# *Chapter Five*

# RESPONSIVENESS OF EXISTING STATE AND FEDERAL LAWS TO SEA-LEVEL RISE

## A. INTRODUCTION

The vulnerability assessment (Chapters Two and Three) concluded that the areas most threatened by the prospect of accelerated sea-level rise are sand beaches and salt marshes. Eroding coastal bluffs are also faced with significant impacts from a continuation of current erosion.

In some of the mapped sites, substantial development is already located in threatened areas. For example, in central Old Orchard Beach, a rise of 50 cm by 2100 would inundate all of the commercial development on both sides of Route 9, back to the railroad tracks. In Camp Ellis, a similar rise in sea level would inundate 71 acres of land already developed with 210 structures.

In these intensely developed areas there is no question that private investment is on a collision course with coastal erosion and inundation. Public investments (e.g., roads, sewer systems and public open space), coastal beach-based recreation and tourism (e.g., sand beaches and public shoreline access areas), and marine resource industries (e.g., critical wetland habitat for commercially valuable species, commercial water dependent uses and commercial access to public waters) may also be heavily impacted by sea-level rise.

Governmental policies, laws and regulations will be instrumental in determining to what extent new public investment and new private development will take place in areas projected to be subject to coastal erosion and inundation as a result of sea-level rise. They will also establish the rules for treatment of existing development as the development is threatened by a change in shoreline position and as that same development threatens to interfere with natural coastal processes. This chapter analyzes existing state and federal laws to evaluate the extent to which they are already prepared to minimize adverse impacts of accelerated sea-level rise, and the extent to which they can be modified to respond to an anticipated change in shoreline position.

In evaluating existing laws and policies, this chapter **posits that a retreat strategy is generally preferable to a protection strategy**. Where the coastal processes and land development are on a collision course, the preferable option will be for the land development to move back from the

shoreline. Only in very limited circumstances (e.g., the commercial port area of the Portland/South Portland harbor) might it make economic sense to deviate from this policy; in limited areas the already disturbed character of the shoreline and the nature and intensity of the threatened development might justify protective engineered solutions, such as seawalls, to keep the shoreline from migrating.

The very simplified cost/benefit analysis of alternative policy response options for one developed, extremely vulnerable site (Camp Ellis, Chapter Four) supports preference for a retreat strategy. It found that the relative costs and benefits of protection and retreat favor the latter in that setting.

Similarly, a survey of innovative policy responses to sea-level rise and coastal erosion in selected coastal states (*See* Appendix B) verified that these states are beginning to embrace a retreat strategy as well, at least as a strategic response to a continuation of historical patterns of shoreline change. While these state approaches vary significantly in detail and in the extent to which they have been able to translate broad policy goals into implementing laws, there are **notable shared themes that Maine's policies should also embrace as guiding principles:**

1. Respect the dynamic nature of coastal systems;
2. Strive to preserve/enhance the resiliency of natural systems;
3. Acknowledge as underlying premises that the public should not be subsidizing private development in hazard areas and that private development in hazard areas can constitute a public nuisance;
4. To maximize political acceptance, build on and strengthen existing coastal policies rather than developing a separate set of sea-level rise policies;
5. Utilize state or regional oversight of local decisions regulating coastal development to facilitate integrated management of coastal systems and to better reflect the state-wide interests in this public resource;
6. Develop an integrated approach to control impacts on beaches, eroding bluffs and migrating wetlands recognizing that they are parts of an interconnected natural system;
7. Acknowledge that no one technique will be sufficient for the entire shoreline; incorporate sufficient flexibility to respond to differences in coastal topography, varying intensity of development, and land use (e.g., water dependent uses);
8. Utilize coastal setback requirements to minimize new development in hazardous coastal areas;
9. Supplement coastal setbacks with a variety of additional regulatory, tax, acqui-sition and planning strategies.

These premises inform the following analysis of Maine's laws and regulations.

## B. MAINE'S LAWS AND REGULATIONS RELEVANT TO SEA-LEVEL RISE

The laws and regulations currently in place in Maine constitute the State's de facto response to the threat of sea-level rise. A few of the laws specifically anticipate the possibility of sea-level rise; other laws address a range of possible coastal hazards which could include sea-level rise. The laws and regulations with primary impact are summarized in Appendix A, with specific focus on their relevance to possible sea-level rise. It may be consulted for more detailed discussion of each law. The analysis in this chapter draws upon that review to identify strengths and weaknesses in existing laws.

This chapter first reviews the general laws and policies which provide the mandate or enabling legislation to plan for sea-level rise. Then, because the regulatory needs are different for each type of coastline (sand beach, marsh/flat, bluff, and engineered shoreline) this chapter analyzes the specific portions of existing laws and regulations most likely to influence development along each type of shoreline.

### 1. Background Law: Coastal Management Policies Act

The 1986 Coastal Management Policies Act[1] is a statement of policies to guide the State in balancing competing coastal uses. The Act establishes nine policies and directs that state, local, and certain federal agencies with responsibility for regulating, planning, developing, or managing coastal resources conduct their activities in a way which is consistent with the nine policies.

The policy relating most directly to sea-level rise is Policy Four which states:

> **Hazard area development.** Discourage growth and new development in coastal areas where, because of coastal storms, flooding, landslides or **sea-level rise,** it is hazardous to human health and safety[.] (emphasis added)

The accompanying illustrative Guidelines[2] express the rationale for the policy, noting that coastal floodplains, sand dunes, and wetlands in their natural state provide storm protection and support a variety of important plants and wildlife. Citing the extensive damage to natural and man-made features visited by coastal storms and the direct and indirect costs to governments of repairing this damage, the Guidelines establish the objective of discouraging development and redevelopment in areas that present threats to public safety or that threaten property damage which will be costly to public entities.

The Guidelines recommend that affected agencies govern themselves in accordance with the following policies:

- Government agency decisions will not support new infrastructure or related facilities in hazardous areas;
- Public funds available for improvements, renovations, or repair to existing infrastructure or other public facilities in hazard areas will give priority to their relocation out of hazardous areas.
- Government agencies will require new and modified structures/facilities to be adequately setback to protect them from erosion for 100 years.

- Government agencies will include scientific projections of sea-level rise in regulatory and management decisions affecting the shoreline.[3]

The Coastal Management Policy Act does not contain any provisions providing sanctions for violating the Act. By Executive Order, state agencies were directed to examine all their programs affecting the coast and to incorporate changes to make them consistent with the Policies before December 31, 1987. This Order was tackled with varying levels of agency enthusiasm and resources, resulting in uneven and unsystematic responses. It is fair to say that the December 31, 1987 goal was not met, but work is continuing on an incremental basis in some agencies to bring the State closer to the goals expressed in the Coastal Policies.[4]

As mentioned, the Act also encouraged federal and local agencies to review their programs for compliance with these Coastal Management Policies, but without establishing any deadlines. For municipalities, the primary land use regulatory entity in Maine, these policies were eventually given greater relevance through provisions in the Growth Management Act[5] and the Shoreland Zoning Act,[6] both of which require the resulting comprehensive plans, comprehensive land use ordinances, and shoreland zoning ordinances adopted by coastal municipalities to "address" the Coastal Management Policies. Coastal Policy Four may be furthered through voluntary comprehensive planning efforts, through state review of local plans for compliance with the Coastal Policies as a condition of awarding implementation grants, through continuing state technical assistance, through state consistency certification for preference for certain funds, and through the long-range restriction that a municipality will not be able to enforce any local land use ordinances (beyond the minimum shoreland zoning requirements) if it has not adopted a comprehensive plan which is consistent with the Act (including furthering its goals and the Coastal Management Policies) by 1998 or 2003.

The possibilities for encouraging municipal compliance under the Shoreland Zoning Act, as currently enforced, are more limited. While the Act recites that each coastal municipality is required to address all of the coastal management policies in its shoreland zoning ordinance, assessing compliance with these policies has not been a high-priority on the part of municipalities or the Department of Environmental Protection. If a municipality meets the minimum Guidelines for Shoreland Zoning Ordinances, it is not independently evaluated to ascertain whether it has addressed the coastal management policies.

In summary, Coastal Management Policy Four and the associated Guidance provisions appear to be sound policy statements as far as they go, but they provide just the merest shadow of an outline for a comprehensive, enforceable strategy. The policy statements and guidelines are very general. They do not shed any light on the weight to be accorded hazards posed by storm-driven erosion, local subsidence, and the threat of sea-level rise as a result of global climate change. Finally, the Act relies on essentially voluntary implementation by affected local, state, and federal agencies. Policy Four of the Coastal Management Policies Act is probably most important as an expression of public purpose which can be invoked by various governmental entities as they adopt statutes, rules, and ordinances which flesh out a detailed response strategy.

The following sections explore in more detail how existing laws currently address the Policy Four goal of discouraging growth and new development in coastal areas where, because of sea-level rise, that type of growth and new development would be hazardous to human health and safety.

## 2. Sand Beaches

### *a. Character of Development*

Sand beaches in Maine are primarily located in the southern part of the state in the Saco Bay and Wells embayments. The northern beaches are more typically composed of cobble. Statewide, beaches (both sand and cobble) constitute only about 10% of the 3,300 mile tidal shoreline.

Many of the southern beach areas first developed as summer resorts. During this century, development spread to cover almost every available space on large beaches and much of the area adjacent to smaller, frequently less stable strandlines as well.[7] These communities of seasonal single family residences are increasingly seeing summer homes converted for year-round residences.

While most of the land adjacent to these southern beaches is already developed to some extent, absent governmental restrictions on the location and intensity of new development, pressure is building for a new generation of higher intensity development on land currently occupied by lower-intensity uses. For example, summer camps have been bought and razed to make way for larger year-round homes. And developers contemplating high-rise residences eye sites currently occupied by small businesses and old motels. Whether this type of development will actually come to pass depends primarily upon economic conditions and upon the limits imposed by state and local land use regulations, including whether the review authorities will have the political will to enforce those restrictions.

As discussed in more detail in Chapter Two, the mapping of selected areas for this project using 50, 100 and 200 cm scenarios projected that the shoreline along sand beaches would move in the magnitude of 50-150 meters (150-500 feet) landward over the next 100 years assuming a 50 cm (1.6 foot) rise in sea level; 100-300 meters (300-1,000 feet) landward over the next 100 years assuming a 100 cm (3.3 foot) rise in sea level; and 200-600 meters (650-2,000 feet) landward over the next 100 years assuming a 200 cm (6.5 foot) rise in sea level. The 50 cm scenario by the year 2100 is the most likely of the three scenarios, but hazard mitigation planning theory suggests that it makes sense to evaluate the higher scenarios as well.

### *b. Natural Resources Protection Act and Sand Dune Rules*

The primary law controlling development in sand beach areas is the Natural Resources Protection Act (NRPA)[8] as further fleshed out in the Coastal Sand Dune Rules.[9] The NRPA requires that all proposed construction affecting critical natural resources meet various standards prior to receiving a permit. The Rules further articulate the standards and other requirements a proposal must meet to be deemed in compliance with NRPA. Together the statute and rules establish policies which prohibit new construction in certain portions of the sand dune system, restrict the intensity of development where it is not prohibited, and require mobility or retreat for new and existing structures in the face of migrating coastal systems.

The Sand Dune Rules articulate the basis for these policies, noting that there is evidence that sea level is currently rising, that "theories have been developed which predict this rise to accelerate in the future,"[10] and that any rise will increase the "rate of shoreline erosion and flooding, and the risk of damage to coastal property."[11] The rules further state:

> The extent to which sea level will change in the future is uncertain. However, under any scenario of increasing sea level, the extensive development of sand dune areas and the

> construction of structures which are not practical to move increase the risk of harm, both to the sand dune system and to the structures themselves.

Therefore, in order to protect the natural supply and movement of sand, and to prevent creation of flood hazards, the Board will evaluate proposed developments with consideration given to future sea-level rise and will impose restrictions on the density and location of development, and on the size of structures.[12]

A permit is generally required for any construction, repair, or alteration of any permanent structure in a coastal sand dune system (defined to include beach berms, frontal dunes, dune ridges, back dunes,[13] and other sand areas deposited by wave or wind action).[14] An applicant is required to demonstrate that the proposed action meets statutory standards for review, which for activities on or adjacent to a sand dune require that the activity "not unreasonably interfere with the natural supply or movement of sand within or to the sand dune system or unreasonably increase the erosion hazard to the sand dune system."[15]

Additional minimum standards are articulated in the Rules which must be satisfied before a permit will issue, including:

> Projects shall not be permitted if, within 100 years, the project may reasonably be expected to be damaged as a result of changes in the shoreline.[16]

The Rules are extensive and complex, but generally establish two sets of restrictions—one applicable to existing structures and the other applicable to new structures. Buildings which have been damaged to greater than 50% of their appraised value due to an ocean storm cannot be reconstructed or replaced and additions to existing structures are not allowed unless they can meet the requirements for new structures.

### *c. Existing Structures*

No State permit is required for the maintenance and *minor* repair of existing structures above the high water line causing no additional intrusion into a sand dune. But a State permit is required for:

- The restoration or replacement of a building which is damaged to greater than 50% of the building's appraised market value by an ocean storm;
- The repair of a seawall if the repair cannot be done with hand tools, or if there will be any increase in dimensions, or if the building behind the seawall has been severely damaged by an ocean storm and the damage exceeds 50% of the building's appraised value;
- Any repair, rehabilitation, or other improvement of a building, the cost of which exceeds 50% of the appraised market value of the building before the start of construction;
- Any work done to enlarge an existing building; and
- Reconstruction or replacement of an existing building.

The owner of a structure damaged by a coastal storm or coastal erosion will be unable to rebuild either the structure or any seawall in front of it without a permit if the structure is damaged by more than 50% of its value. In applying these regulations, no distinction is made based on the source of the damage, such as whether it was caused by a 100-year storm, a 5-year storm, or gradual erosion.

To rebuild, the owner must apply for a permit within one year of the damage, and must meet all of the standards for new buildings (except maximum size and view protection provisions). It is unlikely that such a permit to rebuild would be granted since the extent of the recent damage would make it difficult for the applicant to satisfy the minimum standards, including the standard requiring no unreasonable interference with the natural supply or movement of sand within or to the sand dune system. It might also be considered a flood hazard to itself.

However, until damaged to 50% of its value, existing structures can be maintained, repaired (if the repairs are not so extensive that they actually enlarge, reconstruct or replace the structure), and improved. As written, the allowed "improvement" is rather broad. It can cost up to half of the appraised value of the existing building prior to the start of construction and (except in V-zones) may involve the construction of a second story or dormers.

In summary, these provisions allow existing buildings to not only remain in beach areas which are threatened by sea-level rise, but also in some cases, to be enlarged within the existing footprint (second story, dormers). Substantial improvements can be made until a building is damaged by more than 50% of its value. However, at that point, a permit is required for repairs or rebuilding and a structure cannot be rebuilt unless it can meet the standards for new construction (see below). It is unlikely that an applicant would be able to secure such a permit; the owner of the damaged property would be required to abandon it and retreat to less vulnerable land.

To date, the provisions prohibiting rebuilding if a structure has been damaged by more than 50% of its value have been applied in numerous instances, with only one litigated challenge to the no rebuilding provision. That case involved an after-the-fact permit application (permit applied for after the seasonal cottage was already substantially built) for a post-erosion damage replacement structure at Popham Beach. The Maine Supreme Court upheld the BEP's denial of a sand dune permit, finding that it was supported by substantial evidence. One of the BEP's grounds for denial was that the applicants had failed to meet their burden to show that the project would not reasonably be expected to be damaged within 100 years as a result of changes in the shoreline.[17] The applicants subsequently claimed that denial of a sand dune permit constituted a regulatory taking of property without compensation in violation of the Maine Constitution. The Maine Supreme Court held that no taking had occurred because "beneficial and valuable uses of their property remain."[18]

### *d. New Construction*

The standards for new construction in or on a coastal sand dune system are similarly rigorous. They limit areas and types of structures. New structures are prohibited in V-zones (velocity zones or that portion of the land that would be inundated by wave surges superimposed on a flood) and on or seaward of frontal dunes.

The Maine Supreme Court has been asked to rule on this provision twice. In one case, it upheld the BEP denial of an after-the-fact permit and denial of a variance to build a house addition on Hunnewell Beach in Phippsburg because it was on a frontal dune.[19] A second case involved denial of a permit to build a new residence on a narrow sand dune between a salt marsh and the ocean on the only remaining vacant lot in Horseshoe Cove, Biddeford.[20] Again, accepting Maine Geological Survey's determination that the house would be located on a frontal sand dune, the Supreme Court found that the evidence in the record amply supported the Board's denial of the initial application

and of the variance request. The Court did not, however, reach the applicants' claim that denial of a permit would constitute a regulatory taking under the Maine and United States Constitutions.[21]

New seawalls are prohibited outright, regardless of whether they would be in front of new or existing structures. Property owners have sought relief from this provision through special legislative amendment twice. In one instance in 1987, a few Pine Point property owners succeeded in obtaining an amendment to allow permits to issue for bulkheads along the Scarborough River from the jetty to the town landing. The resulting permits are, however, subject to the requirements that the applicants maintain the bulkheads and also repair any damage to the frontal sand dune between the end of the bulkhead and the town landing.[22] But in 1994, a similar request for legislative amendment by Biddeford property owners was defeated in committee; committee members expressed their determination to maintain the integrity of the Sand Dune Rules by refusing to grant piecemeal exceptions.

In areas where development is not prohibited outright, its intensity is restricted. Developed areas (including driveways, parking, lawns, septic systems, buildings, etc.) are limited to 40% of the site, and no more than 20% of the lot may be covered by buildings.

For larger buildings, the rules establish a more stringent criterion by specifically requiring the permit reviewer to assume that sea level will rise 3 feet over the next 100 years. Specifically, no new building may be more than 35 feet in height or have a footprint of more than 2,500 square feet unless the applicant "demonstrates by clear and convincing evidence that the site will remain stable *after allowing for a three foot rise in sea level over 100 years*" (emphasis added). This is the only provision in the Rules which makes any express assumption of a particular rate of sea-level rise over a specific period of years. The applicant may not rely on the existence of a seawall as evidence of site stability. The applicant may not propose to build a seawall or engage in beach nourishment as a means of stabilizing the site.

In addition to these restrictions on intensity of development, as with existing structures, the regulations establish a policy of retreat if sea level rises. All new, reconstructed, or replacement structures approved after the effective date of the rules[23] are subject to the following conditions:

1) No seawall shall be constructed or expanded on the property.

2) If the shoreline recedes such that the coastal wetland ... [including tidal and subtidal lands] extends to any part of the structure, including support posts, for a period of six months or more, then the approved structure, along with appurtenant facilities, shall be removed and the site shall be restored to natural conditions within one year.

3) Any debris or other remains from damaged structures on the property shall be removed from the sand dune system.

4) No structure shall be relocated within the sand dune system without approval of the Maine Department of Environmental Protection.

These rules are justified within the text of the Rules by findings by the Department of Environmental Protection that sea level is rising, seawalls interfere with the supply and movement of sand and accelerate erosion, and structures in a coastal wetland interfere with the natural supply and movement of sand and create an unreasonable flood hazard.

These Rules effectively prohibit the strategy of building "floodproofed" structures on pilings with the intent to maintain the structure after the beach has eroded out from under it. These retreat conditions maintain flexibility on when they will kick in; if sea level rises more quickly than anticipated they will require retreat sooner than 100 years, but if the rate of rise is less than projected, they will allow the structure to remain longer.

This policy of retreat is enforceable against these new, reconstructed and replaced structures through express conditions of approval. In addition, the Rules state that the Department will record sand dune orders containing any of these conditions with the Registry of Deeds. If this is done, it puts all subsequent owners on notice of these conditions prior to any purchase of the property.

In summary, pursuant to these rules (which only control development along less than 10% of the State's shoreline) new construction in or adjacent to sand dune systems is tightly regulated, and those new, reconstructed, or replacement structures which are allowed are subject to retreat requirements if the shoreline recedes so that any part of the structure is affected by tidal waters for 6 months or more. Similarly, once constructed, if they are damaged by a coastal storm by more than 50%, they would probably be unable to rebuild.

The provision dealing with construction of larger structures requires reviewers to evaluate site stability assuming that sea level will rise 3 feet over the next 100 years. For smaller structures, assessment of site stability must be made on a case-by-case basis guided by the policy that projects will not be permitted if, within 100 years, the project may reasonably be expected to be damaged as a result of changes in the shoreline.[24] No rate of change is specified; typically the DEP and BEP have considered a continuation of the historical rate of change rather than an accelerated rate of change as a result of global climate change. The Rules use an accelerated rate (3 feet over 100 years) for reviewing larger structures but an historical rate for reviewing smaller structures based on the assumption that the smaller structures are movable, and would be moved if threatened by coastal erosion.

### *e. Other Laws Affecting Sand Beaches*

Development on or along sand beaches is also controlled by several other land development regulations which are general in focus, including the Mandatory Shoreland Zoning Act and corresponding local shoreland zoning ordinances,[25] the Site Location of Development Act if the proposed development exceeds certain size/intensity thresholds,[26] the Subdivision Law,[27] and the State Floodplain Management Program.[28] They are much less detailed than the NRPA Sand Dune Rules, but do add a few specific setback requirements and review standards which might supplement the Rules in particular instances.

In addition, the State's Coastal Barrier Resources System Act[29] prohibits the expenditure of state funds or the granting of state financial assistance for development activities within the designated coastal barrier resource system.[30] Proscribed development activities include construction or purchase of structures, construction of roads, airports, boat-landing facilities, bridges or causeways, and erosion prevention projects.

Maine's statute and the parallel federal law are designed to protect and conserve coastal barriers and the adjacent wetlands, marshes, estuaries, inlets, and nearshore waters by discouraging

development on and adjacent to those barriers. To date, only a small fraction of Maine's undeveloped areas (e.g., 32 coves, beaches, islands, points) are designated for inclusion in the coastal barrier system. This law provides limited, though important, protection for these undeveloped areas by prohibiting expenditure of state funds in support of development. It does not restrict private investment.

### *f. Opportunities to Strengthen Controls on Development*

One of the problems with the sand dune permitting system as currently administered is that it requires an individual assessment of site stability, potential interference with the natural supply or movement of sand, and erosion hazard for each application. Advanced designations are currently used only to designate locations of frontal dunes, back dunes, and flood hazard zones through computerized sand dune maps which have been prepared for certain areas of sand dune systems in southern Maine.[31] While the designation of these maps as "best available information" for purposes of establishing these existing zones is important to rule out certain types of development in specific areas, they address only part of the issue. These maps show only existing conditions; they do not project hazards posed by beach erosion, by formation or migration of inlet and marsh channels, by engineered shorelines, or by sea-level rise.

The Maine Coastal Program has identified the need to refine the regulations so that the State makes more advanced judgments about where development should be prohibited based on projections of future hazards. In theory, the advanced designation of hazard areas will not only guide private investment decisions and lend consistency to permitting decisions under NRPA, but will also be useful to guide government agencies in making public infrastructure decisions and will provide important information about natural geologic processes to municipalities for integration into their comprehensive plans and land use regulations.

To accomplish this end, the Maine Geological Survey (MGS) and the Department of Economic and Community Development (DECD) are currently involved in a two-phase Shoreline Erosion Management Project to enhance the sand dune maps so they convey more information about historical shoreline change and the vulnerability to future shoreline retreat. The first phase of the project is to calculate shoreline change rates for three priority hazard areas based on change in shoreline position over time. The second phase will expand the coverage of "coastal hazard maps" to include approximately 30 additional beach systems throughout the state. A Geographic Information System (GIS) system will allow these maps to display information about the existing built environment, locations of frontal and back dunes, past shoreline changes, wave washover and flood zones, erosion rates for selected points, and a shoreline hazard rating. The MGS GIS is able to display information about shoreline change in great detail, since the grid size can be as small as one square meter.

Completing the measurement of historical erosion and developing these increasingly detailed maps of coastal hazards along beach systems throughout the state will give the State the ability to consider adopting different setback lines for each beach or segment of beach based on historical average annual erosion rates. These setbacks could vary based on local historical shoreline change/erosion rates. These area-specific setback lines would reflect significant differences which occur along the coast based on different types of beach systems (type of shoreline (sheltered or exposed), composition (sand to cobbles), off-shore profile, and other relevant characteristics).

The preliminary assessment of policy directions suggests that this information could be used to establish setback distances based on the erosion rate of a particular beach or beach segment using a setback line based on 100 times the historical average annual rate. These maps would give much more explicit guidance in applying the policy already articulated in the Sand Dune Regulations that "projects shall not be permitted if, within 100 years, the project may reasonably be expected to be damaged as a result of changes in the shoreline."[32]

This 100-year policy would place Maine in the forefront of states with state-imposed setback requirements. Several other states use variations on a 30-year/60-year standard for small and large structures.[33] This lower standard has been criticized as being too low to reflect the life expectancy of modern structures.[34] The National Research Council Committee on Coastal Erosion Zone Management in its 1990 report recommended that state and local erosion management programs should be encouraged to adopt stricter erosion standards such as a 50-year/100-year standard for small and large structures.[35] Maine's adoption of a 100-year setback standard for all buildings would be consistent with this recommendation.[36]

However, it should be noted that while substantial public benefits should be expected from enforcing setbacks based on a 100-year erosion projection based on historical erosion rates, these setback lines may still significantly underestimate the area vulnerable to coastal erosion. These new setback maps would determine the mandatory setback from erosion-prone shorelines by assuming that the past average annual erosion rate will continue unchanged into the future. The problem with using historical rates is that it makes no allowance for forecasts of global climate change.

Maine Geological Survey, based on tide gauge readings over fifty years and assuming a continuation of the historical rate of change, predicts that seas in Portland will be 21 to 26 centimeters higher in 2100.[37] Sea level increases based on this historical tide gauge data are projected to be slightly higher in Eastport (27-31 cm) and slightly lower in Kittery (11 cm). Establishing setback lines based on an assumption of a continuation of past erosion rates incorporates an assumption of a continuation of the historical rate of sea level change as well.

However, more recent forecasts of global sea-level rise based on revised International Panel on Climate Change emissions scenarios place the global low-, mid-, and high-level forecasts at 15 cm, 48 cm, and 90 cm respectively.[38] Those numbers have to be increased to reflect local subsidence (based on historical change less historical global rise of approximately 12 cm per century) to project total sea-level change in the local area. Using the revised forecasts, this would result in a forecast rise in Portland by the year 2100 of 24 cm (low), 60 cm (mid), and 104 cm (high). If these scenarios for accelerated global sea-level rise are borne out, the resulting increase in locally-experienced sea-level rise will be approximately 14% (low), 150% (mid), or 300% (high) greater than the increase in sea level assumed by projecting a continuation of historical rates.

In the phase I completion report for the Shoreline Erosion Management Project, the Maine Geological Survey discusses the possibility of global sea-level rise as a result of global warming, and acknowledges that "erosion rates determined in this study are possibly conservative when calculating future beach changes."[39] The basis for this conclusion is that "it is quite likely that an acceleration in the rate of sea level rise will cause an increase in the erosion rates."

In summary, the Shoreline Erosion Management Project assumes a continuation of an historical rate of change without projecting a future, accelerated rate of erosion based on accelerated sea-level rise as a result of global climate change. Thus, the State must still confront the policy issue of how to integrate projections of accelerated sea-level rise into any revised coastal hazard mitigation strategy. Due to the scientific uncertainties currently surrounding those global change projections, the State may be justifiably apprehensive about basing mandatory setback requirements for *all* development on projections of historical erosion *plus* erosion anticipated as a result of accelerated sea-level rise due to global climate change. However, the State should consider using more stringent setback requirements which include assumptions about an accelerated rate of sea-level rise in certain conditions.

For example, the State could further articulate a two-tiered system, similar to the one it uses now, in which some uses are subject to a setback based on 100 times the historical annual average erosion rate for that beach and other uses are subject to a setback based on projections assuming a specified accelerated rise in sea level (e.g., a rise of 3 feet or 100 cm over 100 years). The Sand Dune Regulations as currently applied make this distinction with regard to small and large new development; for all development, the Rules direct that no permit shall be granted if, within 100 years, the project may reasonably be expected to be damaged as a result of changes in the shoreline.[40] For small development, while the means of measurement is not specified, 100 years of stability is assessed using a projected continuation of historical rates. In contrast, the Rules specifically state that 100 years of stability for larger projects is to be assessed assuming a rise in sea level of 3 feet over the 100 years. It would be a good idea to make this distinction more explicit if that is what is intended. With the completion of the maps being developed under the Erosion Management Project, setback requirements for smaller structures could be designated in advance, based on historical change. For larger development, the regulations could continue to contain a setback requirement which requires applicants to assume a 3-foot rise in sea-level over the next 100 years.[41]

Another variation on this system would be to designate particular favored uses (such as water-dependent uses or uses supportive of commercial water-dependent uses) which would be subject to setbacks ranging from 0 feet (if functionally required) to rates based on historical change. The less favored uses (such as non-water dependent commercial and residential structures) would be subject to the requirement that they show the site will be stable assuming a specified accelerated rate of change (e.g., 3 feet over 100 years).

In proposing these setbacks as a component of an anticipatory sea-level rise response strategy, it is assumed that it is rational to continue use of current setback requirements, which are based on 100 times an historical or accelerated sea-level rise rate (using the mid-level 100 cm or approximately 3 foot scenario), particularly since they have been in place for more than a decade. Many current owners of shoreline property, particularly those purchasing during the boom years of the mid-1980s, have assumed ownership with no investment backed expectation of being able to build closer than these setbacks.

However, as yet unresolved Maine litigation may hold that even though the BEP has the power to deny sand dune permits and variances on frontal dunes and forward of these setback lines, the application in a particular fact situations may constitute a taking of private property requiring compensation.[42] This possibility is discussed in more detail in the following chapter.

In evaluating the appropriateness of using setback provisions which incorporate assumptions about accelerated sea-level rise, decision-makers should be cognizant of the EPA's uncertainty analysis. According to EPA, a rise of at least 100 cm has a 5% chance by 2100 and 50% chance by 2200. Assuming these EPA projections are correct, using a setback based on a 3 foot/100 cm rise scenario for larger structures would mean that the State would have a 95% probability of successfully keeping large new structures from interfering with coastal processes for the next 100 years. At the same time, given the uncertainty, it also means that there is a 50% probability that those large structures would not have been affected by a change in shoreline position for 150 to 200 years and could in fact have been built closer to the shoreline with no innundation by 2100.

Policy makers must balance the risk of harm to structures and the natural systems against the chance that they will unnecessarily restrict the use of the property. Factors supporting a cautious approach for larger structures (i.e., establishing setbacks using a 100 cm rather than 50 cm or historical rate assumption) include: 1) the lack of mobility of large structures, 2) the probable continued ability to make some economic use of the site through temporary or smaller more mobile structures, 3) environmental justifications for keeping intense development back from the shoreline, and 4) the possibility of adverse shoreline effects from global climate change separate from a change in shoreline position such as storm surges and an increase in the frequency or intensity of hurricanes in Maine.[43] Conversely, it may be acceptable to use a setback based on a continuation of historical rates of rise for small structures since they are relatively mobile if the sea rises faster than expected. However, it is critical that property owners fully understand that they will be required to move if threatened by a change in shoreline position so that expectation can be built into the property's purchase price and so they have no claim that they should be able to protect their investment by engineered means.

Since the eroding shoreline is a very dynamic system and since some of the scientific uncertainty about global climate change might be reduced over the next decade, any setback regulations should be established in such a way that coastal hazard maps establish a mandatory minimum setback, but do not preclude the State from requiring a greater setback if new information justifies it. This new evidence may include evolving geologic information, evidence of recent storm damage or flooding, and information about changes in tidal inlets, as well as new information about global climate change.

So long as the requirements for removal of new, reconstructed, and replaced structures remain in place and the State retains the institutional will to enforce those requirements, the policy of retreat in the face of sea-level rise will be implemented, regardless of whether there are any mandatory setback requirements. However, incorporating mandatory setback requirements in addition to the retreat requirements will help minimize the amount of private economic loss due to unwise development decisions and will reduce the number of individuals with economic incentives to bring political pressure to bear to weaken the retreat policy.

## 3. Salt Marshes

### *a. Character of Development*

The southwest coastal compartment of Maine (from the New Hampshire border to Cape Elizabeth) constitutes approximately nine percent (9%) of the State's total shoreline; approximately

65% of this shoreline is salt marsh. Similarly in the 31% of coastal shoreline in the area from Cape Elizabeth to Port Clyde, approximately 26% of the shoreline is salt marsh. Along the remaining 60% of the shoreline to the north, salt marsh shoreline is much less prevalent, constituting approximately 10% of the tidal shoreline.[44]

Historically, recreational tourism and summer home shoreline development has tended to concentrate along beaches and on scenic rocky promontories overlooking the sea. Development along marsh areas has not been as intense nor has it been as driven by seasonal or out-of-state users.

As described in Chapter Two, the mapping of selected areas using three scenarios projected that the shoreline along salt marshes would move in the magnitude of 3-35 meters (10-125 feet) landward over the next 100 years assuming a 50 cm (1.6 feet) rise in sea level; 8-50 meters (25-175 feet) landward over the next 100 years assuming a 100 cm (3.3 foot) rise in sea level; and 17-100 meters (50-325 feet) landward over the next 100 years assuming a 200 cm (6.5 foot) rise in sea level.

Structures and infrastructure are usually not the most vulnerable resources of concern in this type of setting since salt marshes are not usually the site of intensive development. The focus is instead on the values and functions of the salt marsh wetlands as critical habitat for birds, including migratory waterfowl, and endangered species; as spawning grounds and nursery areas for commercially valuable fish and shellfish; as a filter for removing pollutants and preserving water quality; as a flood water retention and flow reduction mechanism; and as a buffer protecting upland areas from erosion by absorbing and dissipating wave impacts. To continue to serve this function, it is critical that salt marshes be able to migrate inland with the change in shoreline position.

### *b. Natural Resources Protection Act*

Unlike sand beaches, for salt marshes, there is no single law which takes precedence over all others in managing the conditions under which development on or adjacent to it will be allowed or removed. Several different State laws and local ordinances all have a role to play in placing restrictions on development.

The Natural Resources Protection Act[45] is designed to protect many of the State's resources, including coastal wetlands, from degradation. A NRPA permit is required for any regulated activity in, on, over, or adjacent to any coastal wetland. Coastal wetlands are defined to include all tidal and subtidal lands, all areas with vegetation present that is tolerant of salt water and occurs primarily in a salt water or estuarine habitat, and any marsh, swamp, bog, or other contiguous lowland subject to tidal action during the maximum spring tide level.[46] This definition allows for the regulated area to fluctuate as the shoreline changes in response to global climate change or land subsidence.

The standards of review most applicable to proposed development in salt marsh areas try to minimize loss of the critical beneficial functions generally associated with these coastal wetlands such as wildlife habitat and flood protection. Specifically they include:

- **Soil erosion.** The activity will not cause unreasonable erosion of soil or sediment nor unreasonably inhibit the natural transfer of soil from the terrestrial to the marine or freshwater environment.

- **Harm to habitats; fisheries.** The activity will not unreasonably harm any significant wildlife habitat, ... aquatic habitat, ... estuarine or marine fisheries or other aquatic life....
- **Interfere with natural water flow.** The activity will not unreasonably interfere with the natural flow of any surface or subsurface waters.
- **Flooding.** The activity will not unreasonably cause or increase the flooding of the alteration area or adjacent properties.[47]

The State has promulgated Wetlands Protection Rules to ensure that the NRPA standards are met by applicants proposing regulated activities in, on, over, or adjacent to a coastal wetland.[48] The Rules establish a wetland classification system (with coastal wetlands defined as Class I, and wetlands located within 250 feet of coastal wetlands defined as Class II) and detail standards for avoidance of loss in wetland area, functions and values. They discuss "no practicable alternatives," compensation, mitigation banking, and "no unreasonable impact" criteria. However, unlike the Sand Dune Rules, they assume a relatively fixed shoreline position. No specific provisions are included to require an applicant to demonstrate that the site will remain stable over a long period of time, nor are there any requirements for retreat or removal of any structures that might be affected by a change in shoreline position.

The DEP has promulgated regulations describing the BEP's scope of review under the Soil Erosion Standard. The only regulation that might be of use in prohibiting structures that would prevent the landward migration of wetlands is a statement that in or on "coastal banks" a proposed activity may not unreasonably affect the supply of sediment from the bank to coastal beaches or other land subject to tidal action.[49] However, this provision has not historically been used to prevent the construction of seawalls or similar structures on or adjacent to non-sand coastal wetlands. Similarly, regulations elaborating on the scope of considerations under the harm to wildlife and fisheries and interference with natural flow of waters standards may be broad enough to embrace considerations of allowing landward migration of coastal wetlands, but do not contain express statements of that as a goal.

### *c. Mandatory Shoreland Zoning Act and Guidelines*

The Mandatory Shoreline Zoning Act[50] requires all municipalities to adopt zoning and land use control ordinances applicable to the "shoreland area" within its boundaries which are no less restrictive than minimum guidelines adopted by the Board of Environmental Protection. The shoreland area is defined to include those areas within 250 feet of any saltwater body or within 250 feet of the upland edge of a coastal wetland [10 acres or more, as defined].[51] Among other purposes, the Shoreland Zoning Act was designed to protect against unwise development in that area; to protect buildings and lands from flooding and accelerated erosion; to control building sites, placement of structures, and land uses; to conserve shore cover; and to anticipate and respond to the impacts of development in shoreland areas.

While not specifically crafted in response to anticipated accelerated sea-level rise, the Act contains water *setback requirements* with the potential to minimize the impacts of a change in shoreline position. The Guidelines[52] prohibit the construction of any new principal or accessory structure or any substantial expansion of an existing structure within the shoreland zone unless that structure is set back 100 feet from the normal high-water line of great ponds and rivers, and 75 feet

from the normal high-water line of other water bodies, tributary streams, or the upland edge of a wetland. In addition, there is essentially a 250 foot setback from the upland edge of a salt marsh or salt meadow wetland if the area is zoned Resource Protection; a Resource Protection designation is generally required in undeveloped areas if the area was rated moderate or high value by Inland Fisheries and Wildlife as of January 1, 1973.

There are, however, setback exceptions. A General Development District (or its equivalent, allowing intensive commercial, industrial, and/or recreational use) requires a 25 foot setback. There is no setback requirement in a Commercial Fisheries/Maritime Activities District (allowing functionally water-dependent uses). Thus adjacent to the upland edge of a marsh, the minimum setback requirements could range from 0 feet (for an unlikely water-dependent use in a marsh) to 25 feet for a relatively intense commercial or industrial use to 75 feet for a residential use to 250 feet in undeveloped Resource Protection Areas.

The Guidelines establish performance standards for piers, docks, wharfs, bridges, and other structures and uses extending over or beyond the normal high-water line of a water body or within a wetland. The Guidelines do not, however, establish performance standards for structures adjacent to but not currently in a wetland. This means there are no prohibitions in the mandatory minimum standards which would prevent a landowner from constructing a wall or other structure immediately outside a wetland to prevent the landward migration of a salt marsh as sea level rises.

Thus, while the Shoreland Zoning Act addresses the threat of accelerated sea-level rise to some extent by attempting to protect undeveloped land from development that would interfere with natural coastal processes, it fails to include provisions that anticipate a significant change in shoreline position. For example, the building setbacks were developed assuming a fixed shoreline position, based on how far development should be removed from wetlands to minimize the negative impacts of development on wetland values and functions.

In fact, given the projected rates of change for the different scenarios, except in Resource Protection Areas, the mandatory minimum setbacks fail in two major regards: 1) since they fail to build in a margin for a change in shoreline position, they establish an inadequate buffer to protect wetland values and functions in the long term; and 2) in the more vulnerable salt marsh areas, they also fail to require structures to be set back from the upland edge of a wetland a sufficient distance to protect those structures from being overtaken by a marsh migrating inland with the change in shoreline position. For example, for the more vulnerable of the sample salt marsh sites, this study projects a landward movement of 35 meters or 115 feet over 100 years given a 50 cm rise; this exceeds the general minimum setback requirement by 40 feet, the General Development Setback by 90 feet, and the Commercial Fisheries/Maritime Activities District by 115 feet.

Continued use of inadequate setback requirements, the absence of any prohibition on construction of barriers to salt marsh migration, and the absence of any requirements for removal of structures impacted by migrating marshes sets up a situation where it is almost inevitable that landowners will try to halt the landward migration of marshes through the construction of physical barriers. If this is allowed, it will result in the loss of salt marsh wetlands as the seaward edge moves inland in response to sea-level rise and the landward edge is prevented from migrating.

### *d. Opportunities to Strengthen Controls on Development Along Salt Marshes*

The migration of a marsh toward the upland is much less dramatic than the approach of the sea up a sand beach. The type of structure likely to be threatened in each situation is different too, with higher-intensity development more likely along sand beaches. In addition, the functions valued by the public vary. Sand beaches have significant economic, aesthetic, and recreational value; they attract high density development and anchor the Southern Maine tourism industry. Salt marsh wetlands make their contribution, but in a much less visible way; they serve as critical habitat for commercially valuable fish and shellfish, provide a different type of recreational opportunities, reduce the costs of maintaining water quality, and provide valuable flood and erosion control.

As discussed in the last section, Maine has already adopted a policy of mobility and retreat to protect sand beaches against a change in shoreline position; regulations applicable to new and replacement structures are designed to allow the beach to maintain itself by requiring removal of human impediments to allow a continuation of natural processes. However, the State has yet to explicitly evaluate extension of a policy of mobility or retreat for the salt marsh environment. The State should address the same retreat issue with regard to salt marshes. Without new parallel policies prevent bulkheads or other structures which interfere with wetland migration, a rise in sea level will result in a decrease in important salt marsh wetlands.

The State could use a couple of different approaches. One approach would be to strengthen the requirements under the Shoreland Zoning Act to expand the areas subject to the Resource Protection District prohibition on development within 250 feet of the upland edge of designated coastal wetlands. The State would need to review the sufficiency of the 1973 Inland Fish and Wildlife maps designating moderate and high value wetlands in coastal areas and update those maps if necessary. In addition, it would need to evaluate the exemptions allowing towns to opt for non-Resource Protection designations even in mapped moderate and high value wetland areas, and the provisions allowing special exceptions in Resource Protection Districts to determine whether this approach is likely to succeed.

A second approach would be to amend the Natural Resources Protection Act to broaden the jurisdiction to require a permit for activities on land adjacent to any coastal wetland that might interfere with the projected natural migration of that wetland, assuming a specified rise in sea level. This would expand the Act so it would not only protect against wetland degradation from material or soil washing into wetlands, but would also protect against wetland loss occasioned by precluding wetlands from migrating landward in equilibrium with rising sea level.

The State would need to promulgate detailed regulations designed to prevent the hardening of the upland edge. These regulations could be modeled after the Sand Dune Rules and the amendments to those rules discussed above. They could include a prohibition on hard structures designed to limit the landward migration of salt marshes, an increase in the minimum setback from the upland edge of a salt marsh based on projected rates of change in shoreline position, a requirement that more intensive development be required to prove site stability and adequate buffering given a projected 100 cm rise in sea level over 100 years, and a requirement that all new construction and replacement structures be removed if the shoreline changes so that they are substantially interfering with natural marsh migration processes.

As part of this process, the State will need to make a conscious decision about whether all areas should be subject to the requirements that they facilitate marsh migration, or whether distinctions should be made between particular areas. For example, the State might decide that shoreline in areas already developed to a certain intensity or already developed for a particular type of use need not be maintained in an unhardened state. Or it might make distinctions based on the slope of the adjacent land in its natural state; if the slope is already relatively steep so that the wetland would probably not be able to migrate without substantial loss of area, that might argue in favor of allowing hardening of the upland edge. These options decisions would have to be studied in greater detail before State policy makers can decide what proportion of the salt marsh shoreline should be kept in an unengineered state.

## 4. Eroding Bluffs

### *a. Character of Development*

Maine's shoreline includes ledge areas, which increase from approximately 3% to 24% of the shoreline as one moves northeast.[53] These ledge areas consist of both stable bedrock promontories and high bluffs of landslide-prone Ice Age mud. The bedrock promontories were generally built on first. As those prime sites have been developed, construction has spread to other areas such as eroding coastal bluffs of glacial sediment.[54] In some areas, these bluffs are eroding at a rate of one to three feet per year.[55] When the erosion is unimpeded, these coastal bluffs serve as a source of sand for beaches, particularly in areas lacking a major river to bring sediment from upstream, and a source of mud for salt marsh formation.

Unlike marsh and sand beach erosion, the erosion of most coastal bluffs is driven primarily by coastal storms rather than by any change in sea level, so projections of a change in shoreline position over the next 100 years are the same regardless of the sea-level rise scenario. And also unlike marsh and beach erosion, bluff erosion tends to be periodic, with major slumping events occurring at longer intervals rather than a small amount of erosion each year.

### *b. Natural Resource Protection Act*

Like development in salt marsh areas, bluff development is not regulated by any single law. Development on bluffs generally falls outside the Natural Resources Protection Act (NRPA)[56] unless it is a mapped significant wildlife habitat area, or is deemed to be on land adjacent to a coastal wetland and the proposed activity would operate in such a manner that material or soil may be washed into the coastal wetland. While there are soil erosion standards which conceivably could be applicable if triggered, eroding bluffs in themselves are not a targeted natural resource.

It would be consistent with the philosophy of NRPA to amend the Act to include eroding bluffs as a protected natural resource. That Act is designed to regulate activities which might result in environmental degradation due to activities in, on or over a protected natural resource or due to material or soil being washed into protected natural resources from activities on adjacent land. Development on or adjacent to eroding bluffs increases the risk of harm to the bluff and to other protected natural resources such as sand beaches. For example activities such as lawn watering and use of septic systems may hasten the erosion and degrade the bluff and shoreline area if erosion causes system failure.

A related activity, and one that is regulated by NRPA, is that property owners who have invested in development on bluffs may try to build structures to halt the process of erosion, to the detriment of the sand beach or marsh which was to be nourished by the eroded bluff materials. The NRPA soil erosion and habitat standards would be relevant, as well as the Soil Erosion Standard for activities to affect "coastal banks," which requires that a proposed activity may not unreasonably affect the supply of sediment from the bank to coastal beaches or other land subject to tidal action.[57] As with coastal wetlands, regulations concerning harm to wildlife and fisheries and interference with natural flow of waters standards may also be applicable.

### *c. Mandatory Shoreland Zoning Act*

Development on coastal bluffs will be controlled to a limited extent by the Mandatory Shoreland Zoning Act.[58] These bluffs are within 250 feet of the upland edge of a coastal wetland, thus would be included in the shoreland area. The minimum Guidelines require any permitted development to be set back at least 75 feet from the upland edge of that wetland. In addition, the minimum Guidelines direct the community to include lands "adjacent to tidal waters which are subject to severe erosion or mass movement, such as steep coastal bluffs" in a resource protection district. If zoned for resource protection, only non-intensive uses would be allowed; principal structures for residential, commercial, industrial, governmental, and institutional uses would be precluded. However, these areas will not always be placed in Resource Protection Districts. Under current law, even if coastal bluffs meet the criteria for resource protection designation, a municipality can opt to forego that designation if they are currently developed or meet the criteria for Limited Commercial, General Development, or Commercial Fisheries/Maritime Activities District designation. Additionally, a municipality may opt to grant special exceptions to allow residential development on a lot in a Resource Protection District which could not accommodate development anywhere else on the lot.

### *d. Site Location of Development Act*

A third law that might play a minor role in controlling development on eroding bluffs is the Site Location of Development Act.[59] It includes a soil standard which states that the development must be "built on soil types which are suitable to the nature of the undertaking and will not cause unreasonable erosion of soil or sediment nor inhibit the natural transfer of soil." However, this Act applies only to larger developments and there are no more detailed rules or regulations which directly relate the general standard to eroding bluffs.

### *e. Opportunities to Strengthen Controls on Development Along Eroding Bluffs*

The type of development most likely to be located on eroding coastal bluffs is single family residences. The Site Location of Development Act will not apply to this type of development. As the laws are currently written, the major burden for preventing unwise construction falls on the Shoreland Zoning Act, as enforced by individual municipalities through their Shoreland Zoning Ordinances.

There are several problems with relying on the Shoreland Zoning Act as the primary defense against development on unstable bluffs. First, the Act has always been plagued by compliance problems. These problems may be inherent in the intergovernmental division of responsibilities incorporated in the Act. The State promulgates mandatory minimum guidelines; each individual

municipality is responsible for adopting an ordinance which is consistent with the guidelines and for enforcing that ordinance. It has not been uncommon for municipal boards to view these requirements as unnecessary obstacles imposed on local landowners by the State rather than as part of a comprehensive effort to protect shoreland resources and prevent unwise development. However, local acceptance and enforcement might be growing as a result of improvements in training and certification of local code enforcement officers. If shoreland zoning is going to be relied on as the primary strategy for bluff erosion, a major public education effort on erosion and sea-level rise would be required to increase local acceptance of shoreland zoning provisions designed to mitigate those impacts.

Second, as written, a shoreland zoning ordinance will not be effective to prevent against unwise bluff development unless that area is designated for resource protection and unless the municipality does not grant special exceptions to allow single family development.[60] Municipalities are often reluctant to place land in a resource protection designation, and are frequently sympathetic to variance, special exception, or rezoning requests to allow more intensive use of this land.

Finally, if a municipality does not designate eroding bluffs as resource protection, as currently written, the remaining standards will probably be insufficient to require that development which does occur is setback a sufficient distance to protect it over its useful life. Depending on the particular bluff composition and its orientation, this study projects landward movement of the shoreline of approximately 15 to 45 meters (50 to 150 feet) over 100 years. Other studies have estimated that Maine's coastal bluffs are eroding approximately 1 to 3 feet per year, or 100 to 300 feet over the next 100 years, if the rate stays constant.[61] Thus, the State minimum mandatory setback of 75 feet from the upland edge of a coastal wetland is unlikely to be sufficient to protect the structure over its useful life.

If development is allowed, as the bluff erodes, there will be increasing pressure to invest in public or private bluff stabilization efforts. By definition, those stabilization efforts will interfere with the transfer of sediment from the terrestrial to the marine environment. Eroding coastal bluffs are a major source of mud for the regions mud flats and salt marshes, and can be a local source for beach sand.[62] Current NRPA standards could be applied, but historically have not resulted in denial of permits for that type of bluff stabilization. However, both bluff stabilization structures and individual seawalls along sand beaches raise the same specter of interference with natural processes. This suggests that bluff stabilization structures should be regulated to the same extent as sea walls.

One approach to increase control over development on eroding bluffs is to encourage individual municipalities to amend their shoreland zoning ordinances to address the issue. Municipalities are free to adopt shoreland zoning provisions which are more stringent than the state minimum guidelines.

The Department of Economic and Community Development is in the process of drafting model performance standards for erosion prone coastal areas (beaches and eroding bluffs) designed to be incorporated into municipal shoreland zoning ordinances. These performance standards would apply throughout the shoreland zone, thus would extend protections to bluffs not already included in a resource protection district. The current draft proposes to use a formula to increase the setback beyond the normal 75 feet in areas eroding more than one foot per year; the additional setback

increment would be determined by the average annual recession rate times the structure's assumed life span.

This type of formula would be a significant improvement since it would apply throughout the zone and would tie setbacks to erosion rates. It does, however, anticipate the use of erosion rate data for particular coastal areas which is not yet available from state agencies. Until funds are available for Maine Geological Survey to develop that data for the entire state, the municipality would have to work with its own geologist or Maine Geological Survey to develop that data for each application. The other limiting factor is that without amendment of the Shoreland Zoning Act, municipal adoption of these performance standards is completely voluntary.

The State should also evaluate a second approach: bringing eroding bluffs under more direct State control by amending NRPA to include eroding bluffs as a resource to be protected by the Act. This action could be taken alone or in concert with encouraging municipalities to amend their shoreland zoning ordinances as discussed above

Amending NRPA to include eroding bluffs as a protected natural resource offers the advantage of unifying direct state regulation over all of the major components of the "soft coast": sand beaches, salt marshes and eroding bluffs. By expanding the geographic reach of NRPA, it facilitates review of proposed activity based on its impact on the entire interconnected coastal system. This change should also promote consistency in underlying management policies. In addition, this approach would not have to rely on voluntary local action.

If eroding bluffs are expressly incorporated into NRPA as a protected natural resource, the State could then develop a set of rules parallel to the Sand Dune Rules to elaborate on the soil erosion standard (which mandates that the activity not inhibit the natural transfer of soil from the terrestrial to the marine environment) in the coastal bluff context. The new Rules could establish new setback requirements and a new retreat policy which would put applicants on notice that future bluff erosion would require that new and rebuilt structures be moved. These Rules would also serve to educate the public and municipalities about the fluid nature of this type of land form. Increased awareness alone might be sufficient to deter some coastal construction in this type of hazard area.

A third variation on this approach might be to allow waivers of the setback requirements for small structures with well located septic systems provided that the applicant agrees to a condition, memorialized as a recorded deed restriction putting all future owners on notice, that the structure could not be protected by engineered bank stabilization efforts and that it would have to be removed if any part of the structure was within a certain distance of the edge of the bluff.

## 5. Engineered Urban Shoreline

### *a. Character of Existing Development*

A fourth distinct type of shoreline consists of engineered urban shoreline. Maine does not have much as measured in miles of shorefront. But the extensively engineered portions of harbors, such as the Portland/South Portland inner harbor, are of critical importance to the economic functioning of the region.

The engineered shoreline in this part of the harbor consists of a series of established finger piers, docks, wharfs, seawalls, bridges, and similar structures. These structures were first established, largely on filled land, more than a century ago, and have evolved over time as grandfathered structures, generally free of particular performance standards or new regulations controlling their location or environmental impact. While subject to significant variation from parcel to parcel, according to observations of the Maine Geological Survey, they are generally designed to accommodate seas which are approximately six feet higher than current mean high tide. This means that even given a projected rise in sea level of 200 cm over the next 100 years, the shoreline position will remain in its current location along this urban engineered portion of the shoreline.

However, these structures have not been engineered to accommodate higher water levels as a means of advanced planning for sea-level rise. To the contrary, the extra increment above mean high tide is required to protect uplands from most storm events. Even this added increment is occasionally insufficient in extreme storm events as evidenced by the occasional flooding of parts of Commercial Street (the closest street parallel to the waterfront) and structures located on piers south of Commercial Street. Thus, while this engineered waterfront is not vulnerable to a change in shoreline position due to a rise in sea level, if it remains as it is now, it will be vulnerable to increased storm surges. Unless the structures are raised or reinforced, the geographic extent and frequency of flooding from storm surges will increase as sea-level rises.

The inner harbor portion of the waterfront is in an intensely developed area where any sensitive natural resources have already been disturbed through construction, dredging, intense use, and other perturbations. While regulators should guard against any further environmental degradation, the economic functions rather than environmental or habitat functions are likely to take precedence in most reviews. Unlike salt marsh, sand beach, and eroding bluff areas where future regulatory strategies are driven by preserving or restoring natural functions for maximum public benefit, on engineered urban waterfronts, the maximum public benefit will probably be derived by allowing this working waterfront to continue that economic function.

Individual property owners will experience any rise in sea level as a gradual change over time. It will probably first manifest itself as slightly greater vulnerability to storm events over time. It is likely that in the course of reinforcing and rebuilding existing structures through normal maintenance and repair activities, property owners will accommodate to the increase in sea level by raising the level of decks and designing the structure to protect upland areas from slightly higher waters. This type of response would be incremental, parcel-by-parcel, and uncoordinated. If waterfront users have sufficient resources to reinvest in periodically rebuilding and modifying their infrastructure, this *de facto* response strategy may be sufficient to allow those structures to remain in place and continue their economic functioning.[63] Regulatory policies should be evaluated to determine whether they will permit periodic reconstruction of piers and wharves to allow continued economic functioning of key businesses.

### *b. Local Comprehensive Zoning, Flood Plain, and Shoreland Zoning Ordinances*

The local comprehensive zoning ordinances for Portland and South Portland do not take the possibility of sea-level rise into consideration. Neither ordinance expressly requires the applicant to address site stability in the face of future change in sea level. To the extent that flooding is addressed in local ordinances, it is through the adoption of State-mandated minimum flood plain management regulations.[64] These regulations focus primarily on construction standards such as

minimum elevation of structures and other flood-proofing requirements. The review for compliance with these flood plain management standards tends to be rather cursory, with reviewing staff and boards tending to rely on representations of the developer's architect or engineer to gauge compliance with the technical requirements of the standards.

The Shoreland Zoning Act has only minimal impact on these municipalities. Both Portland and South Portland have complied with the Act by adopting hybrid ordinances that incorporate only selected portions of the Guidelines into local ordinances. The 75 foot mandatory minimum setback requirement under the Shoreland Zoning Act is inapplicable to the engineered portion of the Portland and South Portland shorefronts since the zoning in this area is analogous to General Development (25 foot setback) or Commercial Fisheries/Maritime Activities Districts (no setback) as established in the Act.

The Shoreland Zoning Guideline's performance standards for piers, docks, wharfs, bridges, and other structures,[65] the Submerged Lands Act[66] and the current comprehensive zoning ordinance for the City of Portland generally combine to establish a land use policy favoring water-dependent uses on, over, and immediately adjacent to coastal waters. This was not the case prior to 1987 when Portland and South Portland saw high-density residential condominiums, new office buildings, and tourist attractions such as floating restaurants approved for construction along the waterfront. The use restrictions tend to be the most stringent part of Portland's local zoning ordinances. For example, there are no setback requirements (except for 5 feet from the apron of a pier), lot coverage may be 100%, and buildings may be constructed to a height of 45 feet. Under certain conditions, a limited range of non-water dependent uses are allowed in the upper story space of waterfront buildings.

### *c. Opportunities to Strengthen Controls on Development Along Engineered Urban Shorelines*

There appear to be two regulatory strategies to evaluate with regard to minimizing damage from sea-level rise in the engineered urban harbor context. Since natural processes are no longer at work to maintain the functioning of the shoreline system, the engineered solutions will need to be updated as necessary. One strategy is to ensure that private owners are able to improve their structures to cope with rising waters on a periodic basis as part of regular maintenance and reinvestment opportunities. Any regulations which impede this ability should be identified and evaluated to determine whether there are any unnecessary restrictions which could be eliminated.

The second opportunity to minimize future damage from increased inundation along the engineered urban shoreline is to strengthen land use controls. While not originally adopted as a response to threats posed by accelerated sea-level rise, giving a strong preference to water-dependent uses for shoreline sites can become an important component of a sea-level rise adaptive response strategy.

There are multiple policy reasons for restricting occupancy of structures over water and along the immediate shoreline to uses which must locate there in order to function. Sites which provide reasonable access to navigable waters are a scarce resource, particularly in the Portland/South Portland harbor which has a very small shoreline in comparison to other ports in urban areas of a comparable size.[67] Those sites should be reserved for those uses which cannot function without that access. Other activities which are attracted to the shore primarily for the views, ambiance, or other

amenity values—such as retail shops, residential uses, and non-water dependent offices—should be required to locate further inland. They should not be allowed to preclude marine uses.[68] The only exception to this general principle should be in the case where non-water dependent uses can contribute to the economic health of water-dependent uses and key water-dependent uses would not otherwise be able to maintain the necessary piers, wharves, or similar infrastructure.

Without strong land use controls favoring water-dependent uses, during the last decade, market forces in New England's cities have combined to encourage development of high-density residential dwelling units, festival-type retail marketplaces, and high rise offices directly on the waterfront. This type of high intensity development immediately on the shore places many people, expensive structures, and complex urban infrastructure at risk from the impacts of rising seas.

In contrast, maritime uses tend to involve a lower level of investment in immobile structures or equipment, would have fewer people on site who would be exposed to the risk of storm events, and involve businesses and employees who are more cognizant of and accustomed to dealing with the vagaries of coastal waters. Furthermore, by definition, water-dependent uses have no option but to locate along the waterfront.

Restricting new shoreline development along engineered urban waterfronts to those uses which need to be there—water-dependent-uses—should help minimize the potential damage from storm surges or coastal inundation as a result of sea-level rise. This "no regrets" strategy will hold down the value of development in areas vulnerable to increased damage from possible sea-level rise. But even if sea level doesn't rise, it is consistent with other policies supporting the preservation of shoreline sites for water-dependent uses.

Municipalities should give strict interpretation to the definition of water-dependent uses so as to disallow uses such as residential condominiums with boat slips and floating restaurants as "water-dependent uses." Similarly, as projections of sea-level change are developed with greater precision, municipalities should evaluate whether they should develop more rigorous standards for larger water-dependent use structures which would require applicants to prove that the development is designed to minimize the hazards of storm surges assuming a rise in sea level of 3 feet over the next century. This two-tiered review would be similar to the stricter scrutiny given to structures in excess of certain height and size thresholds under the Sand Dune Rules.

The State should also review its policies on water-dependent uses. The Shoreland Zoning Guidelines allow, but do not mandate, identification of areas for inclusion in Commercial Fisheries/Maritime Activities zones. While Portland has a fairly strong waterfront zoning ordinance, the State should assess whether other communities with highly engineered waterfronts are permitting non-water dependent uses to locate in areas vulnerable to sea-level rise. One way to address the dual goals of protecting and promoting water-dependent uses and of minimizing the risk of damage due to sea-level rise would be to strengthen the Shoreland Zoning Guidelines to require designation of areas meeting particular site characteristics (e.g., a combination of utility as a site for a maritime use and orientation to wind and water making it vulnerable to sea-level rise effects) as Commercial Fisheries/Maritime Activities District, thus precluding new non-water dependent uses.

## C. FEDERAL LAWS AND REGULATIONS RELEVANT TO SEA-LEVEL RISE

In theory, federal laws could also supplement state laws to comprise a *de facto* substantive response to accelerated sea-level rise. In this section, relevant federal laws are reviewed in summary form to identify the extent to which they do supplement the response established by Maine's existing laws and regulations. In general this analysis concludes that while federal research efforts and funding initiatives are important in assisting states with the development of anticipatory response strategies, existing federal laws and regulations do not provide specific guidance to states or supplement state laws in a significant substantive way so as to constitute an anticipatory response strategy to accelerated sea-level rise.

### 1. Coastal Zone Management Program

The federal coastal zone management program, established by the Coastal Zone Management Act of 1972, as amended,[69] encourages and assists the states in preparing and implementing management programs to "preserve, protect, develop and where possible, to restore or enhance the resources of the nation's coastal zone."[70]

The Act was amended in 1990 to incorporate references to sea-level rise. A new Congressional finding states: "[b]ecause global warming may result in a substantial sea level rise with serious adverse effects in the coastal zone, coastal states must anticipate and plan for such an occurrence."[71] Each participating state's management plan is directed to provide for management of coastal development to minimize losses caused by improper development in "flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands."[72] Thus, to remain consistent with the federal law, and therefore eligible for federal financial assistance and leverage over federal actions, coastal management programs are required to incorporate sea-level rise considerations into program objectives and activities.

The 1990 amendments established section 309 Coastal Zone Enhancement Grants to assist states with specific projects to improve their management plans and implementing laws. Eight broad "enhancement objectives" qualify for the funding, including an objective on coastal hazards; anticipating and managing the effects of potential sea-level rise is one of the specific eligible topics within the hazard objective.

In summary, the Coastal Zone Management Act now requires some consideration of sea-level rise as part of the coastal management program and provides an opportunity for enhancement grant funding to facilitate planning and enhanced management. As with other coastal policy objectives, the Act does not mandate any particular sea-level rise strategy. Due to the variation among the states in regulatory framework, problems posed, and institutional allocation of responsibilities, the Act leaves it to each state to develop the response that is most appropriate for it.

## 2. Federal Climate Change Research

Another way the federal government is involved in planning for sea-level rise is through supported research. The U.S. Global Change Research Program is multi-year, multi-agency, federally-funded research program designed to bridge the gap between scientific research and policy initiatives. It encourages research to monitor, understand, and predict global change, and to improve the scientific basis for developing national and international policy. Greenhouse gases in the atmosphere and sea-level rise are among the global change phenomena targeted for study.

Through this program, and with other funding, the United States Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA) have taken lead roles, both within this country and in international efforts, to develop a consensus on greenhouse gas issues and response strategies. The EPA has conducted or funded a significant portion of the state climate change research on adaptive responses to accelerated sea-level rise. It will be important for states to keep themselves informed about the results of this research so that they can review their anticipatory strategies periodically in response to developing information. However, this federal research effort does not, in itself, establish any substantive portion of a policy response strategy.

## 3. Federal Clean Water Act

Section 404 of the federal Clean Water Act[73] is the primary federal law controlling development in coastal wetlands, the area most vulnerable to rising seas. It requires anyone who wants to conduct dredging and filling activities in navigable waters, including wetlands, to obtain a permit from the U.S. Army Corps of Engineers (COE). Federal resource agencies, the Fish and Wildlife Service (F&W), the Environmental Protection Agency (EPA) and the National Marine Fisheries Service (NMFS), review and comment on various permit applications. Through this permitting process, the COE and the resource agencies can play a critical role in reviewing development in coastal and estuarine waters and protecting coastal wetlands.

The COE generally evaluates projects based on historical sea levels. There is no formal guidance directing the COE or the resource agencies to evaluate projects taking into consideration the risks of accelerated sea level rise or the need to ensure that coastal wetlands have the ability to migrate. Even if accelerated sea level rise became a routine consideration in the COE's public interest review, the COE might still have limited influence over major impediments to coastal wetland migration due to the geographic limits of its jurisdiction. Despite a lack of formal guidance or statutory directive, district offices and resource agencies may have the discretion to consider risks of accelerated sea-level rise in project review if the agencies consider them to be significant.[74]

While not within the purview of the Clean Water Act, it should be noted that the COE also plays a major role in civil works functions such as the construction of seawalls, jetties, and other hard erosion control structures, in soft erosion control efforts such as beach restoration and renourishment, and in navigation projects such as channel dredging. Historical erosion rates are typically used in project assessment. The COE is likely to play a major role in these types of engineered responses if sea-level rise accelerates.

## 4. Coastal Barriers Resources Act of 1982

The federal Coastal Barrier Resources Act of 1982[75] established the Coastal Barrier Resources System, consisting of undeveloped coastal barriers along the Atlantic and Gulf of Mexico coasts. The coastal barriers were designated by the Secretary of the Interior in consultation with the Governors and state coastal zone management agencies, after public comment.

The Act imposes limits on federal expenditures within the System; except for a few narrow exceptions, no new federal expenditures or new financial assistance under the authority of any federal law may be made within the System. This precludes financial assistance for most development activities. Proscribed development activities include construction or purchase of structures, construction of roads, airports, boat-landing facilities, bridges or causeways, and most erosion prevention projects.

The only exceptions to the prohibition on federal expenditures or financial assistance are for water-dependent energy resources; navigational channels, structures, and dredge material disposal; maintenance and repair of certain public roads, structures and facilities; certain military activities; Coast Guard facilities; a variety of other emergency, habitat and research activities; and "nonstructural projects for shoreline stabilization that are designed to mimic, enhance or restore a natural stabilization system."[76]

The coastal barriers identified by the federal Coastal Barrier Resources System are also identified by Maine statute as being part of the Maine Coastal Barrier System. Under Maine statute, the use of state funds and financial assistance are also prohibited (with certain exceptions) in the designated areas.[77]

The geographic extent of coverage is very limited. Only approximately 22.5 miles of Maine's 3,400 mile shoreline are included in the Coastal Barrier Resources System (CBRS).[78] Other areas which are already protected (such as through state ownership) are not included in the CBRS designations.

This Act is consistent with a retreat strategy. It prohibits erosion stabilization projects except for nonstructural shoreline stabilization projects that are designed to mimic, enhance, or restore natural stabilization systems. It limits use of public funds for development in these areas and promotes retention of natural storm protection functions. But the Act provides only limited protection; it does not restrict private development nor does it include much of the shoreline.

In light of the threat of accelerated sea-level rise, it is appropriate to evaluate whether there are other areas which meet the criteria and should be included in the system.

## 5. National Flood Insurance Program

The National Flood Insurance Program (NFIP),[79] first enacted in 1968, is designed to reduce the cost of Federal disaster assistance following floods. NFIP, administered by the Federal Insurance Administration under the Federal Emergency Management Agency (FEMA), made previously unavailable flood insurance protection available to property owners in flood hazard areas if the community in which they resided adopted a floodplain ordinance meeting Federal standards designed to reduce or avoid future flood losses. These ordinances were intended to ensure that any new

structures constructed in a floodplain would be designed to withstand a 100-year flood with minimal damage.

Most coastal communities have opted to participate in the program by adopting building codes and zoning rules acceptable to FEMA. This voluntary local participation makes flood insurance available to owners of new and existing structures, allows owners to apply for construction loans from federally-regulated lending institutions, and makes the community eligible to receive non-emergency federal disaster relief funds (e.g., funds to repair roads, schools, sewers, etc.).

The NFIP consists of three stages: the identification stage, the emergency program stage, and the regular program stage. At the identification stage, flood-prone communities are identified, and preliminary maps are prepared to identify general outlines of floodplains, including "A" Zones representing areas expected to be inundated during a 100-year flood. In Maine, all identification has been completed.

To enter the emergency program stage, the community must enact a preliminary ordinance which requires a permit for construction or other development in flood-prone areas and which otherwise meets FEMA standards. The ordinance must require that new construction and substantial improvements be elevated above base flood level or, in non-residential structures, be flood-proofed rather than elevated. Flood insurance is available at this emergency program stage, but there are maximum ceilings on insurance coverage of $35,000 for a single family home and $10,000 for its contents.[80] As of the end of 1993, five Maine communities which had just recently decided to join the program were still in the emergency program stage.

Once a community enters the emergency program, FEMA produces a Flood Insurance Rate Map (FIRM) for the town outlining flood-prone areas. In some communities, the FIRM is prepared based on detailed engineering studies which identify areas of special flood hazard designated Zones A, A1-30, AE, AO and AH. Each zone has corresponding requirements which must be met before a permit will be granted for construction or other development.

In communities with lower flood risks, FEMA may opt to forego detailed studies and identify only "A" Zones on the Flood Insurance Rate Map. In Maine, less than one-half of the participating towns have FIRMS based on detailed studies. The majority of towns do not have detailed studies so in these communities only "A" Zones are mapped.

A community then has six months to enter the regular program by incorporating the FIRM into its zoning ordinance or other floodplain management ordinance. Once in the regular program, full insurance coverage is generally available. A portion of that insurance may be provided at premium-subsidized rates.[81]

The National Flood Insurance Program has been subject to criticism on a variety of grounds since its inception.[82] While those general criticisms may have implications for its usefulness as a mitigation tool, for purposes of this study, the most directly relevant criticism is that the National Flood Insurance Program fails to adequately address gradual shoreline erosion.

Due to the statutory mandate of the Program, it places primary emphasis on avoiding flood damage. To this end, it relies on elevating structures and "flood-proofing" as the primary means of preventing loss of life and structures. The construction standards are primarily designed to bring

structures through the intermittent effects of coastal storms without reducing the capacity of the water to runoff adjacent lands. They are not designed to minimize loss when the land underlying the structure has eroded away through a gradual process.

One study of coastal erosion, reviewing the National Flood Insurance Program and other federal responses, found that:

> recognition of erosion as a hazard in its own right, apart from coastal flooding, has only recently begun to emerge. Federal policy has typically addressed storm-generated erosion as a short-term phenomenon with little attention to longer-term or gradual erosion resulting from the effects of relative sea level rise.[83]

Other analysts have also identified this as a shortcoming of the Act, and have asserted that it fails to incorporate an adequate strategic response to shoreline erosion caused by either historical or future rates of sea-level rise.[84]

While some recent efforts have been made to amend the statute to develop greater erosion management capability based on available historical data, the statute has not been amended to incorporate any assumptions about an accelerated rate of sea-level rise as a result of global climate change.[85] Premiums do not reflect any projections of accelerated erosion due to an increase in sea level.[86] One commentator also suggests that under current law, due to a statutory cap on rate increases, even if the risk of inundation from accelerated sea-level rise becomes known and apparent, these rates will still be unable to reflect this knowledge, thus FEMA will be precluded from charging actuarially sound rates.[87]

Over the years, there have been several efforts to incorporate an erosion element into flood insurance risk assessment. A 1973 amendment added erosion as a possible flood loss,[88] and 1976 regulations further established a framework for communities to use in addressing erosion hazards.[89] But these efforts were very narrow, addressing erosion only if it related to a flood event, and ignoring gradual erosion. A national study commissioned by FEMA found that NFIP failed to take action to implement even these limited flood-related changes.[90]

The next major effort to manage erosion under NFIP took the form of the 1988 Upton-Jones Act amendments to NFIP.[91] These amendments, extended to 1995, authorize payment from the National Flood Insurance Fund to demolish or relocate insured structures that are subject to imminent collapse or subsidence as a result of erosion. The intent was to encourage removal of erosion-prone structures in advance of their collapse, minimizing hazards and reducing the total loss expenditures.

The amendments also established new setback lines by mandating that once the Act applies, no further flood insurance is permitted on that land unless the new or relocated structure is landward of the setbacks. For 1-4 family residential structures, the setback is based on a 30-year erosion standard; for any other structure, it is based on a 60-year erosion standard. These are calculated assuming a continuation of historical rates.

The Upton-Jones Amendments have been praised as an important first step in setting the stage for identifying erosion hazard zones, for adjusting premiums to reflect erosion risks as well as flood risks, and for developing new land-use standards. But there is still widespread concern over the program and multiple revisions have been recommended to improve its effectiveness.[92] For

example, one national evaluation recommended that the geographic area of eligibility, the "zone of imminent collapse," be expanded to facilitate anticipatory removal of structures in advance of a major storm event.[93] Another national assessment of policy options for preparing for climate change recommended that the NFIP mapping and rate structures be revised to incorporate at least conservative estimates of sea-level rise.[94]

Even with the Upton-Jones Amendments, the NFIP still does not include any express consideration of projections of accelerated sea-level rise. Under the current Act, future erosion estimates are to be based on projections of past shoreline change as documented in existing records; sea-level rise trends will not be incorporated into the projection of future risk unless they are already "present in the existing record."[95]

In 1991 and 1992 significant amendments to the NFIP were proposed but in both years the amendments failed.[96] Both proposals expressly recognized the relative rise in sea level as threatening the flood insurance program with greater financial liability.[97] Both proposals also sought to increase compliance by imposing requirements on lenders,[98] to increase local incentives to reduce construction and the number of structures in flood-prone areas through premium rate reductions,[99] and to increase State mitigation activities such as elevation, flood- proofing, and relocation through national mitigation grants.[100] The proposals would also have established erosion management programs with mandatory (1991) or voluntary (1992) land management standards for erosion-prone areas.

Senator Kerry introduced a slightly amended "National Flood Insurance Reform Act of 1993" in August, 1993.[101] Again the bill proposes that Congress find that the relative rise in sea level exposes the NFIP to risks that should be adequately considered in risk assessment. Erosion hazard areas, to be identified based on erosion rate information and other historical data, are defined as areas where erosion is likely to result in damage to or loss of buildings and infrastructure within a 60 year period. Other than requirements that the delineations be updated periodically, there is no express recognition of the threat of an increased rate of sea-level rise as a result of global climate change.

The State should monitor the progress of the Kerry proposal and similar pending bills[102] which would amend the National Flood Insurance Program. These amendments might alter the economic incentives to develop in or retreat from vulnerable areas.

The pending amendments to NFIP do not constitute a direct response to anticipated accelerated sea-level rise as a result of global climate change, but they are designed to manage gradual coastal erosion, divorced from a flood event. They assume a continuation of historical rates of sea-level rise into the future rather than adopt a projected accelerated rate of rise. However to the extent that they would protect threatened areas from further development and would heighten the ability of natural shoreline processes to accommodate to a change in shoreline position, they could help mitigate the impact of accelerated sea-level rise.

The State may also adopt its own measures on coastal erosion to supplement the National Flood Insurance Program. For example, it could adopt provisions to establish locational restrictions for coastal structures in the 100-year floodplain keyed to 50- to 100-times the annual erosion rate and could designate erosion zones within flood hazard areas where only movable structures will be allowed.

## D. CONCLUSION

The federal programs discussed above provide some limited incentives and technical assistance for states to engage in erosion mitigation planning. For example, the Coastal Zone Management Act has been amended to recognize rising seas as a critical area for anticipatory planning and now provides financial assistance for programmatic changes through Enhancement Grants. EPA's Climate Change program also provides valuable technical assistance to states. However, the federal programs are not yet internally consistent, nor are they intended to be a comprehensive response.

Given this lack of a comprehensive policy at the federal level and the general deference given to states in land use and land development matters, state governments have an opportunity to play a vital role in implementing coastal erosion mitigation strategies. States may regulate coastal development directly, as Maine has done in sand dune systems through the Natural Resources Protection Act. While the setback standards can be improved by tailoring them to individual beaches or portions of beaches, in general they have successfully established setback standards for larger structures which incorporate an assumed sea-level rise of three feet over the next century and have established an important retreat policy for all structures.

States may also approach the issue more indirectly by guiding local planning and implementing regulations. Maine has taken this approach through the Coastal Management Policies Act, the Mandatory Shoreland Zoning Act, and the Growth Management Act. Together these Acts establish overall goals and minimum standards, but leave it to individual municipalities to develop plans and regulations which are consistent with these goals.

The products of these state-mandated planning requirements have been uneven, both from town to town, and within local plans, from goal to goal. While towns generally focused a lot of energy on identifying the community's vision for itself, delineating growth and rural areas, and deciding on implementation strategies, they gave less attention to more technical issues such as preventing inappropriate development in natural hazard areas, including flood plains and areas of high erosion. While some technical assistance was available to towns concerning sea-level rise and coastal erosion, these topics did not generally receive major emphasis. At the time, this was probably a rational approach given the difficulty in obtaining municipality-specific information about historical erosion and project sea-level rise, the complexity of coastal hazard mitigation and sea-level rise issues, the existence of local floodplain ordinances, and the degree to which state agencies already regulated development in fragile environmental areas such as wetlands and sand dunes.

However, as indicated in the preceding system-by-system review of state laws and regulations, local reliance on the adequacy of state regulation may be somewhat misplaced. The State generally does a good job of regulating sand dune systems. However, there are significant gaps in state regulation of development adjacent to salt marshes and on eroding bluffs.

State legislators and resource managers will have to evaluate the most appropriate way to proceed to amend state and/or local ordinances to be prepared for the possibility of an accelerated rate of sea-level rise. The State can opt to rely on amendments to NRPA and promulgation of additional rules. Since there already seems to be an expectation that the State regulates development in coastal erosion hazard areas and since the State has the necessary technical expertise, it would make sense for the State to extend shoreline regulation to encompass the entire "soft coast" system

of sand beaches, salt marshes, and eroding bluffs. This state-wide approach is also supported by considerations of:

1) interjurisdictional equity in coastal development management, since all municipalities would operate under the same restrictions;

2) availability of necessary technical and legal expertise, since the development regulations may need to be fairly complex and well-substantiated to avoid legal challenges from owners of land in vulnerable areas;

3) consistent control over state infrastructure and public investment policies; and

4) ability to consider multijurisdictional impacts of changes in coastal systems such as interference with natural processes in one town affecting the shoreline in an adjacent town.

However, the State could also opt to encourage municipalities to make necessary changes in their local land use and shoreland zoning ordinances. It is arguable that this approach would allow local municipalities to tailor the most appropriate regulations for their own conditions. However, any reliance on voluntary municipal action would have to be supplemented by extensive technical assistance from the State to provide model ordinance provisions, detailed data about local historical erosion rates, and detailed projections of changes in shoreline position given assumed sea-level rise scenarios. It would also require extensive public education about the dynamic nature of coastal systems to convince local officials and citizens of the benefit of these regulations.

A hybrid of these approaches may prove most successful since these options are not mutually exclusive. The State could strengthen the NRPA regulations to establish statewide minimum policies and regulations governing development within the "soft coast" system. And those municipalities that wish to go beyond NRPA may adopt their own more rigorous standards regulating development in erosion prone areas or wetlands as part of their shoreland zoning, land use, or wetland ordinances.

## E. ENDNOTES

1. 38 MRSA §§ 1801-03.

2. COASTAL ADVISORY COMMITTEE, COASTAL MANAGEMENT POLICY GUIDELINES 9 (Augusta, ME: Maine State Planning Office, Dec. 1986).

3. *Id.*

4. For example, Maine Geological Survey, the Department of Economic and Community Development and the Department of Environmental Protection are involved in the second phase of a Section 309 Project of Special Merit to designate coastal hazard areas threatened by sea-level rise and to recommend modifications in state laws and regulations to more thoroughly address hazards created by coastal processes including sea-level rise. MAINE STATE PLANNING OFFICE, MAINE'S COASTAL PROGRAM: FUNDING APPLICATION, JULY 1993 THROUGH JUNE 1994 (III-53-56).

5. Comprehensive Planning and Land Use Regulation Act, 30-A MRSA §§ 4311-4344.

6. Mandatory Zoning and Subdivision Control Act, 38 MRSA §§ 435-449.

7. JOSEPH KELLEY, ET AL. LIVING WITH THE COAST OF MAINE 7 (Durham, NC: Duke University Press 1989).

8. 38 MRSA §§ 480-A-U.

9. Coastal Sand Dune Rules, Code Me. R., Ch. 355, §3, 06 096 355-007.

10. *Id.*

11. *Id.*

12. *Id.* §3, Preamble.

13. Development in certain back dunes was exempted from the permit requirements in 1993 (38 M.R.S.A. § 480-Q(16) exempting back dune alterations from permit requirements), but coverage has generally been reinstated by a 1994 emergency amendment which makes the exemption applicable only if the back dune site is not expected to be damaged due to shoreline change within 100 years based on historic and projected trends, and repeals the entire permit exemption for back dunes on February 15, 1995 to be replaced by permit-by-rule performance standards for activities exempt under § 16 on that date. Maine Legislative Service, 116th Legislature, Ch. 522 (March 14, 1994).

14. *Id.* § 480-B(1).

15. *Id.* § 480-D (7).

16. Coastal Sand Dune Rules, *supra* note 9, §3(A)(2).

17. Hall v. Board of Environmental Protection, 498 A.2d 260 (1985). The Court indicated that the same analysis would apply regardless of whether this was treated as new construction or rebuilding of a substantially damaged structure. *Id.* at 264.

18. Hall v. Board of Environmental Protection, 528 A.2d 453 (1987).

19. Rubin v. Board of Environmental Protection, 577 A.2d 1189 (1990).

20. Fichter v. Board of Environmental Protection, 604 A.2d 433 (1992).

21. Plaintiffs' heirs have reportedly discussed pursuing a takings claim, but as of July 1994 had not filed to do so.

22. 38 M.R.S.A. § 480-O.

23. With the exception of piers, and additions, a combined total of which cover less than 250 square feet of ground surface. *Id.* §3 (B)(1).

24. Sand Dune Rules, *supra* note 9, §3(A)(2).

25. See Appendix A, section D of this report for a more detailed discussion.

26. See Appendix A, section E of this report for a more detailed discussion.

27. See Appendix A, section F of this report for a more detailed discussion.

28. See Appendix A, section G of this report for a more detailed discussion.

29. 38 MRSA §§ 1901-1905.

30. See Appendix A, section I of this report for a more detailed discussion.

31. An applicant may contest the mapped designations through an on-site survey.

32. Coastal Sand Dune Rules, *supra* note 9, §3(A)(2).

33. RUTHERFORD H. PLATT, ET AL., COASTAL EROSION: HAS RETREAT SOUNDED? 132-135 (Program on Environment and Behavior Monograph No. 53, Institute of Behavioral Science, University of Colorado, 1992).

34. *Id*. at 191.

35. COMMITTEE ON COASTAL EROSION ZONE MANAGEMENT, MANAGING COASTAL EROSION 9 (Wash., D.C.: National Academy Press 1990).

36. Others contend if the erosion rate is more than one foot or so per year, setbacks established at 100 times the annual erosion rate are too high because they unfairly deprive property owners of the right to use coastal land, particularly if they would not even be allowed to build a small house that could be moved back if required. *See* J.G. Titus, *The Cost of Holding Back the Sea*, 19 COASTAL MANAGEMENT 171 (1991).

37. W.A. Anderson, et al., *Crustal Warping in Coastal Maine*, 12 GEOLOGY (1984).

38. T.M.L. Wigley & S.C.B. Raper, *Implications for Climate and Sea Level of Revised IPCC Emissions Scenarios* 357 NATURE 293-300.

39. STEPHEN M. DICKSON, SHORELINE EROSION MANAGEMENT PROTECT - PHASE I, PROJECT COMPLETION REPORT 2 (Maine Geological Survey, July, 16, 1993).

40. Coastal Sand Dune Rules, *supra* note 9, §3(A)(2).

41. See Coastal Sand Dune Rules, *supra* note 9, §3(B)(2)(c) which requires applicants for buildings greater than 35 feet in height or covering greater than 2500 square feet to show by clear and convincing evidence that the site will remain stable after allowing for a three-foot rise in sea level over 100 years.

42. For example, the *Fichter* situation involves applicants who purchased their vacant lot in the 1950s, well prior to the adoption of the Sand Dune Rules. The lot is surrounded by residences built on similar lots, but is too small to allow the applicant to meet current setback requirements. The applicants' taking claim was not reached in the original litigation. Fichter v. Board of Environmental Protection, 604 A.2d 433 (1992). However, a Maine Superior Court rejected a taking claim in a similar freshwater shoreline situation, holding that even though surrounded by 1920s cottages on small lots which could not meet current requirements, the

applicant did not prove a regulatory taking because the landowners still had economically beneficial or productive uses of their land remaining, despite the prohibition on construction of a seasonal dwelling. Drake v. Town of Sanford, York County Superior Court, Docket #CV-88-679, December 18, 1992.

43. According to some scientists, warmer temperatures may yield a 40-50% increase in the destructive potential of hurricanes. K.A. Emanuel, *The Dependence of Hurricane Intensity on Climate*, *in* AIP CONFERENCE PROCEEDINGS: THE WORLD AT RISK: NATURAL HAZARDS AND CLIMATE CHANGE SYMPOSIUM 25 (Rafale Bras, ed., Cambridge, MA: MIT Center for Global Change Science and Industrial Liaison Program, 1992). If Maine experiences an increase in frequency or intensity, it could cause storm-driven beach erosion which would be in addition to coastal erosion due to an increase in sea level.

44. KELLEY, ET AL., *supra* note 7, at 4.

45. 38 MRSA § 480-A -U.

46. 38 MRSA § 480-B(2).

47. *Id*. § 480-D, (2),(3),(4) and (6).

48. Department of Environmental Protection, Bureau of Land Quality Control, Wetlands Protection Rules, [Chapter 310], Code Me. R., § [06 096 310, Page 203000.727].

49. Department of Environmental Protection, Bureau of Land Quality Control, Soil Erosion Standard of the Coastal Wetlands Law, [1A(4)(b)], Code Me. R. § [06 096 344, Page 203041].

50. Mandatory Zoning and Subdivision Control Act, 38 MRSA §§ 435-449.

51. 38 MRSA § 435.

52. State of Maine Guidelines for Municipal Shoreland Zoning Ordinances, [06-096 Department of Environmental Protection Chapter 1000, March 24, 1990].

53. KELLEY, ET AL., *supra* note 7, at 4.

54. KELLEY, ET AL., *supra* note 7, at 6.

55. KELLEY, ET AL., *supra* note 7, at 5.

56. 38 MRSA § 480-A -U.

57. Department of Environmental Protection, Soil Erosion Standard of the Coastal Wetlands Law, *supra* note 49.

58. 38 MRSA §§ 435-449.

59. 38 MRSA §§ 481-490.

60. Effective October, 1993, municipalities may now incorporate a special exception provision to allow construction of a single family residence of up to 1500 square feet in a resource protection district if there is no other location on the property where a structure may be built, if the improvements will not be on slopes

of 20% or greater, if it is located out of the velocity zone (or floodway of 100-year floodplain), if it otherwise complies with the municipal floodplain ordinance and is set back at least 75 feet and to the greatest practical extent. [Public Laws, 116th Legislature, 1193 First Regular Session, Ch. 318 amending 38 MRSA § 439-A].

61. KELLEY, ET AL., *supra* note 7, at 5.

62. KELLEY, ET AL., *supra* note 7, at 30-31.

63. Further study would be required, however, to determine the vulnerability of office and residential structures on the piers (e.g., the office and condominium development on Portland Pier and Chandler's Wharf and low-lying upland areas adjacent to the piers, such as the Commercial Street office/retail area). It is possible water dependent businesses on the finger piers would be able to modify their structures and functioning to accommodate occasional higher waters, without providing the types of walls that would offer flood protection to these other uses.

64. See Appendix A, section G of this report for a more detailed discussion of the State Floodplain Management Program.

65. These performance standards require that new structures be allowed over or beyond the normal high-water line of a water body only if they require direct access to the water as an operational necessity and prohibits the conversion of existing structures extending beyond the normal high-water line to residential dwelling units. [Guidelines for Municipal Shoreland Zoning Ordinances, March 24, 1990, Section 15 (C)(5-6)].

66. 12 MRSA §§ 552, 558-A - 573. For a more detailed discussion, see Appendix A, section D of this report.

67. *See, e.g.*, MARINE LAW INSTITUTE, GUIDEBOOK TO THE ECONOMICS OF WATERFRONT PLANNING AND WATER DEPENDENT USES (prepared for the New England/New York Coastal Zone Task Force, Portland, ME: Marine Law Institute, 1988) at 233.

68. *See, e.g.*, MARINE LAW INSTITUTE, MANAGING THE SHORELINE FOR WATER DEPENDENT USES (prepared for the New England/New York Coastal Zone Task Force, Portland, ME: Marine Law Institute, 1988) and MARINE LAW INSTITUTE *supra* note 67.

69. 16 U.S.C.A. § 1451 *et seq.*

70. *Id.* § 1452.

71. 16 U.S.C.A. § 1451 (l).

72. 16 U.S.C.A. § 1452 (2)(B).

73. 33 U.S.C. § 1344.

74. The COE has factored relative sea level rise into risk assessments in Louisiana and Texas. PAUL N. KLARIN, ET AL., SEA LEVEL RISE POLICY ALTERNATIVES STUDY: VOLUME 1, ALTERNATIVE POLICY RESPONSES FOR ACCELERATED SEA LEVEL RISE AND THEIR IMPLICATIONS, 1-29 (Olympia, Washington State Department of Ecology, 1990).

75. 16 U.S.C. § 3509.

76. 16 U.S.C. § 3505(a).

77. For further discussion of Maine's Coastal Barrier Resources System, see MRSA § 1901 *et seq*. and the summary in Appendix A of this report.

78. COASTAL BARRIERS STUDY GROUP, REPORT TO CONGRESS: COASTAL BARRIER RESOURCES SYSTEM —RECOMMENDATIONS FOR ADDITIONS TO OR DELETIONS FROM THE COASTAL BARRIER RESOURCES SYSTEM, VOL 2., MAINE, (U.S. Department of the Interior, 1988).

79. 42 U.S.C. §§ 4001-4128; Federal Emergency Management Agency Regulations, 44 C.F.R. §§ 59.1 - 77.2 (1992).

80. 44 C.F.R. § 61.8(b)(1)(i).

81. At this stage, coverage price is supposed to be determined based on actuarial cost. However, for buildings in existence before the FIRM was established, a portion of the cost is subsidized by premiums. For example, for a pre-FIRM single family home the first $35,000 of coverage is at the lower, subsidized rate. An additional $150,000 of coverage can be added, but it must be paid for at the FEMA determined actuarial cost. *Id*. § 61.8(b)(1)(i) and § 61.6(a).

82. For example, in 1992, Senator John Kerry of Massachusetts, the sponsor of a set of proposed amendments to the NFIP, asserted that chronic problems with that Program included: that only 17% of those eligible for flood insurance are actually insured; that communities develop ill-advised areas, with the result that the program is now a larger financial liability; that subsidized premium rates disguise the true risk and market cost of insurance; and that coastal erosion is not factored into the actuarial process for setting rates. 138 CONG. REC. S9145-46 (daily ed. June 29, 1992) (statement of Sen. Kerry); 138 CONG. REC. S18246 (daily ed. Oct. 8, 1992).

83. PLATT, ET AL., *supra* note 33, at 36.

84. *See, e.g.,* THE POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE ON THE UNITED STATES (J.B. Smith & D.A. Tirpak, eds., Hemisphere Publishing Corporation, 1990) at 359 [hereinafter Smith & Tirpak]. A new study prepared for three Congressional committees recommends revamping the National Flood Insurance Program to provide stronger incentives to reduce potential costs associated with high-risk development in coastal areas, to address erosion along the coast, and to incorporate sea level rise into the NFIP mapping and rate structure. U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, I PREPARING FOR AN UNCERTAIN CLIMATE, (Wash., D.C.: U.S. Government Printing Office, October, 1993) at 41, 197 [hereinafter OFFICE OF TECHNOLOGY ASSESSMENT].

85. The FEMA hazard zones as currently drawn do not account for the hazards from erosion or sea-level rise. FEMA commissioned a study "to determine the impact of relative sea level rise on the flood insurance rate maps" and to "project the economic losses associated with estimated sea level rise" for the nation and by region. *See* P.L. 101-137, §5, 103 Stat. 825 (Nov. 3, 1989).

86. BENJAMIN NOBEL, SEA-LEVEL RISE AND COASTAL MANAGEMENT POLICIES IN THE UNITED STATES (Wash., DC: Resources for the Future, 1992) at 9.

87. Smith & Tirpak, *supra* note 84, at 359.

88. Flood Disaster Protection Act of 1973, 42 U.S.C. § 4121.

89. 44 CFR, Part 60.1.

90. NATIONAL RESEARCH COUNCIL, MANAGING COASTAL EROSION (Wash., DC: National Academy Press, 1990) at 73.

91. 42 U.S.C.S. § 4013(c).

92. See, e.g., the conclusions of the National Research Council in its 1990 report, MANAGING COASTAL EROSION, *supra* note 90, at 87-93 and conclusions of the OFFICE OF TECHNOLOGY ASSESSMENT, *supra* note 84, at 197.

93. NATIONAL RESEARCH COUNCIL, *supra* note 90, at 87.

94. OFFICE OF TECHNOLOGY ASSESSMENT, supra note 84, at 197.

95. NOBLE, *supra* note 86, at 17.

96. The companion House bill to the National Flood Insurance Mitigation Act of 1991 passed easily. But the Senate failed to pass the 1991 Act. 138 CONG. REC. S9145 (daily ed. June 29, 1992) (Statement of Sen. Kerry). The Senate did not pass the revised version of the 1991 Act, the National Flood Insurance Reform Act of 1992, either. 138 CONG. REC. S18244 (daily ed. October 8, 1992) (statement of Sen. Kerry).

97. 138 CONG. REC. S9317-9328 (daily ed. June 30, 1992) (reprint of National Flood Insurance Act of 1992) [hereinafter 1992 Act]; 137 CONG. REC. S12207-12217 (daily ed. Aug. 2, 1991) (reprint of National Flood Insurance, Mitigation and Erosion Management Act) [hereinafter 1991 Act].

98. 1992 Act §§ 21-129; 1991 Act §§ 201-209.

99. 1992 Act § 131; 1991 Act § 301.

100. 1992 Act §§ 141-148; 1991 Act §§ 401-406.

101. National Flood Insurance Act of 1993, S. 1405, 103d Cong., 1st Sess., U.S. Senate, August 6, 1993, pending.

102. *See, e.g.*, 1993 H.R. 62, National Flood Insurance Compliance, Mitigation & Erosion Management, 103rd Cong., 1st Sess., U.S. House of Representatives, January 5, 1993, Pending; 1993 S. 1024, Local Innovation and Coastal Protection Act of 1993, 103rd Cong., 1st Sess., U.S. Senate, May 25, 1993, Pending.