

**Defining Threatened in Terms of New Bulkhead Installation
at Existing Development Relative to San Juan County –
Examples and Recommendations**

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Introduction and Purpose

Coastal Geologic Services (CGS) was contracted to produce a short document that describes the different technical methods for assessing and evaluating the level of risk to existing buildings, road or other infrastructure (including pipes and septic systems) threatened by erosion. A brief analysis of the various methodologies and the level and likely cost of scientific expertise necessary to conduct the work, along with the general level of effort required to conduct the assessment is included. Professional/technical opinions on which method would be most suitable for application in San Juan County are included. Conclusions from a meeting and continuing discussion with experienced local planners that explored policy implications of the different methodologies (provided in a preliminary presentation of this report) will likely be incorporated by others into a white paper that includes policy implications.

A clear and concise definition of 'threatened' is not available in San Juan County Shoreline Management Program (SMP) or other plans such as the Critical Areas Ordinance (CAO). The listed definition of 'threatened' is (from dictionary.com): "to be a menace or source of danger to".

Background

Bulkheads and Other Shore Modifications

Recent field mapping projects of bulkhead sites and related shore modifications have been completed in the islands for the San Juan Initiative/Puget Sound Partnership. This included the detailed mapping of approximately 32 miles of shore on 4 islands (MacLennan and Johannessen 2008) and feeder bluff mapping in spring of 2009 at drift cells of San Juan and Lopez Islands (MacLennan and Johannessen in prep.). These projects illustrated the general lack of need for many residential bulkheads in the islands in terms of there being no apparent coastal erosion "threat" to the houses and other primary structures.

Throughout the Puget Sound region and in San Juan County specifically, bluff recession is often perceived to be much more rapid than it actually is. For instance, a sudden landslide can lead to

a sense of urgency to construct a bulkhead, when typical, long-term erosion rates may be only several inches per year. In addition, bulkheads are often constructed to minimize minor storm-induced backshore change at no-bank sites, which is only truly necessary if development features are placed immediately adjacent to the shoreline. In cases where low setbacks and high erosion rates make bulkhead construction a reasonable alternative, it is often more cost effective over the long term to move a house away from an area of increasing hazard.

San Juan County has the full range of exposures to wave energy. Parts of the county are exposed to high energy waves from the Strait of Georgia and the Strait of Juan de Fuca, but the county also has considerable reaches of moderate and low wave energy areas in the more sheltered areas. The county has great biodiversity, and this is a reason for carefully considering construction of new bulkheads and other shoreline modifications, which have been shown to have substantial negative impacts on the marine shoreline (MacDonald et al. 1994, Thom et al. 1994, Johannessen and MacLennan 2007, Penttila 2007, Brennan 2007, Griggs 2005). Impacts of shore armoring will not be discussed here as it is covered in these and other references. What is quite important to note is that the number of new bulkhead installations has been far greater than the number of bulkhead removals over the past few years.

San Juan County in Regional Context

San Juan County is a bit unusual in the greater Puget Sound area in that the county has a large amount of bedrock exposed at the coast. However on the order of half of the county shores are composed of unconsolidated sediments from the glacial and interglacial deposits, which are commonly found in Puget Sound. Landslides are typically very limited in extent and are characterized as shallow slide. Erosion rates (more correctly termed bluff recession rates) in Puget Sound are typically slow, with rates on the order of 1-3 in/yr most common (Keuler 1988). These landslides only recur on the order of 20-40 years apart, such that a single slide may seem serious, but with a long recurrence interval the erosion rate is still fairly slow at almost all San Juan County sites. Large, infrequent (episodic) landslides are rare in San Juan County (such as deep-seated slides).

The feeder bluffs in places such as Lopez Sound and around Orcas Landing, as well as throughout numerous other shores around the county and greater Puget Sound, should be preserved to maintain continued sediment input to the drift cells, which protect and maintain valuable nearshore resources. Examination of the spatial occurrence of shore armoring mapped to date in San Juan County (MacLennan and Johannessen 2008) reveals that there are both clusters of modifications and isolated occurrences in each of the case study areas. Some bulkheads are located on feeder bluffs or other bluff sites, where some amount of erosion is expected, while a moderate percentage are located along no-bank shores, many of which may be stable or accreting.

At a fundamental level, the San Juan County SMP and other SMPs in the region in force generally fail to incorporate several fundamental elements of how our shores function as part of a system. In particular, the lack of a drift cell management approach is problematic. Drift cell management would be based on the systemic concept of net shore-drift cells (drift cells) is the most substantial and fundamental shortcoming. Drift cells make ideal coastal management units

that allow for management of discreet interconnected reaches of shoreline, which can allow for measuring the impacts relative to how intact the resources are at present, or within relative weighing of costs and benefits of development proposals (Johannessen and MacLennan 2008).

Sea Level Rise

The predicted increased rate of sea-level rise, as a result of global climate change will generally lead to higher coastal water levels, thereby altering geomorphologic configurations and increasing erosion rates in many areas, displacing ecosystems and increasing the vulnerability of infrastructure (IPCC 2001, Pethick 2001). Recent research has also reported that non-bedrock shores, such as the glacial material that makes up most of the region's bluffs, are likely to retreat more rapidly in the future due to an increase in toe erosion resulting from sea-level rise. Retreat rates may also be amplified in many areas due to increased precipitation, storminess (wave energy), storm frequency and higher ground water levels (Hosking and McInnes 2002, Pierre and Lahousse 2006).

Changes in sea level will also result in a spatial response of coastal geomorphology, landward and upwards, in a concept known as the Bruun rule (1962). This basic idea (though its accurate application to individual beaches is not well understood) appears to apply to all coastal landforms (Pethick 2001). The landward migration of the shoreline is a response to changes in energy inputs brought about by sea-level rise. Knowing that this translation is to occur offers resource managers a tool, allowing decisions to be made to accommodate and, where possible, facilitate such migration (Pethick 2001).

Accommodating space to enable shoreline translation can enable salt marshes, sand dunes, and beaches to transgress (move landwards while maintaining their overall form and ecologic function). This concept is commonly referred to as 'managed retreat' or 'managed realignment' (Cooper 2003). Accommodating sea level rise prevents the diminishment and loss of natural features such as intertidal, upper beach and dune habitats, from being lost between a static backshore (such as a bulkhead or rock revetment) and rising sea level. The concept is commonly referred to "the coastal squeeze". As a result of these processes related to global climate change San Juan County shores will incur considerable habitat loss unless managers choose to take a pro-active approach and attempt to accommodate or mitigate the effects of sea level rise. Strategies such as managed realignment (ie. removing shore armoring, relocating coastal roads, etc) should be considered, along with limiting new bulkheads. There will also be further pressure to construct emergency erosion control structures as a result of increase erosion rates, storminess and storm frequency. Permitting the building of additional bulkheads is not likely to provide long-term solutions for erosion control, and will only amplify habitat loss caused by the coastal squeeze.

Earlier Work in Puget Sound Region

Sound Nearshore Habitat Regulatory Perspective: A Review of Issues and Obstacles

A paper was prepared for the Puget Sound/Georgia Basin International Task Force, Work Group on nearshore habitat loss by Ginny Broadhurst with assistance from Rob Walkinshaw in 1998. The report was titled Puget Sound Nearshore Habitat Regulatory Perspective: A review of issues

and obstacles. The report did not provide recommendations in general, but summarized issues surrounding nearshore habitat protection that included a moderate amount of discussion on bulkheads. In the summary section titled Summary of Specific Gaps in the Current Regulatory System, the following points were made. These points were selected as most pertinent in preparation of this report, although others were also included.

- Single-family residential construction projects are reviewed with different levels of concern depending on the jurisdiction
- Compensatory mitigation is generally not required for construction projects such as bulkheads and docks at single-family residences
- Current knowledge and understanding of cumulative effects of development activities on the nearshore environment limits the ability of regulatory agencies to address these effects
- Shoreline master programs and critical areas ordinances are the primary tools for regulating shoreline development activities, but are often written and implemented without consideration of nearshore resources
- Responsibility for managing and regulating the nearshore is divided among Puget Sound counties, cities, tribes, and state and federal agencies
- The current system gives local government substantial authority and responsibility for protecting the shoreline
- Enforcement is important but extremely difficult
- Due to exemptions and the need to balance concerns about the economy and private property, many regulations are not fulfilling their own goals to protect and preserve the nearshore environment

Based on the extensive interviews performed by Broadhurst (1998), a number of additional issues were identified that were relevant to protecting the nearshore environment. Among those listed were the need for greater public education and agency staff education, better maps, and the need for demonstration projects for soft shore protection or bioengineering solutions. Also listed was the need for hearing examiners to be removed from the political processes, creation of additional marine reserves, and the need for greater funding for shoreline protection programs at all levels of government. Again, inventory and monitoring were listed as extremely limited in nearshore areas. The lack of monitoring was mentioned for impeding evaluation of the impacts of shoreline development. The biggest gap in the regulatory system of 1998 was identified as the lack of consideration of cumulative effects of individual development projects. This was stressed as important due to the identification of private residential shoreline development as a major stressor in Puget Sound (Broadhurst 1998). One recommendation was for allowing armoring only to prevent documented erosion problems, but detailed consideration of that issue was not performed in the 1998 study.

Coastal Erosion Management Studies (CEMS), for Ecology

Policy alternatives were evaluated in Volume 6 of the Coastal Erosion Management Studies Series produced for Washington Department of Ecology (Ecology) in the mid 1990's (McCabe and Wellman 1994). The volume titled Policy Alternatives evaluated existing and potential approaches for coastal erosion management. The report provided an overview of the current policy framework (at that time) that was used to address coastal erosion in public and private

settings. The study included research, interviews, and analysis of results of a questionnaire, as well as a review of national literature. Interviews included those with shoreline managers from other states with innovative policies and "programs to determine effective alternatives".

The McCabe and Wellman (1994) study summarized issues surrounding the need and/or desire for shoreline protection structures. These were summarized in Table 1.

Table 1. Coastal Erosion Management Issues in Puget Sound (Table 1.2 in McCabe and Wellman 1994).

- Inadequate private property owner involvement in evaluating shoreline modification alternatives
- Inefficient and complicated shoreline modification solutions, where appropriate
- Reliance on hard shoreline modification solutions that results in negative impacts
- Frequent use of variances for residential development that creates a demand for future shoreline modification solutions
- Lack of familiarity with potential risks associated with shoreline property
- Inadequate environment designation provisions to control inappropriate development
- Lack of guidance or consensus on the appropriate balance between private and public property rights

Beyond discussing restricting inappropriate development, the McCabe and Wellman (1994) conducted an analysis for addressing management of developed coastal lands. After discussing constraints such as the "single family exemption" (ESB 6128, which provided a clear preference for protecting properties with a residence occupied prior to January 1, 1992 in Washington State) and property rights, two approaches were forwarded for managing these issues at developed lands:

- 1) Create incentives for relocation or removal of threatened structures
- 2) Require property listing disclosures

The CEMS report detailed existing programs at the time and described the state guide book for hard shoreline modification solutions and other programs at the time including typical SMP setbacks, but was short in technical details. Instead the report was management and policy oriented. The policies such as preference of soft stabilization regulations were stressed at the time by Ecology, such as nonstructural solutions to bank stabilizations must be proved unworkable prior to consideration of structural measures and that bulkheads may be allowed only when "evidence demonstrates that:

- A. serious wave erosion threatens an established use or existing building(s) on upland property and/or
- B. bulkheads are necessary to the operation and location of water dependent and water related activities, provided alternatives have proven infeasible". The policy at the time from Ecology was that "bulkheads are not suitable for feeder bluffs, particularly in areas that are not already developed or are not already subject to shoreline modification" (McCabe and Wellman 1994).

The State Guide Book by Ecology at the time also included the general regulation that "bulkheads are prohibited for any purpose if they will cause significant adverse erosion or beach starvation

and "revetments shall be constructed and maintained in a manner that does not reduce water quality and/or fisheries habitat" (McCabe and Wellman 1994).

The McCabe and Wellman (1994) study recommended increased education and outreach for coastal property owners, along with research, monitoring, and data collection programs. The focus was suggested to be on "priority drift cells that are expected to see an increase in development and for which physical and biological conditions are not well understood." The existing coastal erosion management policies were recommended to be enhanced by modifying the policies "and in some cases establishing new policies" in the targeted drift cells. Policies for analysis and further development were listed and are presented in the Table 2. Additional detail can be obtained by reading the original document.

Table 2. Critical Policies and Strategies for Addressing Coastal Erosion in Puget Sound (Table 1.2 in McCabe and Wellman 1994).

- Coordinated environmental impact review
- Shoreline modification alternatives analysis
- Market incentives to encourage the use of soft solutions
- Strategies for combining policies
- Enhanced environment designations
- Restrictions on inappropriate residential development

Incentives for Relocation or Removal of Threatened Structures - As recommended by McCabe and Wellman (1994), direct financial incentives for property owners to relocate or remove structures away from erosion prone and hazardous areas could be created to reduce the need for shoreline stabilization works.

Technical Appropriateness: Programs that provide incentives for relocating or removing structures from hazardous area are technically appropriate if applied properly to areas that are truly threatened.

Legal and Regulatory Acceptability: ESB 6128 provides a clear preference for effective erosion control for properties with a residence first occupied prior to January 1, 1992. In these cases, relocation could not be required without a change in legislative policy.

Net Cost of Implementation: Similar to the tax incentive programs discussed above, programs that provide incentives for relocating or removing structures from hazardous areas can be very expensive. Michigan has found, however, that relocation of homes is less expensive in the long run than constructing and maintaining erosion-control structures. Additional benefits associated with reduction in loss of life or property and negative environmental impacts may outweigh program costs.

Socio-political Acceptability: Most incentive programs are voluntary and represent a relatively non-intrusive method of influencing behavior. Therefore, they tend to be politically acceptable.

Ease of Implementation: Incentives to relocate or remove structures are fairly easy to implement because the appropriate institutional structures are generally already in place and given their voluntary nature tend to be politically acceptable. Reimbursement programs, such as the Upton-Jones Amendment, will require property value assessments and funding allocations. Incentive programs, while costly in the short run, may prove to be less expensive in the long run than constructing and maintaining erosion-control structures.

Property Listing Disclosures - As recommended by McCabe and Wellman (1994), a disclosure of bluff stability and erosion hazards could be required of all property listings. Such information could reduce levels of uncertainty in purchase decision making and potentially reduce future coastal erosion protection needs.

Legal and Regulatory Acceptability: The legal and regulatory acceptability of property listing requirements is uncertain. Given that other states implement such programs, it appears that they are feasible. However, property listing requirements in Washington may require legislative authorization.

Net Cost of Implementation: A coastal property disclosure statement should not imply significant additional costs. If properly implemented, a property listing disclosure could provide significant benefits in terms of reduced need for potentially costly and environmentally detrimental shoreline protection works.

Socio-Political Acceptability: A coastal property disclosure statement is intended to provide potential buyers of shoreline property with information on site characteristics and the level of risk associated with potential storm or erosion hazards. Such a program should be politically acceptable unless sellers of shoreline property feel that such disclosures will impede and add unwarranted transaction costs to the sales process.

Ease of Implementation: A disclosure program should be fairly easy to implement because institutional structures are generally already in place. That is, a disclosure requirement would only involve addition of a simple document to the standard sales/purchase contract process and provide potential large net benefits to the public and future property purchases.

'Social Justice'

In the Report titled "Social Justice in coastal erosion management: The temporal and spatial dimensions" authors Cooper and McKenna (2008) explore the long range perspective of public welfare over property rights. The idea of social justice in regard to coastal erosion has recently been raised in Great Britain where the cost of maintaining ineffective shore armoring, or coastal defenses, falls on the public, while it may be individuals whose assets are being protected. A good example of this applies to the Puget Sound, as well. SMPs will take into account economic constraints of coastal erosion, weighing the cost of assets at risk, such as a primary structure, versus the cost of coastal defense without regard for whether it is publicly or privately owned. Additionally, an economic value has yet to be assigned to the beach and the health of the beach for future generations.

"There is little advantage in having a fair share of very little or nothing, for example if a beach is lost because the backshore was armored to give "justice" to a property owner. It is wrong to purchase justice for the relatively few today at the expense of the many tomorrow."

With these principles in mind Cooper and McKenna (2008) state that governments should only make exceptions for constructing coastal defenses when:

- There is risk to life or limb
- Cost-effectiveness, i.e. a relatively small structure could bring substantial relief to those in need
- The activity or property protected is of national significance, i.e. protection of food resources
- Relief of distress, where suffering is of such a scale or intensity, i.e. North Sea Storm Surge

Cooper and McKenna (2008) also suggest that social justice is denied to future generations if, when no vital national interest is at stake, they are forced to pay for:

- The cumulative effects of present day coastal defenses in terms of lost amenities and eroding beaches
- The future maintenance of defenses constructed today, with costs rising steeply due to SLR and increased storminess
- Compensation schemes to benefit individuals who's assets may not be at risk in 10 years, but may be at risk to coastal erosion issues in 50 years
- Property compensation to people who can afford to live at the coast and enjoy its many attractions, while the majority of the taxpayers do not

Existing Models for Defining 'Threatened'

The term threatened is common in most shoreline regulation doctrines. The plans, while providing general standards for shore management in terms of shore protection, and in some cases not allowing new hard structures whatsoever (such as in North Carolina) lack a clear or measurable definition for threatened to justify a bulkhead. Language in more updated shoreline regulation plans typically favor bioengineered and soft shore structures with only allowing a hardened bulkhead as a last resort (ie. Whatcom County SMP). Others include clauses such as 'no net loss of habitat' and many county SMPs (including San Juan County) recognize the importance of the feeder bluffs to the nearshore system but do not necessarily apply this principle in regulations. These plans generally prohibit bulkheads on feeder bluffs unless no other option is feasible. Feeder bluff mapping is now underway in approximately half of the drift cell shores in the county, and hopefully the remainder of this work will be funded soon. However, lack of a clear definition of threatened undermines the integrity of progressive standards or protective language in shoreline regulation doctrines.

In order to take the next steps in actively protecting coastal resources a more scientific approach to defining threatened should be incorporated into all shoreline regulation doctrines. The following

section outlines jurisdictions where a quantitative definition of threatened exists (or has been used to deny a bulkhead) and a summary Table 3 of these results is included below:

Local

Washington Administrative Code (WAC)- has set the standard for SMP language with section WAC 173-26-231 (A) (iii) (D)³

Whatcom County – In the recent SMP update, Whatcom County does not allow bulkheads and other hard armoring structures on “accretion shoreforms” except as a conditional use “where exposure to storm waves or drift log battering seriously threaten other similar existing structures and no feasible alternatives exist”. If a geotechnical analysis concludes that a bulkhead is required in these cases, then the structure must be set back 20 ft from ordinary high water mark. Also bulkheads are prohibited in Whatcom County on feeder bluffs and estuarine shores unless “valuable primary structures are at risk and no feasible alternatives exist and where ongoing monitoring, main, and mitigation for impacts to shoreline ecological functions and processes are provided” (23.100.13.B.2). Where the geotechnical analysis does not indicate that the structure is in danger within 3 years, there is a specific provision that allows for permitting a bioengineering approach.

New or expanded bulkheads or other shore protection structures for existing primary structures, including roads, railroads, public facilities, etc. are prohibited unless there is “conclusive evidence documented by a geotechnical analysis that there is a significant possibility that the structure will be damaged within 3 years as a result of shoreline erosion caused by stream processes, tidal action or waves, and only when significant adverse effects are mitigated to ensure no net loss of shoreline ecological functions and/or processes.” However, again the exact definition of risk is not tightly defined in the Whatcom County SMP as to provide more detail on how to quantify the 3 year erosion issue.

The Whatcom County SMP as been hailed as an example of a modern SMP update by some. Chad Yunge of Whatcom County Planning stated that the County has not allowed a bulkhead due to threatened status since he started as Shoreline Administrator 4 years ago (Yunge 2009).

Table 3. Summary of criteria in different jurisdictions for “threatened”.

Approach	Jurisdiction	Information Required
3 years of erosion	Whatcom County, WA	Geotechnical professional judgment; Non-structural is priority
3 years of erosion	Island County, WA	Geotechnical professional judgment; Non-structural is priority
Less than 1.5 Factor of Safety	City of Bainbridge Island, WA	Geotechnical Engineer slope quantitative stability analysis
“Imminent peril”	Oregon	For houses prior to 1977 Non-structural is priority
Within 1-2 major storm cycles	California Coastal Commission	Engineering Geologist Report
15 yr return-interval storm	State of Florida	Professional engineer specialized in geotechnical or foundation engineering
No permanent structures,	State of North Carolina	Site measurements and analysis

sandbags are permitted if home is within 20 ft of erosion scarp		
Typically does not permit bulkheads	State of Mass.	

Island County – A recent set of bulkhead applications were declined based on details in the geotechnical/coastal geologic report not meeting the required standard of structure being threatened within 3 years of erosion. This was in the northeast portion of the Whidbey Island where the sites are exposed to waves from the Strait of Juan de Fuca. The bulkheads were denied for these few properties, but one was granted based on the close proximity of the home to the rapidly eroding shore. A second property was allowed to install a soft shore protection design which consisted of anchored logs within the existing drift log zone.

Island County requires a Coastal Geologic Report that the proposed development will not adversely affect natural shoreline processes, adjacent properties and fish and wildlife habitat if an applicant is proposing to repair an existing jetty, groin, breakwater, boat ramp, boat launch or boat house that extends seaward of the ordinary high water mark.

Bainbridge Island – The City of Bainbridge Island uses an administrative interpretation of how to answer the question of if a structure is threatened via the 3 years rule (Namtvedt-Best 2009). The City uses a slope stability modeling approach that attempts to quantify the “factor of safety”. The factor of safety is approximated by a Geotechnical Engineer through a computer model that has inputs including the detailed slope angle, strength parameters for bluff soils, and effects of groundwater. This approach was designed for analyzing stability as it is related to deep-seated slope failures (large rotational landslides) which are very uncommon in the Puget Lowland. This approach is not based on a model that is designed for the much more common shallow landslides. Under this approach, if a factor of safety analysis conducted and the number is less than 1.5, this is used as a “trigger” for potentially allowing a new bulkhead to be built (Namtvedt-Best 2009).

This approach has generally not provided Bainbridge Island planners with clear information for assessment of the actual need for a new bulkhead and staff has not been satisfied with this approach (Namtvedt-Best 2009). Since the model approach is only as good as the data that is input, the lack of rigorous standards for the use of this approach makes it so the data is often less than adequate and is often not stated. Also, the fundamental flow that the model is designed to assess stability relative to deep-seated slides, makes its use inappropriate for Puget Sound shores overall.

Bainbridge considers the following worthy of protection when warranted: House, garage, septic system, public road, and private driveway/road. The following are generally not considered worthy of protection due to non-significance or inherent location in risk zone: stairs/tram/trail to beach, bathhouse, deck/patio, fence, stormwater facility, sheds, trees, etc. (Namtvedt-Best 2009).

Regional

Oregon - Statewide Planning Goal 17 Implementation Requirement 5 states that: Land-use management practices and non-structural solutions to problems of erosion and flooding shall be preferred to structural solutions. Where shown to be necessary, water and erosion control structures, such as jetties, bulkheads, seawalls, and similar protective structures; and fill, whether located in the waterways or on shorelands above ordinary high water mark, shall be designed to minimize adverse impacts on water currents, erosion, and accretion patterns (Surfrider 2009).

Statewide Planning Goal 18 Implementation Requirement 5 states that: "Permits for beachfront protective structures shall be issued only where development existed on January 1, 1977. Local comprehensive plans shall identify areas where development existed on January 1, 1977. For the purposes of this requirement and Implementation Requirement 7 "development" means houses, commercial and industrial buildings, and vacant subdivision lots which are physically improved through of streets and provision of utilities to the lot and includes areas where an exception to (2) above has been approved. The criteria for review of all shore and beachfront protective structures shall provide that:

- a. visual impacts are minimized;
- b. necessary access to the beach is maintained;
- c. negative impacts on adjacent property are minimized; and
- d. long-term or recurring costs to the public are avoided.

The definition of Threatened used by the State of Oregon is "imminent peril as threat of erosion causing loss or damage to primary structure, etc. and will be referred to as threatened" or "threat to a primary structure of damage or loss due to erosion."

California – Bulkheads are allowed only when structures are proven to be threatened within 1-2 large storm cycles (Griggs 2009).

A document put forth by the California Coastal Commission (CCC) in 1999, known as Beach Erosion and Response (BEAR), serves as a guide to determining whether a bulkhead can be installed and states all required information that is required by the bulkhead applicant to produce (Ewing 2009). The BEAR provides guidelines to the permit applicant and the Commission analyst who determines, based on the information provided by the applicant if the CCC is required to approve the bulkhead under Section 30235 of the Coastal Act. If all of the following circumstances can be proven in order of preference, then a CCC analyst can recommend a conditional approval of a shoreline protective device:

- There is an existing structure to be protected
- The existing structure is in danger from erosion
- Shoreline altering construction is required to protect the existing threatened structure
- There is no less environmentally damaging feasible alternative
- The required protection is designed to eliminate or mitigate the adverse impacts on shoreline sand supply

Definitions of the above mentioned bullets, as justifications or criteria for installing a bulkhead, are addressed by the BEAR and summarized below.

Is There an Existing Structure:

- Coastal Act Section 30235 acknowledges that structural or 'hard' shore protection solutions alter natural shoreline processes and therefore can be approved only when protecting an existing structure
- Only principle structures can be considered for this exception, rather than accessory structures such as patios or decks which are more economically feasible
- Section 30253 requires that new development be designed to avoid the need for protective structures that would substantially alter natural landforms along bluffs and cliffs
- The age of the existing principal structure can be considered for economic feasibility

Is the Structure in Danger from Erosion:

- Analysts consult submitted Engineering Geologic Reports on shoreline processes and potential bluff failure to determine if a threat to a structure from erosion exists
- Engineering Geologic Reports are also consulted to locate a stable site for a new structure, a safe setback distance, septic system sites, develop foundation criteria, and to determine site preparation
- Elements required in the Engineering Geologic Report includes analysis of the entire site and adjacent beach using recent topographic data, contains an objective analysis with both structural and nonstructural options, analysis of potential impacts of the proposed design and alternatives to reduce the effects of the project

Common parameters used (but not limited to) when determining if an existing structure is in danger from erosion includes:

- Existing beach or bluff setback and predicted erosion rate
- Location of the intersection of the projected failure plane and the bluff top
- Angle of repose of the upper bluff and distance for bluff to "lay back" without threatening the existing residence
- Geologist's estimate of when the residence would be undermined or damaged
- Foundation of the structure to be protected
- Estimated wave run-up

Other information taken into account on the erosion criteria includes:

- Consider conditions surrounding the site, whether armoring has been used nearby, and recent permit history in area for context
- Is this site similar to other permitted, or will a precedent be set
- If technical evidence does not clearly indicate the existing structure is in 'danger' the Commission is not required to permit the shoreline protection device
- Technical staff can recommend denial of the project and identify nonstructural alternatives with less impact to natural landforms and adjacent beach
- Alternatives which increase the stability of the site, minimize risk and avoid need for armoring in the future should be recommended

Is the Proposed Protective Device Required for Protection from Erosion or are Other Options Feasible:

- If protection is determined as necessary then the Analyst can require that ground water and surface water control, landscaping, removal of accessory structures, underpinning the structure, or similar is included in the design

Is the Proposed Protective Device the Least Environmentally Damaging Alternative to Provide Protection:

- The Analyst can consider alternatives which avoid identified significant impacts.
- Feasible alternatives can be recommended over the proposed project if they provide protection and are less environmentally damaging
- Factors for consideration for less environmental damage include visual quality, landform alteration, beach encroachment, effects on shoreline access, impact to sensitive resources, and similar

Is the Proposed Protection Designed to Eliminate or Mitigate the Adverse Impacts on Shoreline Sand Supply:

- Impacts to sand supply include encroachment onto the beach, scour effects, end effects, retention of potential beach material, fixing the back of the beach, and landform alteration and must be mitigated to reduce long term impacts to the beach, and include mitigation measures
- The Analyst should determine whether the beach is in State tidelands or could impact State tidelands

Emergency is defined in Section 13009 in California as a "sudden unexpected occurrence demanding immediate action to prevent or mitigate loss or damage to life, health, property or essential public services" and are issued by the CCC Executive Director. This clause is intended to protect the shore with nonpermanent structures for emergency protection, not new development.

While there are opportunities to find reason to allow bulkheads under these criteria where truly needed, the rules in the BEAR document area clearly stated and defined fairly thoroughly. This may be a good model for adaption in San Juan County or Puget Sound region. More details can be found in the BEAR guidance document.

National

Florida - 62B-33.0051(a) Construction of armoring shall be authorized under the following conditions: 1. The proposed armoring is for the protection of an eligible structure; and 2. The structure to be protected is vulnerable. The determination of vulnerability will be made utilizing the dune erosion model contained in the report entitled "Erosion due to High Frequency Storm Events," by the University of Florida, dated November 22, 1995, which cites a 15-year recurrence interval storm.

North Carolina - North Carolina allows temporary erosion control structures in the form of sandbags. Rules for these structures can be found in the NCAC Title 15A, Chapter 7H, section .0308 2(A)-(N). Rules 2(A)-(C) state that:

- Permittable temporary erosion control structures shall be limited to sandbags placed above mean high water and parallel to the shore.
- Temporary erosion control structures as defined in Part (2)(A) of this Subparagraph may be used only to protect imminently threatened roads and associated right of ways, and buildings and associated septic systems. A structure will be considered to be imminently threatened if its foundation septic system, or right-of-way in the case of roads, is less than 20 feet away from the erosion scarp. Buildings and roads located more than 20 feet from the erosion scarp or in areas where there is no obvious erosion scarp may also be found to be imminently threatened when site conditions, such as a flat beach profile or accelerated erosion, tend to increase the risk of imminent damage to the structure.
- Temporary erosion control structures may be used to protect only the principal structure and its associated septic system, but not such appurtenances as gazebos, decks or any amenity that is allowed as an exception to the erosion setback requirement.

Table 4

Approach	Level of Clarity	Measure of Success
Erosion rate with add'l hazard assessment	High - moderate	
Professional opinion of Engineer	Moderate - poor	
Slope Stability model/ Factor of Safety	Moderate - poor	

Recommendations for San Juan County

Before allowing the construction of a bulkhead at existing developed properties, all other options of avoiding hard shore protection should first be seriously evaluated. Only after these options have been exhausted and well documented in a site-specific report for a given property, should the consideration of a permit for a new bulkhead be initiated. The following general list goes through the primary options as laid out in several of the documents discussed in this report, and also mostly found within several Washington SMPs:

1. Structure relocation (setback) is a serious option.
2. All anthropogenic factors should be addressed, such as drainage.

3. Softer solutions that could reduce risk, such as dewatering, revegetating slope, or placement of beach nourishment and/or large woody debris should be evaluated and integrated into a solution.
4. If the above solutions are not adequate/feasible, than minimal bulkheading could be considered to protect only the threatened structure, not the entire property.
5. Mitigate impacts from alterations to functions and processes as they relate to the site and the landscape (drift cell).

Based on our research and understanding of coastal issues we have selected the most appropriate method for San Juan County to define 'threatened' for existing development as one that is based on documented erosion rates over a long enough time to dampen the effect of short-term changes. This time frame is ideally 50 years or more, but in this region we often have to settle on a time frame that goes back the earliest detailed aerial photos. This is generally between 30-40 years, with the 1965-1969 air photos being the latest of the 1:12,000 scale coverage photo series. Bank recession rates have been used to document erosion in many jurisdictions, but the level of analysis has varied tremendously. Reports that simply forward a number for an erosion rate with no indication of methods are not uncommon in the region. Further work could standardize the best methods for determining an accurate, site-specific erosion rate without great expense (on the order of several thousand dollars for an individual property).

The determination of threatened would then rely heavily on the documented erosion rate along with a geologists estimate of when the residence or other key development feature would be undermined based on anticipated slope failures at a site. For safety this would include allowance for bank recession equal to largest documented landslide in the vicinity. The use of a 3 year time frame may be best to maintain as permitting takes some time and management should not be done through emergency permits. Therefore, the distance of the annual erosion rate multiplied by 3 years time, plus the horizontal distance of the largest documented landslide in the local vicinity.

The approach for addressing risk of an existing residence need not be consistent with setback regulations as setbacks for new construction are designed for reducing negative ecosystem/ fish & wildlife impacts such as dealing with vegetation and water quality. Basing the determination of threatened on well-documented erosion rate information was supported in theory by Bob Fritzen (pers. com. 2009) and Hugh Shipman (pers. com. 2009) of the WA Dept. of Ecology.

The factor of safety approach currently used by the City of Bainbridge Island is not recommended. This approach is only applicable for deep-seated landslide analysis and not for the much more common shallow landslides of our region. Also City staff have stated that this method has not been producing predictable or consistent results, and has been used with widely varying standards.

Specific and rigorous standards for Engineering Geology Reports or Coastal Geologic Analysis (Island County term) reports for erosion hazard assessments are needed across the region. Where report standards are in place in Puget Sound jurisdictions, they are still quite vague and non-specific for what is required in the analysis. This has led to many poorly documented sites and many misunderstandings and legal battles. A geology or geotechnical study for a coastal

property needs to account for the wide variety of factors that effect coastal erosion and slope stability. A trained and experienced Engineering Geologist, as opposed to a Professional Engineer, is best suited to determine erosion processes, causes, and trends. Trends include quantification of causes of erosion (recession), past erosion rates over a minimum of 30 years, and a projection of future rates over the next several decades.

The BEAR document from California is the best model found for report standards. Also, report standards could be further refined from one of the recent Critical Areas Ordinances for Geohazards. An Engineering Geologist Report for determining the needs to include the following (developed from the BEAR document from California):

- Detailed topography from house to lower beach
- Medium and long-term erosion rates
- Analysis of slope stability and mechanisms for slope failure in the vicinity
- Geologist's estimate of when the residence would be undermined (to include allowance for bank recession equal to largest documented landslide in the vicinity)
- Detailed analysis of moving house and soft shore protection as alternatives

These report standards must be rigorously applied; not "business as usual", as the geologic and engineering community has not been held to a high standard relative to Puget Sound area coastal analyses.

Also very important to define is exactly what structure/improvements a jurisdiction allows to be protected with a bulkhead or other shore protection structure. This seems particularly important in the San Juan County SMP and/or CAO, as the county SMP currently does not specify this.

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