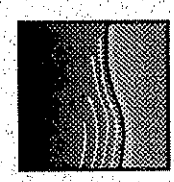
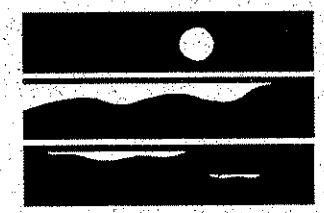


Coastal Erosion Management Strategy

Regional Approaches to Address Coastal Erosion Management

Coastal Erosion Management Studies, Volume 9



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Regional Approaches to Address Coastal Erosion Management

Coastal Erosion Management Studies, Volume 9

June 1994

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Report 94-82

Shorelands and Water Resources Program
WASHINGTON DEPARTMENT OF ECOLOGY
Olympia, Washington 98504-7600

Coastal Erosion Management Strategy

This report is one in a series or reports commissioned or completed by the former Shorelands and Coastal Zone Management Program of the Washington Department of Ecology in fulfillment of the Coastal Erosion Management Strategy project. The project is dedicated to seeking answers to questions on appropriate technical standards for coastal erosion management, the environmental impact of shoreline stabilization techniques, and the assessment and development of policy alternatives. The reports in the series are listed on page iii. Inquiries about the Coastal Erosion Management Strategy project should be directed to the project manager and series editor:

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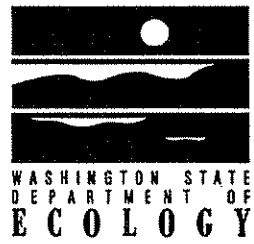

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Coastal Erosion Management Studies

Volumes in the Coastal Erosion Management Studies series will be published over a period of time. At the time of publication of this volume, the printing schedule was as follows.

Volume	Title	Status
Volume 1	Coastal Erosion Management Studies Executive Summary	Published January 1995
Volume 2	Coastal Erosion Management: Annotated Bibliographies on Shoreline Hardening Effects, Vegetative Erosion Control, and Beach Nourishment	Published June 1994
Volume 3	Inventory and Characterization of Shoreline Armoring, Thurston County, Washington, 1977 - 1993	In press
Volume 4	Engineering and Geotechnical Techniques for Coastal Erosion Management in Puget Sound	Published June 1994
Volume 5	Shoreline Armoring Effects on Physical Coastal Processes in Puget Sound, Washington	Published August 1995
Volume 6	Policy Alternatives for Coastal Erosion Management	Published June 1994
Volume 7	Shoreline Armoring Effects on Living Resources and Coastal Ecology in Puget Sound, Washington	Published August 1994
Volume 8	Geotechnical and Land Use Techniques for Coastal Bluff Management in Puget Sound	Published August 1994
Volume 9	Regional Approaches to Address Coastal Erosion Management	Published June 1994
Volume 10	Coastal Erosion Management in Puget Sound: Final Environmental Impact Statement	Scheduled, 1995
Volume 11	Coastal Erosion Management in Puget Sound: Technical and Policy Guidance for Local Government	Scheduled, 1995

Preface

The shores of Washington's inland coast—greater Puget Sound—undergo both shoreline erosion and landsliding. The overall rates of shoreline retreat are usually minor, maybe an inch or two a year, but in some areas may average as much as half a foot per year. This is usually due to a combination of bluff undercutting and steep slope failure, resulting in landslides. At any particular location, landslides occur infrequently, often decades apart. Simple shoreline wave erosion *by itself* is not often the problem in Puget Sound.

Marine shoreline erosion is a concern to both coastal property owners and the users and managers of coastal public resources. Coastal property owners are naturally concerned with protecting their investments in land and buildings. Unfortunately, houses and other buildings are often built dangerously close to the shoreline. Most property owners react to incidents of erosion by erecting erosion control structures such as concrete or rock bulkheads. If properly constructed, these shoreline armoring structures can slow most forms of wave induced shoreline erosion for a period of time, but will probably do little to prevent continuing landsliding. Many shoreline property owners consider shoreline armoring critical to the protection of their real estate.

Resource managers are, of course, concerned about any adverse effects on the habitats which support biological resources such as fish and shellfish and are charged with protecting the public property right in those resources. The scientific literature seems to indicate that shoreline armoring (and the associated vegetation clearing) typically results in the following adverse effects:

- Sediment supply to nearby beaches is cut off, thus leading to "starvation" of the beaches for the sand and other fine grained materials that typically make up a beach.
- The hard face of shoreline armoring, particularly concrete bulkheads, reflects energy back onto the beach, thus exacerbating beach erosion.
- In time, a sandy beach is transformed into gravel or cobbles, and may even be scoured down to bedrock, or more commonly in the Puget Sound basin, a hard clay. The footings of bulkheads are exposed, leading to undermining and failure.
- Vegetation which shades the upper beach is eliminated, thus degrading the value of the beach for spawning habitat.
- Any transformation of the character of the beach affects the kind of life the beach can support.

Request for Investigation and Assessment

The Thurston and Mason County Commissioners, and the Pierce County Executive, in 1991, requested that the Department of Ecology (Ecology) investigate the effects of wide spread shoreline armoring and prepare a programmatic environmental impact statement on the cumulative effects of bulkheading and other forms of armoring. These elected officials were reacting to the large numbers of bulkhead permit applications in recent years, and were voicing concern over their uncertainty about the wisdom of permitting large scale unmitigated shoreline armoring.

Legislative Action

In an action unrelated to the local government requests, the Washington State Legislature in 1992 passed *Engrossed Senate Bill 6128* which amended the Shoreline Management Act to provide for the following:

- Local governments must have erosion management standards in their Shoreline Master Programs. While most local governments have erosion sections in their SMP, these existing regulations may not be as comprehensive as ESB 6128 requires.

- These standards must address both structural and non-structural methods of erosion management. Structural methods are typically bulkheads or rip rap. Non-structural methods include building setbacks and other land use management approaches.

- The standards must give a preference for permitting of erosion protection measures for residences occupied prior to January 1, 1992 where the erosion protection measure "is designed to minimize harm to the shoreline natural environment." This implies no preference for protection measures first occupied after January 1, 1992.

- ESB 6128 expands erosion protection from just a residence to "single family residences and appurtenant structures."

- Permit application processing by local government must be carried out in a timely manner. Shoreline property owners testifying for the bill cited local government delays in permit approval as onerous. Local governments report that most permit delays are caused by incomplete or inaccurate information on the permit application.

The Coastal Erosion Management Strategy

The legislature was unable to provide local governments or Ecology with the funds necessary to carry out the intents of ESB 6128 because of reduced tax revenues. Fortunately, Ecology was successful in obtaining a grant under the federal Coastal Zone Management Act to carry out a comprehensive Coastal Erosion Management Strategy.

CEMS—the Coastal Erosion Management Strategy—is a three year, multi-task program aimed at (1) satisfying local elected officials' requests for assessment of the cumulative effects of shoreline armoring, (2) developing the standards for shoreline erosion management mandated by ESB 6128, and (3) assessing regulatory alternatives for erosion management. Tasks 1 - 4 were completed in 1992-93. Tasks 5 - 7 were completed in 1993-94, and tasks 8 and 9 in 1994-95.

Task 1. Inventory and Characterization of Shoreline Armoring, Thurston County, Washington, 1977 - 1993. Thurston County was selected as the study area for a pilot project because of the availability of large amounts of relevant information already in data management and GIS (geographic information system) computer file formats. This study provides quantitative estimates of the rate and character of shoreline armoring which are not readily available for most of Puget Sound.

Task 2. Engineering and Geotechnical Techniques for Shoreline Protection in Puget Sound. The generally accepted engineering and geotechnical techniques for selected erosion management alternatives (bulkheading, revetments, wave attenuation, beach nourishment, etc.) appropriate to the tidal range, wave energy, and geologic conditions characteristic of Puget Sound are assessed. This report provides the basis (in part) for development of State guidance recommendations to local government for adoption of standards for appropriate erosion management measures.

Task 3. Shoreline Armoring Effects on Physical Coastal Processes in Puget Sound. The key assumptions and questions about the effects of shoreline armoring on coastal processes are evaluated based on the technical literature, and sensitized to Puget Sound conditions. Selected local case examples are provided.

Task 4. Coastal Erosion Management Regulation: Case Examples and Critical Evaluation. Regulatory approaches to coastal erosion management in Puget Sound and other states are evaluated, and policy alternatives for Washington are assessed. This report will provide the basis (in part) for development of State guidance recommendations to local government for adoption of coastal erosion management procedures.

Task 5. Shoreline Armoring Effects on Biological Resources and Coastal Ecology in Puget Sound. Following on from Task 3, the direct effects of shoreline armoring and the secondary effects of changes to coastal processes and conditions upon biological resources are assessed. Selected local case examples are provided.

Task 6. Coastal Bluff Management Alternatives for Puget Sound. A large measure of bulkheading is in reaction to slope failures, not shoreline erosion *per se*. Slope instability is caused by a combination of inherent geologic weaknesses, ground water loading, and toe erosion. Following on from tasks 2 and 4, this task addresses coastal bluff management alternatives.

Task 7. Regional Approaches to Coastal Erosion Management. Traditionally, shoreline management and erosion control permitting has been on a case-by-case basis. Many "soft"

approaches to erosion management (e.g. beach nourishment) or mitigation for adverse effects must be carried out on a regional basis to be effective. Both the technical and political feasibility of regional erosion management is assessed.

Task 8. Coastal Erosion Management Environmental Impact Statement. This task will integrate the special study reports and other information into a programmatic environmental impact assessment.

Task 9. Coastal Erosion Management Recommendations for Puget Sound. Based largely on the foregoing studies, this task will formulate specific model elements which can be recommended as amendments to local Shoreline Master Programs. The guidance will be published as a chapter in Ecology's *Shoreline Management Guidebook*.

Task 1, Inventory and Characterization, was completed by Thurston Regional Planning Council. Tasks 2 through 7 were completed CH2M Hill and Battelle Memorial Laboratories under contract to Ecology. Tasks 8 and 9 will be completed by Ecology.

Tasks 1 through 7 are each designed to answer a relatively narrow set of questions, therefore each task completion report presents only a very limited portion the study. Until the entire project has been completed, the analytical studies have been integrated (Task 8), and Ecology has developed its guidance to local government (Task 9), no conclusions should be drawn from the individual study reports.

The CEMS project is a balancing of concerns and mandates. The Shoreline Management Act (SMA) has goals of both "planning for and fostering all reasonable and appropriate uses" while at the same time "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." ESB 6128, in amending the SMA, gave a preference for permitting of erosion protection measures for residences occupied prior to January 1, 1992 where the erosion protection measure "is designed to minimize harm to the shoreline natural environment."

This review and evaluation of policy alternatives for regional approaches to coastal erosion management was intended to be, and is, theoretical in nature. The conclusions reached do not represent Washington State policy or proposed policy. In fact, some of the alternatives identified might require amendment of the Shoreline Management Act and/or local Shoreline Master Programs. The Department of Ecology will develop and issue its recommendations for coastal erosion management policy in a subsequent volume in this series.

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This report was prepared with the assistance of a number of individuals. We would like to thank these people for their willing participation, guidance, and support.

First we would like to thank Mark Curran and Angela Walters from Battelle who provided excellent summary information on interesting regional approaches being implemented in other areas of the United States. This information was invaluable in designing approaches that might be relevant to Puget Sound.

Second, we would like to thank the participants of the regional approach workshop convened on February 8, 1994. Their insights and comments on the regional approaches described in a discussion report were critical in designing this report. The participants shared their views on the pros and cons of each approach and on which approaches appear to have the greatest merit of succeeding in Puget Sound. A list of these participants is provided in Appendix A.

Lastly, we would like to thank Doug Canning and Hugh Shipman of the Washington State Department of Ecology for their guidance, input, and support.

Contents

1 Introduction

This report builds on findings from a previous report developed for the Washington Department of Ecology (Ecology) — *Policy Alternatives for Coastal Erosion Management,* Coastal Erosion Management Studies, Volume 6, July 1993. This previous report presents an overview of the current policy framework being used in Puget Sound to address coastal erosion and provides a critical evaluation of alternative erosion management policies, strategies, and policy support tools being used by other states that may be appropriate to Puget Sound. In developing the foundation for the current framework in Washington, a survey and interviews were conducted with state officials, local jurisdiction shoreline administrators, tribes, academicians, coastal residents, and shoreline modification contractors and engineers to identify the issues they saw as critical in erosion control management. An assessment was conducted of the state Shoreline Management Guidebook (Ecology, 1990) and local jurisdictions' Shoreline Master Programs (SMPs) to better understand Washington's policy and regulatory framework. This previous report provides a menu of potentially feasible policy alternatives for Ecology to consider in developing its management guidelines for local government.

The focus of most of the policy alternatives in the previous report is on parcel-by-parcel policy approaches. In contrast, this report focuses on regional approaches that may be used to consider coastal erosion issues in the management of residential development and shoreline modification proposals (e.g., construction of bulkheads). Region is not prescriptively defined to allow state and local decision makers to tailor the word to meet their needs. It could, for example, mean a drift cell, reach of shoreline, or embayment. "Region" represents an area where the extent of possible effects, physically or biologically, are felt from some action. A focus on regional approaches was seen as needed because traditional parcel-by-parcel decisions often overlook the cumulative impacts (both spatial and temporal) that may be caused from shoreline development and/or shoreline modification structures (e.g., bulkheads). As is the case with the previous report, this report draws from experiences in other states and provides an analysis of regional policy alternatives and policy support tools that might be applicable to Puget Sound.

The research for this report was conducted using two primary methods. First, a discussion paper on regional approaches was prepared based on the previous report, follow-up interviews, and new case study summaries. Second, a workshop was held on March 8, 1994 with decision makers who participate, at some level, in the review of applications for shoreline development and modification (e.g., armoring). The participants included local planners, state officials from Ecology and the Department of Fish and Wildlife, a representative of the U.S. Army Corps of Engineers, academicians, and the project manager. The discussion paper was used extensively during the workshop to illustrate the pros and cons of the proposed regional policy approaches and support tools in the context of Puget Sound. The workshop discussion was based on two primary needs that were raised by individuals interviewed during the first phase of this study:

- restrict inappropriate modification of shorelines
- restrict inappropriate residential development and foster appropriate development of undeveloped lands.

The discussion that occurred during the workshop is in large part the basis for the analysis of the various regional approaches and policy tools described in this report.

This report is organized into four sections. The first describes possible command and control approaches that could be used regionally in the management of development and shoreline modification measures (e.g., bulkheads). These approaches are meant to capture the types of restrictions or requirements that could be used in a regulatory sense. The second section describes economic incentives and other market based solutions that could be used in coastal erosion management. Third, policy support tools such as research, monitoring, data collection, and education and outreach programs are described that might be necessary or desirable to ensure that the regional policy approaches succeed. Fourth and finally, a conclusion section is provided to summarize the major findings regarding which approaches appear to have the most merit in Puget Sound and to set the stage on what near-term actions need to be taken or at least considered as a next step.

2 Command and Control Approaches

2.1 Restrictive Covenants

Restrictive covenants are contractual obligations of a landowner to other, generally neighboring, landowners that impose restrictions on the use of the landowner's property. If appropriately drafted and recorded (as part of a subdivision plat, deed of title, or separate instrument), a restrictive covenant "runs with the land" — the obligations are enforceable against subsequent owners of the property by subsequent owners of the neighboring property. A local authority could encourage beneficial practices by giving property developers within a region some form of credit if they include mutually enforceable covenants requiring all property owners in a development to follow such practices, as specified in the covenants. Restrictive covenants could cover the types of shoreline protection allowed for a region, the proximity of homes to a bluff or other shoreline feature within a region (e.g., a covenant could state that a home must be situated on a lot in such a manner that no erosion control structures are needed nor allowed in the future), and a requirement that no cutting nor clearing of banks or bluffs are allowed.

Workshop Findings

There was some confusion as to whether the above description intended a government agency to have authority in establishing such covenants or whether a private entity would have the authority. Either is possible.

In the case where the government adds a covenant to an unplatted tract of land, such covenants would give the local government more ground to stand on in denying future buyers of parcels within the tract the right to build their home close to an erosion-prone bluff or to armor their shoreline if the covenant for the tract explicitly forbids such actions. Some workshop participants saw such covenants more as performance standards, which may be another term used for this concept. In any case, it was felt that regulators look for consistency and such covenants would allow for consistency in a region. Furthermore, covenants are legally acceptable. Potential obstacles to governmentally established covenants include the costs associated with deciding where such covenants should be placed (e.g., the data needed to make such determinations might not be available). It should be noted that these costs are associated with any command and control approach. Another potential obstacle is that subdivision developers may object to the government's attempt to establish restrictive covenants. Alternatively, some developers may see such a covenant as an asset if environmentally sensitive subdivisions are valued higher by prospective buyers than subdivisions without such covenants.

Socio-political acceptability should not be a problem in the case of a community or other private entity (e.g., subdivision developer) establishing a covenant. Property owners would have agreed to the covenant through purchase of a parcel in the subdivision with full knowledge that the covenant applied, or through a decision to establish a covenant on their subdivision to protect the subdivision's shoreline against future shoreline armoring in cases where it is viewed as a means to protect their property values (e.g., cases where future armoring would harm the downdrift shoreline of a community beach to which all property owners support and belong). This last case would be most likely in situations where the owners of non-waterfront parcels of a large development with an interest in protecting the overall shoreline, including a communal waterfront area, override the interest owners of waterfront parcels have in protecting their individual property rights. Neighbors would likely enforce such covenants and use the courts to the extent needed. Therefore, there would be no substantial costs to the local or state regulators.

An obstacle to either approach to restrictive covenants on undeveloped lands (government or private entity) is that most of the shoreline is already subdivided, therefore there may not be much opportunity to add such covenants to newly-platted subdivisions. Furthermore, there is no guarantee that the shoreline of a subdivision matches with a geographic region (e.g., drift cell), which can create problems at the boundary of two subdivisions where erosion control practices are in conflict. Education efforts would be critical to making restrictive covenants effective in coastal erosion management.

2.2 Erosion Control Easements

Similar to restrictive covenants, erosion control easements could be established by a private entity to protect against development in an erosion-prone region. The private entity would not own the parcels of land in such a region but would have an easement attached to the parcels' deed. The private entity would monitor the development activities of these parcels and would have to be notified by the seller of a parcel prior to its sale to inform the new owner of the requirements that apply to the parcel. Such an easement could be placed on a regional bluff or bank along a reach, drift cell, or embayment to restrict property owners in the region from cutting or grading these erosion-prone areas of their property. Semiahmoo on Birch Point in Blaine, Washington is an example of a region that has established such an easement.

Example: Brandywine Conservancy Easements

Conservation easements are used by the Brandywine Conservancy to protect the Buck and Doe Run Valley Farms in Chester County, Pennsylvania. The Buck and Doe Run Valley Farms encompass over 5380 acres of land in Chester County — once the largest single landholding in the County. The property is bordered to the north by the West Branch Brandywine Creek, a source of drinking water for northern Delaware, and is transected by Doe Run Creek and Buck Run Creek. Buck Run Creek is a major tributary of the West Branch Brandywine Creek, which in turn feeds the Christina and Delaware Rivers. The

quality of these tributaries is dependent, in large part, on the high percentage of undeveloped and untilled land in the watershed, including the Buck and Doe Run Valley Farms. To help ensure the continued protection of this watershed, conservation easements for the property were donated by Buck and Doe Associates to the Brandywine Conservancy, a nonprofit organization established to protect the Brandywine Creek as a resource which can sustain human use and a healthy ecosystem.

Under these easements, Buck and Doe Associates agreed to establish certain use restrictions on the property. In return, the Brandywine Conservancy agreed to administer these restrictions in perpetuity, including monitoring the property and taking legal action, if necessary, against violators of the easements' conditions. These conditions include restrictions on residential density, the location of new houses on the property, impervious ground cover, the use of well water and constructed ponds, hazardous materials, agricultural activities, woodland harvesting, and signage. The easements also preclude the Buck and Doe Run Valley Farms property from being incorporated in potential developments on surrounding properties.

Workshop Findings

Erosion control easements could be applied to the deeds of developed parcels within a region or to undeveloped parcels within a subdivided region. It was seen as easier to establish an easement for the latter than the former. Such easements could be expanded from use on bluffs and banks to critical tidelands. The majority of advantages and potential obstacles that applied to restrictive covenants would apply to establishing erosion control easements.

2.3 Erosion Overlay District Ordinances

An enhancement to the environmental designation provisions existing in current shoreline master programs is the use of regional erosion overlay district ordinances. Local governments could enact ordinances that create districts to restrict development activities within a region where erosion is deemed critical.

Example: New Hanover County, North Carolina Conservation Overlay District Ordinances

New Hanover County, North Carolina adopted an overlay district ordinance in 1984 (North Carolina Coastal Federation, 1990). Specific to conservation, its purpose is to maintain the ecological systems of the County, to protect estuarine functions important to fish and shellfish resources, to maintain open space, and to protect archaeological and historical resources of the County. The

ordinance targets the protection of natural areas not only for their market value, but also for their intrinsic value as components of a healthy ecosystem.

Under the New Hanover County, North Carolina ordinance, most land subdivision and commercial or industrial development that disturbs more than one acre of land is subject to requirements that are separate from other requirements of the underlying zoning district in which the land is located. In cases where the requirements of the overlay district are more stringent than those of the underlying zoning district, the more restrictive requirements apply.

The New Hanover County ordinance identifies specific resources (conservation resources) that must be preserved within the county, such as swamp forests, natural ponds, fresh marshes, primary nursery areas, and salt marshes. Maps delineating these resources are maintained by the County Planning Department. The conservation overlay district ordinance includes three main requirements:

1) A specified percentage of the conservation resources must be preserved in a natural state and designated as conservation space.

2) The development site must be designed to meet drainage requirements for a 10-year storm, as well as provide for retention of the first inch of stormwater runoff.

3) All structures and impervious surface must be set 100 feet back from the conservation space.

In addition to these site requirements, the New Hanover County ordinance allows for the dedication of conservation spaces to the County, state, or federal government, or to a qualified non-profit organization.

The New Hanover County example is a combination of two policy approaches described in this report: overlay district ordinances and land acquisition and preservation trusts. In Puget Sound, a similar approach could be used if erosion-prone areas were identified as erosion district ordinances that would be overlayed onto existing environmental designation provisions. As with the restrictive covenants, the government would have to bear the cost of identifying where these district ordinances should be applied.

Workshop Findings

There is some merit to this approach, where appropriate and politically acceptable. Analogies were drawn between an erosion overlay district ordinance and a critical area ordinance (as allowed under the Growth Management Act and as being used by Thurston County for marine bluffs). Because a mechanism is in place for local governments to establish erosion overlay district ordinances, this regional approach was seen as very viable.

Other analogous examples of important regions being targeted for special treatment are Special Areas Management Plans under the Coastal Zone Management Act and local SMPs Subarea Plans. In this case, erosion-prone regions or feeder-material regions critical to shoreline processes would be the targets in the erosion overlay districts.

One major advantage of this approach over restrictive covenants and erosion control easements is that such districts would be defined based on scientific need (physical and biological attributes of a region), not on subdivision boundaries. They would, therefore, be more environmentally appropriate.

Possible obstacles to this approach include the fact that local government sometimes lacks the motivation to impose new restrictions due to administrative costs and fear of political repercussions. Local citizens, politicians, and regulators will need to support such overlay districts for them to be effective. As with the many of these approaches, educational efforts will be important. Soil Conservation Districts are a possible resource to provide education and advise on erosion overlay district ordinances. Other obstacles include costs that will be needed to identify the overlay districts (as mentioned above), enforcement costs to the regulator, and costs in the form of lost development opportunity.

2.4 Coordinated Regional Review of Environmental Impacts

A coordinated regional environmental impact review could be encouraged or required as part of the shoreline modification application review process and/or as part of a construction permit for residential development. This approach would serve as a means by which to coordinate all stakeholders (public agencies and private interest parties) involved or interested in a particular shoreline modification or development project that has regional implications.

An appendix to a Washington Department of Ecology report entitled *Nisqually River Management Plan: Final Environmental Impact Statement,* has identified the need for interagency coordination in resource management (Bauer and Canning, 1987). The report points out that without such coordination, applicants may find themselves the victim of conflicting permit approval conditions. Furthermore, a single agency often lacks the technical knowledge to consider all aspects of habitat management in natural resource planning.

A coordinated regional impact review could expedite the shoreline modification application process, ensure that all concerns are considered, and serve as a regional planning tool. Coordination could include review and integration across regulatory functions and across agencies and jurisdictions. Regional authorities and commissions can provide planning and management functions and oversee coordinated regional environmental impact reviews.

Example: Washington State Joint Aquatic Resource Permit Application (JARPA)

Joint Aquatic Resource Permit Application (JARPA) is an example of a joint application review process being used currently for permits to work near shorelines, wetlands, and other waters. Participating permit programs include: Shoreline Management Act, short-term water quality standards modifications, Hydraulic Project Approvals, Section 10 of the Rivers and Harbors Act, Section 404 of the Federal Clean Water Act, and GMA Critical Area Ordinances. A permit applicant fills out one form with one set of site plans. Copies of the application and site plans are then sent to the appropriate agencies simultaneously for review and permitting. This streamlined permit application process is in a pilot stage (Ecology, 1994a).

Across the United States, regional authorities and commissions take on a wide variety of forms and functions. Nordstrom (1992) describes the use of regional authorities and commissions that can provide planning and management functions for estuarine systems. Some of these entities have an economic development focus while others have an ecological protection/conservation focus.

2.4.1 General Regional Coordination

Example: Bayshore Development Office for Raritan Bay, New Jersey, Bay Conservation and Development Commission for San Francisco Bay, California

In New Jersey, the Bayshore Development Office for Raritan Bay shoreline was created to rejuvenate the Raritan Bay waterfront. The Office was established under the direction of the New Jersey Division of Community Affairs and subsequently taken over by the Department of Commerce and Economic Development. The role of the Office is to serve as an intermediary between state and local governments in guiding development applications through the state review process. In contrast, the Bay Conservation and Development Commission for San Francisco Bay has an ecological focus. This Commission operates outside the existing local government structure, acting as a buffer against local government's pressure to fill the Bay for development purposes (Nordstrom, 1992).

Example: Galveston Bay Regional Authority

Galveston Bay National Estuary Program uses a coordinated approach to deal with the inherent difficulties associated with conflicting agency boundaries and natural boundaries. The Galveston Bay Plan offers a unanimous convergence on a new set of boundaries, one that encompasses all the land and water-based sources of the bay's problems. In 1993, a coordinated approach — the

"Galveston Bay Regional Authority" — was endorsed as the preferred implementation option to manage the estuary at the ecosystem level (Shipley, 1994).

Example: Long Island Sound Study (LISS)

The purpose of the Long Island Sound Study (LISS) is to facilitate cooperative efforts between the states of Connecticut and New York, local governments, federal agencies, and the public to develop a management plan for addressing the environmental problems of the Sound (U.S. EPA, 1993a). LISS was established in 1985 through direct appropriations from Congress and became part of the National Estuary Program in 1987. The most serious of the problems facing Long Island Sound, low dissolved oxygen or hypoxia, has been attributed to excess loads of nitrogen from sewage treatment plants, stormwater runoff, and atmospheric deposition. Severe hypoxic events related to algal "blooms" have been documented in Long Island Sound since the 1970s, forcing free-swimming organisms from the area, and rendering habitat unusable for spawning, feeding, or as migration routes.

As a means for addressing point source loads of nitrogen into the Sound, the states of Connecticut and New York established an Interstate Nitrogen "Freeze" policy to prevent increases in current nitrogen loadings. A baseline for nitrogen loadings was established using 1990 levels. To meet this baseline, discharge permits issued under the National Pollutant Discharge Elimination System will be modified to freeze, or in some cases reduce, allowable nitrogen loads to the Sound.

Example: New Jersey Pinelands Commission and the Cape Cod Commission

The New Jersey Pinelands Commission provides coordination between pollution control and land and riverine protection. The program includes seven counties and 53 municipalities. The Cape Cod Commission operates in a manner similar to a council of governments (COG). The Cape Cod Commission provides for source aquifer protection and performance zoning where minimum performance standards are set to meet important objectives pertaining to the protection of groundwater. Wetland protection areas (where regional development is expected to generate more than 2000 gallons per day of sewage effluent) may be required to perform a cumulative impact analysis according to Commission-approved methodology. In this particular case, management is done through on-going state agencies operating within normal assigned areas of responsibility. Cooperative projects are facilitated through memoranda of agreement between participating agencies (River Federation, 1993).

Adjacent jurisdictions in Puget Sound could establish a program similar to LISS to jointly review applications for shoreline modification. Instead of "freezing" nitrogen loadings, adjacent jurisdictions could "freeze" the development of particular hard structures in areas where there would be significant adverse effects to adjacent properties. Such a policy could

also apply to development projects in areas where new homes could be at risk if poorly designed or located dangerously close to an erosion-prone bluff or bank.

2.4.2 Regional Coordination Concerning Erosion

Coordinated regional environmental impact reviews in Puget Sound could result in decisions to phase out reliance on hard shoreline protection structures for public and private properties, where feasible and appropriate. Furthermore, structural design standards could be used where hard solutions are needed, thereby allowing natural forces of a major storm to reshape the coast uniformly. By reviewing impacts regionally, such a policy could require a structure to only withstand minor storms, thus limiting the damage a structure could cause to adjacent properties in a major storm event.

Example: State Policies to Phase Out, Reduce the Reliance on, or Restrict Structural Design of Hard Shoreline Protection Structures

California currently endorses the policy to phase out reliance on hard protective structures for both public and private properties (Griggs et al, 1992). Twelve percent of the California coastline is armored, representing a $5-15 million dollar per mile investment. Protective armoring has largely been paid for or subsidized by the public sector in the form of state projects, state or federal disaster relief, government assistance or low interest loan programs, or directly through insurance payments. California has a recommendation in the report California's Coastal Hazards: A Critical Assessment of Existing Land-Use Policies and Practices that every proposal for a hard works should be accompanied by a technical evaluation of site geology and oceanography, long-term erosion history, structural design criteria, and an evaluation of the effectiveness of any adjacent protective works (Griggs et al., 1992). The report suggests that these evaluations be prepared by experienced professionals and appropriately peer reviewed.

The policy of using structural design standards on hard works where a hard solution is needed is being considered in two states, Massachusetts and Florida. Massachusetts has recently begun to encourage property owners to build structures that are as low as possible to allow the upper bank/bluff to slump in times of severe storm action, thus allowing for the natural influx of upland materials. The policy also requires that residents nourish the bank with compatible bank/bluff material after severe storm action so that material is available for future storms (O'Connel, 1993). Florida's similar policy requires that hard protective structures be designed to withstand minor (5-10 year) but not severe (100 year) storm events. The notion is, again, that the natural force of the storm should be able to reshape the coast uniformly (Green, 1993).

A policy to phase out, reduce the reliance on, or restrict structural design of hard shoreline protection structures would be more effective if it were implemented in a regional context (e.g., for an entire drift cell / reach / embayment). Regions being adversely impacted by such structures could be identified and prioritized. Appropriate state and local agencies could coordinate their efforts to identify these regions and support each other in an effort to enforce this policy.

Coordinated regional reviews could also facilitate the requirement of bluff stability and erosion hazard disclosures in property listings for parcels (developed and undeveloped) in high-risk erosion areas. Presenting hazard information in layman's language and enacting hazard-disclosure laws would make people aware of risks. Disclosing such hazards at the time of purchase would alert property owners to the potential dangers.

Example: State Policies on Property Listing Disclosures

Florida, Michigan, and California require property listing as a means of notifying buyers of potential storm, hazard, or erosion dangers associated with particular parcels of land. Florida requires real estate agents to notify buyers of any potential storm or erosion dangers through a Coastal Property Exposures Statement. Buyers must indicate on the contract that they have been notified about the dangers (Bernd-Cohen, 1993).

Michigan's Level Reference Study Board has recently issued a recommendation of a real-estate disclosure requirement where the seller must disclose whether the property is within a mapped or known flood or erosion hazard area to prospective buyers. The buyer, in turn, would be expected to sign an acknowledgment that he/she has been informed of the risk (Levels Reference Study Board, 1993). This disclosure requirement has not been passed by the Michigan legislature.

California also has provisions in this area. When providing for public safety from fault rupture through the use of the Special Studies Zones Act, the California Legislature requires a seller or his agent to tell the prospective buyer that the real estate is located within a fault-rupture zone, as delineated by the State Geologist. In support of the ordinance that enforces on-site geologic investigations prior to construction, the Santa Clara County Board of Supervisor requires all sellers of real estate lying partly or wholly within the county's flood, landslide, and fault-rupture zones to provide the buyer with a written statement of the geologic risk (Kockelman, 1980).

Coordination of state and local agencies to identify erosion-prone areas, conceivably through erosion overlay district ordinances, could facilitate the effort needed to properly describe the risk associated with properties in a particular region. Disclosure of erosion rates and historical erosion events, where a substantial mass of sediment was lost, could be required in a property listing for a particular region. Parcel specific risks could also be part of the disclosure.

2.4.3 Regional Property Owner Coordination

The standard environmental impact review process could be substantially enhanced if all residents within a drift cell or some other designated region were encouraged to cooperate in the evaluation of coastal erosion measures. Such coordination could significantly reduce spatial cumulative impacts. That is, coordination may obviate the impacts of one property owner's shoreline modification structure resulting in significant downdrift erosion impacts. Coordination could also serve to increase the level of familiarity of property owners within a region with cumulative and regional processes.

Coordination of property owners may, however, be a formidable task and incentives to encourage property owners to cooperate may be required.

> ***Example: The Maryland Shore Erosion Control Program***
>
> *The Maryland Shore Erosion Control Program has provisions for creating Shore Erosion Control Districts (special taxation districts) for property owners in a single community who are affected by serious erosion problems. When erosion problems of a reach or drift cell in a district are judged to be sufficiently severe and shoreline controls structures are found to be warranted, zero interest loans for 25 years are available to the property owners to pay for the building of the structure(s) if a resident willingly coordinates with his/her neighbors in the building of the structure. The program, effective since 1972, operates like a revolving loan fund in that property owners' payments from earlier years are now paying for new structures being built (Loran, 1993).*

The use of incentives will be discussed in greater detail in the next section.

> ***Example: Florida Environmentally Endangered Lands Program***
>
> *Florida's Environmentally Endangered Lands (EEL) Program of Brevard County offers a model for combining several approaches — coordinated regional review of environmental impacts, coordination among property owners, land acquisition, and preservation trusts (DeFreese, 1994). The EEL Program considers local conservation needs in the context of statewide and national conservation networks and priorities. The Program's Selection Committee has focused on land acquisition and management projects that consider the critical functional linkage between uplands, wetlands, and coastal waters. One of the strong tenants of the program is that creative partnerships among government and private conservation agencies can lead to the formation of integrated protected-area networks where shared responsibilities enhance long-term conservation and management.*

An approach similar to the EEL Program could be used in managing coastal erosion by coordinating property owners and public agencies in a review of erosion-prone lands to

determine which lands should be considered for acquisition. Management strategies could be applied to specific coastal systems (e.g., reaches, drift cells, bays). This example of the EEL Program is one of many of the types of combination approaches possible.

Workshop Findings

Multi-agency coordination is needed to develop and enforce programs that plan for the effects erosion will have on residential development and to guide construction of shoreline modification structures. Data needed to identify erosion-risk areas to apply the policies described in this section (e.g., freezing the development of hard structures, phasing out the reliance on hard structures, setting structural design limitations, and identifying risks that would need to be disclosed as part of a property listing) would be best collected and analyzed through a coordinated effort among agencies. One of the primary obstacles to coordinating such efforts is funding and staff limitations. One suggestion is to conduct regional coordination in a phased approach. Coordinated reviews could be conducted to share knowledge across agencies before the optimal data set is available and synthesized to identify or classify regions based on risk of erosion. Later, when the necessary data are available, performance standards, restrictive covenants, erosion easements, and/or erosion overlay districts could be established, permits could be reviewed, and enforcement could occur in a coordinated effort. Education is critical to support general regional coordination and coordinated environmental impact reviews.

Freezing the development of hard structures is unreasonable. A clear and imminent threat to public health and safety from the use of hard structures is necessary to justify the need for such a policy. Furthermore, there is a need for better data on where soft solutions (e.g., beach nourishment) are appropriate. Accretion beach regions may be an exception of where this policy could be justified.

Phasing out the reliance on hard structures may be a difficult policy to implement because of a lack of data. Language to this effect is in the state Guidebook and in several of the local SMPs but it is not being enforced. Data from demonstrations might help in educating the public on the merits of this policy. Similar obstacles apply to enforcing structural design requirements and limitations.

A property disclosure policy is costly to establish, again due to data limitations, but useful in providing prospective property owners with the information they need to decide whether they want to accept the risks associated with a property. One of the disadvantages of this policy is that property owners who choose to buy a parcel in an erosion-prone region could become risk-averse and want to harden their shorelines even more than if they had not been given the disclosure. Education will be critical to describe the risk and the appropriate tactics to use to control it. It is also possible that the use of property listing disclosures could be combined with some restrictive policy (e.g., covenant, easement) to prescribe practices in the erosion-prone section of the lot (e.g., placement of home, bluff clearing and grading restrictions) and limit shoreline modification alternatives (e.g., if no bulkhead exists, no future bulkhead can be

constructed). Property listing disclosures are preferable to property restriction policies in one way — the prospective buyer would know about the risks associated with a property prior to committing earnest money for the property and then finding some restriction attached to the deed.

The environmental appropriateness of property owner coordination to evaluate erosion measures is clear. In addition, if implemented effectively and the government is involved in identifying the most appropriate alternative for modifying the shoreline, the region could be better protected than by ad hoc parcel-by-parcel decision making. However, the uncertainties surrounding the technical effectiveness and net cost of implementation may limit the feasibility of private property owner coordination.

Incentives created to encourage regional coordination among property owners must be combined with shoreline modification restrictions. Otherwise, the reduced individual per unit cost of shoreline modification may create even greater incentives to protect real or perceived eroding private property. This approach will be most effective, as in the case of the Maryland Shore Erosion Control Program, when incentives are combined with state decisions on appropriate shoreline modification efforts.

3 Economic Incentives and Other Market Based Solutions

Shoreline modification policies and residential development policies have traditionally relied on command and control regulations (e.g., setbacks and post-construction standards) to address responses to perceived or real coastal erosion. An alternative to these command and control approaches is the use of market based solutions and/or economic incentives. Economic incentives and other market based solutions may include tax credits, financing policies, transferable development rights, land acquisition, coastal preservation trusts, mitigation banks, and local improvement districts. Any of these may be effectively applied at the regional level.

3.1 Economic Incentives

While both command and control regulations and economic incentives are means of achieving some optimal level of erosion control, market incentives do so by giving the property owner or developer subsidies to reduce the level of shoreline hardening. As such, the property owner or developer is forced to weigh the benefit from not modifying the shoreline (i.e. the subsidy) with the cost (i.e. the uncertain reduction in property values given shoreline erosion). The most commonly applied economic incentives include tax credits and financing mechanisms as described below.

3.1.1 Tax Credits

Tax credits play a role in the conservation and preservation of sensitive environmental areas by encouraging activities and/or land uses with the lowest tax liability. Governments can encourage the conservation of sensitive areas by giving preferential tax treatment to landowners who keep their land in preferred uses. For example, a system of tax credits could be designated to preserve erosion prone areas in their natural states. In addition, the federal tax code allows income and estate tax deductions for gifts of conservation lands and partial interests, bargain sales, transfers of "like kind" property, and involuntary conversions. Tax credits can also be offered to property owners who donate lands, adapt land to appropriate compatible uses or open space (such as the Kitsap open-space tax credit program), or sell conservation easements to government agencies or private conservation groups.

3.1.2 Financing Mechanisms

Almost all construction today involves loans or mortgages by private lenders, many of which are insured by government agencies. Financing mechanisms may be used to reduce develop-

ment in hazardous areas. Private lenders and government agencies could deny loans or loan insurance based on a set of property standards. For example, the U.S. Department of Housing and Urban Development (HUD) has adopted property standards which define the minimum level of acceptability of design and construction for federally assisted housing and housing eligible for federally insured mortgages. These standards require that development proposals take note of natural hazards such as landslides (Kockelman, 1980). Such standards could also be developed for erosion-prone regions. Alternatively, appropriate state agencies could work with the Insurance Commissioner and the insurance industry to revise insurance policies to encourage best management practices (BMPs) such as reduced rates for locating dwellings away from the shoreline, or require property owners to undertake risk-reduction measures before insuring their property (Olshansky and Rogers, 1987).

Example: Maryland Financing Mechanism

Maryland offers a good example of financing mechanisms to control coastal erosion. It has a cost-sharing program (established in 1985) in which the state generally bears 50 percent of the cost of all marsh planting projects. This percentage share may be increased to as much as 65 percent in the case of environmentally critical areas (Loran, 1993). As with the interest free loan program described above, support is provided based on the priority of the site. A resident has to use the methods and materials recommended by the state if they are to be awarded the support (Pito, 1993).

Workshop Findings

Tax credits and other financing mechanisms are a voluntary and non-intrusive method of influencing behavior and thus should meet with little resistance. In addition, if implemented effectively, these approaches are environmentally appropriate from the public resource conservation point of view and should not result in any legal or regulatory issues so long as due process is observed and the agency providing the incentive has the authority to engage in financing. The financing mechanisms, in particular, are analogous to the HUD-established minimum acceptable levels for housing construction. Such levels could be established for erosion in order to receive federally assured mortgages.

Several significant concerns were raised regarding how acceptable and effective these approaches would be. First, local commissioners/tax assessors would oppose tax credits and other financing mechanisms if the local tax revenue base would be eroded significantly. This is a likely result, but will depend upon the amount of credit per unit and the number of units to which the credit applies. Second, incentives may not be great enough to convince developers of as-yet undeveloped areas not to develop these areas. They may simply find that the benefits from developing outweigh the costs in terms of environmental degradation and foregone subsidies. Third, property owners may not follow through with the terms of agreement (e.g., keep their property in an undistributed state or stabilize their bank using vegetation) without some sort of enforcement. Finally, financing mechanisms will likely not

be effective currently because waterfront property owners are not paying more than their non-waterfront neighbors. Insurance rates would need to be higher for waterfront property owners to encourage them to implement BMPs. Modifications to insurance premiums would likely need to occur before this mechanism would be effective.

One potential (albeit partial) solution to the problems associated with tax credits and financing mechanisms is the combination of the former with some setback restrictions such as that used by Thurston County. A 2:1 setback could be combined with an open-space bluff or shoreline easement assuring the property owner with reduced rate loans or some property tax relief.

3.2 Transferable Development Rights

The idea of transferable development permits is derived from marketable pollution permits. As with any restriction or standard setting, the regulating authority allows only a certain level of pollutant emissions, and issues permits for this amount. These permits essentially offer the discharger tradable rights to pollute within a pollution market.

A system of transferable development rights could be created for designated shoreline areas. Whatcom County, for example, has used transferable development rights to protect the groundwater of Lummi Island. The state could establish a quota of developable shoreline. This would require special zoning, a system for market transfer, and a method for assessing development rights and value. The use of transferable development rights would mimic a market place for scarce shoreline made available through state zoning ordinances, allowing those with the highest value for developable shorefront property to acquire it while at the same time restricting the total amount available.

Example: Tar-Pamlico Basin Association

The Tar-Pamlico Basin Association is a coalition of dischargers that is working with the Environmental Defense Fund, the Pamlico-Tar River Foundation, and North Carolina Division of Environmental Management to develop a nutrient trading program to manage nitrogen loading in the Tar-Pamlico Basin. This program is an alternative to conventional point source control programs. Approved by the North Carolina Environmental Management Commission in 1989, this program allows dischargers to pay for installing nonpoint source BMPs in the watershed, gaining credits against their point source nutrient allocations. Under this program, the dischargers contribute funding for agricultural BMPs to achieve all or part of the total nutrient reduction goals established for the Association members. This program often results in a more cost-effective way to meet the reduction goals; the Association estimates that controlling one unit of nonpoint source load with BMPs costs about one-tenth as much as controlling the same load from a point source (U.S. EPA, 1993b). A mechanism similar to the above could be used to control the hazards from developing in erosion-prone areas. Instead of trading rights to allow nutrients to

enter a water body, the development rights for a parcel of property or an entire region could be traded.

Workshop Findings

While theoretically a transferable development rights program (TDR) is a cost-effective regional erosion control management alternative, the use of this approach may be significantly limited for several reasons. First, the influence of TDRs on controlling excessive shoreline armoring is uncertain, due to sensitivity to variations in housing and other market conditions. Second, TDRs are very complicated. A TDR system will require the use of new plans to establish the available units of development, a structure for trading, and an assessment of property values. Third, TDRs are expected to be costly (at least in the short term) due to their administrative demands. Finally, TDRs may lead to problems of monopoly ownership where a small number of developers/land owners control a significant portion of total development rights.

3.3 Land Acquisition and Preservation Trusts

Environmentally important areas can be acquired for conservation or preservation by either the public or private sector. Acquisition of land offers a community or region direct control of activities within them, and can make conservation more permanent than regulation. State or local land acquisition offers property owners the opportunity to sell property to the state at a fair market value, especially in cases where land is inappropriate for development. This approach would allow for the transfer of established private property rights to the state for the future conservation/preservation of these critical and sensitive regions in their natural state for the public as a whole. Another approach to shoreline conservation is to identify and acquire critical shoreline and beach areas directly through publicly sponsored acquisition and open space programs or through support from private conservation groups such as a coastal preservation trust. This kind of trust is a legal entity that can be established to hold and manage property for the benefit of designated individuals or the general public.

Example: North Carolina Coastal Management Program, New Jersey Pinelands Commission, and California Coastal Conservancy

North Carolina's coastal management program has a million dollar provision in its beach access law for acquiring lands that are inappropriate for permanent development. This program grew from an original setback program which left many ocean front lots unbuildable (Benton, 1993). The Department of Environmental Health and Natural Resources sets priorities for purchasing such property. Similarly, the New Jersey Pinelands Commission is well on its way to purchasing 100,000 acres in its 1.1 million acre management area, and uses transfers of development rights to further concentrate development away from sensitive environmental zones (River Federation, 1993). The Commission has

already used their acquisition program to acquire 63,400 acres for $50 million through the New Jersey Green Acres Program. In California, erosion-prone land is typically acquired through the California Coastal Conservancy, or land trusts.

Example: Maine Coast Heritage Trust

The Maine Coast Heritage Trust promotes conservation of the islands and coastline of Maine by negotiating gifts of land and easements to other conservation organizations. From 1970 to 1984, the Trust has worked on 225 easements covering 17,618 acres. Recently it has itself begun to hold interest in land. The Maine Coast Heritage Trust offers professional advice and assistance, generally free of charge, to landowners, land trusts, municipalities and other agencies interested in protecting Maine's coastal landscape. Trusts are being increasingly used as a vehicle for conserving lands in an undeveloped or ecologically beneficial state. Trusts can be established by local authorities or private persons to receive donations of coastal property for either preservation from development or dedication to public or private uses that are environmentally beneficial (Milne, 1985).

Workshop Findings

Land acquisition or the development of public or private preservation trusts are very effective means of guaranteeing that natural resource areas, such as coastal drift cells, evolve naturally over time, if acquisition is done comprehensively on a regional basis. Piecemeal acquisition of properties will not result in effective natural resource conservation.

It may be necessary for the state to fund a program to identify the regions that rank highest in terms of risk and thus should be purchased by the state or a private conservation entity. One type of region where land acquisition or preservation trusts could be helpful is on the front portion of lots on steep-bluff, finger-like points. Such erosion-prone areas could be held in a trust or acquired to be used in their natural state as an amenity for the properties behind the boundary. Both approaches offer an environmentally appropriate solution to coastal erosion management, making conservation more permanent than regulation. In addition, both approaches receive broad public support as a method of protecting critical natural resource areas (assuming, in some cases, original public access is maintained).

Within the state of Washington, existing (albeit limited) programs illustrate the potential for such approaches in coastal erosion management. For example, the Department of Ecology Shorelands and Coastal Zone Management program currently offers "boot strapping" money to local governments for wetland preservation efforts. Existing land trusts that focus on wetlands could retarget efforts toward the purchase of critical tidelands. The Gig Harbor Land Trust acquires waterfront land and removes bulkheads to help return the land to its natural condition.

One clear limitation to land acquisition is that such a program may be prohibitively expensive for public agencies. Acquisition of shorefront property typically involves substantial up-front capital investment. California's land acquisition program, for example, has had limited success due to the high values attached to California coastal properties. One approach for addressing this problem would be to have the state capital funded through a trust which in turn is funded by a fee or penalty program paid into by property owners who have violated some coastal protection regulation. The use of preservation trusts also gets around this funding limitation by virtue of its private sector orientation. Of course, lack of private control implies that the areas of most concern to the coastal erosion managers may not be adequately represented in any particular trust. Education will be especially important to aiding private owners in making appropriate and well-informed decisions about the development and contributions to trusts. Maine's Critical Areas Program (State Planning Office), the Maine Chapter of the Nature Conservancy, and the Maine Coast Heritage Trust have published a brochure entitled *The Landowner's Option* (Milne, 1985). This guide to the voluntary protection of land in Maine could serve as a starting point for the development of preservation trusts in regional coastal erosion management.

3.4 Mitigation Banking and Compensatory Mitigation

Environmental mitigation banks involve the offsite protection, enhancement, restoration, and/or creation of natural resources to compensate for unavoidable adverse impacts associated with development activities. The concept of mitigation banking was developed in the early 1980s as a mechanism to compensate for unavoidable habitat losses primarily associated with the federal Section 10 (Rivers and Harbors Act) and Section 404 (Clean Water Act) permit programs for wetland development projects (Department of Ecology, 1994b).

More traditional compensatory mitigation measures typically involve individual projects, and are implemented by developers. The majority of individual compensation projects are constructed either concurrently with or following development activities, resulting in functional losses over time until the compensation reaches maturity.

Example: Florida and Massachusetts Compensatory Mitigation

Florida's policy requires an individual proposing construction of a protection structure to also apply for and maintain compatible beach sand seaward of the structure. This beach sand is to replace the material that would have been eroded if the shore protection structure had not been built (Terchunian, 1988). Florida requires performance bonds and automatic removal of structures (e.g., bulkheads) found in violation of such permit conditions. Similar to Florida, Massachusetts limits structural design of hard shoreline modification structures and requires bank or bluff nourishment in cases of high storm or natural erosion activity. Local jurisdictions in Massachusetts also require property owners to add sand to beaches every 3-5 years where armoring has been used in the past (O'Connel, 1993).

Mitigation banks are programs created by resource agencies, port districts, large development entities or conservation organizations to provide a relatively large compensatory mitigation site to be used to collectively compensate for many, usually unrelated, development projects. Mitigation bank are generally established in advance of specific development projects by either a property developer or a governmental authority. When a specific property development is proposed, the developer will be allowed to draw on credits in the mitigation bank to mitigate the effects of the development (Ecology, 1994b).

The intent of mitigation banking is to eliminate the uncertainty of success and time lag between resource loss and full compensation for those losses. Like individual offsite mitigation projects, mitigation banking may be implemented only if higher priority mitigation measures (e.g. avoidance, minimization, rectifying, etc.) are not feasible. Mitigation banking is intended also to improve mitigation planning and implementation by increasing public agency involvement (Ecology, 1994b).

Early mitigation banking studies and demonstration projects have focused on wetlands. However, mitigation banking may be useful for other shoreline resources such as beaches, unstable bluffs, or erosion prone shorelines.

Example: Washington Biringer Berry Farm Mitigation Banking Project

A Washington State example of mitigation banking is the Biringer Berry Farm. The firm of Biringer and Ebert has developed a plan to create a 363 acre intertidal salt marsh and associated wetlands in the City of Everett. The firm has engaged Reid Middleton and Pentec Environmental to provide potential cost effective site designs to revert the property back to a tidally influenced wetland. Upon obtaining permits, the firm 's objective is to market land to area developers in need of quality off-site mitigation for wetlands displaced or altered by their developments. The entire site could also be transferred to a public or private entity. The project has already received a Determination of No Significance and a Shoreline Substantial Development/Conditional Use Permit from the Snohomish County Planning Department (Ecology, 1994).

Workshop Findings

Mitigation banking could, in theory, be a technically effective approach to coastal erosion management. One mechanism would be for individuals to buy into regional beach nourishment projects or restore previously bulkheaded properties to their natural state to obtain mitigation credits. For this mechanism to be effective, however, public consciousness about the need to feed certain coastal beaches will have to be raised to the same level as the need to protect wetlands. Education will therefore be important in enhancing the public's awareness and understanding of how their practices (e.g. shoreline armoring) can damage coastal processes and the environment in certain regions.

The environmental appropriateness of mitigation banking is questionable due in part to the significant uncertainties as to our ability to "create" or restore offsite natural resource functions and services equivalent to those that were lost through development and/or shoreline modification. Additional limitations to mitigation banking include the perception that mitigation banking creates an incentive to develop in erosion prone areas or engage in shoreline armoring. Similarly, there is some skepticism as to whether there would be sufficient social and political support for such an approach. Finally, to be effective in coastal erosion management, mitigation banks would probably have to be established by large entities such as a port, given administration cost.

In contrast, compensatory mitigation measures can be effective, technically and environmentally. The costs to the property owner of conducting the mitigation measures could discourage building hard modification structures. The success of compensatory mitigation measures regionally, however, depends on a state's ability to enforce them for adjacent properties in a particular region.

3.5 Local Improvement Districts

Local improvement districts are areas within a locality which directly benefit from a public project financed (typically through special taxation or bond issue), at least in part, by special assessments on the property benefited. For example, Washington cities are authorized to form improvement districts to finance projects to fill or raise tidelands or tideflats within city limits. Puget Sound localities could use this device to undertake and finance such projects to prevent or mitigate coastal erosion and thus discourage unnecessary practices.

Special assessment districts, similar to local improvement districts, have been shown to provide an equitable and effective means of funding the costs of landslide mitigation work and damage repairs. Assessment districts provide cooperative analysis and repair of areawide landslide phenomena that transcend property boundaries – joint endeavors that might not otherwise occur because of the divergent interests of property owners. Assessment districts could be established not only in landslide-damaged areas but also in erosion-prone areas. Unlike insurance, which only helps after an event occurs, assessment districts can promote regular maintenance, monitoring, and preventive actions. Finally, assessment districts can provide communities that have grading ordinances with a means of reducing hazards that predate ordinance adoption.

Example: California Geologic Hazard Abatement Districts

California has provided for local formation of "geologic hazard abatement districts" (GHADs), which are special assessment districts formed specifically to abate actual or threatened landslides, land subsidence, soil erosion, or other natural or unnatural movements of lands or earth. GHADs, acting as independent political subdivisions of the state, have extensive powers to raise money

and implement projects. Either local governments or neighboring property owners may initiate the formation of GHADs (Olshansky and Rogers, 1987).

Workshop Findings

If implemented correctly, (and potentially combined with regional coordination among property owners) the use of local improvements districts could be environmentally appropriate and technically very effective in managing coastal erosion on a regional level, especially in low bank communities. Washington state already has some limited experience in the use of this approach through diking districts. It appears that improvement districts could also work effectively to provide beach nourishment programs in a particular region, such as the Sandyhook Home Owner's Association project in Cultus Bay. The cost to public agencies of local improvement districts should not be significant. However, the increased tax burden or request for bond financing may be met with some opposition from residents, especially in cases where the benefits of the projects are perceived to be incurred by only a few.

4 Policy Support Tools

A major finding of the previous report (McCabe and Wellman, 1993) was the need for policy support tools such as research, monitoring, and data collection, and education and outreach programs to enhance the effectiveness of existing coastal erosion management policy/regulatory framework (the Guidebook and local SMPs). This section expands on this finding by giving examples in other states of programs that may be appropriate for Puget Sound. Added to the list are possible enhancements to watchdog organizations that could also support erosion-focused policies. These programs and tools would have a regional focus to support the regional approaches described in the previous two sections.

4.1 Research, Monitoring, and Data Collection

Data and technical studies are critical to the management of erosion control and reactions to erosion control. Western Washington University's Puget Sound net shore drift studies could provide a first step in filling existing data gaps. Baseline maps and inventories for these shoreline areas could be updated and enhanced with the integration of development and land use patterns. Enhanced data bases could also be used to update/modify environment designation provisions. Research on full drift cells (e.g., determination of littoral drift), erosion rates, and the monitoring of modification solution impacts would be encouraged under this alternative. Other recommended research needs include: cumulative effects of shoreline modification structures on loss of beach resources at the local and regional scale; the effects of structures on water quality and organisms; and, the extent to which non-bulkheaded shoreline segments are at risk when bounded by neighboring bulkheads.

One effective approach for combining a data collection and monitoring program with an education program is to have citizens involved in the former, as illustrated below.

Example: The Massachusetts' Plum Island Sound Minibay Program

A major goal of the Minibay program is to provide technical analysis to local communities for solving their environmental problems for a relatively small embayment and for long term planning (Buschbaum et.al., 1994). The Minibay project is a collaborative effort among the Massachusetts Audubon Society, the towns of Ipswich, Rowley, and Newbury, and Applied Science Associates of Rhode Island to address nonpoint pollution problems in the Sound.

The project integrates the activities of scientists with community leaders and residents. Scientists have focused on quantifying bacterial concentrations and loading rates, developing a model of the flushing rates, comparing land uses, updating state land use maps, and predicting growth patterns. Community

residents have been involved with the research in several ways, including carrying out an extensive shoreline survey to identify potential sources of pollutants and collecting water and fish samples.

Town governments have been very involved in the project. The governments of the three communities are largely run by volunteers and are severely limited in the amount of resources available to address land use planning and environmental issues. Participation by town officials from the beginning of the project was essential for success because it takes time to build a constituency among town officials and residents for the kinds of conservation and management recommendations that were likely to be proposed. Town officials are presented with frequent research updates and every attempt is made to make research transferable to specific needs. To address the concern that this is just "another study," an Action Plan was developed that contains recommendations for immediate specific actions towns can take to address local problems.

A program similar to the Massachusetts' Plum Island Sound Minibay Program could be developed to address the coastal and shoreline erosion issues in Puget Sound. Benefits of such a program could be realized through the following components: collection of needed data while educating community residents; coordination among state and local government agencies; and public education and consensus building. These components could contribute to an informed public and government, working together to preserve the coastal areas of Puget Sound through non-regulatory mechanisms.

Example: Volunteer Citizens' Water Quality Monitoring Network for the Indian River Lagoon

The Marine Resources Council of East Florida with the cooperation of the Florida Department of Environmental Protection initiated the Network in March 1991 (Frease, 1994). Network goals are to document spatial and temporal trends in basic water quality and to educate the public on the significance of water quality as it applies to the entire watershed. Currently more than 100 volunteers monitor 78 stations weekly for salinity, dissolved oxygen, pH, water temperature, and clarity. The program operates under a Comprehensive Quality Assurance plan which has been reviewed and approved by the Quality Assurance Section of the Florida Department of Environmental Protection.

Nine sites within the network have been "adopted" by school groups. These groups monitor weekly and are held to the same Quality Assurance criteria as the adult volunteers. Each school group is in electronic communication with the others through the Florida Information Resource Network (FIRN). The schools can exchange their data with each other to compare how the water quality varies throughout the lagoon system.

A similar volunteer coastal erosion monitoring program could be developed for Puget Sound. School groups and local community residents could be trained to monitor local erosion rates

and episodic events. Monitoring could include areas around existing modification structures (e.g., bulkheads) to promote an understanding of the effects shoreline hardening has had on the coastal system. This type of program would serve to educate the community through a "hands on" approach. Community members would actually witness the dynamics of the coastal system and increase their understanding of how the system responds to environmental events, as well as anthropogenic factors.

Workshop Findings

The three most important data needs are: more realistic quantitative ideas of the rate of shoreline retreat on bluffs; understanding of the flux of material through drift cells; and rate of beach lowering of heavily armored drift cells

Additional data needs are an identification and classification of the different types of shoreline (physical, including geomorphology) and the most appropriate erosion-control solutions for these types of shoreline given the impacts that have been recorded. Biological impact data from shoreline armoring is needed, as is critical habitat data (e.g., identification of spawning areas). It is envisioned that this information could be an overlay (or overlays) to current net shore drift data. The state and/or local jurisdictions could define regions of priority based on impacts recorded and conduct case studies in these regions. Ideally, the state needs a map of "areas at risk" (e.g., small spits and bars) to help inform local jurisdictions, shoreline modification contractors, property developers, and property owners about these areas. In addition, knowing the location of Indian shell middens could help shoreline planners to identify locations where shoreline modification is not appropriate or is illegal. However, the state does not release this information because it wants to avoid vandalism in these areas.

With respect to citizens participating in data collection and monitoring, there are four areas where the support could be beneficial: bulkhead inventory; shoreline retreat measurements, once markers are set by scientists; photographic records of shoreline (e.g., videotapes of shoreline features); and qualitative history about the region.

Several state and local agencies could benefit from this information. Listing out the data needs and where citizens could participate reinforces the need for inter-agency coordination to maximize the use and affect this information can have to manage shoreline activities in Puget Sound.

4.2 Education Programs

Public outreach and education programs can help bring coastal erosion information to the attention of the public. Prudent citizens, when told of hazards and cumulative impacts, theoretically would not wish to risk property losses. Since any program of land use control depends on the support of the public, educating the public becomes of great importance. Programs could be developed to educate the general public, shoreline property owners,

developers, architects, insurers, shoreline modification contractors, engineers, and financial institutions at a regional level. Stakeholders could be informed about the natural dynamic properties of the shoreline and the possible impacts that can result from shoreline protection and alternative stabilization practices. Educational programs could include seminars and workshops for shoreline modification contractors, landscape architects, property owners, insurance writers, realtors, and appraisers; written materials on coastal erosion for these various groups; grassroots education programs; and demonstration projects.

Localities or the state could develop a handbook of "best practices", as provided by Ecology in their manual *Slope Stabilization and Erosion Control Using Vegetation* (Myers Biodynamics Inc., 1993) for developing and maintaining property in a manner that minimizes coastal impacts and vulnerabilities. Such handbooks could be accompanied by a program of education and outreach to developers, builders, and the general public by "coastal extension agents." Ecology has also produced a series of technical advisory papers including "Marine Shoreline Erosion: Structural Property Protection Methods" (Canning, 1993) and "Shoreline Bluff and Slope Stability: Management Options" (Canning, 1991). In addition, Virginia has a state funded Shoreline Erosion Advisory Service which provides assistance to property owners in preventing erosion of waterfront lands (Blair, 1987).

Examples of education and public outreach in other states include workshops held by Michigan as part of its Emergency Home Moving Program to educate property owners about shoreline property protection alternatives (Platt, 1992). Michigan also has a newsletter called "Update" produced by its Levels/Reference Study Board - International Joint Commission. Under Michigan's Shorelands Protection and Management Act, the Michigan Department of Natural Resources Land and Management Division produced a booklet in 1992 that defines landowners' involvement in designating high-risk erosion areas.

North Carolina has a handbook entitled *A Handbook for Development in North Carolina's Coastal Area* provided by its Department of Natural Resources and Community Development (Watts, 1987). The handbook provides extensive information on bulkheads as compared to soft shoreline modification measures. Finally, North Carolina Sea Grant has published a pamphlet entitled *A Homeowner's Guide to Estuarine Bulkheads* that provides information on bulkheads only.

One method for enhancing the acceptance of unfamiliar shoreline modification technologies is through demonstration projects. Ecology could help encourage coordinated, regional coastal protection techniques by working with localities or regional groupings to establish more working demonstrations of technologies, either on public property or in cooperation with local homeowners through such projects as the Silverdale Waterfront Park of Kitsap County. At a demonstration at Cultus Bay Sandyhook Yacht Club in Island County, the local jurisdiction is considering a beach nourishment project which illustrates the possibility of feeding with minimal degradation to the drift cell.

Example: Florida Yards & Neighborhoods Program

The Florida Yards & Neighborhoods Program includes the use of demonstrations, coordination among property owners, and broad education and outreach to be effective (Hoppe, Smith, and Floyd, 1994). It was developed to address increasingly serious problems associated with pollution and loss of native habitat by enlisting homeowners in the effort to save Florida's bays. Homeowners are assisted in improving landscape design and maintenance to increase native habitat, reduce the use of fertilizers and pesticides, and conserve water. The Florida Yards & Neighborhoods provides an opportunity for each property owner to take action to restore the area bays. The program also provides an effective means for local governments to implement federal mandates for public involvement in pollution prevention.

The Tampa Bay area component of this program enlists neighborhood groups to improve their community environment. Neighborhoods may apply for a 12-month partnership that pairs residents committed to improving the environmental quality of their homes and yards with experts trained to advise and assist. Neighborhood partnerships begin each January with an environmental checkup. With input from residents, experts inspect participating neighborhoods to identify ways to improve landscapes and shorelines, save water, and reduce pollution. Results of the checkup are the basis for an action plan calling for specific improvements to achieve during the year. The Florida Yards & Neighborhoods team assists each neighborhood in implementing its plan by conducting special on-site demonstrations and workshops for residents. Working as a group, neighbors build upon personal initiatives to achieve larger improvements. Block captains selected from within participating neighborhoods help to organize and involve their neighbors. The program is funded by the Tampa Bay National Estuary Program and includes a multi-media campaign to promote bay-friendly landscaping practices.

Using the overall framework and strategy of Florida Yards & Neighborhoods, a similar program could be developed to draw property owners together to learn about coastal erosion processes, the overall physical and biological dynamics of their shoreline, and the impacts from shoreline modification practices. Education objectives could include promoting an understanding of how individual pieces of property relate to the system as a whole, and how various shoreline modification practices (e.g., building bulkheads) can negatively affect adjacent parcels. In addition, region-specific information could be provided on recorded erosion rates and events to help allay fears of some perceived threats to coastal property from erosion. Through education and demonstrations, these property owners could learn what shoreline modification alternative is most appropriate for their region.

Workshop Findings

The need for education and outreach programs in Puget Sound is clear. A half-hour video that targets the 3-6 grade level may be one means by which to communicate the harm that can result from using an inappropriate shoreline protection method. The video could include information on the processes of a drift cell and the effects from bulkheading in inappropriate areas. Such a video would reach children and, in turn, their parents.

Sea Grant currently has staff that could serve as coastal extension agents, but at this point their areas of interest have not included erosion issues. It may be possible to increase their interest areas to include erosion and have them become an advocate for considering erosion in selecting appropriate shoreline modification methods and designing development projects.

In addition, a handbook on the various shoreline modification methods that are appropriate for different types of shoreline may be useful. Demonstration projects are also seen as an effective means of educating the public on drift cell processes, erosion rates, and the influence a shoreline modification method for one property can have on adjacent properties. Demonstrations that focus on collecting data on the effectiveness of soft shoreline modification solutions (e.g., beach nourishment) are seen as particularly important, given the poor data available currently. Ideally, citizens should be able to have access to these shoreline demonstrations to observe the results first hand.

Properly funded and conducted education and outreach programs are one of the most efficient and effective ways of increasing stakeholder awareness (stakeholders used here to mean shoreline modification contractors, landscape architects, property owners, insurance writers, realtors, and appraisers) of the effects their actions can have on regional shoreline processes. Understanding how a drift cell operates and the true erosion rates in a region can help encourage properly-designed development and shoreline modification that best fits the region.

4.3 Watchdog Organization Enhancements

Some states have found that watchdog organizations have provided a healthy oversight of coastal development issues.

> ***Example: 1000 Friends of Florida***
>
> *The 1000 Friends of Florida attempts to keep the public's attention on the need to support the implementation of the Growth Management Act (Murley, 1990). The board of directors and professional staff work with state agencies, county-level citizen groups, other environmental organizations such as Florida Audubon and Florida Sierra Club, business groups such as Floridians for Better Transportation, and groups concerned with social issues. Some successes have come from working with federal and state coalitions: the Everglades, Florida Keys, and Coral Reef coalitions, and local environmental groups dealing with*

offshore oil and gas issues. Primarily, the focus is to educate the public about the issues, mediate solutions, and act as a public interest law firm to litigate these issues.

In the future, 1000 Friends of Florida will be working to complete the initial round of implementation of local plans, trying to improve state and regional coordination of organizations that are concerned about issues being addressed by the Coastal Zone Management and Clean Water Acts. One goal is to aid the local plans in playing a greater role in directing state decisions about siting future public facilities. Other goals include increased understanding of the funding decisions made by the legislature and local government officials and encouraging citizen involvement in the process.

In Washington there is a 1000 Friends of Washington organization, but the group has not historically focused on erosion issues with respect to GMA. Encouragement could be given to the group to expand their focus to consider erosion in waterfront home construction and in designing shoreline modification structures. Furthermore, lessons from this Florida example may be relevant to enhancing the role of Puget Sound Water Quality Authority or independent groups such as People for Puget Sound.

Workshop Findings

Watchdog organizations could strive to focus the public's attention and the relevant state and local agencies' attention on the need to conduct environmentally sound practices in developing coastal properties and controlling coastal erosion while protecting property rights. Adopt a Beach and Beachwatchers could also be encouraged to exert similar pressure.

5 Conclusions

5.1 Command and Control Approaches

Ranking the regional approaches as to their effectiveness and appropriateness for Puget Sound is a difficult and, perhaps, inappropriate task. The choice of which approaches, if any, to implement will depend upon the circumstances of a particular local jurisdiction. These circumstances include language of the SMP, political will, stakeholder support, and status of the coastal property (undeveloped and unplatted, platted but undeveloped, and platted and developed). Each of the approaches described could be appropriate for some number of regions and their jurisdictions.

Erosion overlay district ordinances appear to be particularly interesting in that they could be implemented fairly easily under GMA and as an overlay to the Guidebook environmental designation provisions. Furthermore, they could be established for an entire physical region (e.g., drift cell) instead of by subdivision (as is the case for restrictive covenants and erosion control easements). One downside of erosion overlay district ordinances is that, unlike restrictive covenants and erosion control easements, a parcel's deed may not reflect the requirements or restrictions that apply to the property.

Coordinated regional review of environmental impacts should be changed to regional coordination to better describe what is possible and what is needed. Such coordination would not be limited to erosion issues as part of reviewing a permit. If implemented effectively, permit reviews could be greatly streamlined, particularly to identify BMPs. Regional coordination would be critical in collecting data that multiple jurisdictions need in conducting their roles and responsibilities.

Coordination of property owners, though beneficial, may be difficult to accomplish without some restrictive policy being the target of the coordination. The example of the Maryland Shore Erosion Control Program is a case in point. Property owners need to feel that the cost of not participating is greater than the loss of taking an independent approach that fails to consider the impact on neighbors' properties.

5.2 Economic Incentive and Other Market Based Approaches

Of the eight economic and other market based approaches identified in the previous report (McCabe and Wellman, 1993) and described in this document, the two that appear to be the most applicable in Puget Sound, given the existing regulatory and legal environment, are coastal preservation trusts and local improvement districts. These two approaches, if implemented properly, are both technically effective and environmentally appropriate. Both have the advantage of being voluntary and nonintrusive, and thus socially and politically accept-

able. In addition, neither approach would require significant up-front investments or costs on the part of public agencies. Both of these approaches will involve the coordination of property owners which, while difficult, can be encouraged through education and outreach programs and state agency support. A thorough understanding of the successes and failures of preservation trusts such as the Maine Coast Heritage Trust and local improvement districts in other states may be an appropriate next step.

While similar to the preservation trusts in its public acceptability and environmental appropriateness, the technical effectiveness of land acquisition programs is entirely dependent on the public agency's ability to allocate significant funds. It may be possible to alleviate this problem to some extent by combining the acquisition program with some other fee or penalty based program whose revenues would be used exclusively for land acquisition.

The use of tax credits and financing policies may be effective but probably only in coordination with some other command and control policy. The effectiveness of tax credit and financing programs is directly linked to the reaction of property owners and developers to the tool. To predict the potential effectiveness of such a program, an economic analysis of property owner and developer behavior in the face of subsidies will be required.

Transferable development rights (TDRs) and mitigation banks, while not out of the question, appear to not be feasible options for coastal erosion management in Puget Sound at this time. The transferable development rights approach is very complex, involving rezoning, a market for transfer, and a rational property value assessment methodology — all of which may be costly. In addition, the technical effectiveness of TDRs is questionable due to great uncertainty about external market conditions.

Like TDRs, the effectiveness of mitigation banks in coastal erosion management is highly uncertain. The jury is still out on our ability to actually "create" or restore injured natural resource functions and services. The use of mitigation banks may be effective under some very critical conditions. First and foremost, coastal beaches will have to be raised to the same level of public consciousness as are wetlands. The above is not to say that conventional compensatory mitigation projects will not add greatly to coastal erosion management in Puget Sound. A first step may be to consider the combination of compensatory mitigation and local improvement districts. In this case, property owners within a region could coordinate and finance beach nourishment programs, for example, from which all residents would benefit.

To operationalize any of the approaches described above, property owners' and developers' behavior to incentives must be analyzed. If these stakeholders are not willing to participate than the program is doomed to fail. Such an analysis can be conducted through a public involvement exercise and/or simple economic behavioral analyses.

5.3 Policy Support Tools

Two major needs identified with implementing most of the approaches described in this report are identification and characterization of erosion-critical regions and public education and outreach programs to heighten stakeholder awareness of the problems that can stem in these regions from inappropriate property development and shoreline modification structures. Federal, state, and local funding is critical to address these two needs. Finally, involving the full range of stakeholders described in this report is a necessary next step to evaluate these regional approaches and to decide which ones have the most merit in Puget Sound.

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Appendix A: Workshop on Regional Approaches to Address Coastal Erosion Control Issues: List of Attendees

The workshop was convened for the Washington Department of Ecology, Shorelands and Coastal Zone Management Program, by Battelle Seattle Research Center. The workshop was held at the University of Washington's Horticulture Center on March 8, 1994.

Name	Agency	Program or Division
Douglas Canning	Washington Department of Ecology	Shorelands and CZM Program
Hugh Shipman	Washington Department of Ecology	Shorelands and CZM Program
Peter Skowlund	Washington Department of Ecology	Shorelands and CZM Program
Tim Flint	Washington Department of Fish and Wildlife	Habitat Management Division
Neil Rickard	Washington Department of Fish and Wildlife	Habitat Management Division
Roger Geibelhaus	Thurston County	Planning Department
Robert Garwood	City of Bainbridge Island	Planning Department
Eric Nelson	US Army Corps of Engineers	Seattle District
Dr. Marc Hershman	University of Washington	School of Marine Affairs
Dr. Thomas Terich	Western Washington University	Geography and Regional Planning Department
Dr. Tony Gabriel	Western Washington University	Geography and Regional Planning Department
Dr. Keith MacDonald	CH2M Hill	