

# Analysis of Effective Regulation and Stewardship Findings

A REVIEW OF  
PUGET SOUND MARINE AND NEARSHORE  
GRANT PROGRAM RESULTS, PART 1

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## KEY RESULTS

- 1) **A potentially significant amount of shoreline construction is occurring without permits.** Compliance monitoring conducted in two Puget Sound counties and one city found that, on average, about half of shoreline modifications did not have required permits. **Where permits were obtained, requirements were sometimes violated in nontrivial ways.** On-site evaluations of permitted shoreline armoring projects in two counties found that some structures were built longer or closer to the water than was specified in permit documentation.
- 2) **Improved enforcement of existing shoreline regulations is critical for Puget Sound.** Most agency resources are allocated to development or review of regulations and guidelines, with compliance monitoring and enforcement not prioritized. Many local governments have few resources available for enforcement. Shoreline permitting systems with inadequate enforcement penalize those that comply with the rules and reward those willing to violate the rules.
- 3) **Local governments need assistance to effectively implement and enforce regulations.** Program capacity can be improved by increasing access to technical experts in state agencies, providing professional training opportunities, supporting pre-application phase educational efforts, and providing resources to effectively manage permit data. Improving effectiveness of permits for shoreline armoring projects will require resources for additional site inspections.
- 4) **Incentive programs can create a positive cycle of improvement in ecological function.** Working with landowners on a voluntary basis can address both the existing impacts of armoring and the future demand for it. Financial incentives, technical design assistance, and streamlining of permit processes can encourage landowners to consider alterations to existing structures and/or installation of alternative shore protection techniques.
- 5) **Direct and focused landowner engagement is key to changing landowner perceptions and behavior related to armoring.** Participation of trusted community members resulted in positive responses from property owners. Technical assistance is best offered in a non-regulatory context.
- 6) **Protection and enhancement measures are needed to achieve recovery targets for eelgrass.** Numerical biomass and habitat suitability models found significant acreage with physical conditions suitable for eelgrass but with no eelgrass present, indicating stressors need to be managed. Survey input from technical experts and shoreline managers suggests **locals can play a key role in managing stressors** because of the site-specific nature of direct impacts like mooring buoys and overwater structures. Rigorous pre-planting site evaluations did not guarantee restoration success, so protection is vital.
- 7) **Beach-spawning forage fish may be particularly vulnerable to the effects of sea level rise.** Modeling and GIS tools have identified structures, public facilities, and habitats

vulnerable to inundation and erosion hazards in San Juan County. This type of **sea level rise vulnerability assessment facilitated planning and development of climate change adaptation strategies**. Projected changes in shoreline position supports prioritization of infrastructure protection and relocation measures, as well as identification of long-term restoration and conservation targets.

- 8) **Enhancing public understanding of the connections between land use, property management, and nearshore ecosystem functions and values can support effective shoreline regulation.** Economic valuation of ecosystem goods and services enables the economic costs of damaged natural systems to be incorporated into management policies and decisions. **Protection of natural capital is a low-cost alternative to restoration of a damaged system.** In Clallam County, unarmored sections of feeder bluff were estimated to provide more than three times the economic benefits generated by sections with a seawall.

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## 1. BACKGROUND

The Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Natural Resources (WDNR) together serve as the Marine and Nearshore Lead Organization (LO) responsible for developing and implementing a 6-year strategy for implementing priorities of the Action Agenda for Puget Sound. The Puget Sound Marine and Nearshore Grant Program (“the Grant Program”) awards funds provided under the U.S. Environmental Protection Agency’s National Estuary Program for projects related to protecting and restoring marine and nearshore habitat. The Grant Program has organized their investments into five areas:

- 1) effective regulation and stewardship,
- 2) habitat restoration and protection,
- 3) addressing high priority threats (invasive species and oil spills),
- 4) cross cutting issues, and
- 5) adaptive management.

Since 2011, the Grant Program has funded more than 45 projects. Work on grants awarded during Rounds 1-4 of the current 6-year funding cycle has largely been completed. During Round 5, the grant program funded the Puget Sound Institute (PSI) to analyze and synthesize results of the first 4 years of awards. As part of an adaptive management strategy, the aim of this grant is to evaluate past results in order to inform and optimize outcomes at project, programmatic, and Puget Sound recovery levels. PSI is evaluating the Grant Program’s portfolio of projects in groups by investment area.

The 14 grants reviewed in this report are grouped in the effective regulation and stewardship investment area. The Grant Program’s objective for these grants was to:

*“Reduce human development pressure  
in Puget Sound marine and nearshore environments  
through regulatory and voluntary protection measures.”*

This report synthesizes the findings presented in the 14 grant products listed in Table 1. Our analysis is **not** a comprehensive review of regulatory effectiveness and stewardship issues in the Puget Sound region. We focus on the lessons learned and implications of these specific projects.

Analysis of project results is organized by the sub-strategies used in the Action Agenda to facilitate consideration of recommendations contained herein during 2016/2017 updates.

**Table 1. Effective Regulation and Stewardship Grants (Rounds 1-4)**

<b>Grant Title</b>	<b>Project Partners</b>	<b>Product Citations</b>
<b>Marine Shoreline Monitoring and Compliance Pilot Project in WRIA 9</b>	King County Water and Land Resources	King County (2014)
<b>Compliance Assessment</b>	Ecology and WDFW	Talebi and Tyson (2014)
<b>Targeted Outreach to Reduce Impacts from Shore Hardening in the PSMA</b>	Northwest Straits Foundation, Coastal Geologic Services, EE Outcomes Consulting, Island and Snohomish Counties and MRCs	Johannessen (2013 a-b)
<b>Marine Shoreline Design Guidelines</b>	WDFW, Ecology, Coastal Geologic Services, and Qwg Applied Geology	Johannessen et al. (2014)
<b>Nearshore Permitting Effectiveness through T.A.C.T.</b>	Kitsap County, WDFW, and San Juan County	Barnhart et al. (2015) Dionne et al. (2015) Key (2013)
<b>Puget Sound Shoreline Master Program Improvement</b>	Futurewise	Futurewise (2014 a-d)
<b>Protecting the Strait of Juan de Fuca Nearshore</b>	Coastal Watershed Institute, Clallam County, WDNR, Ecology, and Earth Economics	Flores et al. (2013) Kaminsky et al. (2014) Shaffer et al. (2014) Parks (2015)
<b>Puget Sound Feeder Bluffs Mapping</b>	Ecology and Coastal Geologic Services	MacLennan et al., 2013
<b>Support Public Awareness, Outreach and Engagement on SMP Updates</b>	Puget Sound Partnership, WSU Mason County Extension, Heidi Keller Consulting, and Friends of the San Juans	Keller (2012) WSU Mason County Extension (2013)
<b>Sea Level Rise and Cumulative Effects Management Tools</b>	Friends of the San Juans, Coastal Geologic Services, and Salish Sea Biological	MacLennan et al. (2013) Whitman and Hawkins (2013) Loring (2013) Whitman et al. (2014) Friends of the San Juans (2014)
<b>20% More Eelgrass by 2020</b>	WDNR and PNNL	Thom et al. (2014)
<b>Ensuring Regulatory Effectiveness in Puget Sound's Most Special Places</b>	Washington Environmental Council	Washington Environmental Council (2013)
<b>Protecting Nearshore and Marine Habitat in Mason County</b>	Mason County Community Development	Adkins (2013)
<b>Social Marketing Strategy to Reduce Shoreline Armoring<sup>1</sup></b>	Colehour + Cohen, Social Marketing Services, Futurewise, Coastal Geologic Services, and Applied Research Northwest	Colehour + Cohen et al. (2014 a-e)

<sup>1</sup> This grant was part of the “habitat restoration and protection” investment area. It is included here because of this report’s emphasis on shoreline armoring and incentives.



## 2. IMPROVING AND STRENGTHENING REGULATIONS

This section provides an analysis of Grant Program results related to Action Agenda Sub-strategy B1.3 (Improve, strengthen, and streamline implementation and enforcement of laws, regulations, and permits that protect the marine and nearshore ecosystems and estuaries).

The Grant Program funded several investigations evaluating the effectiveness of, and proposing improvements to, existing regulatory protection measures in support of this sub-strategy. Findings and recommendations provided in this section are aggregated into themes (enforcement, implementation, and exemptions) and are based upon results of the following grants:

- 1) Compliance Assessment (Talebi and Tyson, 2014)
- 2) Nearshore Permitting Effectiveness through T.A.C.T. (Barnhart et al., 2015; Dionne et al., 2015; Key 2013)
- 3) Puget Sound Shoreline Master Program Improvement (Futurewise, 2014 a-d)
- 4) Marine Shoreline Monitoring and Compliance Pilot Project in WRIA 9 (King County, 2014)
- 5) Sea Level Rise and Cumulative Effects Management Tools (Friends of the San Juans, 2014)
- 6) Targeted Outreach to Reduce Impacts from Shore Hardening in the PSMA (Johannessen, 2013a)
- 7) Protecting Nearshore and Marine Habitat in Mason County (Adkins, 2013)

Despite the different approaches to problem identification, data collection, and analysis in these projects, the conclusions reached and recommendations made are remarkably similar.

### 2.1 ENFORCEMENT

#### 2.1.1 FINDINGS

- Most local jurisdictions do not have dedicated enforcement staff for shoreline regulations (Talebi and Tyson, 2014; Futurewise, 2014a; Johannessen, 2013a).
- Talebi and Tyson's (2014) survey of compliance with Shoreline Management Act and Hydraulic Code regulations identified a severe gap in understanding of compliance rates along Puget Sound shorelines. Counties were not able to produce informative compliance tracking and enforcement data. They concluded that without reliable data, it is difficult to characterize the extent of the problem, contributory causes, and patterns that need to be addressed.
- However, there is some evidence that shoreline construction is often occurring in the absence of or out of compliance with permits (King County, 2014; Friends of the San Juans,

2014; Dionne et al., 2015; Barnhart et al., 2015; Futurewise, 2014a; Talebi and Tyson, 2014).

- Tables 2 and 3 provide a summary of existing data on compliance with shoreline regulations along Puget Sound’s marine shorelines.
- The highest quality data on *unpermitted* construction in this group derived from surveys using field-based methods (e.g., boat surveys and site visits). Efforts that relied on remote methods for baseline data appeared to identify fewer armoring projects. For example, Mason County identified only 2 new armoring structures despite HPA data (provided on PSP’s Shoreline Armoring Vital Sign website) indicating that 17% of all new armor constructed in Puget Sound between 2005 and 2012 was located in Mason County. This is consistent with previous work that found limitations in photo interpretation as a method for identifying changes in relatively small (50-100 linear feet) segments of armored and unarmored marine shoreline in Puget Sound (Anchor Environmental, 2004; WRIA 9 Implementation Technical Committee, 2012).
- Rigorous baseline inventories of shoreline structures at the parcel scale were useful for identifying unpermitted shoreline construction. This indicates that regular shoreline change monitoring could improve enforcement capability.
- The wide range of reported compliance rates likely reflects the different data collection methods employed and the different outcomes measured. For example, the King County (2014) study included upland changes within SMP jurisdiction while the Quinn (2012) work measured only those changes at or below the ordinary high water mark (OHWM). Some categories of (primarily) upland activities had quite low compliance rates—14% for vegetation clearing and 12% for stairwells—which lowered the overall compliance rate observed in King County (2014).
- Post-construction surveys of 45 recently permitted shoreline stabilization projects (Dionne et al., 2015) revealed that several projects had at least one measurement that was greater than specified in the permit: 11 were longer,<sup>2</sup> 9 were taller, and 9 were built further

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<sup>2</sup> For a total of 287 linear feet of additional armoring above the length indicated in the 11 permits.

waterward.<sup>3</sup> These discrepancies are important because length and waterward extent influence the area and type of shoreline habitat impacted by these structures. Dionne et al. (2015) referred to them as the most critical dimensions for marine shoreline stabilization projects.

- Thus, using permit data to measure new shoreline armoring likely underestimates the extent of new armoring installed annually.<sup>4</sup>
- Deterrence is seen as the key motivator for compliance, but existing SMP enforcement programs fail to deter violators (Futurewise, 2014a). Penalties are not substantial enough to discourage unauthorized activities, and do not fund enforcement programs (Futurewise, 2014a; Johannessen, 2013a).
- Property owner notification and education about regulations can be an additional motivator for compliance (Futurewise, 2014a; Adkins, 2013).
- Anecdotal information indicates that there is widespread awareness among shoreline property owners of lax enforcement, the lack of significant penalties, and frequent granting of “after the fact” permits (Futurewise, 2014a; Johannessen, 2013a).
- Additionally, interviews with county permitting staff indicate that landowners perceive permitting as so expensive and time consuming that many choose to forgo the process, install unpermitted armor, and face penalties (Johannessen, 2013a; Futurewise, 2014a).

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<sup>3</sup> Due to potential measurement error, the number of structures built further waterward than permitted could be as low as 2 or as high as 14. Since tidal elevation datum vary regionally, Dionne et al. (2015) used a tool to translate tidal elevations from the GPS measurements taken in the field. This translation introduces a potential for error, in addition to the potential error associated with the actual GPS measurements. To account for this, they added and subtracted the combined maximum GPS and translation error to their actual field measurements. Adding the maximum potential error essentially pushes their measurement of elevation landward (resulting in more structures in compliance), while subtracting it pushes the measurement waterward (resulting in fewer structures in compliance). Using the actual elevation measurements from the field, 9 structures were built further waterward than permitted. The number drops to 2 when the maximum potential error is added and rises to 14 when the maximum potential error is subtracted.

<sup>4</sup> The following example demonstrates the potential for limited data availability to affect the Puget Sound Partnership’s (PSP) trend analysis for the shoreline armoring indicator, which is calculated using Hydraulic Project Approvals (HPAs) issued by WDFW. PSP’s Shoreline Armoring Vital Sign website shows King County as responsible for 1.5% (522 feet) of new armoring in Puget Sound between 2005-2010. King County (2014) found that 3 of 7 sites with new armoring installed sometime between 2004-2013 were not permitted by the jurisdiction where they were located. These structures were a combined total of 452 feet long, almost doubling the Vital Sign estimate. Although this quick example makes assumptions that may not be correct (both HPAs and SMPs not obtained, projects built before 2011) it is illustrative of the extent to which lack of data can skew a trend analysis.

**Table 2. Summary of Existing Puget Sound Shoreline Compliance Data – Unpermitted Construction**

Source	Outcome(s) Measured	Method(s) to Determine Baseline	Time Period	Area	Data	Compliance Rate
Higgins (2014) *	changes in shoreline condition cross-checked against permit records (includes 200' landward of OHWM)	boat-based surveys and aerial photographs	2004-2013	92 miles of shoreline in King County (6 jurisdictions)	<ul style="list-style-type: none"> <li>• 145 distinct changes in shoreline condition, including 7 new armoring and 66 armoring repairs</li> <li>• 46 changes permitted</li> </ul>	32%
Mason County (2013) *	unpermitted improvements	aerial photographs	2001-2011	10.5 miles of shoreline in Mason County	<ul style="list-style-type: none"> <li>• 42 new overwater structures</li> <li>• 2 new shoreline armoring</li> </ul>	87%
Quinn (2012)	changes in beach structures cross-checked against HPA permit records	aerial photographs	2006-2012	55 miles of shoreline along Bainbridge Island	<ul style="list-style-type: none"> <li>• 82 shoreline changes</li> <li>• 64 HPAs issued</li> </ul>	80%
Quinn (2012) and Key (2013) *	changes in in beach structures cross-checked against HPA and SMP permit records	aerial photographs	2006-2012	34 miles of shoreline in San Juan County	<ul style="list-style-type: none"> <li>• 32 shoreline changes</li> <li>• 10 projects with both HPAs and SMP permits</li> <li>• 6 projects had only HPA or only SMP permits</li> <li>• 16 projects with no permits</li> <li>• 63% of the parcels with no permits on record involved armoring</li> </ul>	50%
Friends of the San Juans (2010)	baseline inventory of shoreline structures	boat-based surveys	April-July 2009	408 miles of shoreline in San Juan County	<ul style="list-style-type: none"> <li>• 710 armored beaches</li> <li>• 472 docks</li> </ul>	not applicable
San Juan Initiative (2008)	shoreline modifications from MacLennan and Johannessen (2008) cross-checked against SMP permit records	boat-based surveys and aerial photographs	1977-2006	34 miles of shoreline in San Juan County	<ul style="list-style-type: none"> <li>• &gt;200 parcels</li> <li>• 9 SMP permits</li> <li>• 12 HPAs</li> </ul>	<10%

\* funded by the Grant Program

**Table 3. Summary of Existing Puget Sound Shoreline Compliance Data – Permitted Construction**

Source	Outcome(s) Measured	Data Collection Method	Time Period	Area Evaluated	Number and Type of Data Points	Compliance Rate
Barnhart et al. (2015) * Appendix A	number of shoreline armoring projects that complied with SMP permit conditions	review of permit records	2007-2012	unincorporated Kitsap County	<ul style="list-style-type: none"> <li>• 60 bulkhead permits evaluated</li> <li>• 32 had at least 1 condition</li> <li>• 9 documented instances where conditions not met</li> </ul>	72%
Dionne et al. (2015) *	as-built dimensions and position of shoreline stabilization structures compared to corresponding measurements specified in issued HPAs	field measurements and review of permit records	permits issued 2006-2014	unincorporated Kitsap County and 34 miles of shoreline in San Juan County	<ul style="list-style-type: none"> <li>• 45 shoreline stabilization structures measured</li> <li>• Compliance was difficult or impossible to measure for several projects because of information missing from the permit record: 6% had no clear statement of structure length and 55% lacked a fixed reference point. 26% longer than permitted</li> <li>• 26% taller than permitted</li> <li>• 21% further waterward than permitted</li> </ul>	
WDFW (2012)	number of projects that complied with mitigation provisions included in HPAs	site visits	2010-2011	12 counties	<ul style="list-style-type: none"> <li>• 95 marine bank protection HPAs</li> <li>• 66 marine overwater structure HPAs</li> </ul>	91%  73%
Quinn et al. (2007)	number of projects that complied with mitigation provisions included in HPAs	site visits	2005-2006	6 counties	<ul style="list-style-type: none"> <li>• 14 marine bank protection HPAs</li> </ul>	40-100% depending on provision
Whitman (2007)	temporal and spatial assessment of shoreline permit activity	geo-database development and queries	1972-2005	408 miles of shoreline in San Juan County	<ul style="list-style-type: none"> <li>• 2,607 permits total</li> <li>• 372 violation permits</li> </ul>	86%
San Juan Initiative (2008)	number of projects that complied with permit conditions	not provided	2006	34 miles of shoreline in San Juan County	<ul style="list-style-type: none"> <li>• 9 SMP permits</li> <li>• 12 HPAs</li> </ul>	<50%

\* funded by the Grant Program

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## 2.1.2 IMPLICATIONS

- Inadequate compliance programs, including limited enforcement and weak penalties, undermine the effectiveness of local Shoreline Master Programs (Futurewise, 2014a; Friends of the San Juans, 2014; Barnhart et al., 2015). Protection of habitat cannot be achieved through promulgation of regulations and development of permit programs alone. Effective compliance programs would deter future violations, minimize unmitigated impacts, and supply the data needed to accurately measure progress towards Vital Sign recovery targets.
- Reliable and consistent data on regulatory compliance needs to be collected and acted upon. Rigorous baseline inventories of shoreline structures at the parcel scale are useful for identifying violations and tracking overall compliance rates. This type of monitoring can also be used by a jurisdiction to evaluate compliance with “no net loss” requirements.<sup>5</sup> Critical information can be collected via simple surveys, but enforcement programs must also be capable of pursuing identified violations.
- Permitting systems with inadequate enforcement programs effectively penalize those that comply with the rules and reward people willing to violate (Futurewise, 2014a). The permit application process should not be more difficult, costly, and time-consuming than the violation resolution process; the benefits of illegal activities should not exceed penalties for violations (Futurewise, 2014a).

## 2.2 IMPLEMENTATION

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### 2.2.1 FINDINGS

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#### REVIEW AND TRACKING PROTOCOLS

- Lack of formal and standardized permit review protocols results in inconsistent application of minimization and/or compensatory mitigation<sup>6</sup> conditions in issued permits. Mechanisms like standardized checklists or review processes for specific types of projects could assist permitting staff in consistent application of permit conditions (Barnhart et al., 2015; Dionne et al., 2015; Futurewise, 2014c; Adkins, 2013).

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<sup>5</sup> The “**no net loss**” standard requires that the impacts of shoreline use and/or development, whether permitted or exempt from permit requirements, be identified and mitigated on a project-by-project basis (WAC 173-26-186(8)b).

<sup>6</sup> Regulatory programs address adverse effects of proposed projects through **mitigation sequencing**. This 3-step process is intended to identify ways to: (1) **avoid** impacts by considering practicable alternatives with fewer adverse impacts; (2) **minimize** impacts by incorporating measures to reduce negative effects; and (3) **compensate** for any unavoidable adverse impacts which remain.

- SMP program fee structures can result in restrictions on staff time that limit activities that minimize impacts, such as homeowner education during the pre-application stage and pre-construction inspections (Barnhart et al., 2015; Futurewise, 2014a; Johannessen, 2013b).
- Correcting identified procedural deficiencies in permit recording (e.g., not including key project measurements into databases or on permits) and standardizing inconsistent naming conventions (new, repair, replacement, enhancement, etc.) could improve tracking (Barnhart et al., 2015; Dionne et al., 2015). Providing standard definitions for types of armoring projects could also help determine if a project qualifies for the restoration/enhancement incentives described in Section 3.4.

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## INTERAGENCY COORDINATION

- The lack of effective interagency coordination is a barrier to strong implementation of shoreline regulations (Futurewise, 2014b). Interagency coordination improves regulatory efficiency, reduces applicant uncertainty, and increases natural resource protection (Futurewise, 2014b).
- Excessive workload was the most consistently identified and most important barrier to interagency coordination reported by shoreline management practitioners during interviews (Futurewise, 2014b). Likewise, the Barnhart et al. (2015) evaluation of shoreline programs in 2 counties found that coordination between WDFW and local jurisdictions was often limited due to staffing constraints.

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## INSPECTIONS

- Barnhart et al. (2105) found that staff conducting field inspections often had no training on locating the OHWM. This is problematic because regulatory programs focus on minimizing negative impacts of marine shoreline development by limiting activities below OHWM.<sup>7</sup>
- Many of the shoreline stabilization permit records reviewed by Dionne et al. (2015) lacked a stable reference point against which the location of a structure on the beach profile could be measured. Several referenced an elevation that could be altered or difficult to assess after the project was constructed.<sup>8</sup>
- Barnhart et al. (2105) found that bulkhead footing location inspections were often conducted concurrently with a final project inspection. Post-construction inspections do not

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<sup>7</sup> For example, WAC 220-110-285(2) and WAC 173-6-231(3)(a)(iii)(c).

<sup>8</sup> Dionne et al. (2015) explain that beach profiles commonly change as a result of construction of stabilization structures and beach nourishment. As a result, it difficult or impossible to evaluate compliance during post-construction inspections when qualitative measurements (i.e., those referencing OHWM or top of bank) were used to describe a proposed alignment in permit documents.

provide an opportunity to fix problems before a structure is complete and damage to ecological functions may have already occurred.

- These results indicate effective implementation of regulations for marine shoreline stabilization projects requires inspections before, during, and after construction (Barnhart et al., 2105).
- However, staffing resources at both the local and state levels are not sufficient to allow the coverage needed for these inspections (Barnhart et al., 2105). The authors suggest collaboration between local government and WDFW staff would be beneficial, and that joint pre-construction site visits should be prioritized to improve outcomes.

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## MITIGATION

- Mitigation sequencing is applied inconsistently during permit review and does not appear to include compensatory mitigation adequate for reaching the “no net loss” standard (Futurewise, 2014c).
- If a permit is conditioned, there are few mechanisms to follow through and ensure requirements are implemented (Talebi and Tyson, 2014; Futurewise, 2014a; Dionne et al., 2015; Barnhart et al., 2105).
- Implementation of SMP “no net loss” requirements is a challenge owing to uncertainty about baseline conditions as well as the difficulty of quantifying and tracking net changes (Futurewise, 2014c).

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## 2.2.2 IMPLICATIONS

Improving SMP permitting processes can strengthen protection of nearshore and marine resources without requiring changes to laws or regulations. Process improvements could also result in better customer service for applicants. Several simple and fundable actions related to standardizing the review process could substantially improve the protection shorelines through regulation. Improving effectiveness of permits for shoreline armoring projects will require resources for additional site inspections. Specific procedural recommendations are provided in Section 2.4 below.



## 2.3 EXEMPTIONS

### 2.3.1 FINDINGS

- SMP exemptions<sup>9</sup> are not handled uniformly across the region. Some jurisdictions require applicants to apply and wait for an exemption permit or a letter of exemption, while others allow applicants to determine whether a project qualifies for an exemption (Futurewise, 2014c).
- Kitsap and San Juan Counties are 2 jurisdictions that require permits for exempt projects. Between 2007 and 2012, an average of 80% of the shoreline armoring permits these counties issued were processed as exemptions (Barnhart et al., 2015).
- Local governments can condition their approval of exempted development<sup>10</sup> but may be prevented from doing so due to the fewer staff hours allotted for processing exemption permits as compared to substantial development permits (Barnhart et al., 2015). This can limit the ability of staff to conduct site visits and/or research pertaining to protected species and habitats in the project area. Additionally, mitigation and inspection requirements can be less protective for exemption permits (S. Key, San Juan County, T.A.C.T. grant contributor, personal communication, June 2015).
- The high volume of shoreline armoring exemptions—particularly repair and replacement exemptions—is a significant threat to habitat but also an opportunity for enhancement and/or restoration (Friends of the San Juans, 2014).
- Though updated SMPs require alternatives to hard armoring be ruled out before new armoring is approved under a shoreline substantial development permit, in-kind replacement is allowed for existing structures (Barnhart et al., 2015).

### 2.3.2 IMPLICATIONS

The high volume of bulkhead exemptions limits the extent to which local SMPs can prevent further degradation of the Shoreline Armoring Vital Sign. More than 100 individual SMPs are being implemented in cities and counties throughout the Puget Sound region. Differences in the way these programs process exempt projects—both among jurisdictions as well as within due to required updates—make it difficult to generalize the extent to which statutory exemptions undermine new rules intended to limit new shoreline armoring.

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<sup>9</sup> The Shoreline Management Act (SMA) exempts construction of a “normal protective bulkhead common to single family residences” and “normal maintenance and repair of existing structures” from substantial development permit procedural requirements (RCW 90.58.030).

<sup>10</sup> WAC 173-27-040(e) authorizes local governments to attach conditions to the approval of exempted developments and/or uses to assure consistency of the project with the local master program and the SMA.

## 2.4 RECOMMENDATIONS

- 1) Prioritize compliance monitoring and enforcement activities to executive-level managers through the Ecosystem Coordination Board. Increases in staffing levels, funding, and training for SMP permitting programs would improve regulatory protections.
- 2) Develop standardized SMP review and inspection forms, procedures, tools, and definitions to improve the permit process and subsequent monitoring/ tracking. Many of the process improvements identified in Barnhart et al. (2015) could be applied in other jurisdictions.
  - Create templates or checklists to streamline and guide consistent application of conditions for different types of projects (Barnhart et al., 2015).
  - Consider providing financial resources and/or technical support to local jurisdictions for creating or updating electronic SMP data management systems to better support project review and enforcement. Many upgrades to city and county systems have already been completed, and can be used to develop recommendations for other jurisdictions (Futurewise, 2014a). Addition of tracking metrics to permit records can assist with both compliance monitoring and implementation of “no net loss” requirements (Barnhart et al., 2015). If the right metrics are input on a consistent basis, automated reporting becomes easy (K. Barnhart, Kitsap County, T.A.C.T. grant contributor, personal communication, November 2015).
  - Consider making changes to application forms (Futurewise, 2014b). Adding fields to input length, width, height, distance from OHWM of existing and/or new portions of armoring structures could facilitate input of this information in permit tracking systems (Barnhart et al., 2015).
- 3) Direct resources towards enforcement programs.
  - Develop standardized compliance monitoring protocols, including baseline inventories of shoreline structures for identifying and tracking future violations. The King County WRIA 9 Compliance Project (King County, 2014) and WDFW Habitat Program compliance monitoring projects (Quinn, 2012; Quinn et al., 2007) are strong models to emulate. Publicizing that such inventories are conducted could help deter future violations.
  - Clarify and communicate SMP compliance monitoring priorities and protocols to encourage consistency across jurisdictions (Talebi and Tyson, 2014). A planned chapter in Ecology’s SMP Handbook<sup>11</sup> on “Administration and Enforcement Provisions” could house this type of guidance for local jurisdictions.

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<sup>11</sup> <http://www.ecy.wa.gov/programs/sea/shorelines/smp/Handbook/index.html>

- Consider inclusion of baseline inventories of shoreline structures as near-term actions in the 2016/2017 Action Agenda and/or individual Local Implementing Organization (LIO) Action Agendas. Prioritize rapidly urbanizing jurisdictions.
  - Consider funding additional grants to pay for enforcement officer salaries and/or train existing local jurisdiction staff on legal and procedural requirements for enforcement actions. Adkins (2013) indicated the hiring of an enforcement officer for 1.5 years was the most beneficial result of the grant received by Mason County. Since staff capacity is a major barrier for small jurisdictions, paying the salary of dedicated enforcement officers is perhaps the most direct way to improve compliance.
  - Investigate ways to improve the efficiency of compliance monitoring (Talebi and Tyson, 2014). New technologies to capture, geo-reference, and render images are developing quickly and could lead to less labor-intensive techniques for collecting and processing information about built shoreline features. Use of boat-based LiDAR as described by Kaminsky et al. (2014) has potential to monitor changes in armoring status over time. Autonomous flight systems like quadcopters can be programmed to quickly capture near-horizontal photographs along long stretches of shoreline. Existing software can process these images and produce 3-D models that can be then used to classify shoreline features. Changes in these features over time could be evaluated in an automated manner, similar to the High Resolution Change Detection (HRCDD) techniques WDFW is applying to aerial imagery.
  - Coordinate enforcement efforts with other department or agencies to increase identification of unpermitted and non-compliant structures, as well as the efficiency of subsequent enforcement actions (Futurewise, 2014a-b; Barnhart et al., 2015).
  - Encourage compliance by implementing penalties or other adverse consequences sufficient to deter non-compliance (Futurewise, 2014a).
- 4) Improve interagency coordination. General strategies are provided in Futurewise (2014b), and crucial stages of permit review that would benefit from improved coordination between WDFW and local jurisdictions are highlighted in Barnhart et al. (2015).
- 5) Prioritize inspections before, during, and after construction of new and repair/replacement marine shoreline stabilization projects.
- The Dionne et al. (2015) work emphasizes the importance of establishing—prior to any construction activity—a stable reference point that will not be affected by project installation, natural process, or tampering. The location and measurements of existing shoreline structure(s) and the OHWM need to be referenced to this datum.
  - An inspection after the project alignment (footing location) is marked with stakes but before installation begins allows changes to be made before a structure is built lower on the beach than intended (Barnhart et al., 2015)

- The post-construction inspection is then necessary to ensure a project was built to plan. Without all 3 inspections, the others are essentially ineffective (S. Key, San Juan County, T.A.C.T. grant contributor, personal communication, November 2015).
- 6) Ensure projects limit and mitigate impacts. Multiple strategies for mitigating impacts are provided in Futurewise (2014c). The Marine Shoreline Design Guidelines (MSDG), described in Section 3.1, provides a framework for alternatives analysis that could support mitigation sequencing for shoreline armoring projects.
- Consider developing an interagency mitigation manual to set standard mitigation requirements for common forms of development like shoreline erosion protection (Futurewise, 2014c). A region-wide mitigation manual could encourage consistency across the multiple jurisdictions and agencies responsible for regulating shoreline development; enable incorporation of the best available science; and result in more efficient and predictable permit review. A mitigation manual could also provide jurisdictions with easy-to-apply conditions for projects processed as exemptions.
- 7) Compile and evaluate information about the range of ways local jurisdictions process exemptions to identify ways for improving regulatory protections applicable to shore protection projects.
- Questions to consider include: What, if any, conditions are applied to exemption permits? How much more staff time is allotted for substantial developments versus exempt projects? Are priority habitats, particularly forage fish spawning beaches, considered? Are exempt projects inspected? If/how policies and procedures are changed as a result of SMP updates. Would SMP programs have capacity to meet dramatically increased workload demands if RCW 90.58.030 were changed to remove exemptions for normal protective bulkheads and repair/replacement of existing structures?
  - This work would address a Biennial Science Work Plan priority (Conduct social science studies to describe the key institutional challenges to attaining no net loss and improvements from restoration).
- 8) Findings and recommendations regarding training for local jurisdiction staff are addressed in Section 4 of this document.

### 3. PROMOTING ARMORING REMOVAL

This section analyses Grant Program results related to Action Agenda Sub-strategy B2.3 (*Remove armoring, use soft armoring replacement or landward setbacks when armoring fails, needs repair, is non protective, and during redevelopment*). Shoreline armoring and incentive-based approaches to encourage alternative methods of shore protection were major themes of work funded in this investment area. Findings and recommendations provided in this section are based upon results of the following grants:

- 1) Marine Shoreline Design Guidelines (Johannessen et al., 2014)
- 2) Protecting the Strait of Juan de Fuca Nearshore (Kaminsky et al., 2014)
- 3) Nearshore Permitting Effectiveness through T.A.C.T. (Dionne et al., 2015; Barnhart et al., 2015)
- 4) Support Public Awareness, Outreach and Engagement on SMP Updates (Keller, 2012; WSU Mason County Extension, 2013)
- 5) Social Marketing Strategy to Reduce Shoreline Armoring (Colehour + Cohen et al., 2014 a-e)
- 6) Targeted Outreach to Reduce Impacts from Shore Hardening in the PSMA (Johannessen, 2013 a-b)
- 7) Ensuring Regulatory Effectiveness in Puget Sound’s Most Special Places (Washington Environmental Council, 2013)
- 8) Protecting the Strait of Juan de Fuca Nearshore (Flores et al., 2013)

### 3.1 MARINE SHORELINE DESIGN GUIDELINES

#### 3.1.1 FINDINGS

The configuration and placement of shoreline structures can significantly affect their relative impacts on biological resources (Williams and Thom, 2001). “Soft” shore protection techniques are considered a preferred approach because they use natural materials and are designed to adjust over time to changing shoreline conditions, thereby minimizing some of the physical mechanisms which could alter ecological processes and functions (Coyle and Dethier, 2010; Williams and Thom, 2001).

The Marine Shoreline Design Guidelines (MSDG) provide:

- A comprehensive framework for site assessment and alternatives analysis that can be applied to evaluate the need for shore protection and inform selection of appropriate erosion management techniques with deliberate consideration of physical processes and ecological impacts.
- Detailed descriptions and standardized design guidance for 5 engineered shore protection options: beach nourishment, large wood, reslope-revegetation, bulkhead removal, and hard armor. Information on application, effects, design considerations, costs, and monitoring/maintenance requirements is included.

The MSDG can be applied in a variety of ways:

- As an engineering standard of practice for properly trained and experienced professionals. Step-by-step instructions for conducting site and coastal process assessments are provided, along with decision tools for developing shore protection projects in a site-appropriate and environmentally responsible manner.
- As an educational resource for landowners and their influencers.<sup>12</sup> Topics addressed include causes and rates of erosion; the impacts of armoring; regulatory oversight of shoreline projects; responsible shore stewardship; and the spectrum of techniques that can be applied to address coastal erosion.
- As a training resource and evaluation tool for local SMP implementers. Permit reviewers want information on shoreline processes, the impacts of armor, as well as characteristics of and applications for “soft shore” techniques (Barnhart et al., 2015; Futurewise, 2014c; Johannessen, 2013a). Use of the MSDG’s framework for alternatives analysis can support mitigation sequencing during application review.
- As support for restoration practitioners during project development. The MSDG provides information to help project proponents evaluate site condition variables and design parameters for bulkhead removal projects, as well as decision tools to support alternatives analyses and impact evaluations required for NEPA and SEPA assessments.

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#### ACTUAL VERSUS PERCEIVED PERCEPTIONS OF RISK

Hard armor has been a “one size fits all” solution for residential shorelines in Puget Sound, but in reality may not be the best way to manage erosion in many areas (Johannessen et al., 2014). Colehour + Cohen et al. (2014c) found that about 300 miles of armored shoreline occur in sheltered areas with low to moderate erosion potential, resulting in more fortification than is necessary to protect landward infrastructure, or were installed for landscaping purposes. Likewise, armor is not effective at preventing landslides where runoff or poor vegetation management are contributing to bluff retreat (Kaminsky et al., 2014; Johannessen et al., 2014).

The MSDG’s approach is based on the premise that hard armor should be considered as a last resort. The level of protection necessary at a site is determined by applying a cumulative risk model that integrates information on the causes and potential magnitude of erosion with risks to infrastructure. The type and proximity of structures are critical to qualifying risk at a site, with the magnitude of the risk directly corresponding to setback distance. The risk model helps distinguish actual need from perceived need. Considered along with other site characteristics, the risk score defines which design techniques are optimal for erosion control.

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<sup>12</sup> **Influencers** are people who provide information to property owners when they are making shoreline modification decisions. They include: realtors, contractors, permitting staff, homeowner associations, neighbors, and outreach professionals with conservation districts, WSU Extension, or NGOs.

Dionne et al. (2015) applied the risk assessment model and decision tree to compare design recommendations generated by the MSDG with as-built conditions for 85 erosion control structures constructed 2006-2014. They found that 68% of the projects were more risk averse than the MSDG recommendation (e.g., hard armor instead of beach nourishment or LWD placement).

Educational programs and focused outreach based upon the MSDG approach may help change widespread perceptions regarding the effectiveness and necessity of bulkheads for shore protection. The Northwest Straits Foundation used this approach for the “Port Susan Marine Stewardship Area Targeted Outreach” grant. Workshops and site visits were used to dispel common misconceptions about erosion and encourage landowners to consider upland BMPs (vegetation and surface/groundwater management) and soft shore protection approaches as effective, relatively inexpensive, and less environmentally damaging alternatives for shore protection. In Round 5, the Grant Program funded development of a MSDG booklet specifically for landowners.

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## CLIMATE CHANGE RESILIENCE

Sea level rise and increased frequency and magnitude of large storms will influence the range of options available to landowners for management of their property (Johannessen, 2013b). Climate change and sea level rise are factors incorporated into the MSDG’s design process. Information on likely geomorphic response by shoretype, potential alterations to nearshore processes, and variables relevant to resilience are provided to inform technique selection.

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## ECOLOGICAL EFFECTS OF ALTERNATIVE ARMORING TECHNIQUES

Studies to quantitatively assess ecological responses to specific soft shore designs are lacking. Some form of post-construction monitoring of biological conditions (e.g., forage fish spawning, benthic invertebrates and terrestrial insects, survival of riparian plantings, eelgrass presence) generally occurs after shoreline restoration and enhancement projects. However, relatively few controlled studies on ecological response have been conducted (e.g., Munsch et al., 2015; Toft et al., 2014; Toft et al., 2013). This limits our ability to identify mechanisms behind variable responses, optimize future project planning, and ensure management actions are delivering desired outcomes.

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### 3.1.2 IMPLICATIONS

The MSDG is a key tool that can be used to determine where alternatives to traditional armoring are a feasible option for erosion control, to encourage techniques for minimizing impacts of existing structures undergoing repair, and to identify candidate sites for bulkhead setbacks or removal.

Widespread adoption of the MSDG in a regulatory context could support robust mitigation sequencing and help minimize regulatory project review time. It provides both applicants and regulators with the information they need to understand how to avoid and minimize the impacts of proposed erosion control projects. The MSDG underscores that “no action” in the form of upland passive management BMPs is often a reasonable and cost-effective alternative.

## 3.2 SHORELINE LANDOWNER AUDIENCE RESEARCH AND OUTREACH

### 3.2.1 FINDINGS

Residential parcels should be the focus of efforts to reverse current shoreline armoring trends. Residential parcels comprise almost 1,400 miles—roughly 57%—of the shoreline of Puget Sound and the southern Strait of Juan de Fuca (Colehour + Cohen et al., 2014c). 71% of the approximately 1,200 HPAs issued for new and replacement marine shoreline stabilization structures between 2005 and 2012 were single family residential (Dionne et al., 2015). Recognizing the importance of this crucial audience, the Grant Program funded several projects that included research and outreach focusing on waterfront landowners.

### AUDIENCE RESEARCH

Focus groups, web-based surveys, and one-on-one interviews of shoreline property owners and their influencers provided insights on common attitudes and beliefs:

- Keller (2012) found the most successful messages were specific and factual, and draw a clear connection between shoreline regulations and the things people value. It is important to acknowledge successes and frame communications around protecting what people value—wildlife, shellfish, clean water, and local jobs.
- Landowners do not understand how armor impacts the health of Puget Sound and many see armor as a desirable, or even crucial, element in protecting shoreline properties (Colehour + Cohen et al., 2014d-e; Keller, 2012).
- Erosion is the top concern of waterfront property owners region-wide (Johannessen, 2013b; Colehour + Cohen et al., 2014d).
- Many property owners are not aware of just how slowly erosion is actually occurring, or how hard armoring can degrade the quality and accessibility of their beach (Johannessen, 2013a). Some believe that soft shore protection is expensive and might not work (Keller, 2012).
- 84% of landowners surveyed had never considered removing armor from their property and 14-18% of landowners surveyed region-wide were receptive to the idea of removing armor or replacing it with engineered soft shore protection (Colehour + Cohen et al., 2014d).
- Landowners want to see and hear about successes with alternatives to hard armor from other shoreline property owners (Colehour + Cohen et al., 2014d).



- The cost of removal projects is a barrier that must be overcome in order for a social marketing effort around armor removal to succeed. Currently, there are not adequate financial incentives in place to overcome the cost barrier (Colehour + Cohen et al., 2014b).
- Mason County focus group participants reacted negatively to blanket, general statements presented without supporting data (e.g., “water quality in Puget Sound had been worsening over time”). Highlighting trouble spots increases credibility (e.g., specific areas with water quality problems (Keller, 2012). This group also reacted negatively to the notion that shoreline homeowners have more responsibility than others in maintaining healthy shorelines.
- Education needs to come from a trusted source. Landowners are suspicious about government officials and contractors/professionals trying to sell them something (Colehour + Cohen et al., 2014d-e; Johannessen, 2013b; Keller, 2012).
- The Shore Stewards model and program materials were very popular among Mason County focus group participants, and many had positive associations with Washington State University<sup>13</sup> (Keller, 2012).

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## OUTREACH

Lessons for focused outreach efforts include:

- Direct and focused face-to-face engagement with landowners is a key element for outreach programs (Johannessen, 2013b; Colehour + Cohen et al., 2014b; Shaffer et al., 2014; Adkins, 2013). Workshops are an effective way to engage and share substantive information with the community (Shaffer et al., 2014; Johannessen, 2013b). Benefits are lost if a dialog stops, so conducting frequent workshops on an ongoing basis is preferred (Shaffer et al., 2014).
- The most effective educational efforts are site-specific and immediately relevant (Johannessen, 2013b; Shaffer et al., 2014). There is high demand for site visits where landowners can receive site-specific management recommendations from local experts in a non-regulatory context (Johannessen, 2013b). Bluff landowners are particularly interested in information about upland management practices (Johannessen, 2013b; Shaffer et al., 2014).
- Participation of trusted community members contributes to positive responses from property owners (Johannessen, 2013b; Keller, 2012; Colehour + Cohen et al., 2014d-e). Explore opportunities to take advantage of existing volunteer organizations and programs before creating a new one (Washington Environmental Council, 2013).

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<sup>13</sup> The Shore Stewards Program is run by WSU Extension.

- Outreach activities targeting shoreline armoring should focus on decision points (times landowners generally make decisions about armor), including immediately after a large storm or when they have recently purchased their shoreline property (Colehour + Cohen et al., 2014b).

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### 3.2.2 IMPLICATIONS

Collaboration with conservation districts and existing community organizations, and the development of standardized outreach materials with consistent messaging can lead to effective programs at lower costs. There is value in testing messages prior to outreach campaign implementation. Participants had negative reactions to some of the general messages presented to them, and this step allowed for the development of more specific communications framed around protecting what people value. This insight provides a foundation for future outreach work, and validates the approach used in developing the Shore Friendly framework (described in Section 3.4).

## 3.3 THE ROLE OF INCENTIVES

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### 3.3.1 FINDINGS

Section 2 of this report describes constraints which limit the ability of regulatory programs to prevent further degradation of the Shoreline Armoring Vital Sign. Development of incentive programs could help address this gap by encouraging applicants to consider alternatives to traditional armoring techniques when repairing/replacing existing structures or building new ones (Colehour + Cohen et al., 2014b). These alternative approaches could help mitigate impacts and offset damage to ecological function as required by the SMA's "no net loss" requirements (Futurewise, 2014c). Incentives can also encourage restoration and create a positive cycle of improvement (Futurewise, 2014d).

Shoreline armoring is an issue which presents a significant opportunity for the application of incentive-based approaches because:

- 48% of Puget Sound's residential parcels are currently armored (Colehour + Cohen et al., 2014c).
- A significant number of hard armor structures that have been in place for decades are losing their structural integrity (Johannessen et al., 2014). Many of these bulkheads were installed prior to implementation of the SMA, when structures were commonly built in intertidal areas. Between 2007 and 2012 in Kitsap and San Juan Counties, 74% of issued permits were for repair or replacement of existing structures (Barnhart et al., 2015). In King County, 95% of observed changes in shoreline armoring between 2004 and 2013 were repairs (King County, 2014).
- Structures approaching the end of their life span—many of in areas where coastal erosion is not a pending threat to buildings, roads, or other infrastructure—present a major

restoration opportunity. Bulkhead removal, setbacks, and/or incorporation of soft shore techniques can reverse some of the damage inflicted by erosion control structures in Puget Sound (Johannessen et al., 2014).

- Many alternatives to hard armor exist for managing risk to structures and infrastructure posed by coastal erosion, but people are often hesitant to try new approaches if they are unfamiliar with them (Johannessen et al., 2014).

Incentive programs can encourage desired armoring behaviors by providing education, financial assistance, professional technical advice, design assistance, and streamlining of permit processes. Futurewise (2014c) developed an incentive “toolkit” of approaches and funding mechanisms. The toolkit includes information for local and state implementers about how these incentives work, success factors and challenges, potential applications, typical users, helpful hints, and specific case studies.

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### 3.3.2 IMPLICATIONS

Working with landowners on a voluntary basis can address both existing impacts as well as future demand for armoring. In a heavily urbanized setting, the combined impact of a series of small incremental improvements can exceed site-specific project benefits (Simenstad et al., 2005). Investing in incentive programs is an opportunity to generate substantial public benefits from management actions on private property (Flores et al., 2013).

## 3.4 BRINGING IT ALL TOGETHER: SHORE FRIENDLY

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### 3.4.1 FINDINGS

The “Shore Friendly” social marketing framework was developed to motivate residential shoreline landowners to voluntarily choose alternatives to hard armor. It provides a coordinated set of audience-tested messages and incentive tools with great potential to change landowner perceptions and behavior regarding the effectiveness and necessity of bulkheads for shore protection.

San Juan, Kitsap, and Island Counties; the Mason Conservation District; and the Northwest Straits Foundation received Round 5 funding from the Grant Program to develop and implement incentive programs and outreach materials. These efforts will test the Shore Friendly strategies described below; results will be available in 2017.

Colehour + Cohen et al. (2014c) developed a Puget Sound parcel database to categorize properties by armor status, erosion potential, and presence/absence of homes. The project partners used this information to identify target behaviors, barriers, and motivations for each of these parcel groups, then developed social marketing incentive tools and messaging strategies to encourage preferred armoring behaviors (see Table 4).

**Table 4. Shore Friendly Social Marketing Campaign Framework (Colehour + Cohen et al., 2014b)**

<b>Audience</b>	<b>Desired Behavior(s)</b>	<b>Barriers</b>	<b>Motivations</b>	<b>Incentive Tools</b>
<b>Category 1</b> 52% of parcels	leave shore unarmored	concern with erosion  and  storms, waves, or tides might change shoreline	<ul style="list-style-type: none"> <li>• being confident their property would be protected or enhanced</li> <li>• enjoying the natural look</li> <li>• providing healthy habitat for fish and wildlife</li> </ul>	<ul style="list-style-type: none"> <li>• free erosion assessment</li> <li>• Shore Friendly ambassador (single point of contact for questions, referrals, assistance)</li> <li>• certified contractor program</li> <li>• workshops</li> <li>• new homeowner packets and visits</li> <li>• stewardship recognition and awards</li> <li>• communication response after erosion events</li> </ul>
<b>Category 2</b> 46% of parcels	remove all or a portion of armor	concern with erosion	<ul style="list-style-type: none"> <li>• being confident their property would be protected or enhanced</li> </ul>	<ul style="list-style-type: none"> <li>• free erosion assessment</li> <li>• free technical assistance</li> <li>• Shore Friendly ambassador</li> <li>• certified contractor program</li> <li>• workshops</li> <li>• new homeowner packets and visits</li> <li>• stewardship recognition and awards</li> </ul>
	replace armor with soft shore protection, if needed	expense of removing armor	<ul style="list-style-type: none"> <li>• tax break</li> <li>• loan or grant</li> </ul>	<ul style="list-style-type: none"> <li>• property tax breaks</li> <li>• grants</li> <li>• loans</li> <li>• group rates for neighborhoods</li> <li>• free technical assistance</li> <li>• free or discounted permits</li> </ul>
		complicated nature of regulatory and permitting process to remove armor	<ul style="list-style-type: none"> <li>• streamlined permitting process</li> </ul>	<ul style="list-style-type: none"> <li>• special Shore Friendly permits</li> <li>• free technical assistance</li> <li>• certified contractor program</li> <li>• expedited permitting</li> <li>• free or discounted permits</li> <li>• Shore Friendly ambassador</li> <li>• ShoreFriendly.org</li> </ul>

Armor removal and soft shore alternatives are generally less feasible for the remaining 1% of parcels due to high erosion potential.

The Shore Friendly social marketing framework was designed to:

- Change the perception that armor is always desirable.
- Direct landowners to tools that they need to make smart choices for their property and the environment.
- Be implemented independently at the local level by jurisdictions and other influencer organizations throughout Puget Sound.
- Identify prioritized groups of parcels to focus efforts where they can have the most impact.
- Create a consistent Puget-Sound-wide look and feel for shoreline armor reduction efforts, as well as provide a rallying point for localized efforts.

The Shore Friendly framework identifies several incentive tools that can be developed to help overcome barriers to desired armoring behaviors. Several of the suggested tools could be based upon existing programs piloted by the Grant Program and others. High priority incentive tools are described below.

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#### FINANCIAL INCENTIVES

Property tax breaks, grants, cost share programs, and loans could help overcome the significant expense barrier associated with removing or replacing armor. Development of financial incentives was a top priority identified by Colehour + Cohen et al. (2014b). Kitsap County's Watershed Stewardship Program, along with partners WA Sea Grant, Futurewise and WSU Extension, will soon be testing the level of cash incentives needed to motivate participation in an armor reduction program. Mason Conservation District will offer 20% cost reimbursements for two bulkhead removal or softening projects.

Free technical assistance programs being developed with Round 5 funding will provide geotechnical consults, pre-application coaching, design services, and permitting assistance to remove the initial price barrier. Reaching landowners *before* they arrive at the permit counter is also expected to reduce demands on county permitting staff (Johannessen, 2013b).

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#### STREAMLINED PERMITTING

Another major barrier for changing armoring behaviors is the complexity of the regulatory process for removal and soft shore projects (Colehour + Cohen et al., 2014b). This process can be just as confusing, expensive, and time-consuming as permitting for traditional bulkhead projects (Johannessen, 2013a). Special review processes, expedited timelines, and reduced permit costs could help overcome this barrier.

San Juan County is testing the Green Shores for Homes<sup>14</sup> rating system as a way to identify “soft shore” projects eligible for expedited permitting (Nicole Faghin, Washington Sea Grant, personal communication, June 2015). Green Shores for Homes (GSH) is a program to assist contractors, homeowners, and shoreline planners in the removal of armoring and the use of soft shore stabilization as an alternative to protect property. Modeled after the LEED™ Green Building program, GSH focuses on positive steps to reduce the impact of residential development on shoreline ecosystems. It uses a checklist system developed by an interdisciplinary team of scientists, regulators and practitioners. The program relies on design guidance in the MSDG and addresses shoreline habitat and processes, vegetation, storm water management, water quality, and stewardship.

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### FREE SITE EROSION ASSESSMENTS

Professional site visits can help landowners understand nearshore processes, assess actual erosion risk, and learn about best management practices for their property.

The Northwest Straits Foundation piloted an outreach program that included free erosion assessments in the Port Susan Marine Stewardship Area. Fifty-one (51) site visits were conducted in Island, Snohomish, and Jefferson Counties to provide landowners with property-specific management recommendations from experienced private consultants (Johannessen, 2013b). Post-visit participant surveys found that 86% were more aware of management alternatives for their property, and 71% planned to implement recommendations they received. Based on the evaluation comments received, the project partners concluded that the unarmored properties visited have a high likelihood of remaining unarmored. This successful project model is being expanded to San Juan, Whatcom, Skagit, and Clallam Counties with a Round 5 Grant.

Mason Conservation District is using Round 5 funding to develop and implement “technical assistance provider” training to build specialized skills and enhance regional capacity for nearshore assistance to landowners within the Puget Sound Conservation Districts (PSCD).

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### PROGRAMS FOR INFLUENCERS

Colehour + Cohen et al. (2014b) emphasize the importance of influencers as secondary targets for social marketing efforts. Several Round 5 projects include training for real estate professionals and/or partnering with realtors to distribute outreach materials to new homeowners. Island County’s efforts will include contractors who construct armoring in Island County. Barnhart et al. (2015) found there is demand for workshops for contractors and consultants (permit, excavation, building, landscaping, geo-tech) to train them in emerging alternatives to hard armoring.

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<sup>14</sup> This work was funded by EPA in conjunction with PSP (FY10 Puget Sound Watershed Assistance Management Program) and builds upon two existing programs: Seattle’s Green Shorelines for Lake Washington and Lake Sammamish and British Columbia’s Green Shores Initiative.

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### 3.4.1 IMPLICATIONS

Landowner willingness and community support for alternative shore protection techniques is an identified barrier to progress for a trailing Vital Sign. This can be addressed through development of recommended incentives programs and implementation of social marketing campaigns.

### 3.5 RECOMMENDATIONS

- 1) Prioritize Sub-Strategy B2.3 in the next Action Agenda update. The degree of degradation continuing to occur for the shoreline armoring indicator, and the building momentum of tools and programs capable of impacting current trends suggests there is opportunity to capitalize on successful projects previously funded by the Marine and Nearshore LO.
- 2) Disseminate the *Shore Friendly How-To Guide* grant product to LIOs.
- 3) Communicate the benefits of using the MSDG in the regulatory arena to support mitigation sequencing, as it provides both applicants and regulators with information on avoiding and minimizing impacts of proposed erosion control projects.
- 4) Communicate information about the case studies evaluated in the MSDG to property owners and influencers to highlight successful application of alternative engineered shore protection techniques. This could include production of videos featuring one or more of the MSDG's authors at project sites demonstrating features and performance of soft shore projects, as well as passive management techniques such as plantings and drainage management.
- 5) Expand current and develop additional incentive programs to encourage armor removal and/or soft shore techniques via near-term actions in the 2016/2017 Action Agenda and/or individual LIO Action Agendas. Financial incentives, streamlined permitting, and technical assistance programs should be prioritized.
  - Develop a training program covering technical application of MSDG site assessment and design selection tools for engineers, consultants, and contractors. Consider developing a certification program and referral list for private-sector professionals, potentially modeled after the University of Washington Professional and Continuing Education Certificate in Wetland Science and Management.
  - Provide continued support for technical assistance programs for homeowners. A recent Washington Sea Grant report evaluates the pros and cons of several potential service delivery models for these types of programs (Faghin and von Reis Crooks, 2015). Its findings should be taken into consideration when further expanding or developing new programs.

- Provide continued support to enhance the Puget Sound Conservation Districts regional capacity for nearshore technical assistance to landowners through training in Shore Friendly and MSDG resources.
  - Prioritize incentive programs in locations where shared management of the shore is already in place, such as homeowners associations (Johannessen, 2013b). Conditions of neighboring properties often preclude recommendations for alternatives such as bulkhead removal and/or “soft shore” protection. Collaboration among neighbors could increase feasibility of alternative techniques or bulkhead removal along multiple parcels.
- 6) Once incentive programs are in place, consider implementation of additional social marketing campaigns.
- Work to integrate Shore Friendly with the Green Shores for Homes program where the two programs provide mutual benefits for homeowners.
  - Consider funding additional work on Shore Friendly campaign messaging that addresses shoreline changes expected as a result of sea level rise and potential increased erosion due to climate change.
- 7) Build on the MSDG case study analysis to compile existing information and monitoring reports—both physical and biological—for large and small alternative shore protection and beach restoration projects in Puget Sound.
- Obtaining permission to enter private property for monitoring can be difficult and time-consuming (Barnhart et al., 2015). Adding a provision to HPAs that would allow WDFW biologist(s) site access for monitoring after the typical 5-year HPA window was suggested by the authors as a way to address this concern.
  - Conduct controlled studies on ecological response to specific soft shore designs to ensure management actions are delivering desired outcomes.
  - Consider developing tools to aggregate physical and biological monitoring data. Analysis of this information is crucial for the performance evaluations necessary to improve design of future projects. Johannessen et al. (2014) provide suggestions for useful information to include. Existing portals such as the Nearshore Data Exchange, Puget Sound Nearshore Projects, or SoundIQ sites<sup>15</sup> could serve as a model or potentially be modified for this purpose.

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<sup>15</sup> <http://maps.nwifc.org/nearshore/>  
<http://www.psnerp.ekosystem.us/>  
<http://www.iqmap.org/gc/Html5Viewer/?viewer=soundiq>



- Encourage the use of standardized protocols for monitoring of beach response to enhancement and restoration projects. The Shoreline Monitoring Toolbox provides a Decision Tree<sup>16</sup> organized by type of shoreline project as described in the MSDG to guide decisions on what to monitor and which protocols to prioritize.

## 4. SUPPORTING LOCAL GOVERNMENTS

This section analyses Grant Program results related to Action Agenda Sub-strategy B1.2 (*Support local governments to adopt and implement plans, regulations, and policies that protect the marine nearshore and estuaries, and incorporate climate change forecasts*). Grant Program projects directly supported SMP programs through staff training; collection of new biological and physical data; climate change forecasting; economic analyses; and development of GIS management tools. Interviews and/or surveys of local government SMP implementers were a component of several of these projects, and allowed for identification of staff needs. Findings and recommendations provided in this section are based upon results of the following grants:

- 1) Compliance Assessment (Talebi and Tyson, 2014)
- 2) Puget Sound Shoreline Master Program Improvement (Futurewise, 2014 a-d)
- 3) Sea Level Rise and Cumulative Effects Management Tools (MacLennan et al., 2013; Friends of the San Juans, 2014)
- 4) Protecting the Strait of Juan de Fuca Nearshore (Flores et al., 2013; Shaffer et al., 2014; Kaminsky et al., 2014)
- 5) Targeted Outreach to Reduce Impacts from Shore Hardening in the PSMA (Johannessen, 2013a)
- 6) Nearshore Permitting Effectiveness through T.A.C.T. (Barnhart et al., 2015)

### 4.1 IDENTIFYING STAFF NEEDS

#### 4.1.1 FINDINGS

Needs identified through interviews and surveys of local government SMP implementers are summarized below:

- SMP programs have experienced staff reductions of 50-60% since 2007 (Talebi and Tyson, 2014), with enforcement personnel disproportionately affected (Futurewise, 2014a). Planning and natural resources staff assigned to take on more responsibilities for

<sup>16</sup> <https://sites.google.com/a/uw.edu/toolbox/decision-tree>

enforcement often do not have the training and skills needed to address the complicated process and investigative requirements associated with violations (Futurewise, 2014a).

- Planning staff generally do not have the background or experience needed to evaluate the need for armor installation, degree of “softness” of a proposed design, or when soft-shore techniques are an option (Johannessen, 2013a; Barnhart et al., 2015). Permit reviewers tend to be generalists seeking “quick-and-dirty” rules and guidelines they can easily apply to a variety of situations. Reviewers need to know enough to determine when to bring in a specialist (Johannessen, 2013a).
- Staff surveyed had concerns about their programs’ capacity to process permits quickly and with adequate conditions and provisions, as well as with their access to technical expertise (Talebi and Tyson, 2014).
- Review staff are allotted a fixed amount of time for processing permits (Johannessen, 2013a; Barnhart et al., 2015). They do not have enough time to educate applicants and are seeking resources to provide to their customers (Futurewise, 2014a).
- State help was specifically requested for public messaging and education about shoreline permitting requirements and providing third-party experts to testify during legal proceedings (Futurewise, 2014a).
- SMP implementers benefit from collaboration with WDFW Area Habitat Biologists during project review, but coordination is limited by staffing levels and workload demands (Barnhart et al., 2015).
- SMP implementers benefit from peer-to-peer communication, and have a desire for facilitated networking on a consistent and ongoing basis (Johannessen, 2013a; Barnhart et al., 2015). The Salish Sea Shoreline Forums<sup>17</sup> were specifically mentioned as useful method for information sharing among implementers.
- There was a high staff level of participation in training workshops when grant funds were used to reimburse jurisdictions for cost of staff time and travel time was minimized (Johannessen, 2013a).

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#### 4.1.2 IMPLICATIONS

Local governments need additional assistance from the state to effectively implement and enforce their shoreline regulatory programs. Providing professional training opportunities, increasing access to technical experts in state agencies, and supporting pre-application phase educational efforts should be top priorities to improve program capacity.

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<sup>17</sup> <http://futurewise.org/action/Salish-Sea-Shoreline-Forum/>

## 4.2 SEA LEVEL RISE VULNERABILITY ASSESSMENT

### 4.2.1 FINDINGS

MacLennan et al. (2013) developed modeling and GIS tools to identify areas within San Juan County vulnerable to sea level rise. Their model produced projections for future shoreline positions based on moderate and high sea level rise scenarios, along with expected increases in erosion rates for some geomorphic shoretypes. Spatial queries were then applied to identify buildings and infrastructure vulnerable to inundation and erosion hazards. Their results show:

- Almost 20 miles of public and private roads and 1,200 shoreline structures (primarily residential) are vulnerable to future inundation and erosion hazards.
- The feeder bluff shoretype is expected to have the largest shore recession distance: 43-75 feet of retreat by 2050, and 75-115 feet of retreat by 2100. The higher recession distances are expected in areas with maximum measure fetch above 5 miles.
- Other shoretypes, like pocket beaches and transport zones, were predicted to experience 8-35 feet of retreat by 2050, and 24-102 feet of retreat by 2100. Pocket beaches had the lower average change rates.
- Certain shoretypes are likely to be more vulnerable to erosion, others to inundation, and some will be vulnerable to both. Inundation hazards are generally higher between now and 2050, while infrastructure vulnerability to increased erosion is more of a concern for the 2050 and 2100 time frame.

A technical advisory team then developed management recommendations based on the MacLennan et al. (2013) assessment results (Friends of the San Juans, 2014). High priority recommendations include:

- Limit new development in areas vulnerable to rising sea levels.
- Require larger setbacks on marine shorelines.
- Conduct a cost/benefit analysis of a variety of management approaches.
- Use easements and acquisitions as a tool to increase resiliency to rising sea levels.
- Decrease public infrastructure along the shoreline. Relocation and/or redesign of public shoreline road infrastructure is a significant opportunity for habitat restoration and enhancement, as well as change adaptation.
- Remove armor from forage fish spawning beaches and feeder bluffs.
- Target restoration to enhance resiliency.

Kaminsky et al. (2014) calculated potential changes in bluff erosion rates related to rising sea levels along the Strait of Juan de Fuca. They expect bluff recession could increase by as much as 0.33 feet/year by 2050—a 20% increase over the mean rate for the period 1939-2001.

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#### 4.2.2 IMPLICATIONS

Tools developed by MacLennan et al. (2013) can be applied in other Puget Sound communities to facilitate planning and development of climate change adaptation strategies based on projected changes in shoreline position and identification of vulnerable structures and habitats.

Understanding future inundation and erosion hazards associated with sea level rise and increased storm severity/ frequency is a crucial first step for developing potential policy responses to climate change. Results of these types of analyses can also be used to identify long-term restoration and conservation targets for increased resiliency.

#### 4.3 ECOSYSTEM SERVICES VALUATION

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##### 4.3.1 FINDINGS

Flores et al. (2013) calculated the economic value of ecosystem goods and services in Clallam County, including a first of its kind economic valuation of feeder bluffs. Their analysis indicates:

- Clallam County's 27,800 acres of nearshore habitats contribute more than \$35 million<sup>18</sup> annually to local and regional economies.
- The value of services provided by feeder bluffs varies depending on the presence or absence of shoreline armoring. An avoided cost analysis of projects needed to sustain bluffs and counteract erosion showed unarmored sections of feeder bluff at the Port Angeles landfill site generate more than three times the economic benefits provided by sections with a seawall—up to \$18.90 per foot compared with \$5.94 per foot.
- The annual flow of value to the local and regional economy from Clallam County's combined nearshore and upland ecosystem services is \$18 billion every year. A similar calculation for all of Puget Sound resulted in an annual flow of value of at least \$305 billion (Batker et al., 2010).
- Applying a 4% discount rate over 100 years, the net present asset value of Clallam County's natural capital is between \$451 billion to \$1.2 trillion dollars, depending on the health of the ecosystem.

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<sup>18</sup> In comparison, calculated value per acre was even higher in two coastal Washington counties with very large, highly productive estuaries. The 120,000 acres of nearshore habitats in Grays Harbor County provide at least \$313 million per year in value (Flores and Schundler, 2014), while the 214,300 acres of nearshore habitats in Pacific County provide at least \$985 million in value (Flores and Batker, 2014).

- Economic data can be applied to inform SMP decision-making, as demonstrated by an analysis of proposed changes to Clallam County setback policies. The 2012 draft SMP would increase marine riparian buffer width requirements for shoreline residential areas. This change would increase the economic contributions of existing buffers by between \$112 million and \$314 million.
- Restoration projects have a high return on investment. Major marine wetland restoration projects that cost up to \$9,000 per acre were expected to generate economic benefits up to \$122,100 per acre per year (Harrison-Cox et al., 2012).
- Investing in the conservation of working and natural landscapes can diminish the risk posed by future erosion and climate instability, avoiding expensive mitigation expenses for cities, the county, and ultimately taxpayers.

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#### 4.3.2 IMPLICATIONS

Natural resource protection is a low-cost alternative to restoration of a damaged ecosystem. The Flores et al. (2013) estimates enable the economic costs of damaged natural systems to be incorporated into management policies and decisions. These results were used in the context of Clallam County's SMP updates to reframe discussions about difficult issues like buffer distances by emphasizing the societal costs of habitat degradation. Ecosystem service valuation can be used as a tool to increase political support for regulatory and incentive-based approaches for nearshore resource protection (Shaffer et al., 2014).

#### 4.4 RECOMMENDATIONS

- 1) Investigate ways to expand participation in existing training opportunities for SMP implementers.
  - Consider expanding class offerings through Ecology's Coastal Training Program. Their current course catalog includes classes designed specifically for shoreline management professionals on several of the topics identified as planner needs. Building Coastal Training Program capacity could result in more frequent class offerings at multiple training sites, and development of new curricula.
  - Encourage peer-to-peer communication through existing networks like Sea Grant and Ecology's Shoreline and Coastal Planners Group<sup>19</sup> and American Planning Association's Washington Chapter. Consider funding additional meetings modeled after the Salish Sea Shoreline Forum.

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<sup>19</sup> <http://wsg.washington.edu/wacoast/>

- Consider increasing participation in these programs by using grant or program funds to reimburse jurisdictions for staff time.
- 2) Develop additional training resources for SMP implementers, with classes and materials covering the MSDG and alternative shoreline stabilization techniques as a top priority.
- A planned chapter in Ecology’s SMP Handbook on “Administration and Enforcement Provisions” has not been completed. This presents an opportunity to incorporate Grant Program findings on improving regulatory effectiveness and the Futurewise (2014a) toolkit on methods to improve compliance and violation enforcement.
  - Disseminate other training resources pulled from grant products through Ecology’s SMP Handbook and/or Shoreline Planners Toolbox<sup>20</sup> web sites. Resources include the Futurewise (2014a-d) toolkits on strategies for effective mitigation sequencing; shoreline ecology basics and general impacts of common development activities; and law and regulations summary, as well as the reference notebook developed for the Johannessen (2013a) planner’s workshop.
  - Consider developing alternative training methods to reduce costs and increase participation. Webinars could reduce costs associated with travel and lodging. Producing Webcasts would support recurring training needs associated with high levels of staff turnover.
- 3) Develop educational materials that local jurisdictions can distribute to potential applicants, and provide pre-application phase support.
- The MSDG booklet under development through a Round 5 grant and Green Shores for Homes materials could be supplemented with general information about why various shoreline regulations exist and a guide to how they are implemented.
  - A focus on the pre-application phase represents early opportunity to educate applicants, communicate requirements, influence designs to make permit review easier, and encourage alternatives that would avoid and/or minimize adverse impacts (Talebi and Tyson, 2014). Incentive tools associated with the Shore Friendly and Green Homes for Shores programs support the pre-application phase and can help reduce demands on permit reviewers.
- 4) Consider including sea level rise vulnerability evaluations in the 2016/2017 Action Agenda to support local government efforts to incorporate climate change forecasts into local plans, regulations, and policies.

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<sup>20</sup> <http://www.ecy.wa.gov/programs/sea/shorelines/smp/toolbox.html>

- Communicate results of the San Juan County sea level rise vulnerability assessment to other jurisdictions.
  - The Coastal Training Program offers a three-course Climate Adaptation Series. This existing program could support jurisdictions in developing management strategies focused on improving ecosystem and human community resiliency.
- 5) Prioritize restoration projects to enhance resiliency of both communities (e.g., decrease public infrastructure like roads along the shoreline) and vulnerable habitats like forage fish spawning beaches (Friends of the San Juans, 2014).
  - 6) Consider funding return on investment analyses for one or more Grant Program funded restoration projects. See the Christin (2014) evaluation of the North Wind's Weir project on the Duwamish River as an example.

## 5. PROTECTING PRIORITY HABITATS AND PROCESSES

This section analyses Grant Program results related to Action Agenda Sub-strategy B2.1 (Permanently protect priority nearshore physical and ecological processes and habitat, including shorelines, migratory corridors, and vegetation particularly in sensitive areas such as eelgrass beds and bluff backed beaches). Data collection and development of tools to assist planners in managing feeder bluffs and beach-spawning forage fish habitat were a focus of several grants. This information can assist with prioritization of protection efforts. Findings and recommendations provided in this section are based upon results of the following grants:

- 1) Puget Sound Feeder Bluffs Mapping (MacLennan et al., 2013)
- 2) Protecting the Strait of Juan de Fuca Nearshore (Flores et al., 2013; Kaminsky et al., 2014; Shaffer et al., 2014)
- 3) Sea Level Rise and Cumulative Effects Management Tools (MacLennan et al., 2013; Whitman et al., 2014; Whitman and Hawkins, 2014; Friends of the San Juans, 2014)
- 4) Nearshore Permitting Effectiveness through T.A.C.T. (Barnhart et al., 2015)
- 5) Social Marketing Strategy to Reduce Shoreline Armoring (Colehour + Cohen et al., 2014c)
- 6) Ensuring Regulatory Effectiveness in Puget Sound's Most Special Places (Washington Environmental Council, 2013)

### 5.1 FEEDER BLUFFS

#### 5.1.1 FINDINGS

- MacLennan et al. (2013) mapped 436 miles of feeder bluffs. They were most abundant in Jefferson, Island, Clallam, Kitsap, Mason, and Pierce Counties. Pierce, Kitsap, King, and

Mason Counties had the longest lengths of shoreline clearly identified as historic feeder bluffs

- Armoring can slow but not stop erosion of feeder bluffs (Kaminsky et al., 2014). Analysis of long-term bluff recession rates along the Strait of Juan de Fuca indicates armored sections of bluff continue to recede, although at a lower rate than unarmored section—50% lower in the Elwha drift cell and 80% lower in the Dungeness drift cell (Kaminsky et al., 2014).
- Boat-based LiDAR surveys of bluffs in Clallam County produced compelling visualizations of erosion in the upper third of the bluff profile (Kaminsky et al., 2104). This type of erosion is driven by precipitation and local groundwater discharge, and would continue with or without armoring. Such images could be a useful tool when educating bluff property owners about best management practices.
- Unarmored feeder bluffs can provide three times the economic benefits generated by sections with a seawall—up to \$18.90 per foot compared to \$5.94 per foot along armored portions (Flores et al., 2013).
- The disruption of sediment recruitment from bluffs caused by armoring has a negative effect on highly functioning beach habitat. Shaffer et al. (2014) shows that surf smelt consistently spawn in areas of active sediment input. Continuous sediment inputs from feeder bluffs are critical in maintaining grain-size distributions suitable for forage fish.
- Public outreach efforts emphasizing long-term recession rates and the economic value of intact nearshore processes can be utilized to develop and enhance political support for SMP setback policies protective of feeder bluffs (Shaffer et al., 2014).
- Climate change is likely to accelerate bluff erosion because of expected increases in storm intensity and frequency, as well as acceleration of sea-level rise (Kaminsky et al., 2014; MacLennan et al., 2013).
- Intact sediment supply is a critical element of beach resilience to sea level rise (Johannessen et al., 2014).

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### 5.1.2 IMPLICATIONS

- Many local jurisdictions have policies that discourage shoreline armoring on feeder bluffs, but effective implementation may have been limited by a lack of detailed feeder bluff mapping prior to MacLennan et al. (2013).
- Detailed sediment budget analyses at a reach scale can support SMP updates by informing appropriate buffer widths. Areas with particularly active feeder bluffs may require setbacks reflective of more dynamic bluff processes.



- Maintaining feeder bluffs in an unbulkheaded condition results in less erosion in down-drift shoreforms, maintains highly functioning habitats, and offers heightened resilience to rising sea levels.

## 5.2 FORAGE FISH SPAWNING BEACHES

### 5.2.1 FINDINGS

- Documented forage fish spawning areas are present along 26% (11,772) of residential shoreline parcels in Puget Sound, and 58% (6,828) of these are armored (Colehour + Cohen et al., 2014c).
- 35% of forage fish eggs were observed at or above mean higher high water (MHHW) and eggs were present up to the ordinary high water mark (OHWM) in San Juan County (Whitman et al., 2014).
- Trained citizen volunteers can conduct beach spawning presence/absence surveys (Washington Environmental Council, 2013).
- Inclusion of forage fish spawning habitat protection policies and language in San Juan County's SMP and Critical Areas Ordinance in 1992 did not result in a reduction in the number or rate of shoreline armoring permits (Whitman and Hawkins, 2014). Between 1992 and 2009, code violation rates associated with armoring doubled.
- The Barnhart et al. (2015) review of issued shoreline armoring permits in Kitsap and San Juan Counties between 2006 and 2013 indicates that 16% of permitted armoring projects were located along surf smelt spawning beaches and 8% were along sand lance beaches. Most of these permits were processed as exemptions.
- Hydraulic Code and SMA regulations generally require bulkheads to be built above the OHWM because alignments below this elevation could result in direct burial of beach spawning habitat. Results of Dionne et al. (2015) permit compliance monitoring indicated that 21% of the armoring projects reviewed were constructed water-ward of the approved project area.
- Forage fish spawning beaches are vulnerable to armoring of up-drift feeder bluffs but could benefit from new sediment disposition resulting from major river delta restoration (Shaffer et al., 2014).
- Forage fish spawning beaches are vulnerable to rising sea levels. Based on vertical egg distribution data from San Juan County, a rise in sea level of 1 foot would inundate 33% of surf smelt eggs, and a 2-foot rise would inundate 79% of eggs (Whitman et al., 2014).

- Approximately 11 acres of spawning habitat in San Juan County has experienced direct burial due to armoring in the upper extent of the spawning zone (Friends of the San Juans, 2014).
- Sea level rise is expected to exacerbate the impacts of shoreline armoring on forage fish spawning habitat. Landward translation of beach habitat due to rising sea levels will be limited at armored sites (the “coastal squeeze”), resulting in a predicted loss of an additional 3 acres of the 85 acres of known beach spawning habitat (Friends of the San Juans, 2014).
- In other areas of Puget Sound, a larger proportion of higher-elevation beach spawning habitat may be lost because of the coastal squeeze. The percentage of San Juan County residential parcels with armored spawning beaches is much lower than the Puget Sound average: 15% (Whitman and Hawkins, 2014) versus 58% (Colehour + Cohen et al., 2014c).

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### 5.2.2 IMPLICATIONS

- Repair and replacement of private bulkheads is a potential threat to beach spawning habitat, as well as a significant opportunity for enhancement and/or restoration.
- Potential loss of forage fish spawning habitat should be considered in sea level rise vulnerability assessments.
- Grant program investments in this area were limited to an assessment of the impacts of armoring for beach-spawning forage fish. The impacts of shoreline armoring on other forage fish populations in Puget Sound are unknown, and consideration should be given to extending similar evaluations to those critically important species, as well.

### 5.3 RECOMMENDATIONS

- Communicate the availability of the new feeder bluff maps to regulators at the local, state, and federal levels, as well as to restoration practitioners.
- Prioritize parcels with feeder bluffs and/or spawning beaches for technical assistance and other incentive programs.
- Armored feeder bluffs landward of spawning beaches should be priority candidates for beach restoration/enhancement and armor removal. The Puget Sound shoreline parcel database identified 2,006 of these properties and jurisdictions in which they are clustered (Colehour + Cohen et al., 2014c).
- Consider developing explicit criteria for prioritizing incentive investments based on the Shore Friendly parcel segmentation report (Colehour + Cohen et al., 2014c), but also considering larger-scale decision support tools like the Puget Sound Nearshore Ecosystem

## Restoration Project (PSNERP) Beach Strategy and the USGS Puget Sound Ecosystem Portfolio Model.<sup>21</sup>

- Implement procedural improvements for permit review to ensure that SMP exemptions for shoreline protection projects are conditioned in a manner protective of these priority habitats. Barnhart et al. (2015) identified several considerations for improving consistency in applying permit conditions. Development and implementation of an interagency mitigation manual for shoreline armoring projects could result in more avoidance, minimization, and compensatory measures incorporated into regulatory approvals.
- Require pre-construction, pre-installation, and post-construction inspections for *all* (including exempt) armoring projects adjacent to spawning beaches. Marking project alignments in the field prior to construction can prevent structures built further waterward and/or larger than authorized. This can prevent direct burial of spawning areas. It is crucial that inspectors are knowledgeable in locating OHWM.
- Incorporate additional information and datasets into the feeder bluff data product. MacLennan et al. (2013) recommended several potential enhancements. Classification of subtypes within the no appreciable drift (NAD) shoretype, particularly within embayments (e.g., pocket beaches, pocket estuaries, lagoons), would be useful for prioritizing restoration efforts because of their high habitat value. We recommend coordinating with users of this product, such as local planners and the PSEMP nearshore work group,<sup>22</sup> to ensure broadest applicability of results.
- Evaluate impacts of shoreline armoring on non-beach spawning forage fish species, and additional life stages of beach spawning forage fish.
- Expand the San Juan County sea level rise assessment across Puget Sound to identify total forage fish spawning beach area vulnerable to sea level rise. This type of analysis would address a Biennial Science Work Plan priority (*Implement studies to identify stressors on forage fish*).

## 6. IMPLEMENTING PRIORITY RESTORATION

This section analyses Grant Program results related to Action Agenda Sub-strategy B2.4 (*Implement a coordinated strategy to achieve the eelgrass recovery target*).

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<sup>21</sup> [http://www.pugetsoundnearshore.org/technical\\_papers/PSNERP\\_Strategies\\_wMaps.pdf](http://www.pugetsoundnearshore.org/technical_papers/PSNERP_Strategies_wMaps.pdf)  
<http://geography.wr.usgs.gov/pugetSound/>

<sup>22</sup> <https://sites.google.com/a/psemp.org/psemp/nearshore>

For the 2016/2017 Action Agenda, B2.4 may be consolidated with Sub-strategy B2.2 (*Implement prioritized nearshore and estuary restoration projects and accelerate projects on public lands*).<sup>23</sup> Findings and recommendations provided in this section are based upon results of the “20% More Eelgrass by 2020” grant (Thom et al., 2014).

## 6.1 EELGRASS

### 6.1.1 FINDINGS

Thom et al. (2014) established a process for identifying potential eelgrass restoration sites, and described stressors and limitations affecting eelgrass survival and recovery. Their approach combined modeling, site evaluations, local expertise/stakeholder surveys, and test plantings at 9 sites. The work funded by this grant has already been incorporated into the Puget Sound Eelgrass Recovery Strategy (March 2015).

- Numerical biomass and habitat suitability models developed as part of this grant identified 7380 ha of promising sites for eelgrass restoration were identified and mapped. PSP’s recovery target for the Eelgrass Vital Sign seeks an increase eelgrass cover by 4,000 ha by 2020.
- The project team then conducted a rigorous site evaluation process considering model outputs and potential stressors such as harbors, mooring areas, overwater structures, shoreline armoring, known sources of pollution or eutrophication, significant seasonal freshwater inputs, and macroalgal blooms. They identified 24 sites for further evaluation as potential restoration candidates.
- Plantings occurred at 9 test plots in 5 locations. Post-planting monitoring found high mortality at 5 of the 9 test plots. Two plots had excellent survival rates and were determined to be good candidates for larger plantings, while 2 others did well enough to warrant further investigation for future restoration actions. These results indicate successful use of the habitat suitability model requires both site evaluations of areas with higher scores, as well as test planting prior to implementation of larger projects.
- The project team solicited input from shoreline managers and regulators, tribal members, research scientists, and citizen groups with interest/expertise in nearshore marine vegetation to facilitate understanding of barriers to eelgrass protection, conservation, and restoration. Survey respondents identified dredging and filling, shoreline development, and water quality as having large impacts on eelgrass in Puget Sound. Areas where respondents identified absence of eelgrass that existed previously were mapped. When asked what type of policy changes would enhance eelgrass in Puget Sound, the top response was

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<sup>23</sup> See PSP’s 2016/2017 Action Agenda Strategic Initiative Update Workgroup Recommendations (dated June 11, 2015).

improvement to degraded environmental conditions (e.g., poor water quality and nutrient loading). Protection from direct impacts (e.g., dredging, overwater structures, and mooring buoys) and requirements for greater project compliance (e.g., larger mitigation ratios and higher transplant criteria) were also selected frequently.

The authors conclude their model results suggest there is ample area available in Puget Sound to increase eelgrass cover by 4,000 ha. However, they stress that protection and enhancement measures are needed in addition to restoration to reach the 2020 recovery target. Avoiding damage to eelgrass beds and enhancing existing areas through stressor abatement will likely be required. A site evaluation process combining modeling, local expertise, and test plantings can increase the chances of large-scale eelgrass restoration success. However, restoration may be inefficient or ineffective if stressors are not addressed.

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### 6.1.2 IMPLICATIONS

Locals can play a key role in managing stressors because of the site-specific nature of direct impacts like mooring buoys and overwater structures.

### 6.3 RECOMMENDATIONS

- 1) Communicate the locations of potential restoration areas to LIOs and local jurisdictions. Emphasize the need to identify site-specific stressors and limit activities that disturb eelgrass (e.g., boat groundings, boat anchors, recreational shellfish harvest). Encourage measures to address algal blooms and high levels of suspended sediment.
- 2) Educate harbor masters, waterfront homeowners associations, park managers, homeowners with mooring buoys, Shore Stewards, and others about boating impacts to eelgrass and ways to minimize them (e.g., establishing anchor-out zones).
- 3) Evaluate areas that modeling outputs show are suitable for eelgrass to understand the reasons it is absent or sparse.
- 4) Recognize the link between eelgrass colonization of recently accreted sediment and restoration of large deltas in the Implementation Strategy for the Estuaries Vital Sign (currently under development).
- 5) Conduct field investigations to elucidate empirical relationships between stressors and eelgrass responses. This types of study would address a Biennial Science Work Plan priority (*Identify key stressors on eelgrass*).
- 6) Build upon the regional knowledge about eelgrass restoration and recovery prospects by supporting an evaluation of the potential impacts of sea level rise on eelgrass in Puget Sound, and long-term prospects for achieving the eelgrass Vital Sign target.

## 7. SUMMARY

### 7.1 RECOMMENDATIONS FOR THE GRANT PROGRAM

- 1) Continue to encourage collaboration between WDFW, Ecology, and local jurisdictions regarding implementation, compliance monitoring, and enforcement for Hydraulic Code and SMA regulatory programs.
  - Development and communication of compliance monitoring guidelines for implementation by local governments would be a logical extension of the “Compliance Assessment” grant.
  - Fostering partnerships between WDFW and local jurisdictions through efforts like the “Nearshore Permitting Effectiveness through T.A.C.T.” grant could identify more mechanisms to improve Area Habitat Biologist/planner coordination during project review and increase planner access to technical experts in state agencies.
  - Compile and evaluate information about the range of ways local jurisdictions process exemptions.
- 2) Consider providing financial resources and/or technical support to local jurisdictions. Training for SMP implementers, assistance creating/updating electronic SMP data management systems, and providing educational materials for distribution to SMP applicants were high-priority items identified in grant products.
- 3) Facilitate development of an interagency mitigation manual for shoreline armoring projects. The MSDG provides a framework encouraging impact avoidance and minimization. Combining it with sets of predetermined requirements could help ensure impacts of shore protection projects—particularly those processed as exemptions—are fully mitigated.
- 4) Continue to provide support for MSDG training and outreach, as well as technical assistance programs for homeowners and Shore Friendly campaign implementation.
- 5) Continue to provide support for HPA effectiveness monitoring field surveys to evaluate the extent to which mitigation provisions result in desired outcomes, and differences in ecological response of soft shore projects compared to traditional armoring.
  - Consider adding sampling of benthic invertebrates.
  - Toft et al. (2010) advise paying attention to statistical power, developing of testable hypotheses, including multiple reference sites, and recognizing the importance of long-term data sets.
- 6) Consider developing tools to aggregate project information and monitoring reports for alternative shore protection and beach restoration efforts in Puget Sound. Support analysis of project effectiveness to inform design and assist in permit review of future projects.

- 7) Consider funding return on investment analyses for Grant Program funded shoreline restoration projects and/or incentive programs. Such analyses would address a Biennial Science Work Plan priority (*Develop assessments of ecosystem services to help decision makers make informed decisions about restoration and protection*).
- 8) Expand on new knowledge about impacts of shoreline armoring on forage fish spawning beaches by funding work to assess the impacts of armoring on other forage fish species and other life stages of forage fish, which are equally dependent upon natural shoreline features and likely put at risk by shoreline armoring.
- 9) Consider funding enhancements to the feeder bluff mapping data product.
- 10) To maximize potential success of future funding efforts, coordinate with other state agencies and departments about existing programs prior to funding grants within their purview. This will ensure that grant projects meet an identified need and there is capacity for follow-through with grant-funded programs. For example, WDNR's Aquatic Reserve Program was not able to support the "Ensuring Regulatory Effectiveness in Puget Sound's Most Special Places" grant to the extent expected by the Washington Environmental Council/People for Puget Sound.

## 7.2 RECOMMENDATIONS FOR THE 2016/2017 ACTION AGENDA FOR PUGET SOUND

This report identifies several institutional challenges that limit the ability of regulatory programs to prevent further degradation of the shoreline armoring indicator. The degree of degradation continuing to occur, and the building momentum of tools and programs capable of impacting current trends suggests there is opportunity to capitalize on successful projects previously funded by the Marine and Nearshore Lead Organization. We recommend prioritizing Sub-Strategy B2.3 in the next Action Agenda update, and selecting this indicator for preparation of the next group of Implementation Strategies.

The findings summarized in this report support inclusion of the following as potential near-term actions in the 2016/2017 Action Agenda for Puget Sound:

- 1) Conduct baseline inventories of shoreline structures to inform compliance monitoring and enforcement efforts. Prioritize rapidly urbanizing jurisdictions.
- 2) Support for local governments to improve implementation and enforcement of SMP regulations.
- 3) Expand and/or develop additional outreach and incentive programs to encourage armor removal and/or soft shore techniques. Financial incentives, streamlined permitting, and technical assistance to homeowners should be prioritized.
- 4) Conduct sea level rise vulnerability assessments at the local level to identify infrastructure and habitats vulnerable to inundation and/or erosion hazards.

## 8. ACRONYMS AND ABBREVIATIONS

Ecology.....	Washington Department of Ecology
EPA .....	U.S. Environmental Protection Agency
GIS.....	Geographic Information Systems
GSH .....	Green Shores for Homes
HPA.....	Hydraulic Project Approval
HRCD.....	High Resolution Change Detection
JARPA.....	Joint Aquatic Resources Permit Application
LIO.....	Local Integrating Organization
LO .....	Lead Organization
MHHW .....	Mean Higher High Water
MRC .....	Marine Resources Committee
MSDG .....	Marine Shoreline Design Guidelines
NEP .....	National Estuary Program
NEPA.....	National Environmental Policy Act
OHWM.....	Ordinary High Water Mark
PSEMP .....	Puget Sound Ecosystem Monitoring Program
PSI .....	Puget Sound Institute
PSNERP.....	Puget Sound Nearshore Ecosystem Restoration Project
PSP .....	Puget Sound Partnership
SEPA.....	State Environmental Policy Act
SMA.....	Washington Shoreline Management Act
SMP.....	Shoreline Master Program
WDFW .....	Washington Department of Fish and Wildlife
WDNR.....	Washington Department of Natural Resources
WEC.....	Washington Environmental Council
WRIA.....	Water Resource Inventory Area
WSU .....	Washington State University



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**APPENDIX A. EFFECTIVE REGULATION AND STEWARDSHIP INVESTMENT AREA GRANTS**

<b>Grant Title</b>	<b>Partners</b>	<b>Major Product(s)</b>	<b>Related 2014/15 Action Agenda Recovery Sub-Strategy</b>
<b>Compliance Assessment</b>	Department of Ecology (Ecology) and WDFW	<b>Talebi and Tyson (2014)</b> – Puget Sound Marine and Nearshore Grant Program Compliance Assessment	B1.3 Improve, strengthen, and streamline implementation and enforcement of laws, regulations, and permits that to protect marine and nearshore ecosystems and estuaries.
<b>Marine Shoreline Monitoring and Compliance Project in WRIA 9</b>	King County Water and Land Resources	<b>King County (2014)</b> – <a href="#">The WRIA 9 Marine Shoreline Monitoring and Compliance Pilot Project</a>	B1.3 Improve, strengthen, and streamline implementation and enforcement of laws, regulations, and permits that to protect marine and nearshore ecosystems and estuaries.
<b>Puget Sound Shoreline Master Program Improvement</b>	Futurewise	<b>Futurewise (2014)</b> – (a) <a href="#">Compliance Practical Guide</a> ; (b) <a href="#">Interagency Coordination Practical Guide</a> ; (c) <a href="#">Permitting and Mitigation for “No Net Loss” Practical Guide</a> ; (d) <a href="#">Incentives for Restoration and Protection Practical Guide</a>	B1.2 Support local governments to adopt and implement plans, regulations, and policies that protect the marine nearshore and estuaries, and incorporate climate change forecasts.  B1.3 Improve, strengthen, and streamline implementation and enforcement of laws, regulations, and permits that to protect marine and nearshore ecosystems and estuaries.
<b>Marine Shoreline Design Guidelines (MSDG)</b>	WDFW, Ecology, Coastal Geologic Services, and Qwg Applied Geology	<b>Johannessen et al. (2014)</b> – <a href="#">Marine Shoreline Design Guidelines</a>	B2.3 Remove armoring, and use soft armoring replacement or landward setbacks when armoring fails, needs repair, is non-protective, and during redevelopment.
<b>Puget Sound Feeder Bluff Mapping</b>	Ecology and Coastal Geologic Services	<b>MacLennan et al. (2013)</b> – <a href="#">Feeder Bluff Mapping of Puget Sound</a> (data layers are available on Ecology’s feeder bluff mapping site)	B1.1 Use complete, accurate, and recent information in shoreline planning and decision-making at the site-specific and regional levels.  B2.1 Permanently protect priority nearshore physical and ecological processes and habitat, including shorelines, migratory corridors, and vegetation particularly in sensitive areas such as eelgrass beds and bluff backed beaches.

Grant Title	Partners	Major Product(s)	Related 2014/15 Action Agenda Recovery Sub-Strategy
<b>Nearshore Permitting Effectiveness through T.A.C.T.</b>	WDFW, Kitsap County, and San Juan County	<p><b>Dionne et al. (2015)</b> – Tracking and Monitoring of Marine Shoreline Stabilization Permits Final Report</p> <p><b>Barnhart et al. (2015)</b> – Shoreline Permitting Effectiveness Through T.A.C.T. Final Report</p> <p><b>Key (2013)</b> – Results of an Analysis of the San Juan Initiative’s Measures of Success</p>	B1.3 Improve, strengthen, and streamline implementation and enforcement of laws, regulations, and permits that to protect marine and nearshore ecosystems and estuaries.
<b>20% More Eelgrass by 2020: Restoration Site Identification, and Investigating Restoration Barriers</b>	WDNR and Pacific Northwest National Laboratory (PNNL)	<b>Thom et al. (2014)</b> – <a href="#">Eelgrass (<i>Zostera marina</i> L.) Restoration in Puget Sound: Development and Testing of Tools for Optimizing Site Selection</a>	B2.4 Implement a coordinated strategy to achieve the eelgrass recovery target
<b>Protecting the Strait of Juan de Fuca Nearshore</b>	Coastal Watershed Institute, Clallam County, WDNR, Ecology, and Earth Economics	<p><b>Flores et al. (2013)</b> – <a href="#">Nature’s Value in Clallam County: The Economic Benefits of Feeder Bluffs and 12 Other Ecosystems</a></p> <p><b>Kaminsky et al. (2014)</b> – Mapping and Monitoring Bluff Erosion with Boat-based LIDAR and the Development of a Sediment Budget and Erosion Model for the Elwha and Dungeness Littoral Cells</p> <p><b>Shaffer et al. (2014)</b> – Protecting the Strait of Juan de Fuca Nearshore through Shoreline Master Program Improvements, Bluff Development Buffers and Building Setbacks, Ecosystem Services Valuation, and Community Stewardship: Field Metrics Final Report</p> <p><b>Parks (2015)</b> – <a href="#">Bluff recession in the Elwha and Dungeness littoral cells</a></p>	<p>B1.2 Support local governments to adopt and implement plans, regulations, and policies that protect the marine nearshore and estuaries, and incorporate climate change forecasts.</p> <p>B1.3 Improve, strengthen, and streamline implementation and enforcement of laws, regulations, and permits that to protect marine and nearshore ecosystems and estuaries.</p>
<b>Targeted Outreach to Reduce Impacts from Shore Hardening in the PSMA</b>	Northwest Straits Foundation, Coastal Geologic Services, EE Outcomes Consulting, Island and Snohomish County Planning Depts. and MRCs	<b>Johannessen (2013)</b> – (a) County Planner Needs Assessment and Workshop Summary Report; (b) <a href="#">Targeted Outreach to Reduce Impacts from Shore Armor in the Port Susan Marine Stewardship Area: Program Assessment Summary Report</a>	B2.3 Remove armoring, and use soft armoring replacement or landward setbacks when armoring fails, needs repair, is non-protective, and during redevelopment.

Grant Title	Partners	Major Product(s)	Related 2014/15 Action Agenda Recovery Sub-Strategy
<b>Support Public Awareness, Outreach and Engagement on SMP Updates (Targeted Awareness Grants)</b>	Puget Sound Partnership, WSU Mason County Extension, Heidi Keller Consulting, and Friends of the San Juans	<b>Keller (2012)</b> – Exploration of Shoreline Property Owner Knowledge and Awareness of Shoreline Management and Habitat Issues  <b>WSU Mason County Extension (2013)</b> – Shoreline Master Plan Targeted Awareness Grant Final Report	B1.2 Support local governments to adopt and implement plans, regulations, and policies that protect the marine nearshore and estuaries, and incorporate climate change forecasts.
<b>Sea Level Rise and Cumulative Effects Management Tools</b>	Friends of the San Juans, Coastal Geologic Services, and Salish Sea Biological	<b>MacLennan et al. (2013)</b> – <a href="#">Sea Level Rise Vulnerability Assessment for San Juan County, Washington</a>  <b>Whitman et al. (2014)</b> – <a href="#">Tidal Elevation of Surf Smelt Spawn Habitat Study for San Juan County, Washington</a>  <b>Whitman and Hawkins (2014)</b> – <a href="#">The Impacts of Shoreline Armoring on Beach Spawning Forage Fish Habitat in San Juan County</a>  <b>Friends of the San Juans (2014)</b> – <a href="#">Healthy Beaches for People and Fish: Protecting Shorelines from the Impacts of Armoring Today and Rising Seas Tomorrow Final Report</a>	B1.2 Support local governments to adopt and implement plans, regulations, and policies that protect the marine nearshore and estuaries, and incorporate climate change forecasts.
<b>Ensuring Regulatory Effectiveness in Puget Sound’s Most Special Places</b>	Washington Environmental Council	<b>WEC (2013)</b> – Final Report for Grant 12-1103  <a href="http://www.aquaticreserves.org/">http://www.aquaticreserves.org/</a>	B3.1 Protect intact marine ecosystems particularly in sensitive areas and for sensitive species.
<b>Protecting Nearshore and Marine Habitat in Mason County</b>	Mason County Department of Community Development	<b>Adkins (2013)</b> – Final Report for Grant 10-1744	B1.2 Support local governments to adopt and implement plans, regulations, and policies that protect the marine nearshore and estuaries, and incorporate climate change forecasts.
<b>Social Marketing Strategy to Reduce Shoreline Armoring</b>	Colehour + Cohen, Social Marketing Services, Futurewise, Coastal Geologic Services, and Applied Research Northwest	<b>Colehour + Cohen et al. (2014)</b> – (a) <a href="#">Shore Friendly Final Report</a> ; (b) <a href="#">Social Marketing Approach and Campaign Implementation Tools for the Reduction of Puget Sound Shoreline Armor</a> ; (c) <a href="#">Puget Sound Shoreline Parcel Segmentation Report</a> ; (d) <a href="#">Survey of Shoreline Property Owners Report</a> ; (e) <a href="#">Shoreline Armor Focus Group Findings</a>	B2.3 Remove armoring, and use soft armoring replacement or landward setbacks when armoring fails, needs repair, is non-protective, and during redevelopment.



**APPENDIX B. EFFECTIVE REGULATION AND STEWARDSHIP INVESTMENTS  
ADVANCING PRIORITIES IDENTIFIED IN THE 2011-2013 BIENNIAL SCIENCE WORK  
PLAN**

<b>Action Agenda Strategy</b>	<b>Priority Science Action</b>	<b>Grant Product(s)</b>
<b>B2</b>	Develop analytical tools to identify priority areas for protection, restoration, and stewardship	MacLennan et al. (2013) Thom et al. (2014) Colehour + Cohen et al. (2014c) Kaminsky et al. (2014) Johannessen et al. (2014)
<b>B2</b>	Identify the key stressors on eelgrass.	Thom et al. (2014)
<b>B5</b>	Implement studies to identify stressors on forage fish.	Whitman and Hawkins (2013) Whitman and Penttila (2014)
<b>D1</b>	Conduct institutional analyses of the overall governance and management structures in which Puget Sound recovery strategies operate.	Talebi and Tyson (2014) Futurewise (2104 a-d) Barnhart et al. (2015) Dionne et al. (2015)
<b>D7</b>	Develop assessments of ecosystem services to help decision makers make informed decisions about restoration and protection.	Flores et al. (2013)
<b>D7</b>	Evaluate the most effective combinations of regulatory, incentive, and educational programs for different demographics in Puget Sound.	Colehour + Cohen et al. (2014a-e)