PRACTICAL GUIDE:

SHORELINE PERMITTING AND MITIGATION TO ACHIEVE NO NET LOSS

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SHORELINE PERMITTING AND MITIGATION TO ACHIEVE NO NET LOSS

August 2014

Dean Patterson, Heather Trim, and Tim Trohimovich
Futurewise

This practical guide is one of a series of guides addressing protection of shorelines in the Puget Sound region.

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EXECUTIVE SUMMARY

Shorelines of the Salish Sea basin are fragile narrow ribbons that support our marine ecosystem in vital ways, from serving as the nursery areas for many aquatic species, to being the migration corridor for outgoing juvenile salmon and the sources of land-based nourishment to the water. In 1972, citizens in Washington State passed a referendum which adopted the Shoreline Management Act. The Act is designed to guide the management and use of shorelines of the state while protecting its natural resources and allowing for responsible development and public access. Under the Act, cities and counties in Washington are required to adopt, update and implement local Shoreline Master Programs (SMPs), which are land use policies and regulations designed to manage shoreline use.

IMPLEMENTING SMPS AND NO NET LOSS

The success of shoreline management depends on both the quality of each SMP and the ability of local jurisdictions to implement their SMPs. Cities and counties have been increasingly under financial pressure resulting in staff cutbacks and lack of funding for technology upgrades, on-the-ground restoration work, and enforcement. Streamlining innovative techniques, providing quick easy tips, and sharing lessons learned are ways to help enhance local implementation of SMPs.

One of the key innovations of the new SMP updates is that they are based on “no net loss” of ecological functions. This no net loss standard is designated to stop the habitat loss that has occurred on the state’s shorelines since 1972, but the on-the-ground implementation of no net loss is also a major challenge because of uncertainty about the baseline conditions as well as the difficulty of quantifying and tracking net changes (PSNERP, 2009). The success of the new generation of SMPs will depend on our ability to meet this challenge.

Applicants propose shoreline development projects ranging from single family homes and accessory structures to large projects such as marinas, port facilities and transportation infrastructure. Activities include construction, repair and replacement of buildings, bulkheads, docks and piers, utility lines, grading, and clearing. These development activities cause the loss and disruption of shoreline ecological functions due to loss of vegetation and habitat, change of ground/surface water and sediment movement, addition of pollutants, and increase in human–related intrusion.

THIS GUIDE

One of the goals of writing local permits to implement shoreline regulations is to meet the standard of no net loss of ecological functions for development activities. Planners and permit writers for local jurisdictions use a variety of approaches for reviewing, writing, and following up on permits. There are a number of cost-effective tools that they have identified which aid in improving permit review, which are brought together in this guide as recommendations.

Most critically, mitigation associated with development projects is not consistent across the region and has not generally proven to include adequate compensatory mitigation. National, regional and local studies have shown that this variation has led to ecological losses rather than no net loss. In recent years, state and federal agencies have worked to significantly increase consistency for mitigation for wetlands. More slowly this effort is being extended to other shoreline resources. This practical guide draws together existing work to provide recommended options for mitigation for shoreline projects. The guide is meant to be part of the continuing dialogue about shoreline-related mitigation in the Puget Sound region, with the expectation that one of the regulatory agencies will publish mitigation guidance, similar to guidance for wetlands, in the near future.

EFFECTIVE PERMITTING PROGRAMS

City and county planning departments are in the critical role of regulating shoreline development activities, especially through the issuance of land use permits. An effective permitting program includes:

- Staff well versed in natural resources knowledge or with access to technical experts, either in-house or as consultants, including access to up-to-date training for staff.
- Pre-application assistance that provides upfront technical information to project proponents so that they are better able to submit complete, well written applications, as well as advice to guide projects to use greener techniques and features. Useful assistance includes:
  - Strong webpages and educational materials.
  - Walk-in counter service staffed with technical experts on-call.
  - GIS tools and other resources that provide visual information.
  - Pre-application site visits and meetings.
- Permit review process that includes:
  - A well-tuned, easy-to-use internal coordination process that includes all relevant departments.
  - Coordinated permit reviews with local, state and federal agencies, and Indian tribes and nations.
  - Site visits to ensure that details that aren’t easily conveyed “on paper” are made evident.
  - Tools that staff need (GIS, aerial photography).
- Permit writing that uses well-constructed financial guarantees, staging and timing conditions (for larger or complex projects), and complete mitigation plans written with success measures.

USING MITIGATION TO ACHIEVE NO NET LOSS

Developing effective mitigation includes departmental policies which:

- Stand firm on avoiding and minimizing impacts and requiring compensation for remaining impacts, with complete review of all potential impacts;
- Honor the required buffers;
- Move back structures for uses that are not truly water dependent and protect areas with intact vegetation; and
- Ensure that variances or exemptions are the rare exception, rather than the rule, and that full compensatory mitigation is provided.

It is also important to:

- Carefully design mitigation to replace all of ecological functions lost by the development or activity.
- Require high enough replacement ratios so the mitigation can replace the functions that would otherwise be lost.
- Make sure the mitigation is located in an area that it can function, and that it is monitored and maintained until it is fully established.

IMPACT ASSESSMENT AND MITIGATION RECOMMENDATIONS

Summaries of the impacts associated with each development activity along with recommended menus of mitigation options (avoidance, minimization and compensatory) make up the remainder of this guide, covering the following activities:

Upland development:

- ***Removal of vegetation and/or habitat***
- ***Other impacts from structures and new impervious surfaces (in addition to vegetation and habitat removal impacts)***
- ***If in wildfire hazard areas***
- ***Grading (excavation, fill, beach and dune disturbance, and dredge disposal)***
- ***If excavating in shallow groundwater areas***
- ***Linear features (roads, trails, utilities, walls, trenches and ditches, pipes, dikes, subsurface drainage)***

In-water development:

- ***Removal of aquatic vegetation and habitat***
- ***Overwater structures (docks, piers, floats, boat houses, launching facilities and associated pilings and moorings)***
- ***Dredging and fill in marine areas, ponded areas, and riverine areas (dredge disposal)***
- ***Connecting channels and large scale excavations (pits in flood plains, marine or lake areas)***

In-water and near-water development:

- ***Stabilization and erosion control structures (bulkheads, rip rap, flood control, breakwaters, groins, weirs)***
- ***Transportation and utility crossings - stabilization and support structures***

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We gratefully would like to acknowledge the assistance and information provided in creating this series of guides. Shorelines and planning work in Washington State is the work of many!

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Practical Guide: Shoreline Permitting and Mitigation to Achieve No Net Loss
Practical Guide: Cost-Effective Compliance with Shoreline Regulations
Practical Guide: Interagency Coordination in Implementing Shoreline Regulations

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1. INTRODUCTION

The shorelines of the Puget Sound basin are the fragile narrow ribbon that supports the ecosystem in vital ways, from serving as the nursery area for many aquatic species, to providing a migration corridor for outgoing juvenile salmon, and an important conduit for land-based nourishment to the water. In 1972, the citizens of Washington State voted to adopt the Shoreline Management Act (SMA). The Act is designed to guide the management and use of the shorelines of the state while protecting their natural resources and allowing for responsible development and public access. Under the Act, cities and counties in Washington are required to adopt, update, and implement local Shoreline Master Programs (SMPs) which are land use policies and regulations designed to manage shoreline uses and activities. The Washington Department of Ecology (Ecology) is charged with assisting local governments in carrying out the Act and with approving locally adopted SMPs. In recent years, local jurisdictions have been updating their SMPs to incorporate new science, the Shoreline Master Program Guidelines, and local priorities and information.

The success of shoreline management depends on both the quality of the SMPs and the ability of local jurisdictions to implement those SMPs through regulatory programs, such as shoreline permits and voluntary actions (including restoration projects). Cities and counties have been increasingly under financial pressure, resulting in staff cutbacks, lack of funding for technology upgrades, and cuts in enforcement programs. Streamlining innovative techniques, providing quick easy tips, and sharing lessons learned are ways to help enhance local implementation of SMPs.

One of the key innovations of the new SMP updates is that they are based on "no net loss" of ecological functions. This no net loss standard is designed to stop habitat loss that has occurred on the state's shorelines since 1972. On-the-ground implementation of no net loss, however, is a major challenge because of uncertainty about the baseline conditions as well as the difficulty of quantifying and tracking net changes (PSNERP, 2009). The success of the new generation of SMPs will depend on our ability to meet this challenge.

With this in mind, Futurewise, with funding support from Washington Department of Fish and Wildlife (WDFW) through the Environmental Protection Agency (EPA), developed this practical guide to help local governments and agencies achieve no net loss when permitting shoreline development. The tools in this guide include streamlining, innovative techniques, and effective permitting. The first chapters of the guide examine ways to improve permit processes to achieve no net loss (chapters 2 to 5). These include ideas for the formal project review processes, informal policies guiding project review, and staff practices to improve review outcomes. While these ideas are important for all types of permit review processes (such as zoning, subdivision, building permit, flood permit, etc.), they are magnified for natural resources reviews because of the expertise needed to determine impacts to the resource, and the necessary coordination with natural resource agencies.

Achieving no net loss requires the full application of mitigation sequencing (avoid, minimize, and compensate). As highlighted by the *Making Mitigation Work: The Report of the Mitigation that Works Forum in 2008*, mitigation in Washington State has not been achieving no net loss. The report states:

"Many mitigation projects continue to be poorly sited, poorly designed and implemented, and poorly maintained (if they are maintained at all), and not enough attention has been devoted to monitoring, compliance, and adaptive management. As a result, ecological values and functions continue to be lost and the cumulative impact of many poor decisions (or failure to mitigate at all) is increasingly degrading watershed conditions, especially in developing areas (Ecology, 2008)."

The final sections of this guide provide background and recommendations on how to craft mitigation for permit conditions (chapters 6 to 9). These chapters provide an understanding of the basic SMA policy and SMP Guidelines requirements as they relate to no-net-loss of ecological functions, mitigation sequencing, how specific development impacts ecological functions, and ways to mitigate those impacts through conditions of approval. Chapter 8 is also intended to serve as a resource to help identify the common impacts of different types of development. Chapter 9 provides a brief summary of impacts along with recommended mitigation for those impacts. Chapter 9 is designed to be a stand-alone quick reference guide.

METHODOLOGY

This guide draws on the work of others - the many professional planners, managers, and scientists working to improve the health of the Puget Sound ecosystem. We carried out interviews with permit review practitioners from the staff of different agencies at the federal, state and local level to learn about:

- Their experience with regard to permitting and mitigation.
- Their opinion and experience on ways to improve permitting and mitigation.
- Success factors and barriers to adoption and/or implementation of potential approaches.

Through these interviews and reviewing published reports, we have tried to distill their advice and conclusions into a document that can serve as an easy reference. In addition there are several documents that have been written with tips for permit writing (See Appendix 1) and some of this advice has been incorporated in this guide. This guide also draws from

published papers and government guidance on mitigation, but these are generally limited in scope or topic area. There is not a general guide for shoreline mitigation that addresses the full range of impacts for planners to use. This lack makes it more difficult for local government planners to meet the no net loss standard.

NEED FOR A MITIGATION MANUAL

The mitigation guidance gap was highlighted in the 2011 report, *A Qualitative Assessment of Implementation of the Puget Sound Chinook Salmon Recovery Plan*, by Millie Judge, prepared for the National Marine Fisheries Service which notes that related to salmon habitat:

> *"…there is little to no guidance in existence at the federal, state or local level for implementing regulations that employ —mitigation sequencing (meaning one that calls on developers to avoid, minimize, mitigate, and/or restore habitat impacted by development). There is no guidance as to how much of an effort must be made to avoid, before one is allowed to minimize or mitigate impacts. This type of guidance is crucial to understanding the true level of protection that will be afforded from regulatory standards" (NOAA-NMFS, 2011a).*

2. STAFFING, TRAINING, OUTSIDE ASSISTANCE FOR PERMIT REVIEWS

Staffing, education and training for staff, as well as outside assistance, are important components of effective permit review processes in order to achieve no net loss of shoreline ecological functions. Staffing and staff support has become even more vital with tight economic times compounded by newly updated Shoreline Master Programs with new requirements.[1] One local planner we interviewed in preparation for this guide said:

"Nowadays, you practically have to be a biologist to do shoreline permits."

Permit writers and planners receive land use applications for many types of projects in critical areas ranging from wetlands to steep slopes to special habitats and to shorelines, both in and out of water. Island County, for example (see Side Box on page 16), public noticed twenty nine permits with closures dates in a short three-month period (March 5 to May 28, 2013). The breadth of these projects included the following that were in or near the following features:

Number of projects	**Near or in:**
15	Shoreline jurisdiction
10	Marine Fish & Wildlife Habitat Conservation Areas
6	Wetland or wetland buffer
13	Feeder bluff
7	Critical drainage area
9	Geohazard area
13	Steep slope

Two applications were for new or relocated homes, three were for bulkhead repair and one was for a new two-lot bulkhead (variance requested). Some of these projects were proposed to be constructed in or near special habitats, eagle habitats or habitats of local importance.

In just this short period of time for a single jurisdiction, the range of applications and variety of critical areas and shorelines highlights the importance of knowledgeable staff who are well supported to tackle permitting and mitigation - the subject of the next sections of this guide.

STAFF EDUCATION AND TRAINING

Staff education and training are primary needs for two reasons. First, individual reviewers benefit from having personal knowledge about ecological functions so that they can accurately identify impacts to natural resources. Regardless of any other factors, if staff (whether natural resource experts or not) are unable to accurately identify impacts and determine appropriate mitigation, local jurisdictions cannot consistently achieve no net loss through permit approvals.

Second, a departmental policy to provide training about ecological functions and no net loss creates a culture in which planners are empowered to address difficult situations that arise when project proponents challenge the science behind mitigation requirements. Staff with expertise in natural resources permit review will know which questions to ask and are able to see gaps in information provided in applications. They also tend to have more confidence in discussing natural resource issues with consultants and are able to object to inadequate reports, including identifying unqualified consultants, identifying missing issues, and ensuring that adequate mitigation is provided. As described by a local planner, it can sometimes be difficult to converse with applicants:

"We have a challenge in persuading the applicant that the mitigation is 'reasonable.' We take a beating as it is, in the effort to get reasonable mitigation"

Even if staff with expertise are on-hand with specific experience in some fields, it is helpful to provide training related to natural resource subjects outside staff's area of expertise. Persons with strong backgrounds in some areas can sometimes be unaware of key questions or considerations that they should consider related to other resource issues. As the science evolves and as shoreline regulations become better focused on achieving no net loss, experts also need training related to accurately identifying and mitigating impacts. Chapters 6 through 9 of this guide also provide information on mitigation.

Some training opportunities include:

- Salish Sea Ecosystem Research Conference. Held every two years, alternating between Seattle and Vancouver BC: http://www.wwu.edu/salishseaconference
- Coastal Training Program – Washington: http://www.coastaltraining-wa.org
- King County Science

1 *This is supported by the literature. See for example Philip Gibbons and David B. Lindenmayer, Offsets for land clearing: No net loss or the tail wagging the dog? 8 ECOLOGICAL MANAGEMENT AND RESTORATION 26, 29 (April 2007). Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1442-8903.2007.00328.x/full)*

Side Box

EXAMPLES OF LAND USE APPLICATIONS IN ISLAND COUNTY

The table below shows the large breadth of land use and variance critical areas and shorelines applications listed for public comment by Island County in just a three- month period, from March 5 to May 28, 2013.

Camano Island: Proposal - Island County Public Works proposes to repair an existing stormwater drain system replacing corroded pipe with new pipe & catch basins. Project site is in or near: MFWHCA, shoreline jurisdiction, critical drainage area, vicinity of cultural resources & feeder bluff.
Camano Island: Proposal - To co-locate an omni-directional antenna, a 6 foot diameter microwave dish, & a panel antenna on existing tower. Also, to construct a 10x16 pre-fabricated, unmanned equipment shelter; the installation of a backup generator, & an expansion of the fenced area to accommodate the new shelter & generator. Project is in or near: steep slopes.
Camano Island: Proposal - To construct a 120ft long rock retaining wall 6-8ft in height. Project is in or near: shoreline jurisdiction, critical drainage, geo hazardous area & steep slopes.
Camano Island: Proposal - To construct a new single-family residence. Project site is in or near: Marine Fish & Wildlife Habitat Conservation Areas, feeder bluff, vicinity of cultural resources, shoreline jurisdiction, geo hazard area & steep slopes.
Camano Island: Proposal - To demo an existing home, construct new home, install a new septic & replace existing retaining wall. Project site is in or near: Marine Fish & Wildlife Habitat Conservation Areas, shoreline, feeder bluff, steep slope & geo hazardous area.
Camano Island: Proposal - To repair /replace tie backs on an existing concrete bulkhead. Project is in or near, shoreline, feeder bluff, flood hazard area, critical drainage, vicinity of cultural resources, geo hazardous area & steep slopes.
Camano Island: To request a shoreline exemption permit & road setback variance for remodel work on an existing SFR. Project is in or near: Marine Fish & Wildlife Habitat Conservation Areas, shoreline jurisdiction, feeder bluff, flood hazard area, steep slope, geo hazard area & vicinity of cultural resources.
Camano Island: Proposal - To request a shoreline exemption permit & road setback variance for remodel work on an existing SFR. Additionally, applicants request a certificate of zoning compliance review to establish existence of SFR. Project is in or near: Marine Fish & Wildlife Habitat Conservation Areas, shoreline jurisdiction, feeder bluff, flood hazard area, steep slope, geo hazard area & vicinity of cultural resources
Camano Island: Proposal - Applicants request shoreline exemption permit for a 2-lot bulkhead. Project is in or near: shoreline jurisdiction, feeder bluff, critical drainage, flood hazard, steep slope & vicinity of cultural resources.
Clinton: Proposal - Island County Public Works proposes to use a combination of pumps & siphons to manage rising water levels in Deer Lake. Project site is in or near: wetland, stream & shoreline jurisdiction.
Clinton: Proposal - Replacement of existing bulkhead. Project is in or near: shoreline jurisdiction, steep slopes, geo hazardous area, Marine Fish & Wildlife Habitat Conservation Areas, flood zone, eagle habitat & feeder bluff.
Clinton: Proposal - To add on to a permitted shed within the road setback. Expansion will be a 5 ft increase in height. Project is in or near: geo hazardous area & steep slopes.
Clinton: Proposal - To relocate an existing house onto a platted lot to replace a pre-existing house which has been removed. The relocated house will be within the buffer of a wetland.
Clinton: Proposal - To replace an existing cabin & septic system with a new single-family residence & new septic system. Project is in or near: wetlands, Marine Fish & Wildlife Habitat Conservation Areas, shoreline jurisdiction, feeder bluff, & habitat of local importance.
Coupeville: Proposal - Island County Public Works proposes to build a new 1.54 mile road. The road would serve as an alternate route in the event of emergency closure to SR 525. Wetlands & a stream will be impacted by the new road, & mitigation is proposed.
Coupeville: Proposal - Island County Public Works proposes bulkhead repair to protect drainage outfall. Project is in or near: Marine Fish & Wildlife Habitat Conservation Areas, shoreline jurisdiction, feeder bluff, flood hazard, steep slopes, geo hazardous area, noise zone & critical drainage area.
Coupeville: Proposal - Island Transit proposes to request site plan amendment to include a 40ft mono-pole communication tower on parcel. Project is in or near: noise zone level & Ebey's Reserve.
Coupeville: Proposal - Puget Sound Energy proposes to relocate existing 115kv transmission line to a new location in the same property; will involve clearing & grading. Project is in or near: steep slopes, eagle habitat, HPC & vicinity of cultural resources.
Coupeville: Proposal - To add on to existing single family residence including upgrading the existing septic system & adding a second floor to existing structure. Project is in or near: Marine Fish & Wildlife Habitat Conservation Areas, shoreline jurisdiction, feeder bluff, flood hazard, noise zone, & vicinity of cultural resources.
Coupeville: Proposal - To assess the development potential of a lot by determining if base density is qualified by the gross acreage of a lot - including lands covered by water. Project site is in or near: wetlands, Marine Fish & Wildlife Habitat Conservation Areas, shoreline, flood hazard, habitat of local importance, noise zone, Ebey's Preserve & vicinity of cultural resources.
Coupeville: Proposal - To divide a 1.12 ac parcel into 2 lots. Proposed land division will meet base density requirements. Project is in or near: shoreline jurisdiction, Marine Fish & Wildlife Habitat Conservation Areas, flood hazard area, steep slope, AICUZ noise zone.
Freeland: Proposal - Applicant is requesting amendment to previously approve site plan review 026/96 to provide off-site gravel parking for employees. Project is in or near: critical drainage area.
Freeland: Proposal - Island County Public Works proposes to construct an educational sign. Project site is in or near: Marine Fish & Wildlife Habitat Conservation Areas, shoreline, feeder bluff, critical drainage, & flood hazard.
Freeland: Proposal - Island County Public Works proposes to repair a failing culvert by sealing it with a spray-on epoxy liner. The culvert conveying a perennial stream under Walden Loop will be temporarily diverted during construction.
Greenbank: Proposal - Obtain site plan approval to construct a 180' radio tower and equipment storage building. Project is in or near stream.
Langley: Proposal - Request for SEPA determination for winery expansion; in addition to future plans for a bed & breakfast, event center, commercial kitchen & wine tasting room. Project site is in or near: steep slopes.
Langley: Proposal - To repair and reinforce 20 deteriorating dock piles. Project is in or near: shoreline jurisdiction, feeder bluff, flood hazard & vicinity of cultural resources.
Langley: Proposal - To repair pilings on existing wood float & gangway. Project site is in or near: Marine Fish & Wildlife Habitat Conservation Areas, shoreline jurisdiction, feeder bluff, flood hazard, steep slope, & geo hazard area.
Oak Harbor: Proposal - Review of proposed restoration & mitigation for un-permitted clearing within geologic hazard area & wetland buffer.

Source: Island County. *Public Notification.* Retrieved from http://www.islandcounty.net/planning/PublicNotices.htm

STAFF WITH NATURAL RESOURCE EXPERTISE AND ALTERNATIVES

Ideally, local jurisdictions are able to include some staff with natural resource expertise in their shoreline and critical area permit review sections. When education or career expertise is not possible, it is beneficial to provide intensive training to permit staff. When resources are unavailable to train or hire staff with natural resources expertise, other options for additional expertise are currently being used in Puget Sound and are listed below and described in more detail below:

- **Contract with government.** Cities or counties can contract with other jurisdictions (could be either counties or cities) to perform reviews with their staff. This strategy is regularly used for other services, such as building permits. It allows jurisdictions to spread the cost of specialized expertise over several organizations.
- **Share resources.** Multiple jurisdictions can join together to hire a full-time staff or a consultant to do reviews. This might be similar to a circuit-rider planner used by rural jurisdictions.
- **Hire consultants.** Jurisdictions can keep consultants on retainer to do reviews as needed.
- **Use decision support systems.** While not yet common in the planning field, decision support systems could be developed to walk less experienced staff through the natural resources permit review process. These computer-based systems can help assure that the relevant criteria are considered and produce better and more consistent decisions. Decision support systems also help document the process, impacts identified, and even mitigation. Decision support systems could be funded by state or federal agencies, a consortium of local governments, or a combination.

Funding these options may be a challenge, but can include normal budgeting allocations for consultants, setting fees to pay the consultant, or requiring applicants to sign an agreement to pay fees for the work.

A PERMIT REVIEW PROCESS EMPHASIZING AND UTILIZING EXPERTISE

Because of the complexity of shoreline projects, property owners generally hire professionals to complete applications and provide technical reports, maps and other information. It, therefore, brings significant benefits to the review process if a city or county has staff (or access to consultants) with natural resource expertise who can independently and objectively confirm that natural resources are protected. They can review and question reports with ease, identify impacts, and develop mitigation. Having no expertise usually means that the staff has to rely on the project proponents for doing the substantive review. Staff may be less able to question report findings or reliably identify impacts and mitigation. The distinction can make a difference in accomplishing no net loss of ecological functions.

Below are three alternatives that are found among jurisdictions in the Puget Sound for permit review.

Use in-house staff with expertise to perform review

Many counties and larger cities in Puget Sound have resources to support a staff team with expertise in natural resources and environmental science. For the rare project with unique characteristics, outside consultants are hired for specialized review. This approach is ideal because it allows staff with expertise to independently confirm adequacy of reports and determine project impacts and mitigation. The staff work day to day on issues related to their geographic area, are aware of the history of nearby and related projects, and might be involved in long term planning. This creates a well-rounded overall-approach that can aid in achieving the no net loss goal. An example of this approach is Pierce County in which the natural resources staff assist with those issues across all aspects of the county's development review function. In addition, planning departments can draw on experts from other departments within the jurisdiction, such as flood management staff.

Hire outside natural resources expertise

Smaller jurisdictions often hire outside natural resource experts to assist with permit reviews. Some jurisdictions with good financial resources may use outside assistance on a limited basis to supplement in-house expertise. The approach is to pay a consultant to review project reports, identify additional impacts, and suggest additional mitigation. Examples approaches include:

- Contracting with another county or city to perform the review using their staff.
- Joining with other jurisdictions to hire a full-time staff or a consultant to do reviews.
- Keeping a consultant on retainer to do reviews as needed.
- Hiring consultants on a case by case basis.
- Using a "circuit-rider" planner, biologist or other needed specialist, individually or via a consultant (See Case Study on page 19). Association of Washington Cities or Washington State Association of Counties might be good organizations to help set up circuit rider programs, if this idea is embraced by local jurisdictions.

The use of outside experts as the primary approach can result in good permit review - but it has limits. Unless an individual consultant can be engaged for a significant period of time or is a local consultant, the consultant is not likely to have knowledge of local resources. Hiring consultants is expensive, though it may be cost-efficient compared to maintaining staff with expertise where the expertise is not needed fulltime. Using consultants as a primary means of review requires careful consideration of funding needs. When a consistent funding

method is not developed, normal budget pressures will tend to limit the use of consultants, leaving the jurisdiction in the position of doing the review without expertise. Given the range of work a natural resource review can require, it may be beneficial to use an agreement with applicants requiring them to pay permit fees to cover costs. On the other hand this approach can be a good supplement to in-house expertise on arcane subjects as long as there is supervision by the in-house staff.

Rely on others for natural resources expertise

Small population jurisdictions with few resources often have to rely on the expertise of others. In the barest form of this approach, the jurisdiction relies entirely on reports prepared by the applicant's consultant to identify natural resources, determine impacts, and propose mitigation. Since the consultant is an advocate for the project, it is likely that issues will be missed, or that minimal mitigation is proposed. One reality of consulting for smaller and routine projects is to minimize the work done for the fee charged. This may mean that the mitigation sequence[2] stops at the "minimization" step and does not provide adequate compensation for proposed projects.

Tribal governments can be key partners to gather background data, help develop permit processes that work at all levels, and help monitor the progress of project-related outcomes. They can also be critical allies in working with the elected officials and the public. Federal governments all have staff, resources and expertise that can be helpful at all stages of shoreline permitting and implementation.

In speaking with the staff of several jurisdictions, we learned that they tend use state or federal agency's review of project reports and identification of additional impacts and mitigation as the guidepost for their local permit requirements. In some cases they ask for direct advice from the state or federal agency. While state and federal agencies often have the needed expertise and provide thorough project reviews, the agency's advice is likely to be limited to the authority of the agency, not that of the local jurisdiction. This is especially the case for projects impacting the upland portion of a property because in-water work requires additional state and federal permits. In addition, the ability of state and federal agencies to provide assistance is inconsistent and subject to their staffing and funding limits, workload, training (training budgets have been limited in recent years) and willingness to do the jurisdiction's work. In the absence of assistance or for issues beyond those of the state or federal agency's mandate, the jurisdiction is left to rely on the report alone. Staff training and other opportunities to learn about potential mitigation gaps is helpful in light of the new requirements in updated SMPs and changing knowledge of shoreline science. Partnerships with federal, tribal, and state agency staff can be invaluable and should be maximized.

RECOMMENDATION SUMMARY: STAFFING FOR PERMIT REVIEW

- Provide training for all permit review staff, including staff who already have expertise in some natural resource fields. Training is needed so that staff are aware of and confident in addressing current science on development impacts, biological and physical shoreline functions, and potential mitigation options. A planning department can help establish a culture of support for staff by providing this training.
- When the shoreline and critical areas review workload supports a full-time or part-time staff person, provide staffing with a person who has expertise or significant experience in natural resources. In some cases, experts within a jurisdiction can provide assistance in permit reviews in multiple departments.
- Maximize partnerships with federal, tribal and state agency staff.
- For smaller jurisdictions with fewer resources, expertise to provide permit reviews to protect natural resources can be obtained by:
    - Hiring outside consultants either on retainer or on case-by-case basis,
    - Joining with other jurisdictions to share a permit reviewer, or
    - Joining a circuit rider program.

  Oversight is needed, though, to ensure that the outside consultant's recommendations are consistent with the broader local knowledge and that no net loss for the jurisdiction is achieved.

- Caution is advised for jurisdictions with small population bases (and thus few permit applications and limited funding) which must entirely rely on applicants' reports and federal or state agency staff assistance. Relying on this assistance has limitations and so it is beneficial for planners to keep abreast of current science by attending trainings and science conferences and reviewing new Puget Sound-focused research publications.

2 *WAC 173-26-201(2)(e)(i) requires that where mitigation is required for developments, mitigation sequencing shall be used.*

Case Study

A CIRCUIT RIDER'S EXPERIENCE: KURT DANISON

Kurt Danison of Highlands Associates began riding his circuit in 1988 and is currently a circuit rider planner for five small cities in Okanogan County: Brewster, Pateros, Twisp, Tonasket and Omak.

What is a circuit rider?

Like the ministers who traveled by horse from town to town in frontier America, circuit rider planners are consultants who have contractual relationships with multiple cities. They take on a large number of staff functions and work closely with elected officials to support land use planning and regulatory actions.

How is Kurt contracted?

Kurt has annual contracts with each city, some running back as far as 1988, which typically include a set number of hours per week (up to a cap) and provisions for doing additional projects, as needed.

Kurt's projects

Kurt's job has changed over time as the communities have increased their own capacities and needs have evolved. Currently, his main focus is keeping local plans current, updating land use codes, and providing a shared resource, including some GIS services. Kurt wrote the original SMPs (early 1990's) and is now working on SMP Updates for some of his cities, and advising on others. He also wrote the first draft of the county's current SMP update. Most of the communities have long lists of projects, be it for parks, trails, streets or sewer lines, so they need to remain eligible for state grant and loan programs. Kurt helps keep them in compliance with program requirements and informed of potential funding opportunities. In addition, he works on a variety of transportation, utility infrastructure and economic/community development planning and grant writing as well as representing the communities on several regional organizations.

Permit writing: The communities on Kurt's circuit do not have a lot of demand for development permits, particular in shoreline areas. The typical community may have up to 2-3 shoreline exemptions per year and a substantial development permit once every year or two. Depending on the community he also processes land use permits, prepares staff reports and drafts permits in coordination with other department heads.

Other regulatory actions: When requested, Kurt also assists in obtaining compliance when violations are identified through discussions with landowners, drafting of letters which then are sent out on city letterhead by city officials, and coordinating with legal counsel.

How Kurt interacts with city staff and officials

Generally, Kurt is treated like staff. He attends staff meetings in several of the communities. He is not the permit administrator (i.e., signatory on permits) except in one of his towns in which he does act as the administrator and signs permits. He regularly attends planning commissions and council meetings as requested. He has helped build capacity in the communities by working closely with Clerks and their staff and building officials. Kurt likes the variety of his job, as he says it is:

"Much more fun because I get to work in many different towns. I never know what is going to happen from one day to the next. If the phone rings then there will be a new issue to figure out."

Source: Kurt Danison, personal communication, May 30, 2013.

3. GETTING A STRONG PROJECT APPLICATION IN THE DOOR

EARLY ASSISTANCE AND EDUCATION ARE CRITICAL

A critical "lesson learned" for effective permitting is to provide early, easily accessed assistance to project applicants and to explain why the regulations are in place. A local planner told us:

"People are getting better educated. Many people know you can't get a new bulkhead. But they don't know why. 'I understand your rules, but I don't know why.' 'I will do it under protest.'"

This comment underscores how providing information and assistance can be a key way to avoid conflicts with applicants by helping ensure that their project is designed to meet requirements. Avoiding disputes is important for all permit review systems, but it is especially important for natural resource reviews. Conflicts often result in compromises that adversely impact ecological functions, though those impacts could have been avoided. Equally important to the jurisdiction, conflicts cost additional time and money, and can result in bad public relations.

Applicants also want to avoid conflict, from the perspective of avoiding nasty surprises on their project. Consequently, they want three things - after the obvious desire to build their project as they want it. They want:

- To know as early as possible if the answer is "no,"
- To pay for designing the project only once, and
- To avoid being surprised by extra requirements that cause delay and added expense.

It may be difficult both technically and politically for a department to provide an "early no" on projects that are not allowed or have major problems. This generally requires department support and training to empower staff to be proactive in identifying projects with obvious environmental impacts, and then informing applicants that their project has problems, cannot be supported, or will probably be denied. It also requires an approach which overcomes a system in which applications are automatically accepted with a default plan of attempting to condition a project into approval, even though there is a small likelihood of being able to mitigate the impacts. In addition, early advice can help steer projects away from bad designs. Staff can promote ideas that would better protect natural resources if they are able to talk to the applicant prior to their investing in their initial design.

Early assistance can help save money for the department. The investment of staff time upfront can significantly reduce the workload during later permit review by preventing bad projects from being submitted and by making applications easier to review because key issues are addressed in the application rather than through the review.

The provision of early assistance includes three components whenever possible: educational websites and materials, general counter assistance for people inquiring during the early feasibility stages of a project, and project-specific pre-application assistance for when projects advance to the pre-design stage.

FEES MAY NOT COVER ACTUAL COSTS

Counter assistance and pre-application project meetings are an important way to provide early assistance. Fees can be charged for pre-application meetings and site visits.

The Side box on page 22 provides examples of land use permit-related fees from six Puget Sound jurisdictions. This information is provided to give the reader a sense of the types of fees and how these costs vary. It should be noted that for the same services, the fees can be quite divergent. For example, the fees for pre-meetings range from $100 to $638. Exemptions range from $100 to $800.

We learned from interviews with practitioners that the fees charged by most jurisdictions are inadequate to cover costs for the review, regulation and follow-up of development projects. As one planner noted,

"There hasn't been a year since I started when the permit fees cover the costs."

Kitsap County has partially addressed the fee issue by including a more general description of how it charges for staff time upfront in its fee structure:

"Land Use and Development fees will be based on an hourly rate to review/process pre-applications, engineering, environmental, and land use applications. Inspections associated with these application types will also incur an hourly rate. (Hourly rate includes applicable travel time.)"

They currently charge $350 for pre-application consultation (up to 30 minutes) which is credited towards the application fee (Kitsap County DCD, 2013).

Side Box

SELECTED LAND USE PERMIT-RELATED FEES

Selected fees from six Puget Sound jurisdictions are shown below (2013 fees) in order illustrate the types of fees and the cost range of fees for land use permit. In some cases, for the same services the fees greatly vary.

Category	Mason County	City of Bellingham	City of Gig Harbor In some cases fees are consolidated
Pre-application meeting/ Site visit	Pre-meeting $190 + 70/Hr Site inspection $255	Pre-meeting $638	Planning review $325
Shoreline Substantial Development Permit Conditional Use Permit Variance Exemption	Shoreline Permit: Substantial Development Permit $1,300 Conditional Use Permit – Type II $850 Conditional Use Permit – Type III $1750 Variance $1750 Exemption $100	Shoreline Exemption - Repair and Maintenance $564 Shoreline Exemption - Timber Harvest in Forest Production District $394.80 Shoreline Exemption - In APD or RA-Zone with Farm Plan $394.80 Shoreline Exemption - All Others $184.80/hour Shoreline Development Application $184.80/hour Conditional Use Permit: Residential, Home Industry, Tower $5,922	Shoreline Permit: Value Fee ≤$10,000 $4,600 $10,001- 100,000 $4,800 $100,001 - 500000 $5,300 $500,001 - 1000000 $5,900 >$1000000 $6,500 Conditional Use $5,100 Exemption $800 Variance $4,350
Land Clearing Permit		$106	$275
URL	http://www.co.mason.wa.us/forms/Community_Dev/2009_planning_fees.pdf	http://www.cob.org/documents/planning/applications-forms/permit-center-fees/land-use-fee-sheet.pdf	http://www.cityofgigharbor.net/files/library/a325a473addf3ff8.pdf

Category	City of Bremerton	King County Permit administration fee of $78.75	Pierce County
Pre-application meeting/ Site visit	Pre-application meeting/Site visit Pre-application conference: $100	Pre-application meeting/Site visit Pre-application conference: $100	Project Meetings (> more than 4 per project per year) $250 Minor Predevelopment Meeting $840 Major Predevelopment Meeting $2,060 Customer Information Meeting (with up to 2 Technical Support Staff) $170 Site Reconnaissance $410
Shoreline Substantial Development Permit Conditional Use Permit Variance Exemption	Shoreline Permit: Substantial Development Permit $1,300 Conditional Use Permit – Type II $850 Conditional Use Permit – Type III $1750 Variance $1750 Exemption $100	Shoreline Exemption - Repair and Maintenance $564 Shoreline Exemption - Timber Harvest in Forest Production District $394.80 Shoreline Exemption - In APD or RA-Zone with Farm Plan $394.80 Shoreline Exemption - All Others $184.80/hour Shoreline Development Application $184.80/hour Conditional Use Permit: Residential, Home Industry, Tower $5,922	Shoreline Permit: Value Fee ≤$10,000 $4,600 $10,001- 100,000 $4,800 $100,001 - 500000 $5,300 $500,001 - 1000000 $5,900 >$1000000 $6,500 Conditional Use $5,100 Exemption $800 Variance $4,350
Land Clearing Permit		Minor clearing permit: $394.80	
URL	http://www.ci.bremerton.wa.us/forms/city/RatesFees.pdf	http://www.kingcounty.gov/property/permits/info/applying/fees.aspx#2013FeeSchedule	http://www.co.pierce.wa.us/DocumentCenter/View/4081

Source: Island County. *Public Notification.* Retrieved from http://www.islandcounty.net/planning/PublicNotices.htm

EDUCATIONAL MATERIALS FOR THE PUBLIC

Getting the word out to the public about new and existing regulations is challenging. It is especially difficult for topics such as shorelines which are heavily science-based. It is also challenging because so many of the homes are seasonal. As described by one local planner:

"The key now is education. Often it is mom and pop who don't really know. They have vacation homes they don't deal with regularly or are not keyed into zoning."

Most local jurisdictions have basic shoreline permit information on their web page but only a few have detailed information explaining the "why" of the new regulations or have detailed explanations of the different permits needed (i.e., those required by different agencies). Given that many people turn to the internet first for many topics of interest, it could be well worth the cost for local jurisdictions to build their own web pages with information about shoreline science and permit requirements. Alternatively, a single, well managed and updated webpage designed for landowners seeking permits and hosted by a state agency to which all of the local jurisdictions could link would also be beneficial.

Some particularly good examples of web pages with helpful features include:

- San Juan County: http://www.co.san-juan.wa.us/shoreline/setbacks.aspx
- WRIA 8 (Lake Washington and Lake Sammamish) Green shorelines: http://www.govlink.org/watersheds/8/action/greenshorelines/
- City of Kirkland: http://www.kirklandwa.gov/depart/Planning/SMP/Shoreline_Permit_Process.htm?

COUNTER ASSISTANCE

One effective technique for early assistance is technical assistance with natural resources expertise at the counter, front desk or by telephone. This could potentially be an unpopular task for both staff and administrators. It may be viewed by staff as menial work or as a task that interrupts their review workload. Administrators may dislike the cost of allocating staff to the counter.

The staff answering in-person and phone inquiries should have natural resource expertise because the objective is to answer site-specific questions, direct people to resources, and provide advice on project design. Depending on the natural resources workload and resources of the jurisdiction, the options for staffing this function range from establishing a permanent position at the counter, rotating counter duty among the staff with technical expertise, or on-call staff duty.

In some counties, such as Thurston County, over 50% of their applicants use counter service for free advice. As noted by King County staff, counter assistance can be important for getting basic requirements instilled into the applicant's early concepts for the design and can reduce the time needed for a natural resource review after the application is received (See Side Box on page 24).

Specific recommendations to maximize the benefits of counter assistance include:

- Provide policy support and training to empower planners to provide an "early no" to project proponents for projects that clearly violate the SMP or cannot be modified in a way that can bring them into compliance. Encourage staff to provide "early notification" to proponents of projects that they have problems, cannot be supported, and may be denied.
- Conversely, for green projects, find ways to get to "yes" earlier with streamlined processes.
- Establish department policy, and commit to staffing counter assistance.
- Invest in experienced staff being available for counter assistance, either directly or in support of less experienced staff. It is less desirable to assign staff with minimal training to counter assistance for natural resources as this will likely not accomplish the objective of getting strong project applications
- Invest in GIS tools to make counter assistance meaningful for both applicant and staff since relevant resource and jurisdictional layers can be called up and discussed on the spot. Small jurisdictions can contract for workstation services from the county or other jurisdiction to use their user interface and data. See Appendix 2 for useful GIS data portals.
- Invest in an aerial photography history with the best resolution possible. Make use of inter-government data sharing partnerships, and obtain public data. Many satellite or aerial photos are available free or at low cost. The main cost is manpower to accurately register photos within the GIS environment, check for errors, and make corrections. These costs are not extreme and some photographs are available already registered, which is referred to as "georeferenced." As one planner mentioned:

"We always look at aerials. We can usually tell what year they built various structures."

Case Study

WALK-IN TECHNICAL SERVICE AT THE COUNTER: KING COUNTY

King County's Department of Permitting and Environmental Review offers free walk-in customer service at their Snoqualmie location. Services offered include records information, "over the counter permits" (a subcategory of easy streamlined permits for minor projects) and pre-submittal reviews. Limited services are available one day a week at King County's Vashon office.

How it works

King County has two customer service staff who handle the walk-in service and who work with three permit staff in the front area. These staff are supported by permitting review staff and technicians are assigned to be "on-call" from King County's different "product lines": critical areas, grading, drainage, zoning, site development, building plans examiners, fire engineers, code enforcement, and permit issuance. These specialists are called forward to answer the specific questions. The technical staff are assigned on a rotating schedule and the pool includes the majority of the staff. Staff plan to be in the office and do not do field work on their assigned on-call dates. Inspectors are not included in the program because they are mostly out in the field.

Program began in 2012

King County offered a less formalized counter assistance program for years, and in October 2012, initiated this new enhanced customer service approach, including the scheduled rotation of permit review staff and technicians.

How often and how much free advice is offered
The walk-in hours are mornings five days a week as well as Wednesday afternoons. As the program is provide on a first come, first serve basis, customers sign in and then wait for their turn, with wait times varying. While the system is set up to provide 15 minutes of free service, the reality is that the sessions are usually 20 to 30 minutes. King County had 350 customers come in for all services in April 2013.
King County requires that more complex and detailed

PHOTO: KING COUNTY

project applicants come in for a mandatory pre-application/feasibility meeting for which fees are charged at the department's current rate. In addition, projects on parcels that include critical areas such as wetlands, streams, steep slopes, critical drainage basins, landslide hazards, or erosion hazards require pre-application meeting. The pre-application meeting has a fixed cost (currently $375 for a basic permit) which is deducted from the cost of the permit and allows for as much help as the customer needs.

Staff likes the program

The permit review staff like the free walk-in program because it has resulted in the receipt of more complete applications. Staff also has had to do less back and forth with the applicants to get more information needed for the permits.

"People really appreciate being able to drop in and ask questions in a customer friendly atmosphere."

Source: King County. *Department of Permitting and Environmental Review.* Retrieved fromhttp://www.kingcounty.gov/property/permits/about/HoursLocations.aspx#pc
King County staff, personal communication.

- Provide information about other permitting processes, including state and federal permits. In addition, including information about ESA Section 7 consultation requirements, where appropriate for the permitting process, will help reduce the confusion and uncertainty at the permit counter.

PRE-APPLICATION SITE VISITS AND MEETINGS

Another effective mechanism for early advice is pre-application scheduled meetings such as site visits and pre-application meetings. These are good ways to both influence the initial design of the project by heading off projects that should not be undertaken and to reduce the time needed for later permit reviews. As one local planner mentioned, direct information is needed by property owners:

> *"We are limited by contractors and staff knowledge about soft armoring. It is almost harder to do the soft... There is a gap of knowledge of the science of what a bulkhead does. There is an impression by all property owners that the bulkhead will stay there forever. They don't know it hurts the neighbor."*

By informing applicants of requirements early in the process, this direct assistance makes the permit reviews run more smoothly and improves relationships between staff and applicants, since the initial contact is an assistance interaction. Usually the fee for these meetings and visits is deducted from the full permit fee later.

The casual nature of site visits best provides *informal* site-specific advice to prospective applicants, and opportunities to provide them with application materials and advice for filling them out. On the other hand, pre-application meetings held in the office are more conducive to providing *formal* site-specific advice and information on application needs. Such meetings are especially useful if undertaken as joint meetings with staff on hand who are managing the various relevant permit reviews – for example natural resources, zoning, building permits, and floodplain review.

Site visits and pre-application meetings offer interagency coordination opportunities to include staff from state, federal and tribal agencies, thus increasing communication and efficiency. Agency participation is especially useful for site visits, and often easier to obtain than office meetings. Site visits give agencies on-the-ground project information and opportunities to provide informal advice on the major issues that they must address under their authority. State agencies and Indian tribal governments have extensive knowledge of natural resources and natural resources management expertise. Agency participation in any coordination effort tends to have the effect of getting all participants to think out of their "box" about other issues leading to consideration of their permit requirements in terms of also addressing previously unconsidered issues.

Conducting site visits at the pre-application stage can identify important issues not evident in paper applications, which is important for projects impacting natural resources. The need for pre-application *meetings*, however, is more dependent on the complexity of the project – both structurally and permit-wise – as there may be some simple projects which do not warrant this level of attention. When using both site-visits and meetings, it is most helpful to perform the site visit before the meeting so that it can inform the more formal advice provided to the applicant. The two can be combined, but it can be difficult to hold a meeting and keep track of discussion in the field and then document it later in the office.

Specific recommendations to maximize the benefits of pre-application assistance include:

- Establish department policy or regulations making pre-application assistance mandatory or at least determined on a case-by-case basis.
- Hold pre-application site visits whenever possible, and perform them in advance of pre-application meetings.
- Use pre-application meetings when needed – especially for complex projects. Maximize efficiency by including relevant staff for all permits related to the project, including natural resources, zoning, building permits, floodplain, etc.
- When possible, include joint agency attendance for meetings and site visits. Agency participation (state, federal, tribal) is especially useful for site visits, and often easier to obtain than at meetings.
- Fund pre-application assistance by methods including:
  - Building the cost of the overall effort into the overall fee structure. This is easier when pre-application assistance is mandatory.
  - Establishing a separate charge for site visits, meetings, and project reviews. This makes most sense when pre-application assistance is not mandatory. It also helps fund the work done for projects that are not submitted for review.

ESTABLISHING A PROCESS TO REQUIRE ADEQUATE APPLICATION SUBMITTALS

As described above, the best chance of fully mitigating impacts of a project is when the applicant proposes that mitigation in the design with the initial application. A strong application reduces staff requests for additional information, surprises for the applicants (and thus their stress and frustration with the permit process), the need for permit conditions (because

the project is well designed), and the potential for appeals. In addition, money is saved because of speedier staff reviews and avoidance of project redesigns. Most importantly, strong applications lead to projects that comply with the applicable policies and regulations.

Quality matters. In addition to early assistance, applications can be improved by incentivizing good technical reports and creating a stronger application process through development of application requirements and forms as well as instructions, education and guidance included with those application materials.

Management of technical reports

In addition to the approaches described in the previous sections for staffing (maintain staff or consultants with expertise) and early assistance (head off problems), additional steps can be taken to provide support to staff to manage technical submittals. It is beneficial to establish department policy or regulations to identify qualified consultants for different natural resources. While some jurisdictions do not allow a published list of qualified consultants, departments can maintain lists of criteria for persons that are qualified for certain types of studies.

King County has created an incentive system for strong technical reports. Their program rewards biologists under a "preferred consultant program." If a consulting biologist has submitted three reports that are approvable, they are eligible for reduced fees as a preferred consultant. For example, in 2013, the county charged a flat fee ($1,184.40) for a critical areas review and site visit for a complex residential project if a preferred consultant is used. If not, the county charged an hourly rate ($184.80/hour). Importantly, the program applies to individual consultants, not their firms. The county maintains three lists of preferred consultants on their web page for preferred consultants: civil engineers, geotechnical professionals, and wetland specialists. The standard is strict and consultants will be removed from preferred status if they don't perform: "A consultant will be removed from the list if any of the criteria are not met during the course of any single project review" (King County, Preferred consultants web page)

It is also beneficial to provide staff with training on how to communicate with difficult consultants or third party providers. While some consultants may not be qualified to perform work in a particular subject area, even qualified consultants may submit inadequate reports due to budget or other constraints. All are advocating for their clients' interests, and may try to challenge staff.

Consultants sometimes are not current on methods or techniques. Staff can benefit by being knowledgeable so they can explain how current science has changed older practices. It is helpful if staff can give concrete examples, such as the new non-structural methods of protecting properties from erosion.

Consultants may resist review of their reports saying, according to some staff: "you have no expertise to say my report is inadequate." Staff need to have the expertise, good support regulations or department policies regarding report contents, and have full understanding of common impacts and mitigation to point out deficiencies. The jurisdiction may want to have backup resources (other staff, consultants, etc.) where expertise beyond that currently available is needed.

A local planner mentioned that consultants are good about using the proper verbiage that will get a permit through, because "…the liability is sitting on their head. They use the correct terms and criteria." Another planner described the on-the-ground reality he experiences – that needed mitigation can be severely downplayed by the applicants' third party advisors:

> *"Docks, is a good example. Applicant's lawyer will make the argument that it doesn't matter at all."*

Permit review can be better streamlined if applications address common impacts of the proposed development. Applicants proposing large and complex projects will submit reports that tease out the nuances of ecological impacts and proposed mitigation. Proponents of small projects, however, usually do not have that capability – especially for single family residences. Staff often has to rely on ad-hoc approaches to mitigation. Guidance to help determine impacts and mitigation is the subject of Chapter 8 and 9.

Management of application materials and guidelines

Managing the submittal of application materials is an important step in ensuring no-net-loss. Inadequate application submittals should not be accepted. To help improve applications, it is helpful for the application or guidance materials to include text which clearly describes compliance with the regulations. This ensures that the applicant reads the regulations relevant to their project – a step that is sometimes missed. Recommendations for these materials include:

- Create *application materials*, including those at a basic level for the general public, focused on the relevant policies and regulations.
- Develop an *application questionnaire* that elicits information about the project regarding important elements of the policies and regulation, including relevant code sections. This is in addition to the simple checklist for a complete application. See Appendix 3 for an example application questionnaire from Yakima County as well as a sample evaluation worksheet from San Juan County which can be useful templates.

- Develop high quality *educational material*, including those at a basic level for the general public. Mitigation guidance materials for the public in the form of a mitigation manual, templates, standard designs, or examples that describe common impacts and common mitigation are helpful. Documents that show alternative, more environmentally-friendly approaches help members of the public visualize alternatives, such as those by Kitsap County and City of Seattle (See Side Box on page 28).

It should be cautioned that the primary benefit of educational material is to help raise landowner awareness about issues and about alternative approaches. Follow-up technical assistance with willing landowners, however, is critical so that specific site conditions can be addressed and accurate technical information conveyed.

POINT OF SALE NOTIFICATION

- Another way to help educate the public and improve permit applications would be to add a requirement that new owners be notified at the point of sale that the property is within the shoreline management jurisdiction. Legislation would be required to authorize such notifications. The real estate industry generally opposes legislative efforts for point of sale notifications because of the added paperwork requirements but it would benefit local jurisdictions significantly by reducing the surprise element and reducing future conflicts.

RECOMMENDATION SUMMARY: STRONG PROJECT APPLICATIONS

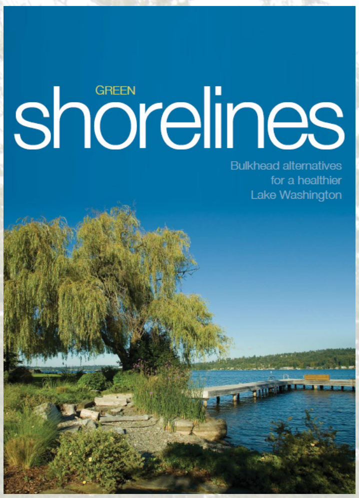
- Provide walk-in counter service for potential applicants, staffed with technical experts on-call, so that green alternatives can be promoted upfront and so that subsequently submitted applications are more complete, saving time and money for the staff and the applicants.
- Invest in GIS tools and other resources that provide visual information, such as critical areas, that can be quickly accessed both by applicants (at the desk) and by planning staff.
- Hold pre-application site visits, whenever possible, as well as pre-application meetings. Build the funding for pre-application site visits and meetings into the permit fee structure.
- Set strong expectations, including incentive program such as preferred consultants, for technical reports and materials associated with permit applications.
- Provide clear application materials including a questionnaire, in order to get high quality applications.
- Create strong webpage and educational materials for the public so that they can understand the ecological issues and why the regulations in the shoreline master program are needed, and can easily navigate the permitting system. Also provide materials that demonstrate greener alternatives with photos and graphic images.

Case Study

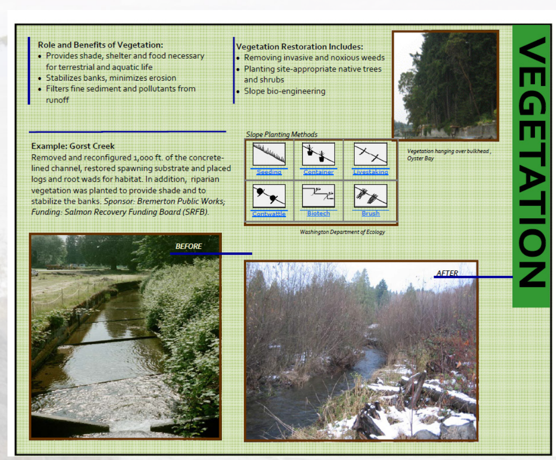
PUBLIC EDUCATION BROCHURES: SEATTLE AND KITSAP COUNTY

Kitsap County and City of Seattle (for Lake Washington and Lake Sammamish) have developed visually appealing brochures for the public highlighting environmentally friendly alternatives to bulkheads along with restoration before and after photos.

Seattle's Green Shorelines for Lake Washington and Lake Sammamish: Green Shorelines brochure



Kitsap County Shoreline Restoration



Sources: Lake Washington/Cedar/Sammamish Watershed. *Green Shorelines for Lake Washington and Lake Sammamish.* Retrieved from http://www.govlink.org/watersheds/8/action/greenshorelines
Kitsap County. *Kitsap Shoreline.* Retrieved from http://www.kitsapshoreline.org/Kitsap_Shoreline_Booklet_Final_62910.pdf

4. A PERMIT REVIEW PROCESS THAT ACHIEVES NO NET LOSS

Achieving no net loss requires an accurate assessment of impacts, avoiding unnecessary and un-mitigatable impacts, and then mitigating the unavoidable impacts through a systematic permit review process. The basic steps to be addressed include:

Application complete? Does the reviewer have all the information that is needed to evaluate the permit or exemption application? This includes reviewing the application and submittals to make sure they are complete and accurate. If additional information is needed it should be required.

Outside review needed? Do any of the submittals require peer review to determine their accuracy? If so, have them peer reviewed.

Mitigation sequencing incorporated? Has mitigation sequencing been applied to the proposal? See "Mitigation sequencing" on page xx.

Shoreline impacts identified? What shoreline ecological functions will be adversely impacted after mitigation sequencing and what is the magnitude of the impact? See "Table 3: Summary of Impacts of different types of development" on page 66 and Chapter 8 (Shoreline Development Impacts) starting on page 67.

No? (go to "Project approvable?")

Mitigation feasible? Is the replacement of the ecological values lost from the construction and operation of the proposal through mitigation feasible? See Chapter 6 (Using Mitigation to Achieve No Net Loss) starting on page 39.

No? → deny proposal

Advance mitigation needed? The lag between a project's impacts on shoreline ecological functions and the replacement of the functions through mitigation may result in significant adverse impacts that may be difficult or impossible to mitigate (Gibbons and Lindenmayer, 2007). If that lag will constitute an immediate risk to a priority species, the population of a priority species, or an ecological process, then require advance mitigation. See Advance Mitigation on page 51.

Project approvable? Does the proposal, with or without conditions, comply with the other applicable policies and regulations including the uses and activities allowed in the applicable shoreline environments? If yes proceed. If no, deny the proposal.

Permit conditions? Prepare permit conditions requiring the mitigation sequencing, the necessary mitigation, monitoring, and performance guarantees. Include any other conditions required for compliance with the applicable policies and regulations. The mitigation should last for the life of the proposal. For most developments, mitigation must be permanent as the habitat loss will be permanent.

Ready to approve the permit and transmit to Ecology? Approve the permit subject to the permit conditions. If the proposal includes a shoreline conditional use or variance, transmit to Ecology for a decision.

Monitoring and other follow-up? Monitor compliance and take any necessary remedial actions. As a note, there are two types of monitoring that are beneficial: compliance (did they do what they said they would do?) and effectiveness monitoring (did the mitigation work – and has it been maintained over time?). This second form of monitoring is rarely done (due to a variety of reasons) and provides a basis for requiring levels of mitigation that will compensate for uncertainties.

INTERNAL COORDINATION FOR PROJECT REVIEW

If a jurisdiction is to accomplish no-net-loss, thorough and coordinated project reviews must be achieved. In permit reviews, if there is insufficient internal coordination, natural resources may not be protected.

Coordinating and sequencing reviews and communications between departments is critical. For example, it doesn't work if building permits are issued without a zoning review, or if building permits are issued or floodplain reviews are performed without natural resources reviews.

Sometimes there is inadequate coordination involving the jurisdiction's own capital projects – roads, bridges, floodplain dikes, road maintenance programs, and other construction. These projects are planned for and undertaken without meeting the land use and natural resource laws that the all projects must follow. This can result in expensive redesign.

A thorough and coordinated review process reaps great benefits for improved customer service, positive public relations, efficient permit review processes, and protection of natural resources.

Recommendations for a coordinated review process to protect shoreline natural resources include establishment of the following features.

Jurisdiction policy for coordinated review

Developing a policy and providing cross-departmental training on a coordinated review policy, its benefits, and its requirements can help overcome staff and department objections to coordinating their actions with others.

Centralized permit review and tracking database

A centralized permit review platform for all jurisdiction construction permits, including building permits, grading permits, surface water reviews, and floodplain alteration reviews has been instituted successfully in many local jurisdictions. If resources are not available for a separate software platform, alternatives such as e-mail, paper copies, and routing systems can work well, especially if there are only a limited number of permit reviews per year. Pierce County has developed a system that is working well for internal review (See Side Box on page 33)

Round-table review system

A coordinated round-table process for the permit review for all construction permits, especially shoreline projects, will ensure that natural resource staff can raise issues and suggest solutions early in the review process, before the city or county decides any permits. Concurrent reviews can be tracked and completed reviews checked off within the tracking system. Some jurisdictions conduct in-person meetings about major projects.

Include the health district's septic permits into the permit review tracking system

For cities and counties with septic systems, incorporating the local health district permits is advisable because many septic systems get placed close to water features. District staff may need guidance and training so that they are knowledgeable about requirements for natural resource reviews and design alternatives that reduce impacts of septic systems.

Include all jurisdictional construction activities into the permit review system

Major public projects often have a much bigger scale of impact than private projects and thus it is beneficial for the review system to include most of the planning documents, SEPA reviews, and construction permits for these big projects. Examples include sewer system improvements, road and bridge improvements, road maintenance and repair activity (ditch cleaning, bridge repair, etc.), and building construction. Sewer, water, and roads departments sometimes work directly with the local decision makers on a fast track that gets ahead of planning regulations and natural resource review requirements. This can result in either undetected construction without natural resources review or compromise that unnecessarily degrades natural resources.

Secure state, federal and tribal input early

In order to be able to coordinate with outside agencies so that major problems can be addressed, asking for their "red flag" feedback early can be useful during local round-table meetings or an established communication process. Thus, it is helpful to contact state agencies and Indian tribal governments to learn the information they need, the time they need to respond, and the types and locations of projects in which they are interested.

Common state-wide internet application (and permit)

In our interviews with local planners, we learned that some practitioners support the concept of a common state-wide internet permit application which would include customized components for each jurisdiction. This could be similar to or an enhancement of an internet-based JARPA application. The current JARPA is not customized for local jurisdictional requirements. An automated system would have multiple benefits of coordination and tracking among agencies, including enforcement. Another idea that some support is a consolidated permit (i.e., one permit that covers all levels of government).[3]

ACCURATE SITE INFORMATION

For effective permit review, staff needs access to good information about the project site, ideally through site visits and use of a comprehensive geographic information system (GIS).

3 *This topic is covered in more detail in Futurewise's companion guide in this series: Practical Guide: Interagency Coordination in Implementing Shoreline Regulations*

Site visit

Direct observations of actual site conditions can differ significantly from the initial impressions conveyed in written applications, on site plans, or gleaned from GIS information. Consequently, many natural resource experts generally feel that permit reviews should not be performed without site visits, except for limited situations. According to one planner:

"There is nothing that beats a joint site visit. Those are worth their weight in gold."

Site visits are easy to accomplish for cities, since the travel distance is small. Counties may lack the resources to support site visits due to the time consumed for traveling larger distances. This problem can be overcome by including site visits in the fee structure and by doing multi-purpose trips.

Recommendations to make site visits more cost-effective include:

- Conduct both pre-application site visits and normal application site visits, if possible.
- Schedule site visits for a consistent day with time slots, fill the schedule in advance, and group scheduled site visits into geographic areas to reduce travel time.
- Have support materials prepared in advance to make the most of site visit time (GIS materials, natural resource information, proposal sketches, etc.).
- If possible, it is beneficial to include staff, either from the local jurisdiction or another agency, who has training and experience doing natural resource assessments related to development.
- Opportunistically include site visits for projects, such as when driving by a site for other reasons. This might include a second visit to confirm conditions, adding a new pre-application site visit, emergency situations, etc.

Data resources

A robust database and mapping system (i.e., GIS) is extremely useful for the administration of all permit review within a jurisdiction. For shoreline and critical areas program a GIS system with complete natural resources information is critical. Without this information, it is difficult for staff to thoroughly and efficiently understand the natural resource functions within the limited timeframe of a project review.

Almost all counties have GIS programs. Small cities and counties with few resources can contract with a county GIS program to obtain GIS workstations based on the county's user interface and data layers.

In addition, high quality GIS data are available at no or low cost on state, federal, or other websites and GIS portals. The main costs are data preparation and manipulation for local use. The available data layers include fish and wildlife habitat areas, water resources, topography, geology, all of which are important for administration of natural resource permits.

One of the most useful datasets for day-to-day administration of land use permits is a set of good aerial photos, including photos over time. Aerial photos are particularly important for understanding the history of development activity on or near a review site. Some jurisdictions are blessed with a broad chronological spread of air photos. For those that are not, there are a variety of sources from which aerial photos can be obtained.

- Washington State Coastal Atlas contains shoreline photos (https://fortress.wa.gov/ecy/coastalatlas/tools/ShorePhotos.aspx)
- Counties and public/academic libraries may have boxed up old aerial photos from the past, sometimes archived in storage facilities.
- Government agricultural agencies that administer subsidies have extensive photo histories for areas under agricultural production called the National Agriculture Imagery Program (NAIP) and other programs.
- The Washington State Department of Transportation has an extensive collection of aerial photographs dating to the 1930s. County transportation departments also have photo histories of transportation corridors, which often follow rivers and waterways.
- Federal irrigation reservoir and canal projects have photo histories of the service areas, and especially areas modified by dams and diversions.
- Major federal flood control reservoir and levee projects have photo histories related to floodplains and areas modified by levees or dams.
- The US Bureau of Land Management has aerial photos dating back to the 1940s.
- Where state and local facilities (reservoirs, levees, etc.) exist, the state agency or local district or local government may have aerial photos.

ADDRESSING EXEMPTIONS IN A CONSISTENT MANNER

The issue of how exemptions are addressed was raised by practitioners in our interviews and has been re-emphasized in a recent assessment of shoreline regulation implementation by the Salmon Recovery Council. There is variation from jurisdiction to jurisdiction.

Specifically, through interviews with planners and agency staff, the Salmon Recovery Council consultants found that there are local regulatory/permitting program differences in the interpretation and handling of SMA exemptions in these ways:

- "Exemptions don't always filter through to the local level; some jurisdictions have more stringent interpretations than SMP guidelines.
- Some jurisdictions use a process that requires the applicant to apply for an exemption by submitting project-specific information to the regulatory entity (e.g., city, county) for review. Regulatory entity responds with a concurrence/non-concurrence letter for the proposed exemption. This approach is similar to a permitting program.
- Other jurisdictions allow the applicant to make the determination on whether a project qualifies for an exemption. Such jurisdictions typically do not want the potential liability associated with making such a determination and leave it up to the applicant, as they are the ones ultimately responsible for providing the burden of proof for the exemption."
- Sometimes an action that seems eligible for an exemption under SMA cannot meet local development standards (e.g., Growth Management Act [GMA] Critical Areas Ordinance) and thus cannot be considered exempt."

In addition, the authors found that variances, conditional use permits and substantial development permits are "often different from one jurisdiction to the next because the SMA does not provide clear and consistent rules on how to deal with situation when both types of authorizations are triggered." Sometimes two permits are issued while some jurisdictions only issue one (PSP, 2014).

RECOMMENDATION SUMMARY: PERMIT REVIEW PROCESS

- Create or maintain an effective permit review process which provides for peer review of scientific reports, identifies impacts, uses mitigation sequencing to avoid and minimize impacts, determines whether impacts can be mitigated, and requires effective mitigation. Creating such an effective system requires an internal coordination process that includes:
  - Permit review and tracking system via database or other means; and
  - Cross-departmental review to consider shoreline impacts of activities approved by other departments, including, for example, review of Department of Health septic system applications.
- Coordinate permit reviews with jurisdiction and state federal agencies, and Indian tribes and nations.
- Conduct site visits to ensure that details that aren't easily conveyed "on paper" are made evident
- Acquire the tools needed to enhance internal knowledge and history about project sites such as aerial photography.

Case Study

PIERCE COUNTY PERMIT TRACKING SYSTEM

Pierce County Planning and Land Services (PALS) upgraded to a new database tracking system in October 2012. It includes functions for the public as well as functions for internal coordination among staff.

External functions for the public

Not only can the public apply and track their permits online, they can also see how many people are in line for service before them. The county estimates that the new dashboard-type system will save an estimated 3,000 miles per month in trips to the Development Center in Tacoma. In their press release about the new system, PALS Director Dennis Hanberg said, "Thanks to the online dashboard, we have seen a 25 percent decrease in walk-in traffic at the Development Center, even as business has increased."

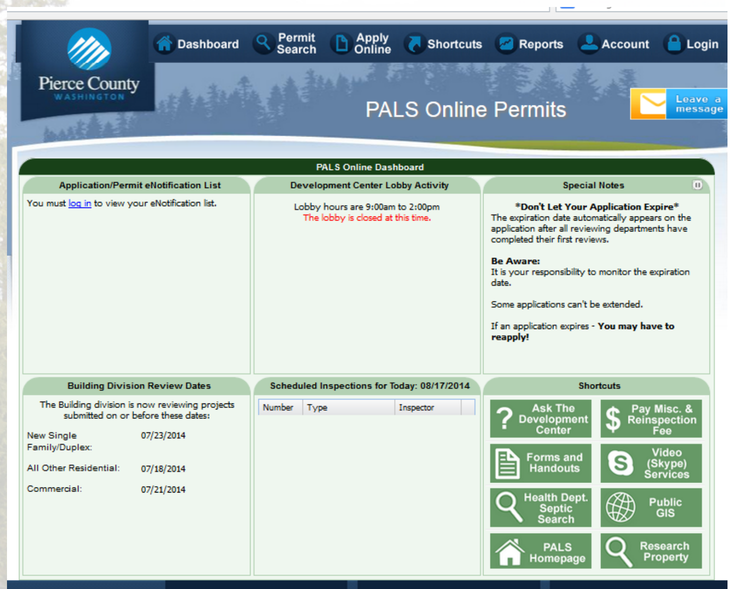
Features

- **About My Property:** Provides detailed information about specific properties, including zoning regulations, environmental conditions, and school and fire districts.
- **Public GIS** mapping technology gives visuals of parcels with terrain, photo and information overlay options.
- **Permit Search** allows users to easily search records of any current and past permits on properties, including any comments or public access documents and maps attached to permit applications.
- **Inspection schedule** shows which properties are scheduled to be inspected that day.
- **E-Notification** keeps customers informed via email on the status of permit applications.
- **E-submittal/epayment** allows users to quickly and easily apply and pay for permit applications online.

Internal functions for staff

Permit managers also have worked to streamline the approval process, reducing the number of "in-boxes" that a permit must pass through and clarifying internal roles and responsibilities. All permit data goes into the system, so staff can make comments directly into the system. An email notification in the system sends an email whenever anyone is working on a project site. According to staff, everyone is aware of what they are accountable for and what they have to do to the document in the system. A planner said:

"People are doing concurrent review. No longer putting it off to wait for other staff to do their review. The PALS plus system has been great. We are acting as a smoothly operating team."



Sources: Pierce County. (2012, November 20). *News Flash: Executive: Online upgrades make building permits faster and easier.* Retrieved from http://www.co.pierce.wa.us/CivicAlerts.aspx?AID=436.
Pierce County staff, personal communication.

5. PERMIT CONDITIONS THAT WORK

After project impacts are accurately identified and are fully mitigated in their design and permit conditions, ecological functions can be lost through inadequate implementation by the developer, and then by limited compliance follow-through by the jurisdiction. Developers can lose focus on permit compliance in the press of construction demands. The jurisdiction often has limited resources to follow-up on permit conditions. These problems can be reduced by strategic use of permit conditions. From discussions with permit review staff, certain permit conditions can be used to keep the focus on compliance for both the applicant and the jurisdiction including financial guarantees, timing and staging conditions, and mitigation plans incorporating clear success standards.

FINANCIAL GUARANTEES

Using financial guarantees can greatly improve compliance with permit conditions. Funds are held in reserve to ensure completion of work, creating a direct incentive for the applicant to complete the work to regain the financial resources. Different financial instruments can be used such as bonds, escrows, CDs, and cash. Examples of work that can be financially guaranteed include vegetation plantings, maintaining the plantings until they are established and functioning, restoration of altered topography (such as removing fill), and construction of public access.

The use of financial guarantees involves staff resources and thus is not a universally used tool by local jurisdictions in the Puget Sound region. The advantage of guarantees, though, is the assurance that the mitigation work will be completed and that project proponents (or their representatives) will submit monitoring reports because they want to get their money back. See Appendix 4 for an example of a financial guarantee.

Recommendations for creating and improving the administration of a financial guarantee system include:

- Authorize financial guarantees in regulations and administer the guarantees through regulations and department policy so the authority and standards for the guarantees are clear.
- Develop boilerplate agreements that can be customized as needed for each project.
- Require estimates based on hiring a contractor to do the work and reality check the amount.
- Include an "extra cushion" using a percentage of the total, to account for increases in cost over time.
- Require the property owner to grant permission to the jurisdiction and Ecology to access the site and allow the jurisdiction, Ecology, or their contractors to do the work in the event the applicant does not. The permission clause should also provide that it is binding on subsequent purchasers, assigns, and successors in interest.
- Use caution for bonds, which have a defined life after which the bond expires and may have limitations on where and how they can be negotiated. An assignment of a savings account in a local bank provides stronger security.
- Address the status of interest accrued by held funds or assigned accounts.[4]

TIMING AND STAGING CONDITIONS

Conditions of approval can be used to establish compliance checks for phased projects such as large subdivisions, resorts, shopping centers, and mining operations. Doing so places an incentive on the developer to comply with the conditions applicable to the earlier stage and demonstrate compliance with conditions necessary for the next stage of the project.

Staging conditions are useful for tying different portions of compensatory mitigation to particular stages of construction, so that it is not deferred to the end of the project, especially for larger projects or multi-year projects. In addition, conditions can require advance mitigation and tie the compensatory mitigation to stages.

Conditions can be written to rely on defined stages in the application, or stages defined by the jurisdiction in the approval, or to use as gate-keeping for obtaining some other approval. Gate-keeping using an occupancy permit or approval is a common strategy for building departments, and often for planning departments; it requires an effective occupancy permit system to be in place. Boilerplate conditions increase consistency; they can be incorporated and edited as needed into project approvals. They save time and reduce errors as they are written in advance.

For staging conditions, it is desirable to use a consistent approach, but probably not boilerplate conditions. Except for an occupancy signoff condition, they need to be highly customized to specific projects.

4 *Additional detail about the use of financial guarantees are included in Futurewise's companion guide: Practical Guide: Cost-Effective Compliance with Shoreline Regulations*

WRITING AND REVIEWING THE MITIGATION PLAN WITH SUCCESSFUL STANDARDS

Mitigation plans should be complete. State agencies recommend that mitigation plans for projects with significant impacts should include, at a minimum, the following:

- Baseline impact site conditions.
- Quantitative and spatial estimate of impacts of proposed development.
- Proposed avoidance, minimization, and rectification measures.
- Statement of need for compensation/justification of why impacts are unavoidable.
- Goals and objectives of compensation.
- Detailed implementation plan.
- Adequate replacement ratio to compensate for temporal losses as negotiated with permitting agencies.
- Performance standards to measure whether goals are being reached.
- Maps and drawings of proposal.
- Operation and maintenance plans (including who will perform).
- Monitoring and evaluation plans (including schedules).
- Contingency plans, including corrective actions that will be taken if mitigation developments do not meet goals and objectives.
- Agreements on performance bonds or other guarantees that the proponent will fulfill mitigation, operation and maintenance, monitoring, and contingency plan (Ecology, 2000).

Many SMP updates include similar lists of required elements of mitigation plans.

Washington State Department of Transportation (WSDOT) Guidelines

In 1999, the Washington State Department of Transportation worked with other agencies and the broader scientific community to develop helpful, practical guidelines for wetlands mitigation success standards, which can be generalized to shorelines locations as well:

- "Language is very important in writing success standards - you must be extremely precise and unambiguous in order to define appropriate monitoring and contingency plans."
- "Don't use action verbs in standards - standards should be measures, not actions. (i.e., Instead of 'Build ten acres of wetland,' use 'The wetland area will be at least 10 acres.')"
- "Avoid using fixed numbers except in cases where you have a need to achieve exactly that amount: instead specify a minimum, maximum, or range."
- "Plan your project and write your standards with the intent of exceeding the minimum thresholds by a wide margin. This will help avoid costly remediation for cases where the result is just slightly below the standard."
  [As a note: For SMP requirements there must be a scientific basis for requiring more mitigation than the amount that will be impacted from the development. Wetlands are different in that a wetland is "created" and the requirements are based on years of studies.]
- "The wetland design and monitoring teams must review and approve all standards and measures to ensure that they are both: 1) achievable, and 2) capable of being monitored with available resources."

WSDOT Success Standards

WSDOT and partners also identified the following mitigation success standards to be incorporated into permit language (we modified this to be more generally applicable). Examples include:

- **Size of replanted or replacement area:** Example: The xx will be a minimum of ___ acres after ___ years.
- **Herbaceous cover:** Example: By year ___, the ___ (wetland/ buffer/emergent zone/etc.) will have a minimum of ___ % vegetative cover in the herbaceous layer excluding areas designated as non-vegetated (e.g. open water).

  Suggested benchmark values (use lower cover standards for slow-growing species; decreasing cover over time in scrub-shrub or forested areas):

Year	% cover
3	80
5	90

- **Survival of planted individuals:** Example: There will be a minimum of ___ % survival of planted individuals after year ___ (use only for the first 2 or 3 years after planting).

  Note: when designating standards for herbaceous cover in areas planted with dense woody vegetation. Ground cover will be mostly shaded out after a few years.

  If you want to ensure presence of all planted species, include the following: For each species planted, a minimum of ___% of the individuals will survive.
  Note: Monitoring for individual survival requires stem counts and is not feasible for ground-covering or multi-stemmed species including many herbaceous species. Survival monitoring is most often used to determine contractor's fulfillment of planting obligation during the plant establishment period in the first year or two after planting.

- **Control of invasive species:** Example: ___ (species or category, e.g. non- native grasses) will comprise no more than X% of the relative cover (adjusted to 100%) of the ___ (wetland/buffer/etc.) at year ___.

  Note: If this standard is used, it is important to name particular species of concern. Also, remember to consider the initial ground cover treatment and follow-up management approach to be used. It may be useful to use non-native groundcovers during early site development if *aggressive invasive species such as reed canary grass are a threat. Set a standard that can be achieved.*

For project-specific special circumstances (to be used only as needed to verify establishment of a site characteristic that must be present in order for the site to provide a particular function), examples include:

- **Size of any specified area:** wildlife habitat, amount of various functions. *Example*: The ___ (buffer/open water/ forested wetland/etc.) area will be at least ___ acres after ___ years.
- **Relative presence of wetland/habitat classes: wildlife habitat.** *Example*: ___ will comprise no less than ___ % of the total habitat/wetland area after ___ years.

  Vegetation may not meet exact cover and height criteria until more mature, but appropriate species should be present. Caution - set percentages significantly lower than what is planned to allow for some flexibility, but they need to be high enough to replace the lost functions.
- **Plant species diversity: biodiversity.** *Example*: After ___ years, the ___ (wetland/buffer/etc.) will have at least ___ native plant species with a minimum of ___ (1/5/10/etc.) % cover each.
- **Aquatic invertebrate diversity: fish or wildlife habitat, food chain support.** *Example*: The minimum diversity index for ___ (benthic, water column) invertebrates will be ___.
- **Surface water depth and duration: nutrient & pollutant retention, fish or wildlife habitat.** *Example*: The deepest portion of the ___ (wetland/emergent/pond/etc.) area will be ponded with depths ranging from ___ inches to ___ inches during the period ___ (e.g. April through June) in years of average rainfall. (Depth may be greater or less than the given range during abnormally wet or dry periods.)
- **Water temperature: fish habitat.** *Example*: Measured mid-day summer water temperature will not exceed ___ degrees F.

  Note: If water temperature is expected to be controlled by shading, don't apply standard until vegetation has had sufficient time to develop.
- **Water chemistry: may be important in areas receiving stormwater runoff.** *Example*: ___ samples meets water quality standards for nutrients, Biological oxygen demand, phosphorous, etc. (WSDOT, 1999).

RECOMMENDATION SUMMARY: PERMIT CONDITIONS

- Use well-constructed financial guarantees to ensure that the mitigation and required monitoring will be completed.
- Use standard conditions language for common conditions. Writing one-off conditions every time takes time and makes errors more likely. Effect of permit conditions should equal no net loss.
- For large or complex projects, use staging and timing conditions to incentivize project proponents to conduct effective mitigation.
- Make sure mitigation plans are complete and written with an eye towards being able to easily measure success in follow-up monitoring (such as specifying exactly the number of acres or the percentage survival of plantings).

6. USING MITIGATION TO ACHIEVE NO NET LOSS

Achieving no net loss requires avoiding adverse impacts, prohibiting impacts that cannot be mitigated, and mitigating un-avoided impacts.

BACKGROUND: BASIS OF NO-NET-LOSS AND MITIGATION SEQUENCING REQUIREMENTS

The Shoreline Management Act's (SMA) voter approved policy statement in RCW 90.58.020 lists a primary policy objective of the act [with emphasis added]:

> "This policy contemplates protecting against adverse effects to the public health, ***the land and its vegetation and wildlife, and the waters of the state and their aquatic life,*** while protecting generally public rights of navigation and corollary rights incidental thereto."

Thus, while new development is allowed, it must protect natural functions and ecological features, and the public's interest in health and navigation. Even water-dependent uses are subject to this policy. This policy is echoed by the policy paragraph that provides particular protection for Shorelines of Statewide Significance.

In addition, the SMA policy provides that

> "[p]ermitted uses in the shorelines of the state shall be designed and conducted in a manner to ***minimize,*** insofar as practical, any resultant damage to the ecology and environment of the shoreline area and any interference with the public's use of the water."

These two principles are implemented in the SMP Guidelines[5] through requirements for **no-net-loss** of ecological function and mitigation sequencing. Regarding no-net-loss of ecological functions, all updated SMPs will incorporate this requirement, and implement it through subsequent shoreline permits and reviews[6] using the following SMP Update practices as described in Ecology's "No Net Loss" Chapter in the SMP Handbook:

- "Locate, design and mitigate development within a watershed context. *During the SMP update process, use the characterization of ecosystem processes and functions to identify the best areas for future development and mitigation.*
- Prohibit uses that are not water-dependent or preferred shoreline uses. *For example, office and multi-family housing buildings are not water-dependent or preferred uses.*
- Require that all future shoreline development, including water-dependent and preferred uses, is carried out in a manner that limits further degradation of the shoreline environment. *No uses or activities, including preferred uses, are exempt from the requirement to protect shoreline ecological functions.*
- Require buffers and setbacks. *Vegetated buffers and building setbacks from those buffers reduce the impacts of development on the shoreline environment.*
- Establish appropriate shoreline environment designations. [For example,] *A shoreline landscape that is relatively unaltered should be designated Natural and protected from any use that would degrade the natural character of the shoreline.*
- Establish strong policies and regulations. *Policies and regulations will define what type of development can occur in each shoreline environment designation, determine the level of review required through the type of shoreline permit, and set up mitigation measures and restoration requirements.*
- Develop policies and requirements for restoration. *These should be consistent with the shoreline restoration plan.*
- Recommend actions outside shoreline jurisdiction. *The master program or an SMP supporting document can recommend actions for properties that are outside shoreline jurisdiction but have impacts on shorelands.*
- In all cases, require mitigation sequencing. *The SMP must include regulations that require developers to follow mitigation sequencing: avoid impacts, minimize impacts, rectify impacts, reduce impacts over time, compensate for impacts." (Ecology, 2010).*

WHAT DOES "NO NET LOSS" MEAN?

In 1988, President George H. W. Bush's administration adopted "no net loss" as a national goal related to wetlands (USDA NRCS, 2013). The concept represented a compromise between conservation and development interests. Conservationists would have preferred to see stronger measures to reduce damage to the environment to make the environment healthier. Washington also adopted the concept in 1989 with an executive order by Governor Booth Gardner (WA State Executive Order 89-10).

While much work has been done to address criteria for mitigation related to no net loss of wetlands, rather than shoreline habitats explicitly, it should be noted that approximately 30% of Washington's freshwater wetlands and all of the tidal wetlands are under SMA jurisdiction (Ecology, 1998).

The SMP Guidelines, in WAC 173-26-186(8)(b), establishes the no net loss requirement [with emphasis added]:

5 Despite being called "Guidelines," the SMA, in RCW 90.58.080(1), requires that shoreline master programs shall be consistent with the SMP Guidelines.

6 WAC 173-26-186(8)(b) under Governing Principles of the Guidelines relating to ecological functions; and implemented in WAC 173-26-201(2)(c) under Basic Concepts.

> "Local master programs shall include policies and regulations designed to achieve no net loss of those ecological functions.
> (i) Local master programs shall include regulations and mitigation standards ensuring that ***each permitted development will not cause a net loss of ecological functions*** of the shoreline; local government shall design and implement such regulations and mitigation standards in a manner consistent with all relevant constitutional and other legal limitations on the regulation of private property.
>
> (ii) Local master programs shall include regulations ensuring that ***exempt development*** in the aggregate will not cause a net loss of ecological functions of the shoreline."
> *Note: Exempt development includes normal maintenance and repair of existing structures, single family residences, bulkheads to protect single family residences, emergency construction, etc.*

The SMP Guidelines also provide (WAC 173-26-201(2)(e)(i))) that "[t]o assure no net loss of shoreline ecological functions, master programs shall include provisions that require proposed individual uses and developments to analyze environmental impacts of the proposal and include measures to mitigate environmental impacts not otherwise avoided or mitigated by compliance with the master program and other applicable regulations."

Ecology's Shoreline *Master Programs Handbook* (Chapter 4) contains a clarifying description of no net loss in relation to reviewing development permits [with emphasis added]:

> Over time, the existing condition of shoreline ecological functions should remain the same as the SMP is implemented. Simply stated, the no net loss standard is designed to halt the introduction of new impacts to shoreline ecological functions resulting from new development. … Local governments must achieve this standard through both the SMP planning process and **by appropriately regulating individual developments** as they are proposed in the future. ... Based on past practice, **current science tells us that most, if not all, shoreline development produces some impact** to ecological functions. However, the recognition that future development will occur is basic to the no net loss standard. The challenge is in maintaining shoreline ecological functions while allowing appropriate new development … The existing condition of shoreline ecological functions should not deteriorate due to permitted development. New adverse impacts … should be avoided. When this is not possible, impacts should be minimized through **mitigation sequencing** (Ecology, 2010).

MITIGATION SEQUENCING

Like the concept of no net loss, mitigation sequencing originated in federal wetlands policy. The mitigation terms were incorporated into Section 404 of the Clean Water Act in 1977 amendments, were clarified as a defined sequence by the Council on Environmental Quality in the National Environmental Policy Act (NEPA) regulations (Section 1508.20) in 1978 and included by EPA in the 1980 Section 404(b)(1) Guidelines. A 1990 Memorandum of Agreement between EPA and United States Army Corps of Engineers (Corps) formally and clearly establishes that the mitigation sequence (distilled down to avoid, minimize and compensate) would help guide mitigation decisions and determine the type and level of mitigation required under Clean Water Act Section 404 regulations (Hough and Robertson, 2009). The mitigation sequence was also included in the Washington State Environmental Policy Act regulations in WAC 197-11-768 in 1984.

Mitigation sequencing recognizes that certain habitat types are difficult or impossible to replace. As the 2008 Making *Mitigation Work: The Report of the Mitigation that Works Forum* stated:

> Impact avoidance is especially important when it comes to protecting aquatic resources that are exceptional, rare, unique, or have proven difficult or impossible to replace. Bogs, fens, vernal pools, native grasslands, and mature forested wetlands are examples of habitats that are becoming increasingly rare and are almost impossible to replicate. We cannot afford to lose any more of these systems, even small ones, and need to redouble our efforts to protect them. We also need to clearly communicate that some high value resources will be off-limits to development. We need to strengthen our approach to impact avoidance and minimization in these situations (Ecology, 2008).

Riparian vegetation has also proven difficult to mitigate (Quigley and Harper, 2006). The best approach to protect these habitats is to avoid impacting them. That is why the SMP Guidelines (in WAC 173-26-201(2)(e)(i)) provide that where mitigation is required for developments the mitigation shall be applied in the following sequence of steps that are listed in the order of priority. These are listed below with notes added, and they are arranged in an order of preference for less impact:

- **Avoiding** the impact altogether by not taking a certain action or parts of an action;
- **Minimizing** impacts by limiting the degree or magnitude of the action and its implementation by using appropriate technology or by taking affirmative steps to avoid or reduce impacts;

- **Rectifying** the impact by repairing, rehabilitating, or restoring the affected environment; *[A form of compensatory mitigation.]*
- **Reducing** or eliminating the impact over time by preservation and maintenance operations; *[A form of minimization done over time.]*
- **Compensating** for the impact by replacing, enhancing, or providing substitute resources or environments; and
- **Monitoring** the impact and the compensation projects and taking appropriate corrective measures. *[A part of compensatory mitigation.]*

To simplify the sequence for practical application: one should first try to avoid the impacts; then for impacts that cannot be avoided, one should adjust the project to minimize impacts; then one should compensate for all the impacts that remain after avoidance and minimization – typically through some form of enhancement.

Stated another way, allowing development to impact the shoreline is the last option, not the first option. WAC 173-26-221(5)(b) makes that clear, providing [with emphasis added]:

> Where uses or development that impact ecological functions are necessary to achieve other objectives of RCW 90.58.020, master program provisions shall, to the greatest extent feasible, protect existing ecological functions and avoid new impacts to habitat and ecological functions **before implementing other measures** designed to achieve no net loss of ecological functions.

There are two important points from the above citations: (1) almost all development has impacts and (2) almost all development needs to provide compensatory mitigation after avoidance and minimization steps are used.

FEDERAL AND STATE GUIDANCE ON MITIGATION

Federal and state agencies have developed guidance for determining mitigation for projects requiring permits and certifications such as the Hydraulic Project Approval (HPA) from WDFW, Section 401 Water Quality Certification and Coastal Zone Management Certification from Ecology, and Discharge of Dredge or Fill Material, Section 404 Permit, Work for Structures in Navigable Waters, and Section 10 Permit from the Corps. These often apply in shoreline jurisdictions.

Washington Department of Fish and Wildlife (WDFW)

In 1999, WDFW, in conjunction with Ecology, developed a Mitigation Policy, POL-M5002 Requiring or Recommending Mitigation, which serves as a guide for their permitting actions as well as for technical and other reviews provided by the department staff. The goal of the policy is to ensure no net loss of functions and values of fish and wildlife habitat in the state. The policies require compensatory mitigation, after avoidance and minimization, using replacement ratios greater than 1:1:

> Mitigation credits and debits shall be based on a scientifically valid measure of habitat function, value, and area. Ratios shall be greater than 1:1 to compensate for temporal losses, uncertainty of performance, and differences in functions and values (WDFW, 1999).

Furthermore, the policy requires that mitigation must last permanently or at a minimum for the life of the project:

> Mitigation site shall be protected for the life of the project. The mitigation site shall be protected permanently, or at a minimum, for the life of the project. This protection shall be through conservation easement, deed restriction, donation to WDFW, or other legally binding method (WDFW, 1999).

In 2000, WDFW and Ecology created a document that brought together a general agreement for mitigation - *Alternative Mitigation Policy Guidance Interagency Implementation Agreement*. That document includes the seven questions Ecology uses to plan compensation of unavoidable impacts:

- What are the species, habitat types, or functions being adversely affected?
- Is replacement or reintroduction of the species, habitat type, or functions vital to the health of the watershed, and if so, do they need to be replaced on site to maintain the necessary functions?
- If it is determined that on-site, in-kind replacement is not necessary, are there higher priority species, habitat types, or functions that are critical or limiting within the watershed?
- If both on- and off-site compensatory mitigation are available, will the species, habitat type, or functions proposed as off-site compensatory mitigation provide greater value to the health of the watershed than those proposed as on-site?
- How will the proposed compensatory mitigation maintain, protect, or enhance impaired functions, or the critical or limiting functions of a watershed?
- Will the proposed compensatory mitigation have a high likelihood of success?
- Will the proposed compensatory mitigation be sustainable in consideration of expected future land uses? (Ecology, 2000)

Federal Programs (Corps, EPA)

The Corps and EPA work together to regulate activities which impact waters of the nation and to determine mitigation for those projects through Clean Water Act section 404 permits and other permits issued by the Corps. In 2008, they finalized

rules (73 FR 19594; April 10, 2008) defining "compensatory mitigation" as "the restoration (re-establishment or rehabilitation), establishment(creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse effects which remain after all appropriate and practicable avoidance and minimization has been achieved." Again, compensatory mitigation is considered the strategy to use after first avoiding and minimizing harm.

The rule replaced previous Corps and EPA mitigation guidance and incorporated improvements in the planning, implementation, and management of mitigation projects by:

- "Emphasizing a watershed approach in selecting mitigation project locations;
- Specifying the components of a complete mitigation banking plan, including assurance of long-term protection of compensation sites, financial assurances, and identification of the parties responsible for specific project tasks; and
- Requiring measurable, enforceable ecological standards and regular monitoring for all types of compensation."

Importantly, the rule deprioritized permittee-responsible compensatory mitigation (i.e., the permittee conducts the mitigation either on or off-site) relative to in-lieu mitigation, and mitigation banks. Thus the federal hierarchy of preferred forms of mitigation is (although it should be noted that this hierarchy has not been universally embraced by others):

- Mitigation banks
- In-lieu fee programs
- Permittee-responsible mitigation that is undertaken using a watershed approach, if appropriate and practicable
- On-site and in-kind
- Off-site and/or out-of-kind (NOAA-NMFS, 2011b)

Prior to that major nation-wide revision, in 2006, Ecology in partnership with the Corps (Seattle District), and EPA Region 10 had published two companion guidance documents related to wetland mitigation in Washington: *Wetland Mitigation in Washington State: Part 1 - Agency Policies and Guidance and Part 2 - Developing Mitigation Plans*. These documents include a great deal of specificity about the "how to" for mitigating wetlands using a landscape approach focus including the statement: "Compensatory mitigation projects that contribute to the functioning of a larger landscape are preferable to simply replacing acreage at the site of the impact" (Ecology/Corps/EPA, 2006).

In 2009, Ecology, the Corps (Seattle District), and EPA Region 10 published a guidance document for selecting wetland compensatory mitigation sites within a watershed, reflecting a shift in national and state policies towards using a watershed-based approach over on-site or nearby mitigation sites, when appropriate. Specifically, their guide "promotes mitigation that is located appropriately on the landscape, addresses restoration of watershed processes, is sustainable, and has a high likelihood of ecological success." The guide emphasizes identifying and addressing the changes to the ecological processes that have created and maintained a site in an altered state, rather than the traditional mitigation approach that focused on re-establishment of the natural vegetation and structure at a site. Thus a critical point is that "sites where constraints cannot be removed are not suitable for mitigation" (Ecology, 2009).

SOME CONSIDERATIONS IN INITIAL PROJECT ASSESSMENTS

Identifying Impacts

Accomplishing no net loss critically depends on accurately identifying development impacts. An unidentified impact is an unmitigated impact that then reduces the ability to accomplish no net loss for the area. Chapter 8 details key development impacts and Chapter 9 provides mitigation options for those impacts.

When identifying impacts, it is important to consider all of the following:

- **Conversion.** Ecological functions are lost when intact aquatic or upland areas (including vegetation inside or outside a regulatory buffer) are converted to developed areas.
- **Human presence.** Fish and wildlife will be disturbed by the presence of humans in areas that previously had little or no human presence.
- **Value of degraded areas.** The impact of converting areas with degraded riparian vegetation to development can be significant (e.g., creation of impervious surfaces). Even degraded buffers should be protected.

Modifications must also actively use mitigation sequencing

Modifications follow different rules than uses in the SMP Guidelines Modifications, and are usually constructed "in support of" a primary use: "structural shoreline modifications [are] only [allowed] where they are demonstrated to be necessary to support or protect an allowed primary structure or a legally existing shoreline use that is in danger of loss or substantial damage."[7] Because modifications themselves are not uses, they must meet the use limits of the primary use. This is especially important with regard to a "water-dependency" classification.

Since uses that are not water-dependent are not allowed to be in the water or to cause damage to the environment, they

7 *See WAC 173-26-231(1) and WAC 173-26-23(2)(e) for more information.*

are classified by water-dependency. *Modifications*, however, are allowed based on the "necessity," but are not classified as water-dependent. The result is that modifications which happen to be in the water are not water-dependent uses but rather just in-water modifications. Such development must first be necessary or have some good reason to be in the water, such as being for a water-dependent use, a hardship (such as an imminent hazard), or a water crossing.
In addition, WAC 173-26-231(2) requires that projects with modifications must also reduce their intensity and impacts to the environment using a number of strategies:

- Use mitigation sequencing, including compensating for remaining impacts after using avoidance and minimization measures.
- Limit the extent and number of modifications, such as reducing disturbance area and size of structures.
- Only allow modifications consistent with the environment conditions of the site. When intact areas or intact buffers are present, only modifications that minimally alter the environment should be allowed.
- Apply a preference for modifications and methods that have a lesser impact in all shoreline areas. This especially applies to choices of options and construction methods.

Establishing new uses often have greater impacts than expansion of existing uses

When identifying impacts of development and determining mitigation, an important consideration is whether the project is establishing new impacts or expanding existing impacts. The initial development of sites with existing intact vegetation causes the most impacts, since whole suites of impacts are established that were not there before. Although most sites have had some level of human use, it is the extent of vegetation and land alteration, the extent of structural development, and the level of human activity that determine new impacts. For example, clearing natural vegetation for new agriculture or structural uses or constructing new commercial and residential uses on vacant waterfront lots establish new impacts. These new impacts are typically of a much larger scale than those from expansion of existing development or uses, and require more compensatory mitigation.

Expansion of existing uses, on the other hand, are typically of a much smaller scale than developing an undeveloped lot or changing a use, and consequently require relatively less compensatory mitigation.

STRATEGIES FOR AVOIDING AND MINIMIZING IMPACTS

It is important to first **avoid** and **minimize** impacts from a proposed project. It can be difficult to implement avoidance steps even though *avoidance* options are typically much more available than are actually implemented. Further, it can be challenging for planners to enforce the application of avoidance after a permit is received because it often requires a total redesign of the project. It is typically easier to enforce the use of minimization, which can be done through minor redesign or with permit conditions, especially for single family residence properties. As a local practitioner described, it is often the individual applicant who is pushing for their ideal outcome, rather than more seasoned paid consultants or proponents of larger projects: "Professional folks try to stay out of the areas [i.e., avoid and minimize]. Don't like to have to do mitigation and paying. The single family property owners have more of a sense of indignation.
They take a shot at it."

As described in Chapter 4, getting well-designed projects that use avoidance strategies requires good permit review processes and early interactions with applicants. It is also important to avoid impacts to ecological functions that cannot be mitigated (Ecology, 2008). Programs like Jefferson County's new Square One project, which provides early permit assistance to landowners, also help provide education about how to avoid and minimize impacts in project designs.

Three critical factors to keep in mind when implementing these first steps of mitigation sequencing include honoring the buffer, determining water dependency, and assessing the degree to which the site includes intact vegetation.

Honor the buffer

Buffers are the key protection for shoreline ecological functions. The establishment of buffers and setbacks in critical areas regulations and SMP updates has been controversial with the public. During permitting, applicants often try to build or expand in the buffer because they don't understand why buffers and setbacks are important or, as a local planner mentioned, they want to fulfill their strong desire to be near the water or have unobstructed views. Sometimes, they come to a later realization that there are personal benefits to being set back from the water:

> *"There is a public perception that people need to get close to the water. The social norm is that 'close to water is better.' In retrospect, for some people they would have liked more room in front of their house."*

WDFW's Aquatic Habitat Guideline Program's 2010 (revised from 2007) report Protecting Nearshore Habitat and Functions in Puget Sound summarized earlier work (WDFW, 2009a; King Co, 2004; WSG, 2004) which demonstrates the critical importance of buffers by documenting the role of marine riparian vegetation for maintaining the health of Puget Sound nearshore. Marine riparian vegetation provides large woody debris, organic matter, and habitat for insects and marine

invertebrates. Tidal plain vegetation provides refuge and shelter to juvenile salmon. Recent studies have illustrated the importance of shade and moisture for summer spawning surf smelt (PSNRP, 2007; Rice, 2006). Shade/canopy or vegetation cover, which moderates microclimate conditions, is important for a diverse array of both terrestrial and aquatic species. Marine riparian vegetation also helps maintain water quality by acting as a filter, reducing surface erosion, retaining sediments (thus reducing pollutants), and preventing excessive turbidity. Submerged vegetation causes sediment to settle out in the nearshore (WDFW, 2010; WDFW, 2009a).

Removing or disturbing marine riparian vegetation in buffers results in reduced ecological functions as does decreasing the width of the vegetated riparian area, reducing plant density, and reducing plant diversity (WDFW, 2010). The widths of marine riparian vegetation necessary to provide the functions listed above vary with the function. To maintain 100 percent of the delivery of large organic debris is estimated to require approximately 200 feet of marine riparian vegetation (WDFW, 2009a). Most of the leaf litter and other organic matter that reaches Puget Sound is from vegetation 100 to 200 feet from the sound (WDFW 2009a). Shading forage fish spawning habitat can require 56 – 125 feet of marine riparian vegetation to maintain 80 percent of the shaded area (WDFW 2009a). *Protecting Nearshore Habitat and Functions in Puget Sound* documents that protecting wildlife habitats requires buffers 240 to 902 feet wide (WDFW, 2010). Removing 99 percent of the sediment for runoff requires 984 feet of riparian vegetation (WDFW, 2009a). To effectively perform these functions, the riparian buffers need to be undisturbed and to be growing native vegetation(WDFW 2009a). The buffer widths needed to provide similar functions on rivers and streams are similar to those on marine waters (Desbonnet et al, 2004, 2005; WDFW, 2009a; King Co, 2004; WSG, 2004).

Since achieving no net loss of shoreline ecological functions requires maintaining buffers of native vegetation, it is not possible to reduce required buffers and achieve no net loss. That is why it is critical to require adherence to the buffers in the SMP when permitting shoreline development.

Consider if the use is water dependent

The SMA policy (RCW 90.58.020 – paragraph four) requires that in the course of implementing the SMA policy, two important preferences must be used:

- A preference for uses that control pollution and prevent damage to the environment.
- A preference for water-dependent uses that need to be in or near the water.

Thus there is an understanding that uses that need to be in or near the water are preferred and inherently can damage the environment. Of course, like all development, they must minimize the damage and compensate for their impacts.

Conversely, non-water dependent uses must avoid damage to the environment to be considered preferred uses. The SMP Guidelines specifically state that such uses must be prohibited or carefully controlled with special conditions (see WAC 173-26-241(2)(a)(iii)). They cannot be treated the same as preferred uses; otherwise there is no effect to the preference.

Thus, in permitting, it is important to accurately determine water dependency for proposed projects. Some applicants might want to claim water dependency. The Shorelines Hearings Board, however, has many decisions on what uses are water dependent, water-related, and water enjoyment uses and these decisions provide a useful reference if there is any question as to whether a use fits into these categories.

A common situation is an existing water-dependent use that a landowner wishes to expand. In these cases, the vegetation around and waterward of the existing use is often of inadequate width and is almost always degraded. Consequently, the project should provide compensatory mitigation in some manner.

Non water-dependent uses should not be allowed in buffers or setbacks without good reasons. Some examples of good reasons for non water-dependent development being allowed in the buffer include:

- Linear facilities that need to cross or provide access to the water.
- Hardship conditions that meet the standards for a shoreline variance.
- Measures to protect single-family residences occupied prior to January 1, 1992, from damage due to erosion, or expansions of existing development that are already close to the water and meet standards in a community's SMP.

Consider if the vegetation is intact

The most substantial loss of ecological function occurs when new developments are built in areas that have largely intact vegetation. Intact vegetation provides ecological functions

Table 1. Strategies to Avoid and Minimize Impacts through location and design choices

Preference	Strategy
	Strategies to Avoid and Minimize through Choosing Areas to Develop
Increasing preference (arrow pointing up; items listed from most preferred at top)	**Place development outside shoreline jurisdiction** when possible – especially if the site is intact, the use is high intensity with large impacts, or the development is a linear facility. For example, locate buildings outside shoreline jurisdiction and use the areas within shoreline jurisdiction for buffers and low intensity recreational uses.
	Use existing facilities that are available. For example, convert existing structures for re-use, gain access using non-shoreline roads or existing roads, rather than building new roads or accesses in shoreline jurisdiction. Share existing private facilities such as docks, bridges, etc., rather than building new ones or multiple ones.
	Develop avoiding intact vegetation areas, especially native vegetation (both inside and outside buffer).
	Develop outside of required buffer and setbacks. As required by the SMPs, there must be a good reason to locate within the buffer.
	Move development landward as possible. This can also help protect structures for erosion, channel migration, and sea level rise.
	Move away from water areas and critical areas such as wetlands, habitats, geological hazards, and their buffers.
	Place uses and structures in the least impacting areas. Just as SMPs can take a landscape approach to determine the least impacting areas, so can site design. For example, constructing a house on or at the bottom of a feeder bluff on Puget Sound or deposition areas, such as a sand spit, in a drift cell is dangerous for the house and its occupants and can disrupt the critical ecological functions of the drift cell. Constructing the same house on the shoreline along the transport zone, however, has much less impact on shoreline ecological functions and is a safer location. In addition, structures should be sited outside flood plains and channel migration zones.
	Move landward non-water dependent facilities that are part of water-dependent uses (i.e., those not needing water access).
	Strategies to Avoid and Minimize through Design Choices
No order preference	**Reduce area of disturbance.** For example, create small yard areas around houses in sites with intact vegetation.
	Reduce size of structures and use areas.
	Use less impacting methods. For example, flood-proof houses by elevating on a foundation rather than fill under and around the house, or use bioengineering stabilization rather than structures.
	Co-locate new facilities together or with existing facilities.
	Share facilities. Allow new facilities to be shared in the future with other nearby development. Examples include private docks, bridges, driveways, and utility lines. This is similar to shared subdivision facilities and can include late-comer payback mechanisms.

including wildlife habitat - both inside and outside the buffer. According to the SMP Guidelines, updated SMPs should protect intact areas with protective shoreline environments that have limits on intense uses, and should protect intact vegetation with science-based buffers.

When there is intact vegetation present, mitigation sequencing indicates that avoidance should be used to prevent impacts, and then minimization should be used by limiting the intensity of the use and development methods. For sites that consist largely of intact vegetation, it is a challenge to determine how to provide mitigation for developments that require the removal of vegetation. There are few or no enhancement opportunities, and those that exist are likely not of the same scale as the development impacts. This is why it is critical to limit development near the water to uses that have a good reason to be there. When development must disturb intact vegetation (inside or outside a buffer), the development should be minimized in size to disturb as small an area as possible, should use fewer structural elements, and use less impacting methods. All these factors reduce intensity of the use.

Choose least impacting areas of the site for development and other methods of preventing and reducing damage

There are numerous strategies to avoid and minimize ecological harm by making location and design choices for uses and modifications as shown in Table 1. In the table, relocation strategies are listed in order of preference. Higher preferences may still be applicable while using lower preference options. For example, a development that must be placed within the buffer should both avoid intact vegetation areas and be located as far landward as possible. Strategies using less impacting choices in design and methods are not listed in an order of preference as they could all be used at the same time.

GENERAL STRATEGIES FOR COMPENSATORY MITIGATION

Compensatory mitigation is almost always needed for development in the shoreline to address remaining impacts after avoidance and minimization have been applied. It is difficult, however, to determine compensatory mitigation, as explained by one local planner:

"We don't get too much mitigation for streams and creeks. Minimization is hard to get. In the buffer, have to replant xx square feet plus more. People tend to reduce and average and tweak the buffer. The overwhelming mitigation technique is usually planting."

To determine needed compensatory mitigation, there are the specific strategies related to different types of development (see Chapter 9) and there are general strategies that potentially apply to all projects and are described in this section including in-kind and out-of-kind mitigation, mitigation ratios, advance mitigation, mitigation programs built into SMPs, and in-lieu mitigation.

Determining compensatory mitigation

A compendium of streamside mitigation techniques by state agencies in 2003 recommends that the following questions should be considered when determining compensatory mitigation:

- What is the level of certainty of success of the mitigation feature for the duration of the impact?
- Is the proposed mitigation technique proven to be successful or is it experimental?
- What is the level of certainty that the mitigation feature will be constructed as intended?
- Is the mitigation feature self-maintaining, and what is the certainty of follow-up or corrective actions necessary to maintain full mitigation function?
- What is the time lag between the initial project impact and the full maturity of the mitigation?
- Will the mitigation function variably over its life?
- What is the importance of the impacted habitat to the fish and wildlife that depend on the mitigation? Is the habitat unique or does it limit productive capacity?
- What is the status of impacted fish or wildlife? (WDFW, 2003)

Role of enhancement and restoration

Restoration and enhancement in the right location can help mitigate the adverse impacts of new development. SMP Guidelines provide that new shoreline development should not be required to restore past damage to the shorelines. Certain shoreline uses such as commercial uses, however, are required to consider restoration to meet the SMA use preferences.[8] The guidelines also recognize that restoration can be required to offset damage to the shorelines that will be caused by new development (See WAC 173-26-186(8)(c) and WAC 173-26-211(4)(b) and (5)). So restoration has an important role to play in mitigating the adverse effects of new shoreline development.

8 *See for example WAC 173-26-241(3)(d) "Master programs should require that public access and ecological restoration be considered as potential mitigation of impacts to shoreline resources and values for all water-related or water-dependent commercial development unless such improvements are demonstrated to be infeasible or inappropriate."*

Two recent studies provide helpful guidance in developing mitigation strategies and restoration opportunities. Ecology's *Puget Sound Characterization Project* has identified characteristics for Puget Sound basins useful for assessing mitigation opportunities. The project includes landscape assessments of fish and wildlife habitat in terrestrial, freshwater and marine environments. The assessments prioritize small watersheds, or habitat areas, relative to one another for their protection and restoration value and are designed to help planners in the Puget Sound region make better decisions about land use and effective protection, restoration, and conservation strategies for the Sound's natural resources by:

- "Describing a multi-scale framework for land-use planning that integrates information on water flow, water quality, and habitat.
- Providing results from assessments that can help guide the protection and restoration of watersheds and the habitats they support.
- Explaining how to interpret and apply the results of these assessments" (WDFW, 2013).

Similarly, the Puget Sound Nearshore Ecosystem Restoration Project's *Strategies for Nearshore Protection and Restoration in Puget Sound* identifies the locations on Puget Sound and its tributaries that are best suited to restoration and enhancement (PSNERP, 2012).

IN-KIND MITIGATION (ON-SITE AND OFF-SITE)

SMA policy provides important guidance on how to compensate for lost functions, which is to protect and restore the ecology and natural character. Thus, when natural features that provide ecological functions are eliminated or degraded to a lower level, they need to be replaced with features that perform the lost functions. In addition, compensation should take place where the impact happened for those impacted functions that are site-specific.

"In-kind" "on-site" mitigation is the most common and, for site-specific functions that need to be maintained on-site, the preferred method of compensatory mitigation. Examples of in-kind mitigation include:

Development Activity	Example of in-kind mitigation
Clearing native vegetation	Planting native vegetation
Installation of new over-water structures	Removal of over-water structures
Installation of new impervious surface	Removal of impervious surface
Installation of new armoring	Removal of adjacent armoring

In-kind mitigation is often the preferred form of mitigation.

Mitigation for some functions *must* take place on-site. For example, at a site where part of a stream is filled, mitigation to replace the lost flow capacity must be provided on-site. It may be preferable for other functions to be mitigated off-site. Since it can be difficult to replace certain functions on-site and mitigation may not be successful if the site is not suited to the mitigation work, off-site mitigation, when done well, can result in a greater certainty that the functions will be replaced.

When mitigation takes place off-site, issues related to the ownership and control of the mitigation site need to be addressed. For mitigation banks and in-lieu-of programs those issues are addressed upfront. Examples where off-site mitigation may be suitable include the following situations:

- The proposed development site already has largely intact vegetation so adding replacement vegetation is not feasible.
- The site is so intensely developed there is no room or no suitable site for compensating mitigation such as vegetation enhancement.
- The site is so small there are no onsite mitigation opportunities after the development is complete.
- Mitigation is done in advance so it is known that mitigation is working to replace the lost functions. (See description of in-lieu and similar programs starting on page 54).
- There are nearby in-kind mitigation opportunities such as reducing a nearby dock to mitigate the overwater coverage of new dock.

Because of the historic loss of estuarine wetlands in Washington and their ecosystem functional importance, the agencies will require in-kind compensation, that is, with replacement with another estuarine wetland, although often this will be off-site. Freshwater wetlands as mitigation are rarely considered acceptable as compensation for impacts to estuarine systems (Ecology/Corps/EPA, 2006).

Attempts to recreate habitat in new locations can be especially challenging. Projects, for example, to establish vegetation at barren sites is probably unadvisable as there are good reasons why there is no vegetation at these sites in the first place, such as unfavorable temperature, water, or wind conditions. In addition, at newly planted sites vegetation maintenance must be implemented including irrigation and weeding (Quigley and Harper, 2006).

Another issue is the availability of off-site locations that are within the same reach or drift cell, or even in the same watershed. In some highly developed areas, land costs are high and there is a tendency to do mitigation work on public lands.

Replacing ecological functions in off-site locations using programs such as in-lieu and conservation banks (described below) have been slow to catch on. The 2008 *Making Mitigation Work: The Report of the Mitigation that Works*

Forum (Ecology) concluded:

> "Alternatives to on-site mitigation have not been adequately explored or put into place, limiting choices and encouraging site-scale mitigation efforts even when these efforts are not likely to be sustainable over time. Local governments, especially cities, often are reluctant to approve off-site mitigation if it occurs outside their jurisdictional boundaries."

OUT-OF-KIND MITIGATION

While "in-kind" mitigation should be used as much as possible, "out-of-kind" mitigation may be needed. Indeed, out-of-kind mitigation may be more common than in-kind mitigation in some shoreline areas. A local planner said that for docks, especially, it is difficult to get in-kind mitigation:

"What is adequate mitigation for a dock? Can't make them remove another dock."

While there are sometimes opportunities to remove overwater structures to mitigate new docks, where that is not possible, out-of-kind mitigation such as planting on the beach and placing in-water woody debris is often the only available fallback. It is important to try to use the out-of-kind mitigation to reverse, or mitigate for, the impacts of the new development. For example, freshwater docks can create habitat for non-native fish that prey on salmon so it is desirable for required out-of-kind mitigation to focus on habitat improvements that increase salmon survival and compensate for increase in salmon predation. In that situation, requiring appropriate planting of native vegetation along the shore could provide more insects where conditions are food limited for salmon.

Perhaps the most common out-of-kind mitigation usage is for degraded sites that can be enhanced by planting native vegetation when in-kind compensation options are not available. Out-of-kind mitigation is especially useful for features and functions that are difficult to replace such as for the replacement of some marine habitats. Installing a new bulkhead that removes upper beach functions may, for example, be mitigated in part by beach nourishment, which seeks to replace the sediment that would have been transferred from the site to other beaches through the longshore drift. Another example is the planting overhanging vegetation, which can increase the survival of forage fish eggs, where bulkheads damage forage fish spawning beaches.

QUANTIFYING MITIGATION AND MITIGATION RATIOS

A key mitigation question is "how much?" How much replacement of habitat or ecologic function – i.e., replacement ratio - is needed to compensate for the lost value at project sites?

SMP Updates include mitigation ratios for wetlands impacts and some include ratios for buffer impacts. There is a growing body of research about mitigation ratios for riparian vegetation and other critical areas. For SMPs that do not have mitigation ratios, it can be difficult to determine the right mitigation ratios. Nearly all CAOs and SMPs do have fixed ratios for wetlands mitigation and now there is a trend to expand this to riparian areas and ultimately fish and wildlife habitats. For impacts where mitigation ratios are not available, permit writers seek other means to determine the proper level of mitigation.

As summarized by King and Price in 2005 a mitigation ratio should take account of these factors:

- "The existing level of [ecological] function at the site prior to the mitigation;
- The resulting level of [ecological] function expected at the mitigation site after the project is fully successful;
- The length of time before the mitigation is expected to be fully successful;
- The risk that the mitigation project may not succeed; and
- Differences in the location of the [lost function at the site] and the mitigation site that affect the services and values they have the capacity and opportunity to generate."

Determining appropriate replacement ratios has been an ongoing challenge and numerous papers examining decades of wetlands mitigation have shown that replacement ratios have generally been too low to offset adverse impacts. The 1:1 replacement ratio has been shown to be inadequate (King and Price, 2005). Ecology's current wetland recommendations take these studies into account. Those higher ratios are being incorporated into the SMP updates and those ratios should be used for wetland mitigation for standard forms of mitigation.

Looking beyond wetlands, and assessing numerous factors ranging from invertebrates to soil and fish, a study of 16 in-channel and riparian habitat mitigation projects across Canada showed that 63% resulted in a net loss of habitat function. Many sites did not meet their target mitigation ratios, and the authors demonstrated that the mitigation ratios were not high enough. They found that replacement mitigation ratios of 2:1 would not have achieved no net loss of fish productivity. To achieve a net gain, mitigation ratios of "approximately" 5:1 were necessary (i.e., replacement habitat was five times the lost habitat). This study also found that riparian vegetation was difficult to compensate for because of large losses in riparian productivity. In addition, to larger replacement ratios, they note that mitigation success depends on a better understanding and documentation of the compensation sites, maintenance programs, increased monitoring and enforcement, and attention to limiting factors on a watershed basis (Quigley and Harper, 2006). Similar results have been shown (i.e., failure of wetland mitigation) in the United States

(Ambrose, 2004).

The higher ratios found necessary in the Canadian report are similar to the ratios needed to compensate for the losses of moderate to high quality wetlands (Granger et al, 2005). So absent other scientific evidence, replacement compensation for vegetation and habitats relying on vegetation should take place at four to five times the area (or other unit) adversely affected to compensate for failure rates, the difficulty of mitigation, the age and maturity of the vegetation, and the time needed to become fully functional.

It is inappropriate to replace functions derived from natural features with functions derived from artificial features. Replacement compensation should always use more natural options. Attempts to replace lost functions by constructing something artificial usually result in additional impacts to other functions. An example is the elimination of buffer vegetation and replacement of the bank stability functions with shore armoring – other functions are not accounted for. Another example is compensation for impervious surface using storm water facilities placed in a buffer area – it causes other impacts.

Approaches to quantifying mitigation

There have been a variety of approaches developed to quantify mitigation, especially for wetlands. In recent years, there has been a move towards using a credit/debit method to calculate compensatory mitigation.

Habitat Evaluation Procedure (HEP)

U.S. Fish and Wildlife Service developed the Habitat Evaluation Procedure (HEP) in 1980 for use in impact assessment and project planning. HEP uses a species-habitat based approach to impact assessment and can be used to document the predicted effects of proposed management actions, including mitigation. HEPs are based on the assumption that habitat for a selected species can be described by a Habitat Suitability Index (HSI) or habitat quality which compares the habitat at a site to an optimal habitat for a species (scale from 0.0 to 1.0 (optimal). This can be multiplied by the area of the site to give a habitat unit (HU). The assessment process is limited to the species selected for the HEP (USFWS, 1980).

Ecology Wetlands Tool

For freshwater wetlands, Ecology has created a tool that calculates mitigation actions needed to replace the functions and value lost at wetlands that are filled or damaged. The tool is based on the Washington State Wetland Rating System for Western Washington, as well as some previous work by King County to develop a credit system. The credit/debit method generates scores for wetlands ranging from 1-9 for each of three wetland functions: improving water quality; flood storage and flow reductions; and habitat. The score is based on three aspects of each function: the potential of the site to provide the function, the potential of the landscape to maintain each function at the site scale, and the value of each function. A debit score is generated for the impact sites, multiplied by the size of the sites as well as a multiplier with accounts for the temporal loss of functions assumed because of the time lag before mitigation replacement is fully functional. Separately, credit scores are generated for lift sites, multiplied by their sizes, and a multiplier based on risk of failure (i.e., plants dying or other problems). The ratio used to account for the risk of failure is 1.5:1. Mitigation projects are usually deemed adequate when "credit" scores for the projects are higher than "debit" scores for impacted wetlands. The specifics of this tool are only applicable to freshwater wetlands (Ecology, 2012).

Stream Functions Pyramid

Based on a credit/debit system and focusing on restoration and mitigation for altered streams, a new function-based method to calculate mitigation for altered functions, called the Stream Functions Pyramid approach, has been developed under EPA sponsorship (See Side Box on page 50). This approach quantifies the functions in a credit-debit fashion and involves completing a functional or condition assessment at the impact site to quantify ecological losses (debits) and at the mitigation site to quantify projected ecological gains (credits).

Habitat Equivalency Analysis (HEA)

Under Section 7 of the Endangered Species Act, project proponents are required to consult with NOAA to determine impacts and mitigation for their project. NOAA has long used Habitat Equivalency Analysis (HEA) as a method of assessing damage and mitigation requirements for resource impact, to determine the loss or gain from the impact. This method is now being used to quantify project-related habitat impacts and to determine conservation credits for conservation banks. The calculation is used for projects where there is an adverse effect (inputs are area impacted, extent of the impact, and rate at which recovery will occur) and it is believed that adverse effects can be offset. The calculation uses a unit value of service (at landscape scale) which is independent of change in service level at the injured and restored site. For example, if the site involves the last old growth tree needed for marbled murrelet habitat, HEA could not be used, because there is no possible offset. By using this model to calculate mitigation, quicker ESA consultations can be done. In addition, the approach serves as a model for others to use or modify (Fisher and Ehinger, 2014).

Seattle's Habitat Evaluation Procedures (HEP) Program

The City of Seattle has now extended the credit/debit approach to quantifying shoreline functions and mitigation assessment. Seattle's Habitat Evaluation Procedures (HEP) (formerly called SAMP) was developed using USFW's Habitat Evaluation Procedures (see above) and Habitat Suitability curves for ecological needs of juvenile Chinook salmon. Thus features like shallow water and near-water vegetation are important. Scores for impacted sites are totaled so that property owners can then see how much on and off-site mitigation (credit) is needed. HEP was initiated as a pilot project for the Ship Canal area of the city and the program was incorporated into their SMP Update (See Side Box on page 52).

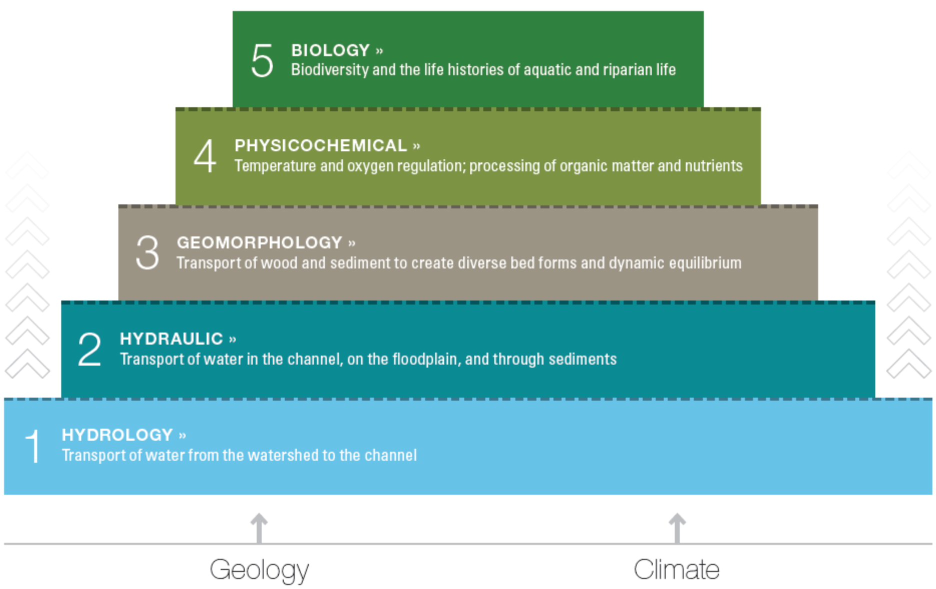
Side Box

STREAM FUNCTIONS APPROACH TO QUANTIFYING MITIGATION

Sponsored by the EPA, a new framework for approaching stream assessment and restoration from a function-based perspective has been recently developed. The Stream Functions Pyramid approach is designed to move *beyond* a wetlands approach to determine ecological functions *to* a fluvial geomorphological and stream ecological approach. The framework can be used to determine compensatory mitigation credits and losses and success standards for **streams, rivers and their riparian zones**.

many projects being evaluated simply on visual observations of channel stability, in-stream structure integrity, and condition of the riparian buffer." The Stream Functions Pyramid, on the other hand, allows for the development of function-based goals and assessments leading to credits based on the potential functional lift.

The Stream Functions Pyramid. The underlying assumption of the approach is that stream functions are interrelated and generally build on each other in a specific order, a functional hierarchy ranging from Level 1 to Level 5: hydrology (Level 1) hydraulic (Level 2), geomorphology (Level 3), physicochemical (Level 4) and biology (Level 5). Higher-level functions are supported by lower level functions, like a pyramid (thus hydraulic functions cannot occur without hydrologic functions, and so on). The Stream Functions Pyramid includes over 30 parameters, not all of which will be needed for each project:



Old mitigation approach versus new approach

Currently, most stream mitigation is based on restoration priority levels and/or changes to stream dimension, pattern and profile to create a stable channel. This results in a push for maximum stream channel shape change to get a maximum number of credits and a focus on shape rather than stream functions. As the authors of this new approach report, "This credit determination method has resulted in

Source: United States Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. (2012). *A Function-Based Framework for Stream Assessment and Restoration Projects.* Written by Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. Washington, DC EPA 843-K-12-006.

Comprehensive program to determine success of mitigation in King County

In assessing mitigation it is important to determine if the lost functions can be feasibly replaced. The ability to replace lost habitat should be documented by scientific studies of successful mitigation or examples of mitigation projects where monitoring shows success.

Natural resource staff at King County conducted an extensive study of the success of mitigation related to development projects in the county over the past five years. They specifically assessed permitted development in rural transitional watersheds to determine compliance with permits and to determine if the regulatory actions taken by King County in 2005, including critical areas, grading and clearing and stormwater ordinances, are protective of the ecological functions. That is, are they meeting no net loss? The control watersheds for the study are those that are closed to development. (See Side Box on page 53).

ADVANCE MITIGATION

If the available science information indicates that lost functions can be replaced but the proposed mitigation does not have a proven record of success, advance mitigation can be used. Advance mitigation "is a form of permittee-responsible compensatory mitigation constructed in advance of a permitted impact." (Corps/Ecology/WDFW, 2012). An advance mitigation site needs to be planned, designed, permitted, and constructed before a development project can use any mitigation credit generated by the site. Advance mitigation can be a cost-effective and ecologically beneficial mitigation option as the permitting agency may allow a lower mitigation ratio because the actual mitigation success can be shown.

In December 2012, federal and state agency permits released a guide for advance mitigation which includes the following guidance relevant to local shoreline permitting:

- Applicants conduct advance mitigation at their own risk. Establishing compensatory advance mitigation does not guarantee that it will be accepted as adequate and/or suitable mitigation for any specific future project.
- Advance mitigation can be combined with concurrent mitigation required by a Federal, State, or local permit.
- The credit value of mitigation efforts at a site will generally increase over time because the temporal loss is eliminated or decreased if a mitigation effort is established and meeting performance standards.
- When proposing advance mitigation in a service area where a mitigation bank or in-lieu fee program has been approved, the applicant must demonstrate why the advance site is ecologically preferable to other forms of mitigation.
- In some cases it may be necessary to replace critical functions onsite (Corps/Ecology/WDFW, 2012).

Advance mitigation offered in SMPs

In their SMP Updates, Kitsap County and Island County included provisions that offer credit for up to five years of advance mitigation. Island County's advance mitigation applies to the removal of structural shoreline stabilization in advance of shoreline development or redevelopment within five years, and provides (17.05A.090.I.4) that:

- "The applicant or property owner provides conclusive evidence of the pre- and post-restoration conditions using photographs, reports, plans, affidavits, or similar evidence;
- "The County confirms via site inspection, photographs, affidavits or other evidence that the restoration actions have improved shoreline conditions; and
- "The applicant or property owner provides assurances that the restoration area will be maintained for the life of the project. The assurance can be in the form of a notice on title, conservation easement, or similar mechanism" (Island County, 2012).

MITIGATION MANUALS AND PROGRAMS BUILT INTO SMPS

Some SMPs include built-in programs to mitigate the impacts of common forms of development. These predetermined forms of mitigation can ensure that common impacts are fully mitigated and provide certainty for potential applicants. They can also reduce transaction costs for local governments and applicants by reducing the scope of scientific reports to analyze project impacts and develop appropriate mitigation. Another advantage is the reduction of time needed for expert review of the reports and mitigation associated with qualifying projects.

The use of prescribed replacement vegetation requirements in some of the SMP updates makes it easier for homeowners to do the plantings themselves, without the expense of hiring a landscaper or consultant. A local planner reported that:

"Most homeowners can do it. So no report required. They are developing their mitigation in what is left of the buffer. They use a good mix of plants. They [can get help from the local nurseries] who know the native plants and the ones that are suitable for various locations. They hold their hands."

Case Study

QUANTIFYING "NO NET LOSS" - SEATTLE'S HEP APPROACH

In 2006, the City of Seattle developed a system to calculate habitat unit values as the key driver of a Shoreline Alternative Mitigation Plan (SAMP), part of an initiative, later renamed Habitat Evaluation Procedures (HEP), to support the maritime industry while also promoting shoreline habitat restoration. The focus was on the Ship Canal and Lake Union areas of Seattle, with plans to eventually extend the program to the rest of city. The proposed plan included a form of a mitigation bank in which eligible applicants for water-dependent and water-related land shoreline development permits could, after making project revisions to eliminate or reduce harm, either mitigate remaining shoreline impacts on-site, or contribute to a fund for shoreline restoration mitigation elsewhere within the Ship Canal or Lake Union area. For example, if a project results in the loss of 1000 habitat units, then mitigation must produce 1000 (or more if a ratio is used) new habitat units to offset the loss. Success of offsite restoration mitigation would be tracked; contingency provisions are included in the plan. **Key to the approach was a new system to measure shoreline impacts.**

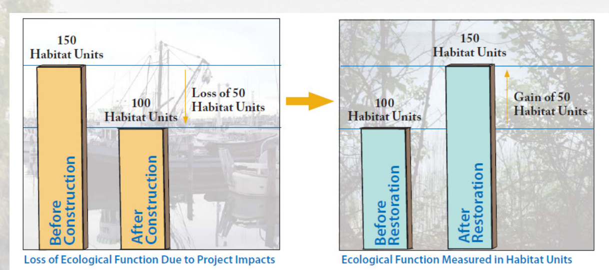
Calculating habitat values and impacts in shorelines

The city created a baseline map of existing shoreline conditions for the project area in 2006. Seattle derived measurable "habitat unit" values for ecological functions and impacts (see table to right) based on a synthesis of current science and a Habitat Suitability Index model. The approach is based on US Fish and Wildlife *Habitat Evaluation Procedures* using Chinook salmon habitat requirements. Over time, the values for habitat units will be updated as new research on shoreline ecology is conducted. Currently the City is piloting a restoration project in the Ship Canal. This project will help ground truth the cost of habitat units developed in HEP.

Seattle Habitat Equivalency Table (2008 draft)

Development Activity/Impact	Habitat Unit Equivalency
Riparian Vegetation *(vegetated area contiguous to the shoreline. Planting of riparian vegetation refers to planting native plant species at densities specified by City staff)*	
Grass	7 units per linear foot
Shrubs	15 units per linear foot
Native Vegetation 1-3 M tall within:	
0 to 10 feet of shoreline	30 units per linear foot
10 to 100 feet of shoreline	30 units per linear foot
Native Vegetation greater than 3 M tall within:	
0 to 10 feet of shoreline	45 units per linear foot
10 to 100 feet of shoreline	70 units per linear foot
Shoreline Condition	
Natural/Unretained	30 units per linear foot
Sloping Bulkhead	20 units per linear foot
Vertical Bulkhead	10 units per linear foot
Overwater Coverage total	
None	24 units per square foot
Grated Surface Area	11 units per square foot
Solid – less than 3 feet in width	11 units per square foot
Shallow water 12 feet or less in depth	
Creation/Reduction in the amount of contiguous shallow water (up to 12 feet in depth) present on submerged portion of subject property	26 units per square foot
Change in slope of submerged parcel area	
Less than 2% slope	27 units per square foot
Greater than 2 up to 4%	16 units per square foot
In-water Substrate Composition	
Sand/Silt/Gravel	26 units per square foot
Invasive Aquatic Macrophytes/ Submerged Debris	
Absent	
Moderately Dense	44 units per square foot
	14 units per square foot

Development Activity On-site Habitat Unit Equivalency



Seattle's chart showing how habitat units would be applied at project site and at restoration site.

Sources: Seattle, City of. Department of Planning and Development. (2006, May). *Shoreline Alternative Mitigation Plan: Preliminary Plan.* Retrieved from http://www.seattle.gov/DPD/Planning/Shoreline_Alternative_Mitigation_Plan/Overview

Seattle, City of. Department of Planning and Development. (2008). *Draft Director's Rule XX -2008.* Retrieved from http://www.seattle.gov/dpd/cms/groups/pan/@pan/@plan/@shorelinemasterprog/documents/web_informational/dpdp020806.pdf

Side Box

KING COUNTY STUDY: ARE LAND USE REGULATIONS PROTECTING THE ENVIRONMENT?

King County and EPA recently concluded a five-year (2007 – 2012) watershed-scale study of the effectiveness of the County's land use regulations in 6 rural watersheds with ongoing development as compared to 3 undeveloped reference areas. Because of low levels of development during the project, presumably due to the economic downturn, 100 years of land cover history (since ~ 1900), future full build-out and urban watershed scenarios were modeled to provide additional perspective.

Goals of the project

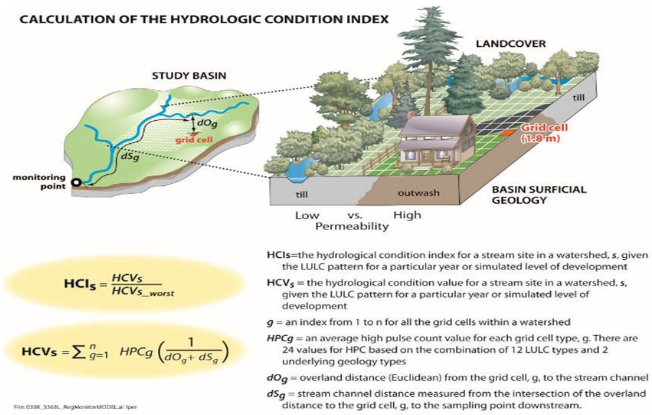
King County wanted to assess effectiveness of - and compliance with - its relatively new (2005) land use regulations, consisting of three ordinances: critical areas, grading and clearing and stormwater. Study goals were to establish and implement a framework for isolating the effect of the County's regulations, quantifying land cover change and environmental response over time and, if a response was detected, to identify possible changes in regulation or management.

Watershed characteristics assessed

The project tracked changes in land cover, land use, permit compliance, hydrology, water quality (conductivity and temperature), biology (benthic invertebrates, BIBI) and channel complexity (salt tracer-based reach-averaged velocities in conjunction with measurements of substrate, thalweg, pools, channel depths and widths, large wood). A novel Hydrologic Condition Index (HCI) was developed to quantify the hydrologic effect of land cover change (not just the change) across differing time and space scales in these lowland watersheds.

Conclusions

Results suggest that in rural areas, King County's existing regulatory structure should protect watershed hydrological attributes as future development occurs. Results should be viewed as preliminary, however, because of the limited development activity observed during the project time period.



Compliance results

With respect to compliance, no large or ongoing problems were observed over the five years. When estimated as the area of land cover change that required and obtained a permit, regulatory compliance was about 63%. The area of land cover change, however, was small relative to the area studied; almost 97% of the watershed area showed no change in land covers at all during the study period. In regulatory stream buffers, land cover change was even smaller than at the watershed scale with over 99% of the buffer area remaining unchanged over five years suggesting regulations may be protective of buffers as well as hydrology.

The study framework and its detailed information across 9 watersheds and 5 years provides the Puget Sound Region with a "watershed laboratory" with potential to assess regulatory effectiveness elsewhere and to assess the future effects of rural land use, climate change and the effectiveness of other management actions, such as for stormwater and habitat protection and restoration. Study results, overview presentations and a final report are at http://www.kingcounty.gov/environment/wlr/sections-programs/science-section/critical-areas.aspx

Sources: King County. Water and Land Resources Division. (2014). *Assessing land use effects and regulatory effectiveness on streams in rural watersheds of King County, Washington.* Written by Lucchetti, G., Burkey, J., Gregersen, C., Fore, L., Knutson, C., Latterell, J., McCombs, P., Timm, R., Vanderhoof, J., and Wilhelm, J. Retrieved from http://your.kingcounty.gov/dnrp/library/water-and-land/critical-areas/CAO-Report-Final-for-Web.pdf

King County. (2008). *Quality Assurance Project Plan for Regulatory Effectiveness Monitoring for Developing Rural Areas.* Written by Lucchetti, Gino and Latterell, Joshua. Retrieved from http://your.kingcounty.gov/dnrp/library/water-and-land/data-and-trends/monitoring/critical-areas/081119-epa-cao-qapp.pdf

King County. (2011). *Assessing the Effectiveness of Land Use Regulations in Developing, Rural King County, WA. Presentation to the American Fisheries Society.* By Lucchetti, Gino, Latterell, Joshua, Timm, Ray, Michalak, Julia, Torgersen, Christian, Alberti, Marina, and Knutson, Christopher B. Retrieved from http://your.kingcounty.gov/dnrp/library/water-and-land/critical-areas/2011-presentations/land-use-regulation-effectiveness.pdf

Some SMP Updates, such as Pierce County (see Side Box on page 55), include tiered levels of required mitigation reports with less complex reports required for projects covered by built-in mitigation and more detailed reports required for other projects.

In their SMP Update, Kitsap County included a Mitigation Options Table to achieve buffer flexibility without the need to hire a professional consultant. The table guides the property owner through mitigation, provides a list of mitigation options to choose from, and also allows for alternative proposals from the applicant (See Side Box on page 56).

Mitigation manuals, adopted along with SMPs or as later additions, can include methodologies for assessing impacts and determining mitigation, and can set standard mitigation requirements as well as standards for monitoring mitigation. These manuals can be useful tools for permit applicants and permit reviewers. They help improve mitigation and reduce transaction costs. Bainbridge Island has developed a user-friendly mitigation manual for single family properties (See Side Box on page 57).

IN-LIEU MITIGATION PROGRAMS

In-lieu programs perform off-site mitigation for projects for a fee. Jurisdictions can initiate their own programs and some SMPs include in-lieu provisions. In-lieu programs can take different forms including:

- ***Wetland mitigation banks.*** Wetland banks are becoming more common across the nation. Banks for other forms of mitigation are possible as well, though rare or non-existent at this date. Developers purchase mitigation credits from banks, which have created new wetland habitat or other features.
- ***Fee-in-lieu mitigation program.*** Fee-in-lieu mitigation programs are fairly new. They are similar to mitigation banks, but the fee pays for restoration work that happens at a future date.
- ***Less formal programs.*** Other less formal in-lieu programs are possible when they don't require federal or state approval for water and wetland permits. Examples include the Mount Vernon buffer mitigation bank and Seattle's Habitat Evaluation Procedures (HEP) program (See Side Box on page 52) which uses an approach similar to Ecology's new credit-debit system by giving scores to functions (Ecology, 2013c). Other options are only limited by imagination and the willingness to do the work necessary to establish the program.

While in-lieu programs are attractive, innovative and can result in better mitigation outcomes, when well-designed and effectively implemented, they require accurate accounting

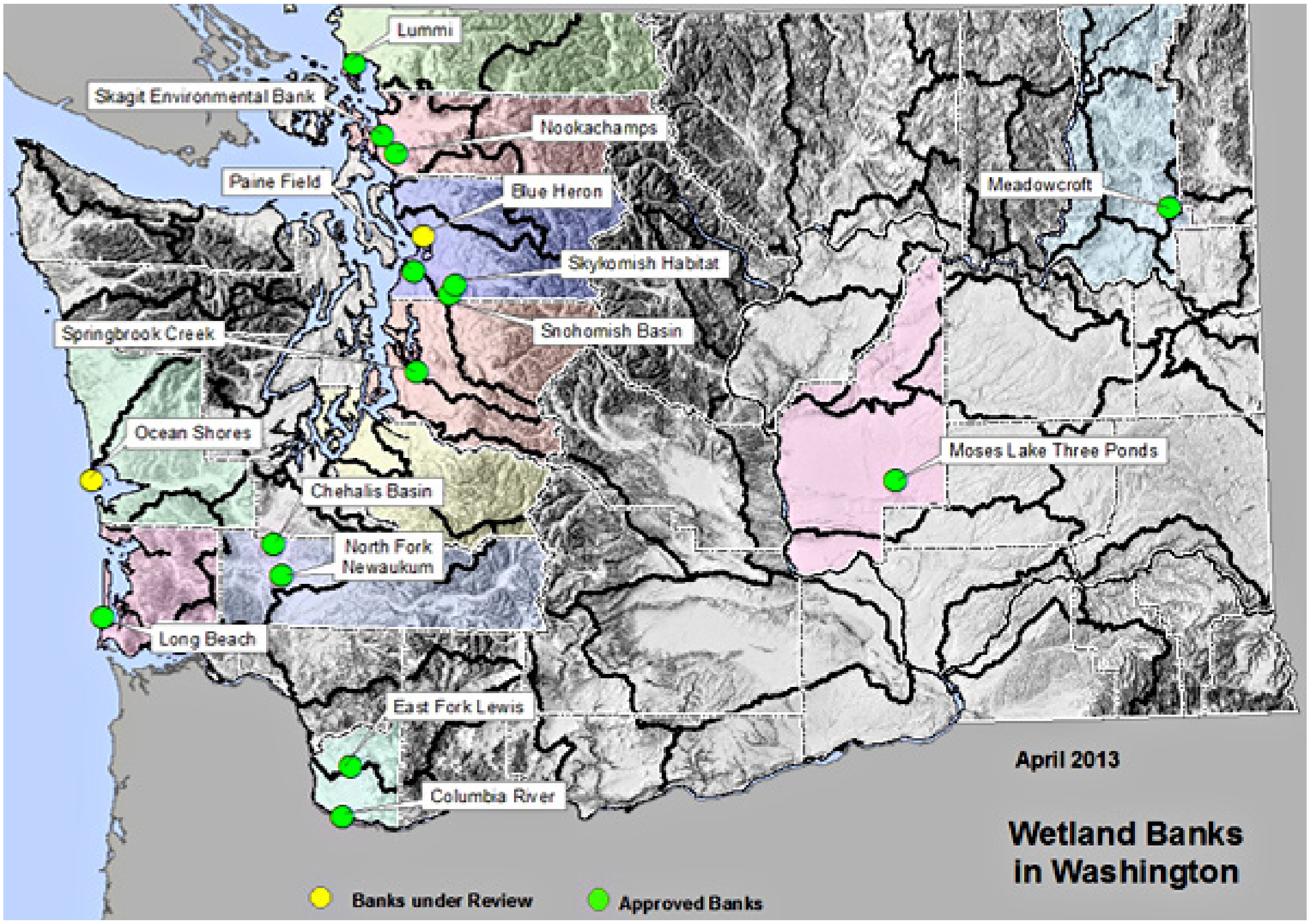


PHOTO: WASHINGTON DEPARTMENT OF ECOLOGY 2013B

Case Study

PIERCE COUNTY TIERED MITIGATION APPROACH

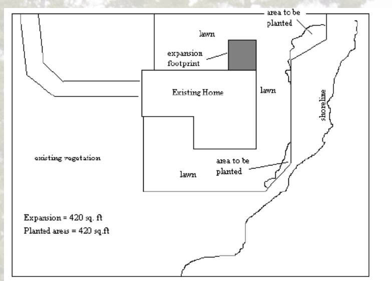
Pierce County's draft SMP Update includes a tiered mitigation strategy (18E.40.050) which prescribes simpler requirements for minor projects and more customized requirements for larger projects:

Larger and more complex projects

Abbreviated Planting Plan

An applicant can submit an *Abbreviated Planting Plan* for expansion or new development projects affecting less than 1,000 square feet of a buffer or setback. An equal area of native vegetation is required to compensate for the additional impervious area including a minimum of one tree species, two shrub species, and two groundcover species, using the following formulas:

Number of Plants to be installed under Abbreviated Planting Plan		
Plant Type	**Spacing**	**Number of Plants = Square Footage divided by:**
Trees	12-15 feet on-center	144 – 225 square feet
Shrubs	6 feet on-center	36 square feet
Herb/Groundcover	3 feet on-center	9 square feet



Example Abbreviated Planting Plan Site Diagram from Pierce County's draft SMP update

Habitat Assessment Study

An applicant must conduct a *Habitat Assessment Study* for projects that affect 1,000 square feet or more of a buffer or setback. The study includes an environmental baseline, non-field documentation of location and condition of relevant Critical Fish and Wildlife habitat areas and buffers and setbacks, identification of the presence of the habitat area or species on the site, a detailed project description, discussion of how Fish and Wildlife Habitat Conservation Area standards will be met, and proposed mitigation.

Habitat Assessment Report

An applicant must submit a *Habitat Assessment Report* for mitigation plans more complex than simple buffer or setback planting and may include additional mitigation elements such as timing restrictions, clearing limitations, avoidance of specific areas, special construction techniques, Conversion Option [Timber] Harvest Plan conditions, Hydraulic Project Approval permit conditions, habitat enhancement (i.e. fish passage barrier removal), and best management practices.

Source: Pierce County Planning and Land Services. (2012, September 25). *Exhibit "D" to Staff Report, Pierce County Planning Commission.*

Case Study

BAINBRIDGE SINGLE FAMILY RESIDENCE SHORELINE MITIGATION MANUAL

As part of their SMP Update, the City of Bainbridge developed a *Mitigation Manual* to make it easier for single family residential projects to determine mitigation requirements.

What qualifies

Homeowners are eligible for the simpler mitigation requirements, after first designing their project to **avoid** impact, if their site is a) not part of a new subdivision, b) not located adjacent to a marsh or lagoon, and c) meets the threshold and structure type limits. The manual does not apply to new in-water or overwater projects. In addition, new or expanded home and accessory structures must be no larger than 4000 square feet, detached garage no larger than 580 square feet, new patio no larger than 120 square feet, boathouse no larger than 200 square feet, and replacement bulkhead the same size as existing.

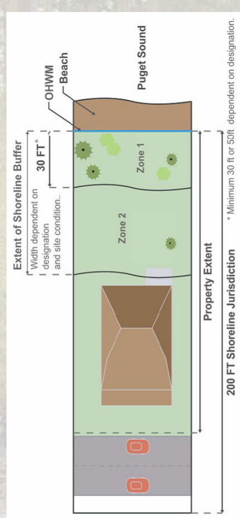
Mitigation covered by the manual

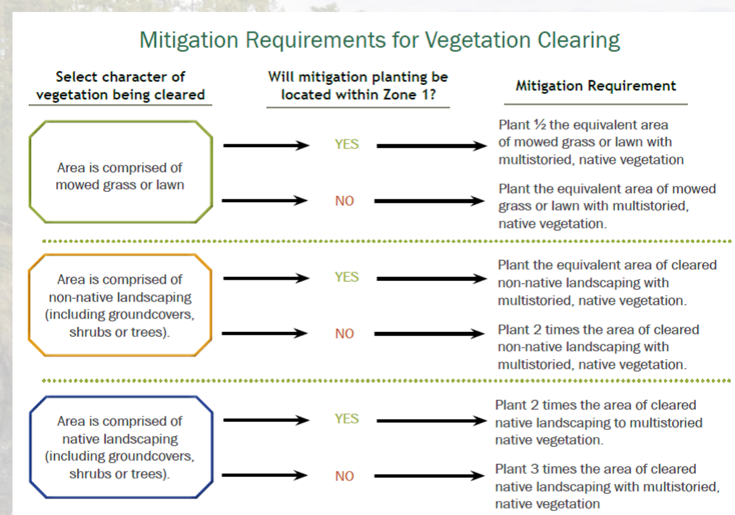
- Types and amount of replanting if vegetation is cleared.
- Removal of impervious areas or installation of rain gardens if impervious surface is created.
- Removal of fill or nourishing beach if fill is removed below ordinary high water mark.
- Restoration of any disturbed areas and replanting with native vegetation if aquatic habitat is disturbed.

It should be noted that replacement of docks or stairs with retractable systems are exempt from City required mitigation. Repairs or replacements that reduce the shading footprint of an existing dock are similarly exempt.

Example mitigation requirement from Manual

Below are the mitigation requirements for projects that involve vegetation clearing. The city has designed the manual to promote the most environmental benefit in the area closest to the water – zone 1 – as designated in the draft SMP Update. Species are to be planted with spacing designed to achieve a minimum 65 percent native vegetation coverage within 10 years within the replanted area. Views can be protected.



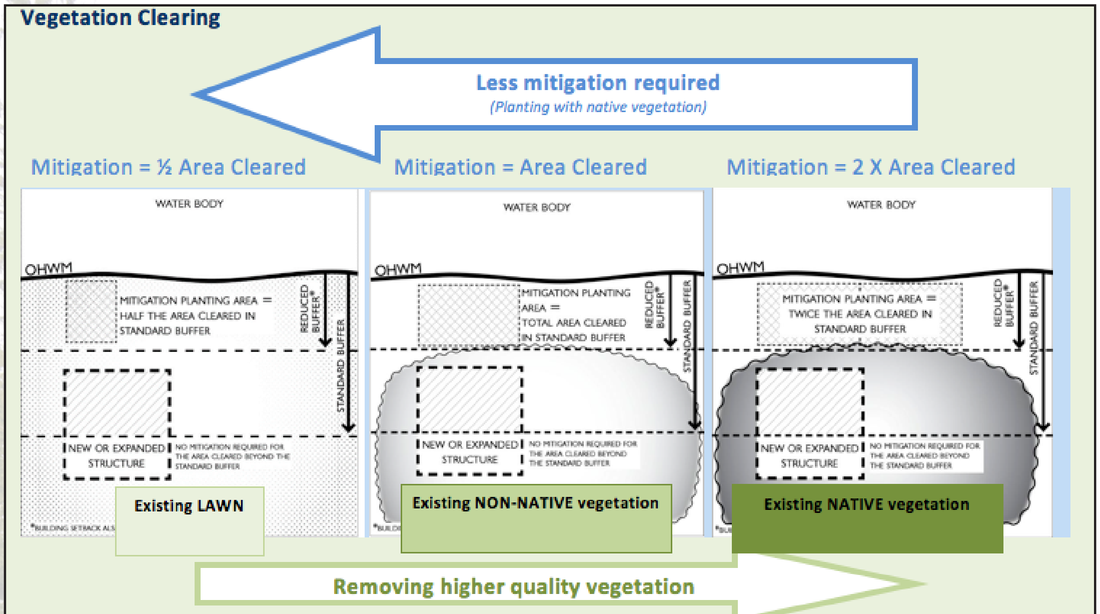


Source: Bainbridge, City of, Planning & Community Development. (2012, July). *Single Family Residence Shoreline Mitigation Manual.* Prepared by Herrera Environmental Consultants, Inc. as part of the draft Bainbridge SMP Update. Retrieved from http://www.ci.bainbridge-isl.wa.us/documents/pln/2011_smp_resources/revbainbridgemitigationmanual_final.pdf

Case Study

CASE STUDY: KITSAP COUNTY MITIGATION OPTIONS

Kitsap County's SMP Update includes mitigation options for vegetation removal and installation of bulkheads and overwater coverage. Provision of public access halves mitigation



* Pervious and semi-pervious decks or rain gardens can replace some of the planting, if replacing lawn or non-native vegetation. Removal of impervious surface and replacement with vegetation may be utilized for mitigation credit at a 1:1 ratio.

New and Replacement Shoreline Armoring or Barrier Structures

Preference

- For new bulkhead, **remove** an equivalent length of bulkhead (1:1)
- For replacement, if > 50% of existing structure, **use soft or hybrid** alternative(s) such as adding logs or stumps...
- For new or replacement:
  - a. **Remove fill** and move armoring landward.
  - b. **Add a "pocket beach"** to the design, where appropriate.
  - c. **Add overhanging vegetation** along the bulkhead edge or other portion of shoreline.
  - d. **Add beach nourishment**, where determined appropriate.

New and Replacement Overwater Structure

Preference

- For new overwater coverage, **remove** legal existing over-water and/or in-water coverage.
- For new or replacement, **add site appropriate habitat features.**
- For dock additions, partial dock replacements, or other modifications, replace areas of existing solid over-water cover with **grated material** or use grating on those altered portions of docks.
- **Plant native vegetation** along the shoreline immediately landward of the OHWM. (1:1)
- **Remove or ecologically improve hardened shoreline**, including existing launch ramps or hard structures.
- **Remove man-made debris** waterward of the OHWM, such as car bodies, oil drums, concrete or asphalt debris.
- **Place large woody debris.**
- Participate in an approved **mitigation banking or in-lieu-fee** program.

Source: Kitsap County. (2013, January 30). *Appendix B: Mitigation Options to Achieve No Net Loss for New or Re-Development Activities in Kitsap County Locally Adopted Draft. Shoreline Master Program.*

of impacts and the needed mitigation. In addition, these programs require the conversion of that mitigation into units provided by the program, and establishment of fees to cover the mitigation units.

RECOMMENDATION SUMMARY: USING MITIGATION TO ACHIEVE NO NET LOSS

- Following state and federal guidelines, it is important to stand firm on avoiding and minimizing impacts and to require compensation for remaining impacts. In analyzing project impacts, consider the full range of impacts, including the impacts from vegetation removal, land clearing, filling, grading, excavating, and human use.
- Buffers and setbacks have been established to protect natural resources and should be adhered to as a first consideration, except for water dependent uses. In addition, projects that are not truly water dependent should be moved back and extensive intact vegetation protected.
- Site uses and activities on the parts of the parcel that will have the least impact on shoreline ecological functions. There are numerous techniques through design choice and optimization of the site to avoid and minimize ecological harm.
- For impacts that cannot be avoided or minimized, require compensatory mitigation to replace the lost functions by using the following general guidelines:
    - In-kind mitigation is typically the best approach to replicate functions that would otherwise be lost.
    - Sometimes in-kind mitigation is not possible. Then require out-of-kind mitigation that can reverse (that is, mitigate for) the impacts of the new development on specific ecological function. For example, if a new dock increases potential for predation of juvenile fish, mitigation should provide function to either reduce predation in other ways or increase salmon population.
    - Require high enough replacement ratios so the mitigation can actually replace the functions that would otherwise be lost. Ratios must be high enough to account for failure risk rates, time for plants to mature, and conditions of a new geographic sit).
    - Make sure the mitigation is located in an area where it can function, and that it is monitored and maintained
    - until it is fully established. In many cases, this may be an off-site location if the project site does not have adequate space for replacement mitigation. Off-site mitigation should replace the function within a logical geographic nexus (e.g. same stretch of drift cells, same watershed).
    - Make sure the mitigation is protected for the life of the use.

7. SHORELINE ECOLOGICAL BASICS

Effective shoreline project review relies on a good understanding of the basics of physical, chemical and biological functions of the nearshore and upland ecological systems. This chapter, along with Appendix 5, covers some of the key shoreline functions and is meant to serve as an easy reference.

Shoreline natural processes and ecological functions typically operate as a system of balancing inputs and outputs that continually fluctuate within a range that is normal for the site. Ecology's SMP Guidelines reinforce this holistic approach in their ecological definitions (See WAC 173-26-020(13); (14) for more information).

Shoreline Master Program Guidelines provide two important definitions:

Ecological functions or 'shoreline functions' means the work performed or role played by the physical, chemical, and biological processes that contribute to the maintenance of the aquatic and terrestrial environments that constitute the shoreline's natural ecosystem.

Ecosystem-wide processes means the suite of naturally occurring physical and geologic processes of erosion, transport, and deposition; and specific chemical processes that shape landforms within a specific shoreline ecosystem and determine both the types of habitat and the associated ecological functions.

When the natural processes are changed or disrupted by activities such as construction and repair of buildings, bulkheads, docks and piers, utility lines, grading, and clearing, the balance is upset and organisms are affected – often in a negative manner.

These development activities cause loss and disruption of shoreline ecological functions due to loss of vegetation and habitat, change of surface water and sediment movement (including groundwater), and increase in human–related intrusion (including pollution). These are summarized below (and in Appendix 5).

VEGETATION AND HABITAT LOSS

Shoreline vegetation provides direct habitat value (i.e., living plants and debris) and indirect value (i.e., prey uses the plants) in both upland and aquatic areas. It performs many functions that alter water, sediment, and other processes that together form a consistent environment that animals and the plants themselves have evolved within and rely on. Animals use both upland and aquatic vegetation for all aspects of habitat, including nesting, raising young, feeding, refuge, and migration.

Aquatic vegetation areas are often the most productive aquatic habitats, and include marsh grass meadows, eelgrass meadows, kelp forests, and macroalgae beds. They provide nursery grounds for a huge percentage of the aquatic species.

Riparian areas have been identified as being important as a category, aside from possibly being another habitat of special interest. They serve as habitat like many vegetation areas do, but they have more functions and importance to species than other upland areas. It has been reported that 85 percent of Washington's terrestrial vertebrate animal species rely on riparian vegetation for essential life activities (WDFW, 1997).

Functions of vegetation

The scientific literature shows that intact native vegetation in an area of adequate width performs many critical ecological functions - some of which are provided below, grouped by similarity. SMP Guidelines (WAC 173-26-221(5)(b)) also describe vegetation functions stressing the role of intact native vegetation, as outlined below.

Water quality improvement and infiltration functions of vegetation

- Inhibits surface erosion from surface runoff and flood flows.
- Filters sediment from surface runoff and flood flows.
- Removes and transforms nutrients and harmful substances from surface runoff and flood flows.
- Infiltrates and stores surface runoff and flood flows into groundwater for later release to water bodies.
- Removes and transforms nutrients and harmful substances from groundwater passing through root zones.

Stabilization functions of vegetation

- Provides stabilization to streambanks, lake shores, and marine waters against erosive water forces through root mats and root-strength.
- Contributes in-water woody debris which reduces and slows erosive water forces against streambanks and lake shores through barriers and increased roughness.
- Protects uplands from surface erosion caused by storms and rising sea levels.

In-water habitat contributions and functions of vegetation

- Provides fish with over-water hanging cover from predators.
- Provides shade to help cool the water, especially for shallow margins.
- Contributes in-water woody debris needed for creation of fish habitat.
- Contributes in-water organic matter to support fish food species (insects and invertebrates), and other aquatic life.
- Alters the microclimate at the water's edge to be more suitable for aquatic and riparian species by sheltering from

wind and holding humidity. Microclimate is particularly important for amphibians and many priority species.

- Screens or dampens noise, glare, and human activity from the water.

Land habitat functions of vegetation

- Provides refuge for fish from fast flows during floods, as well as access to new food sources.
- Provides wildlife habitat areas (for feeding, reproducing, and resting) for riparian species, and for upland species that use riparian areas. This includes the small species (such as amphibians, small mammals, birds, and insects) that serve as food for larger species.
- Contributes large woody debris needed for small animal habitat, as well as larger animals.
- Provides a wildlife dispersal and migration corridor along the water to other areas.
- Generates organic matter needed for the foundation of the food web.
- Provides natural processes and food web functions to support wildlife.
- Alters the microclimate near the water to be more suitable for aquatic and riparian species by sheltering from wind and holding humidity. Microclimate is particularly important for amphibians and many priority species.
- Screens or dampens noise, glare, and human activity.
- Provides separation from human activity for sensitive aquatic and upland species.

Beneficial functions of vegetation increase closer to the water

Several studies, best illustrated in a report by Spence et al, have shown that wider vegetation areas perform better than narrower ones, and that a greater percentage of ecological functions occur closer to the water than further from the water on a foot-per-foot basis (Spence et al, 1996). Thus for most ecological benefit, a wider area of vegetation and protection of vegetation closest to water is needed. Consequently, development that is closer to the water has more impacts and needs more compensation than development further from the water.

Developments impact both intact and degraded shoreline functions

Currently available science research about riparian vegetation has several *policy implications, especially for buffers,* that bear on developing mitigation for a project:

- If there is an adequate width of intact vegetation, it can provide functions and protect the resource from most impacts of adjacent development, though some impacts will still exist.
- If an adequate width is used but it does not have intact vegetation, the area cannot provide the functions nor protect the resource from adjacent development and there will be impacts.
- If development takes place within the needed vegetation width, whether intact or not, there will be impacts.
- When development already exists within the needed vegetation width, the vegetation is both degraded and there is not enough width. Additional development in the area will increase the impacts.

Thus, almost all development has negative impacts. Expansion of existing development on degraded sites, new development on vacant land, and redevelopment for different uses all adversely affect shoreline resources and functions. Even existing development can continue to cause impacts to ecological functions.

Even when riparian vegetation is degraded, it still performs functions at a dampened level, depending on the amount of degradation. For example, lawns can provide better animal feeding, runoff treatment, and other functions than paved surfaces and structures. New impervious surfaces and more intensive use will degrade these even further. Thus the remaining functions can still be impacted by new development.

Blocks of intact natural areas and areas of intact native vegetation (including buffers and aquatic vegetation) form the best habitat areas. Development, with its clearing, grading, and construction of structures, removes vegetation and habitat causing a loss of shoreline ecological functions in these ways:

- Adding new structures, additions, or impervious surfaces, and removing or simplifying vegetation (i.e., cutting trees, replacing shrubs with lawn, and paving) can result in habitat impacts. Higher value habitat areas and migration pathways are eliminated or replaced with lower value areas, until the most simplified areas (open impervious surfaces) have only limited value for migration pathways and separation areas. More complex areas for nesting and refuge are most susceptible to loss.
- Substituting native vegetation with non-native species, or their total removal, results in a loss of food sources for the entire food web. For example, many native insect species cannot effectively use non-native vegetation for food. Reductions in insect populations then affect fish that feed on them.
- Natural processes, insect food sources, and food web functions are reduced or eliminated with progressive removal of complex vegetation elements.
- Species (large and small) capable of using degraded areas are greatly reduced with greater degradation.
- Microclimate is altered for species currently using the site.
- Removing or simplifying vegetation near the water reduces the root strength and root mats that provide bank stabilization. It also increases sun exposure on shallow water areas and heats them.

WATER AND SEDIMENT MOVEMENT

The dominant shoreline physical factor is the presence and action of water, including its influence on the nearby lands. Water and sediment movement are the drivers of aquatic habitat and create the erosion forces that concern shoreline landowners. In the case of rivers and streams, water flows mobilize and deposit the sediments, including gravels that create in stream habitats for salmon, steelhead, and other species.

Most shoreforms are created by wave and current action. On marine shorelines, wave action moves most of the sediment that build-up beaches, spits, and other shore forms and habitats. Sediment is often contributed by rivers and streams and the erosion of shore formations including dunes and bluffs. Along the edges of Puget Sound, drift cells can be identified as discrete units in which littoral drift moved sediment from sources such as feeder bluffs to depositional areas such as beaches or spits.

Lake waves also move sediment, but the waves are generally smaller and move less sediment. In the right conditions they create beaches and other depositional features.

Development adversely impacts shoreline water-related functions in these ways:

- ***New structures and impervious surfaces*** increase runoff volumes, remove vegetation, remove native soils that absorb water and reduce the area available to infiltrate those volumes. These impacts may be partially mitigated through storm water ordinances. However, storm water regulations generally only address increased peak runoff volumes, not the other impacts (Ecology, 2005b). This is changing with new requirements for low-impact development techniques that also address storm water quality. In addition, small developments are only required to comply with some of the storm water requirements, thus reducing the ability of those regulations to address the full range of impacts.
- ***Grading and vegetation removal*** can cause increased runoff to be focused into smaller receiving areas, thus increasing the erosive power and sediment carrying ability of the surface runoff in those areas.
- ***Removal of vegetation*** reduces the ability of areas to filter sediment and nutrients from flood waters and allows larger volumes of surface water runoff passing over the site. Less native soil and vegetation root structure is available to treat groundwater.
- ***Installation of bulkheads*** and shoreline stabilization structures cut off sources of sediments that nourish beaches and reduce upper beach habitat. These forms of hard armoring continue to increase in Puget Sound (See Side Box on page 63).
- ***Individual projects add up*** creating decreased infiltration overall in a drainage basin, changing the hydrology of the basin, and increasing winter flows and deceasing summer and fall flows, resulting in water quality problems and degraded aquatic habitats.

GROUNDWATER MOVEMENT

Human activity can alter the groundwater patterns, drain groundwater, lower the water table and thus impact shorelines and critical area water features that depend on groundwater.

These features include:

- Springs and wetlands at the base of floodplain and marine terraces, and at the base of hillside slopes and marine bluffs.
- Floodplain wetlands and marine backshore marshes.
- Streams and ponds.

In some situations, increased water input to groundwater can jeopardize slope stability, or increase soil saturation conditions.

While water and sediment movement influence in-water areas more than groundwater dynamics, groundwater level and movement often have the stronger influence on wetland, floodplain, and near-water upland areas. Groundwater movement in deep aquifers can play a role in shoreline hydrology (cliff seeps and underwater inputs), but it is *shallow aquifers* that most influence shorelines. Shallow aquifers are generally not confined between impervious layers of rock and can receive direct water recharge through the soil from precipitation and irrigation.

Examples of how development disrupts or alters groundwater flow include:

- ***Subsurface structures*** (like walls) can block shallow groundwater flow, which increases groundwater elevation on up-gradient face and sides, and decreases elevation on down-gradient face and sides. This can cause problems such as disruption of baseflow needed for streams and wetlands.
- ***Excavated hillsides*** can drain groundwater onto the excavation surface (forming springs), up-gradient groundwater drains and the slope all around the excavation steepens to feed water faster into the pit. Draining continues until input and output balance. Down-gradient areas that were fed by the interrupted and captured flow are also impacted.
- ***Ponds excavated in flatter areas*** (i.e. mines) can drain up-gradient groundwater elevations and increase the surrounding groundwater slopes till they meet the final pond level (or the bottom if the pit is pumped dry). The pond surface lies flat and equalizes at the elevation of a surface outlet. If there is no surface outlet, the pond elevation increases till it is above the previous groundwater

elevation on the down-gradient side. This increases groundwater outflow. The pond elevation stabilizes at a point that increased down-gradient outflow can equal the increased up-gradient inflow. In normal conditions, the pond elevation will stabilize at an elevation where the elevation drop on the up-gradient side generally equals the elevation increase on the down-gradient side. Changes in earth porosity around the pond can change the balancing process.

- ***Ditches excavated into shallow groundwater areas*** can intercept and drain groundwater – converting it to surface flow, like a spring. The elevation of groundwater all around the ditched area will drop to the elevation of the ditch bottom as long as it continues to provide a surface outlet. The bottom of the ditch can then form a stream-like feature and even form wetland characteristics similar to a floodplain channel and wetland corridor. Using floodplain channels as ditch locations increases the effect.
- ***Trenches excavated for linear facilities*** (i.e., pipes) can intercept the groundwater table. The native excavated earth may have layers with different porosity, which are then mixed during excavation and replaced into the trench after construction. This can increase or decrease porosity in the groundwater part of the trench. In addition, the construction practices and facilities themselves can change the effective porosity. If the porosity of the trench is changed, it will affect local groundwater patterns.
- ***Irrigation of yards and agriculture as well as septic system inputs*** on a bluff or cliff can elevate the groundwater table and increase aquifer flow off the face of the bluff or cliff. Additional water changes the incidence of slope failure. Where such failures previously happened only during major precipitation events, the addition of the human inputs can elevate smaller, more frequent precipitation events to a higher risk.

In general, these changes in groundwater flow cause increased or decreased water inputs into wetlands, ponds, creeks and other surface features, changes in slope stability, and other impacts which affect shoreline ecological health.

DEVELOPMENT AND HUMAN IMPACTS ON THE SHORELINE ENVIRONMENT

Whatever the condition of the physical habitat, human presence adds additional impacts. Areas that are highly altered with intense development have low levels of ecological functions, but if there is no human presence (e.g. an abandoned industrial site), wildlife can use the remaining functions. Intact natural areas have high levels of ecological function, but if they are subject to constant and intense human presence (e.g., parts of an urban hiking park), wildlife will not use the functions.[9]

The effect of human presence is best illustrated by examining development in largely intact sites. Development injects human, vehicle, and pet activity in and near wildlife habitat areas, including areas intended to be buffers. While there are a few species that can tolerate human presence, and even some that thrive (some becoming pests), regular human presence and pets generally drive most wildlife out, making the active use area unusable for habitat.

Human presence impacts

- Human presence and activity impacts or drives off fish and wildlife, especially species at the top of the food chain. Larger residences typically mean more people on the property, whether family members or guests.
- Pets prey on or drive off wildlife. More family members increase the likelihood of having more pets.
- Regular disturbances that cause animals to move away from human contact, referred to as flight, accumulate to create an area of avoidance that wildlife preferentially avoids as a general (not exclusive) rule. The area of avoidance degrades the existing habitat functions based on the intensity of disturbances.
- Machinery and vehicular noise drives off fish and wildlife. More people on the property increase the likelihood of having more machines and vehicles – including automobiles, watercraft, yard machinery, and recreational vehicles.
- Operation of vehicles contributes pollutants from their emissions and leaks.
- Chemicals and fertilizers used in homes and yards can drift or runoff into surrounding areas. Larger structures and grounds increase the use of chemicals.
- Night lighting impacts or drives off fish and wildlife. Larger structures and grounds typically increase the amount of exterior night lighting and escaping interior light.

Hard armoring in Puget Sound – the recent story

WDFW's Habitat Program assessed 980 shoreline armoring Hydraulic Project Approvals that were issued from January 2005 through December 2010 to determine the status of hard armoring changes along the edges of Puget Sound. The assessment included new, complete removal, and complete

9 *For studies on the impact of humans on habitat please see the following compilations of scientific studies:*
Gulf of the Farallones, National Marine Sanctuary. Disturbance Concerns and Conservation Efforts. Retrieved from http://farallones.noaa.gov/eco/seabird/pdf/news/journal/disturbcon.pdf
Massachusetts Land Trust Coalition. References from Recreation Impacts: What Science Tells Us About Managing Conservation Lands. Retrieved from http://massland.org/files/reation_impacts_references_for_land_managers.pdf
Friends of Boulder Open Space. Bibliography Regarding the Effects of Recreation on Natural Resources and Habitats of Open-Space Lands. Retrieved from http://www.friendsofboulderopenspace.org/recreation_effects.php
Audubon Society. Human Disturbance Literature (partial listing). Retrieved from http://web4.audubon.org/bird/iba/iba_resources/References/Disturbance%20Literature_April2007_NC.pdf
Massachusetts Land Trust Coalition. References from Recreation Impacts: What Science Tells Us About Managing Conservation Lands. Retrieved from http://massland.org/files/reation_impacts_references_for_land_managers.pdf
Friends of Boulder Open Space. Bibliography Regarding the Effects of Recreation on Natural Resources and Habitats of Open-Space Lands. Retrieved from http://www.friendsofboulderopenspace.org/recreation_effects.php
Audubon Society. Human Disturbance Literature (partial listing). Retrieved from http://web4.audubon.org/bird/iba/iba_resources/References/Disturbance%20Literature_April2007_NC.pdf

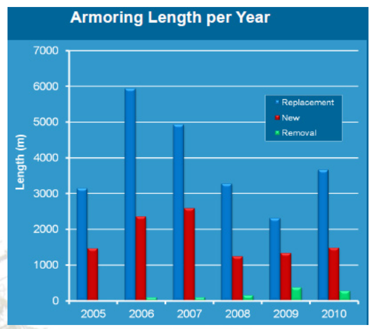
Side Box

STATUS OF SHORELINE ARMORING IN PUGET SOUND

Puget Sound Partnership Goal for Reduction of Hard Armoring

In 2011, recognizing the critical need to reduce hard armoring along beaches, lakes and rivers, the Puget Sound Partnership – the state agency charged with recovering the health of the Sound's ecosystem – adopted the following goal:

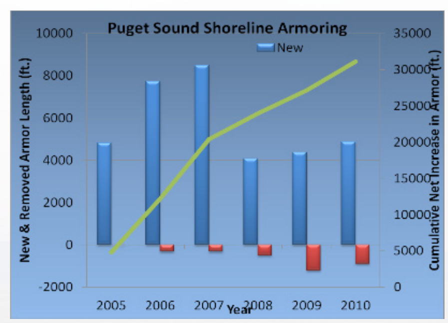
From 2011 to 2020, the total amount of armoring removed should be greater than the total amount of new armoring in Puget Sound (total miles removed is greater than the total miles added).

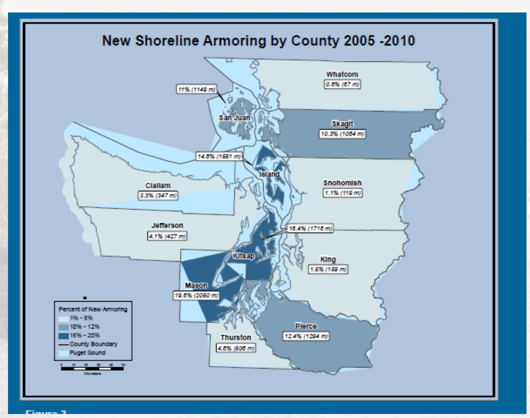


replacement projects, but not repair and maintenance projects. They found that significantly more armoring was being built than being removed leading to a net cumulative increase of 5.9 miles. During the same time period 14.45 miles of replacement armoring was installed (see graphs to right). The counties with the highest percentages of new armoring were Island, Kitsap and Mason, totaling 51% (see map below). The counties with the highest percentage of replacement armoring were Island, Kitsap and Pierce, totaling 59%.

Who are doing armor projects?

The Habitat Program found that the majority of new armor was constructed for single-family residential projects (76%), followed by government installations (14%), non-profit (5%), commercial (3%) and multi-family (2%). Government properties led on armor removal (63%), followed by single family residential (25%), and nonprofit (12%).





Source: Carman, R., Benson, B., Quinn, T., and Price, D. (2011). *Trends in Shoreline Armoring in Puget Sound 2005-2010.* 2011 Salish Sea Ecosystem Conference. Washington Department of Fish and Wildlife.

Water quality impacts

Surface runoff from lawns and stormwater outfalls and their pollutants have significant impacts in the nearshore. Treated wood (including creosote and ACZA) in timber piles leach toxic pollutants into the surrounding waters that can harm or kill fish and other aquatic organisms. Biological effects to aquatic species from the toxins found in wood treatments, herbicides, pesticides and stormwater have been documented by NOAA research and other Puget Sound scientists. These findings have been incorporated into SMPs, considering, for example, the type of materials used for in-water structures. ESA habitat and species biological needs overlap with the local, state, and federal permit requirements in areas with ESA-listed species. For instance, a Sec 7 ESA consultation will require the treatment of stormwater effluent to discrete biological thresholds which are significantly more stringent than those required by Ecology or EPA. Since SMPs apply to ongoing activities that require five year permit renewals (i.e., Stormwater NPDES permits), SMPs can require measures to protect shoreline functions when those permits are renewed.

Looking specifically at SMPs, Table 3 provides a cross reference between the uses listed in the SMP Guidelines (and thus are in SMPs) and the range of alterations that are possible. While any combination of alterations is possible for any use, the table identifies the most common ones. As described in the SMP Guidelines, modifications are alterations that are undertaken in support of a use. The guidelines discuss seven categories of modifications in detail; these modifications often occur in-water (in Table 3 in-water modifications are shown in italics). Many other alterations are done in the course of establishing a use and the impacts of these must be mitigated.

SUMMARY OF IMPACTS OF DIFFERENT TYPES OF DEVELOPMENT ON SHORELINES

The Whatcom County SMP Update Shoreline Inventory and Characterization report contains a comprehensive table that summarizes the key shoreline-related ecological processes and their responses to alterations (Table 2).

Looking specifically at SMPs, Table 3 provides a cross reference between the uses listed in the SMP Guidelines (and thus are in SMPs) and the range of alterations that are possible. While any combination of alterations is possible for any use, the table identifies the most common ones. As described in the SMP Guidelines, modifications are alterations that are undertaken in support of a use. The guidelines discuss seven categories of modifications in detail; these modifications often occur in-water (in Table 3 in-water modifications are shown in italics). Many other alterations are done in the course of establishing a use and the impacts of these must be mitigated.

Table 2. Key Processes and Responses to Alterations *(from Whatcom County SMP Update Shoreline Inventory and Characterization, 2006)*

Process	Mechanism	Primary Structural Response to Impairment	Secondary Responses
Hydrology	▪ Infiltration and recharge ▪ Surface runoff ▪ Surface water storage ▪ Groundwater	▪ Increased frequency and duration of flow ▪ Decreased baseflow. ▪ Increased peak flow, channel erosion, morphological homogeneity ▪ Increasd duration and decresed volume of low flow	Peak flow: ▪ Channel incision ▪ Loss of habitat complexity ▪ Increased bedload transport ▪ Decreased biodiversity and productivity ▪ Increased redd scour and juvenile flushing ▪ Reduced egg to emergence survival ▪ Baseflow: ▪ Migratory barriers ▪ Decreased habitat availability ▪ Increased temperature
Sediment supply	▪ Inputs ▪ Storage	▪ Substrate fining or bimodal substrate distribution ▪ High total suspended solids (TSS) and turbidity ▪ Increased coarse sediment supply ▪ Increased channel instability	▪ Reduced hyporheic connection nad volume ▪ Lower BIBI score (assessment of stream bugs) ▪ Increased interstitial infilling ▪ Degraded spawning grounds ▪ Aggraded and entrenched channels ▪ Reduced juvenile salmomid refugia habitat ▪ Increased migration avoidance/delay
Water quality (toxic chemicals, phphosphorus/ nitrogen, fecal matter)	▪ Inputs ▪ Starage/ transformaton/loss	▪ Increased concentrations (303(d) listings of impaired waterbodies)	▪ Increased mortality ▪ Increased biological oxygen demand (BOD) and eutrophication ▪ Increased shellfish contamination incidents ▪ Reduced species richness ▪ Drinking water contamination ▪ Sub-lethal effects such as impaired homing abilities, reduced growth or reproductive success)
Organic inputs	▪ Large woody debris inputs	▪ Riparian disturbanc ▪ Forest cover loss on landslide-prone areas	▪ Biotic energy loss ▪ Decreased large woody debris density ▪ Reduced habitat complexity (pool density and quality) ▪ Decreased sediment and organic matter storage and sorting ▪ Decreased biodiversity and productivity
Heat/light	▪ Inputs	▪ Riparian disturbance (decrased shading) ▪ Greater temperature extremes (increased 303(d) listings of impaired waterbodies)	▪ Increased primary productivity ▪ Reduced dissolved oxygen ▪ Migration barriers ▪ Reduced species richness ▪ Reduced growth ▪ Increased disease susceptibility ▪ Decreased egg viability

Table 3: Summary of impacts of different types of development modifications and alterations associated with uses. In-water modifications are shown in italics.

Types of Modifications or Alterations (See WAC 173-26-231 for descriptions of some modifications)	***Uses*** (excluding expansions of existing uses within the same footprint)											
	Resource Uses				Development Uses				Other Uses			
Blank = Uncommon or minor impact O = Common impact X = Primary or defining impact	Agriculture	Aquaculture	Forestry	Mining	Recreation	Residential	Commercial	Industrial	Transportation (not central)	Utilities (not central)	Boating Facility	In-Water Structural Use
Vegetation/habitat/species alterations and conversion	X	O	X	X	O	O	O	O	O	O	O	O
Human presence and activity associated with permitted use	O	O	O	X	X	X	X	X	X		X	O
On land grading - including beach enhancement	O	O	O	X	O	O	O	O	O	O	O	O
In-water grading – including dredging and filling		O		X					O	O	X	X
Shoreline stabilization	O			X	O	O	O	X	O	O	O	O
Impervious surface structures (generally)					X	X	X	X	X		X	O
Building structures					O	X	X	X			O	
Assorted other structures and alterations	O	O	O	O	O	O	O	O	O	X	O	O
Linear facilities - Underground	O				O	O	O	O		X	O	X
Linear facilities - Surface	O			O	O	O	O	O	X	O	X	X
Linear facilities - Aerial					O	O	O	O	O	X	O	X
Boating structures and *piers/docks*					O	O		O			X	
Breakwaters, jetties, groins, weirs				O					O		X	O
Dams	O							O				X
Restoration and enhancement*												
***Aquaculture*-specific activity not covered in other sections**		X										
Other in-water structures not otherwise listed								O		O		O
***Dune modification* (south pacific coast only)**					O	O	O					

** Restoration and enhancement is undertaken separately to help restore shoreline ecological functions and in this way is like a use. It is also undertaken as a mitigation measure to any use that would otherwise result in a net loss of shoreline ecological function. In this context it is a modification. It can be undertaken in the water and on the uplands.*

8. SHORELINE DEVELOPMENT IMPACTS

The following pages include brief summaries of impacts related to proposed shoreline development projects and activities.

SOURCES FOR THIS CHAPTER

The impact information is drawn from federal and state documents. A core group of published citations were used and are listed below. Throughout this chapter, endnotes are used for additional citations.

- Washington Department of Fish and Wildlife. (1997). *Management Recommendations for Washington's Priority Habitats: Riparian*. Written by K. L. Knutson and V. L. Naef.
- Washington Department of Fish and Wildlife. (2009a). *Protection of Marine Riparian Functions in Puget Sound, Washington*. Prepared by Rachel Gregg, and P. I. Pete Granger, Washington Sea Grant.
- Washington Department of Fish and Wildlife. (2009b). *Landscape Planning for Washington's Wildlife: Managing for Biodiversity in Developing Areas.* Written by Jeff Azerrad, J Carlton, J Davis, T Quinn, C Sato, M Tirhi, G Wilhere, and S Tomassi.
- Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. (2001). *White Paper: Marine and Estuarine Shoreline Modification Issues*. Written by Gregory D. Williams and Ronald M. Thom.
- Washington Department of Fish and Wildlife. Washington State Aquatic Habitat Guidelines Program. (2010, revised from 2007 version). *Protecting Nearshore Habitat and Functions in Puget Sound.* Prepared with EnviroVision and Herrera Environmental.
- Washington Department of Fish and Wildlife. (2003). *Integrated Streambank Protection Guidelines*. Written by M. Cramer, K. Bates, D. Miller, K. Boyd, L. Fotherby, P. Skidmore, and T. Hoitsma for Washington State Aquatic Habitat Guidelines Program.
- Washington Department of Fish and Wildlife. (2009c, March). *Compiled White Papers For Hydraulic Project Approval Habitat Conservation Plan (HCP).*

Development Activity and Impact:

UPLAND DEVELOPMENT: REMOVAL OF VEGETATION AND/OR HABITAT

IMPORTANCE

Vegetation serves as one of the most important habitat components even when the vegetation is degraded. Riparian vegetation is most valuable when it is close the water. Habitat that has been specially identified as more important includes riparian vegetation, Priority Habitats and Species (PHS) vegetation habitats, and Washington Rare Plant Species. Some areas are naturally non-vegetated and yet provide valuable habitat value. Examples include sandy marine shores, marine feeder bluffs, caves, cliffs, and talus slopes, herbaceous balds, sparsely vegetated herbaceous steppe, and eastern Washington inland dunes which are all PHS habitats.

The habitat value of native vegetation has been documented in peer-reviewed scientific studies. For example researchers studied the insect and bird abundance in six matched pairs of properties in the Pennsylvania Piedmont. “One site-pair member was landscaped conventionally, with large mowed lawns of cool-season Eurasian grasses, Asian shrubs and understory trees, and a native canopy. The other was landscaped entirely with native ornamentals at all vegetative levels (canopy, understory, shrubs, and grasses).” These types of landscaping can be found along Puget Sound shorelines. The percentage of total vegetation cover did not differ materially between the native and conventionally landscaped sites. The number of butterflies (Lepidoptera) was four times greater on the sites landscaped with native plants than on the sites that were conventionally landscaped. The number of butterfly species was three times greater on the sites landscaped with native plants than on the sites that were conventionally landscaped. Bird abundance, species richness, biomass, diversity, and native nesting pairs “were all significantly greater on properties landscaped with native species than on those with conventional landscaping ....” The researchers also wrote that “[w]hat is becoming more apparent is that by reducing insect food availability, non-native plants are indirectly reducing bird abundance in natural systems ....”

The reduction in insects affects more than birds. Terrestrial insects are an important food source for Chinook salmon and cutthroat trout. Removing native vegetation and substituting conventional landscaping will indirectly reduce Chinook salmon and cutthroat trout abundance along with other species. This is why native vegetation must be maintained and planted in buffers and mitigation sites. Otherwise, a net loss of shoreline ecological functions will occur.

See also:

- In wildfire hazard areas, additional vegetation removal impacts might occur (page 70).

IMPACT

Vegetated areas. Since vegetation provides a major component of upland habitat, riparian vegetation greatly reduces or eliminates those habitat functions, as well as other ecological functions. Replacement vegetation plantings cannot compensate for native vegetation losses by using a 1:1 ratio, though it could for other types of losses. Lost mature vegetation functions will not be replaced by new plantings for many years or even decades. New plantings have an undeterminable failure rate, and monitoring and enforcement has never been foolproof. The number of riparian vegetation/habitat functions and their importance increase as one moves closer to water.

Naturally non-vegetated areas and habitat structure. Surface clearing and removal of non-vegetated areas and structural habitat elements causes impacts to processes, habitat functions, and animals in those habitats. Examples include logs, woody debris, and rocks that provide structural habitats. Occupying and altering (without grading) naturally non-vegetated upland areas with equipment, structures, or intense human activity cause adverse impacts.

Placement and size of structures. Shoreline development includes facilities and structures related to the water use and enjoyment such as stairs, gazebos, viewing decks, and boat storage facilities. The size and placement of these facilities should be considered to reduce clearing. For example, boat storage structures can be efficiently sized. A 20 sq. ft., 3 ft. high box can store two small kayaks on edge or stacked (3X7), or a long canoe /kayak (2X10). A 30 sq. ft. shed that is 10 ft. tall can store a modest variety of equipment, especially vertically. Larger buildings need to be outside the buffer, unless a variance is obtained, and should be limited in size.

In reviewing site plans, vegetation clearing needs should be considered for all features including fences and septic system installation.

End note references for this section: 1 2 3 4 5 6 7 8

Development Activity and Impact:

UPLAND DEVELOPMENT: OTHER IMPACTS FROM STRUCTURES AND NEW IMPERVIOUS SURFACES (IN ADDITION TO VEGETATION AND HABITAT REMOVAL IMPACTS)

IMPORTANCE

In addition to ecological impacts due to vegetation and habitat removal, the construction of structures or impervious surfaces create other adverse impacts including water quality, increased storm water runoff, artificial lighting, and other impacts. New or increased human presence adds an additional impact to the physical alterations and use areas by reducing animal species' opportunity to use the remaining habitat functions.

See also:

- Many features associated with development will also have linear feature impacts including roads, driveways, sidewalks, power lines, sewer lines, well pipes, and utility lines (page 72).
- Upland development can include grading (page 70) and in some cases excavation that impacts groundwater (page 71).

IMPACT

Water quality: impervious surface. New paved areas, buildings, and other impervious surfaces greatly increase the amount of storm water runoff. Oil leaks and other vehicle related pollutants can run off from driveways and parking pads. If the project is large enough, stormwater control facilities such as drains may be needed; these may add their own impacts. Oil and toxic chemicals can cause reproductive and growth problems for eelgrass and kelp.

Water quality: Septic systems. Tanks and drainfields occupy space and may clear vegetation and require tree removal. They are often gravity fed and placed downhill from the main structure and closer to the water. Pumped systems have better siting alternatives, and all fields can be configured creatively to minimize impacts (such L-shaped or long and narrow to fit between the house and vegetation). Well-functioning septic systems are good at some types of treatment (microbes) and not good at others (nitrates & household chemicals). Septic systems near the water can have water quality impacts. All septic systems have a limited life, and will eventually fail unless maintained and repaired. Some components, such as drainfields must be replaced.

Wildlife impediment. Buildings can wall off rivers, lakes, and other shorelines and prevent wildlife movement. When applied at high density or in narrow lots along the water, structures can act like a fence to limit the movement of wildlife between the water and riparian areas and blocks of intact upland vegetation and habitat areas in non-urban areas. This effect can be caused by single structures covering extensive areas, or with a linear orientation parallel to the water line, or, more commonly, by close-set residences that create a "wall of houses" effect.

In addition, *fences* using panel construction (i.e., chain link, solid board, concrete block) can obstruct wildlife migration and movement and can serve as a barrier to surface water and flood flows. Chain link and close set wire fences will screen and capture flood debris, clog up, and obstruct flood flows; then they fail and create hazards as they ball-up or entangle objects and animals. Construction of the fence often requires clearing a corridor, which creates vegetation removal effects.

Artificial lighting. Light poles and lighting have impacts on fish and wildlife habitat by altering animal behavior when the light is confused for moonlight or daylight. Lights also alter insect behavior as they are attracted to human areas, which may affect their populations, and in turn alter animal feeding patterns toward human areas, or in other unnatural ways.
[Also consider impacts under linear features section for power lines, though they may be de minimis at the site scale]

Wells. Wells can have great cumulative impacts since many houses in an area can accumulate to large water withdrawals. Shallow wells will drain the shallow aquifer that feeds and is fed by the nearby water bodies and wetlands, thus reducing surface flows. This effect is stronger the closer to the water body the well is. In marine areas shallow wells contribute to saltwater intrusion. Even with out-of-kind compensation, the effects on water resources will still accumulate.

Human activities. The area of avoidance resulting from human, pet, and vehicle (including off-road) activity extends well beyond the physical alterations. Roaming dogs and cats can be especially impactful to wildlife.
Decks, pools, ball courts, hot tubs, child playsets, gazebos and similar constructions are places of focused human gathering and activity that impact wildlife habitat based on intensity. New or increased human activity (adjacent to new development) can also include incidental or regular traverses into areas that formerly were unimpacted. Low, moderate, and high levels of human

foot traffic and all vehicle traffic cause compaction of the soil and aquatic beds. Some soils can resist compaction to some extent (sandy beaches, gravel, bedrock), but most soils are mixed composition that compacts easily under repeated foot traffic and almost all vehicle traffic. Compaction takes extended time to recover, as evidenced by park trail rehabilitation and wildland recovery efforts. The impacts on the ground surface, subsurface, and biotic processes and functions can be similar to those of grading and impervious surface (such as roads).

The effect of human activities degrades existing habitat functions to a lower level and already degraded habitat functions are degraded further. The effect decreases in intensity with distance. The combined alert distance and flight initiation distance vary by species, but are often around 200 feet. Areas of avoidance will vary by the frequency of human activity. Use both attributes as a rough measure to calculate additional area of effect around the project site, though this only partially accounts for pet roaming encroachments.

End note references for this section: 9 10 11 12 13 14 15

Development Activity and Impact:

UPLAND DEVELOPMENT: IF IN WILDFIRE HAZARD AREAS

IMPACT

New development in areas of wildfire hazard may require vegetation management around structures. Clearing all vegetation is often preferred for fire control, which may conflict with vegetation protection requirements. Clearing native vegetation for fire hazard reduction causes vegetation impacts. Wildfire setback regulations have alternatives to clearing that allow vegetation management using species and pruning standards.

Applicants with existing development may also desire to provide wildfire hazard setbacks by clearing native vegetation.

End note references for this section: 16

Development Activity and Impact:

UPLAND DEVELOPMENT: GRADING (EXCAVATION, FILL, BEACH AND DUNE DISTURBANCE, AND DREDGE DISPOSAL)

IMPORTANCE

On-land grading and other alterations that eliminate or degrade soil functions have many different impacts. Even with avoidance and minimization, most alterations will have remaining impacts to biological functions in addition to any vegetation clearing impacts.

The surface soil typically provides the basic foundation for vegetation and biotic communities. The soil is the repository of organic matter, and it provides a loose substrate for plants and animals to live in. It also houses extensive microbial, invertebrate, and insect activity that enriches the soil for use by plants and animals, including as a food source. Soil depth varies, but is most productive near the surface. Soil surveys typically consider the top 3 feet to be soil.

See also:

- Excavations that impact groundwater (page 71).

IMPACT

Filling and excavation eliminates the subsurface habitat and most of the functions that soil provides. Simple surface grading blends and mixes the soil structure. Deeper excavation normally blends soil throughout the other excavated earth thereby eliminating soil structure. Covering the soil with earthen fill, structures, impervious surfaces, or compacted human use areas eliminates or degrades the soil. Grading can increase erosion potential by changing the slope altering water flow and erosion potential, impacting water quality. Increased erosion also causes sedimentation in other places. Eroded channels tend to propagate uphill and downcut into the slope, which increases the concentration of flow. Grading in areas with surface drainage can alter the natural drainage patterns and can result in unnatural conditions.

These impacts are well documented for road construction, the most widespread use of grading alterations, but they also apply to smaller sites with smaller scale impacts. Another form of disturbance with similar impact is periodic substrate alteration, such as for agriculture.

Filling areas of focused surface flows: Pathways of concentrated surface flows, such as flood channels, gullies or swales, and dry stream beds, pass water rapidly through the site and are naturally configured to handle focused flows. Where unobstructed flow meets an altered and obstructed flow, the flow is redirected onto other sites with soil compositions that are unaccustomed to that intensity of flow. This will result in erosion and sedimentation along the new flow path, and cause damage to human structures in the path. Floodplain alterations can reduce the overall flood flow capacity both at the site and the local area, and increase the area of local floodplain needed to continue passing the flow.

Beaches and dunes. Beaches and dunes are important plant and wildlife habitats and may have other associated features such as the interdune wetlands. In addition, many coastal residents and businesses rely on the ground water resources of the dunes for drinking water. Some development, including beach nourishment, dredge disposal, and beach development, directly changes beach and dune features (see Appendix 5 for description of dune features). Like other upland grading alterations, these activities eliminate habitat, soil, and other functions and often go without compensatory mitigation.

End note references for this section: 17 18 19 20 21 22

Development Activity and Impact:

UPLAND DEVELOPMENT: IF EXCAVATING IN SHALLOW GROUNDWATER AREAS

IMPORTANCE

Shoreline and critical area locations often have shallow groundwater levels. Excavation below the groundwater table can change groundwater patterns, which usually lowers groundwater levels and rarely raises them.

See also:

- Linear features (walls, trenches) that interact with ground water (page 72).

IMPACT

Alterations and excavations that lower a groundwater table can impact streams, springs, seeps, or wetlands that depend on the groundwater for their base flow. Wetlands will shrink and lose riparian vegetation. Streams will have reduced flows and possibly lose their riparian vegetation. Loss of seeps and springs found along banks and bluffs and flow down to the beach cuts off support to various biotic communities. All excavations into groundwater that are (a) in floodplains, (b) near streams and rivers, (c) down-gradient from wetlands, lakes and ponds, or (d) subject to marine water flow-through (rarely) also have high likelihood of intercepting the hyporheic zone. The hyporheic zone is the area of oxygenated groundwater near waterbodies caused by groundwater and surface water mixing and interchanging, which provides habitat for micro invertebrates and other biota. Water flow through the area influences water quality, and organism movement provides food sources to water bodies and riparian areas. Because groundwater usually moves by gravity, there are distinct implications from alteration for surface aquifers on sloped sites, sites near water features, and sites in floodplains.

Water-loving plants: Groundwater alterations will cause some water-loving native plants lose the water source they depend on, and wither or die. Where normal groundwater elevations (including seasonal cycles) reach near the surface (~3 feet or less), distinct native vegetation and habitat develop that relies on the water. This can occur over a broad area or along a low drainage feature. It can occur on flat or sloped sites – for example floodplains.

Hillsides: Excavated hillsides can drain up-gradient groundwater around the pit to the lowest excavation point. A spring may remain. Down-gradient areas that were fed by newly interrupted and captured flow also have a reduced water table elevation for some distance. Major excavations into groundwater can cause drastic changes to local groundwater patterns both near and distant. Such changes could impact nearby wells using shallow groundwater, wetlands, vegetation habitat relying on shallow groundwater, and drain stream flow.

Breaching an aquitard: Excavating through a non-porous geologic layer supporting the surface aquifer can cause the nearby groundwater to drain through the layer and capture the future ground water flows into the site. Impacts will extend down-gradient and upgradient and prevent the aquifer recharge for some distance.

Flat areas: Excavations into groundwater underlying flatter areas (i.e. ponds and mines) typically result in the creation of open water features. Excavations drain up-gradient groundwater elevations to the final pond level or the bottom of a pumped out pit. Deep excavations that are pumped out can result in temporary, but drastic and expansive changes to surrounding groundwater levels that impact water features, vegetation dependent on shallow groundwater, and shallow wells. Pond surfaces equalize at the elevation of a surface outlet. If there is no surface outlet, the pond elevation will normally balance out at an elevation where the elevation drop on the up-gradient side generally equals the elevation increase on the down-gradient side. They can also create a lake-like environment in a riverine location where one would not normally occur. This may increase the likelihood of stream or river capture (i.e., shifting courses) exposing ground water to increased risk of pollution.

Information need: Impacts related to excavations in areas of shallow groundwater cannot be determined without site-specific information (i.e., groundwater study) and it may not be possible to completely mitigate the impacts. It is useful to consult the area soil survey and other sources to identify if a site is in a shallow groundwater area. If so, require that the applicant identify the highest groundwater elevations and general flow direction. For all deep excavations, require that the depth of groundwater be specifically identified, as well as the geologic conditions that influence it. For excavation into potential hyporheic zones (which should be assumed to exist adjacent to most waterbodies), determine the zone's extent using test wells and water testing. Determine if the excavation will intercept the groundwater table, and if so, determine the extent of change to elevations and inputs to water features and vegetation. Determine area of features and vegetation that will be impacted so that compensatory mitigation can be determined.

End note references for this section: 23 24 25

Development Activity and Impact:

UPLAND DEVELOPMENT: LINEAR FEATURES (ROADS, TRAILS, UTILITIES, WALLS, TRENCHES AND DITCHES, PIPES, DIKES, SUBSURFACE DRAINAGE)

IMPORTANCE

There are great variety of linear facilities, including communication utilities, power lines, sewer and water lines, roads, freeways, railroads, airport runways, flood dikes, ditches and trenches, dikes, subsurface drainage pipes, and surface and underground transmission pipelines. The impacts of such facilities are generally the same as those for limited-site construction projects but with additional impacts related to their long length and their position (underground, surface, and/or aerial). Often primary features are accompanied by associated impacts. For example, underground utilities often have related surface alterations. Surface roads are often accompanied by underground piping, bridges and utilities may have aerial bridges. Aerial utilities usually have associated surface alterations, support structures (though often not of a linear nature) and clearing (some exceptions might be a plow installed utility under a prairie or a long span aerial cable facility). While rare, walls and building structures can have a linear effect as well. Some linear facilities include walls or fences as an accessory element, especially major highways. Trails and roads additionally introduce direct disturbance to wildlife by human activities.

See also:

- Vegetation and habitat removal (page 68).
- Impervious surface impacts (page 69).
- Stabilization and support structures for water crossing structures for roads, utilities, bulkheads (page 79).

IMPACT

Linear facilities have a common character in that they can affect an area much greater than the facility itself by obstructing processes and functions that cross the linear facility. While linear facilities can directly impact extensive areas of ground surface because the narrow width may be multiplied by miles of length and can add up rapidly, applying these alterations to long linear facilities corridors generates an additional group of impacts that non-linear facilities do not have. This means that linear facilities can easily have ecosystem-wide impacts much more readily than non-linear facilities. Similarly, linear facilities that run along the path of natural systems can change their speed or character. For example, a power line running down a steep slope can reduce erosion resistance and increase erosion within its corridor. Linear facilities with similar construction relationships will have similar general impacts. For example trench construction has largely the same impact regardless of the type of utility. Elevated berm construction largely has the same impact whether it's for a dike or a road. The main difference is scale. Linear facilities can vary greatly in scale, ranging from residential accessory utilities and driveways to major freeways and power line corridors.

The additional environmental impacts (above and beyond normal construction impacts) of linear facilities are well documented. The most widespread, impactful, and thus best studied, linear structures are roads which bring clearing, filling and excavating, soil compaction, elevation on fill or vertical structures, and sometimes intense activity (vehicles). Utilities often have many of the same alterations that have the same impacts, though they may be at a lower intensity.

Linear clearing impacts. Most linear facilities will require clearing. Additional impacts from the linear nature of these facilities include:

- Fragmentation of large blocks of habitat and intact vegetation by cutting through them.
- Increased predation for animals that don't normally use open spaces, cannot cross, or resist crossing.
- Blockage of routes parallel to shorelines cut off or restricts travel to and from the water for large areas of landscape.
- Creation of a sizable edge effect extends into intact vegetation, changes the micro-climate, and degrades habitat for existing resident species.
- Introduction of invasive species by vehicles and people using roads and trails.
- Stormwater flow alteration, capture, and concentration, with resultant changes to surface erosion patterns.
- Reduced resistance to floodwaters, focusing erosion where vegetation has been cleared, and making the corridor susceptible to the formation of flood channels, channel migration, and avulsion.

Some facilities can minimize vegetation and other impacts. Examples include non-obstructing fences and rudimentary trails - if they avoid vegetation clearing; plow-installed utility cable under a prairie that is allowed to recover from the tractor impacts; and cross valley spans of a power line that needs no clearing.

Surface linear facilities

Surface linear facilities generally use the same group of construction methods that increase in impact as they increase in surface disturbance, increase elevation of fill or use structural walls. Since so many natural processes and functions happen at the surface, it is surface linear facilities that have the greatest potential for impacts compared to other underground and aerial facilities. In addition, within the group of linear surface alterations there is a distinction between parallel and crossing routes. Parallel routes that cut off associated features have the system-wide impacts over the long term, but such impacts often go unnoticed or unmitigated. Crossing routes have much more immediate impacts that are much more visible, though they are typically more local in their effect. Given that the impacts of linear facilities extend far beyond the facility itself, they should be avoided whenever possible. The closer to the water, the greater the impact with the greatest impact being in or at the edge of the water.

At-grade facilities can retard or re-route natural functions such as flood inundation and flow, beach or bank sediment erosion, wildlife movement, and cross-corridor surface sediment movement. The most common examples include most local roads and state routes and the more substantial trails and driveways. Many forms of stabilization are wall-like and obstructive to functions – for example, sea walls, and bulkheads with fill behind to make a level site (see Stabilization Features on page 79). Additional problems from at-grade facilities (in addition to the linear facility problems listed above) include:

- Fragmentation by physical structure. Fragmentation of intact vegetation blocks and obstructions to wildlife movement (see linear clearing impacts) are increased (possibly dramatically, beyond just vegetation clearing) by adding surface structures that can confuse or inhibit animal movement. This is greatly increased for human, pet, and vehicle movement – see transportation specific impacts below.
- Structures and major topographic modifications can severely alter surface water flow (including floodwater) and erosion patterns for a large area, greatly increasing impacts compared to linear clearing. Storm water sheetflow and rivulets are captured and re-routed to larger water channels, which retards erosion in old pathways, and increases it in the new pathways. Changes can significantly alter local patterns.
- Surface connections between water features (streams, ponds, and wetlands) can be rerouted (and even cut off for small or seasonal connections), which can cause direct losses of stream segments and wetlands, and can alter groundwater patterns.
- At-grade alterations can similarly alter floodwater flow patterns by redirecting floodwater to different locations or concentrating the flow. The changes also cause erosion or sedimentation along altered paths. When alterations are within the channel migration zone or near a stream, they are typically protected from damage, and the channels are prevented from moving near the facility using armoring or other stream channel controls. This effectively cuts off the channel migration zone for that area.
- Compaction of the subsurface under the facility is often a purposeful or incidental effect. The result can retard groundwater flow and cause groundwater to elevate till it drains out roadside ditches.

Linear elevated surface structure impacts. These facilities include transportation facilities (i.e., roads and driveways) elevated on fill, dikes and levees, stabilization that is wall-like and obstructive to functions (sea walls, or bulkheads with fill behind to make a level site), walls along freeways, obstructive fences, long structure walls, and close set residences that have a wall of houses effect. These elevated surface structures usually fully obstruct natural functions across the facility - such as flood inundation, beach or bank sediment erosion, wildlife movement, cross-corridor surface sediment movement. Facilities may not be effective in extreme events as even a 100-year dike can be overtopped. These facilities have major impacts to system-wide ecological functions. Impacts from these facilities (additional to those listed above) include:

- Large structures can sever surface water flow and erosion patterns
- Large elevated fill and wall-like structures can sever surface connections between water features.
- Elevated fill and wall-like structures will, at a minimum, alter floodwater flow patterns similar to at-grade facilities; the larger facilities (roads and dikes) are usually designed to specifically do so. This includes impacts to the channel migration corridors. Facilities can cut off large areas of floodplain from the water body, and result in the major loss of associated functions.

Aerial linear facilities (support structures). Aerial linear facilities are mostly utilities, such as powerlines. The great majority of linear aerial facilities are accessory facilities for a primary use – power and communication lines on poles and private water crossings for access roads and utilities. Less common facilities include larger transportation and utility facilities. Rare facilities would include power and communication transmission lines and highway/freeway bridges. Aerial facilities use support structures to hold up the facility and the resulting on-land impacts are mainly determined by the scale of the support structures and of the above-ground pathway.

Trails and roads. In addition to impacts described above (removal of vegetation, wildlife impediment) and water quality problems associated with new impervious surface, trails and roads inject human activity into wildlife areas, including areas intended to be buffers. Trails also introduce pet (mainly dog) activity. Regular human presence, and especially dog presence drives wildlife away from the trail corridor, and degrades the habitat functions to lower levels. While construction of the trail directly impacts a narrow width of land multiplied by the length, human presence significantly increases the wildlife impacts to a wider corridor. The effect can be substantial for busy trails. The effect tends to grow stronger for animals that are larger and more visible, or unable to hide as well. Safe habituation can reduce the effect. Since vegetation closer to the water has more functions and is more important, placing a busy trail parallel to and near the water has significant and system-wide effects on riparian species. Placing spur trails perpendicular to the water to provide access has more limited impacts.

Vehicle corridors are hazards to animals. In addition to the physical presence of vehicles, roadways also introduce noise and fume impacts. These in turn cause wildlife to preferentially avoid the corridor, and only enter it when other better options are not available. The avoidance effect would increase with increased traffic and associated hazards. The result is that roads have vastly greater impacts than utilities, though still less than for surface construction.

Underground facilities

The great majority of linear underground utilities are accessory utilities for a primary use – sewer, septic, and water lines and power and communication cables. When these facilities are located in the immediate vicinity of the primary use, they are not considered linear facilities. Distribution/collection line utilities are less common. There are a variety of basic construction

methods for underground utilities that vary in their impact. Greater extent of digging (depth and width) leads to more impacts and, thus, deep trenching is the most damaging. So, the preference for open country installations is boring, tunneling, or plowing (plowing is most useful for cable installation) rather than trenching.

Material disposal. Linear underground facilities almost always have large quantities of excess material which needs to be appropriately disposed or used in order to avoid ecological impacts. A project plan should include a calculation for excess material and include a disposal plan.

Ditches and trenches interacting with groundwater. Trenches are distinguished from ditches in that they are deeper than they are wide. Trench and ditch constructed utility lines can have significant impacts on groundwater patterns and the natural features that rely on groundwater. Ditches/trenches excavated into groundwater and some utility features will by design or inadvertently intercept and drain groundwater far beyond the facility location. The effect can take the more localized effect of a spring and make it widespread far beyond the ditch/trench location. Canals that carry water seasonally can act as a drain when they are turned off. Furthermore, in construction of ditches/trenches, the excavated material is mixed during excavation and then replaced after construction. The porosity of the ground can change and affect local groundwater patterns. Utilities in trenches are often placed on a bed of pea-gravel or similar material which increases porosity. Increased porosity below groundwater elevation will intercept and drain out the groundwater along the trench by acting as a french-drain. The groundwater elevation is lowered in the area, affecting local wetlands, streams, and native vegetation that rely on the groundwater. In cases where the porosity is decreased by the excavation activity, the trench will act to obstruct groundwater flow and increase groundwater elevations on the up-gradient side.

Subsurface structures: Excavation for and construction of subsurface structures (like walls) can block groundwater flow, increase groundwater table elevation on the up-gradient face and sides, and decrease elevation on the down-gradient face and sides.

Subsurface drainage facilities: Underground drains act like surface ditches, but they are placed underground where their effect is hidden. They are specifically intended to drain the groundwater table for some purpose. They may include stand-alone perforated pipe drainage systems often found in agricultural areas, or they may be an “under-drain” placed below a utility line to lower the groundwater table. They have the normal construction impacts of grading and mixing of trench material. These facilities, however, can have a large effect of lowering groundwater table elevations across broad areas far from the facility itself, along with adverse impacts on wetlands, streams, and vegetation. In addition, the outlet for the drains can potentially cause surface water flow problems.

End note references for this section: 26 27 28 29 30 31 32 33

Development Activity and Impact:

IN-WATER DEVELOPMENT: REMOVAL OF AQUATIC VEGETATION AND HABITAT

IMPORTANCE

Vegetation serves as one of the most important habitat components in aquatic areas, including tidelands, lake beds, and river beds, even when the vegetation is degraded. Almost all marine aquatic vegetation is critical saltwater habitat (kelp, eelgrass, vascular plants). Habitat that has been specially identified as more important includes critical saltwater and freshwater habitat vegetation, Priority Habitats and Species (PHS) vegetation habitats, and Washington Rare Plant Species.

Non-vegetated marine habitat areas are important to protect. They are usually more prevalent than aquatic vegetation habitats. These include mudflats, and forage fish spawning beaches (critical saltwater habitats); sandy beaches, intertidal areas, rocky shores, habitat forming species sites such as oyster/barnacle beds, and estuaries and pocket estuaries. While aquatic vegetation receives much attention, structural aquatic habitat elements and especially non-vegetated habitat areas also need consideration and protection from development impacts. Their importance and impacts to them have been documented in the scientific literature. Unfortunately, unvegetated areas do not get the same protection (especially compensatory mitigation) as vegetated areas, especially in relation to dredging.

See also:

- In-water grading (page 82).
- Overwater coverage (page 76).
- In-water stabilization and support structures (page 79).

IMPACT

Clearing native vegetation greatly reduces or eliminates habitat functions in the aquatic environment. Replacement vegetation plantings cannot compensate for native vegetation losses by using a 1:1 ratio. New plantings have an undeterminable failure rate, and monitoring and enforcement has never been foolproof.

Removal of non-vegetated elements causes impacts to natural processes, habitat functions, and animals in those habitats. Examples include removal of s logs, woody debris, log jams, and rocks that provide structure habitats.

Occupying and altering (without grading) naturally un-vegetated aquatic and upland areas with equipment, structures, or intense human activity cause adverse impacts. These alterations may require removal or relocation of dense populations of individual native surface animals, mainly for non-mobile animals. This is most common in marine areas, where, for example, species such as sand dollars, sea stars, moon snails, fishes, and other wildlife occur. Specific dense populations occur because of site-specific habitat conditions not found broadly, and generally cannot be recreated.

Eelgrass. Eelgrass is an important aquatic plant with many functions supporting the Puget Sound ecosystem. Eelgrass habitat can be damaged or degraded by dredging and filling, shading and alteration of circulation patterns, as well as excessive sediment, nutrients, and freshwater flows.

End note references for this section: 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

Development Activity and Impact:

IN-WATER DEVELOPMENT: OVERWATER STRUCTURES (DOCKS, PIERS, FLOATS, BOAT HOUSES, LAUNCHING FACILITIES AND ASSOCIATED PILINGS AND MOORINGS)

IMPORTANCE

Overwater coverage structures and their support structures include marinas, docks, piers, floats, boat houses and other storage structures, lifts, ramps, moorings, buoys, and floating residents. The terms pier and dock are often used interchangeably, although sometimes dock is reserved for floating structures and sometimes pier is reserved for large ship facilities or for fill-constructed docking purposes, jetties or breakwaters. Piers and docks are usually used for moorage. Non-moorage purposes include fishing, hiking and wildlife viewing, utility operations and maintenance. Impacts include those associated with habitat impairments, water quality problems and disturbances caused by human activities on and with the facilities.

Boating structures are most commonly related to single family residential use, and include the typical piers and docks related to moorage, but also include a myriad of accessory facilities that perform moorage, launching, and storage functions. The largest of moorage facilities are often marinas and similar multi-user facilities, which are called "boating facilities" in the 2003 SMP Guidelines, and have specific additional requirements.

See also:

- In-water vegetation removal (page 75).
- In-water grading (pile driving, anchor installation, and excavation are a grading disturbance that affects a larger area – consider 10 feet in diameter per location (page 82).
- Upland vegetation removal related to water access (paths, launch ramps/rails, and roads) and accessory boat storage facilities displaces vegetation and habitat, and forms linear facilities (page 68).

IMPACT

Different types of overwater and related facilities vary in their impact partially based on their function: mooring, launching, or support. Boating structures degrade aquatic vegetation due to shading. In addition, boat props can scour aquatic vegetation and non-vegetated aquatic habitat. Smaller scale options often have significantly fewer impacts than the larger ones. Multiple kinds of facilities may be used, and multiple facilities of the same kind may be used. Unnecessary impacts can be caused by redundant or similar structures. In the past, boating structures were often maximized, rather than minimized, by building at the largest scale (e.g. dimensions and enclosed structures), by building multiple structures with the same purpose (e.g. a launching ramp and a boat lift), and by building multiple structures for the same use (e.g. 2 docks or 3 jet ski lifts).

Overwater structures and their use areas usually span the waterline, so they can have both upland riparian impacts and aquatic impacts.

Habitat Loss/Alteration impacts

Mooring and decked facilities (includes off shore). Mooring and decked facilities include the typical piers, docks and wharfs and also includes minimalistic moorage, using buoys, pilings, and off-shore floating platforms (such as for swimming or floatplanes). In these cases, a small hand launch platform might be placed on the shore for a small boat. Rare options include specialized bulkheads. Dry moorage found in marinas is actually a launching service and upland storage. It should be noted that like a pier or dock, floating platforms might be used for non-moorage purposes, such as swimming. Decked facilities have shading impacts and moorage also has shading impacts for the area occupied by the boat and lift (for boats and personal watercraft). Other structures or quasi-structures create overwater coverage, including covered moorage and boat canopies (often suspended on poles), and boat garages (including all alternate names, such as boat storage and boathouses). In addition, the moored boats and planes themselves create overwater coverage - including moorage for buoys.

Shading: Overwater coverage has shading impacts that change the micro-climate and habitat characteristics under and near the structure, and thus change the biotic community composition. Effects vary by width of coverage and height above water.

- Shade reduces in-water primary productivity, reduces microscopic plant abundance, and impacts food web for larger creatures.
- Covered water changes the food supply by eliminating or altering airborne insect and organic litter inputs.
- Shade alters fish behavior for both predator and prey species. This is especially important for threatened salmonid species, which are preyed upon when small.
- Shade changes the light levels and species preferences for using the area.

Elevated structures allow some light to enter from the sides below the structure while floating objects have the most shading effect. The shading effect is greatest under the center of a structure, and improves toward the edges. The shading effects change throughout the day with the hourly sun angle, and change with the seasonal sun angle. The shading effect is altered by the orientation of the dock or pier. North-south orientations allow greater east-west shadow variation by the hour, and reduce concentrated effects. East-west orientations have much less variation, and more concentrated shadow effects.

Docks and piers, specifically. Like all development that cause environmental impacts, docks and piers should not be allowed unless they are necessary for a water-dependent use – this is a specific requirement of all updated SMPs. A special exception is made for a dock/pier for a single family residence (even though it's a non-water-dependent use). A dock/pier accessory to multi-family residential or other non-water-dependent use would not be allowed unless designed to be a Boating Facility, which is a separate use with special requirements.

Floating decking (such as docks and platforms), and to a lesser extent boats, dampen wave power and sediment movement. Floating breakwaters are designed to maximize this effect. The result is that fine sediments settle more readily, in addition to the effect of any pilings. The sediment and water energy micro-climate are changed, which affects the biotic community composition as some species must move out and others move in.

Pilings and similar construction. The obstructions created by pilings and similar structures create greater shore roughness, and have water power and sediment transport impacts. The result is that fine sediments settle more readily, changing nearshore substrate and beach composition characteristics. The sediment and water energy micro-climate are changed, which affects the biotic community composition as some species must move out and others move in. These changes (in worse case scenarios) can convert habitat for one group of species to a habitat for a different group of species. Placement of pilings also creates a spatial loss of benthic habitat. In addition, smallmouth bass and largemouth bass have a strong affinity for pilings and so fewer pilings are better for replacement and new projects.

Launching facilities. Launching facilities include the typical launching ramp, and the less common launching railway. Also included are the minimalistic lift systems (for boats and personal watercraft) that can be placed on docks, pilings adjacent to docks, bulkheads, and on floats. Marina launching facilities can also include specialized lifts, such as cranes or forklift-type machines. Lifts do not require upland or aquatic bed alterations other than possible increases to overwater structures/floats. They have fewer impacts than ramps and railways that extend well into both the water and uplands. Lifts that hold vessels over the dock eliminate water coverage caused by the boat, but negate light penetration mounted into the dock. Lifts that hold the vessel over the water reduce the shading impacts of the vessel, but do not negate them. Lifts with floating perimeter frames tend to increase the impacts of the vessel coverage. Once boats are mounted on the launching ramp or railway equipment, the difficulty of moving it is minor. Placing storage structures or areas outside the riparian vegetation is not a hardship. Like all pathways, launching ramps and railways can have vegetation, grading, linear facility, and other impacts (mitigation described in other sections). Importantly, the impacts fall across both water and land environments. These facilities must be transitioned from an upland pathway to an active sediment bed. Structures can alter water power and sediment flow, resulting in increased sedimentation or erosion.

Storage structures. Storage structures can range from small storage boxes, to small sheds, to storage buildings, to boat garages. Storage has no need to be over the water or in the buffer vegetation as, in general, walking outside the buffer to store items is not a hardship. Storage facilities of a de minimis impact may be acceptable such as a small on-dock storage box. Boat garages over water and covered moorage (including canopies) eliminate or impair ecological functions by enclosing over-water area, limiting wave action and sediment movement, eliminating vegetation and habitat, and excluding animal use. Covered open moorage may have fewer impacts, though it is still unnecessary. Canopies can cause equal impacts as covered moorage, but can also be easily designed to be limited in size, close to the boat itself, to reduce impacts. Some are boat mounted and removed with each use. When designed correctly canopies may be acceptable.

Accessory facilities. Accessories facilities sometimes accompany boating structures, often for recreational purposes. Some examples include floating swim platforms, waterslides, benches, and picnic tables. These facilities increase impacts of docks when existing or new docks are expanded in size to accommodate them. Public parks and recreation areas may be water-dependent uses or public accesses that are allowed to have docks. Residences are not water-dependent, except the special exception for the boat dock, and thus extensive other in-water facilities should not be allowed. De minimis facilities (i.e., swim related activities), however, may be acceptable.

Accessory facilities may increase impacts such as overwater coverage and shading, or may impede minimization for other impacts.

Water Quality impacts

Floating residences, marinas, and other boating structures have incidental pollution, usually unintentional. Floating residences can release both blackwater (human waste) and greywater (from dish and clothes washing, and showers). Neither should be allowed to discharge to surface waters. Other pollution from boating and overwater activities include fueling drips and spills, daily use litter and spills (from food and beverages), painting, sanding and other marine vessel maintenance activities, chemicals from swimmers (such as lotions), and fish cleaning waste.

Additional impacts due to associated human activity

Human activities associated with overwater structures include bed damage and disturbance of wildlife. Bed damage can be caused by buoys, dock-on-bed, and propeller scour. Boats and personal watercraft (jet skis) in shallow water can cause propeller scour similar to grading (see that section) when excessive power is used to reach deeper water. Sites with variable water levels (reservoirs and tidal) have difficulty preventing propeller scour. Buoys and similar floating anchored facilities in variable water elevation locations (reservoirs and tidal) often have slack built into their anchor lines. Various methods can reduce effects, but almost all still cause damage to the bed. Docks and other floating decks in variable water elevation locations (reservoirs and tidal) can land on and damage the aquatic bed at low water elevations. Mechanisms are needed to prevent these impacts.

Boating activities can disturb wildlife. In general, since these impacts are not compensated as they happen, they should be compensated in advance.

Finally, storage of small vessels (in addition to recreational floats, firewood, and other miscellaneous materials) often occurs in the backshore/riparian area. This is a common practice in some areas, resulting in damage to backshore/riparian vegetation – habitat loss and degradation.

End note references for this section: 49 50 51 52 53 54 55 56 57

Development Activity and Impact:

IN-WATER AND NEAR-WATER DEVELOPMENT: STABILIZATION AND EROSION CONTROL STRUCTURES (BULKHEADS, RIP RAP, FLOOD CONTROL, BREAKWATERS, GROINS, WEIRS)

IMPORTANCE

In- and near-water stabilization includes a range of facilities constructed in areas that often have strong habitat function. Shore armor includes bulkheads, rip rap, revetments, and other structures which are specifically intended to stop erosion, with the result that these structures cut off the natural sediment inputs to water bodies. This is of more importance on some sites than others, but the cumulative effect of numerous armor structures can result in significant reach-wide or system-wide reductions in sediment supply to beaches, among other impacts. Flood control structures (on streams) and water exclusion structures (on lakes and marine shores) typically (but not exclusively) have two purposes: (1) excluding the water body from part of its floodplain or to convert water or wetland areas to dry land and (2) providing armoring against water flow and erosion. Other stabilization structures, such as breakwaters, jetties, groins, weirs, and dams, are intended to directly alter water flow and sediment transport patterns. Most engineered structures in the surf zone of the marine environment, such as bulkheads, fail after 15-40 years, necessitating replacement or consideration of an alternative such as no structure, setbacks, or a softer technique.

IMPACT

Erosion control and stabilization structures cause the systemic reduction or alteration in overall water power and sediment transport resulting in numerous impacts. Direct habitat damage is done through excavation, filling and covering of habitat. One measure of impact is the size and length of the structure but major impacts can be imposed by one small poorly placed structure. While there are specific complexities to water power and sediment transport, general impacts include:

- Existing sedimentation and erosion environments are changed in significant ways that affect broad areas both within the work area and far from the actual structures.
- Above instream obstructions, sediment fills the channel and floodplain, reducing floodplain capacity, increasing flooding risk, and covering existing vegetation areas with sediment.
- Below instream obstructions, sediment starvation and erosion occurs, encouraging channel downcutting and bank erosion.
- Upcurrent of open water (marine, lake) beach obstructions, sediment accumulates on the shore, covering existing habitat areas with sediment.
- Downcurrent of open water (marine, lake) beach obstructions, sediment is eroded from the shore, eliminating habitat in those sediments.
- In-water excavations intercept and capture sediment load from upstream, causing sediment starvation downstream, and possibly causing headcutting erosion upstream from the excavation site.
- The altered water flow and sediment environments also have biological impacts to aquatic habitat formation processes, and directly to fish and wildlife habitat.

Bulkheads and shore armor: Shore armor is specifically designed to stop or slow erosion processes operating at the site. These are usually hard structures of sloping or vertical rock, concrete, and wood. These structures directly bury habitat as well as significantly impacting many habitat functions by reducing sources of organic matter and insect food. They reflect wave and flow energy back to the water, resulting in increased turbulence, water power, and erosion in their vicinity or downstream. This effect has many consequences that can extend far from the actual structure. Perhaps the biggest consequence is that hard shoreline protection structures such as bulkheads can significantly reduce physical beach habitat area for many species. They also reduce the friction and roughness influence on water flow and energy. They often increase the slope of the bank, which increases water flow. The increased water speed or wave energy on the face of the armor increases erosion potential, which often causes erosion at the toe of the structure, increases depth and can lower the beach. Increased depth also increases water velocity and energy. This feedback cycle often results in the failure of the installed armor or expansion of the initial conditions of concern. The increased water energy also extends past the structure and affects down flow sites. In rivers, the change in water flow can cross the river with the meander pattern. Then off-site locations can experience increased erosion. Additional impacts are associated with the construction, such as vegetation and habitat clearing, grading, and dredging.

Groins. Groins are generally solid structures extending perpendicular to and into the water that are a full obstacle to water flow parallel to shore, commonly used in marine and lake locations, but sometimes used on rivers. They are related to breakwaters

and jetties, but much smaller and often more numerous. Groins capture sediment at their base, and force sediment flow off the tip of the structure. Marine and lake groins force longshore sediment flow to deeper water, where it is lost until it can fill the new location to a sufficiently shallow depth to resume movement. The impact will vary in severity mostly based on the percent obstruction of water or sediment flow. Impacts are similar to grading these areas. River groins also physically obstruct flow through a portion of the channel cross section, forcing water levels higher and forcing high speed velocity closer to the opposite bank. The result is more frequent and higher flood levels and increased erosion forces on the opposite bank.

Breakwaters and jetties: Breakwaters and jetties are generally large scale structures extending well off-shore, usually in marine and lake locations. There is discrepancy in use between the two names, but general principles can be applied. Both tend to enclose an area to protect it from wave action. Breakwaters are typically placed off-shore as a parallel obstacle - sometimes connected at one end, and sometimes with openings. Jetties typically extend more directly off-shore or across an inlet, and may be used for docking ships or boats. Breakwaters and jetties connected to land act like groins in capturing sediment and altering longshore sediment flow along their length. Enclosed/protected areas are converted from an active environment (such as a beach) to a low energy environment (such as a bay or barrier island lagoon). These structures greatly alter the nearby wave and water flow patterns resulting in changes in the sediment flow and settling patterns in the area. Effects vary depending on the design, but are unlikely to be minor. At worst, structures can totally stop sediment flow past the site, causing down-flow beach loss and sediment composition changes, along with biological changes. Overall, the existing environmental conditions are significantly changed with major biological shifts. Jetties are considered the shoreline modification which is most damaging to nearshore ecosystems because they intercept littoral transport, cut off groundwater supply, disturb natural nearshore circulation, bury benthic communities, and convert the substrate to different habitat types (rocky intertidal/subtidal). Floating structures are sometimes used because such structures avoid re-routing sediment flow along a solid structure, and avoid its potential loss to deep water, but the sediment is then captured in the protected area - greatly increasing sedimentation (especially where the sediment enters the protected area). This may then encourage dredging alterations in the future.

Weirs and bank barbs. Weirs and partial weirs are river structures that create an impoundment effect. The most common structure is the bank barb – a partial weir used for bank erosion control. The impoundment effect of full weirs creates impacts similar to minor dams without the major water management function of large dams. They are generally intended to be overtopped or submerged, at least part of the time. Many weir structures (especially partial ones) are used as a method of shore stabilization or armoring. Most proponents of weir projects intend to maintain and replace them, making them functionally permanent, even when made of loose rock piles. This in turn makes the local and broad scale impacts permanent. Repeated temporary alterations that shift locations, however, are less impactful than the permanent weirs that lock a dynamic river system in place, impairing its functions. Full weirs operate like small dams across a river, and are generally used as a water diversion structure. They are usually intended to be permanent, with an emphasis on preventing future damage. Consequently, they are usually highly engineered concrete and steel structures. Small structures may be constructed of large rocks, and may be for purposes such as for a small diversion, or to lock a river bed in place; and sometimes they are configured to redirect flow, like partial weirs.

Weirs are generally designed to lock the stream channel in place at a given height and horizontal location. Consequently, it impacts water and bed flow, and all the related processes and functions. Weirs that span the full width of the channel (and some that span most of the width) can cause substantial impoundment and sediment capture. Depending on the depth of impoundment, riparian vegetation may be submerged and eliminated or may shift with limited successful re-establishment. The waterfall effect can also create large erosive forces below the weir. Obstructing sediment flow can cause channel filling upstream; and loss of sediment and increasing erosion below the structure can cause channel down-cutting. Both effects change upstream and downstream floodplain character and flood patterns, and have biological effects far from the structure itself. The sedimentation and erosion impacts are similar to excavation and filling.

Partial weirs can include mid-stream chevrons, j-hooks that extend from one bank to just past mid-river, and bank-barbs or stream-barbs that extend short distances from a bank. Partial weirs usually are intended to protect a bank, or redirect the river's flow using the submerged obstacle effect to lock the river bed in place, or both. They usually have a higher elevation at the bank than in mid-flow to concentrate their effect toward the middle, and to function at various water levels. Their small scale and easier construction mean they are more often constructed of large rocks. Their impacts are smaller-scale and more localized, relative to full weirs, and are largely determined by the width of channel they affect. The common result is that erosive forces are directed away from the bank and toward the center or opposite bank. Sedimentation is concentrated directly upstream from the structure. Badly designed partial weirs can increase the problems they are intended to address, and have more impacts than a well-designed weir.

Dams. Dams have similarities to full weirs, but they are expanded in scale and scope. They typically store and manage water for flood control, irrigation or municipal water, power generation, fisheries management, or multiple purposes. Dams are generally not intended to be overtopped or submerged, except in specific locations for specific situations – for example, at extreme

reservoir levels. They often pass the full stream flow through the body of the dam in a controlled manner. Dams cause major disruption of all river processes and ecological functions at an ecosystem-wide scale. They capture all upstream sediment, and cause sediment starvation of downstream reaches. They impede normal flood patterns downstream, and eliminate floodplain area upstream. The deep impoundment submerges and eliminates riparian vegetation. The length of shore may be increased but the commonly steep slopes and water level fluctuations limit the opportunity for re-establishment of characteristic riparian vegetation. They significantly alter sediment transport processes. They impede normal channel migration processes downstream. As with weirs, dams impede movement and migration of fish and aquatic species. They alter conditions that support wildlife habitat along the river downstream, and outright submerge fish and wildlife habitat upstream.

References for this section: 58 59 60 61 62 63 64 65 66 67 68 69 70

Development Activity and Impact:

IN-WATER AND NEAR-WATER DEVELOPMENT: TRANSPORTATION AND UTILITY CROSSINGS - STABILIZATION AND SUPPORT STRUCTURES

IMPORTANCE

Bridges and utility crossings have impacts similar to stabilization (see page 79), with some additions. Support structures are placed in- and near-water perpendicular to the water flow or along the shoreline. Stabilization structures are constructed to protect the support structures.

IMPACT

Crossings over streams that encroach into the floodway or channel migration zone can constrain or deform the meander pattern, with impacts to stream length, water power, short term sediment flow, floodplains, fish and wildlife habitat forming processes, and other functions. Crossings that encroach into floodplains (and especially floodways and channel migration zones) can constrict or obstruct flood water flows. This causes impacts to surrounding flood elevations, water power and sediment flow, wetlands and nearby water features, and associated biotic functions. Crossings that prevent the full flow of floodwater can have reach-scale impacts above and below the crossing. These crossings cause floodwater to back up and settle out larger particles than the channel is accustomed to, with great impacts over time. Impacts of crossings (additional to stabilization impacts listed above) include:

- Crossings over streams that encroach into the floodway or channel migration zone can constrain or deform the meander pattern, with impacts to stream length, water power, short term sediment flow, floodplains, fish and wildlife habitat forming processes, and other functions.
- Crossings that encroach into floodplains (and especially floodways and channel migration zones) can constrict or obstruct flood water flows. This causes impacts to surrounding flood elevations, water power and sediment flow, wetlands and nearby water features, and associated biotic functions.
- Crossings that prevent the full flow of floodwater can have reach-scale impacts above and below the crossing. These crossings cause floodwater to back up and settle out larger particles than the channel is accustomed to, with great impacts over time:
- Sediment fills the channel and floodplain upstream, reducing floodplain capacity, increasing flooding risk, and covering existing vegetation areas with sediment.
- Sediment starvation and erosion occurs downstream, encouraging channel downcutting and bank erosion.
- The altered water power and sediment environments also have biological impacts to aquatic habitat formation processes, and directly to fish and wildlife habitat.
- Bridges result in shade impacts underneath them. The impacts are similar to docks, and depend on the height and width of the bridge deck.
- Water quality impacts occur from vehicle pollution or spills and leaks from utility pipes.

Support structures. Support structures can have direct impacts from their placement and construction, and from failures due to inadequate design. There may be many reasons for the failure of water crossings. One reason for failure is inadequate clearance t that results in water power being applied to the upper structure when it is not designed for such forces. Failure may also result when floating debris hits a bridge with inadequate clearance.

Another reason is scouring of the support structures in unforeseen ways as storms change beach configurations, and as rivers change their channel configuration and location. Scouring may not immediately result in failure but often requires ongoing repair and in-water alteration work that has high cost and repeated ecological impacts. Structure designs should be tailored to the site, given the wide variations of naturally functioning shorelines. Support structures can also impact water flow, sediment transport, and erosion and sedimentation processes. A sometimes unforeseen impact of bridges is the effect of mid-span piers during flood flows. These can sometime operate as planned during low flows, but obstruct or deflect flood flows in ways that cause undesired changes to functions.

Culverts and small bridges: There are naming discrepancies – small bridges are often called culverts even though they appear to be bridges. The important features are the length of span, the number of support structures, and whether it is open-bottomed or enclosed/piped. Spans that best preserve the natural flow, sediment, and vegetation processes and functions will have the least impact. Enclosing the water in an artificial structure usually also means an inadequate flow capacity, and loss of many sediment and biotic functions. Crossings should provide a sediment bed. Partial span crossings obstruct water flow across the facility, and impact sediment and floodwater flow (especially for streams), nearby flooding patterns, and the associated biotic functions.

Utility repair safety. Repair of utilities that fail at water crossings can require full or partial reconstruction, essentially repeating the impacts of original construction. In addition, broken lines that transport physical materials cause pollution impacts. Safety systems are needed to reduce impacts. Casings can greatly reduce impacts of new construction by allowing the line to slide through the casing without excavation. Casings can direct leakage of liquids out of the water and shutoff valves can reduce spills into the water.

Underground utility crossings. Underground utilities constructed within or across a stream corridor can obstruct bed load movement, or be damaged during flood events when the bed load mobilizes, or be damaged when channels migrate or change locations in the floodplain. Facilities should be buried below the expected depth of mobilization during a flood event, including alternate channels in the floodplain. It is recommended to keep the depth below the normal bed elevation by at least four feet, or 1/3 of the bankfull depth, whichever is greater. Maintaining depth below any associated floodway and floodplain to the maximum extent of potential channel migration is also important, especially for utilities conveying contaminating substances.

Proliferation. Ongoing extensive land development has resulted in a proliferation of private access and utility crossings over streams in the Puget Sound region. The cumulative effects are profound, and in extreme cases, can add up to the equivalent of diking or enclosing the stream. Repeated individual crossings accumulate to system-wide impacts. It is desirable, therefore, for new crossings to allow shared use for adjacent properties using requirements similar to those commonly used for subdivisions. These may include easements, property covenants, maintenance agreements, and late-comer re-payment options.

Surface utility safety impacts. Surface utility transmission lines within floodplain hazards have safety issues. All facilities should be protected from flood debris damage to prevent the need for repair construction impacts. In addition, materials that have the potential for significant pollution (chemicals and waste) should not be placed on the surface in the highest hazard locations without a real need for an above ground location. Appurtenant facilities for transmission lines are subject to the same flood hazards as the transmission line itself. Such facilities have much more flexibility in their placement and should not be allowed in hazardous locations. The exception would be safety shutoff valves.

End note references for this section: 71 72 73 74 75 76 77 78

Development Activity and Impact:

IN-WATER DEVELOPMENT: DREDGING AND FILL IN MARINE AREAS, PONDED AREAS, AND RIVERINE AREAS (DREDGE DISPOSAL)

IMPORTANCE

In-water dredge and fill includes activities for construction and maintenance activities. Dredging (as opposed to simply moving material around) excavates sediment that is “in the way” of some use or activity – most often navigation channels. The sediment naturally lies in that location due to site conditions. Fill (including dredging spoils) can be used for a variety of specific purposes (usually construction related), or for convenience of disposing of dredged material, or sometimes to supplement a restoration project. Marine locations typically have more biological functions and sediment transport functions that would be impacted by fill than do lake environments.

IMPACT

In-water dredging and fill impact sediment storage and movement as well as habitat. While much attention focuses on impacts to vegetated aquatic habitat areas, non-vegetated areas also have documented impacts which need attention. Activities that cause periodic substrate disturbance include dredging navigation channels, marinas, and boat basins. Dredged or filled slopes that exceed those that naturally occur at the site can experience erosion that propagates up-flow wherever water flow is enough to move sediment (in areas of wave or current movement), and can change beach character and cause water quality problems (during construction). Sediment is stored in waterways for future sediment transport by the water feature. In addition, important fish and wildlife habitat are associated with sediment. Excavation eliminates stored sediment.

In riverine channel migration zones and near-bank locations (floodplains of small streams), dredging removes sediment from the system that the rivers' natural processes would use for channel construction and movement. In beach locations, dredging removes sediment that would be used for wave sediment transport. In the long-term, these sediment sources cannot be accessed, resulting in less sediment in the system with reach-wide or system-wide impacts. Associated fish and wildlife habitat and processes are also permanently or temporarily removed.

Sediment and water movement. Dredging and filling across longshore drift paths, or similar major sediment flow paths, causes the greatest impacts since it cuts off, shifts, or captures the sediment flow within the altered area. Locations down-flow of obstructions lose their sediment sources, experience sediment depletion and altered patterns, and undergo sediment composition changes, beach loss, and biological changes. Locations receiving increased sediment inputs get filled, with related biological impacts. Fill converts aquatic habitat to upland habitat, or a different aquatic habitat, reducing its biological productivity, adversely impacting in-water plants and animals, and, in lakes, reducing the water storage capacity. Dredging and filling in marine settling basins may also impact flow paths where tidal flow and waves together may move sediment. Locations down-flow of dredging can lose their sediment sources and change their morphology. The biological impacts of in-water dredging/grading can extend far beyond the actual grading site due to sediment transport and slope erosion impacts, and these areas should be considered in determining the area of impact that needs to be mitigated.

Changes in beach character. Beach configuration and character is a balance between wave energy, sediment particle size, and sediment inputs and outputs. Impacts are more pronounced in locations with pronounced variation in wave energy, especially oceans compared to lakes. Disturbances that change the shore slope can alter the wave energy patterns and sediment movement patterns. Changes in sediment movement patterns often alter the sediment grain size on-site, nearby, and down-current. Conversely, disturbances that change the sediment size composition in upper soil layers also change the wave energy and sediment movement patterns. For example, excavation can bring subsurface rocks to the surface of a sandy beach, or can bring subsurface silts and mucks to the surface of a pebble beach. Such changes can alter wave energy and movement of sediments, for example promoting rapid erosion of fine particles and retarding sediment deposition. Altered wave energy environments, and altered beach composition in turn results in altered substrate habitat and microclimate.

Change in riverine character. Bed composition can be altered in riverine aquatic habitats due to in-water grading and construction activities. River bed and shore configuration and character is a balance between water flow (including flood levels); sediment particle size (in-stream, banks, and floodplain); sediment sources (from up-stream, floodplains, and banks); sediment outputs (moving downstream) and bed roughness. This balance has a much more pronounced linear nature in riverine environments than marine and lake environments. Impacts are more pronounced in locations with large variations in flow levels. Examples of impacts (from excavation or from fill) include:

- Grading that changes the angle of water flow can greatly change the erosive strength of the stream at a site.
- Altered stream water flow patterns in turn alter sediment movement patterns and sediment size. Most often, increased stream flow washes away smaller sediments, leaving the larger material. Eroded material is deposited downstream in low water power locations.
- Altered stream energy environment, and altered bed composition in turn results in altered substrate habitat and microclimate.
- Salt water moving farther upstream when riverine systems are dredged (in some situations).

In-stream excavation removes local bed load, causes sediment depletion downstream, and affects the downstream sediment patterns. Removing material from rivers, such as gravel bar scalping, typically reduces preferred salmonid spawning and rearing habitat. It also removes the active coarse surface layer of a gravel bed channel, increasing the mobility of the gravel bed at lower flows and increasing the potential to scour salmon redds and other significant impacts.

Periodic substrate disturbance, such as gravel bar scalping, bridge cleanouts, and irrigation diversions, can leave erodible slopes, and depressions. Given the large bed load, the benefits of dredging are typically short lived, as the area fills back in during the

next event that mobilizes bed load. Applicants may propose these activities from year to year and these should be treated with the same mitigation requirements as larger one-time activities.

Finally, in-stream excavation that breaks through the well sorted bed "seal" allows the loss of stream flow to the groundwater in losing reaches (stream sections losing sediment).

Water quality. During construction, pollutants that may leak or spill from machinery operating over or in the water are often toxic to the health of wildlife and humans. Grading suspends silt and sand, including any associated contaminants. In waterbodies, suspended sediment obscures vision of aquatic animals and impairs their activity, obstructs sunlight and photosynthesis, impairs bodily functions of plants and animals (such as respiration and senses), and drives off animals to better locations. It also can make fresh water unsuitable for human consumption.

References for this section: 79 80 81 82 83 84 85 86 87 88 89 90

Development Activity and Impact:

IN-WATER DEVELOPMENT: CONNECTING CHANNELS AND LARGE SCALE EXCAVATIONS (PITS IN FLOOD PLAINS, MARINE OR LAKE AREAS)

IMPORTANCE

Intentional and accidental connections between natural waters and excavated open water ponds can cause additional impacts beyond those of the excavation and loss of vegetation and habitat. The connection can interrupt sediment flow and degrade water quality.

IMPACT

Connecting channels: Excavated open water channel features (such as canals and ponds), connecting streams, lakes, and marine areas cause impacts to ecological functions. Excavation creates artificial slack water areas where they normally would not develop. Connecting the excavated area to the shoreline extends the shore into the excavated area, thus triggering shoreline regulations. In addition, artificial open water is typically subject to water quality problems, especially when combined with human uses. Problems include high nutrient loading, chemical pollution, algae blooms, and temperature increases. Circulation transfers water quality problems from the impounded waterbody to the natural water feature. The connecting channel can interrupt or capture the normal flow of sediment along the original shore, resulting in sediment losses down-flow of the connection – the connection typically must be repeatedly dredged (see dredging impacts and mitigation as well). Connections to saltwater may allow saltwater intrusion inland.

Excavations in floodplain and Channel Migration Zone. Large scale excavations, such as gravel mines in the floodplain and Channel Migration Zone, often extend into the groundwater table and to a depth below the water and bed elevations of the river, and can result in stream capture during large flood events. Specifically, deep excavations have the potential to cause the stream to meander or avulse into the excavation, which will then capture its bedload for a long duration. Large-scale shallow excavations within the Floodway or Channel Migration Zone can also encourage channel migration through the site. The steep channel entry point into the pit will be subject to intense erosion, will downcut, and will travel upstream, causing stream power, sediment transport, channel incision, and floodplain impacts -- impacts similar to in-stream excavation.

Stream capture will have major ecosystem-wide impacts, and is likely to happen over the long term (100 years) within the Channel Migration Zone or Floodway. Even temporary capture can have major impacts. Structures intended to prevent such events often fail, and typically have major impacts themselves (e.g. floodplain dikes and concrete structures). An extreme example is a situation in which floodplains are mined out on both sides of a river, leaving it perched like an aqueduct between two deep ponds. If the containment dikes fail, the erosion could destroy the elevated bed permanently, making the river pass through a lake. Such a failure is also possible with a pond on one side, with repair being extremely difficult and costly.

Excavations in other locations: Large scale excavations in beach and dune locations (such as mining and residential canal construction) are rare. Deep excavations near lakes and marine waters have the potential that a major storm event will destroy the separation, allowing the water body into the excavation. Capture is more likely to happen in high energy marine locations

than in lake locations. Large-scale shallow excavations have less risk. Any inflow entry points (streams, tides, waves) over steep excavated faces will be subject to intense erosion, and will downcut in an up-flow direction.

Ocean capture into deep pits (similar to breaches of barrier islands) is likely to happen over the long term (100 years) on lowest elevations of the shore, and will have major ecosystem-wide impacts related to converting freshwater environments to saltwater environments. Structures intended to prevent such events often fail, and typically have major impacts themselves (such as breakwaters, sea walls, and armoring).

End note references for this section: 91 92
(see other related sections – dredging, dredging and aquatic vegetation and habitat sections – for additional documentation of impacts)

9. MITIGATION GUIDES FOR SHORELINE DEVELOPMENT IMPACTS

In interviews with local, state and federal staff, we found that mitigation associated with development projects is not consistent across the region and often has not generally proven to include adequate compensatory mitigation. National, regional and local studies have shown that this variation has led to ecological losses rather than no net loss. In recent years, state and federal agencies have worked to significantly increase consistency for mitigation for wetlands. More slowly this effort is being extended to other shoreline resources.

MITIGATION OPTIONS

The following pages include tabulated information for mitigation of impacts related to proposed shoreline development projects. Each section includes a table that summarizes key impacts described (including citations) in Chapter 8 and a listing of avoidance, minimization and compensatory mitigation guidelines. These recommendations draw together existing work to provide mitigation options.

RATIOS

For compensatory mitigation, per WDFW's 1999 Mitigation Policy[93], replacement ratios should be ***greater*** than 1:1 (one unit of mitigation for each unit of impacted area; Policy M5002). As documented above, the ratios need to be much greater, often four times the disturbed area, to fully mitigation impacts on fish habitat.[94]

WETLANDS

Mitigation options are not provided for wetlands because of the extensive set of published guidance for wetlands, many of which are previously referenced in this guide. If wetland impacts for a project would be significant, agencies may require the use of the Methods for Assessing Wetland Functions.[95]

CONSTRUCTION IMPACTS

Mitigation options are not provided for construction impacts, many of which are typically addressed by best management practices.

SITE-SPECIFIC CONDITIONS

While the goal of this guidance is to help improve overall mitigation consistency across Puget Sound, mitigation specifics should reflect site conditions, degree of development impacts, variability and dynamic nature of shorelines, and other factors. Thus the recommended mitigation options in the following sections should be considered as guidance to be customized as appropriate.

Unfortunately, there are currently few well-developed and tested site assessment and mitigation plans which account for the full range of potential impacts to ecological functions in nearshore marine areas. This is, in part, because the full suite of ecological functions in the marine nearshore environment is not yet fully understood and well-quantified for either pristine or altered/modified sites.

NEXT STEPS

The guide is meant to be part of the continuing dialogue about shoreline-related mitigation in the Puget Sound region, with the expectation that one of the regulatory agencies will publish mitigation guidance, similar to guidance for wetlands, in the near future.

SOURCES

The information and mitigation recommendations are drawn from federal and state documents as well as scientific studies and personal communication with planners and scientists. A core group of published citations were also used to develop recommendations and are listed below. Throughout this chapter, endnotes are used for additional citations.

- Washington Department of Fish and Wildlife. (1997). *Management Recommendations for Washington's Priority Habitats: Riparian*. Written by K. L. Knutson and V. L. Naef.
- Washington State Department of Fish and Wildlife. (2009). *Protection of Marine Riparian Functions in Puget Sound, Washington*. Written by Jim Brennan, Hilary Culverwell, and Rachel Gregg, and Pete Granger.
- Washington State Department of Fish and Wildlife. (2009). Landscape *Planning for Washington's Wildlife: Managing for Biodiversity in Developing Areas*. Written by Jeff Azerrad, J Carlton, J Davis, T Quinn, C Sato, M Tirhi, G Wilhere, and S Tomassi.
- Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. (2001). *White Paper: Marine and Estuarine Shoreline Modification Issues*. Written by Gregory D. Williams and Ronald M. Thom.
- Washington Department of Fish and Wildlife. Washington State Aquatic Habitat Guidelines Program. (2010, revised from 2007 version). *Protecting Nearshore Habitat and Functions in Puget Sound*. Prepared with EnviroVision and Herrera Environmental.

- Washington Department of Fish and Wildlife. (2003). *Integrated Streambank Protection Guidelines*. Written by M. Cramer, K. Bates, D. Miller, K. Boyd, L. Fotherby, P. Skidmore, and T. Hoitsma for Washington State Aquatic Habitat Guidelines Program.
- Washington Department of Fish and Wildlife. (2009, March). Compiled White Papers For Hydraulic Project Approval Habitat Conservation Plan (HCP).

Mitigation:

UPLAND DEVELOPMENT: REMOVAL OF VEGETATION AND/OR HABITAT

Structures and creation of impervious structures (in addition to loss of vegetation and habitat) cause:	
▪ Water quality and quantity impacts from runoff (from impervious surfaces) harming eelgrass, kelp, other biota and wildlife. ▪ Water quality impacts from septic systems, particularly causing excess nutrient problems. ▪ Wildlife movement impediment by structures and fencing. ▪ Light impacts from artificial lighting. ▪ Groundwater impacts from wells.	**Additionally:** For introduction of human activity: ▪ Disturbance by humans (by foot, bike, or in motorized vehicle). ▪ Compaction of soil or physical alteration of habitat features. ▪ Disturbance by pets of wildlife and their habitat.

Recommended Mitigation

General recommendation: Permit applications should identify the human use areas that accompany all approved uses, beyond just the physical alterations.

Specific mitigation based on site conditions and ecological functions

	Avoidance
Preference	▪ Place intense uses outside shoreline jurisdiction. ▪ Keep intense uses outside largely intact vegetation areas, or outside SMP buffers and setbacks. ▪ Keep features such as play structures close to the primary structure. ▪ Do not allow lights adjacent to water and native vegetation. ▪ Do not allow fences that obstruct wildlife (use rail fences or other fence styles designed to have de minimis obstruction potential). Replace fences with natural barriers using spiny or thorny native plants such as rose, salmonberry, gooseberry, hawthorn, or stinging nettles. [122] ▪ Do not allow land use practices in riparian areas that involve the use or generation of nutrients, pathogens, and toxics.[123]
	Additionally for wells and septic systems: ▪ Avoid impacts to groundwater used for drinking water by placing wells upland from the primary use. ▪ Require wells to be fully cased, and drilled to an aquifer other than the surface aquifer. ▪ Place septic systems more than 200 feet from the water.

Minimization	

Preference	- Minimize impervious surface coverage.
	  - If impervious surfaces must be located in riparian areas, minimize footprint. [124]
	  - Use pervious material as much as possible. Use Low Impact Development techniques such as bioswales, raingardens, green roofs, and cisterns. Caution should be taken when designing and installing bioretention and other facilities that infiltrate water along slopes and bluffs, to lessen the likelihood of mass failures or erosion. [125]
	- For wildlife impediment impacts:
	  - Limit development to low or very low intensity options and modifications.
	  - Minimize new and expansions footprints by allowing additional height.
	  - Require substantial spacing of residences – provide double the width of the use area (200 feet for a 100' house and yard).
	  - Break large structures into smaller ones.
	  - Provide safe wildlife corridors for developments with large structures.
	- For lighting, screen/direct lights down/away from native vegetation, habitat areas, and aquatic areas. Use minimal wattage systems.

	Additionally for wells and septic systems: - Comprehensive plans should match planned growth with available water resources. - Place well and septic close to primary use. - Place septic no closer than 100' from water and upland from the primary use. - Require septic to use pumped system, and use creative layout and location.

	Additionally for human activities:
	- Minimize yard areas, recreation areas, aquaculture traffic areas, and trail/road encroachments into native vegetation areas and near water areas. Limit human use to locations with the least impact, with the least native vegetation, and areas that have already been altered.
	- Minimize impacts of unsupervised cats and dogs, off-road vehicles, and other human activity using:
	  - Signage – can be effective at minimizing unintentional encroachments.
	  - Fencing - can be effective for limiting human activity to certain areas. Fencing should be crafted so that it does not block wildlife movement (see above).

Compensation

Preference

- Provide vegetation and habitat for lost habitat areas. Allow use of a rain garden that is sized to be at least 20 percent of the area of new impervious surface. [126]
- Follow storm water program requirements for runoff and pollution control. When storm water programs do not apply, require similar control measures.
- For wildlife impediment impacts from incompatible fences and structures:
  - May have to provide individually developed compensatory mitigation off-site. For example, establishment of wildlife corridors where they are needed off site.
- For light impacts, remove existing lighting sources or do individually developed out-of-kind compensation.

Additionally for wells and septic systems:

- Water flow and quality impacts cannot be compensated, except for individually developed out-of-kind compensation.

Additionally for human activities:

- For low intensity development (resource usage, and residential of more than 5 acre lots), if above minimization techniques are used, one can consider the broader outdoor effects of human presence to be de minimis and limited to the defined use area. (The use area should already have vegetation and habitat compensatory mitigation provided.)
- For urban and rural areas, out-of-kind mitigation will likely be needed for outdoor activity area of effect.
- Possible out-of-kind upland revegetation based on area of native vegetation or resource lands within 200’ of activity areas.
  - Commercial/industrial areas: equal to full area
  - Urban residential areas (1 acre or smaller residential lots): equal to ½ of area
  - Rural residential areas (1-5 acre residential lots): equal to ¼ of area
  - Low intensity development not using above minimization techniques: equal to 1/10 of area (which may have to be offsite for largely intact areas).
- For compaction of travel paths, use grading and impervious surface compensation.

Mitigation:

UPLAND DEVELOPMENT: IF IN WILDFIRE HAZARD AREAS

Development in wildfire hazard areas causes:
▪ Pressure to remove all vegetation around structures, including native vegetation, (see impacts due to vegetation loss on page 89)

Recommended Mitigation

General Recommendation: Use mitigation similar to vegetation and habitat (see page 89). Other recommendations below are based on the application to the fire code rules.

Specific mitigation based on site conditions and ecological functions

Avoidance	
Preference	▪ Require new development to setback from existing native vegetation, rather than clearing native vegetation to meet the setback.

Minimization	
Preference	▪ Minimize clearing. ▪ Measure the wildfire setback away from the required riparian buffer line, rather than allowing clearing of the riparian vegetation. ▪ Require that existing development use alternatives available in the code to meet wildfire hazard reduction requirements where possible. This includes more fire resistant construction and pruning plants rather than clearing.

Compensation	
Preference	▪ Use vegetation and habitat compensatory mitigation for native vegetation impacts, other than for minor removal. ▪ Allow replanting with native plants that have lower fire hazard and are acceptable to the local jurisdiction (which will vary by jurisdiction code). Appropriate additional ratios may be needed.

Mitigation:

UPLAND DEVELOPMENT: GRADING (EXCAVATION, FILL, BEACH AND DUNE DISTURBANCE, AND DREDGE DISPOSAL)

Grading and excavation causes loss or alteration of:	
▪ Rich substrate filled with organic elements that support broader habitats and species. ▪ Subsurface habitat areas by removing them, burying them, or mixing them. This includes nests for burrowing surface creatures. Periodic disturbance or occupation of a site with human uses makes the disturbance effectively permanent. When not permanent, habitat requires extended time periods to re-establish. If the resulting geologic material is not suitable for reformation of habitat, the elimination is effectively permanent. ▪ Wildlife, by causing death, maiming, injury, or behavioral trauma to substrate creatures that cannot readily move. ▪ Food sources provided by those subsurface creatures for predator species; results in reduced abundance of larger surface and subsurface animals. ▪ Biological diversity at site, with effects that extend to adjacent areas. ▪ Water quality problems due to increased erosion potential (can cause excess siltation). ▪ Natural drainage patterns.	**Additionally:** For beach and dune features: ▪ Dune and beach habitats and the dunes themselves.

Recommended Mitigation

Specific mitigation based on site conditions and ecological functions

Avoidance	
Preference	▪ Use alternative location that does not need grading or that is outside shoreline jurisdiction. ▪ Use site locations that have historically had soil eliminated or degraded. ▪ Design project to work within existing grade such as by the use of piling foundations. ▪ Maintain priority habitats (the habitats with which priority species have a primary association and their necessary buffers in their natural condition).[127]
	Additionally for dunes and beach features: ▪ Do not develop on foredune, interdunal wetlands, areas identified by the PHS program as priority habitats and areas with which priority species have a primary association, rare plant habitats, areas where dune stabilization will be required, and undeveloped spits and similar accretion land forms. The foredune provides protection for both natural feature and human built features from high winds, waves, extreme tides, and erosion.[128]

Minimization

Preference

- Limit the scale of the facility and use areas to the minimum necessary. Limit grading to only those facilities and use areas that need grading work to operate. Resulting slopes should not require stabilization either on land or in water.
- Limit the footprint of grading through facility design:
  - Design and orient grading areas with narrow width perpendicular to the slope.
  - Choose structural methods such as increasing foundation height, or using posts and piers to elevate the structure or walls rather than using fill and extending fill slopes around the structure.
- Store topsoil layer and replace it over graded site at project completion.[129]
- Reduce impacts to surface drainage patterns:
  - Use structural alternatives to elevate new homes (described above) in the floodplain, rather than using fill and extending fill slopes around the structure.[130]
  - Maintain surface drainage input and output locations as much as possible.
- For grading that increases erosion potential:
  - Use vegetation for erosion control whenever possible and use native species.
  - When storm water programs require erosion control, rely on them. When storm water programs do not apply, require similar methods.

Additionally for dunes and beach features:

- Minimize development in the dune and beach areas.

Compensation

Preference

- For in-kind compensation: Restore areas of existing or historic grading and provide basic vegetation cover, remove areas of fill, or refill excavated areas.
- For out-of-kind compensation: Because soil disturbance impacts a range of functions, it is recommended that aggregate out-of-kind compensation be applied. While not a perfect solution, it is practical, and makes sense because subsurface functions often operate at a smaller scale or slower rate than functions on the surface. Shallow (to 6 inches or so) on-land grading related to vegetation clearing is included in the recommended compensatory mitigation for vegetation and surface habitat impacts. Deeper excavation or filling of soil areas should require additional compensation.
- Excavation into groundwater will require other mitigation (see those activities).

Additionally for dunes and beach features:

- In addition to wetland and unvegetated habitat compensation, some impacts likely cannot be mitigated with in-kind compensation. Individually developed out-of-kind compensation will need to accompany the project.

Additionally for new agriculture using periodic substrate disturbance:

- Treat grading impacts as effectively permanent, and provide mitigation at initial alteration.

Mitigation:

UPLAND DEVELOPMENT: IF EXCAVATING IN SHALLOW GROUNDWATER AREAS

Excavation in shallow groundwater areas causes:

For vegetated areas that depend on shallow groundwater:

- Changes in habitats that depend on shallow groundwater.

For streams and wetlands (and hyporheic zones) supported by local surface groundwater, alteration of:

- Base flow in streams.
- Associated riparian areas.
- Hyporheic habitats and support functions for other species and water quality.

For flat areas:

- Creation of open water areas such as ponds or lakes which then change nearby groundwater elevations.

For upgradient areas and sloped sites:

- Draining and lowering of upgradient and adjacent groundwater elevation to the base of excavation.
- Interrupted and probably lowered groundwater elevation downgradient.
- Exposure of springs (temporarily or permanently) causing rapid draining of groundwater as surface flow.

For subsurface structures:

- Blocking or partial blocking of groundwater flow.

Recommended Mitigation

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Relocate excavation sites away from shallow groundwater.
- For near water features or wells that are dependent on the shallow groundwater, limit excavation depth to the top of the groundwater table. If no water features, wells, or distinctive vegetation exist, small excavations may cause no impact.
- Major excavations into hillslope groundwater should be prohibited.
- Excavations through any geologic support layer should normally be prohibited.
- Design the layout and construction to prevent water table changes.

Minimization

Preference

- Alter the project design to minimize changes to groundwater table:
  - Minimize area and depth of excavation.
  - Break large ponds into smaller ponds.
  - Orient ponds to minimize their extent across the normal drop in groundwater elevation (and thus difference in pond leveling at the edges).
- Be sure to consider where excess or altered runoff due to placement of impervious surfaces will go and how it will be distributed. Systems can be designed to capture increased surface runoff, to be distributed similar to natural conditions downslope after completion of excavation and construction.

Compensation

Preference

- Replace wetlands, riparian vegetation, shallow groundwater vegetation, and stream functions that are lost due to groundwater changes.
- Deepen or provide new wells when existing wells are impacted by excavation.
- In many cases, groundwater impacts are additive to other grading impacts, and are likely limited to out-of-kind compensation.
  - Use aggregate compensation described for general grading impacts for any remaining soil impacts.
  - For excavation and loss of hyporheic zone area, provide additional out-of-kind revegetation compensation of ½:1 of the excavated hyporheic zone.

Mitigation:

UPLAND DEVELOPMENT: LINEAR FEATURES (ROADS, TRAILS, UTILITIES, WALLS, TRENCHES AND DITCHES, PIPES, DIKES, SUBSURFACE DRAINAGE)

<table>
<tr><th colspan="2">Linear facilities cause:</th></tr>
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For clearing of vegetation for construction of linear facility:

- Fragmentation of large blocks of habitat and intact vegetation.
- Increased predation for animals.
- Blockage or restriction of migration routes.
- Creation of edge effect.
- Introduction of invasive species.
- Stormwater flow alteration, capture, and concentration (changing surface erosion patterns).
- Reduced resistance to floodwaters.

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Additionally:

For at-grade or elevated structures:

- Fragmentation by physical structure.
- Severe alteration of surface water flow.
- Rerouting of surface connections between water features (such as streams, ponds, wetlands).
- Alteration of floodwater flow patterns.
- Compaction of the subsurface under the facility.

For trails and roads:

- Introduction of human activities, including pets causing disturbance of wildlife and habitat.
- Physical presence of vehicles.
- Water quality problems from toxic chemicals (vehicles).

For ditches, trenches and drains (linear features):

- Drainage of groundwater to distances far beyond facility.
- Creation of a groundwater blockage (if less porous fill used).
- Creation of a groundwater conduit (if more porous fill used).

For subsurface features, such as walls:

- Blockage or partial blockage of groundwater flow.

For subsurface drainage:

- Reduction of groundwater level.
- Creation of surface water flow problems elsewhere.

</td>
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Recommended Mitigation

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Apply protective environments and use limits to prevent the development of remaining intact vegetation areas (including consideration of road construction, which is usually the first step towards widespread development of an area).
- Apply the following strategy for avoidance and minimization related to location, design, and construction mitigation listed in order of preference, but using all that are possible:
  - Do not place facilities in shoreline jurisdiction.
  - Choose routes to avoid need for crossing.
  - Use existing corridors and crossings rather than create a new one. Re-route old corridors and crossings if they pose an environmental threat (for example, old sewer lines placed in beaches and old roads/utilities placed on beaches, or along beaches).
  - Place facility as far landward as possible.
  - If in shoreline jurisdiction, take the most direct route possible, with least impact.
  - Do not place in areas with native vegetation, especially buffer vegetation.
  - Use least damaging construction methods.
  - Reduce vegetation and topographic disturbances by using aerial structures when possible; or use underground installation when groundwater issues are not present (especially methods with minimal surface damage like boring or plowing). This reduction option may include rudimentary road construction with minor grading.
- For subsurface drainage:
  - Prohibit the use of under-drains and underground drainage systems (such as perforated pipes).
  - Existing facilities that are repaired or replaced should eliminate drainage elements.

Additionally for elevated linear structures:

- Do not use elevated stabilization except in cases with the most dire need of protecting broad areas of development - use spot protection instead, and keep at or below grade.
- Do not use elevated utilities structures, except when co-locating with an existing elevated structure. Use aerial, underground, or at-grade facilities with less impact.
- Do not use elevated transportation structures parallel to the water, except for routes of statewide importance that cannot bear the loss of service.

Additionally for roads and trails:

- Do not install public trails or roads parallel to the water within shoreline jurisdiction.

Additionally for ditches, trenches and canals, including subsurface utilities:

- Prohibit facilities that intercept the groundwater table – including its seasonal cycles.
- Prohibit ditches intended to drain groundwater. Do not allow expansion and deepening of existing ditches below the groundwater level.
- Place line bedding above the groundwater table, or do not use gravel bedding.

Minimization

Preference

- Limit impacts using the linear facility preferences above.
- Limit corridor width. Choose a route path with the least impact. Limit grading in the corridor.
- Design facility to follow existing grade, and limit cut and fill elements that can redirect water flow. This often requires that facilities in flat floodplains must vary vertically (roller-coastering) for stormwater control. In such situations, balance the above and below grade segments. Design facilities to match and maintain natural flow paths and flood paths.
- Design facilities to accommodate floodwaters over the corridor.
- Design facilities to pass stormwater cross-flow and reduce concentration by canting the grade of the facility downslope (or similar methods) rather than capturing, crowning, and ditching.
- Design facility with extensive use of stormwater flow crossings to limit flow disruption.

Additionally for surface and elevated linear structures:

- Minimize height, bulk, and scale to allow functions to cross by providing openings through the elevated structure. For some functions, minimization of the facility will not reduce the impact (i.e., a short or tall wall may be equally obstructive).
- Provide the maximum level or frequency of function crossing (such as floodwater overtopping) that the facility can accept.

Additionally for roads and trails:

- Rudimentary roads should not use cuts and fill except in extreme cases. Allow tilted roads to avoid concentration of runoff.
- Design modified grades and rudimentary roads to pass surface water cross-flow and reduce concentration by canting the grade of the facility downslope (or similar methods) rather than capturing and ditching.
- Limit impacts from individual residential trails to a de minimis level by limiting them to rudimentary trails with minor clearing, grading, and structural alterations.
- For *public* trails and roads, use spur segments to provide point access to the water.
- Limit the placement of parallel facilities within riparian vegetation.
- Limit vehicle speeds and road capacity to reduce roadkill and wildlife disturbance.

Additionally for ditches, trenches and canals, including subsurface utilities:

- Keep depth of facilities shallower than the groundwater level.
- For existing ditches that intercept groundwater, install periodic obstructions/gates to reduce impacts. New ditches with these features should not be allowed, since the features are easily removed. Limited encroachments into groundwater can be minimized by sealing the ditch or canal during or after construction.
- Backfill with the native earthen material that was excavated. Identify layers of earthen materials before construction, and replace them in their original configuration, as feasible.
- Require that line bedding be periodically interrupted with plugs of native material, or use of synthetic pipe collars extending beyond the pipe bedding to limit disruption of ecological processes. Use periodic spacing (for example ~ 200 feet) in flat locations and closer spacing in sloped locations.
- Require that repair and replacement of these facilities also use these methods.

Additionally for subsurface structures, such as walls:

- Limit groundwater cross-flow dimensions to a de minimis amount (~50 ft.).
- For larger structures, use stilt foundations rather than walls, or use pervious design, such as drain and flow-through systems.
- Minimize length of structures.
- Design openings in structures and space them appropriately.

Compensation	
Preference	▪ Replant native vegetation to return site to natural conditions wherever possible. Where there are vegetation limits (such as under power lines), choose compatible native species, such as shorter trees, shrubs rather than trees, and groundcover. ▪ Remaining impacts such as those altering cross-corridor surface, storm, and flood water flow functions, and their associated sediment movement functions, likely cannot be compensated. Use additional individually developed out-of-kind compensation. ▪ Where soils are compacted, scarify them to promote vegetation growth.
	Additionally for large surface structures: ▪ The impacts of obstructing ecological functions from large areas likely cannot be compensated directly. Equally large compensation will need to be individually developed for the project.
	Additionally for roads and trails: ▪ Compensation may not be needed for de minimis impacts of rudimentary individual private residential trails (which remove minimal amounts of vegetation) and use above avoidance and minimization recommendations. ▪ Well-used trails and roads will need to provide out-of-kind compensation for human presence based on the additional width effect and intensity. Use compensation listed in sections for vegetation and habitat, grading, structural, and other trail impacts.
	Additionally for ditches and trenches: ▪ For new ditches/trenches that intercept groundwater, fill in other ditches/trenches. Use aggregate compensation for soil and hyporheic impacts. ▪ In many cases, groundwater table alteration impacts are likely limited to individually developed out-of-kind compensation.

Mitigation:

IN-WATER DEVELOPMENT: REMOVAL OF AQUATIC VEGETATION AND HABITAT

Removal of aquatic vegetation and habitat causes loss of:

- Physical habitat areas, including unvegetated habitat.
- Range of habitat diversity.
- Structural diversity.
- Abundance of biota and fauna and food sources provided by that biota and fauna.
- Abundance of larger animals.
- Fish refuge from predators.
- Attenuation of wave energy.
- Wave, flood, and sediment patterns (and micro-patterns). In extreme cases, can alter sediment composition, microclimate, and habitat.
- Biological diversity.

Additionally:

Removal or relocation of naturally non-vegetated areas causes:

- Direct death or maiming and injury.
- Behavioral trauma.
- Increased competition in new location.

Recommended Mitigation

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Protect ecologically intact and undeveloped locations with protective environments and use limits.
- Do not allow alterations of aquatic areas without real need.
  - Only allow alterations for water-dependent uses.
  - Only allow when other alternatives are not possible.
- Do not remove habitat features (e.g., logs, aquatic vegetation) from the aquatic environment.[130]

Minimization

Preference

- Work around key habitat areas.
- Limit disturbance area by changing location, configuration, and design of facilities and use areas.
- Site facilities and use areas in existing and historically disturbed areas.
- Relocate existing structural elements nearby, including ensuring embedded stability. Relocate non-mobile aquatic life such as seastars, sand dollars, and moon snails.
- When installing piers, limit disturbance to a work area strip no wider than twice the width of the pier.[131] Use work area limits for other alterations, as well.

Compensation

- Recreate structural habitat elements elsewhere using new materials.
- If feasible, recreate lost habitats (in-kind), though opportunities are unlikely. Relocation and removal impacts to animals cannot be compensated directly.
- When performing in-kind aquatic vegetation compensation, use equivalent site-appropriate native species, ensuring that the location of the new plantings has historical/baseline information indicating vegetation presence at the site and that there is suitable depth, substrate, and wave energy. Loss of eelgrass habitat should be mitigated by the restoration of degraded eelgrass habitat in the immediate vicinity of the project, or the creation of new habitat. [132]
- When out-of-kind compensation is needed, use replacement ratios described below.

Recommended replacement ratios:

At least 20% in-water replacement of vegetation at ratios of 2:1

- Possible out-of-kind *upland revegetation* replacement ratios (**WHY**: These ratios are based on the significant habitat values of in-water vegetation; the high ratios that scientific studies show are necessary to replace habitat values in riparian and similar areas; the scientific studies showing a preference for in-kind mitigation to mitigate impacts; and because, since the habitats are being mitigated out-of-kind, large areas of substitute upland habitats would be necessary to provide no net loss of shoreline functions.):
  - Removal of aquatic vegetation: 4.5:1
  - Removal of special habitats: 5:1
  - Special habitats: 5:1
  - Dense population sites: 5:1
  - Other aquatic: 4:1
- Eelgrass:
  - 2:1 minimum and an adequate density of plants (at least 20 shoots per square meter in order to function as an eelgrass bed). **WHY:** Eelgrass is sensitive to changes in the estuarine environment; re-establishment generally has a success rate of only 40-60%.[133]
  - Up to 4.8. **WHY:** Twenty-five years of eelgrass transplant history shows a 75% failure rate in some locations in California.[134]

Mitigation:

IN-WATER DEVELOPMENT: OVERWATER STRUCTURES (DOCKS, PIERS, FLOATS, BOAT HOUSES, LAUNCHING FACILITIES AND ASSOCIATED PILINGS AND MOORINGS)

Overwater structures and their support structures:

For moorings, pilings and other support structures:
- Dampen wave power and sediment movement.
- Change micro-energy in vicinity of facility.
- Possibly convert one habitat to another.
- Cause marine shell hash deposits and changes in sediment.
- Cause loss of benthic habitat.

Land launching facilities:
- Alter water flow and sedimentation pattern.
- Possibly convert one habitat to another.

Maintenance and operation (human activities) cause:
- Water quality impairments from introduction of pathogens, toxic chemicals and nutrients.
- Chemicals leeching from structural materials.
- Bed damage from anchors, propeller scour, and groundings of structures or boats.
- Wildlife and fish disturbance.

Decked structures and light blocking features (boats, lifts, boat garages) cause:
- Shading that reduces in-water primary productivity.
- Changes in the food supply due to elimination or alteration of airborne insect and organic litter inputs.
- Alteration of fish behavior for both predator and prey species.
- Shading that changes the light levels and species preferences for using the area.

Recommended Mitigation

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Do not allow floats, float support piling, and helical anchors, watercraft grids or lifts, in documented areas of Pacific herring, surf smelt and/or sand lance habitat.[135]
- Do not allow structures in shallow areas such as tidal flats because the structure would need to be very long in order to reach a depth where boats can be moored.[136]
- Allow docks, piers, or boating structures ONLY for water-dependent uses, and single family residential boating structures.
- Other options should be considered before creating new facilities. Nearby public launching facilities negate the need for private land launching facilities (applicant should show proof that shared facilities are full or are unavailable).[137] Sharing the existing facilities of nearby properties is also possible. Encouraging shared-use docks minimizes cumulative impacts.[138] (Applicant should show proof that they contacted neighbors and that the neighbors are unwilling to share.)[139]
  - If new facilities are built, they should be shared with adjacent properties to reduce the number of future facilities, thereby eliminating the need for new facilities on many lots.
- Do not allow facilities to be located in areas where they will adversely impact shoreline ecological functions or processes (including currents and littoral drift) or in areas containing sensitive, unique, or high-value fish and shellfish habitat.[140]
- Do not allow in-water structures in free-flowing areas of systems where northern pike minnow occur, because they create back-eddies and low-velocity microhabitat which increases predation on juvenile salmon.[141]
- Additional shoreline or pier lighting on lakes should not be permitted.[142]

Additionally for docks and piers:

- Docks should not be located on shallowly sloped beach areas because of the large footprint required to attain adequate water depths for launching.[143]

Additionally for floats:

- Do not allow swimming floats for sites with a dock/pier.

Additionally for boat storage and launching facilities:

- Prohibit new boat garages over water - always place upland.[144]
- Prohibit new covered moorage.
- Allow de minimis storage – either:
  - Dock box – ~20 sq. ft., 3 feet high.
  - Shore shed – ~30 sq. ft., 10 ft. high, and at least 10 ft. from the water on the pathway.
- Place other storage buildings outside the riparian vegetation.

Additionally for accessory facilities:

- Facilities should be co-located on existing structures, rather than having their own structures, unless for public recreation or public access.

Minimization	
Preference	▪ Use the following minimization preference list, in order of facilities that have the least impact: ▪ Non-dock/pier mooring alternative with small boat access, possibly with a hand launch platform. Examples include: mooring buoy, mooring piling, and mooring platform (off-shore). ▪ Above-water structure (on pilings). ▪ Floating structure. ▪ Limit boating structures to the minimum combination to provide reasonable access. For example: ▪ Launching ramps and railways should not include a dock/pier - use minimal moorage alternatives. ▪ A dock/pier should not include a launching ramp or railway – use a boat lift, preferably dock-mounted. ▪ Do not allow multiple mooring facilities or multiple launching facilities, except for Boating Facility uses (i.e., marinas). ▪ New boat structures should allow shared use for adjacent properties using requirements similar to those commonly used for subdivisions: easements, property covenants, and maintenance agreements, unless nearby properties already have such structures. ▪ Allow only one slip per single family residence, except for encouraging alternative mooring systems by allowing two boat moorages. ▪ Limit overwater coverage and habitat impact of facilities: ▪ Design for minimal interference with geomorphic and littoral drift processes.[145] ▪ Place structures to perpendicularly span the shoreline spawning habitat zone.[146] ▪ Locate facilities in areas that are currently devoid of native aquatic vegetation.[147] ▪ Facilities constructed over documented surf smelt and/or sand lance spawning habitat should span that habitat to the maximum extent practicable.[148] ▪ Do not build new structures within 25 feet (horizontally) of macroalgae or eelgrass beds.[149] ▪ Floats or support pilings for replacement structures installed where macroalgae or eelgrass beds and/or documented Pacific herring habitat are present within 25 feet of the float in any direction, should have a minimum of four feet depth between the top of the float stopper and the top of the habitat feature.[150] ▪ Design structures to avoid watercraft resting on the substrate at all times.[151] ▪ Require buoys and anchored deck structures to be placed in deeper water and to use systems that reduce anchor cable damage. ▪ Design pile-supported structures with maximum open space between pilings to allow waves, currents, and sediment to pass beneath. [152] ▪ Use as few pilings as possible. [153] Keep pilings out of surf zone using a long first span, when possible. Place pilings at least 20 feet apart, or otherwise space to limit shading and dissipate wave energy and sediment transport.[154] Use piles of 8 inches in diameter or less.[155] ▪ 15% rule: If new salt water facility is proposed to intrude more than 15% into the fetch (shore to shore), then require a navigation study.[156] ▪ For overwater structures, to limit shading impacts: ▪ Require decking that passes light to cover a large percentage of the structure surface. Decking occupied by opaque objects (such as lifts and storage) should not count. Use deck materials, in order of preference: transparent, translucent, grating.

	Minimization *continued*

Preference	- Clear panels provide the most light-passage but only for the area installed. Other areas are still opaque. Translucent panels are similar to clear ones, but with a reduction based on the translucency rating.
	- Grating effectiveness is reduced by the effect of angled sunlight being blocked by the sidewalls of the grating. It is also reduced by the physical area of the grating grid. Thick grating sheets with small holes have minimal benefit. Larger openings and thinner sheets have more benefit.
	- Any walkways should be 100 percent grating; floats and docks should be at least 60 percent grating. [157]
	- Orient grating to maximize transmission of light under the structure.[158]
	- To reduce pollution from construction materials:
	  - Do not use creosote-treated wood. Replacement or proposed new pilings can be steel, concrete, plastic or untreated wood.[159]
	  - When using existing treated wood pilings, incorporate design features like plastic rub strips or metal bands that limit contact abrasion to limit the release of toxic chemicals into the environment.[160]
	- For human operations:
	  - Manage equipment and vessel operations and establish no-construction or no-vessel activity buffers around existing aquatic vegetation to protect this habitat and its contribution to ecological functions.[161]
	  - Establish operation plans or guidelines to reduce prop scour, and use signage to remind people to follow rules.
	  - Establish operation plans or guidelines to reduce incidental pollution impacts. Use signage to remind people to follow rules. Clean propellers before putting boats into the water to reduce the spread of noxious weeds.[162]
	  - If aquatic vegetation is present at or adjacent to a pier or wharf facility, establish guidelines and protocols outlining where vessel traffic should occur when entering or leaving the site. [163]

	Additionally for docks and piers:
	- Limit pier or dock to the minimum length and width necessary (up to 4 feet wide, up to 6 wide if using grating).[164]
	- Limit ramp width to 4 feet and use functional grating (i.e., 60% minimum open area) for entire ramp surface.[165]
	- Limit railing to 36 inches in height with an open framework.[166]
	- Minimize the amount of pier area that directly contacts the shoreline, to allow light penetration to the nearshore intertidal and shallow subtidal areas.[167]
	- Minimize dimensions of floating structures placed perpendicular to shorelines (which dampen wave action and prohibit natural shoreline erosional processes). [168]
	- Use simple dock configurations that limit coverage (i.e. I-shaped). Do not allow complex configurations (F-/ U-/ T-/ J-shaped), except for shared docks of 5 or more boats, and for boating facilities. Use extra mooring pilings rather than dock fingers for boat stability.
	- Require linear structures to use a north-south orientation, as much as possible. [169]
	- Design piers and docks for the maximum height practicable to maintain light transmission from the sides below the structure. [170]
	  - Minimum height of 6 feet over the substrate bed is desirable to maintain light transmission.[171]
	  - Use piers that elevate decking at least 2 feet above high water.
	- Require moorage designs to foresee the need to turn the boat around for dock-side maintenance, to avoid finger docks.

Minimization *continued*

Preference

Additionally for floats:

- Limit the size of offshore boating floats to 100 sq. ft. and 25 foot length.
- Functional grating should be over 30% of surface for floats up to 6 feet in width, and over 50% of surface for floats from 6 to 8 feet in width.[172]
- For floats, use square or rectangular configuration, limit size to the minimum width necessary, and orient with largest dimension oriented north-south to the maximum extent practicable.[173]
- Do not allow floats to ground out on low tides.[174]
- For anchoring:
  - Where water levels fluctuate, design floats with stoppers or support pilings that keep the bottom of the floats at least 1 foot above the substrate so that the structure will not rest on the bottom.[175]
  - Limit floatation anchoring to a maximum of four helical screw anchors, piles, piling with stoppers, and/or float support/stub piles.[176]
- Enclose floats in shells (such as polyethylene).[177]

Additionally for boat storage and launching facilities:

- Use the following minimization preference list, in order of facilities that have the least impact:
  - Lift mounted on a pier, dock, existing bulkhead, or land.
  - Floating lift.
  - Launching railway.
  - Launching ramp.[178]
- Allow only one launching system per site, except for boating facility uses, and except for encouraging lifts by allowing two lifts (including use by personal watercraft).
- For grids and lifts, ensure the bottom of the grid rests at least 1 foot from the tidal substrate and does not rest on the substrate at any time and only use the minimum number of additional piles necessary to support the watercraft grid/lift (e.g., two additional piles per lift).[179]
- Pass railways and ramps through the buffer to storage locations with minimal disturbance.
  - Railways should be elevated to pass sediment flows.
  - For rarely used ramp launches, use rudimentary pathways rather than permanent installations. For low-use ramps, use removable ramps and only put them out at instances or seasons when needed – and allow upland storage. For frequently-used ramps, use methods to reduce impacts (such as elevated platforms, grating, and adjustable features).
- Limit any accessory storage buildings that can't avoid placement in riparian shoreline vegetation to 100 sq. ft.
- Storage buildings that can't avoid placement in riparian shoreline vegetation should be limited to 200 sq. ft.
- Encourage the use of upland boat storage areas and the use of slings to limit shading of aquatic vegetation.[180]
- Require overwater boat canopies to be transparent, or at least highly translucent (including use of clear skylights) covering at least 50% of roof area, require them to be limited to the size of the boat, require them to be removable, limit wall materials to the minimum open structural framework needed for roof support (to limit shading effects), limit roof area to less than 200 square feet and 15 feet height above the ordinary high water mark.[181]

Additionally for accessory facilities:

- Any accessory facilities needed for co-location should be of a de minimis scale. For example, if a swim platform is allowed, it should be limited to 50 sq. ft.

Minimization *continued*	
Preference	**Additionally for mooring buoys:** ▪ Limit size to maximum 3 feet in diameter and materials such as hollow plastic, hard plastic-encapsulated styrofoam, aluminum kegs or other approved materials.[182] ▪ Helix or Manta Ray-style anchors should be nylon rope or chain and rope combinations, with appropriate line "scope" (i.e. length to depth ratio) for location as per U.S. Coast Guard or local boating association guidance (typically 7:1 ratio of line length to depth). Chain should have a mid-line float (no counterweight) that fully suspends the chain off the bottom at all tidal elevations.[183] ▪ Locate buoy so that anchor, buoy and moored vessels will not shade or otherwise impact vegetated shallows.[184] ▪ Limit vessels using mooring buoys to less than 65 feet total length and limit buoys to no more than four per acre.[185] ▪ Limit buoy use to 6 months/year or less to extent practicable and avoid use during winter months and stormy weather to avoid dragging anchors across substrate.[186]

Compensation	
Preference	▪ Remove an equal area of existing decking, number of pilings, area of boat storage structures, launching facilities, or provide grading compensation (page 117) vegetation and habitat compensation using ratios under aquatic vegetation removal (page 101). Include compensation for both boat shading and structure shading. ▪ When removing or adding fill below OHWM (for example, associated with installation of stabilization structure related to overwater coverage facility), replace with 1:1 fill onsite or 2:1 offsite. Examples of types of fill that may be removed for mitigation include construction debris such as concrete pieces, riprap, creosote logs, pilings, and failing bulkheads.[187] ▪ Use a minimum of 20% in-water mitigation, such as debris removal (City of Seattle approach).[188] ▪ Prop scour and floating anchor damage needs advance compensation, using grading, vegetation, and habitat compensation. ▪ Incidental pollution needs additional advance compensation, which most likely will be out-of-kind.

Mitigation:

IN-WATER AND NEAR-WATER DEVELOPMENT: STABILIZATION AND EROSION CONTROL STRUCTURES (BULKHEADS, RIP RAP, FLOOD CONTROL, BREAKWATERS, GROINS, WEIRS)

Stabilization and erosion control structures cause:

For structures that prevent sediment movement:

- Change in wave energy and longshore drift patterns.
- Change in river, lake, beach and nearshore sediment characteristics including:
  - Eventual loss of small particles that are not replaced as they transport out of system.
  - Coarsening of sediment beds.
  - Slower loss of larger particles that are not replaced as they transport out of system.
  - Sediment filling the channel and floodplain upstream, reducing floodplain capacity, increasing flooding risk, and covering existing vegetation areas with sediment.
- Changes in beach profile, size and backshore, including beach starvation.
- Loss of accretion land forms such as spits, hooks, and bars.
- Downcutting of small particle stream beds.
- Greater bank erosion.
- Restriction of channel movement.
- Altered water flow and sediment environments causing biological impacts to aquatic habitat formation processes, and directly to fish and wildlife habitat, including forage fish spawning areas.
- Shifts in vegetation community types and loss of habitat complexity.

Additionally:

For armor:

- Alteration of down-drift beach size, shape and substrate.
- Reduced beach area, including public beach area in some locations.
- Downcutting (lowering) of beach due to greater wave energy at the bulkhead face.
- Increased scouring leading to additional beach erosion.
- Direct burial of the upper beach.
- Coarsening of substrate (vertical bulkheads).

For groins:

- Marine and Lake: Sediment being forced into unnatural movement/locations, including into deeper water, which alters species composition
- River: Higher water flow velocity closer to the opposite bank resulting in more frequent and higher flood levels and increased erosion.

For breakwaters and jetties:

- Altered wave and current pattern, significantly changing sediment movement and settling patterns (including downdrift starvation), which alters species composition.
- High energy environments to become low energy areas.

For weirs and dams:

- Altered sediment movement, including sediment capture and upstream channel filling.
- Erosive conditions, including channel downcutting.
- Altered floodplain character and flood patterns.
- Partial weirs: direct erosion to opposite bank.
- Dams: impeded fish movement.

Recommended Mitigation

General recommendation: For stabilization features, apply linear features and vegetation loss mitigation, where applicable.

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Locate development so it doesn't need stabilization or erosion control structure.
- Use other methods to address erosion such as drainage controls, bioengineering and vegetation planting before using stabilization and armor, including these techniques:
  - Direct surface drainage to the toe of bluff slopes as appropriate; design discharge to avoid point erosion.
  - Limit excessive irrigation or other sources of excessive runoff and/or infiltration.
  - Direct sanitary drain fields away from bluffs to the greatest extent possible.[189]
- Move the threatened facility out of harm's way.
- Use replacement methods that can be considered restoration.

Additionally for armor:

- Replace existing armor with soft shore protection to restore, protect, or enhance the natural shoreline environment. These techniques mimic natural conditions for ecological functions and ecosystem-wide processes. Examples include:
  - Bioengineered shoreline stabilization (carefully designed soft shore protection rather than structures that essentially mimic hard structures).
  - Beach nourishment/replenishment (ensuring that it does not cause a substantial change in beach substrate type and size, bury existing flora and fauna, nor require significant ongoing nourishment (in perpetuity). *It should be noted that currently some mitigation typically consists of dumping 10 or 20 cubic yards of "fish mix" sand to pea gravel on the beach. Often it is dispersed within a week or two whereas the bulkheads can last for 50 years.*
  - Bank Re-slope/vegetated soil stabilization retention methods.
  - Driftwood and large boulders (anchored).
  - Coir fiber logs or other natural materials.
  - Nonstructural erosion control.[190] [191]

Additionally for dikes:

- Do not use dikes except in cases with the most dire need to protect critical facilities.
- For other development, accept flood damage or move facilities out of hazardous areas. Otherwise use minimization to provide spot protection (such as ring dikes, critter pads, elevate buildings, or other methods).

Additionally for groins (primarily currently used in freshwater systems):

- Prohibit groins in all but the most dire instances of needing to protect existing structures. This includes precluding groins for the purpose of building recreation beaches.
- One exception is restoration for non-recreation habitat purposes where urban density development has eliminated other options. For example, groins are sometimes used to create beaches or beach habitat, thus allowing for the removal of an existing seawall or to facilitate an otherwise risky soft shore protection treatment.
- Do not allow the use of structural members that would interrupt groundwater exchange between the waterbody and the shore. [192]
- Do not allow the use of vertical bulkheads[193] (Soft shore protection is preferable if erosion control structure is unavoidable).

Avoidance *continued*

Preference

Additionally for breakwaters and jetties:
- Avoid in all but the most dire instances of needing to protect existing structures, and for existing marinas or ports when other options will not work.
- Do not allow new breakwaters and jetties for small scale moorage protection.
- Locate new moorage facilities so they do not need breakwaters or jetties, and do not allow new protected areas when such options exist.
- Do not allow new breakwaters or jetties that close off estuaries, lagoons and inlets.

Additionally for weirs and bank barbs:
- Design projects to work with existing conditions rather than constructing new structures.
- Use pump facilities rather than diversion structures.
- Use bed manipulation (with different impacts and mitigation) for water diversions rather than permanent structures.

Additionally for dams:
- New dams should not be permitted in any situation, other than as a state agency initiative.

Minimization

Preference

- Relocate threatened structures to reduce the need or scope of erosion protection or stabilization structures.
- Keep bulk, height, length, and number of structures to smallest size or number possible.
- All stabilization projects should incorporate a preference for less impacting methods as a means of minimization, in the following order:
  - Enhance degraded vegetation to improve erosion resistance.
  - Soft stabilization/Bio-engineering.
  - Hybrid structures.
  - Structural stabilization or erosion control using natural materials (logs, rocks, earth) including attenuator designs, which incorporate features like large rocks and/or logs that dissipate wave energy.[194]
  - Concrete (and similar) structural stabilization or armor
- Flood control and water exclusion structures that include armor or other stabilization features must also meet stabilization requirements.

Additionally for armor:
- A geotechnical report is required to demonstrate risk to structures in order to allow hard armor per SMP Guidelines.
- Place stabilization as far landward and out of the water as possible.
  - Traditional, hard armor should be placed landward of the OHWM elevation, except in special circumstances where this may not be possible.[195]
  - Replacement structures for shoreline armor should be placed landward of existing structures.[196]
  - Locate bank protection structures outside of the floodplain and channel migration zones to prevent precluding access to off-channel areas. [197]

Additionally for groins (primarily currently used in freshwater systems):
- Reduce length to be as short as possible, including groin wetted length. Reduce the structure's cross-section in the shore-parallel direction.[198]
- Incorporate earthen materials or untreated wood where possible. [199]
- Allow wrack to accumulate in and around the structure. [200]
- Reduce the protrusion of the structure into the flow as much as possible. [201]
- To reduce habitat losses, woody debris can be incorporated into the construction of groins. Groins may also capture floating wood debris, especially if the surface is left jagged rather than smooth.[202] [203]

Minimization *continued*

Preference

Additionally for breakwaters and jetties:

- Where possible, use removable, temporary floating breakwaters in place of permanent, continuous breakwater walls:[204]
  - Use temporary structures that can be removed seasonally to allow normal processes.
  - Use floating structures rather than ground supported structures, and design solid structures with openings. Both designs allow some wave action and sediment flow functions to remain in the protected area. An example is a moored float. [205]
- If a permanent breakwater is necessary, locate the breakwater(s) to best connect the activity site to other areas of hard-rock habitat in order to reduce the probability of an invasive species infestation. [206]
- Use clean materials where possible (i.e., no materials that would leech metals or other exotic organic compounds, such as creosote-treated wood). [207]
- Where possible and where appropriate (i.e., not creating a larger impactful footprint), mimic the slope of predevelopment shoreline (rather than a vertical wall), which in most cases in Puget Sound is between 6:1 and 10:1. [208]
- Submerge the breakwaters where possible (i.e., in areas of small tides and large waves, the outer coast). [209]
- Don't use simple geometric designs. A complex landscape has been shown to be more productive for a wide variety of fishes than simple geometries. [210] Provide a rough, complex surface, such as gullies and small crevices, on which a variety of organisms can colonize. Alternative structures, including floating, portable or submerged breakwater structures, or several smaller discontinuous structures, should be considered where physical conditions make such alternatives with less impact feasible.[211]

Additionally for weirs and bank barbs:

- Use bed manipulation or temporary structures that can be removed, rather than permanent structures.
- Use designs that will accept destruction and replacement, rather than permanence.
- Accept maintenance and replacement of smaller less-permanent structures, rather constructing larger more-permanent structures to reduce maintenance.
- Use partial weirs rather than full weirs.
- Use basic minimization to reduce the size, scale, and number of structures – especially reach across channel.

Additionally for dams:

- Reduce inundation area by using off channel or run of the river facilities.

Compensation	
Preference (arrow)	

Compensation

Preference

- All stabilization and erosion control structures are purposefully designed to alter natural processes and ecological functions. There are no instances for which these structures can have zero impacts. Furthermore, full in-kind mitigation is likely impossible for loss of sediment, change in water flow, erosion impacts, and resulting biological impacts. Remaining impacts will need to use out-of-kind individually developed compensation:
  - For marine projects: Require site and project specific studies to determine specific impacts, and prepare a mitigation plan to provide in-kind and out-of-kind mitigation to provide replacement resources to address the adverse impacts.
  - For riverine projects: Use *Stream Functions Pyramid* approach or similar for on or off site mitigation to calculate needed replacement of functions (see page 50)
- Remove other similar stabilization or erosion control structures on-site or off-site. [212]
- To replace any sediment loss, provide periodic sediment replacement.
- For fill removal or addition below OHWM (for example, associated with the installation of a stabilization structure), replace with 1:1 fill on-site or 2:1 off-site. Examples of types of fill that may be removed for mitigation include construction debris such as concrete pieces, riprap, creosote logs, pilings, and failing bulkheads.[213]
- For projects which result in loss of suitable spawning substrate for surf smelt and sand lance (i.e., sand and fine gravel substrate high in the intertidal zone), either directly within the project footprint or through effects on sediment recruitment and longshore drift processes, mitigation should replace beach spawning habitat at a *suitable location*:
  - Which has adequate wave energy and sediment transport characteristics to maintain the necessary substrate characteristics over time.
  - Where spawning substrates can be maintained at the correct intertidal elevation.
  - Which has sufficient spawning area and/or microhabitat characteristics to ensure equivalent spawning productivity.[214]
- If a *suitable location* is found that already has forage fish spawning, then great care must be taken in undertaking restoration or enhancement work. If not, there is going to be a degree of uncertainty as to whether the site would be fully utilized. The higher the degree of uncertainty of success, the higher the mitigation ratio should be, as well as greater requirements for monitoring and adaptive management (i.e., contingency plan, with a bond to ensure that appropriate actions are taken). Little is known about forage fish spawning site fidelity, or repeated use, precise conditions, or spawning success (e.g., survival). Most documented spawning sites have only been surveyed/determined to be spawning sites based upon a single survey. Therefore, monitoring should be used to verify success.
- In-kind mitigation should be required for any project that eliminates off-channel habitat or reduces the opportunity for the creation of off-channel habitat in the future, either on-site or through contribution to the creation of such habitat elsewhere.[215]
- For projects which cause spawning habitat loss in riverine systems:
  - For gravel-poor streams, supplement gravel.
  - For gravel-rich streams, supplement large wood to natural levels.[216]
  - Require creation of a sediment or wood supplementation plan for downstream reach.[217]
- For projects which cause rearing habitat loss in riverine systems:
  - Place large wood structures to form pools.
  - Create or re-connect off-channel habitat.[218]

Compensation *continued*

Preference

Additionally for armor:

- If bank stabilization or erosion control structures cause wave or water flow changes, require installation of energy dissipation structures,[219] which may then in turn require additional mitigation.
- If loss of beach sediment is expected due to armor, require spawning gravel supplementation or beach nourishment.[220] Nourishment projects must be carefully designed and managed to reflect site conditions.
- If structures eliminate streamside habitat, require off-site construction of side channel(s).[221]
- If alteration results in loss of beach in a public area, require additional public access.[222]

Additionally for groins, breakwaters and jetties:

- Develop a sediment bypass strategy and establish a frequent sediment dredging and relocation program (which will have its own impacts and costs) to move captured sediment past the site, but note that this cannot compensate for loss of constant and consistent flow.[223]
- Permanent loss of longshore sediment flow, sedimentation filling effects, and erosive excavation effects should use out-of-kind grading, vegetation, and habitat compensation for affected areas. Require site and project specific studies to determine specific impacts and prepare a mitigation plan to provide in-kind and out-of-kind mitigation to provide replacement resources to address the adverse impacts.

Additionally for weirs:

- Remove existing weirs, though opportunities are rare.

Additionally for dams:

- Remove a dam as mitigation for a new one, but opportunities are rare.
- The impacts of dams are so large, system-wide, and long-term that the impacts cannot be mitigated with in-kind compensation. Out of kind compensation on an equally massive scale will need to accompany the project.

Mitigation:

IN-WATER AND NEAR-WATER DEVELOPMENT: TRANSPORTATION AND UTILITY CROSSINGS - STABILIZATION AND SUPPORT STRUCTURES

Stabilization and support structures associated with crossings cause:

The same impacts as stabilization structures (page 109) and:

- Water quality impacts from vehicle pollution or spills and leaks from utility pipes.

Recommended Mitigation

General recommendation: For stabilization and support features associated with crossings, apply stabilization, linear features and vegetation loss mitigation, where applicable.

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Do not construct new bridges. Use fords for seasonal and small stream crossings. Direct traffic around to existing crossings for larger streams. Attach to or use existing bridges and crossing structures, rather than building new structures. Exceptions are those rare circumstances in which a bridge is preferable to construction of miles of road to an existing bridge.
- When any elevated transportation or utility structure is necessary (including bridge approaches), use the preferences below to reduce impacts of obstructing the cross-corridor processes and functions.
  - Elevated on fill with extensive use of spans to allow crossing of areas with processes and functions.
  - Elevated on fill with dips to allow crossing of areas with ecological processes and functions.
  - Elevated on fill with no cross-connections.
- Support structures for aerial crossings and culverts should provide adequate height and capacity to clear 100-year flood flows or storm wave heights, and include additional height to pass expected in-water debris (typically tree root-wads) during the event.
- Use aerial facilities whenever possible, especially for water crossings.

Minimization

Preference

- Support structures located within river or beach floodplains should be placed in areas of lowest flood velocity, shallowest flood depth, and least ecologically sensitive locations.
- Increase structure span to reduce need for stabilization structures, including rip rap.224
- If disrupting meander migration, size water crossing to accommodate meander migration expected to be encountered within the life span of the structure, and add large wood jams to alter flow patterns.225
- Support structures in the active wave energy zone, stream channel, floodway, or channel migration zone should:
  - Consider future changes to stream channel depth and location.
  - Resist floodwater velocity and erosion forces.
  - Use configurations to limit flow obstruction and flow deflection while considering differences between both normal and high water flows.
- Limit new facilities (transportation and utilities) to water crossings only and avoid paralleling the shore.
- To protect water quality and reduce repair work, utility water crossings should:
  - Use a sleeve casing.
  - Extend casing outside the vegetation buffer.
  - Require shut-off valves, best placed outside of vegetation buffer and floodplains.

Additionally for underground utilities (crossings):

- Bury underground utilities deep enough to avoid hazards and below the depth of bed mobilization: at least four feet below the normal bed elevation, or 1/3 of the bankfull depth, whichever is greater.
- Maintain depth of utility within the floodplain to the maximum extent of potential channel migration, and otherwise at a depth below natural and artificial drainage features.
- For pipelines transporting potentially contaminating substances, (such as petroleum and waste), the greater depth should be maintained throughout the floodplain.

Additionally for surface utilities (crossings):

- Require that any surface utility transmission line within a floodway, channel migration zone, or active wave zone be protected from debris damage. Require lines for hazardous materials to use underground or aerial methods within the wave inundation zone or floodplain, except where surface construction is unavoidable.
- Require that aboveground appurtenant facilities (control centers, routing stations, and pumping stations) be kept out of the floodway, and also out of the floodplain unless no alternative is available.

Compensation

Preference

- Require repairs to provide pollution and disturbance compensatory mitigation, determined after repair and replacement incidents.
- Obstruction of bedload cannot be compensated for, other than out-of-kind compensation. Repair of damaged facilities and any pollution from the incident should be compensated based on alterations and pollution.

Mitigation:

IN-WATER DEVELOPMENT: DREDGING AND FILL IN MARINE AREAS, PONDED AREAS, AND RIVERINE AREAS (DREDGE DISPOSAL)

Dredge and fill causes:

- Alterations in sediment movement and in amounts of stored sediment.
- Change in sediment composition.
- Habitat damage or shift (aquatic habitat area becoming terrestrial due to fill or loss of spawning areas in rivers, for example).
- Water quality impacts from leaking toxic chemicals or from sediment/turbidity problems.
- Creation of habitat associated with sediment.

Additionally

For marine areas

- Altered beach configuration and character.
- Altered biotic community composition.

For riverine areas

- Change in stream sediment erosion and movement patterns, including the biota that develops on sediment areas (i.e., gravel bars).
- Altered ground water flow if breach or disturb underlying formations (bed "seal").

For dry channels and gullies:

- Increased erosion.
- Damage to structures.
- In floodplains, reduction of flow capacity at site and locally.

Recommended Mitigation

Historically, with a few exceptions, in-water grading and other in-water development has had little or no compensatory mitigation. This includes gravel bar scalping, under-bridge "clean outs," navigation channel dredging, or even new dredging. When compensation is considered, it is often at a smaller scale than the project impacts. Using a systematic compensatory mitigation system can help address this.

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Use designs and locations that do not need dredging or filling or excavation.
- In water grading should only be allowed for water-dependent uses and navigation purposes or as part of a comprehensive flood control plan, not to acquire gravel or other materials.
- Do not expand or deepen existing dredged areas when conducting maintenance dredging.
- Don't fill in or near channels. Require full span bridges or elevated structures (piers allowed) or redesign project to other locations on the site.
- Avoid major lake and marine excavation on beaches, dunes, and low-bank sedimentary deposits.
- Use best management practices to eliminate water quality impacts

Additionally for riverine areas:

- With no information on gaining/losing status of the reach, avoid instream excavation, or excavation through the bed "seal." For an identified losing reach, avoid excavation.
- Use methods for crossings that do not need excavation.
- Avoid major riverine excavation within channel migration zones and FEMA Floodways, where identified and where these are not identified (e.g., smaller streams) within the floodplain.

	Avoidance *continued*
Preference	**Additionally for dredge disposal:** - Do not dispose of dredge spoils in areas other than state approved locations, or in upland sites preferably outside shoreline jurisdiction and using upland mitigation and compensation.

	Minimization

Preference	- Reduce dredging and filling (including area and depth).
	- Avoid dredging and fill in sediment transport pathways.
	- Use the largest span possible for bridges or crossings structures.
	- Slope changes:
	  - Limit slope changes and size of area to be resloped.
	  - Reserve surface bed material and replace it when done.
	  - Reserve surface texture features and replace them when done.
	- To reduce water quality impacts, use curtains or other filters, project timing, equipment maintenance, and good operation oversight.

	Additionally for riverine areas: - Do not allow excavated slopes at more than normal gradient. - If exposing bedrock or hardpan, place large wood to store sediment (must be dug in or ballasted with sediment).[226] - If construction disrupts the stream profile, regrade the channel to restore equilibrium and create properly designed up- and downstream transitions.[227]

Compensation	

Preference ↑	▪ There are no instances for which aquatic dredging and filling have zero impacts. Furthermore, full in-kind mitigation is likely impossible for loss of sediment transport, sediment storage, change in water flow, and erosion impacts. Such effects can extend far from the project site and these areas should be considered in compensatory mitigation. In rivers, changes to water flow and sediment movement can propagate well upstream and downstream of the work. These impacts will have to use individually developed out-of-kind mitigation. Hyporheic zone impacts for stream and pond settings can be compensated using recommendations in the groundwater mitigation section.
	▪ Treat dredge spoils as a separate fill element of the project. Erosion, sedimentation, and interrupted sediment transport will likely need out-of-kind compensation at a broader scale than the actual dredging site. Estimate increased area for compensation purposes
	▪ Provide in-kind mitigation by restoring degraded dredge/fill locations to return bathymetry to normal conditions and undertaking habitat restoration.
	▪ For aquatic vegetation and habitat impacts:
	  ▪ Aside from actual dredge/fill locations, account for partial burial of habitat areas resulting from sediment plumes. Also account for sediment turbidity that impacts eelgrass and other aquatic vegetation.[228] [229] No extra compensation is needed when disturbance is only a few inches deep (4 or 6 inches).
	  ▪ Compensation for the depth of dredging is normally based on the actual depth based on the habitat that is provided by different depth ranges and it is tied to MLLW or MHHW.

	Additionally for riverine areas: ▪ In-kind compensation might include construction of an alternative channel or flow path of adequate size and configuration that also provides habitat replacement. ▪ Include mitigation for riverine dredge projects in which salt water moves farther upstream. ▪ For on or off-site mitigation, use the Stream Functions Pyramid or similar approach to calculate needed replacement of functions (see Side Box on page 50). ▪ Reconstruct bed to resemble previous "seal" using native materials (groundwater problems).

Mitigation:

IN-WATER DEVELOPMENT: CONNECTING CHANNELS AND LARGE SCALE EXCAVATIONS (PITS IN FLOOD PLAINS, MARINE OR LAKE AREAS)

Larger scale excavations cause:

For connecting channels:

- Slack water areas.
- Introduction of water quality problems into natural areas.
- Alteration of sediment movement.
- Conversion of freshwater habitats to saltwater habitats

For excavation in floodplain and channel migration zone:

- Stream capture.
- Channel migration through site.
- Perching of stream.
- Erosion and back cutting.

For excavation in lakes and beaches:

- Capture.
- Erosion and back cutting.

Recommended Mitigation

Specific mitigation based on site conditions and ecological functions

Avoidance

Preference

- Do not allow deep excavations or widespread shallow excavations within river floodways, channel migration zones, flat marine and lake shorelines, or in close proximity to other freshwater and saltwater shorelines.
- Do not attempt to use flood exclusion or wave structures to prevent failures.
- Require excavations in marine or lake sites to be above expected high wave elevations.

Additionally for connecting channels:

- Do not allow excavated water areas to have an open water connection to natural water features.
- Do not allow human uses along the artificial open water.

Minimization

Preference

- Limit major excavations in the floodplain (and outside the floodway and channel migration zone) to be no deeper than the bottom of the adjacent river channel, unless behind an existing federally certified flood control structure. Do not allow new dikes to protect the excavation. Locate pits on upper terraces and the furthest possible distance from river.
- Limit excavations in marine and lake low bank areas to be no deeper than OHWM elevation or sea level. Locate sites on upper elevations, furthest from the water.

Compensation	
Preference	▪ Catastrophic failure that causes saltwater contamination and water quality impacts cannot be mitigated, other than with individually developed out-of-kind compensation. Require any existing or new sites to provide compensation at the time of failure. ▪ Catastrophic effects of failure that cause sediment transport impacts cannot be compensated for, and these alterations should not be allowed beyond the avoidance and minimization recommendations. Require any sites to provide individually developed out-of-kind compensation at the time of failure. Require all sites to have contingency plans to address major high water events, and prevent and respond to catastrophic failure. ▪ For on or off-site mitigation, use the Stream Functions Pyramid or similar approach to calculate needed replacement of functions (see Side Box on page 50)
	Additionally for connecting channels: ▪ For existing locations and any new sites with open water connections to shorelines, require the development of a sediment protection and management plan. Require regular maintenance dredging, and require spoils to be spread down-flow from connection. Monitor down-flow sediment patterns.

END NOTES

1 WDFW, 2010a

2 Information on Priority Habitats and Species (PHS) can be found at the Washington State Department of Fish and Wildlife's "Priority Habitats and Species (PHS)" webpage at http://wdfw.wa.gov/conservation/phs/list/ Information on the Washington Rare Plant Species can be found at the Washington State Department of Natural Resources's webpage "Rare Plants Information Available from the Washington Natural Heritage Program" at http://www1.dnr.wa.gov/nhp/refdesk/plants.html

3 Burghardt et al, 2009

4 King County, 2004

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6 WDFW, 2009a

7 WDFW, 2009b

8 WDFW, 1997

9 Ecology, 2005a

10 Trombulak and Frissell, 2000

11 WDFW, 2010

12 WDFW, 2009a

13 WDFW, 1997

14 WDFW, 2009b

15 WDFW, 2009c

16 Blonski et al, 2010

17 WDFW, 2009b

18 Foth, 1991

19 Trombulak and Frissell, 2000

20 Forman, 1998

21 Kennish, 1991

22 Peterson and Bishop, 2005

23 Robertson and Wood, 2010

24 Winter, 1999

25 Heath, 1983

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28 WDFW, 1997

29 WDFW, 2009c

30 Trombulak and Frissell, 2000

31 WDFW, 2009b

32 Andrews, 1990

33 WDFW, 2009c

34 WDFW, 2010

35 WDFW/Ecology/WSDOT, 2001a

36 WDFW, 2003

37 WDFW, 2009c

38 Peterson and Bishop, 2005

39 Information on Priority Habitats and Species (PHS) and be found at the Washington State Department of Fish and Wildlife's "Priority Habitats and Species (PHS)" webpage accessed on April, 10, 2013 at: http://wdfw.wa.gov/conservation/phs/list/

Information on the Washington Rare Plant Species can be found at the Washington State Department of Natural Resources's webpage "Rare Plants Information Available from the Washington Natural Heritage Program" at http://www1.dnr.wa.gov/nhp/refdesk/plants.html

40 WDFW, 2010

41 NOAA-NMFS, 2012

42 NOAA-NMFS, 2011c

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45 Erftemeijer et al, 2006

46 Trombulak and Frissell, 2000

47 Kondolf, 1997

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51 WDFW, 2010

52 WDFW/Ecology/WSDOT, 2001a

53 WDFW, 2003

54 WDFW, 2009c

55 WDFW, 1997

56 WDFW, 2009b

57 WDFW, 2009a

58 WDFW, 2010

59 PSNERP, 2009

60 WDFW, 2013

61 Carman et al, 2010

62 Shipman, 2010

63 WDFW, 2009c

64 City of Bellevue, 2000

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69 WDFW, 2003

70 Kondolf, 1997

71 WDFW, 2010

72 WDFW, 2013

73 WDFW, 2009c

74 City of Bellevue, 2000

75 WDFW/Ecology/WSDOT, 2001a

76 WDFW, 1997

77 WDFW, 2003

78 Yakima County SMP has useful riverine and floodplain standards for utility and roads. See YCC Title, 16D at http://www.codepublishing.com/WA/yakimacounty

79 Peterson and Bishop, 2005

80 WDFW, 2013

81 WDFW, 2010

82 Kondolf et al, 2001

83 WDFW, 2001d

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85 WDFW, 2003

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87 Peterson and Bishop, 2005

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101 WDFW, 2009a

102 WDFW, 2009a

103 WDFW, 2009c

104 WDFW, 2010

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107 WDFW, 2010

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110 City of Bainbridge, 2012

111 WDFW, 2009c

112 See Shoreline Master Program provisions and the Priority Habitats and Species Management Recommendations at http://wdfw.wa.gov/publications/search.php?Cat=Priority Habitats and Species

113 WDFW/DNR/WSDOT/Ecology/PSP/RCO/PSP/USFWS, 2012

114 City of Bainbridge, 2012

115 Quigley et al, 2006

116 Quigley et al, 2006

117 City of Bainbridge, 2012

118 Tumwater (TMC Chapter, 16.08 Protection of trees and vegetation): Cut trees must be replaced at 3:1 ratio above a threshold, similar species, similar locations, at least 4 foot)
119 Mercer Island (MICC, 19.10 Trees. Effective March, 15, 2002): City Arborist may require up to 4 replacement trees for each tree cut (depending upon geologic and slope stability concerns, tree size and species, lot size and area available for planting, tec.).
120 City of Bainbridge, 2012
121 Ecology/Corps/EPA, 2006
122 WDFW, 2009a
123 WDFW, 2009a
124 WDFW, 2009a
125 City of Bainbridge, 2012
126 WDFW, 1997
127 Wiedemann, 1984
128 DNR mine reclamation standards include this soil protection standard to ensure successful mine reclamation. Summary page at http://www.dnr.wa.gov/businesspermits/topics/miningenergyresourceregulation/pages/smr.aspx
129 See Yakima County SMP – YCC, 16D.06.21 at http://www.codepublishing.com/WA/yakimacounty
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131 WDFW, 2010
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133 Oregon Department of State Land, 2011
134 NOAA-NMFS, 2011c
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144 WDFW/Ecology/WSDOT, 2001b
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148 WDFW, 2010
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150 WDFW, 2010
151 WDFW, 2010
152 WDFW, 2009c
153 WDFW/Ecology/WSDOT, 2001b
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156 Pierce County (Pierce County Title, 20 Shoreline Management Use Regulations): "Saltwater docks and piers … intrusion into water of any pier or dock on saltwater shall not exceed, 15 percent of the fetch." Kitsap County Draft SMP requires navigational study if proposed to exceed, 15%.
157 WDFW, 2009c
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169 WDFW/Ecology/WSDOT, 2001b
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187 City of Bainbridge, 2012
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221 WDFW, 2009c
222 NOAA-OOC, 2007
223 WDFW, 2009c
224 WDFW, 2013
225 WDFW, 2013
226 WDFW, 2013
227 WDFW, 2013
228 Erftemeijer et al, 2006
229 WDFW, 2010

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Corps	U.S. Army Corps of Engineers
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
NOAA-NMFS	National Oceanic and Atmospheric Administration. National Marine Fisheries Service
NOAA-OOC	National Oceanic and Atmospheric Administration. Office of Ocean and Coastal Resource Management
PSNERP	Puget Sound Nearshore Ecosystem Restoration Project
PSP	Puget Sound Partnership
USDA NRCS	U.S. Department of Agriculture and Natural Resources Conservation Service
USFWS	U.S. Fish and Wildlife Services
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation

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APPENDICES

PERMITTING BEST PRACTICES DOCUMENTS

GIS PORTALS FOR WASHINGTON DATA

EXAMPLE APPLICATION QUESTIONNAIRE AND EVALUATION WORKSHEET

EXAMPLE BOND LANGUAGE

SUMMARY OF BASIC SHORELINE NATURAL RESOURCES FUNCTIONS

SHORELINE BUFFERS IN PUGET SOUND COUNTIES AND SEATTLE, BAINBRIDGE, TACOMA, OLYMPIA

APPENDIX 1. PERMITTING BEST PRACTICES DOCUMENTS

Useful reference documents with tips for improving permitting process are provided below. We used information from many of these references throughout our guide. These references are annotated below if the reader wishes to delve into them further:

- Washington State Governor's Office of Regulatory Assistance. *Local Government Permitting - Best Practices* (with appendices in separate document). ORA Publication No. ENV-015-08. (August 2008). http://www.ora.wa.gov/resources/government.asp

Highlights: Seven best practices to improve permitting.

- Build a common understanding between agencies, industry, elected officials, and the public of the "how" and "why" of the permit process. Work on coordination, and educate all participants about effective permitting.
- Pre-application assistance to identify and resolve requirements and constraints before work is spent on detailed design.
- Communicate requirements for complete applications, require them at submittal, and educate applicants on the requirements.
- Analyze the process, develop information materials, and communicate the process to applicants. Mapping out the process also reveals opportunities for improvement and helps set permit fees.
- Use technology such as electronic permit tracking systems, geographic information systems (GIS), and connecting them online. This can improve communication, reduce paperwork, and allows access to records.
- Develop staffing flexibility to deal with high volume periods and specialty skills, including temporary hiring, on-call consultants, contracting out, and interlocal agreements.
- Use case managers to coordinate reviews across departments and agencies and provide applicants with a single point of contact.

- Massachusetts Association of Regional Planning Agencies (MARPA). *A Best Practices Model for Streamlined Local Permitting* (November 30, 2007).
  http://www.mass.gov/hed/economic/eohed/pro/tools/best-practices-model-for-streamlined-local.html

Highlights: Includes a bibliography with links to other reports, including several from Washington. See the appendix downloads on the website. Includes 26 recommendations that include the recommendations from the Washington State reference listed above. The list also includes some other useful suggestions:

- Tips for communicating with applicants (i.e., forms and checklists),
- Tips for improving in-house review and communication,
- Making the review process uniform and streamlined across permit types, and
- Creating a culture of training.

- Centre Regional Planning Agency. *Best Practices For Development Review and Permitting.* Pennsylvania Centre Region Council of Governments. (March 2012).
  http://www.crcog.net/index.asp?Type=B_BASIC&SEC={DD77FD99-C633-4CC3-A857-49BBE090D63C}

Highlights: Includes 17 recommendations that include the recommendations listed for the Washington and Massachusetts references.

- King County Auditor's Office. *Special Study - Department of Development and Environmental Services (DDES) Permitting Best Practices Review*. Report No. 2004-01. (March 2, 2004). http://www.kingcounty.gov/operations/auditor/Reports/Dept/DDES.aspx

Highlights: This study covers much of the same material as the other references. Of interest is a discussion of offering expedited permit review, such as approving building permit templates for repeated structures, fee or process improvements for consultants that are preferred because they produce consistently high quality work, fee distinctions for applicants that are familiar or unfamiliar with the process. King County implemented some of these recommendations and we highlight them in this guide.

- Municipal Research and Services Center (MRSC) Resources section of the web page. http://www.mrsc.org/subjects/planning/permproc.aspx

Highlights: MRCS provides some resources for improving permit processes. This link provides access to other documents on their website that have been generated by Washington cities and counties.

- WRIA 8 Green Shorelines for Lake Washington and Lake Sammamish web page (http://www.govlink.org/watersheds/8/action/greenshorelines)

Highlights: This web page has education pieces and videos as well as links to other resources.

APPENDIX 2. GIS PORTALS FOR WASHINGTON DATA

- Washington State Geospatial Clearinghouse: http://metadata.gis.washington.edu/geoportal/catalog/main/home.page
- WAGDA (the Washington State Geospatial Data Archive): http://wagda.lib.washington.edu
- Washington State Department of Ecology Geographic Information Systems (GIS) webpage: http://www.ecy.wa.gov/services/gis
- Washington State Department of Natural Resources GIS Data Center: http://www.dnr.wa.gov/BusinessPermits/Topics/Data/Pages/gis_data_center.aspx
- Washington State Department of Transportation WSDOT GeoData Distribution Catalog: http://www.wsdot.wa.gov/mapsdata/geodatacatalog
- Washington State Department of Transportation Purchase Aerial Photography Products and Services ordering webpage: http://www.wsdot.wa.gov/MapsData/Aerial/PurchaseProducts.htm
- USGS National Map (includes downloadable data layers too): http://nationalmap.gov/viewer.html

APPENDIX 3. EXAMPLE APPLICATION QUESTIONNAIRE AND EVALUATION WORKSHEET

Yakima County Application Questionnaire

Shoreline & Critical Areas Questionnaire
For Streams, Ponds, Wetlands, Floodplains, and other Habitat Areas

INSTRUCTIONS

NOTE: If your project involves Agricultural Activities on designated Rural or Agriculture lands, consult with a natural resources planner.

Consult with a Natural Resources Planner BEFORE using this application form. Read this questionnaire BEFORE designing your project so that you can design the project to meet the standards. If you have designed the project without consideration of the legal requirements, then the review process will be much more difficult, take much more time, and will likely need costly changes to the plans. A project that clearly meets all the standards is much easier and less time consuming for your project reviewer to approve. Please consider if you will be able to prepare the application yourself or whether you will need to work with a private consultant.

IMPORTANT: Please understand that many projects require that a critical areas study performed by qualified professional be submitted to identify the critical area. There are some instances where staff can easily perform the identification, and help you avoid a report, but that is not always the case.

Please note that you probably will not need to submit all pages – only those that apply. There are 5 required pages. Supplemental pages may be needed. The Natural Resources Planner assisting you will help you determine which pages to remove, and will help with answering questions.

The questions are designed to help you and the application reviewer understand how your project meets the legal requirements in the Critical Area Ordinance (CAO) and Shoreline Master Program (SMP). In filling out this questionnaire, be sure to refer to the appropriate sections of the CAO. If you are within Shoreline jurisdiction, you should also refer to the SMP. You can obtain a copy of the SMP in our offices. You can obtain a copy of the CAO in our offices, or access it on the internet at: http://www.co.yakima.wa.us/cmrs (choose 'County Code)

The questionnaire is organized around groups of questions concerning different subjects, which are clearly labeled. All applications are required to answer the questions regarding whether the Use is Allowed and for meeting the General Standards. The questions on the supplemental must be answered when different subjects apply to the project (for example, filling, roads and utilities). There are seven (7) questions on the first page of the questionnaire used to determine which of the supplemental sheets to fill out. If you answer YES to one of these questions, then that sheet of questions applies to the project and you must

include it. If there is a sheet of questions which do not apply to your project, you may remove that sheet from the questionnaire.

Each group of questions relates to a particular subject and is headed by a shaded box. The box asks if all the standards for that subject are met. Circle either the YES or NO answer based on the questions under the shaded box. If you answer NO in the shaded box, you will need to modify your plans or apply for an adjustment or variance of the standard – a separate application. The questions under the shaded box help you determine if you are meeting the standards. The questions are arranged in nested order – meaning that when questions are indented under another question, they are related to just that question. If you need help understanding the layout of the questionnaire, or need help with specific questions, contact your Natural Resources Planner. If you wish to fill out the questionnaire digitally, contact a staff person for a MS Word version.

Project description (from application form): ____

Owner Name: ____ Phone #: ______________________
(Be sure to sign this form on last page.)

For Staff Reference
Project #: ____________________________ Case #: ___________________________

NOTE: If you answer NO to the questions in the shaded boxes of the questionnaire, you will need to either change your plans to conform to the requirement, or obtain an Adjustment or Variance from the standard that is not met. Such reviews require separate forms and materials to be prepared, and may delay the project.

QUESTION SHEETS TO INCLUDE IN THIS QUESTIONNAIRE
All projects must answer questions on the 5 REQUIRED sheets regarding Allowed Uses and General Standards. Answer the questions below to determine what supplemental sheets you also need to fill out. If you answer YES, then that sheet of questions must be included. If there is a supplemental sheet of questions which do not apply to your project, you may remove that sheet from the questionnaire.

- Suppl. A - Does your proposal disturb land or water areas; or revegetate critical areas? NO YES

- Suppl. B - Does your proposal include work on a transportation facility? NO YES
[EXAMPLES include driveways, parking areas, roads, bridges, etc.]

- Suppl. C - Does your proposal include work on utilities? NO YES
[EXAMPLES include sewer/septic, water, electrical, communication, etc.]

- Suppl. D - Does your proposal include in-channel work, bank stabilization, or flood protection? NO YES
[EXAMPLES include bank barbs, weirs, groins, jetties, dikes/levees, large wood, etc.]

- Suppl. E - Does your proposal include excavation on land or dredging in water? NO YES
[NOTE: Be sure to consider the material excavated for foundations and crawl spaces.]

- Suppl. F - Does your proposal include placing fill material on the land or in the water so it elevates the surface? NO YES
[NOTE: Be sure to consider the material excavated for foundations and crawl spaces.]

- Suppl. G - Does your proposal involve gravel mining? NO YES

I certify that the pages indicated above are filled out and attached as part of this application:

LANDOWNER'S SIGNATURE: ______________________________________ DATE: ____________

1. Is the proposed use either an Allowed Use or an existing Non-Conforming Use? YES NO

(See YCC 16C.06.10; 16C.05.32.020; 16C.05.36.020; 16C.06.11(23); & SMP Sections 9 & 15)

(A) What is/are the existing use(s) of the property?

(B) What will the use(s) be after the project?

(C) Does the project include an activity that is a Prohibited Use that will be located within a stream, wetland, vegetative buffer, floodplain, or floodway? (See YCC 16C.06.10) YES NO

Prohibited uses include:

- Storage/handling of dangerous/hazardous materials - Storage/handling of waste materials
- Draining/filling a wetland (except under certain cases) - Excavation to obtain fill
- Wells that are shallow or uncased - Mine tailings, spoilage, mining waste
- Confined Animal Feeding Operations - Automobile wrecking yards
- Vehicle and material storage within a floodway - Dwellings/residences in a floodway
- Waste disposal facilities (includes stormwater wells/ponds, but doesn't include filtration swales)
- Construction or storage of objects in a floodway that can float or move during a flood
- Structures and fill in a floodway, except in certain circumstances
- Damming a watercourse in a floodway, except in certain circumstances
- New and expanded Mobile Home Parks in the floodplain

(D) Does the project involve changing from one use-type to another? YES NO

(See YCC 16C.06.11(23)) (Examples include residential to commercial, agriculture/vacant to residential, commercial to recreation, etc.)

If YES:

(i) How will the conversion reduce impacts to the critical area or shoreline?

(ii) How will the conversion restore/enhance the critical area or shoreline functions and values?

(E) Is the project within Shoreline Jurisdiction? YES NO

[NOTE: Please consult with a Natural Resources Planner for assistance on Shoreline matters. The Shoreline Master Program regulations apply in Shoreline jurisdiction.]

If YES:

(i) What Shoreline environment is it in?

(ii) Is the project an allowable use for the Shoreline environment? YES NO

(iii) Does the project meet the special requirements for the applicable uses and activities listed below? Circle all appropriate uses and activities and provide a written response to standards.

Agriculture Aquaculture Forestry Mining Recreation

Commercial Industrial Residential Transportation Utilities

Filling Excavation/Dredging Signs Shore Stabilization

(F) If this project qualifies for an exemption, please list it: ___________________________________

TABLE OF USES AND CRITICAL AREAS – Get assistance from your Natural Resources Planner to fill out the table on the next page using the instructions near the top.

Water Related Natural Features on or Adjacent to Property

2. Does the project meet the General Standards (see YCC 16C.06.11), the Vegetative Buffer Standards (see YCC 16C.06.12-.16; & SMP 15), and the General Critical Areas Protective Measures for subdivisions (see YCC 16C.03.27(3))? YES NO

(A) Water Dependancy - Are parts of the project particularly dependant or YES NO

related to the water? (See YCC 16C. 06.12-.16)

(i) If YES, which ones?

(B) Will all Non-Water Oriented parts of your project meet the vegetative buffer and setbacks in YCC 16C.06.16? YES NO

[NOTE: The questions below cover common project elements to consider.]

(i) Does your vegetation management zone (a width around the structure) for Wildland-Urban fire protection meet the buffer requirements? YES NO

(ii) Does your septic tank/drainfield, well and well house, power poles, and all utility lines meet the buffer requirements? YES NO

(iii) Does your driveway/access road meet buffer requirements? YES NO

(iv) Do your yard, outdoor use areas, landscape features, recreation facilities, etc. meet buffer requirements? YES NO

(v) Do the construction areas for the items above meet buffer requirements? YES NO

(C) Are the critical area features marked on the ground? YES NO

(D) How will you protect other riparian vegetation (water loving plants growing because there is a stream or wetland nearby) on the property?

(E) How will you avoid disrupting fish habitat and wildlife habitat?

(F) Can you avoid critical areas by placing the project away from them? YES NO

(G) Can you reduce the size of the project (amount of fill, size of structures, etc.)? YES NO

(H) Describe how you are minimizing the amount of disturbance on the property.

(I) Are you obtaining a local/federal/state/or tribal stormwater permit? YES NO

(If not or if you are exempt from them, you must meet the CAO's stormwater standards.)

(J) Describe your erosion control measures and your stormwater runoff control measures.

(K) Are chemicals, nutrients, wastes, or toxins currently present on the site, or used during development, construction, or operation of the property? YES NO

(L) Will the project change or cross a stream channel or wetland? YES NO

(i) If YES, describe what changes are proposed?

(M) Will the project change or cross the floodplain, floodway, or any flood overflow channels?

(i) If YES, describe what changes are proposed?

(N) Is the project near an eroding bend in a stream or near a Channel Migration Zone (for larger streams)? YES NO

(O) Will there be a well used? YES NO

(i) If YES, provide details on the depth and casing/lining? (If existing, provide the well log.)

(P) Does the project include the subdivision of land? YES NO

(i) If YES, are the lots configured to protect critical areas as required by 16C.03.27(3)? (For example critical area lots, building envelopes, lot size, restoration of degraded areas, etc.) YES NO

3. For proposals that involve disturbing land or water areas, or replanting critical area vegetation, does the project meet the Reclamation standards? YES NO NONE PROPOSED ___
(See YCC 16C.06.23)
(A) Will there be disturbances in the water or wetlands? YES NO

(B) Will there be disturbances on land? YES NO

(C) When will you restore disturbed areas?

(D) How will you restore disturbed areas (if you have prepared a restoration plan, just refer to it)?

(i) Will you need to add fill to ensure that vegetation has a growing medium? YES NO

(E) Describe how you will make the final site topography stable.

(F) What plants will you use to re-vegetate the different areas of the site?

(G) Describe what mitigation you are proposing to compensate for impacts to the critical areas or shorelines? (If you need assistance, contact a natural resources planner.)

1. For proposals that include establishing a transportation facility, does the project meet the Roads and Railroads standards? YES NO
(See YCC 16C.06.17; 16C.05.36.010(7) & (2); SMP 15.09)
(Examples include driveways and parking areas.)
(A) Why do you need to locate the transportation facility in the critical area or shoreline?

(B) Describe the ways you could place the facility further away from or outside of the critical area or shoreline?

(C) Will fill be used to elevate the facility, or will it be constructed at grade?

(D) Will any fill used in the facility include construction waste or other debris? YES NO

(E) Is the facility located in any designated floodplain or floodway area, or in a flood overflow channel? YES NO

(i) If YES, has a floodway been defined at this location? YES NO
(See YCC 16C.05.36.010(7) & (2A/B/G)
(F) Does the project involve a bridge or other crossing over a stream or wetland? YES NO
If YES:
(i) Is there a way to provide access without using a new crossing (to a different road, etc.)? YES NO

(ii) Is there an existing crossing nearby? YES NO

(iii) Describe how the crossing location was chosen to use the most direct route, and have the least impact possible?

(iv) Will the crossing constrict the stream channel (the width between the channel banks) or impede the stream flow? (See YCC 16C.06.17(5)) YES NO

(v) Will the crossing constrict the width of any defined floodway? YES NO
(See YCC 16C.05.36.010(7 & 2B))

(vi) Describe how have you have designed your crossing's approaches to allow high floodwaters to pass around them without destroying the crossing or approaches (using a road dip, returning to grade quickly, extra culverts, etc.)? (See YCC 16C.06.17(3 & 10))

(vii) Is the crossing a culvert? YES NO
If YES:
(a) Does the culvert parallel the stream's flow and match the channel bed? YES NO

(b) Does the culvert provide for a natural material channel bottom (arch pipes, squash pipes, open bottom)? YES NO

1. For proposals that include Utilities or Transmission Lines, does the project meet the Utility standards? YES NO
(See YCC 16C.06.18; 16C.05.32.010; 16C.05.36.010(2); SMP 15.10; SMP 15.06; SMP 15.07)
(Examples include sewer/septic, water, electrical, communication, etc.)
(A) Why do you need to locate the utility facility in the critical area or shoreline?

(B) Describe the ways you could place the facility further away from or outside of the critical area or shoreline?

(C) Will the utility result in elevated ground or structures that can block/divert flood flows?

(D) Where will excess material that is displaced by lines and bedding material, or foundations be deposited? [NOTE: That location may also require zoning, critical areas, or other review.]

(E) Does the utility facility handle hazardous materials or potential pollutants? YES NO
(i) If YES, describe them.

(F) Does the facility only provide service to individual customers in the immediate area? YES NO
(see YCC 16C.05.32.010 & 16C.05.36.010)

(G) Is the utility facility above ground or below ground?

[NOTE: Most utilities in shoreline jurisdiction must be buried underground.]
(i) If above ground (overhead lines, connecting to bridge, etc.):
(a) Are supports placed as far upland as possible or (if within the floodwaters) in areas safest from high flood velocities and depth? YES NO

(ii) If below ground (pipelines, etc.):
(a) Describe its depth and the method of installation (bored, or trenched, or 'plowed').

(b) Describe how you will prevent the trench from acting like a "french-drain" in shallow groundwater areas.

(c) Is there a Channel Migration Zone or indications of historic channels in this location? (NOTE: Contact a staff planner for assistance.) YES NO

(d) Will it be placed in a sleeve for easy repair outside any stream/wetland? YES NO

(H) Does the utility facility involve a bridge or other crossing over a stream or wetland? YES NO
If YES:
(i) Is there a way to provide the utility service without a new crossing by connecting from another direction? YES NO

(ii) Are you using an existing crossing location? (See YCC 16C.06.18(4)) YES NO

(iii) Describe how the crossing location was chosen to use the most direct route, and have the least impact possible.

1. For proposals that involve in-channel work, bank stabilization, or flood protection, does the project meet the Shore Stabilization standards? YES NO
(See YCC 16C.06.19; SMP 15.13; 16C.05.28.010(a & d)); 16C.05.36.010(5 & 6)
(Examples include bank barbs, channel weirs, groins, jetties, berms/dikes, large wood, etc.)
(A) Describe the shore stabilization work are you proposing?

(B) What consultants and agencies are assisting you at this time?
[NOTE: You will need professional assistance to design your stabilization work.]

(C) Why do you need to do the in-channel work, bank stabilization, or flood protection?

(i) When did the problem start?

(ii) Rate the severity of the problem. Mild Moderate High Extreme

(iii) Has there been a sudden and major bank failure? YES NO

(iv) Is the problem caused by normal river/stream movement? YES NO

(v) Is the bank already armored? YES NO

(a) If YES, is it being maintained? YES NO

(D) Are there any structures at risk due to close proximity to an erosion problem? YES NO
(i) If YES, list the structures and their distance from the problem site

Structure	Distance

(E) Is the project in a designated floodway? YES NO

(F) Is your project designed using the Integrated Streambank Protection Guidelines prepared by Wa. Dept. of Fish and Wildlife? YES NO
[NOTE: You will likely need professional assistance.]

(G) Describe how you are minimizing the number and size of structures?

(H) Have you implemented the preference for non-structural protection measures? YES NO
[NOTE: The questions below are arranged from most preferred to least preferred]
(i) Have you tried using non-structural protection measures yet? YES NO
(Avoidance, moving the facility, general vegetation planting, etc.)
(a) If NO, explain why not.

(ii) Have you tried using 'bio-engineering' yet? YES NO
(Intensive revegetation, branch-cutting bundles, planted soil lifts, etc.)
(a) If NO, explain why not.

(iii) Are you installing specific features made of natural materials (wood & rock)? YES NO
(Bank barbs, log vanes, root-wad armoring, etc.)

(iv) Are you installing an erosion resistant covering (rip-rap, etc.) using natural-materials? YES NO

(v) Are you installing structures using concrete? YES NO
(Bulkheads, revetments, rock grouting, etc.)

(I) Are you installing permanent structures? YES NO
(Examples include barbs, bulkheads, revetments, breakwaters, groins, etc.)
If YES:
(i) Described how you have minimized the height of the structures?

(ii) Describe your plans for future maintenance?

(J) Will the effect of your work be to prevent normal channel movement processes, either vertically (grade control) or horizontally (bank armoring)? YES NO

(K) Are you trying to restore lost land? YES NO

(i) If YES, will the new land be within the existing ordinary high water? YES NO

(L) Describe how your structures are designed to be stable over time, including the need for any periodic maintenance.

1. For proposals that include excavation on land or dredging in the water, does the project meet the Dredging and Excavation standards? YES NO NONE PROPOSED__
(see YCC 16C.06.20; SMP 15.16)
[NOTE: Be sure to consider the material excavated for foundations and crawl spaces.]
(A) Will there be dredging in the water or a wetland? YES NO
If YES:

(i) What use is the dredging for?

(ii) Where will the dredge spoils go?

(iii) Have you attached a dredging plan? YES NO

(B) Will there be excavation on the land? YES NO
If YES:
(i) What use is the excavation for?

(ii) Where will the excavated material go?

(iii) What volume of excavation is proposed?

(C) Describe how you are minimizing the amount of dredging/excavation needed.

2. For proposals that include Fill, does the project meet the Filling standards? YES NO
(See YCC 16C.06.21; 16C.05.36.020(2); SMP 15.14) NONE PROPOSED__
[NOTE: Be sure to consider the disposal of material excavated for foundations and crawl spaces.]
(A) Is there fill placed in the water or a wetland? YES NO
(i) If YES, what use is it for, and what type of material is to be used?

(B) Is there fill placed in the floodplain or floodway? YES NO
(i) If YES, what use is it for?

(C) Is there fill placed in other land areas? YES NO
(i) If YES, what use is it for?

(D) Describe how you are minimizing the amount of fill needed.

(i) Are you using fill to elevate a structure? YES NO
If YES:
(a) Is it possible to use pilings/piers rather than fill? YES NO

(b) Is it possible to elevate any structure on a foundation rather than on fill? YES NO

(E) What volumes and materials are you using for the fill?

(F) What erosion control will you use for the fill area?

1. For proposals that involve gravel mining, does the project meet the Gravel Mining standards?
(See YCC 16C.06.22; 16C.05.36.010-.020; SMP 15.04) YES NO
(A) Have you attached a description of your mine (material, volumes, etc.), an operations plan with maps, your plans for protecting critical areas and a reclamation plan with maps? YES NO

(B) How will the mining operation affect the critical area or shoreline?

(C) What will be the subsequent use of the site after mining is completed?

(i) How will the subsequent use affect the critical area or shoreline?

(D) Will bodies of open water (below groundwater level, or from capturing runoff) result from the mining operation? YES NO

(E) Describe how you are minimizing the amount of, and severity of impacts to the critical area or shoreline?

(i) Describe how you will minimize the obstruction of flood flows?

(ii) Where you permanently impact a critical area or shoreline, how will you replace its function and value?

(F) Are you able to meet the operational setbacks in the ordinance? YES NO

(G) Will mine reclamation meet state standards? YES NO
[NOTE: Provide copy of DNR permit, or reclamation plans following state standards.]

San Juan County Pre-Application Evaluation Worksheet

(Available at: http://sanjuanco.com/cdp/CAO_ImplemenationDocs.aspx)

Pre-application Evaluation Number ______________________

Tax Parcel Number ______

San Juan County

COMMUNITY DEVELOPMENT & PLANNING

135 Rhone Street, P.O. Box 947, Friday Harbor, WA. 98250

(360) 378-2354 | (360) 378-2116 | Fax (360) 378-3922

cdp@sanjuanco.com | www.sanjuanco.com

LAND USE PRE-APPLICATION EVALUATION WORKSHEET

Maps, photos of protected plants and animals, and other critical area guidance materials are on the county web site at: http://sanjuanco.com/cdp/CAO_ImplementationDocs.aspx

The county's Polaris mapping application, which includes zoning maps, aerial photos and topographic contour lines useful in site evaluations, are at: https://www.sjcgis.org/SJCGIS/Welcome.html

Materials needed for review

- Completed application form with attachments (including at least two copies of completed site plan).
- Aerial photo with contour lines [10' if possible).
- If in the field, 100 ft. tape measure and clinometer or other instrument for measuring slope.
- Critical area maps (available on above web site).
- Clear dot grid overlay for determining percent canopy cover.
- Excel table for calculating composite stormwater discharge factor (available on above web site).
- Pencil and eraser.
- Calculator.
- For development or vegetation removal within 205 feet of a wetland, scaled site plan showing edge of wetland facing area proposed for development or vegetation removal.
- Available site-specific reports.

Provisions not covered in this worksheet

- Mitigation procedures and requirements.
- Reasonable use procedures and requirements.
- Variance procedures and requirements.
- Provisions for Public Agency/ Utility Exceptions.
- Review of expanded or modified agricultural activities in or adjacent to critical areas.
- Review of activities associated with shoreline modifications.
- Detailed requirements associated with regulations for urban growth areas, activity centers and master planned resorts.
- Requirements associated with the San Juan County Flood Control Ordinance.
- State and Federal requirements.

Section A. General Review (Zoning, permit requirements)

1. Land use designation: ____________Shoreline designation: __________
2. Is a project or development permit or review required for the proposed activity? yes / no

If yes, list below.

3. Proposed methods for treating, reinfiltrating or otherwise managing pollutants and runoff associated with the development or vegetation removal

4. Discharge within 25 feet of County ditches approved by County Engineer? yes / no
5. Stormwater discharge conflicts with location of sewage disposal systems? yes / no
6. Stormwater discharge conflicts with locations of water wells? yes / no
7. Proposed development triggers requirement for review of stormwater plans (e.g. creation of 2,000 sf impervious area or 7,000 sf land disturbing activity) ? yes / no

Section B. Shoreline Master Program Review (for parcels within shoreline designation). For residential development see SJCC 18.50.330.

1. Structural setbacks: Side:_________feet; Front:_____________feet: Road:_____________feet; __________feet from top of bank or ordinary high water mark.
2. Lot coverage limitations __________
3. Other requirements related to vegetation removal, or location and height of structures. (For residential structures see SJCC 18.50.330.B.8, 13 and 14). ______

4. Is modification of existing shoreline uses or structures proposed? yes / no

If yes, which option is the applicant selecting (response required)?

No net loss of shoreline ecological function (application must include information sufficient to demonstrate compliance including information on how runoff and pollutants will be managed, and how adverse impacts associated with vegetation removal will be mitigated), or

Compliance with critical area requirements.

Section C. Activity Center, UGA and Subarea Plan Review

1. Is parcel subject to special requirements for activity centers, urban growth areas, subareas, or master planned resorts? yes / no

(list)

If yes, review for compliance. The following areas have special requirements:

Orcas Island: Eastsound UGA; Country Corner; Olga Hamlet; Doe Bay; Westsound; Deer Harbor; Orcas Landing; Rosario Resort.

San Juan Island: Friday Harbor UGA; Roche Harbor.

Lopez Island: Lopez Village.

Shaw Island.

Waldron Island

Section D. Critical Area Review (for 2013 Critical Area Regulations)

Exemptions (SJCC 18.30.110.C). Do any exemptions apply (see associated conditions)?

-
1. Emergency response yes / no
2. Operation, maintenance, repair, remodel or replacement of existing structures, facilities, infrastructure systems, development areas and uses yes / no
3. Installation, construction, replacement, or modification of electrical lines, telecommunication lines, water lines, or sewer lines yes / no
4. Removal of hazard trees and for structures existing prior to March 1, 2013, removal of 30 feet of vegetation around buildings yes / no
5. Forest practices regulated under RCW Chapter 76.09 and WAC Title 222 yes / no
6. Installation of navigation aids and survey markers yes / no
7. Site investigative work associated with land use applications yes / no
8. Activity is entirely covered by an exemption and all exemption conditions will be met? yes / no
If no, proceed to complete critical area evaluation.

Section E. Frequently Flooded areas (SJCC 18.30.130 and 15.12)

1. Is development proposed within an Area of Special Flood Hazard as shown on the most current Flood Insurance Rate Map? yes / no
If yes list type and review County Flood Control Ordinance (SJCC 15.12) for requirements

Flood Hazard maps available at: https://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1
2. Is development proposed within 10 vertical feet of the ordinary high water mark of marine shorelines? yes / no
If yes see information on sea level rise and climate change.
3. Review complete and any required conditions, reports or application materials listed below.

Section F. Critical Aquifer Recharge Areas (SJCC 18.30.140)

1. Is the proposed development for a commercial, industrial, institutional or public facility? yes / no
If yes, review proposal for compliance with SJCC 18.30.140.
2. Review complete and any required conditions, reports or application materials listed below.

Section G. Geologically Hazardous Areas (SJCC 18.30.120)

1. Check the following maps and available information to identify geologically hazardous areas in or within 200 feet of area where development or vegetation removal is proposed:

Category I – Landslide Hazards:
San Juan County map of Category I Landslide Hazard. Cat. 1 areas identified? yes / no
Areas identified in a site-specific geologic report as a landslide hazard? yes / no
Areas with more than 20 ft. vertical drop and more than 50% slope (except unfractured bedrock)? yes / no
Areas designated as quaternary slumps, earthflows, mudflows, or landslides on maps published by the US Geological Survey or the WA Dept. of Natural Resources? yes / no
Note: Maps available at: http://www.dnr.wa.gov/researchscience/topics/geosciencesdata/pages/geology_portal.aspx). The township and section, or name of quadrangle map, are needed to obtain the map from this web site.

Category II – Erosion, Landslide and Other Hazards:
DNR Liquefaction Susceptibility Map. Medium to high risk of liquefaction during earthquake? yes / no
San Juan County map of potential Category II Erosion, Landslide and Other Hazards. Soils with a land capability subclass

of “e” identified? yes / no

Slopes over 15%? yes / no

Areas with seeps or springs, and slopes exceeding 15%, and pervious soil layers overlying semi-pervious to impervious soil layers (based on information provided by applicant or site visit)?

yes / no

If site is underlain with bedrock it is not a geologically hazardous area. See Soil Liquefaction map for location of bedrock.

Mine Hazards. Limestone quarries or other areas with steep and/or unstable slopes created by mining activity (based on information provided by applicant or site visit) ? yes / no

2. Is development located within 50 vertical feet of the ordinary high water mark of a marine shoreline?

yes / no

If yes see information on tsunami risks.

3. Does project involve construction of structural shoreline stabilization measures? yes / no

If yes required geotechnical report must identify any potential adverse impacts to adjacent and nearby properties, and adverse impacts must be mitigated in accordance with SJCC 18.30.110.F.

4. Review proposal for compliance with regulations for the type of geohazard area identified and note any conditions or requirements below.

5. Review complete and any required conditions, reports or application materials listed below.

Section H. Wetlands(SJCC 18.30.150)

1. Are proposed vegetation removal, development or other site modifications located within 205 feet of a wetland? yes / no / maybe

If no, no additional action is required to determine compliance with wetland protection requirements.

2. Review proposed activities for consistency with activities allowed in wetlands (see SJCC Table 3.8), and if the edge of the wetland has been delineated by a qualified wetlands professional, for activities allowed in wetland buffers. If no trees are proposed for removal, the proposed activity is allowed, and associated conditions will be met, no further review for compliance with wetland requirements is necessary. (Note: If activity is allowed in wetland buffers, but not in wetlands, then edge of the wetland must be located by a qualified professional).

3. Wetland type ______ For some types (e.g. bog) a qualified wetland professional may be needed. Is the wetland part of a mosaic? yes / no

(See SJCC 18.30.150.B. and definition of wetland mosaic in SJCC chapter 18.20).

4. Water quality-sensitivity rating of wetland (based on wetland type) _____

(See SJCC 18.30.150.C).

5. Habitat importance-sensitivity rating of wetland (based on wetland type) _____

(See SJCC 18.30.150.C).

6. Does the wetland contain habitat that is protected as a fish and wildlife habitat conservation area?

yes / no

If yes, which habitats? _____

Do the water quality-sensitivity and habitat importance-sensitivity ratings for the wetland need to be adjusted upward for these areas? yes / no

[See SJCC 18.30.160.F and Table 3.11. For protected plants the water quality-sensitivity rating is at least “medium” and the habitat importance-sensitivity rating is “high”].

7. What is the approximate size of the wetland? _____sf

Is the wetland small enough to qualify for one of the size exemptions? yes / no

If yes, activities are not regulated by San Juan County but may be subject to State or Federal requirements.

8. Identify the edge of the wetland facing the proposed development or vegetation removal, show it on the site plan and mark it in the field. A qualified wetland professional is required for this step but depending on the scope and location of the development a full delineation may not be required.

9. Is the Green Development option proposed? yes / no

If yes, check for compliance with associated requirements. (See SJCC 18.30.150.E.1.a. Step 5).

10. Is use of the UGA option proposed? yes / no

If yes, mitigation actions must be approved in accordance with SJCC 18.30.110.F

11. If runoff from the area proposed for development, vegetation removal or other site modification drains to the wetland, determine size and location of water quality buffer. (See SJCC 18.30.150.E.1.a. and the Excel composite stormwater discharge factor calculator). Draw the flow path used to determine the buffer (through the most intensely developed portion of

the proposed development), and the buffer and wetland edge on the site plan, and attach worksheets used to determine the stormwater discharge factors. For bogs the water quality buffer is at least 200 ft. [Note: If wetland buffers are determined in the field and the slope between the edge of the buffer and the wetland equals or exceeds 20%, add the following number of feet to the buffer to adjust for the difference between the horizontal measurement of the buffer, and the measurement along the ground surface]:

Slope in %	Additional buffer in feet per 100 feet
20 – 24 %	2 feet
25 – 29 %	3 feet
≥ 30 %	Measure distances remotely (e.g. using Polaris) or determine appropriate correction factor for the slope.

Stormwater Discharge Factor and size of water quality buffer (record for all that apply):

Residence or primary structure: ___________
Lawn/ gardens: ____________________
Other: _______
Composite discharge factor: _______

Lawn/ gardens: ____________________
Garage: __________________
Other: __________
____

12. Determine size and location of habitat buffer and draw on site plan (encircles wetland). (See SJCC 18.30.150.E.1.b).

13. Determine location of any tree protection zones and draw them on the site plan (50 ft. no cut zone around clusters of trees in wetlands). (See SJCC 18.30.150.E.1.b).

14. Is averaging of habitat buffer proposed? yes / no

If yes, determine if requirements will be met and where habitat buffer will be located. Draw buffer on site plan. (See SJCC 18.30.150.E.1.b).

15. Adjust buffers and tree protection zones so they do not cross public roads. For private roads, review for compliance with conditions and determine if buffers/ tree protection zones cross the road. (See SJCC 18.30.150.E.1.b.2).

16. Once location of buffers and tree protection zones are determined, mark them in the field.

17. Review proposed activities for compliance with wetland protection requirements and note any requirements below.

18. Determine if wetland report or additional delineation of boundaries is necessary. [Note: Objective of report is to provide enough information to determine compliance with requirements.]

19. Review complete and any required conditions, reports or application materials listed below.

Section I. Fish and Wildlife Habitat Conservation Areas

Aquatic FWHCAs (applies within 200 feet of streams, lakes, natural ponds, marine shorelines)

1. Are proposed vegetation removal, development or other site modifications located in or over a stream, natural pond, lake or marine waters? yes / no

   Within 200 feet of the ordinary high water mark (OHWM) of a marine shoreline? yes / no

   Within 125 ft. of the OHWM of a lake or natural pond? yes / no

   Within 125 feet of the bank full width of a stream? yes / no

   If no to all, no additional action is required to determine compliance with protection requirements for aquatic FWHCAs. Continue to evaluate compliance with protection measures for individual species and habitats (see below).
2. Review proposed activities for consistency with activities allowed in or over the water, or in buffers (see SJCC table 3.10). If proposed activity is allowed and associated conditions will be met, no further review for compliance with County requirements for aquatic FWHCAs is necessary.
3. For areas within 200 ft. of marine shorelines, is the site underlain with unfractured bedrock? yes / no

   (Map of soil liquefaction zones shows areas of bedrock). If no, does the shoreline provide sediment to an area with eelgrass, shellfish, spawning or holding areas for forage fish, mudflats, or intertidal habitats with vascular plants? yes / no

   (See drift cell map).

   If yes, a geotechnical report is required and setbacks, buffers, or other measures must be identified to allow for natural erosive processes for the life of structures (at least 75 years).
4. Identify the edge of the aquatic FWHCA facing the proposed development or vegetation removal, show it on the site plan and mark it in the field. For streams, the edge is the top of the bank; for lakes, natural ponds, and marine shorelines, it is the OHWM.
5. Is use of the UGA option proposed for either the water quality buffer or the tree protection zone? yes / no

   If yes, mitigation actions must be approved in accordance with SJCC 18.30.110.F.
6. For areas on bedrock, is all development located more than 110 feet from the top of bank for streams, or the OHWM for lakes, natural ponds and marine shorelines? yes / no

   Within zone 2 of the tree protection zone (starts 35 feet from the bank/ OHWM and extends to 110 feet) will at least 21% canopy cover of trees be maintained? yes / no

   If yes to all it is not necessary to do a detailed analysis to determine the water quality buffer and tree protection zone (skip steps 7-12).
7. Determine size and location of water quality buffer. (See SJCC 18.30.160.E.1, 18.30.150.E.1.a. and the Excel composite stormwater discharge factor calculator). Draw the flow path used to determine the buffer (through the most intensely developed portion of the proposed development), and the buffer and wetland edge on the site plan, and attach worksheets used to determine stormwater discharge factors. [Note: If buffers are determined in the field and the slope between the edge of the buffer and the top of bank/OHWM equals or exceeds 20%, add the following number of feet to the buffer to adjust for the difference between the horizontal measurement of the buffer, and the measurement along the ground surface]:

Slope in %	Additional buffer in feet per 100 feet
20 – 24 %	2 feet
25 – 29 %	3 feet
≥ 30 %	Measure distances remotely (e.g. using Polaris) or determine appropriate correction factor for the slope.

Stormwater Discharge Factor and size of water quality buffer (record for all that apply):

Residence or primary structure: _________
Lawn/ gardens: _________________
Other: ______
Composite discharge factor: ______

Lawn/ gardens: _________________
Garage: _____________
Other: _________
____

8. Stream type from map: ____________
9. Determine location of tree protection zones. Draw them on the site plan. (See SJCC 18.30.160.E.1, Step 4).
10. If averaging of tree protection zones is proposed, determine if requirements have been met and where tree protection zones will be located. Draw them on the site plan. (See SJCC 18.30.160.E.1, Step 5).
11. Adjust buffers and tree protection zones so they do not cross public roads. For private roads, review for compliance with conditions and determine if buffers/ tree protection zones cross the road. (See SJCC 18.30.160.E.1, Step 6).
12. Does location potentially qualify for reduced water quality buffers and tree protection zones due to obstructed views due to existing houses on adjoining waterfront parcels yes / no

Note: Adverse impacts must be identified and mitigated in accordance with SJCC 18.30.110.F. and other associated requirements must be met. (See SJCC 18.30.160.E.6).

13. Once the location of buffers and tree protection zones are determined, mark them in the field.
14. Review proposed activities for compliance with protection requirements including lighting requirements.

<u>Individual Species and Habitats with Additional Protection Recommendations/ Requirements</u> (see SJCC 18.30.160.F and definitions in chapter 18.20).

15. Is the proposed development, vegetation removal, or other site modification within 1,000 ft. of golden eagle nest or ¼ mile of peregrine falcon or great blue heron nest? yes / no
16. Is the proposed development, vegetation removal or other site modification within 200 ft. of a West Side Prairie, Herbaceous Bald and Bluffs, Garry Oak Woodlands or Savannas, or an area with which a protected plant or animal species has a primary association? yes / no

List all that apply.

17. Review proposal for compliance with recommendations and requirements including lighting requirements.
18. Review complete and any required conditions, reports or application materials listed below.

<u>Required permits, reviews and reports:</u>

<u>Conditions:</u>

A site visit was/ was not conducted as part of this pre-application review.

____

____ ______________________

____

Name and title of reviewer

Signature of reviewer

Date

APPENDIX 4. EXAMPLE BOND LANGUAGE

SURETY BOND OREGON DEPARTMENT OF STATE LANDS

For (Removal-Fill Permit / Enforcement File) No. ______________________Bond No.____
Site Location: Township _, Range _, Section _ , Tax Lot(s) __, County_____

KNOW ALL MEN BY THESE PRESENTS:

That ____(name of permittee), as principal, and ____, a corporation duly licensed to do business in the State of Oregon, as surety are held and firmly bound unto the State of Oregon, acting by and through the Oregon Department of State Lands (Department) in the sum of ____dollars ($______) lawful money of the United States for payment of which will and truly to be made we bind ourselves and our legal representatives jointly and severally by these presents.

Dated this ___________ day of ____________________ , 20 ____

.

The condition of the above obligation is such that whereas the above principal is required to perform compensatory mitigation in accordance with (Removal-Fill Permit No.________ / Enforcement File No.__________) pursuant to ORS 196.800 through 196.990.

It is understood and agreed that the Department may grant to principal extensions of time to complete his mitigation plan, which are based upon delays occasioned by causes beyond principal's control. Such extensions of time shall not cancel the bond, but continue it in full force and effect for the period of such extension of time.

NOW THEREFORE, if the said principal shall faithfully perform the requirements of the mitigation plan filed with the Department, the terms and conditions of his (Removal-Fill permit / Enforcement Order); and the provisions of ORS 196.800 through 196.990; and the rules of said Department adopted thereunder, then this obligation to be void, otherwise to remain in full force and effect. The Surety may not cancel this bond without sending written notice within 45 days of said proposed date and receiving written permission to do so from the Department.

The Surety hereby agrees that prompt notice will be provided to the principal and the Director of the Department of any action filed alleging the insolvency or bankruptcy of said surety or action filed alleging any violations which would result in suspension or revocation of the surety's license or authorization to conduct business in the State of Oregon

____

(Name of Principal – *print or type*)

____

(Signature of Principal & Date)

____

(Name of Surety Company – *print or type*)

____

(Name & Title of Attorney-in-Fact – *print or type*)

(Signature & Date)

(Address)

____

(Phone)

ORIGINAL TO EACH: PRINCIPAL / DEPARTMENT / SURETY
/Users/ummmhayley/Downloads/Futurewise Shorelines Guide Permitting and Mitigation June 30 2014 footnotes_HB.doc
From: http://www.oregon.gov/dsl/PERMITS/Pages/forms.aspx#Mitigation

APPENDIX 5. SUMMARY OF BASIC SHORELINE NATURAL RESOURCES FUNCTIONS

This appendix summarizes key shoreline ecological functions. The purpose is to aid in the understanding of the impacts of development on the shoreline environment.

Water and sediment flow

Due to the nature of shorelines, the dominant physical factor is the presence and action of water, including its influence on the nearby lands. Water movement and sediment movement are important to understand at a basic level because they are the drivers of aquatic habitat as well as drivers of erosion forces that influence the geomorphology of shorelines.

The power of water has shaped the lands above and below the water line, by the movement of sediment. This interaction of water power and sediment movement is the driving natural process in the formation of shoreline ecological functions. Water flow is in a constant balancing act with sediment flow. Rivers and their floodplains have a surprisingly large water exchange through the sediment called hyporheic flow that passes through a hyporheic zone. Wherever water moves over land, it is moving sediment either in suspension or along the bed. Beaches, too, function like rivers in that sediment is moved by wave action.

Sediment particle movement in water

Sediment transport is most strongly determined by the velocity of the water flow. As water power goes up, the particle size it can mobilize goes up - particles are nudged, then rolled, then suspended above the bed with the water flow. As particles on the bed surface move, particles underneath are subjected to both water power and particle collisions that may mobilize them depending on those particle sizes. The sediment is evacuated into suspension or rolled and slid along the bed, though the movement speed will go down with depth till it reaches zero. Some exceptions are aquatic beds made of bedrock, massive boulders, or otherwise bound sediment. Bed mobilization is the process that encourages larger rocks or logs that resist the water power to settle deeper into beach or river bed as smaller particles around and under them are mobilized.

When water flow slows, the particles are deposited on the bed in graduating layers as first larger particles are dropped, then smaller particles. With a fast drop in water flow, multiple particle sizes will settle out together and form a highly mixed sediment layer. When water flow drops slowly, particle sizes settle out in layers of more uniform particle size.

When the water flow is consistently of a certain level, it results in a predominant particle size that can resist the water power. This is why a stream bed or beach may be largely composed of cobbles or gravels – the smaller particles that continue to come into the site move through rapidly and don't settle. Low flow rivers may have already settled sediment out before reaching the site – a common occurrence at impoundments behind dams.

Bed load and sediment transport

Bed mobilization is particularly evident for streams, where pipelines or cables thought to be safely under the stream get washed out. While the depth of stream bed mobilization varies by stream flow and sediment composition, during floods, the sediment generally mobilizes for a depth under the normal bed level of up to 1/3 of the bankfull depth (measured between the normal bed level and the top of bank). In the case of marine or lake beaches, the mobilization of sediment takes on a more distinct pattern generated by the rhythm and intensity of the waves, with most motion at the surface and less motion with depth.

Factors affecting water power

Water's energy and ability to move sediment is generally determined by the velocity of water applied to an area of the bed. Water power is also affected by a number of characteristics of the aquatic bed, such as slope, volume, depth, bed roughness, etc. Some important characteristics to keep in mind are:

- ***Depth.*** Greater water depth allows more water to avoid friction against the bed and allows higher velocities, while shallower water depth applies bed friction to more of the water, and reduces velocities. This is one reason why there is more damage during high water events: overall river velocities increase and the high energy part of a wave can move further landward.
- ***Bed Area.*** Greater bed area applies more friction against the water. This reduces velocity and water power. Long flat beaches spread out the wave power, undulating marine shores stretch out the length of beach that wave power is applied to (with localized exceptions), braided rivers divide the stream power among the braids, river meanders reduce the slope of the river (and its velocity and stream power) by extending the length of bed for the same elevation drop.
- ***Slope.*** Steeper slopes give greater velocity and power to water passing over the slope compared to flatter slopes. Steeper

slopes tend to have less area of bed and allow greater depth compared to flatter slopes.

- ***Roughness*.** Bed roughness increases the amount of friction between the water and bed. Greater bed roughness reduces velocity and water power. Roughness is determined by the obstructions extending into the water flow, such as large particle size (i.e., cobbles and boulders), large rocks, and logs.

Water power is not consistent across the entire length of a shoreline. It changes from segment to segment based on site-specific conditions. The biotic systems of each segment develop over time in balance with the water power and sediment transport characteristics.

Obstructions in stream flow

Water movement is affected by many factors such as bed and channel character, obstructions, and turbulence. Minor changes in bed configuration or obstructions redirect straight-line flow into adjacent straight-line flow, which causes turbulence. Straight line flow that encounters an obstruction will direct over or around the obstruction. Some different situations are:

- When the obstruction is encountered, the water slows or stops, causing a localized backup of water, which creates the change in elevation needed to get around the obstacle. The buildup is higher in the middle of the obstacle and lower where the water can escape around the obstacle. The differences in elevation allow flow along the face of the obstacle to where it escapes. The humped area of water is usually visible.
- If the flow is high enough to go over the obstacle, the upper portion of flow will go over and drop down behind the obstacle. The lower portion will continue going around the obstacle. This effect is visible as a hump as flowing water passes over a rock.
- Water that overtops the obstruction will tend to be redirected at a right angle to the obstruction, because it is influenced by gravity as it “falls over” the edge of the obstruction. Thus, for an obstruction lying straight across the water flow, the right angle redirection results in no change in stream flow direction. An obstruction lying at an angle to the water flow, however, will be redirected into a turn. For example, a bank barb angled upstream will redirect flow toward the middle of the stream, but if it’s angled downstream, flow will be redirected toward the bank. The more complete the impoundment effect, the greater the tendency for this effect. For example, a branch on the bed of the river will have a small effect, but a cross-channel weir will have a big effect.
- The turbulence of obstacles allows mobilized sediment to be stirred high in the water column rather than just flowing along the bottom.

Bank erosion

While bed load and sedimentation occur in the waterbody, erosion can happen on the adjacent land. This makes erosion (especially bank erosion) of great concern to property owners because they may lose land or structures close to the bank are at risk.

Under natural conditions, upland erosion takes place and delivers sediment directly to aquatic areas, where it may move as bed load through tributaries to other aquatic areas. The three most important categories of upland erosion sources are:

- Mass wasting sources such as bluffs and high banks. Mass wasting is the delivery of large quantities of sediment.
- Sediment deposits from past events in a readily accessible location such as river banks, floodplains, low banks and spits.
- Surface erosion (mostly small particles generated from steeper slopes).

Bank erosion is natural and biotic systems have developed over time within specific erosion patterns and are dependent on them. Mass wasting sources are an obvious and continual source of material (sometimes in spectacular fashion) as long as the water force is applied to the toe of the bank. They are more easily identified as hazardous for human structures, and generally less developed than low bank locations. Low bank locations are also continual sources of material.

Bank erosion (both high and low bank) that encroaches into upland areas includes situations when the slope is only underwater during a storm event, such as a flood. If the site is accessible to the bed load and not too steep to hold the bed load, the eroded material can be replaced by the moving bed load with little erosion. A slope that can resist the water force will not erode. A more easily erosive slope is moved landward until it encroaches into or undermines the bank.

Resistance to bank erosion

The determining factor for whether erosion takes place is whether the slope can resist the erosion. The main factors are particle size and cohesiveness of the sediment matrix. Factors that can influence erosiveness include:

- ***Roughness***. A site with more roughness will reduce the site's water erosive force more than if it had less roughness: in-water roughness can be altered by removing logs or aquatic vegetation that reduce water power; upland roughness can be altered by clearing vegetation that reduces water force during flooding.
- ***Vegetation.*** Vegetation root mats bind the sediment and soil together. More robust vegetation binds sediment more strongly than if the vegetation were cleared: aquatic vegetation root mats can hold in-water sediment, upland vegetation root mats can hold upland sediments in flooded areas, and upland vegetation roots can reach down the bank and resist erosion in the bank.

When these factors are changed by human alterations (usually by removing roughness features and clearing vegetation), erosion can happen more easily during smaller events.

Relationship to the biotic systems

Aquatic areas have developed over the course of thousands of years or more, and stabilized into their current configuration based on a consistent range of water power established by the yearly flow and common storm events. New human-induced or natural changes that affect water flow or sediment transport can fundamentally alter the characteristics that the biotic system, plants, fish, and wildlife.

While vegetation forms the habitat of many species, sediment also forms the habitat of many other species, such as clams and riverine salmonids. Direct changes in site sediment characteristics can make it unsuitable for some species. Furthermore many species depend on processes that periodically refresh sediment composition for their survival.

Water power and sediment movement on open water shores (marine and lake).

Basic wave action

- A wave washes up a beach, carrying sediment with it.
- A wave falls and hits sediment with impact and turbulence, and continues washing up the beach; which mobilizes sediment deeply in the impact zone and carries it further along.
- A wave pauses, loosing strength and dropping sediment.
- During the full course of the wave, water continually soaks into the sediment. Thus there is more water on the incoming wave than on the outflow, which tends to move more sediment in incoming direction than outgoing direction. This is how upper beaches and beach ridge deposits are formed.
- A wave flows downslope, carrying sediment back to water.
- Where incoming and outgoing flows coincide, there is turbulence that mobilizes sediment. In addition outgoing flow tends to submerge under incoming wave and carry sediment with it.
- Water that soaked into the sediment begins flowing back through the sediment toward the water body, and re-emerges again, possibly above water level or below water level. The flow at the emergence point can mobilize sediment for movement in the prevailing water direction.
- Beaches tend to build until the slope increases enough to where the in-flow and out-flow of sediment balance. Long term changes in sediment flow or wave power can change beach configuration in significant ways over time.

Longshore current and sediment drift

- Wave hits the beach at an angle continually pushing sediment in that direction. These waves are typically driven by wind. The greater the angle, the faster the flow of sediment. Since waves typically hit the beach at an angle, most shores have some amount of longshore current and sediment drift. This is often referred to as the longshore drift, which is the sediment transported along a coast in the nearshore waters by the long shore current. Sediment is also transported by the beach drift, the wave-induced motion of sediment on the beach in a longitudinal direction. On the Washington coast the net longshore drift is north (Wiedemann, 1984). In Puget Sound the direction varies with the drift cell's orientation and predominate wind direction (PSNERP, 2007a).
- Where currents converge, sediment builds into a different configuration until the methods of output can equal the methods of input. As an example, sediment may build up in steeper beaches or dunes until rip-currents can form to carry out excess sediment.
- *Dunes*: "The foredune is a ridge of sand parallel to the beach just above the limit of ordinary wave action." The foredune is also sometimes referred to as the primary dune. The foredune provides protection for both natural feature and human built features from high winds, waves, extreme tides, and erosion(Wiedemann ,1984). As sea levels continue to rise, the foredune will likely become even more important to protect coast. While there has been significant development of privately owned

foredunes, protecting foredunes is important to protect the built and natural environments on the coast. In 2012, the National Research Council concluded that global sea level had risen by about seven inches in the 20th Century and would likely rise by 24 inches on the Washington coast by 2100 (National Research Council, 2012).

- Where currents diverge, fine sediment tends to be moved out of the site by water power without being replaced to the point where larger particles can resist wave power. This can result in exposed bed rock and boulder shores.
- Where sediment movement is obstructed or cut off, the fine sediment in the shore down-drift from the obstruction will be moved out of the site by water flow without being replaced to a point that particle size can resist the water power.
- When water power at one site exceeds the normal water power along a segment of shore, the fine sediments will move through rapidly rather than settling to form a visible feature. The visible deposits are composed of particle sizes that can resist the water power.

Spits and bars

- A physical shore feature creates a protected area with reduced water energy. Examples include a shore inlet (like a stream valley) or a rocky extension into the water.
- The longshore sediment drift reaches the area of reduced water energy, and larger particles drop out and form a deposit that extends over time.
- As more sediment deposits, the point of reduced water force extends down current, forming a spit or bar, which extends in a line until the methods of output can equal the methods of input. As an example, a spit may extend across an inlet to the point where the stream and tidal flow are concentrated enough to carry excess sediment out to sea or past the opening. Alternatively, if the tidal and stream outflow is minimal, the bar can close, and a lagoon or wetland can form. Water elevation in the enclosed area will stabilize at a point where the groundwater outflow can match the inflow. As another example, a spit may extend into and lose sediment to an off-shore current. Alternatively, a spit in deep water may be losing its sediment to the depth as it slowing builds itself; while a spit in shallow water may have already filled in nearby water areas.

Mudflats, estuaries, and ponds

- Low water energy shores can occur for a variety of reasons (and more than one reason). A lake or pond may be small with little wave action. Spits or bars can protect an area. An inlet into a stream or river valley can be very flat. Sites with extraordinary sediment input (such as a delta) are very flat.
- In these locations very fine material present in the incoming water (whether from a stream or tidal flow) reaches the still waters and is able to settle. These areas tend to slowly fill with mud sediment. The lack of wave action prevents their erosion. These protected shallow water environments allow a different group and wider variety of species to live there than in other nearby locations.

Water energy and sediment movement in riverine areas

River bedload and standard bank erosion

- The river's water energy carries bed load, as previously described. During floods, bed load reaches great quantities. Water energy against an underwater slope and adjacent river bank that cannot resist the water energy may cause bank erosion. A drop in water energy can result in sediment deposits.
- The highly mobile sediment pattern that continually erodes and re-deposits material throughout the river system are habitat forming processes that the biotic community depends on.
- The gradual increase and decrease of flood events leaves a bed load that is well sorted, and tends to be carefully stacked and packed (sometimes into a shingle formation). Smaller sediments then settle in the voids of larger material. This process can have the effect of sort of mildly "sealing" the bed of the stream. This helps maintain in-stream flows from loss through "losing" reaches of the stream. Disturbing a well-sorted bed can significantly increase stream water loss to the groundwater table.

Natural river levees

- Water energy is strong in the deepest, fastest moving area of the main river channel, where it also carries the most bed load sediment.
- During floods, water moves into the shallow, slower moving areas of the river bank and adjacent floodplain. Water energy drops and sediment begins to settle out. Over time this forms a humped natural levee deposit parallel to the river bank and set a bit back from the bank.

- Local variations in water energy can prevent their formation, reduce or increase their size, or cause their subsequent erosion or elimination.

Floodplain deposit formation

- As flood waters extend into the floodplain and encounter calm, low energy locations, fine sediments are deposited. Over thousands of years or more, this sediment builds up a very flat floodplain surface landward from the natural river levees. The floodplain forms a temporary storage location for sediments that are then mobilized by future bank and surface erosion by the river.

River meander migration and bank erosion

- Minor changes in bed configuration redirect straight-line flow into adjacent straight-line flow, which causes turbulence. Obstructions in the river flow do the same thing, and also cause turbulence. Straight flow encounters turbulent flow and is redirected.
- These continual redirections tend to make the river flow waver from side to side into the river banks. Water energy applied to river banks cause bank erosion that forms a curved edge.
- Where a waver points the river at the eroded bank, the curved edge of the bank is continually located across the path of the river flow throughout the curved segment, which focuses bank erosion in that location.
- The river bank is an obstruction that redirects the water flow along the edge. After it passes through the curved area of erosion, it has been redirected back across the original river path, and into the opposite bank.
- Water energy applied to the opposite river bank causes bank erosion, and the process repeats; bouncing back and forth in the form of meanders.
- Over time bank erosion allows the body of the river to move landward at the curve, which results in the meander migrating over time.
- In addition to curve-ward migration, gravity tends to pull water downhill, even in the face of obstructions. So side to side meanders also tend migrate down the river valley.
- This process happens most rapidly during high water events, such as floods.
- The process of river meandering greatly increases the distance a river travels for a given drop in elevation, compared to a path straight downslope. This means that the overall slope of the river is lessened by meanders and the overall water energy is also less. When a meander is cutoff or eliminated, the slope and water energy of the river are increased. The longer river bed also increases the area against which the water energy is applied, also tending to reduce velocity and water energy.
- Meander migration and deposits are the primary drivers of habitat forming processes needed for aquatic species – particularly salmonids. The regular mobilization and sedimentation cycles generated by flood events, moves, re-sorts, cleans, and refreshes the sediments.

River meander point bars and deposits

- Because the water energy is focused into the outside bank of the meander curve, the inside back loses water energy. This results in the largest particles of bed load depositing and forming a bar on the inside of the meander curve.
- During a flood reaching higher than the river bank, the upstream and downstream ends of a meander can form a half circle with a slack water area in the middle. This can result in extreme deposits that can reach higher than the original river bank.

River avulsion

- When a river rapidly changes the location of its channel by forming a new channel or reoccupying an old channel, it is called an avulsion. Such changes often result in split or multiple channels at some locations.
- One means of avulsion is when a meander erodes into an old channel, and actively passes water into it.
- Another more complex means of avulsion illustrates how changes in water energy interact with changes in sediment movement. A flooded river moves a large bed load with a variety of particle sizes. Floodplain water flow finds old channel locations and concentrates flow and water energy. As water flow from the channel to the floodplain increases, its water energy and erosion potential increase. Since most of the bed load does not usually deposit in the floodplain, erosion takes place between the current channel and the floodplain channel without bed load replacing it. With large floods, erosion can breach the current river bank and capture a large portion of river flow. The breach significantly drops water energy in the original channel, and significantly increases the amount of bed load that drops out and rapidly fills the channel. The breach also increases the captured portion of river flow, increases the new channel’s erosive energy, and excavates the new channel rapidly. The old channel is abandoned, or becomes a side channel, or is only active during flood events.

Oxbow and side channel formation

- As meanders move, they may encounter previously formed channel features. In very flat locations, meanders may become extreme to the point of intercepting or overrunning an active meander. The river can then short-cut that meander – one form of avulsion. The result is a short-term slack-water side channel, which eventually gets separated from the river to form an oxbow lake or similar feature. It may eventually become a wetland.
- A more typical situation is a meander that over-runs an old river channel. It may abandon the current channel, create a seasonal side channel in either location, or stay in the current location and turn the old channel into a more active water feature.

Flood channel formation and floodplain wetlands

- While old river channels can be found throughout the floodplain, smaller channels can form as well.
- The concentrated water has greater energy, and during the biggest flood events the channel width may be increased due to the erosion.
- Groundwater in the floodplain builds up until it can find a rapid out-flow at the surface. Flood channels and old river channels are the deepest features in the floodplain, and consequently the first to capture groundwater flow.
- Long linear wetland areas can serve as habitat and migration corridors throughout a floodplain. They may be active annually, and thus act as side channels of the river; or they may be active only during the rare large flood events.
- Where dikes have cut the floodplain off from the river, these wetland corridors still form associated wetlands because the elevation of groundwater is influenced by water levels in the river.

Channel Migration Zone

- While there are variations how the width of channel migration zone (channel migration zone) may be mapped, the general area can be captured by examining current and historic data from the past century and marking the outer boundary of historic channels and old channel scars. Data can include historic air photos, historic topographic maps (including the original General Land Office maps), modern fine scale topographic data (such as LIDAR). FEMA Floodway maps are developed for non-constrained areas of a river and they often generally match the channel migration zone boundary. Channel migration zones, however, can also extend to the edge of a floodplain. In specific locations, the channel migration zones can extend outside floodplains due to erosion potential.
- Channel migration zones mark the boundary of area that the river channel needs to move freely without artificial obstructions. Major reductions of channel migration zone areas have significant effects on the water flow and sediment transport characteristics of the river.
- River channels moving across a broad area of floodplain create a highly diverse and variable environment. A high density of hazardous and natural features occur, such as floodplains, wetlands, deep water flood channels, erosion hazards, habitat corridors, complex and variable vegetation patterns, and fish and wildlife habitat. While bed load and meander erosion and sedimentation provide the active habitat forming processes, the channel migration zone and floodplain provide the long-term locations and materials for these processes.

Alterations

Major individual changes can have a significant impact on the aquatic environment.

Dams

Dams alter system-wide water volumes and water flow to meet human uses. Dams also alter natural erosion and wide sediment budget of the river by trapping sediment flow and preventing it from being part of the bedload of downstream flow. The finest sediments tend to be washed out of the system over the long term without being replaced, leaving the system with larger sized particles. Reduced sediment flow also decreases the sediment budget of lakes or marine receiving bodies, resulting in system-wide impacts to their sediment patterns and biotic systems.

River mining

Sediment scalping mines remove sediment from the downstream sediment budget. The scale of impacts depends on the scale of sediment removal. Pit mines in the river or floodplain are eventually captured by the river channel either by intent or by catastrophic dike failure. The result is that the river enters a pit that captures all bed load sediment, resulting in system-wide impacts downstream from the mine pit until the pit fills up.

Dikes and linear transportation facilities

Dikes and linear transportation facilities placed in the floodplain reduce natural flood functions for that area and also have system-wide impacts. They prevent water from spreading out, so water is deeper with higher water energy. They eliminate meandering, so that the river tends to be shorter and steeper. They cut off water features in the floodplain from the main water body and reduce the amount of native vegetation, which is usually extensive in the floodplain.

Estuary and lagoon barriers

Estuary and lagoon barriers (such as for linear transportation, or jetties) have system-wide impacts on estuaries and lagoons by eliminating or restricting the interaction between ocean and estuary, changing salinity and other chemical characteristics, as well as open water biotic systems. Altered water flow interchange also changes sediment patterns in the enclosed areas, possibly increasing sediment flow in some places and reducing it in others.

Cumulative impact changes include the following examples.

Watershed Impervious Surface

Increased impervious surface within a watershed - a cumulative change – results in more water flowing off the land during storm events directly to water courses rather than soaking into the groundwater system. As an example, storm flows can be altered so that historic 100-year floods are changed to 2- or 10-year floods. The increased incidence of extreme events applies water energy to a sediment bed that established under lower water energy with smaller particles causing bed excavation with fewer chances for redeposition. Such changes unravel the ecological foundation of the sediment that had formed over thousands of years, and degrades or destroys its biotic system. Conversely, the material that is washed away is deposited in lakes, marine deltas and other locations causing potential excess deposition issues.

Bridges

The occurrence of a large number of bridges on a river can constrict the channel causing system-wide impacts by blocking downstream movement of meanders, causing repetitive obstructions and slackwater areas during floods that alter water energy, changing sedimentation and erosion patterns, and encouraging additional alterations and channelization of the river.

Historically, human alterations have significantly reduced both roughness and obstructions, and the area of bed. In turn the increased water energy has resulted in increased erosion. Human alterations include:

- Removal of logs from rivers, and clearing of river buffers resulting in fewer logs in the river beds and fewer logs washing out to ocean beaches. Removing logs from ocean beaches, and clearing ocean buffers also causes depletions. Removing floating logs to encourage small boat travel (large boats are not affected) has reduced the number of logs on the beach.
- Waterline and in-water bulkheads, and fill in the waterbodies reducing beach areas.
- Linear facilities (roads, railroads, dikes, and bulkheads) cutting off stream meanders, increasing slope of the stream and reducing the bed area.
- River constrictions increasing depth of flow and stream energy.
- Bulkheads and other alterations increasing toe erosion, often deepening the application of water energy and further increasing water energy.

SHORELINE VEGETATION, HABITATS, AND SPECIES

Shoreline vegetation is particularly important because animals rely on it directly (living plants and debris) and indirectly (prey uses the plants) in both upland and aquatic areas. It forms the basis of the food web, because plants are the primary food source for the both the animals at the base of food web (insects and invertebrates) and for many larger herbivores and omnivores. Animals use both upland and aquatic vegetation for all aspects of habitat, including nesting, raising young, feeding, refuge, and migration. Thus vegetation provides both physical function and habitat functions.

Aquatic vegetation areas are often the most productive aquatic habitats, and include marsh grass meadows, eelgrass meadows, kelp forests, and macroalgae beds. They provide nursery grounds for a huge percentage of the aquatic species. Upland habitat areas that may have little or no vegetation include dunes and upper beaches, cliffs, talus slopes, and dry desert lakebeds. Yet animals still rely on these land areas for habitat – for example burrowing owls, small mammals, and reptiles. Many aquatic habitat areas have little or no vegetation, including stream beds, mudflats, sand beaches and tidal beds, and rocky shores. Yet many aquatic animals rely on them for habitat – for example a salmon fry, forage fish, aquatic insects, most bivalves, and flatfish.

One of the most difficult habitats to understand and protect is mudflats. Mudflats appear barren and empty because the mud substrate creates anoxic, very low oxygen, conditions that prevent most large aquatic plants from establishing. High levels of organic matter make mudflats highly productive habitats for substrate animals like worms, clams, insects, and other invertebrates that burrow. The high densities of these substrate creatures, in turn makes mudflats highly attractive as a food source for larger animals, especially birds. The flat and open nature of mudflats also provides a relatively safe location to feed.

Scientific Literature for Specific Aquatic and Upland Habitats

There are many habitats that have been given special consideration, including Washington's Priority Habitats and Species, and GMA Critical Areas, and the SMA Critical Saltwater and Freshwater Habitats. Riparian areas have also been identified as being important as a category, aside from possibly being another habitat of special interest. They serve as habitat but they have more functions and importance to species than other upland areas. Indeed 85 percent of Washington's terrestrial vertebrate animal species rely on riparian vegetation for essential life activities (WDFW, 1997). Since human development is largely focused in upland areas, extensive scientific literature has also been developed to describe upland riparian vegetation functions, and the buffer widths needed to perform functions and protect water features.

Peer-reviewed scientific evidence has been reviewed and synthesized in several documents that show that intact vegetation of adequate width is needed to provide important functions and to mitigate the impacts of adjacent development on lakes, rivers, streams, marine waters, and wetlands. They in turn show that narrow vegetation width (even with intact native vegetation) is incapable of providing all functions and fully mitigating development impacts and degraded vegetation is unable to fully perform its mitigation function.[10] An item of particular note is that some studies[11] found that riparian vegetation performed similar functions for all types of water environments.

Below is a bibliographic list of some of these scientific synthesis documents:

Lakes:
Karen Cappiella and Tom Schueler, *Crafting a Lake Protection Ordinance*, Urban Lake Management, Watershed Protection Techniques 3(4) (2001). (http://www.cwp.org/Resource_Library/Center_Docs/special/lakes/ulm_lakeprotectionord.pdf)
Widths - p. 756; Functions - pp. 752-754.

S. Engel and J. L. Pederson Jr., *The construction, aesthetics, and effects of lakeshore development: a literature review*. Research report 177, Wisconsin. Dept. of Natural Resources (1998). (http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?id=EcoNatRes.DNRRep177)
Functions - pp. 9-24; widths not addressed.

Streams, Lakes, and Marine:
National Oceanic and Atmospheric Administration. National Marine Fisheries Service - Northwest Region, *Endangered Species Act Section 7 Consultation Final Biological Opinion for Implementation of the National Flood Insurance Program in the State of Washington, Phase One Document – Puget Sound Region* (Sept. 22, 2008), ***also*** *Second Notice of Error and Correction in Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the on-going National Flood Insurance Program carried out in the Puget Sound area in Washington State* HUC 17110020 Puget Sound (May 14, 2009).
(https://pcts.nmfs.noaa.gov/pls/pcts-pub/biop_results_detail?reg_inclause_in=('NWR')&idin=29082)
also: https://pcts.nmfs.noaa.gov/pls/pcts-pub/sxn7.pcts_upload.download?p_file=F22552/200600472_FEMANFIP_errata2_05-14-2009.pdf.
Widths – p. 5 of the Second Notice and; Functions and development impacts: pp. 24 – 150 of the Final Biological Opinion.

Streams and Lakes:
Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki, *An Ecosystem Approach to Salmonid Conservation.* (ManTech Environmental Research Services Corp., Corvallis, OR: 1996. TR-4501-96-6057 available from the National Marine Fisheries Service, Portland, Oregon. 1996). (http://www.nwr.noaa.gov/publications/reference_documents/esa_refs/mantech/)
Widths - pp. 215-230 (esp. p. 229); Functions - pp. 51-55.

10 *For more information see especially Spence et al 1996*
11 *For more information see especially Ecology 2005a; WDFW 2009a; WDFW 2010*

Streams:
Washington Department of Fish and Wildlife. (1997). *Management Recommendations for Washington's Priority Habitats: Riparian*. Written by K. L. Knutson and V. L. Naef. Retrieved from http://wdfw.wa.gov/publications/00029
Widths - p. 87; Functions - pp. 19-38.

Wetlands:
Washington State Department of Ecology. (2005). *Wetlands in Washington State - Volume 1: A Synthesis of the Science.* Written by D. Sheldon, T. Hruby, P. Johnson, K. Harper, A. McMillan, T. Granger, S. Stanley, and E. Stockdale. Ecology Publication #05-06-006. Retrieved from http://www.ecy.wa.gov/biblio/0506006.html.
Widths – all of Chapter 5 & p. 5-55; Functions – All of Chapter 2 & parts of Chapter 3 and 4.

Marine:
Washington Department of Fish and Wildlife. Washington State Aquatic Habitat Guidelines Program. (2010, revised from 2007 version*). Protecting Nearshore Habitat and Functions in Puget Sound*. Prepared with EnviroVision and Herrera Environmental. Retrieved from http://wdfw.wa.gov/publications/00047
Widths - pp III-38 to III-41; Functions - pp. II-38 to II-46.

Washington Sea Grant. (2004). *Marine Riparian: An Assessment of Riparian Functions in Marine Ecosystems.* Written by J. S. Brennan, and H. Culverwell. Retrieved from http://www.wsg.washington.edu/research/pdfs/brennan.pdf
Widths - p. 16; Functions pp. ii-iii & 3-14.

GROUNDWATER INFLUENCES ON SHORELINE WATER FEATURES

Shallow aquifers and earth porosity

Shallow aquifers operate more like surface water in that they flow from points of high groundwater elevation to points of low groundwater elevation. In addition, it often generally follows the broad patterns of the ground surface.

Subsurface sediment porosity creates resistance and describes how easily water passes through a particular area. This resistance causes a slope to form between higher and lower elevations – the slope of the groundwater table. The porosity determines how fast the groundwater flows. While groundwater moves very slowly, the volume of groundwater movement quite large in normal situations.

Inputs and outputs

Like water and sediment flow, shallow aquifers are driven by a balance of inputs and outputs. Additional inputs increase groundwater elevation until the outputs increase to be in balance, then the system stabilizes. Inputs can come from a variety of sources, including man-made sources – for example:

- Groundwater inputs that flow-through from adjacent areas – slow moving but usually large volume
- Rain and snow precipitation
- Inputs from streams, lakes, and wetlands along their "losing" segments
- Human irrigation and septic discharges
- Sewer and water system leakage

Outputs include:

- Groundwater outputs that flow out of the area –slow moving but usually large volume
- Outputs to stream, lakes, and wetlands along their "gaining" segments
- Hill slope springs, and floodplain channel springs
- Marine shores – usually the final destination of groundwater
- Soil evaporation, and vegetation transpiration from riparian and wetland plants.
- Ditches and man-made drains
- Wells for human use, such as residential or irrigation

If an area of higher porosity earth is encountered, groundwater flows faster, and requires a smaller cross section to pass the flow, and the groundwater elevation drops. A common situation for river valleys is where groundwater encounters a buried river channel full of gravel. The higher porosity allows water to flow along the old channel more rapidly than other areas. This can affect the local groundwater elevation over the old channel, but it is also an important element for hyporheic flow and biota such as insects and microbes.

Hyporheic Zone. The hyporheic zone is the saturated interstitial spaces below the river or stream bed and adjacent river and stream banks that contain some proportion of channel water. Lakes, wetlands, and sometimes marine waters may also have hyporheic zones. The depth the hyporheic zone extends depends on the groundwater interchange and the flow away from the water feature. Furthermore, the activity of hyporheic zones is typically greatest closest to the bed where exchange and water freshness is highest consequently, in-water grading almost always impacts the hyporheic zone.

Groundwater and natural features

Many shorelines and critical area features are dependent on groundwater – for example wetlands, streams, and some ponds. The appearance of groundwater onto the land surface almost always also produces different vegetation, such as riparian vegetation, and often produces wetlands with their own characteristic vegetation patterns. Groundwater also influences subsurface biology. In well oxygenated groundwater, important biotic communities and biological processes develop that improve water quality. A fluctuation effect can occur and can be pronounced near streams and rivers that have banks of porous material - they can have one or more daily fluctuation cycles. Tidal cycles also drive fluctuations as groundwater is dammed at high tide, and discharged to the ocean during low tide.

Springs and outlets drive surface aquifer groundwater levels

Wherever the surface of the ground intercepts the groundwater table, one finds a spring, seep, stream headwater, or wetland, often the source of stream-like features. Sometimes, in a depression, the water doesn't escape resulting in isolated wetland and ponds.

Springs can alter groundwater table

A spring feeding streams on a slope create a situation in which water flows away from the site much faster than groundwater flows underground. This means the groundwater that intersects the surface drains out. Similar to a cone of depression around a groundwater well, the groundwater table is altered in the area around the spring by tilting down to form a slope between the drain point and the normal groundwater table.

If there were no overall groundwater inputs coming into the area, a spring would eventually drain out until the groundwater reached the point of discharge, and the groundwater slope dropped till it was flat. A normal groundwater system can replace the spring discharge. If the surrounding groundwater table increases, the boundary of the drainage area and the drainage slope adjust till water drains faster out of the spring. Eventually, the output balances with the input and the groundwater stabilizes. Thus human activities which alter groundwater level can change stream flow in these areas.

Linear discharge features alter groundwater table

Linear features, where groundwater discharges to the surface, such as a marine or lake shores, floodplain channels, and streams, can cause similar effects. The difference is that instead of forming a cone shaped drainage area; a broad slope is formed that follows along the linear feature. Like a spring, the upper groundwater level drains to the lower groundwater level based on inputs, outputs, and earth porosity.

Groundwater patterns at steep slopes

Many steep slopes are found near shorelines and critical areas, such as floodplain terraces, marine terraces, steep river valley slopes, and marine bluffs. Where the upland has a shallow groundwater table, and the water feature has a different shallow groundwater table, the groundwater table must also develop a stable transition near the steep slope, creating a transitional groundwater table between the two elevations over time.

If the upper groundwater table were extended through the steep slope, it intersects the surface. The steepened groundwater table feeds water quickly down to the lower water table, creating springs and wetlands near the bottom edges of these steep slopes.

Surface groundwater tables follow the patterns of the ground surface

Groundwater that has no outlet pools to a flat surface until surface erosion cuts an outlet. This applies at both the grand basin

scale and the local stream reaches. This effect has altered surface water tables across the landscape over time to slope down toward the outlet just as the ground slopes toward the streams, lakes, and oceans.

Bluff and cliff groundwater patterns

Surface groundwater at cliffs or bluffs is often elevated on top of a layer of non-porous rock. When a bluff or cliff cuts through the surface material and the non-porous layer, the groundwater will tend to spill off similar to a surface waterfall. If there is no debris facing the bluff or cliff, a line of springs should form above the non-porous layer. If debris conceals this subsurface waterfall, it may free-flow to the lower groundwater table, or it may form a steep but consistent groundwater slope of its own till it reaches the lower groundwater table. Where water passes onto or near the surface of the debris, riparian or similar vegetation can normally be observed.

Cliffs or bluffs of unconsolidated material are often characterized by mass wasting such as landslides, surface erosion events, and creep. Changes to the groundwater pattern that increases the water content can increase the likelihood and rate of mass wasting events.

Similar patterns are found for deep or confined aquifers that encounter bluffs and cliffs. One can encounter both surface water springs and confined aquifer springs on the same cliff.

Lake and wetland groundwater patterns

Since open water sits flat, it determines the local groundwater table. Typically the groundwater feeds the open surface water; but in some locations lake or wetland water can feed the groundwater. An example might be a large volume stream filling a depression to form a pond. The geologic character and earthen material around the pond may allow groundwater to drain away quickly. This is more common in arid areas.

Outlets of lakes or wetlands determine the elevation of the lake and the discharge point for groundwater along its perimeter. When a flat ground surface lies at or below the water surface, extensive wetlands can form within the lake boundary. These wetlands have a boundary within the ordinary high water mark of the lake. When a flat ground surface lies just above the water surface, extensive wetlands can form that are driven by groundwater controlled of the lake's surface elevation. These wetlands have a boundary outside the ordinary high water mark of the lake. Both situations are considered associated wetlands under SMA.

Since lakes and wetlands are low energy environments where particles settle out, they are often characterized by fine sediments except near stream tributaries. Almost all of incoming sediment is trapped, and over time, lakes and ponds fill in and eventually become wetlands and prairies. These former lake and wetland locations have shallow groundwater.

Marine groundwater patterns

Ocean tides cause groundwater levels to fluctuate broadly compared to lakes and wetlands, so the groundwater patterns are much more dynamic near the tidelands. Typically groundwater feeds into the ocean resulting in freshwater groundwater overlying ocean driven groundwater (since freshwater is lighter, it generally rises on top of the saltwater). The result is a boundary that starts near the high tide line and is angled landward and downward. Greater freshwater input pushes the boundary oceanward, less input pushes the boundary landward. Large tides and storm surges extending inland and up estuaries can cause saltwater intrusion, or cause contamination of freshwater aquifers.[12]

Like lakes, wetlands can form with boundaries either inside or outside the ocean's ordinary high water mark/high tide line. Higher elevation wetlands will tend to be driven more by groundwater than tidal inundation. Where groundwater from the upland reaches a flat marine shore lying near sea level, high groundwater conditions are usually present between the steeper uplands and the ocean. Where ground surface undulations intersect the groundwater, marshes and wetlands can form. If they are low elevation and subject to seawater intrusion, or if they are regularly inundated by the sea, they might be saltwater or brackish wetlands, if not, they will be freshwater. Fresh groundwater and precipitation inputs will tend to push the flow seaward, so areas of high groundwater typically flow in that direction.

12 *See USGS site for text and graphics to illustrate the freshwater-saltwater boundary: http://pubs.usgs.gov/circ/2003/circ1262*

River groundwater patterns

Gaining and losing reaches

Segments where groundwater discharges into or out of the stream are called "gaining" or "losing" reaches because the stream is gaining or losing water. If a stream flows through losing reaches for too long, the stream may go dry and flow subsurface. The stream may begin flowing further downstream when conditions change.

While gaining reaches are more common in the Puget Sound region, a losing reach can occur for a variety of reasons that cause the local surface water table to be consistently lower than the stream elevation so that water flows from the stream to the groundwater. Below are some examples:

- A sudden rise in stream flow can cause water to flow into the floodplain and banks.
- Heavy agricultural pumping may lower the groundwater levels below the stream level.
- Local geologic conditions (such as exiting a ravine into an alluvial fan, or into a larger valley with thick sediment deposits) may make the surface aquifer drop significantly.
- The river may flow into an arid area that has low groundwater levels.

River level influences floodplain groundwater

Because floodplains are broad and flat, and because groundwater is held at the level of the river, floodplains are locations of high groundwater. The groundwater in a floodplain is highly influenced by the water elevations in the river. This is because during high water and spring freshets, groundwater cannot discharge to the river. It stalls and builds up in elevation and can even flow from the river to the floodplain. This causes low areas in the floodplain (such as old stream channels) to become saturated until they drain to the surface and find an outlet. In addition, since the groundwater table tends to be higher at floodplain terraces, groundwater levels may rise and discharge at the bottom of the terrace as a spring or seep.

The shallow groundwater levels typical in a floodplain make wetlands a frequent feature of floodplains - occupying the low-lying locations. This link between the river level and the floodplain groundwater level is the reason that floodplain wetlands are considered to be associated wetlands, even for floodplains that are diked off. In these locations, groundwater can be obstructed by high river levels and build up toward the surface of the floodplain to feed the wetlands.

Applying groundwater concepts to human alterations

Human alterations can easily change groundwater patterns, and can cause damage to water features (especially wetlands). The most common situation is where excavation into groundwater changes groundwater patterns.

ADDITIONAL REFERENCES

The Puget Sound Science Update at http://www.psp.wa.gov/scienceupdate.php

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APPENDIX 6. SHORELINE BUFFERS IN PUGET SOUND COUNTIES AND SEATTLE, BAINBRIDGE, TACOMA, OLYMPIA

Buffers as of October 2013, primarily drawn from SMPs (CAOs in a few cases). Buffer widths shown in feet, unless otherwise noted.

Jurisdiction (status)	Stream Buffers					Lake / Pond buffer	Marine buffer	Wetland Buffers					Building Setback from buffer	Other Habitat Buffers		SMP setbacks							
	Shoreline / Type 1	Fish / Type 2	Nonfish perenn. / Type 3	Nonfish season. / Type 4	Other Stream / Type 5			Small Wetlands covered?	Cat. 1	Cat. 2	Cat. 3	Cat. 4				Natural	Resource	Rural Conserv.	Urban Conserv.	Shoreline	Urban / High Intensity	Aquatic	Priority Aquatic
Whatcom County ***(Completed)***	150	100	50	50		100/50 (lg./sm.)	150	No - under 1/10 acre	Highly variable (50-300)	Highly variable (50-275)	Highly variable (50-150)	Highly variable (25-50)	10	150 for Shellfish, aq. veg., forage fish	As needed for other species	None different	None different	None different	None different	None different	None different	None different	None different
Skagit County ***(Draft)***	200	150/100 (lg./sm.)	50	50		None set for non-shoreline	See Shorel.	No - under 4000 sf	Variable (150-300, or less)	Variable (150-300, or less)	Variable (75-150)	Variable (25-50)	15	Buffers incr. to top of steep slope	Ponds and all other undefined	200	100 (Rural)	150 (Conser.)		100 (Rural Resid.)	140	NA	NA
Snohomish County ***(Completed)***	150	150/100 (Anad/ non-Anad)	50	50		Same as Stream	150	No - w/ nuances under 10,000 sf	Highly variable (50-300)	Highly variable (50-300)	Highly variable (40-150)	Highly variable (25-50)	?	None indicated	Buffers incr. to top of steep slope	150 w/ limited nuances	150 w/ limited nuances	150 w/ limited nuances	150 w/ limited nuances	Hi-Intens. 150 w/ limited nuances	150 w/ limited nuances	See upland	
King County ***(Completed)***	115/165 (UGA/ non-UGA)	115/165 (UGA/ non-UGA)	65 Nonfish connect	25 Nonfish non-conn		Same as Stream	115/165 (UGA/ non-UGA)		Highly variable (50-300)	Highly variable (50-300)	Highly variable (40-150)	Highly variable (25-50)	15	None indicated		None different	None different	None different	None different	None different	None different	None different	None different
Pierce County ***(Draft)***		150 (uncl. Shorel)	115 (w/ in 1/4 mi of fish water)	65 (not near fish water)	35 (lake/ pond w/o "critical fish"	Same as Stream (Tapps/ Spnwy. none)	100 (Critical Salmon Habitat)	No - w/ nuances under 10,000 sf	Highly variable (50-300)	Highly variable (50-300)	Highly variable (40-150)	Highly variable (25-50)	?	25-300 from Aquatic Veg by activity	Str. buffers from CMZ if applic.	150 or CAO		100 or CAO (Conser)		75 or CAO	50 or CAO (Hi-Intens)		
Thurston County ***(Draft)***	250 +50' RMZ	250/ 200/ 150 (lg/ med/ sm) +50' RMZ	150 Nonfish connect	100 Nonfish non-conn	225 Nonfish geo-haz	100 (excl. <1000 sf)	250 +50' RMZ except SMP Rural	No - certain ones under 1000 sf	100-300 (no category)	100-300 (no category)	100-300 (no category)	100-300 (no category)		Also CMZ +100.'	Buffers incr. to top of steep slope	?	?	?	?	?	?	?	?
Mason County ***(Draft)***	150	150	100	75	200 (Special design streams)	35 - Ponds. 100 - Shorel	See SMP buffers	No - certain ones under 1000 sf	Highly variable (50-250)	Highly variable (50-225)	Highly variable (40-150)	Highly variable (25-50)	15	No other identified		150 Marine	150 Marine (Conser)	100 Marine (Rural)		100 Marine (Resid)	50 Marine		
Jefferson County ***(Completed)***	150	150	75	75/50 (steep/ flat)		50-pond/ 100 - Shorel	150	No - certain ones under 1/10 acre	Highly variable (50-300)	Highly variable (50-300)	Highly variable (40-150)	Highly variable (25-50)	10	150 Special aquatic & Upland Habitats		None different	None different	None different	None different	None different	None different	None different	None different

Jurisdiction (status)	Stream Buffers					Lake / Pond buffer	Marine buffer	Wetland Buffers					Building Setback from buffer	Other Habitat Buffers		SMP setbacks							
	Shoreline / Type 1	Fish / Type 2	Nonfish perenn. / Type 3	Nonfish season. / Type 4	Other Stream / Type 5			Small Wetlands covered?	Cat. 1	Cat. 2	Cat. 3	Cat. 4				Natural	Resource	Rural Conserv.	Urban Conserv.	Shoreline	Urban / High Intensity	Aquatic	Priority Aquatic
Clallam County ***(Draft)***	150 & see SMP	150/65 (maj/min devel)	100/60 (maj/min devel)	50/50 (maj/min devel)	50/50 (maj/min devel)	Same as Stream & see SMP	150 & see SMP	No - under 10,000 sf	200/100 (maj/ min devel)	150/75 (maj/ min devel)	75/50 (maj/ min devel)	25/50 (maj/min devel)				175	150 (Resourc Conser)		150/100 (maj/min devel) Shorlin Res Conserv	100/50 (maj/min devel)	100/50 (maj/min devel) Marine Wtfrt	None different	None different
Kitsap County ***(Awaiting Ecology approval)***	200	150	50	50		Same as Stream & see SMP	See SMP	Yes	Highly variable (50-250)	Highly variable (50-225)	Highly variable (40-150)	Highly variable (25-50)	15	Design. species & Habitat by report	Buffers incr. to top of ravines	200 (not str.)		130 (not str.)	100 (not str.)	85 (not str.)	50 (not str.)		
Island County ***(Awaiting Ecology approval)***	150 (none exist)	100	50	50		<.5 ac - no prot./ larger- as wetland / Shorl see SMP	See SMP	No - degraded <1 ac.	100 (Cat. A - most wetland & pond)	25/50 (Cat. B - highly degraded wetland & pond)			10'-45'	Some species & hab buffers		125-130 +steep slopes		75-80 +steep slopes	50-80 +steep slopes	30 +steep slopes	30 +steep slopes	0-20 Other highly devel areas	
San Juan County ***(Draft)***	trees only, also see wetland calcs. 35 full, 110 partial	trees only, also see wetland calcs. 35 full, 110 partial	trees only, also see wetland calcs. 35 full, 50 partial	trees only, also see wetland calcs. 35 full, 50 partial	Zero for Nonfish seasonal less than 6 mo.	Nonfish - Zero / Shor & Fish 110 - trees only, also see wetland calcs	Only design Crit Saltw Hab - same as streams/ lakes	No - 1000/ 2500 sf based on habitat	Limited exclusion Complex most <100, not over 200 - only	Limited exclusion Complex most <100, not over 200 - only	Limited exclusion Complex most <100, not over 200 - only	Limited exclusion Complex most <100, not over 200 - only		Stds for wide range of species & habitats		None different	None different	None different	None different	None different	None different	None different	None different
Bainbridge Island ***(Draft)***	See SMP	150	50	50		**See SMP - others not critical area**	See SMP	Yes	Highly variable (50-300)	Highly variable (50-300)	Highly variable (60-150)	Highly variable (40-50)	15			200		100-150 (Island Conserv)	75-150 (Shorel Res Conserv)	50-75 or more (Shorel Resid)	30		
Seattle ***(Draft)***	100	100	100	100	100	**Shorel See Stream - others not CA**	**Shorel See Stream**	Yes	100-200	100-200	60-85	50				None different	None different	None different	None different	None different	None different	None different	None different
Tacoma ***(Completed)***	150 (incl local import)	150/100 (salm/ non-salm)	100	75/25 (connect /non-conn)		**150 Shorel / others none / <.5 ac not CA**	See SMP	Yes	200	100	75	50				Multiple 200		Multiple 115	Multiple 115	Multiple 50	Multiple 50		
Olympia	250	250	200	150		250 Capitol Lake others as wetland	150-250 Budd Inlet	No - certain ones under 1000 sf	100-300	100-300	80+	50		Buffers incr. to top of ravines +50		200 w/200 setback	150 (Waterfr Recreat)	30 w/30 or 75 setback (Various Recreat)	50 w/100 setback	20 w/30 or 75 setback	0-30 w/0-100 setback (various urban)		