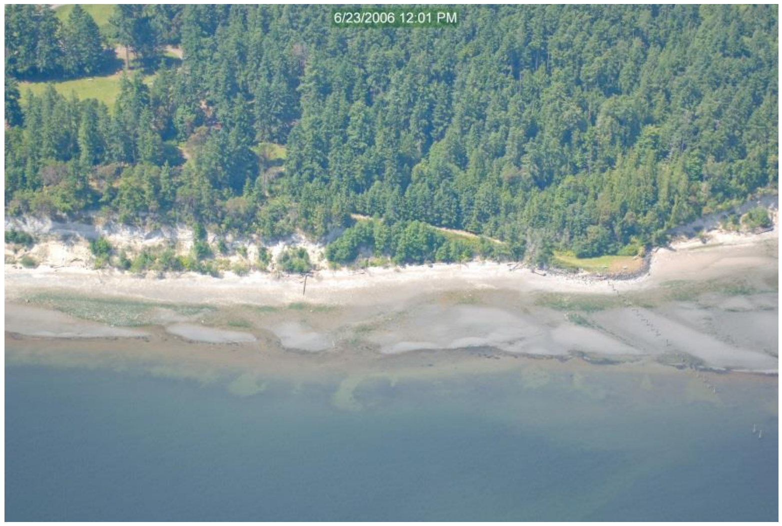
Port Townsend Bay Eelgrass Survey

July 18, 2015



by

Ian Fraser

Submitted To:

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August 1st, 2015

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Introduction

The Jefferson County Marine Resources Committee (JCMRC) requested a videographic survey of eelgrass (*Zostera marina*) resources along two designated sections of the waterfront in Port Townsend Bay. The purpose of the survey was to gather pre-project baseline data for submitting state, federal and local permit applications for a Voluntary No-anchor Zone south of the ferry dock and to document eelgrass extent near Fort Townsend State Park. The survey will also be used to compare pre- and post-restoration data collected in the future.

Methods

Personnel

We conducted the survey on July 18, 2015. Table 1 lists the personnel on board the vessel during the survey.

Table 1. Personnel list.

Date	Name	Position
July 18, 2015	Ian Fraser	Skipper & Chief Scientist
	Griffin Hoins	Field Technician

Site Description

The study area was defined to coincide with two DNR Marine Vegetation Atlas sites, cps2594 and cps2590. The cps2594 is site directly adjacent to the southwest side of the old train trestle at the Port of Port Townsend Boat Haven. The cps2590 site is located straddling the water access point of Fort Townsend State Park and the associated mooring buoys.

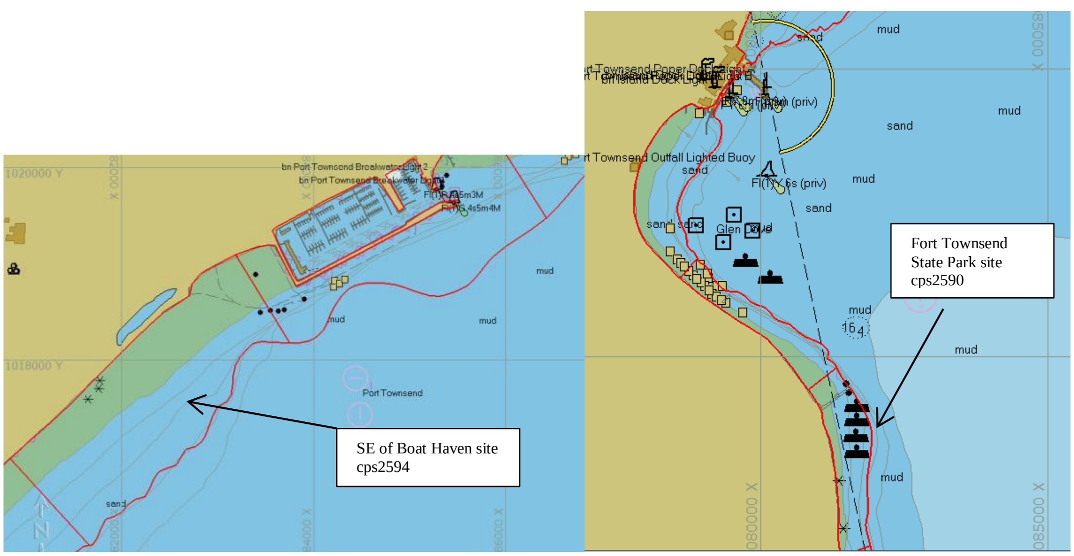

Figure 1. Maps of study areas with boundaries of the DNR Marine Vegetation Atlas sites.

Sampling Plan

Washington State Department of Natural Resources (DNR) Submerged Vegetation Monitoring Project (SVMP) (Berry et al. 2003; Dowty 2005; Dowty et al. 2005) methods for generating statistical estimates of eelgrass parameters require the use of randomly placed transects within each site. In order to compromise between statistical randomness and even coverage, we selected three sets of 6 systematically spaced transects for cps2590 and three sets of 5 systematically spaced transects for cps2594. Each of the three transect sets were spaced evenly, and started at a random location in the southwestern most 1/6th or 1/5th end of the

Because these transects were selected from the wider area, they can be applied to analyses for any subset of the study area not dependent on the transect placement itself.

As with SVMP protocols, all transects were conducted in a straight line 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.

Finally, a meandering transect was conducted in order to further define the extents of eelgrass bed near the mooring buoys at Fort Townsend State Park.

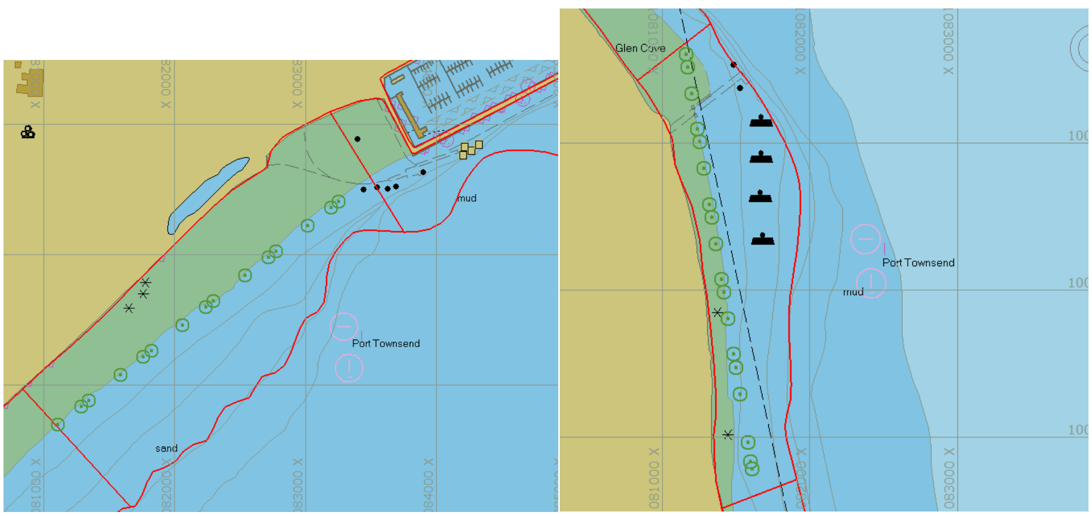

Figure 2. Maps of study areas cps2594 and cps2590 showing the three randomly selected sets of 5 and 6 (respectively) systematically placed transects (green circles).

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-meter differential global positioning system (DGPS) with the antenna located at the tip of the A-frame used to deploy the camera towfish. Differential corrections were received from the United States Coast Guard public DGPS network using the WGS84 datum. A laptop computer running Hypack 2012 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 3. 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	Trimble AgGPS 124 (sub-meter accuracy)
Depth Sounders	BioSonics DE4000 system (including Dell laptop computer with Submerged Aquatic Vegetation software)
	BioSonics MX system
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 2012
Video Overlay Controller	Video Logix Proteus II
DVD Recorder	Sony VRD-MC6
HDV Hard Drive Recorder	DataVideo DN-500
HD Hard Drive Recorder	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 HD (1080i) video images directly onto a hard drive in both ProRes 422 LT codec and HDV .M2T format, as well as a down-converted SD (480i) signal to a DVD-R disk.

Depth Data

Our depth measurement system uses two BioSonics echosounders. On the port stern corner of the boat we have mounted a BioSonics DE4000 480kHz system, and on the starboard stern corner of the boat we have mounted a BioSonics MX Aquatic Habitat 204kHz echosounder. 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 final 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, individual transect files are combined into larger files and processed through EcoSAV and Visual Habitat software (part of the BioSonics system). 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.

In addition to the post-processed depths, the BioSonics MX system outputs a real-time depth below transducer measurement. These measurements are generally not as accurate as the post-processed measurements, and estimate depth to the top of the vegetation canopy at times rather than to the seabed.

For both echosounders, we mounted the portable transducers on poles attached to the starboard (MX) and port (DE4000) 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 average the depth readings from both depth sounders to estimate the depth 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 2012 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 1 m/sec). During the transect, the skipper 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.” We reviewed videotapes 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.

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 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).

Discussion

Unlike our 2014 Port Townsend Waterfront work, the surveys conducted in this study were both first time surveys for the designated areas, so we did not have any previous data with which to compare our results. In both of these areas the eelgrass beds appear not to extend to the depths reached by the eelgrass beds toward the north end of Port Townsend Bay.

The visual quality of images were compromised on the day of collection due to lower than average ambient light, heavier than average plankton content in the water column, and heavy green algae blooms inundating the shallower eelgrass depths. In addition to using the video images alone, we also made use of the BioSonics echograms with the Visual Habitat software programs to aid in identifying eelgrass where it existed in the heavier algal bloom areas.

If the primary concern with eelgrass is avoiding anchor damage in potential mooring areas, there appears to be little eelgrass under direct threat.

At site cps2594, the eelgrass appears to grow in frequent patches in the low intertidal, becoming a more continuous bed in the upper sub-tidal areas. This eelgrass bed covers much of the broad, shallow bench, and end shortly after the bathymetry break which quickly falls to -35 to -40 feet MLLW. The eelgrass bed only appears to extend to approximately -12 feet

MLLW at the southwest end to approximately -15 feet MLLW at the northeast end of the site. During the time of our survey, all of the boats anchored in the area had chosen to anchor in the -35 to -40 feet MLLW depth range where the seabottom flattens out to a more level plain.

At site cps2590, located near the beach access and mooring buoys of Fort Townsend State Park, the eelgrass at the southern portion of the site appears to extend only to approximately -5 feet MLLW. We identified a few stray plants out to approximately -10 feet MLLW, and while some may have been drift plants entangled within the thick mixed algae beds (many reds, greens and browns), some were assuredly growing at those depths. Along the southern portion of this site, the eelgrass would seem to be under a greater potential scaring threat from skiffs grounding on the beach, than by anchor damage.

At the northern end of the site, the eelgrass bed gradually begins to fill in more frequently in the -10 feet MLLW depth range, and at the area of the park mooring buoys, the grass extends all of the way to -15 feet MLLW,and at some points slightly beyond the park buoys. (Note that the location of the park buoys are not marked accurately on the NOAA charts below.) Throughout the site cps2590, the eelgrass bed remains somewhat fragmented/patchy, and is never completely solid. We conducted an additional meandering track near the southernmost mooring buoy to get a better picture of this deeper eelgrass extension, and it appears to be quite an abrupt change.

It is not immediately clear why the eelgrass bed abruptly changes in the area of the mooring buoys. The changes in bathymetry seem to be conceivably partially responsibly, but There are changes in bathymetry that may contribute, as well as heavier algal growth in the southern portion. There does not appear to be heavy anchoring in this area, and during our survey there were no boats anchored and none utilizing the park moorings.

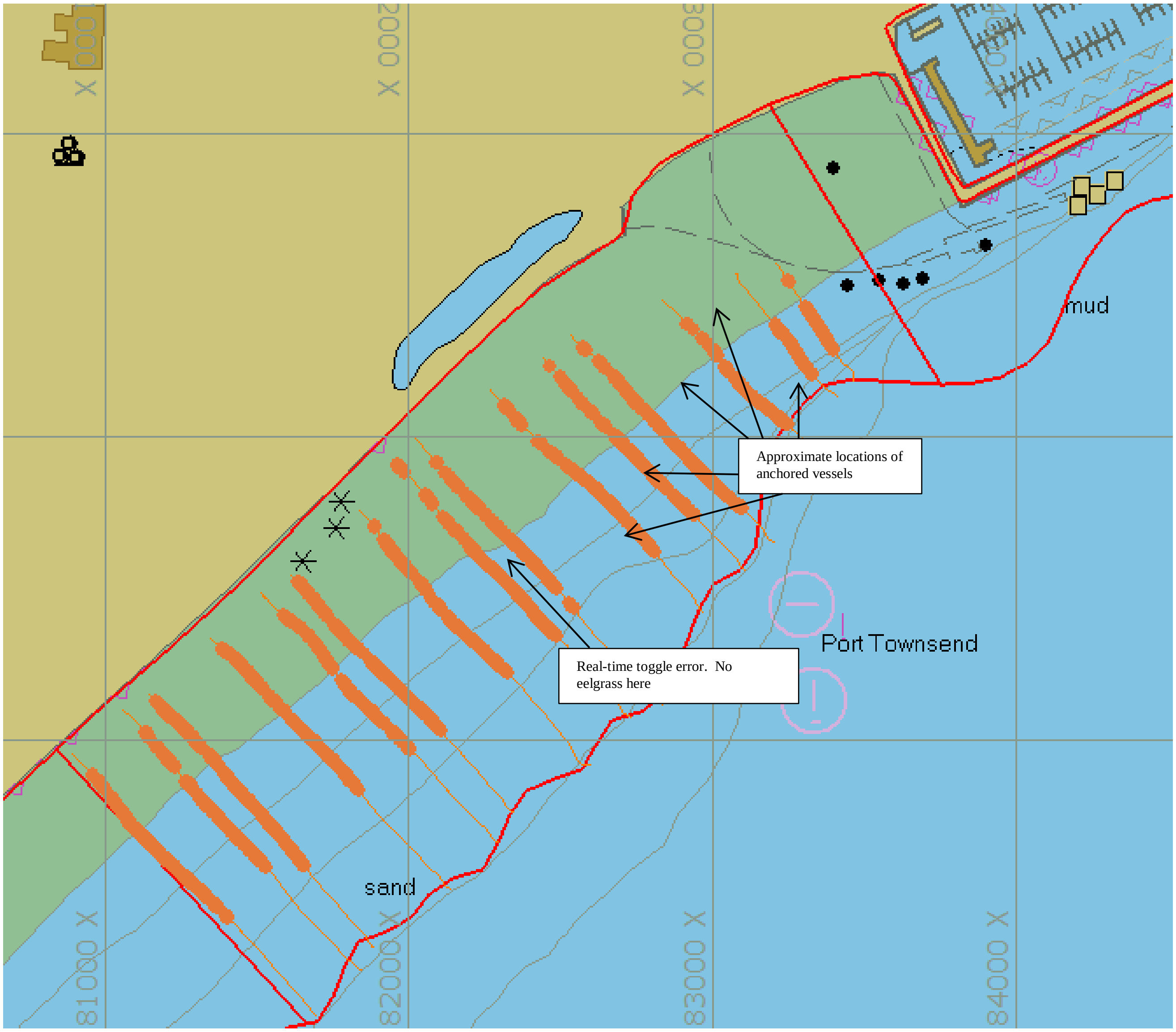

Figure 4. Field map showing transects conducted and associated real-time eelgrass observations 2015 (thin/thick orange) for fringe site CPS2594 southwest of the Port of Port Townsend Boat Haven.

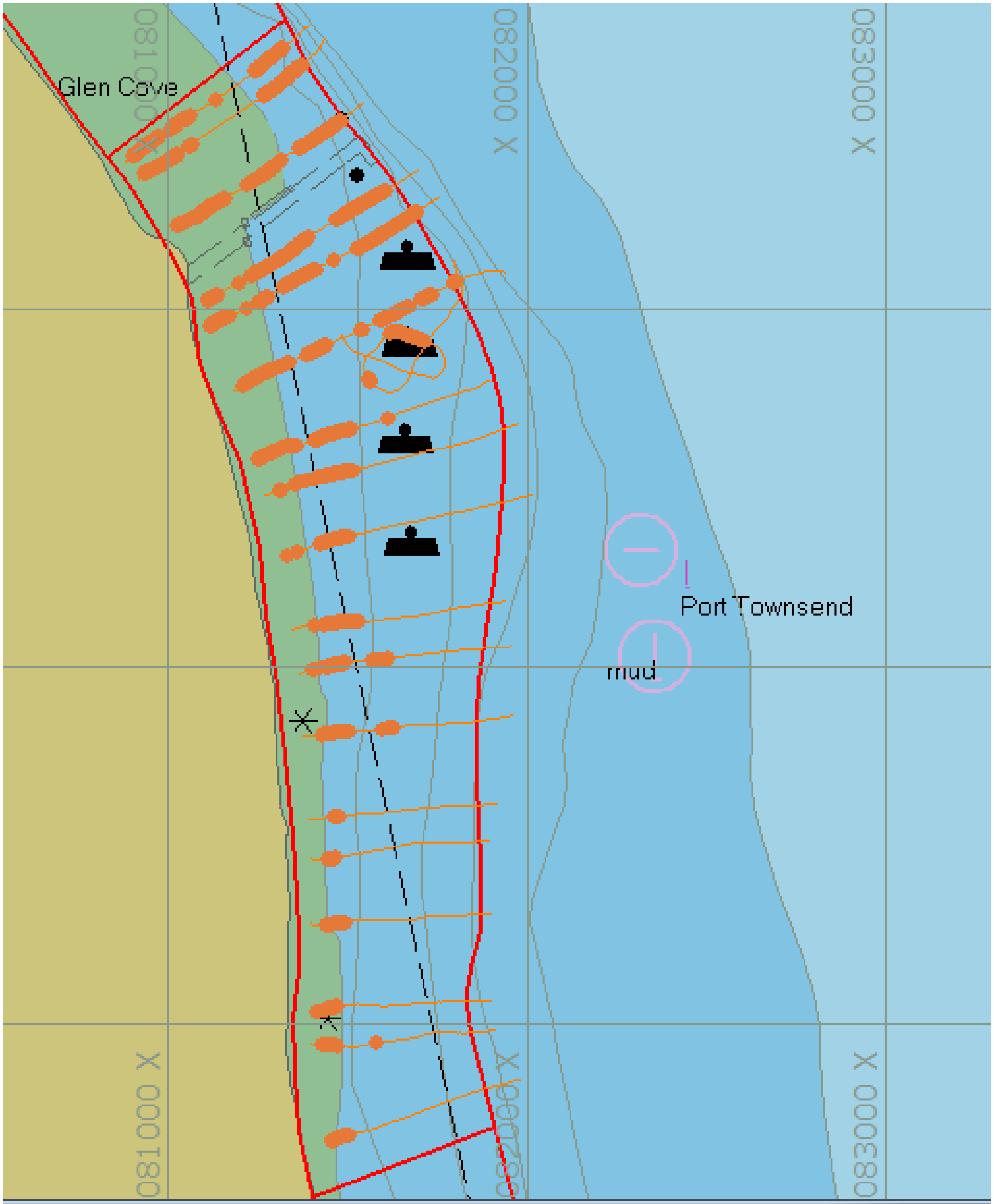

Figure 5. Field map showing transects and associated real-time eelgrass observations conducted in 2015 (thin/thick orange) for fringe site CPS2590 near the Fort Townsend State Park.

References

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Appendix A

Field Notes—July 18, 2015

Date	Site	Track	Time	Ninja	DV	Comment
7/18/2015	Cps2590	1	1700	15	1	Grass from about MLLW to -5 ft. South end of site
7/18/2015	Cps2590	2	1708	16	2	Similar. Maybe a stray ZM @~-10ft MLLW.
7/18/2015	Cps2590	3	1715	17	3	ZM->Big bladed browns->mixed sparse algae
7/18/2015	Cps2590	4	1720	18	4	Algae sparseenough to see sediment @~-15mllw
7/18/2015	Cps2590	5	1730	20	5	Even less ZM. More algae?
7/18/2015	Cps2590	6	1736	21	6	Same pattern, but ZM starts a bit deeper. Not much
7/18/2015	Cps2590	7	1742	22	7	A bit more ZM + a few plants @~-10 mllw
7/18/2015	Cps2590	8	1750	23	8	Shallow grass sparser, more of the deep plants
7/18/2015	Cps2590	9	1757	24	9	Deeper deep edge to main patch, but no deeper stray plants.
7/18/2015	Cps2590	10	1802	25	10	Some shallower plants. Deepest @~-5MLLW?
7/18/2015	Cps2590	11	1810	26	11	Shallow ZM more sparse, deep ZM more thoroughly mixed with algae.
7/18/2015	Cps2590	12	1820	28	12	More shallow ZM. Also a plant out ~-10MLLW.
7/18/2015	Cps2590	13	1828	29	13	Grass all the way out to moorings + stay plant @~-15 feet MLLW.
7/18/2015	Cps2590	14	1838	30	14	Similar to last, but more solid deep bed past moorings.
7/18/2015	Cps2590	15	1845	31	15	Ends ~-10 MLLW just before moorings.
7/18/2015	Cps2590	16	1852	32	16	At beach access point, broader bench & steeper drop.
7/18/2015	Cps2590	17	1902	33	17	Bigger gap between deep and shallow beds
7/18/2015	Cps2590	18	1908	34	18	Similar to last
7/18/2015	Cps2590	19	1916	35	19	Meander near southernmost mooring buoy to see transition to deeper grass area.
7/18/2015	Cps2594	20	1935	36	20	Broad ZM bed. Heavily mixed w/greens, especially at start
7/18/2015	Cps2594	21	1945	37	21	Same

Date	Site	Track	Time	Ninja	DV	Comment
7/18/2015	Cps2594	22	1955	38	22	Such heavy green algae—hard to tell in shallows
7/18/2015	Cps2594	23	2010	39	23	Similar. ZM ends ~-10 to -12 mllw.
7/18/2015	Cps2594	24	2020	40	24	A bit patchier.
7/18/2015	Cps2594	25	2030	41	25	Same
7/18/2015	Cps2594	26	2040	42	??	Same
7/18/2015	Cps2594	27	2055	43	29	Patchier in shallows
7/18/2015	Cps2594	28	2103	44	30	Less @ shallow end. Last toggle click is just drift plant.
7/18/2015	Cps2594	29	2110	45	31	Similar, but maybe -14 MLLW for deepest plants.
7/18/2015	Cps2594	30	2118	46	32	Shallow ½ even patchier
7/18/2015	Cps2594	31	2128	47	33	Goes out a little deeper. Maybe -16 feet MLLW
7/18/2015	Cps2594	32	2138	48	Fail	Less of the shallow stuff
7/18/2015	Cps2594	33	2145	49	27!?	None in the high shallows
7/18/2015	Cps2594	34	2153	50	34	OK! Done.
						Apparent track numbering issue with HD DV recorder. Perhaps look at file creation times if things are not immediately obvious.