
Appendix B

SELECTED STATE/REGIONAL POLICY RESPONSES TO ACCELERATED SEA-LEVEL RISE AND COASTAL EROSION

**A. APPROACHES TO ANTICIPATED
ACCELERATED SEA-LEVEL RISE AS A
RESULT OF GLOBAL CLIMATE CHANGE**

While some states have started to address the issue of planning for accelerated sea-level rise as a result of global climate change, even the most advanced states are only in the very preliminary stages of developing a unified response strategy. Many are still in the problem recognition stage, where they are beginning to understand the potential scope of the problem, but have yet to translate that recognition into any specific studies, statutes or programs. The following section summarizes activities in selected non-Maine jurisdictions.

1. Washington State

The State of Washington became very active in planning for accelerated sea-level rise through its Sea Level Rise Response Program, begun in 1988. Through that program, it evaluated the scientific literature on vertical land movement in the western Washington area, mapped broad patterns of vertical land movement, supported additional research on subsidence in Puget Sound, and began to study "near term, internal policy alternatives."¹

The following policy issues were identified in Washington: siting standards and protection alternatives for coastal facilities; management of old coastal solid and hazardous waste disposal sites; shore protection alternatives; wetlands and shallow water habitat protection alternatives; and sea water intrusion responses.²

Washington's studies emphasize the theme that in the face of likely but uncertain levels of accelerated sea-level rise, the "first steps" toward regulation addressing this problem "can and should be done for other fiscally prudent reasons."³ For example, if Washington accepts the theory that global warming will cause greater frequency of severe storms, a prudent response may be to require stricter design standards. The State's design standards already reflect safety measures based on "hydraulic design storms," or standards based on the projected frequency and severity of storm events (e.g., requiring that buildings be constructed in such a way or location to avoid damage from a 25-, 50- or 100-year storm). Using the "other fiscally prudent reasons" test, one response option would be to increase those design standards to require design to avoid damage from a less frequent, more severe storm event. Washington's studies suggest this type of regulation may be more politically acceptable than others based solely on anticipated sea-level rise, especially if regulations based on sea-level rise are perceived to interfere with the use of private

property. However, the State has not yet acted to incorporate the more rigorous design standards.

The State of Washington has expressed interest in conducting a formal cost-benefit analysis of specific response options if it can obtain sufficient funding. Such an analysis might be used to evaluate the different problems posed by inundation of private property in areas of high- and low-intensity development.

Douglas Canning, Sea Level Rise Project Manager of the Shorelands and Coastal Zone Management Program at the Washington State Department of Ecology, believes that such an analysis would show that highly-developed, low-lying waterfront areas, such as those in Seattle, Tacoma, and Olympia, would need to be structurally protected at some public cost because relocation would be far more costly than protection. On the other hand, he expects that private land of lower density development, such as agricultural, rural residential, and timber lands, may well cost more to protect than they are presently worth, and therefore it is unlikely that public monies should be spent to protect them.

The State of Washington's Sea Level Rise Response Program has evolved into the Coastal Erosion Management Program. The focus is on protecting natural coastal systems so they are able to respond to shoreline changes regardless of the driving force behind the change. Components of this program include working with local governments to prepare a programmatic environmental impact statement on the impacts of shoreline armoring, and developing additional information and policies on shoreline erosion control. The Sea Level Rise Response Program also facilitated use of coastal zone management funds for a sea-level rise impact study conducted by the City of Olympia.

2. California

Various agencies in California have also begun to focus on global climate change in general, and sea-level rise in particular. The April 1989 Assembly Natural Resources Committee "blueprint" for State response⁴ identifies damag-

ing shoreline erosion, decline in delta water quality, damage to structures and loss of recreational beaches, increased need for shoreline protective devices, and expensive modifications to port facilities as possible negative impacts of sea-level rise. It recommends legislation to require agencies to begin to consider global warming impacts, but does contain specific policy recommendations.

In the San Francisco Bay Area, planning for specific areas at risk from flooding is encouraged, and varying strategies are emphasized, depending on the type of coastal feature and the threat of risk from sea-level rise. In its report, the San Francisco Bay Conservation and Development Commission (BCDC)⁵ recommends that planners for the area take global climate change and accelerated rates of sea-level rise into account. The report also notes that, due to local sedimentation patterns, land movement and other factors, inundation will occur at variable rates in the Bay area, and this needs to be accounted for through planning. Not surprisingly, the report finds that marshes and other tidal wetlands are at the greatest risk from flooding and notes that the economic costs of protecting them may be prohibitive.

BCDC recommendations are based on extensive research and mapping of various areas around San Francisco Bay. BCDC has also conducted detailed studies to assess expected impacts associated with tidal flooding of urban development, the creation of an inland sea in the Delta, increased salinity levels in Suisun Bay and the Delta, flooding and impeded drainage in low-lying shoreline areas, and the loss of tidal marshes and managed wetlands. These studies have resulted in the development of an engineering design review process to be used by designers and reviewing authorities to assure safety from hazards of tidal flooding.⁶

The six adopted policies⁷ regarding sea-level rise are limited to the Bay Conservation and Development Commission's jurisdiction, which covers activities in San Francisco Bay and landward to 100 feet from the shoreline. The policies are mandatory design standards rather than merely advisory criteria directing that sea-level rise be

considered. While some flexibility is allowed, the Commission has set a range of rates within which engineers may work with twice the historic rate of sea-level rise established as the minimum standard assumed rate. This standard was based on data which show a doubling of the rate of sea-level rise in the Bay over the last 20 years. Engineers for all proposed projects are required to defend the specific rate of sea-level rise chosen for a particular project proposal before the Commission.

The California Coastal Commission staff has also undertaken detailed research on projected impacts on coastal wetlands, beach erosion, cliff retreat, and harbors and structures.⁸ This research may eventually lead to the development of specific policy responses, but no specific implementation action has been taken since the 1989 study.⁹

3. Oregon

Oregon has begun to review possible impacts from global warming through the development of a preliminary report illustrating the range of changes that might result from global warming.¹⁰ The report characterizes itself as speculative rather than predictive, but identifies sea-level rise concerns about shoreline retreat, flooding of coastal areas, and salt water intrusion. Following an opportunity for public comment and debate, the Oregon Department of Energy plans to develop a second report which will include recommendations for actions by State agencies.

In addition to the Department of Energy's report, James Good of Oregon State University has also conducted a recent study of the Siletz area cell on the Oregon coast to analyze the effectiveness of Oregon's laws and regulations regarding shoreline protection and beach access.¹¹

Good found that State land use planning goals, regulations, and legislation have failed to adequately control the building of hard shoreline protective structures, with the result that considerable amounts of sediment are "locked up" behind such structures, and are thus unable to migrate and nourish eroding beaches.

According to this study:

despite the fact that Oregon has one of the most far-sighted set of state land use policies in the United States ... including three land use goals that focus on natural hazards, the hazard management strategies actually employed by landowners depend more on structural mitigation than on hazard avoidance. Along the Siletz cell, the result has been the proliferation of SPSs [shoreline protective structures].¹²

The study also found that setback requirements in the research area have proven inadequate to prevent the construction of SPSs, and that a large number of lots too shallow to provide for erosion protection continue to result from subdivision.

Good asserts that the building of hard erosion control structures in the coastal zone is actually encouraged and "institutionalized" by the failure of local planning decisions to give adequate weight to State goals and regulations directing that non-structural solutions are to be "preferred".¹³ He predicts that more SPSs will further exacerbate the rate of coastal erosion, which will create even more demand for permits for these structures.

To minimize coastal erosion, coastal hazards, and the use of hard erosion control structures, the study recommends concentrating on hazard avoidance as the "fundamental principle" for guiding development.¹⁴ Where the use of these hard structures is unavoidable, Good suggests that compensation for "unavoidable adverse impacts—individual and cumulative—should be required,"¹⁵ similar to the system Oregon uses to compensate for adverse impacts to wetland resources.

Coast-wide construction setbacks and comprehensive area management planning for the various "cells" of the Oregon coast are also suggested as useful strategies in planning for sea-level rise. In addition, Good recommends increasing State oversight of local land use decision making in flood and erosion hazard areas to help insulate local decision-makers from some of the pro-

development political pressures they now feel.

More recently, in October 1993, the Oregon Coastal Natural Hazards Policy Working Group published an "Issues and Options" report which incorporates both the types of suggestions outlined above and public reaction.¹⁶ Participants discussed many coastal management issues. Sea-level rise was not a separate issue, but rather was addressed through related issues such as coastal erosion and flooding. Policy options and suggestions considered in the report included: instituting a mandatory preference for soft erosion control strategies over hard structural solutions; prohibiting hard shoreline protective structures outright; eliminating public subsidies for development of hazardous areas; classifying sites by susceptibility to natural hazards; using public funds to buy lots made unbuildable by setback requirements; instituting more restrictive setbacks; instituting tax credits for the donation of coastal hazard properties to state or local governments; imposing stricter limitations on variances; prohibiting development in high hazard areas; imposing more restrictive lot coverage requirements; and requiring hazard disclosure to potential buyers. The report also discusses seismic issues unique to the west coast.

4. New Hampshire

New Hampshire's Office of State Planning commissioned a 1987 technical report that recommends a three-step process to approach the issue of how sea-level rise should be factored into coastal zone planning.¹⁷ The three steps are to delineate impact areas, inventory potentially affected populations, assets and resources, and develop regulatory and legislative responses.

Based on the recommendations of this report, in 1991 the Rockingham Planning Commission published a "Preliminary Study of Coastal Submergence and Sea Level Rise in Selected Areas of New Hampshire." It describes the phenomenon of relative sea-level rise, examines the various projections for accelerated sea-level rise, and identifies potentially threatened areas by applying sea-level rise predictions to local area maps, taking account of local topography, water bodies,

and patterns of development.

The report contains general suggestions for managing coastal areas in anticipation of likely but uncertain increasing rates of sea-level rise. The report stresses the importance of anticipating the phenomenon well in advance in order to minimize both costs and environmental damage:

Some of the most cost-effective solutions to property losses that could arise take several decades to implement. Future dislocations of development can be greatly lessened by directing development away from areas that lie within the range of likely sea level rise.¹⁸

The report finds the risk to developed areas to be "relatively minor" in the study areas given a projected sea-level increase of 5 feet, discounting the effects of storm flooding. It finds that the structures at risk under this scenario do not account for much more than those already at risk from current storm generated flooding: "For the most part, structures within the submergence areas are already at risk from storm driven flooding."¹⁹

The report is less optimistic about the fate of coastal wetlands, and cites EPA estimates of wetlands losses of 26% to 82% under a one meter rise in sea-level. The report cites two basic problems for wetlands migration: 1) that sea-level will rise too rapidly for wetlands to keep pace in their upland migrations and 2) that development adjacent to wetlands will effectively prevent that migration if landowners erect hard structures such as bulkheads to protect their properties. Noting that there is little that coastal planners can do about the first problem, but that the second problem can be mitigated by coastal land use regulation, the Rockingham County report suggests a few strategies in this regard:

Such approaches might include: acting now to limit future development in areas where wetlands are likely to migrate to; allowing development in sensitive areas only on the condition that no attempt will be made to protect the property (via bulkheads, seawalls, etc.) from advancing wetland, and modifying the federal flood

insurance program to greatly discourage or disallow reconstruction of structures damaged as a consequence of sea level rise.²⁰

The report stresses federal, state, and local cooperation "to devise fair and equitable ways to abandon development that is in the path of wetland migration,"²¹ but it does not suggest any concrete or particular strategies which New Hampshire should follow. However, it does stress that preventive planning is both more effective in minimizing losses of natural resources such as wetlands and is also cheaper than after-the-fact regulation.

5. Massachusetts: The Cape Cod Commission

Barnstable County's Regional Policy Plan²² identifies the peninsula of Cape Cod, Massachusetts, as an area which is particularly vulnerable to the effects of erosion from storms and wave processes, as well as to potential problems posed by anticipated sea-level rise. By April 1990, the town of Barnstable had held two conferences on the potential effects of sea-level rise on the community as part of an effort to determine what steps community leaders could take to alleviate these effects.²³ Since that report, the County of Barnstable has incorporated specific measures to control the detrimental effects of sea-level rise on Cape Cod into its Regional Policy Plan.

The plan addresses accelerated sea-level rise in its section on coastal resources.²⁴ The plan notes that the present rate of erosion on the Cape results in the loss of "24 acres of upland per year, or 1080 acres by 2025." The plan compares this present rate of annual erosion with EPA's mid-range predictions, and also uses a study by Woods Hole Oceanographic Institution geologists which projects a loss of 3900 acres, based on a 1.57 foot rise in relative sea-level. The plan also notes that, at the time it was written, existing laws and regulations did not specifically address projected increases in the rate of relative sea-level rise.

The Cape Cod Regional Management Plan enumerates certain policies to deal with acceler-

ated sea-level rise, in addition to other measures designed to control erosion or to allow for the migration of coastal features at the historic rate of sea-level rise. One goal is "[t]o limit development in high hazard areas in order to minimize the loss of life and structures and the environmental damage resulting from storms, natural disasters and sea level rise."²⁵ To achieve this goal, the section enumerates minimum performance standards, one of which reads:

In order to *accommodate possible sea level rise* and increased storm intensity, ensure human health and safety, and protect the integrity of coastal landforms and natural resources, all new buildings, including replacements, within FEMA A and V flood zones shall be designed one vertical foot above existing FEMA base flood elevation and state building code construction standards.²⁶

To address the problem of eroding bank and dune systems, another standard specifies that:

[i]n areas where banks or dunes are eroding, the *setback* for all new buildings and septic systems to the top of the coastal bank or dune crest *shall be at least 30 times the average annual erosion rate* of the bank or dune. This rate shall be determined by averaging the erosion over the previous 30-year period at a minimum."²⁷

Other standards under this goal section include a prohibition on development or redevelopment within FEMA V flood zones, although allowing an exemption for certain water-dependent uses where "no feasible alternative" exists.²⁸ A similar prohibition includes similar exceptions, on development and redevelopment on barrier beaches and coastal dunes.²⁹ There are also prohibitions on the building or expansion of public infrastructure in flood hazard zones.³⁰ Another performance standard prohibits the reconstruction of buildings which have been damaged at greater than 50 percent of their tax assessment valuation in flood hazard zones, on coastal banks, dunes, or barrier beaches unless they comply with specified standards for new development.³¹

6. New York: Long Island

In New York State, a hazard management plan has been proposed for the South Shore of Long Island to deal with accelerated sea-level rise and its attendant problems of increased erosion, more frequent coastal storms and resulting dislocation.³² The South Shore Hazard Management Plan works within the framework of the New York State Coastal Erosion Hazard Areas Act.³³

Long Island is especially vulnerable to the effects of sea-level rise in that it is characterized by extensive barrier beaches fronting on the Atlantic Ocean. At the same time, areas of its coastline are highly developed. The area also provides recreation benefits to the many residents of the metropolitan New York area. The Long Island Regional Planning Board has developed a proposed management plan for the island's south shore addressing these problems and prioritizing goals for the management of various sub-areas on Long Island's south shore.

The Long Island plan stresses the importance of planning and advanced identification of critical natural resources and undeveloped areas through extensive mapping. Responses to erosion and sea-level rise are to be tailored to specific areas. According to the plan, relatively undeveloped hazard areas are to be protected from further development; isolated structures are not to be rebuilt after destruction; building of new structures in hazard areas is discouraged; in built-up areas, some additional protective structures might be allowed if there is no significant amount of pristine shoreline.

The plan encourages "soft" management strategies, such as using sand from south shore inlet maintenance dredging to nourish downdrift beaches.³⁴ It discourages rebuilding in V Zone Hazard areas (determined by flood insurance rate maps) for private structures damaged over 50%. Sea-level rise is specifically mentioned, although no specific rate assumptions or timetables for retreat are given. The plan recommends that:

a strategic retreat from vulnerable coastal areas is the rational approach to follow.

While it is not recommended that wholesale abandonment of existing public facilities and private development located in coastal areas should occur in advance of actual sea level rise acceleration, structures should be removed from vulnerable locations over the long-term when subject to substantial damage from erosion and flooding impacts.³⁵

In general, the plan designates thirteen segments of Long Island's south shore to be treated as distinct regional management units. It describes specific, detailed recommendations for shoreline management for each coastal segment. These recommendations are tailored for each segment by taking into consideration natural and anthropogenic coastal features and population densities in setting priorities for each section.

The plan is consistent with other jurisdictions in placing emphasis on the public value of the coastline, both as public recreation and as flood and storm protection. It specifically recognizes that private coastal landowners, particularly those in high risk areas, may impinge on the rights of other members of the public through their activities in such high risk zones.

The executive summary of the plan asserts, "[p]roperty owners should not adversely impact coastal processes to the detriment of adjacent shoreline areas."³⁶ In the coastal high risk zone, or the Federal Flood Insurance V zone, the plan notes that the public should not be expected to pay for damage to private property: "Private interests ... should bear the burden of the loss of such structures and/or property due to erosion and flooding. Within this Coastal High Risk Zone, there is minimal public interest in making government expenditures for maintaining private development."³⁷ The plan also recommends that changes be made to the National Flood Insurance Program, specifically that "the elimination of federal flood insurance coverage for structures located on barrier islands and spits must be considered."³⁸

The plan states a preference for retreat from high hazard areas, where feasible. It also recognizes that most often severe damage will occur as

the result of storm events, and that often there are not adequate planning mechanisms in place to deal with the problems communities face in the wake of a severe coastal storm. It therefore recommends "that post-storm community re-development plans be prepared in advance to deal with those instances where a severe storm event destroys a large portion of a community and government can neither prevent re-development through regulation nor acquire properties because of a lack of financial resources."³⁹

On Long Island, planners realize that preparation for the aftermath of coastal storms is an integral component of planning in areas at great risk from erosion. In very high risk areas where the preferred policy on Long Island is one of "strategic retreat," it is noted that the alternative may be chaotic and involuntary retreat at any rate:

The policy of strategic retreat from vulnerable coastal areas in light of potential acceleration in the rate of sea level rise and subsequent flooding of low lying coastal areas is the rational approach to follow.... The alternative of gradual retreat is involuntary retreat as a result of disaster situations.⁴⁰

Communities are to ensure that post-storm development does not exceed planned density levels, and to that end, it prohibits public expenditures for infrastructure which would have the effect of encouraging denser development on coastal barriers. In keeping with the view that the coastal barrier islands represent a significant recreational resource, communities are encouraged to consider expenditures on infrastructure for water-dependent uses facilitating public access, such as beaches, parks and fishing piers.⁴¹ In addition, in certain high-risk coastal areas owned by the state where residents currently hold long-term leases, the plan proposes a gradual abandonment policy under which those leases are to be phased out.

The Long Island plan also recommends government purchase of certain undeveloped coastal lands for purposes of recreation and open space.⁴² Again, this is in keeping with the policy that such areas provide needed recreation areas for

the public at large, and that these areas are being threatened by both sea-level rise and increased coastal development.

Other priorities involve the protection of coastal wetlands and coastal bluffs, which the plan notes are threatened by accelerated rates of sea-level rise. The plan stresses the need for public awareness of the possible negative effects of bulkheads and other hard erosion control devices on wetlands, and emphasizes planning to provide for adequate buffer zones.⁴³

With respect to coastal bluffs, the plan emphasizes that permit decisions regarding armoring structures should include consideration of the local sediment budget and the structure's possible negative effects on down-drift beach areas. Mitigation schemes are contemplated, such as conditioning permits for construction of erosion control devices on a requirement to replace sand on certain down-drift beaches deprived of sediment by the artificial structure. The plan also differentiates bluffs from dunes, and points out that attempts to stabilize them may have negative impacts on local sediment budgets: "unlike the dunes, bluffs are a relic feature and cannot be expected to recover after an erosional event; the erosion of bluffs may have a more important role in the sediment budget ... than the role of dune erosion."⁴⁴

In general, the Long Island plan is a comprehensive and flexible document, which, while it advocates a gradual retreat from the shoreline in erosion hazard areas, modifies its recommendations according to pre-existing coastal land uses and densities. It achieves this through treating the various coastal regions of Long Island separately, from the highly developed sections to the west, to the relatively pristine areas to the east.

<p>B. SELECTED COASTAL EROSION RESPONSE STRATEGIES</p>

Many states have adopted specific policies to minimize loss due to coastal erosion caused by coastal storms and the continuation of historic

submergence. These policies have been developed in response to historical rates of change over the last century, and rarely incorporate any assumptions anticipating an increase in the rate of sea-level rise during the next century as a result of global climate change.

Since these laws are designed to mitigate erosion losses if historic rates continue into the future, as currently written, they may prove inadequate if future sea-level rise significantly exceeds historic rates of change. However, selected statutes are surveyed here for the purpose of identifying innovative land use management techniques that may be amenable to modification for application in strategies designed to respond to accelerated rates of sea-level rise.⁴⁵

State erosion response legislation has been characterized as falling into three general groups: erosion management laws (e.g., New York, Pennsylvania, South Carolina), coastal zone management laws with an erosion element (e.g., Florida, Rhode Island, North Carolina, Michigan), and related resource management laws (e.g., New Jersey, Massachusetts and Texas).⁴⁶ This summary focuses on laws in the first two categories.

1. Rhode Island

The State of Rhode Island's Coastal Resources Management Program identifies sea-level rise as a concern, but it does not specifically mention an accelerated rate of sea-level rise as a result of global climate change. Nevertheless, the plan does address the problems caused by sea-level rise at historic rates through policies specifically tailored to protect various types of coastal environments, and varying densities of development on those features.

The Program is based on a system which classifies all waters of the state into six quality categories, based primarily on the characteristics of the adjacent shoreline. Those categories include type 1, conservation areas; type 2, low intensity use; type 3, high intensity boating; type 4, multipurpose waters (i.e. those that support or could support both commercial and recreational activities, as well as providing good fish and

wildlife habitat); type 5, commercial and recreational harbors; and type 6, industrial waterfronts and commercial navigation channels.

Recommended responses to shoreline erosion and possible sea-level rise in Rhode Island vary according to the type of shoreline feature involved as well as type of waters to which they are adjacent. However, standard setbacks of a minimum of 50 feet "from the inland boundary of the coastal feature" are required, "except in areas designated by the Council as Critical Erosion Areas"⁴⁷ In critical erosion areas, setbacks of 30 and 60 times the average annual erosion rate are required, the more stringent standard being reserved for higher density development.⁴⁸

The section entitled "Shoreline Features" specifically mentions sea-level rise, albeit at historic rates:

All shoreline systems are dynamic, and change their shape and character in response to storms, currents, human modifications, and *the gradual rise in sea level....* The present rate of sea-level rise is about one foot each century. A foot of vertical rise, however, accounts for an inland retreat of some 30 feet along low-profile shores."⁴⁹

The plan asserts that most erosion to the Rhode Island Coast occurs not as a result of gradual sea-level rise, but rather from discreet storm events.

As has been noted, the plan provides for general coastal setbacks as well as more stringent ones for "Critical Erosion Areas." These critical erosion areas are mapped under 4 categories, (A-D), with annual estimated erosion rates from 2-2.5 feet for category A, to 5-6 feet for category D. Corresponding required setbacks range from 75 and 150 feet, (for four or fewer dwelling units, and for more than four dwelling units, respectively) in category (A), to 180 and 360 feet, respectively, in category (D).

Categories of Critical Erosion Areas are determined by the Rhode Island Coastal Resources Management Council independent from decisions regarding adjacent water quality. They

are shown on detailed coastal planning maps included in the Rhode Island Coastal Resources Management Program document, and appear to cover only the areas of the coast most exposed and prone to erosion.

There is a variance mechanism for applicants who cannot meet such standards, but the granting of a variance "does not remove the applicant's responsibility to comply with all other Program requirements."⁵⁰ Applicants must also show that proposed alterations are "the minimum necessary to remove an undue hardship"⁵¹ and will not cause "significant adverse environmental impacts or use conflicts,"⁵² among other requirements. Another section contemplates Special Exceptions for projects which do not comply with the program's goals for projects serving "a compelling public purpose" which are water-dependent, or for which no alternative sites exist.⁵³

The Plan also provides for post-hurricane emergency procedures. These procedures provide for a *temporary moratorium* on reconstruction of structures "to remain in effect for a maximum of 30 days from the disaster declaration." The moratorium should provide local officials time to assess damage, to consult with state officials, to act on possible ameliorative response actions in high damage areas such as the purchase of open space, and to "make a policy decision about re-permitting according to best available options for hurricane mitigation."⁵⁴

The plan also emphasizes protection of coastal features, including coastal beaches and dunes, barrier beaches, coastal wetlands, coastal cliffs, bluffs and banks, rocky shores, and man-made shores.⁵⁵ It notes that "beaches are dynamic, flexible features," and that hard erosion control structures may interfere with the natural processes of dynamic coastal features.⁵⁶

The plan states that this dynamism is particularly true for barrier beaches, which it describes as being "particularly ill-suited to human occupation."⁵⁷ It categorizes beaches as undeveloped, moderately developed, and developed, and its restrictions on development vary according to the level of development, from no new construction on undeveloped barrier beaches to requiring

construction lines on three specific barrier beaches classified as developed.⁵⁸

Regarding coastal wetlands, the Rhode Island plan notes that, "[b]ulkheading and filling along the inland perimeter of a marsh prevents inland migration of wetland vegetation as sea level rises." The plan therefore forbids use of "structural shoreline protection" except when "the primary purpose is to enhance the site as a conservation area and/or a natural buffer against storms" in Type 1 waters, and allows such structures only pending permit approval in Type 2 waters.⁵⁹

The discussion regarding coastal bluffs and cliffs notes that their erosion may actually provide needed sediments to down-drift beaches, and therefore instructs the Council to "encourage the use of non-structural methods to correct erosion problems associated with coastal cliffs, banks, and bluffs adjacent to Type 1 and Type 2 waters."⁶⁰ Although hard erosion control strategies are to be discouraged in these areas, they may be permitted under certain exceptional circumstances. However, the Council is instructed to:

weigh the impact of the proposed structure on the supply of sediments to nearby beaches. Where the Council finds that a substantial reduction or elimination of sediment is likely to result, and that natural erosional processes affecting the nearby beach will thereby be accelerated, it shall deny its Assent [for the permit]."⁶¹

The plan also deals with rocky shores and with man-made shorelines,⁶² but it points out that "[t]he presence of isolated seawalls, bulkheads, and similar structures does not constitute a man-made shoreline, as the term is used in this Program."⁶³

In Rhode Island, the Coastal Resources Management Council "may order restoration or removal [of isolated structures] where it finds that the structure poses a hazard to navigation, interferes with the public's right of access to and along the shore, causes flooding or wave damage to abutting properties, or degrades the scenic qualities of the area."⁶⁴

2. South Carolina

South Carolina's Coastal Tidelands and Wetlands Law⁶⁵ implements an aggressive and detailed beach preservation policy. The legislative findings section⁶⁶ of this statute notes that previously existing state legislation (prior to 1988) "did not provide adequate jurisdiction to the South Carolina Coastal Council to enable it to effectively protect the integrity of the beach/dune system."⁶⁷ It cites the importance of the beach/dune ecosystem to the State as a protective storm barrier, as a basis for tourism, as habitat for wildlife, and as providing recreational opportunities for South Carolinians.⁶⁸ In addition, this section notes that the system is threatened by development too close to the shore and specifically points to hard erosion control devices as exacerbating the problem of shoreline erosion:

These armoring devices have given a false sense of security to beachfront property owners. In reality, these hard structures, in many instances, have increased the vulnerability of beachfront property to damage from wind and wave while contributing to the deterioration and loss of the dry sand beach which is so important to the tourism industry.⁶⁹

In addition to this finding, the section points out that erosion is a natural process, which causes problems for humans "only when structures are erected in close proximity to the natural system." The section specifically notes that it is important to afford the dynamic beach/dune system space to erode and reform without hindrance by hard erosion control devices and other structures. It also states a preference for retreat from exposed beaches:

It is in both the public and private interests to afford the beach/dune system space to accrete and erode in its natural cycle. This space can be provided only by discouraging new construction in close proximity to the beach/dune system and encouraging those who have erected structures too close to the system to retreat from it.⁷⁰

It is the stated policy of the law to "protect, preserve, restore and enhance the beach/dune system"⁷¹ To achieve this general goal, "local comprehensive beach management plans" are required within the context of "a comprehensive, long-range beach management plan," and the plans are "to include a gradual retreat from the system over a forty-year period."⁷² Other ancillary policies aim to "severely restrict the use of hard erosion control devices ... and to encourage the replacement of hard erosion control devices with soft technologies," encourage erosion control techniques with low environmental impacts, promote beach nourishment, preserve and promote public beach access, involve local governments in the coastal planning process, and to "establish procedures and guidelines for the emergency management of the beach/dune system following a significant storm event."⁷³

The forty-year gradual retreat policy for areas of the South Carolina coast is based on a setback of forty times the annual erosion rate.⁷⁴ The policy requires the Council to establish a baseline paralleling the shoreline along the "crest of the primary oceanfront sand dune."⁷⁵ In addition, a setback line:

must be established landward of the baseline a distance which is forty times the average annual erosion rate or not less than twenty feet from the baseline for each erosion zone based upon the best historical and scientific data adopted by the council as part of the State Comprehensive Beach Management Plan.⁷⁶

The law also requires mandatory periodic revision of the baseline,⁷⁷ and "monumented and controlled survey points" in each Atlantic coastal county are required.⁷⁸ Exempted structures not subject to the setback include: wooden walkways, small wooden decks, fishing piers providing public access, golf courses, "normal landscaping," pools, and specially permitted structures.⁷⁹

An aggrieved landowner provision is also included, whereby a landowner who feels that the setback line is in error "must be granted a review of the setback line, baseline, or erosion rate, or a review of all three."⁸⁰ These requests for review

are to be forwarded to the "appropriate committee of the council and handled in accordance with the council's regulations on appeals."

The Act only allows structures other than erosion control devices to be rebuilt seaward of the baseline by special permit if:

the structure is not constructed or reconstructed on a primary oceanfront sand dune or on the active beach and, if the beach erodes to the extent the permitted structure becomes situated on the active beach, the permittee agrees to remove the structure from the active beach if the council orders the removal ... [and] the use of the property authorized under this provision, in the determination of the council, must not be detrimental to the public health, safety, or welfare.⁸¹

Parties aggrieved by a decision by the Council to grant or deny such a permit have the opportunity to appeal to the full Council.⁸²

The Act also provides for the gradual phasing out of erosion control structures and devices seaward of the setback line by applying an incremental system under which they may not be rebuilt in the event of damage, with the threshold of percent damage decreasing with time. Thus, erosion control structures destroyed more than eighty percent may be rebuilt until 1995 and more than two-thirds until 2010. After June 30, 2010, an erosion control structure may only be rebuilt if it is less than fifty percent destroyed.

In addition, the Act limits construction of habitable structures seaward of the setback line by providing that structures are limited to less than five thousand square feet of heated space, no part is seaward of the baseline (dune line), and that no erosion control devices are incorporated into the structure. Repairs and maintenance are allowed on if the total result is not greater than five thousand square feet of heated space. Repair or renovation is allowed for structures not damaged beyond repair. Replacement of structures destroyed by natural causes is take place, where possible, landward of the setback line; enlargement of the structure is prohibited; and the re-

placement may be no farther seaward than the original.⁸³

Dispute resolution regarding damage assessments of damage to protective structures is to be carried out "by a registered professional engineer acting on behalf of the council,"⁸⁴ but a property owner may challenge this assessment by obtaining "an assessment by a registered professional engineer." The section also provides for an assessment by a third registered professional engineer, should the two assessments differ. The third engineer is to be selected by the first two engineers, or, failing that, by "the clerk of the court of the county where the structure or device lies ... [and] [t]he determination of percentage of damage by the third engineer is conclusive."⁸⁵

3. Delaware

Delaware's Beach Preservation Act specifically mentions sea-level rise as a phenomenon to be considered in regulating beach use:

Beach erosion and shoreline migration occur due to the influence of waves, currents, tides, storms and *rising sea level*.... Development and habitation of beaches must be done with due consideration given to the natural forces impacting upon them and the dynamic nature of those natural features....⁸⁶

Delaware's legislation puts sea-level rise in the context of on-going coastal erosion problems by defining "beach preservation," "beach erosion control" and "erosion control" as including but "not limited to, erosion control, hurricane protection, coastal flood control, shoreline and offshore rehabilitation."⁸⁷

The legislation defines a building line parallel to the coast, "seaward of which construction of any kind shall be prohibited without a permit or letter of approval from the Department (Delaware Department of Natural Resources and Environmental Control)."⁸⁸ In addition, construction "landward of the building line on any beach ... shall be permitted only under a letter of approval from the Department."⁸⁹ Furthermore, construction carried out in violation of the Beach Preserva-

tion Law is declared to be a public nuisance.⁹⁰ The law also sets up a Beach Preservation Fund⁹¹ to be used to fulfill the law's general goals.

Also of interest in Delaware are recommendations for strategic retreat through "planned obsolescence," developing "post-storm plan[s]," and advocating land uses which are compatible with the goals of beach preservation, "such as fishing camps and recreational uses, or for donating conservation easements."⁹²

Such incentive strategies, along with improved public education and awareness about coastal processes and the consequences of sea-level rise and coastal erosion may prove an important addition to coastal hazard management programs. They may help to decrease friction between government and private property owners over an issue which is likely to increase in importance for coastal managers, residents, and user groups.

4. Florida

Florida's Beach and Shore Preservation Law provides for the establishment of construction control lines⁹³ which are to be periodically reviewed and updated "after consideration of hydrographic and topographic data which indicates shoreline changes that render established coastal construction control lines to be ineffective for the purposes of this act."⁹⁴ Construction control lines are to be established taking into consideration "historical storm and hurricane tides, predicted maximum wave uprush, beach and offshore ground contours, the vegetation line, erosion trends, the dune or bluff line ... and existing upland development."⁹⁵ Public hearings are required for the establishment of these lines, and allowance is made for administrative review of construction control lines for aggrieved riparian upland owners.⁹⁶ The mutable aspect and periodic review of the construction control lines allow Florida the flexibility to use the Beach and Shore Preservation Law to respond to changes in the rate of sea-level rise. The statute also envisions a state/local partnership in the preservation of beaches.⁹⁷ The section provides for state funding of beach renourishment and restoration projects

from the Beach Management Trust Fund of up to 75%, while local municipalities are required to pay the remainder.

5. Pennsylvania

While Pennsylvania's legislation does not specifically mention the issue of sea-level rise, it does contemplate the problem of coastal erosion in its Bluff Recession and Setback Act,⁹⁸ and it encourages state and municipal cooperation to regulate land uses in erosion hazard areas. The legislation deals specifically with bluffs on Lake Erie, but provides an interesting example of state-local cooperation which has applicability to the regulation of coastal bluffs.

The law provides for Pennsylvania's Environmental Quality Board to establish regulations for minimum bluff setback requirements in bluff recession hazard areas. These areas are defined as "area[s] or zone[s] where the rate of progressive bluff recession creates a substantial threat to the safety or stability of nearby or future structures or utility facilities."⁹⁹ However, six months after a given municipality has been designated as including such bluff recession hazard areas, the municipality must implement an ordinance which requires setbacks in those areas and which complies with the minimum State standards set by the Environmental Quality Board.¹⁰⁰ Municipal ordinances may be more restrictive than the State's minimum setback requirements.¹⁰¹ The State may bring an enforcement action against municipalities which fail to adopt or implement setback ordinances.

6. Maryland: The Chesapeake Bay

Planners in Chesapeake Bay have identified the need for development of alternative site-specific strategies to protect wetlands from inundation.¹⁰²

In the Chesapeake Bay area, private landowners have often invested heavily in waterfront properties, and are unlikely to choose to simply abandon these properties without trying to protect them. Analyses by Chesapeake Bay area coastal managers contend that the building of seawalls

and dikes to protect private upland property from sea-level rise will likely have significant negative impacts on wetlands. If development is situated immediately upland of a coastal wetland, there will be nowhere for that wetland to migrate should it become inundated as the result of accelerated sea-level rise.

This is particularly significant for Chesapeake Bay, where historical wetlands and whole islands, mapped in the eighteenth century, have already disappeared.¹⁰³ Due to the nature of coastal wetlands as low-lying, very gently-sloping areas, coastal wetlands will be the first areas to be inundated, and an increase in the rate of sea-level rise will accentuate this trend.

If owners of private upland property construct sea walls and dikes, the wetlands cannot migrate to the adjacent uplands, but will rather be more quickly inundated. A possible wide-spread loss of wetlands, in addition to the ongoing anthropogenic direct destruction of wetlands through dredging and filling operations could have devastating effects on already threatened coastal ecosystems. If wetlands do not have a chance to migrate, the biological productivity of coastal ecosystems will be seriously impaired.

Maryland's wetlands protection legislation covers all areas within 1000 feet of the Chesapeake Bay that are less than 50% developed. It requires local governments to develop protection plans for wetlands by requiring buffer zones.¹⁰⁴ Because the legislation covers such vast areas in the Chesapeake Bay area and requires buffer zones, it may be adaptable to ameliorating the effects of accelerated sea-level rise on wetlands. Maryland also requires private landowners to pay for the costs of erosion control projects which benefit their properties, although the levy is to be calculated to cover only the cost of the project itself, and apparently does not include calculations of costs resulting from the loss of natural shoreline features resulting from the project.¹⁰⁵

C. CONCLUSION

Several recurrent themes appear in the methods these jurisdictions have adopted or are contemplating using to address the issues of sea-level rise and coastal erosion. These are summarized below.

1. Respect Dynamic Nature of Coastal Systems

One important theme is an increasing realization among legislators and planners that coastal systems are dynamic and that attempts to stabilize them may have detrimental effects on the coastal ecosystem. As the understanding of coastal processes increases, the expectation that coastal areas are immutable and permanent has come to be considered unrealistic and environmentally unsound. This is true not only in states evaluating the possible impacts of accelerated sea-level rise (e.g., Washington, Oregon, and New Hampshire) but also in states with laws designed to protect against a continuation of historical rates of shoreline change (e.g., Rhode Island, South Carolina, Florida).

2. Preserve/Enhance Resiliency of Natural System

Similarly, there is growing rejection of hard structural solutions and increased focus on maintaining (and in cases, improving) the resiliency of natural systems as the best way to minimize coastal hazards (e.g., Washington, Rhode Island, South Carolina). This approach entails: 1) preserving buffers to allow room for natural systems to migrate (Rhode Island, Washington, Maryland); 2) hazard avoidance by directing new development away from potentially high-risk areas (New Hampshire, Oregon, Florida); and 3) gradual retreat of existing development from hazard areas, at least through restrictions on rebuilding after a specified level of destruction (Cape Cod, Long Island).

3. Revisit Issues of Public Nuisance, Public Subsidy

As a related theme, the developing public policies suggest that private development in high hazard areas is increasingly being seen as a public nuisance which diminishes the quality of a public resource, often at the monetary expense of the public. There appears to be a decreasing tolerance for such hidden subsidies, and an increasing awareness that anticipated accelerated sea-level rise will exacerbate these problems. For example, it has been suggested that property owners who erect hard erosion control structures be required to pay for beach nourishment for beaches which have been starved of sand due to the erection of the structure (Long Island, Oregon).

4. Build on Existing Policies

Several factors make it difficult to implement anticipatory accelerated sea-level rise strategies at this time, including: scientific uncertainty about the timing, magnitude, and impacts of global climate change; lack of public education about and public acceptance of the probability of accelerated sea-level rise; and a failure to appreciate the possible severity of impacts caused by relatively small changes in temperature or sea-level. Furthermore, coastal resource managers and coastal landowners are just beginning to understand the importance of adjusting to accommodate the dynamic shoreline system within the parameters of non-accelerating rates of shoreline change. It is difficult enough to win acceptance of regulations designed to minimize damage from coastal erosion projected to continue at historical rates. The case has to be made even more convincing to cause coastal residents to adopt regulations to protect against unquestionably serious but remote-in-time, uncertain projections of accelerated rates of change.

Despite a leading state-level research program, the State of Washington has opted not to develop a new, stand-alone, accelerated sea-level rise response strategy. Instead it is focusing its current efforts on more mainstream coastal erosion issues. A study conducted for that State suggests that amendments to existing laws are

much more palatable and are more likely to produce the type of "no regrets" (e.g., it makes sense even if sea level doesn't rise) strategy which the State is seeking. Similarly, other states have not developed specific new legislation to address sea-level rise projections, but appear to be working within a framework of amendments to existing laws to make them more effective if accelerated sea-level rise becomes a reality. Thus prudent planners appear to be basing planning and regulations on the evidence of what coastal storms and erosion are already expected to do, but build into those regulations an extra precautionary increment for an accelerated rise, or build in a structured retreat as conditions require it.

5. Retain State/Regional Oversight of Local Decisions

Another common issue relates to the allocation of responsibilities between state, regional, and local authorities. In several jurisdictions, states and progressive regional authorities have established mandatory minimum standards for local governments; the local governments are free to establish more stringent standards if they so choose (e.g., Pennsylvania bluff erosion). An Oregon study also suggested this retained state oversight may be the optimal arrangement for this type of coastal management problem because it allows for integrated management of a public resource and helps insulate the decision-making process from some of the pro-development political pressures.

6. Develop an Integrated Strategy: Beaches, Eroding Bluffs, Migrating Wetlands

The most developed state/regional strategies are grounded in a comprehensive philosophy that applies not only to beaches, but also to the other "soft" components of the coastal system—eroding bluffs (e.g., Rhode Island, Washington, Long Island) and coastal wetlands (California, Long Island, Maryland, Rhode Island). For example, they require that permit reviews for bluff stabilization projects evaluate the importance of the eroding coastal bluffs as part of the beach sedi-

ment supply system (Oregon, Rhode Island). Several states have policies, some implemented through regulations, to protect wetlands by preserving the opportunity for inland migration by discouraging or prohibiting the hardening of the inland perimeter of coastal marshes (Rhode Island, Maryland).

7. Recognize the Complexity of Planning Process: Topography, Intensity, and Land Use

Despite a comprehensive philosophy toward the soft coast, another recurrent theme is the complexity of planning for coastal land loss due to the fact that it will affect different coastal features in different ways, at different rates. In addition, due the response costs, some strategies will only be feasible in intensely developed areas. A meaningful plan must be sufficiently sensitive to take into account the variations in coastal

8. Utilize Coastal Setback Requirements

Most surveyed jurisdictions use setback requirements to minimize erosion hazards, including Cape Cod (30 times average historical erosion rate), South Carolina (40 times average annual erosion rate), and Rhode Island (in critical erosion control areas, 30 times annual erosion rate for up to 4 units and 60 times that rate for 4 or more units). These requirements are typically based on an increment of the historical average annual rates rather than on projections of accelerated rates of sea-level rise, but there is no reason future trends could not be used to establish the setback if justified by particular circumstances. Taking a slightly different approach, San Francisco Bay Conservation and Development Commission requires applicants to design for a minimum of twice the historic annual rate of sea-level rise.

9. Evaluate a Variety of Additional Strategies

Setbacks for new construction are merely one component. Other strategies adopted or being considered include restrictions on rebuilding structures or seawalls if damaged by more than a

features and land uses.

For example, special area management planning has been advocated for the littoral cells of Oregon in planning for sea-level rise. The Long Island South Shore plan also uses a special area management planning approach to deal with its varied coast. The State of Rhode Island regulates coastal areas not by geographic region, but by shore type, population density, and the uses of adjacent waters, effectively creating a kind of special area management planning. These plans typically distinguish between strategies for undeveloped and developed areas, with general recognition that the more costly methods (e.g., hard protective structures and beach nourishment)—both in terms of financial expenditures and environmental degradation—can only be justified, if at all, in the more heavily developed areas.

certain percent of pre-damage value (Cape Cod, South Carolina), provisions for recalculation of coastal setback lines in response to sea-level rise or other changes (Florida), heightened design standards which take sea-level rise into account (San Francisco), stricter building codes which require an additional increment above current floodproofing requirements (Washington, Cape Cod), limits on building or expanding public infrastructure in flood hazard areas (Cape Cod), tax incentives for less intense uses along the shoreline (Delaware), purchase of undeveloped coastal lands (Long Island) and advanced post-storm redevelopment planning and/or provisions for temporary post-storm building moratoria (Long Island, Delaware, Rhode Island, South Carolina).

D. ENDNOTES APPENDIX B

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64. *Id.* § 210.6.C.3.
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69. *Id.* § 250(5).
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71. *Id.* § 260(1).
72. *Id.* § 260(2).
73. *Id.* § 260(3)-(8).
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81. *Id.* § 290(D)(1).
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