


Figure 1. Map of study area showing boundaries of the DNR SVMP fringe sites (in red).

Sampling Plan

We attempted to duplicate sampling of 69 survey transects from the 2014 & 2015 surveys, as well as the six supplemental 2014 transects from the Indian Point vicinity. A few additional reconnaissance transects were to be conducted where any obvious significant changes may have occurred since the previous surveys, as well as a meandering zig-zag along the deep edge of any observed eelgrass to help with delineation and/or adjustments of the voluntary no-anchor zone.

The transects originally selected in 2014 comprised three sets of 18 systematically spaced random transects spanning the three DNR SVMP sites CPS2595, CPS2597, and CPS2598. Each of the three transect sets were spaced every 495 feet, and started at a random distance between 0 and 495 feet from the southeast end along a line drawn from approximately (48º 6.243'N, 122º 46.737'W) and (48º 7.036'N, 122º 44.899'W). The transects for the 2015 survey comprised three sets of five similarly selected systematic random transects covering the area corresponding to DNR SVMP site CPS2594 between the Port of Port Townsend Boat Haven and the Port Townsend Paper Mill.The Indian Point supplemental transects consisted of two sets of three systematic random transects in this sub-area to allow comparisons with similar surveys conducted throughout the 1990s and early 200s by Marine Resources Consultants for the Port Townsend Marine Science Center.

The transects surveyed in 2014-2015 were sampled in as straight a line as possible approximately perpendicular to the bathymetry gradient, from a point inshore of the shallowest eelgrass out to a depth of approximately -30 ft MLLW, or assuredly beyond the maximum eelgrass depth at that location. For the 2022 re-survey, three transects from each SVMP site were randomly selected to be extended out to -15m MLLW in order to allow for a more full characterization of the population of select invertebrates and macro-algae along the Port Townsend waterfront.

Survey Equipment and Methods

Vessel

We conducted sampling aboard the 36-ft *R/V Brendan D II* (Fig. 3). We acquired position data using a sub-decimeter ATLAS corrected differential global positioning system (DGPS) with the antenna located at the tip of the A-frame used to deploy the camera towfish. Corrections were received from a Hemisphere ATLAS satellite correction network using the WGS84 datum. A laptop computer running Hypack 2021 hydrographic survey software stored time, position and GPS quality data from the DGPS, depth data from one echosounder (Garmin), and user-supplied transect information onto its hard drive. Position data were stored in both latitude/longitude and State Plane coordinates (Washington South, US Survey Feet NAD83 HPGN). All data were updated at 1 s intervals. Table 3 lists all the equipment used during this survey.

Figure 2. The *R/V Brendan D II*.

Table 2. Equipment used onboard the *R/V Brendan D II* during the survey.

Item	Manufacturer/Model
Differential GPS	Hemisphere A326 Smart antenna (sub-decimeter accuracy)
Depth Sounders	BioSonics MX system (including Panasonic Toughbook laptop computer with Submerged Aquatic Vegetation software) Garmin FishFinder 250
Underwater Cameras (2)	SplashCam Deep Blue HD 1080i (Ocean Systems, Inc.) SplashCam Deep Blue Pro Color SD (Ocean Systems, Inc.)
Lasers	Deep Sea Power & Light
Navigation Software	Hypack 2021
Video Overlay Controller	Intuitive Circuits TimeFrame (SD) & Video Logix Proteus II (HD)
DVD Recorder	Sony VRD-MC6
DV Hard Drive Recorders	3x Atomos Ninja 2—ProRes 422 LT Codec

Video Data

We obtained underwater video images using an underwater camera mounted in a down-looking orientation on a heavy towfish. Two parallel red lasers mounted 10 cm apart created two red dots in the video images as a scaling reference. We mounted a second forward looking underwater camera on the towfish to give the winch operator a better view of the seabed. We deployed the towfish directly off the stern of the vessel using the A-frame and winch. Video monitors located in both the pilothouse and the work deck assisted the helmsman and winch operator control the speed and vertical position of the towfish. The weight of the towfish kept the camera positioned directly beneath the DGPS antenna, thus ensuring that the position data accurately reflected the geographic location of the camera. A video overlay controller integrated DGPS data (date, time) and user supplied transect information (transect number and site code) into the video signal. We stored video images directly onto a a DVD-R disk, and three portable hard drives in ProRes 422 LT Codec.

Depth Data

Our primary depth sounder was a BioSonics MX system. The advantage of this system is its ability to accurately measure distance between the transducer and the seabed, even when the seabed is covered with dense vegetation (e.g., eelgrass and/or macroalgae). Other depth sounders often measure distance only to the top of the vegetation canopy. The BioSonics system does not produce depth readings in real time. Instead, it records on a laptop computer all of the returning raw signals in separate files for individual transects. During post-processing the user can view the echrogram in high detail resolution, and edit all identification of the bottom in order to avoid those issues. Individual transect files are combined into larger files and processed through proprietary BioSonics software. The output is a single text file with time, depth, and position data. These data are then merged with the tide correction data (see sub-section below) to give corrected depths.

Our backup depth sounder was a Garmin FishFinder 250. Although this echosounder provided real-time estimates of depth (which were recorded by the Hypack 2021 program), at times it estimated depth only to the top of the vegetation canopy rather than to the seabed.

For both echosounders, we mounted the portable transducers on poles attached to the starboard (Garmin) and port (BioSonics) corners of the transom. Since the DGPS antenna was mounted along the centerline of the vessel, each transducer was offset 1.5 m from the DGPS antenna. During analysis, we ignore this slight offset and assumed that depth readings from both depth sounders were taken at the location of the DGPS antenna.

Real-time Eelgrass Identification

A custom hand-held toggle switch (or “clicker”) and an “add-on” to the Hypack 2021 program allowed us to display and record eelgrass positions in real time. The vessel’s track was displayed in the navigation window as either a thin black line (clicker “off”) or a thick orange line (clicker “on”). In the stored database, the clicker field was stored as either a 0 (clicker “off”) or 1 (clicker “on). The ability to display track lines and eelgrass positions in real time allowed us to adjust the sampling plan on the fly to best identify any eelgrass bed.

Field Sampling Procedures

For underwater video transects, the skipper backed the vessel close to the shoreline or pier and the winch operator (chief scientist) lowered the camera to just above the seabed. Visual references were noted and all video recorders and data loggers were started. As the vessel moved along the transect the winch operator raised and lowered the camera towfish to follow the seabed contour. The field of view changed with the height above the bottom. The vessel speed was held as constant as possible (about 0.5 m/sec, or approximately 1 knot). During the transect, the onboard scientist monitored the video images and set the clicker to the "on" position whenever eelgrass was observed. At the end of the transect, we stopped the recorders, retrieved the camera towfish, and moved the vessel to the next sampling position. We maintained field notes for each transect (Appendix A).

Meandering and zig-zag transects were conducted in a similar manner, though with different geographical and directional references.

Underwater Video Data Post-Processing

Data stored on the laptop computer were downloaded and organized into spreadsheet files including blank columns for "video code" and "eelgrass code." The video may be viewed in the laboratory to assign video codes (0 = cannot view the seabed; 1 = seabed in view) and eelgrass codes (0 = absent; 1 = present) to each position record. Additional columns may be added for any viewable attribute of interest.

Tide Heights

We used the BioSonics echosounder to gather bathymetry data. Raw depths collected from the echosounder measure the distance between the seabed and the transducer. We attempt to correct depths to MLLW by two methods.

For the traditional DNR SVMP method, we apply three factors to correct these depths to the MLLW vertical datum:

- transducer offset (i.e., distance between the transducer and the water surface);
- predicted tidal height (i.e., predicted distance between the surface and MLLW);
- tide prediction error (i.e., predicted tidal height minus the observed tidal height at a reference station).

Corrected depth equals depth below the transducer plus the transducer offset minus the predicted tidal height plus the tide prediction error. We measured the transducer offsets directly each day. We use the predicted tide heights from the computer program Tides and Currents Pro 3.0; Nobletec Corporation) for the Port Townsend station (station ID 1049; 47 36.20 N; 122 20.20 W). We compute tide prediction errors by comparing the computer program predicted tide heights for the Port Townsend station with actual observed tide heights published by the National Oceanic and Atmospheric Administration (NOAA) on their web site (http://www.co-ops.nos.noaa.gov/data_res.html).

This process can be applied at any time once the NOAA observed tide heights are published (usually once per month).

Beginning in 2020, with the addition of the ATLAS correct sub-decimeter DGPS accuracy we also introduced a pseudo Real-Time Kinematic (RTK) depth estimate. The Hemisphere A326 with H10 ATLAS corrections claims an approximately 1 foot accuracy along the vertical axis. By applying the 14.25 foot offset from the antenna to the BioSonics transducer, Hypack can internally convert the WGS-84 antenna location using the g2018-CONUS geoid model and Washington Puget Sound V-Datum to a local MLLW reference “tide correction”. This tide correction can be directly applied to the depth below transducer measured by the BioSonics to estimate the local depth for each record.

Discussion

The initial impression in the field is of general consistency over the 2007-2022 period for distribution of eelgrass. Over much of the study area there appear to be small changes along the shallow edge of the eelgrass beds with apparent shoreward increases near Union Wharf, and between Indian Point and the Boat Haven, and an apparent loss of shoreward eelgrass directly west of the ferry terminal.

In the area near the southwest end of the Port of Port Townsend Boat Haven where the remains of the old train trestly were completely removed between the 2007 and 2014 surveys, the increase in eelgrass observed in 2014 appears to have continued with possible further shoreward expansion.

Further southwest, however, in the area between the Boat Haven and the paper mill there appears to be a significant loss of shallow shoreside eelgrass as well as a small retreat along the deep edge of many of the transects. This should be examined carefully in the video from both 2014 and 2022 to confirm.

There also appears to be one small hillock directly offshore of the Quimper Mercantile plaza (between Union Wharf and the ferry terminal) where eelgrass observed in both 2007 and 2014 was not found in 2022.

The cove between Indian Point and the Boat Haven has extensive shallow, undulating, sand flats. This may be a result of relatively active sediment transport and dynamic bathymetry over a years-scale. There appears to have been more shallow edge shore-side eelgrass observed in 2022 than 2014, with even less observed in 2007. However, there also appears to be some areas in the middle of the eelgrass bed where there are patch gaps in the eelgrass in 2022 that were more fully covered in 2014, as well as some areas near the Boat Haven entrance where the eelgrass previously observed has completely disappeared.

Finally, we would like to note that few boats appear to choose to anchor within the VNZ. In all areas very few boats chose to anchor within the depths supporting eelgrass through the study site, with the most likely conflicts occurring in the patchy areas surrounding the ferry terminal.

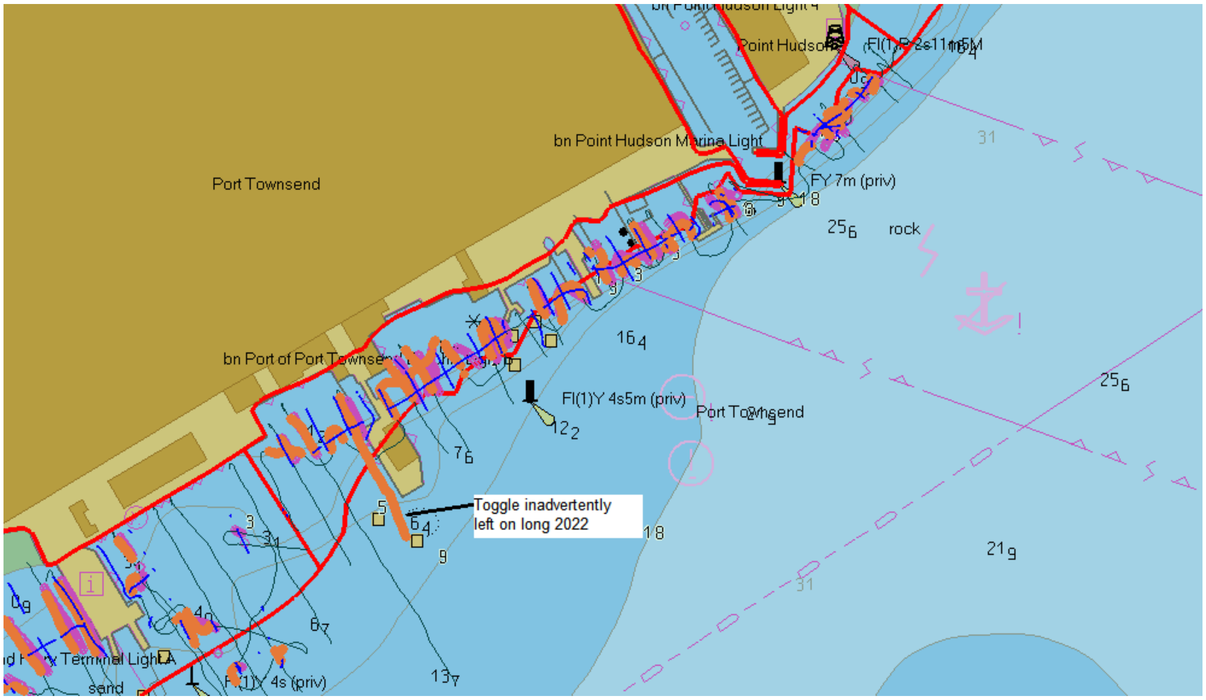


Figure 3. Field map showing transects conducted and associated real-time eelgrass observations in 2022 (orange), 2014 (purple) and 2007 (blue) for fringe site CPS2598 near Point Hudson.

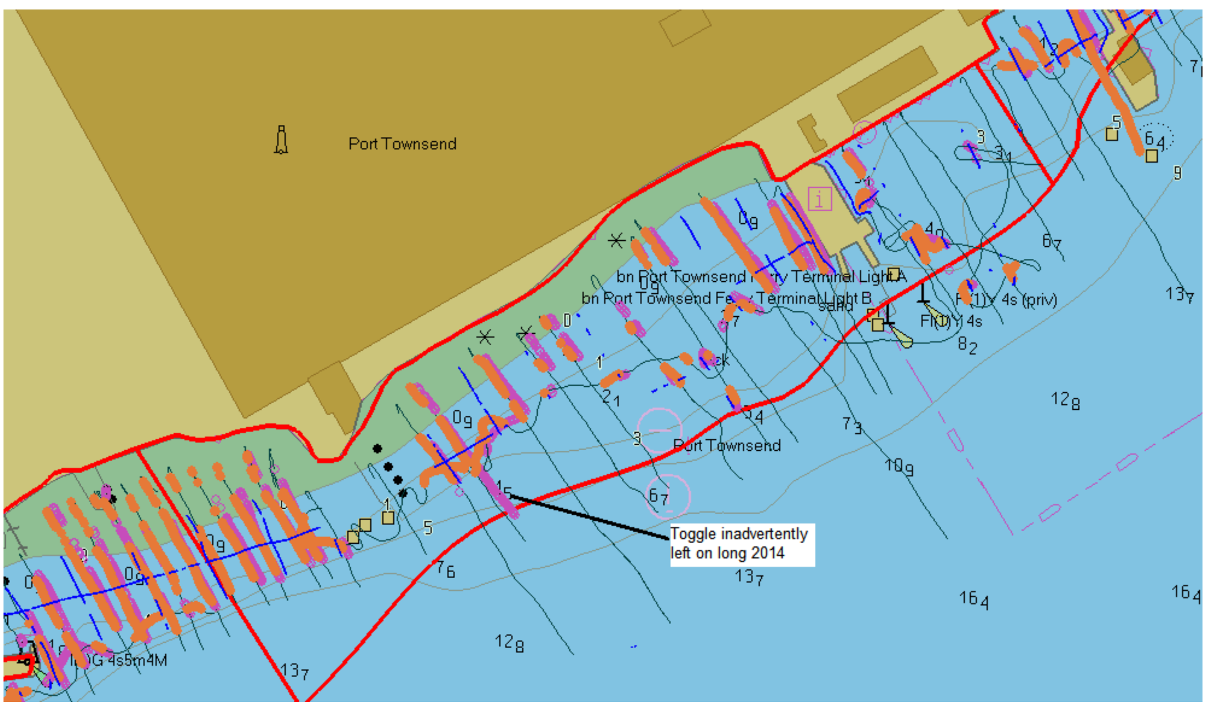


Figure 4. Field map showing transects and associated real-time eelgrass observations conducted in 2022 (orange), 2014 (purple), and 2007 (blue) for fringe site CPS2597 near the WA State Ferry terminal.

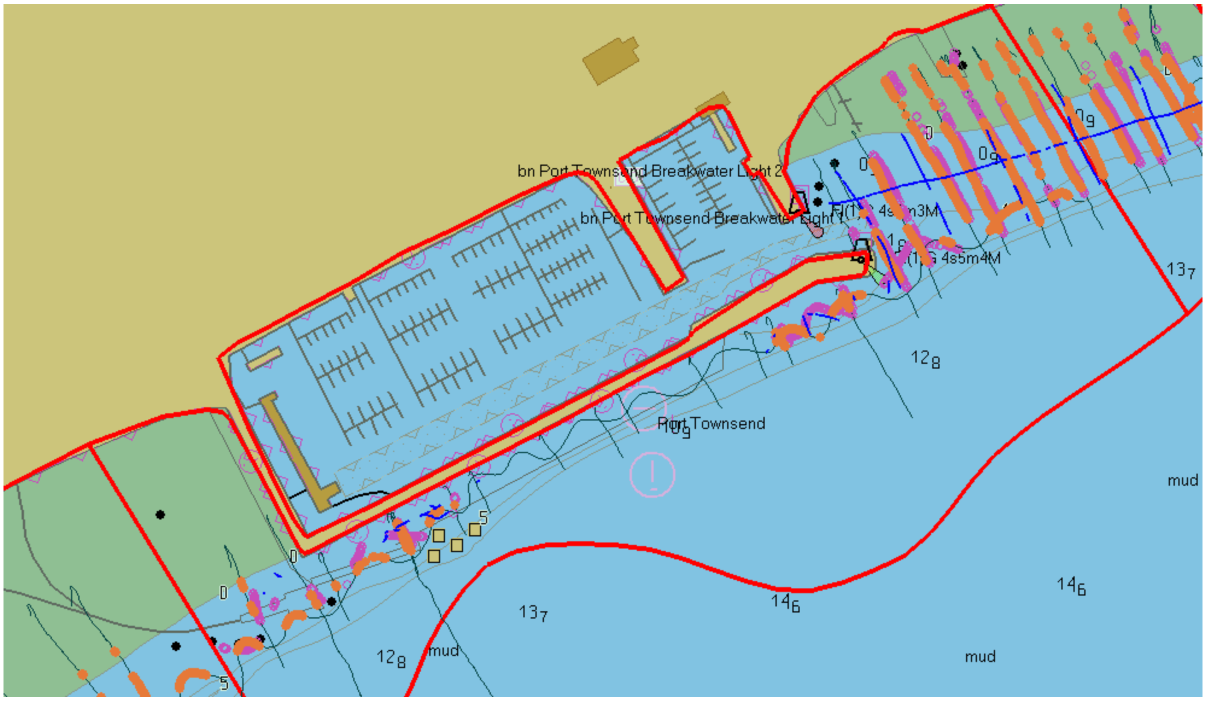
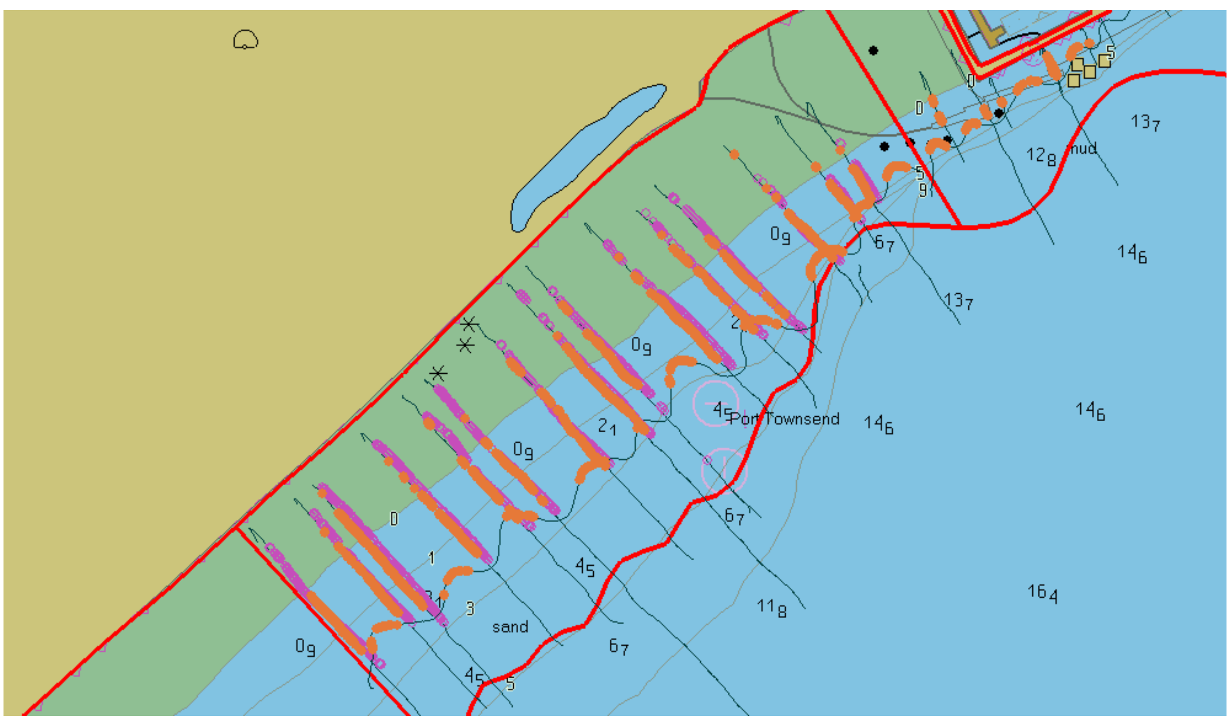


Figure 5. Field map showing transects and associated real-time eelgrass observations conducted in 2022 (orange), 2014 (purple), and 2007 (blue) for fringe site CPS2596 near the Port of Port Townsend Boat Haven.

Figure 6. Field map showing transects and associated real-time eelgrass observations conducted in 2022 (orange), and 2015 (purple) for fringe site CPS2594 between the Port of Port Townsend Boat Haven and the Port Townsend Paper Mill.



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Appendix A

DNR transect notes and site descriptions worksheets

See accompanying pdf "Jefferson County Transect Notes"