

**PUGET SOUND MARINE AND NEARSHORE GRANT PROGRAM**

# ANALYSIS OF 2017-2019 CAPITAL INVESTMENTS

**ADDENDUM TO THE PART 3 REPORT**

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## EXECUTIVE SUMMARY

Since 2011, the Puget Sound Marine and Nearshore Grant Program has invested National Estuary Program funds to implement priorities outlined in the [Action Agenda for Puget Sound](#). Habitat restoration and protection has been a major focus of the program.

In September 2016, Puget Sound Institute released a report analyzing 27 restoration, acquisition, social marketing, and education/outreach, and social marketing grants funded by the Grant Program through 2014 (Kinney et al. 2016b).

This report is an addendum that summarizes 2 projects completed since 2016 and provides a wrap-up of project outputs from all 6 years of capital investments, including cost updates for 3 projects that had not been completed at the time the 2016 Part 3 report was written.

Measurable results of Grant Program capital investments between 2011 and 2017 include:

- More than 52 acres of subtidal habitat restored through removal of 290 derelict fishing nets;
- 423 acres of restored and/or enhanced tidal hydrology at 3 major river deltas;
- 57 acres of restored and/or enhanced tidal hydrology in 2 small estuaries;
- 373 acres of habitat and 2.85 miles (13,582 feet) of shoreline permanently protected;
- 0.92 mile (4,801 linear feet) of shoreline armor removed;
- 165,569 shoots of eelgrass transplanted over 0.38 acres (1520 m<sup>2</sup>); and
- 600 creosote pilings removed.

The 2 awards reviewed in this addendum are:

- (1) **Derelict Net Reporting, Response, and Retrieval Program** – A grant to the Northwest Straits Foundation to increase reporting of lost nets by enhancing outreach activities using a social marketing approach; conduct focused outreach to the tribal fishing community; and continue retrieval of newly lost nets in a timely manner. During the grant period, 31 nets were verified, located, and removed.
- (2) **Eelgrass restoration and monitoring** – A grant to the Washington Department of Natural Resources to transplant eelgrass at 3 large-scale sites and 9 test sites. Survival and expansion rates were monitored over 2 growing seasons. Results of this restoration effort were disappointing, as only one of the large-scale plantings was successful and no new locations suitable for large-scale restoration were identified. The role of poor water quality warrants additional attention in eelgrass recovery planning.

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## 1. INTRODUCTION

The Puget Sound Marine and Nearshore Grant Program (“the Grant Program”) is a partnership between the Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Natural Resources (WDNR). Since 2011, the Grant Program has distributed National Estuary Program funds to support more than 75 projects that implement recovery priorities identified in the [Action Agenda for Puget Sound](#).

Five years into their 6-year funding cycle, the Grant Program funded the Puget Sound Institute (PSI) to analyze and synthesize the results of their first 4 years of awards. The aim of this grant was to evaluate the results of completed work in order to inform and optimize future work at project, programmatic, and Puget Sound recovery levels. PSI evaluated and synthesized the reports and deliverables of 50 grants in a series of four analysis reports:

- Part 1 covered 14 regulatory effectiveness and stewardship grants (Kinney et al. 2015);
- Part 2 covered 9 grants related to high-priority threats, and the Puget Sound Pressures Assessment (Kinney et al. 2016a);
- Part 3 covered 20 habitat protection and restoration grants, as well as 6 outreach efforts (Kinney et al. 2016b); and
- A final report synthesizing all 2011-2014 investments (Kinney et al. 2016c).

In 2018, the Grant Program funded PSI to analyze and synthesize results of projects completed since 2016. Results of the 30 most recent awards are summarized in 3 addendums to the original analysis reports and a new Part 4 analysis report. **This addendum covers 2 new grants (Table 1) in the topic area covered by the 2016 Part 3 Report.** This report also provides a **wrap-up of project outputs from all 6 rounds of capital funding**, including cost updates for 3 projects that had not been completed at the time the 2016 Part 3 report was written.

**Table 1. Capital Investments**

Awards	Grantees	Product Citations
Derelict Net Reporting, Response, and Retrieval Program	Northwest Straits Foundation	Northwest Straits Foundation (2019)
Eelgrass restoration and monitoring	WDNR	Gaeckle (2019)

## 2. DERELICT NET REPORTING, RESPONSE, AND RETRIEVAL PROGRAM

Loss of fishing nets when they are caught on Puget Sound’s rocky outcroppings and ledges leads to lethal entanglement of fish, birds, marine mammals, and invertebrates. Since 2002, the Northwest Straits Foundation (NWSF) has worked with a number of partners to remove derelict fishing gear.

A 2012 Grant Program award allowed the NWSF to remove legacy derelict fishing nets and develop a pilot **Reporting, Response, and Retrieval Program** intended to **ensure newly lost nets do not re-accumulate** (see Analysis Report Part 3 for more). NWSF program staff and crews, in coordination with WDFW managers and enforcement staff, developed and tested a process for **coordinated response to reports of lost nets**.

A second grant in 2015 allowed NWSF to increase reporting of lost nets by enhancing outreach activities and thereby retrieve newly lost nets in a timely manner. A social marketing approach was used to evaluate perspectives and barriers among tribal and non-tribal fishermen about reporting lost gillnets and derelict gear, opportunities to encourage cooperation, and effective messaging to promote behavior change. Results from this second grant are summarized below.

## 2.1 RESULTS

- Informational and advertisement materials based on a marketing analysis and communications strategy were developed, audience-tested, produced, and distributed.
  - A key finding of the marketing research was that messaging can be misconstrued as “political” if not carefully expressed.
  - The tag line selected to be included on all outreach materials was “Be a Sound Thinker. Report Lost Nets.”
  - Outreach materials were distributed widely: 22 posters placed at marinas, marine supply stores, and other locations frequented by commercial fishermen; 844 wallet cards and 574 magnets handed out during meetings and included in annual mailings to all licensed net fishermen; and monthly print ads placed in regional fishing magazines.
- NWSF staff also presented information about the program to over 1,500 individuals (commercial fishermen, resource managers, researchers, university students, and general public) at 35 events. 16 guests (media, resource managers, concerned citizens) observed removal operations aboard the retrieval vessel. Removal and prevention efforts were featured in 16 media stories during the project period.
- **Focused outreach to the tribal fishing community continued during this grant.** 24 meetings (7 in-person and 17 telephone) were held with 12 different tribes and the Northwest Indian Fisheries Commission during the grant period. The meetings emphasized NWSF’s availability to address reports of lost nets while continuing to give the tribes the opportunity to respond rapidly.
- **50 reports of derelict fishing gear in Puget Sound were received during the 3-year grant period.** 48 of these reports were nets, and 2 were crab pots. This brings the total number of reports received since inception of the reporting program to 113.
- **31 nets were verified, located, and removed.** Not all of these nets had size data collected; those that did measured approximately 191,036 square feet (4.34 acres). This brings the total nets removed since inception of the reporting program to 70. 12 mammals, 14 birds, 39 fish, and 386 invertebrates were *observed* entangled in these nets.

## 2.2 RECOMMENDATIONS

The NWSF's derelict fishing gear program has resulted in substantial, direct positive impacts to populations of marine species, as well as Puget Sound rocky reef habitat. To ensure newly lost nets do not become derelict, continued investment in personnel devoted to responding to reports of lost nets is warranted.

The Grant Program contributed National Estuary Program funding to complete derelict net removal and start up a coordinated reporting and retrieval program. National Estuary Program funding is not intended for long-term program support. NWSF leveraged funding from NOAA's Marine Debris Program, WDFW, and private donations during the recent 3-year grant period. To help maintain the program into the future, Puget Sound Partnership and Habitat Strategic Initiative should offer support letters for federal grant applications and/or investigate ways to secure stable funding through existing WDFW programs.

## 3. EELGRASS RESTORATION

A 2011 Grant Program award resulted in the development of an approach and set of tools to optimize eelgrass restoration in Puget Sound. Thom et al. (2014) developed a habitat suitability model to identify eelgrass restoration sites with a maximum chance of success; evaluated the high-potential sites; and conducted test plantings in 2013 to determine suitability for large-scale restoration plantings.

A second grant was awarded in 2014 for **large-scale transplants at promising sites identified during the previous project**, as well as **additional test plantings** at other sites evaluated during the first phase. **Survival and expansion rates were monitored over 2 growing seasons**. Water quality data—temperature, pH, dissolved oxygen, and photosynthetic available radiation (PAR)—was also collected at the restoration sites and nearby unvegetated areas.

During the 2016 round of plantings, the grantee wove individual shoots through holes in a rectangular strip of burlap for planting (burlap strip method). This method was time-consuming, so in 2017 groups of shoots were anchored with metal landscaping staples (bare root method) to reduce cost. A third method involving rebar and hemp cord was also tried at one site.

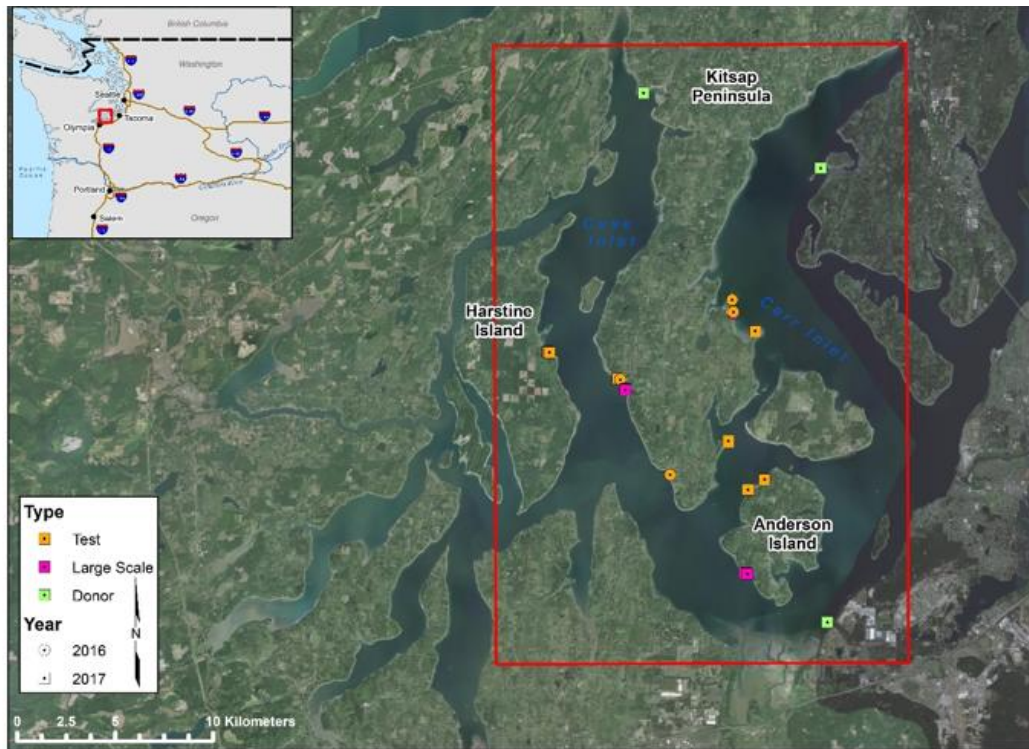
### 3.1 RESULTS

Large-scale transplants occurred at 3 locations (7 plots): Joemma Beach, Anderson Island, and Delano Beach. See Figure 1.

- **155,092 shoots were planted across 1,171 m<sup>2</sup>**
- Survival was mixed. Only one plot was successful. This plot, one of four plots at Joemma Beach State Park, had transplanted eelgrass coalescing into a more continuous eelgrass bed. Three other plots at Joemma Beach and one at Anderson Island had surviving eelgrass, but abundance was low. Two plots – one at Anderson Island and one at Delano Beach - failed.

- Transplant method may be a factor in lower survival rates at three of the Joemma Beach plots. The most successful site was planted using the more secure burlap method, while the bare root method was used at the other plots.

**Figure 1. Eelgrass transplant locations (From Gaeckle 2019)**



Test transplants occurred at 9 locations (15 plots).

- **10,477 shoots were planted across 349 m<sup>2</sup>.**
- Survival was very poor. Only 1 of the 15 plots had eelgrass during the second year of monitoring, and the survival rate was 14%.
- None of the test sites are candidates for large-scale restoration.
- The grantees identified several possible causes of transplant failure at the test sites: smothering by ulva (green algae); a donor site with eelgrass that had short canopy height; sediment disruption from geoduck harvests and/or burrowing shrimp.
  - Each year, there were high levels of green algae observed at most of the test-transplant sites, often totally covering the eelgrass. It was believed to have smothered and blocked the eelgrass from light, and possibly created anoxic conditions.

Water quality observations:

- Temperatures were almost identical between vegetated and unvegetated areas.



- pH values trended higher in eelgrass beds than unvegetated areas, but the difference was not statistically significant.
- Dissolved oxygen levels at the successful Joemma Beach plot were higher than unvegetated substrate at the site. There was no difference in dissolved oxygen between the 3 less successful Joemma Beach plots planted in 2017 and unvegetated areas.
- Photosynthetic available radiation (PAR) measurements were compromised by high levels of ulva.

### 3.2 RECOMMENDATIONS

Results of this restoration effort were disappointing, as only one of the large-scale plantings was successful and no new locations suitable for large-scale restoration were identified. Accumulation of and fouling by green algae—an indicator of nutrient enrichment—was implicated as a contributor to transplant failure, by smothering and blocking light from reaching eelgrass.

However, **other effects of nutrient enrichment could also have played a role.** A Gaeckle (2012) literature review established that **toxic levels of nitrogen in seagrass tissue can cause other essential nutrients to become limited and potentially cause transplant failure** (Burkholder et al. 1992, van Katwijk et al. 1997, Burkholder et al. 2007).

**Gaeckle (2016) measured nitrogen content and carbon-nitrogen ratios in eelgrass tissue from 15 Puget Sound sites.** Results indicate exposure to high concentrations of nitrogen:

- Measured carbon-nitrogen ratios were consistently <10 in above-ground biomass and <15 in below-ground biomass at most sites. A C:N below 20 indicates nutrient over-enrichment.
- Some **measured nitrogen content values were higher than those associated with ammonium toxicity** in eelgrass per van Katwijk et al. (1997). Tissue nutrient content values are highly variable and reflect seasonal patterns (Burkholder et al. 2007), so additional data would be needed to determine if Puget Sound nitrogen levels are high enough to result in ammonium toxicity or other direct physiological responses.

Restoration is one element of WDNR’s Puget Sound eelgrass recovery strategy (WDNR 2015). Consistent with Thom et al. (2014), the recovery plan recognizes that stressor abatement is also required. Evidence from Gaeckle (2012), Gaeckle (2016), and Gaeckle (2019)—all supported by Grant Program funding—indicates that **poor water quality warrants additional attention in eelgrass recovery planning.**

Reducing nutrient inputs is the focus of the Department of Ecology’s ongoing **Puget Sound Nutrient Source Reduction Project** and a **Marine Water Quality Implementation Strategy**. Data obtained by Gaeckle (2016) and Gaeckle (2019) is relevant to these efforts because it could **provide Ecology with evidence, or a new line of inquiry, to support eelgrass as an indicator for nutrient enrichment.** In addition,  $\delta^{15}\text{N}$  values provided by Gaeckle (2016) can

indicate anthropogenic nutrient sources; isolating anthropogenic impacts has been challenging given high marine nitrogen inputs.

#### 4. SUMMARY OF ROUNDS 1-6 CAPITAL INVESTMENTS

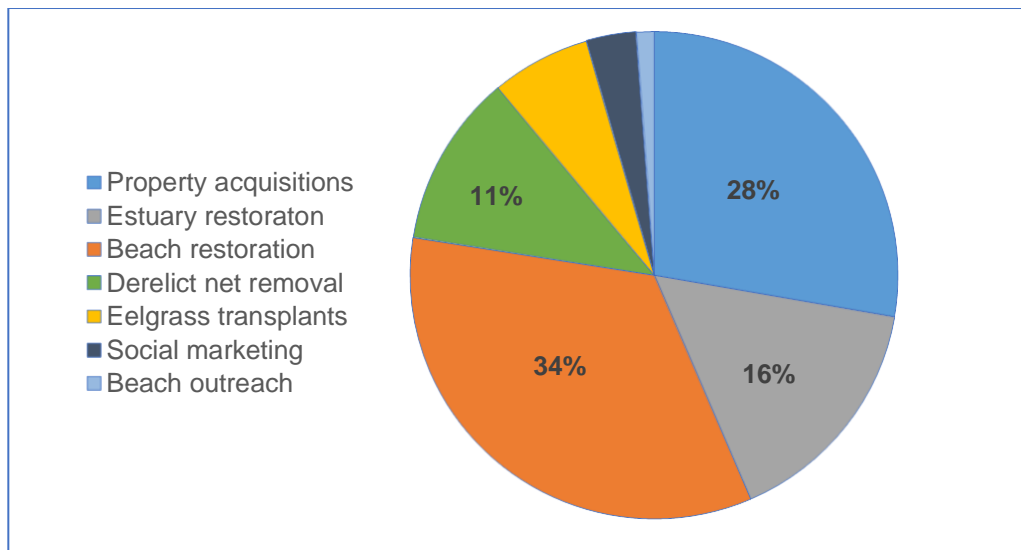
The Part 3 analysis report (Kinney et al. 2016b) provided summary information about capital investments the Grant Program made during their first 4 rounds of awards. Below is an update of key wrap-up metrics for all 6 rounds of awards (2011-2017).

Measurable outputs of the Grant Program’s capital investments are substantial:

- More than 52 acres of subtidal habitat uncovered through removal of 290 derelict fishing nets;
- 423 acres of restored and/or enhanced tidal hydrology at 3 major river deltas;
- 57 acres of restored and/or enhanced tidal hydrology in 2 small estuaries;
- 373 acres of habitat and 2.85 miles (13,582 feet) of shoreline permanently protected;
- 0.92 mile (4,801 linear feet) of shoreline armor removed
- 165,569 shoots of eelgrass transplanted over 0.38 acre (1520 m<sup>2</sup>); and
- 600 creosote pilings removed.

**Error! Reference source not found.** shows how investments were allocated among the various types of projects. The appendix updates project cost data presented in Tables 7 - 8 from Kinney et al. (2016b).

**Figure 1. Capital Investments by Category (Rounds 1-6)**



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## APPENDIX: UPDATED PROJECT COST DATA

This appendix updates Table 7 and Table 8 of Kinney et al (2016b). Cost of eelgrass restoration and the second derelict net grant have been added in Table 2. Table 3 provides final reported costs for three armor removal projects (Fort Townsend, Bowman Bay, and Titlow Park). Construction had not been completed when the Part 3 analysis report was written, so budgeted costs were included in the 2016 report.

**Table 2. Updated Cost Summary for Estuary and Marine Projects**

	Total Acres	Primary Restoration Actions	Cost	NEP Contribution	Cost per Acre
<b>AGRICULTURAL DELTA PROJECTS</b>					
<b>Skokomish Project #11-1361</b>	223	6,600 yards of tidal channel created/modified, culvert removal, and bridge construction	\$1,405,665	\$85,253	\$6,303
<b>Port Susan Project #11-1650</b>	150	1.4 miles of dike removed, and 1 mile built to protect neighboring farmland	\$771,049	\$162,450	\$5,140
<b>Milltown Island Project #11-1669</b>	50	0.7 mile of dike removed, 300 yards of tidal channel created, and 1.2 acres of wetland planting	\$420,745	\$237,197	\$8,415
<b>OTHER PROJECTS</b>					
<b>Meadowbrook Project #11-1343</b>	45	0.3 mile of dike removal, in-channel modifications, and armor removal	\$1,272,776	\$130,982	\$28,294
<b>Woodard Bay Project #10-1116</b>	1.3	600 creosote pilings removed	\$705,000	\$162,450	\$542,308
<b>Beard's Cove Project #14-1326</b>	12.3	Intertidal fill removed; 0.23 mile of tidal channel created	\$935,000	\$409,000	\$76,016
<b>Derelict Net Removal</b>	52	290 nets removed	\$872,941*	\$768,796	\$16,787
<b>Eelgrass</b>	0.38	165,569 shoots transplanted	\$500,000**	\$500,000	\$1.3 million
<b>TOTAL</b>	<b>534</b>		<b>\$6,883,180</b>	<b>\$2,456,130</b>	

\* Includes communication strategy and grant administration/reporting likely costs not included the other marine projects managed by the Estuary and Salmon Restoration Program. May exclude leveraged resources/match for Phase 1 (budget was not available for review).

\*\* Includes monitoring and grant administration/reporting costs likely not included the other marine projects managed by the Estuary and Salmon Restoration Program.

**Table 3. Updated Cost Summary for Armor Removal Projects**

	<b>Total Acres</b>	<b>Miles Removed</b>	<b>Feet Removed</b>	<b>Cost</b>	<b>NEP Contribution</b>	<b>Cost per Linear Foot</b>
<b>Brown Island Project #13-1177</b>	0.1	0.01	53	\$117,525	\$69,975	\$2,217
<b>Bowman Bay Project #13-1235</b>	0.7	0.1	528	\$250,830	\$235,035	\$475
<b>Seahurst Park Project #09-1415</b>	11	0.5	2640	\$4,307,743	\$646,937	\$1,632
<b>Ft. Townsend Project #13-1234</b>	0.46	0.06	317	\$496,076	\$480,250	\$1,564
<b>Howarth Park Project #13-1106</b>	3.3	0.08	422	\$1,138,764	\$600,000	\$2,698
<b>Titlow Beach Project #15-1447</b>	1.5	0.03	158	\$653,403	\$548,899	\$4,135
<b>Maury Island Project #14-2226</b>	3.1	0.14	700	\$936,712	n/a*	\$1,338
<b>TOTAL</b>	<b>20.16</b>	<b>0.92</b>	<b>4,818</b>	<b>\$7,901,053</b>	<b>\$2,581,096</b>	<b>\$1,640</b>

*Average cost per linear foot of beach restored — \$2,008*

\* NEP dollars contributed to property acquisition at this site