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Articles

RISING SEAS, COASTAL EROSION, AND THE TAKINGS CLAUSE: HOW TO SAVE WETLANDS AND BEACHES WITHOUT HURTING PROPERTY OWNERS

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I. INTRODUCTION

A. *Shall We Give Away the Shore?*

In the next century, the majority of America's publicly owned tidal shorelines could be replaced by a wall, not because anyone decided that this should happen but because no one decided that it should not. Throughout the United States, housing developments are being built just inland of the marshes, swamps, muddy shores, and sandy beaches that collectively comprise the Apublic trust tidelands.@ Because sea level is rising and most shores are eroding, the water will eventually reach these houses unless either the houses are moved or somehow the sea is held back.

The most common response has been to build a wall near the boundary between the private dry land and the public tidelands, saving the former but allowing the latter to erode away. Most states tacitly reward riparian owners who build these walls with sole custody of what had been the public shore, by allowing the owners to exclude the public from the area inland from the wall, where there would have been a public beach or wetland had the wall not been built. In Maryland alone, more than 300 miles of tidal shoreline have been armored in the last

twenty years.[1] This trend will accelerate if the greenhouse effect increases the rate of sea level rise.[2]

We should not, however, paint all coasts with a single brush, because America has two types of coast: the ocean and the bay. Along the ocean, sandy public beaches dominate.[3] Recognizing these beaches to be their Acrown jewels,@ coastal communities and states protect them with a variety of policies that seem likely to ensure their survival in all but a few locations.

Farther inland lies the hidden coast that comprises eighty percent of our tidal shorelines. Part sand, part mud, and part vegetated wetland, these shores have diverse uses. Unlike the open ocean coast, our bay shores are gradually being replaced with walls of steel, stone, concrete, and wood (hereinafter Abulkheads@).[4] Where once a fisherman could walk on the public beach, there is no beach. In order to walk along the bulkheads that replaced it, the fisherman must trespass in the backyards of the property owners who built them. Unlike the ocean resorts, where every block has a road leading to the beach, bayfront developments usually provide no access to the shore.[5] Environmental regulations provide only temporary relief, having been designed as if shorelines and sea level were stable.[6] Effective strategies for saving our natural shores apply to the open ocean**C**but not to the hidden bay.

Why do we treat the ocean and bay coasts differently? Virtually every state has made the policy decision to keep its ocean beaches and

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1. *See infra* Appendix 2.

2. *See* JAMES G. TITUS & VIJAY K. NARAYANAN, U.S. ENVTL. PROTECTION AGENCY, THE PROBABILITY OF SEA LEVEL RISE 145 (1995) [hereinafter EPA 1995] (estimating that along the U.S. coast, there is a 10% chance that sea level will rise 40 cm by 2050, 85 cm by 2100, and 230 cm by 2200); WORKING GROUP I, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995: THE SCIENCE OF CLIMATE CHANGE 381 (1996) [hereinafter IPCC 1995] (estimating that global sea level is likely to rise 20-86 cm by 2100).

3. Rocky coasts with occasional pocket beaches are more common in Maine, Washington, Oregon, and northern California. *See infra* note 23 and accompanying text.

4. Coastal engineers use many types of walls to hold back the sea. For simplicity, this Article uses the term Abulkhead@ to refer to all of those structures. See *infra* note 81 for further discussion of these structures.

5. The potential for a constituency concerned about these trends is impeded in part by the lack of roads leading all the way to the shore in new subdivisions. *See* KARL F. NORDSTROM, ESTUARINE BEACHES 120 (1992) (describing the lack of access routes to beaches). Hence, realistic public access is denied right from the start.

6. *Cf.* Paul Klarin & Marc Hershman, *Response of Coastal Zone Management Programs to Sea Level Rise in the United States*, 18 COASTAL MGMT. 143, 144 (1990) (stating that although the federal government has studied sea level rise, it has not provided clear guidance or policies to state and local governments).

FIGURE 1
THE TRANSITORY SUCCESS OF CURRENT TIDELANDS POLICIES

The public trust doctrine and wetland-protection policies prevent people from filling wetlands and beaches. As a result, new construction is generally set back inland from the high water mark. Because these policies do not consider shoreline erosion, however, the shore will eventually erode up to the development, leaving the same situation that would have resulted had developers been allowed to fill the wetlands in the first place.

not to privatize ocean shores that are currently open to the public.[7] Yet, policy makers have not addressed the loss of natural shores along the hidden coast. The rising sea has placed riparian owners' rights to protect their homes on a collision course with the public's ownership of the intertidal wetlands and beaches. Some of the shore[8] has been given away, and more will be given away as wetlands and beaches erode.

Should we not decide which portions of our bay shores will remain public and in a natural condition? Ironically, land use planning has provided state and local governments with a process for ensuring that some of the *privately* owned farms and forests remain as open space. Coastal states, however, have no process for deciding how much of the *publicly* owned shore should remain in its natural condition, or even in public hands.

B. Organization and Summary

This Article examines land use planning options[9] by which coastal states might retain some of their public trust tidelands *in perpetuity*Cno matter how much the sea risesCat least in areas that have not yet been developed. A key assumption of this analysis is that policies should protect coastal property values. Any policy that fails to do so is likely to be unfair and inefficient and to engender a well-deserved opposition sufficient to prevent implementation on the scale necessary to have a lasting effect. This analysis also assumes a preference for policies that rely on the free market (where possible) and that deal rationally with our inability to say how much the sea will rise.

Part II presents key background information. For example, a four-foot rise in sea level would inundate 7000 square miles of dry land in the

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7. This policy is reflected both in the widespread use of beach nourishment and regulations that prevent structures on the beach. *See* U.S. ARMY CORPS OF ENG'RS, SHORELINE PROTECTION AND BEACH EROSION CONTROL STUDY, PHASE I: COST COMPARISON OF SHORELINE PROTECTION PROJECTS OF THE U.S. ARMY CORPS OF ENGINEERS 6, 42-46 (1994) (stating that beach nourishment has attained broad acceptance as a substitute for fixed structures and listing three-fourths of the states as employing beach nourishment); Paul Klarin & Marc Hershman, *State and Local Institutional Response to Sea Level Rise: An Evaluation of Current Policies and Problems*, *in* 1 CHANGING CLIMATE AND THE COAST 297, 303 (James G. Titus ed., 1990) (noting that seven states have setbacks based on a multiple of the erosion rate).

8. This Article uses Ashore@ to refer to the land that is immediately adjacent to the sea. In most states, the public owns the land below mean high tideCi.e., the shore is publicly owned. *See infra* Part IV. But if the land below high tide is eliminated, then the privately owned land above high tide is the shore. Therefore, by definition, the elimination of wetlands and beaches converts the shore to private ownership.

9. Soft engineering responses such as beach nourishment and artificial marsh building are worth analyzing as well, but are outside the scope of this Article.

contiguous United States—an area the size of Massachusetts.[10] Although the sea is most likely to rise one foot every fifty years for the next few centuries, it could rise at twice that rate—or more.[11] Part II also outlines and analyzes three ways to protect tidelands: (1) *prevent development* in vulnerable areas seaward of a "setback line," (2) *defer action*, and (3) create *rolling easements*, which allow development but prohibit property owners from holding back the sea. Part II also identifies some combinations of these approaches, as well as options for retaining public shorelines even where bulkheads are built.

Setbacks have been employed along bay shores to limit pollution runoff and along ocean coasts to keep homes from being built in areas that are vulnerable to erosion or storms. In undeveloped areas where all the low land is within a few hundred feet of the shore, preventing or restricting development may be the best way to retain the tidelands. But purchasing an area the size of Massachusetts would be expensive, and regulations to prevent development in such a large area would be inefficient, unfair, and politically infeasible. Moreover, the need to draw a setback line on the map poses two practical difficulties: (1) sea level rise is uncertain and, therefore, defining the appropriate setback line would be difficult; and (2) eventually the shore would retreat to any setback that is established, unless development was prevented in an area much larger than the land that is at risk in the next century. Deferring action will not save the tidelands unless politicians in the future are willing to buy or order the abandonment of this same land after it is developed.

Rolling easements seem more likely to succeed on a broad scale. They do not require particular lines to be drawn on a map, and their impact on current property values would generally be less than one percent. Governments could afford to compensate riparian owners, but even a failure to compensate them would impose only a minor burden. Developers who deny that the sea will rise would view the policy as costing them nothing. Unlike setbacks, rolling easements allow landowners to decide how best to use their property between now and whenever the land finally erodes. Nevertheless, enforcement may be politically difficult. A combination of density restrictions, setbacks, and rolling easements would probably be more successful than relying on any single option.

Would these policies require compensation under the Takings Clause of the Fifth Amendment? Part III examines that question, based

10. *See infra* note 102 and accompanying text.
11. *See infra* notes 98-100 and accompanying text.

on the assumption that property owners *have* the right to build a home and protect it from the sea. In areas where the land has already been subdivided, development would often be the only economically productive use of the land. In such cases, preventing development would require compensation. In areas that have not been subdivided, however, preexisting land uses may be profitable. In these cases, preventing development may not require compensation. Deferring action and subsequently requiring people to abandon their homes would involve a taking if the homeowner is willing and able to protect the shore, assuming a right to hold back the sea. Rolling easements, by contrast, would probably not require compensation, given their trivial impact on property values and the several decades that would pass before they had any actual effect.

Part IV suggests that shorefront owners *do not* have a right to hold back the sea. For over a thousand years, the Alaw of erosion@ has held that the boundary between public and private land migrates inland as the shore erodes, and there is no right to *increase* one's land at the expense of a neighbor. Granted, it does not automatically follow that there is no right to prevent a *reduction* in one's land at the expense of a neighbor, but the theoretical justifications are the same.

Another ancient principle of property law, the public trust doctrine, provides independent support for this view. Although some portions of this doctrine are controversial, no one disputes the rule that a state does not lose ownership of the shore[12] unless it intends to do so. It follows that the state is never *required* to allow bulkheads that privatize the shoreline. Thus, rolling easements are a codification of the expectations that generally prevailed under the common law. This logic might apply to deferred action, but not if states waive their property interests by telling property owners that they have a right to hold back the sea.[13]

Part V shows that the low cost of rolling easements allows government to bypass the takings issue by simply purchasing the easements from current landowners. This option is also available to developers and conservancy groups, and may be feasible even in areas that are already developed.

This Article concludes with recommendations for moving the issue forward. Local master plans should explicitly indicate which areas will retain natural shorelines. State legislatures should authorize tideland planning studies that recommend how much of the shore should be

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12. In most states, the public owns the land below mean high water; in five states, the public only owns the area seaward of mean low water. *See infra* Part IV.B.1.

13. Maryland has explicitly granted a right to hold back the sea, but has not waived this public property right. *See infra* Part IV.C.1.d.

given away. Conservancies and developers should challenge governments by taking initiatives on their own. The federal government may also have a role in its status as a coastal property owner.

Because land use is a state and local responsibility,[14] this Article does *not* focus on a federal regulatory solution to this problem. The federal government has had a paramount role in efforts to stop people from destroying coastal wetlands, because those wetlands are generally found within the ebb and flow of our coastal waters, where the federal government has always had jurisdiction.[15] The survival of our coastal wetlands as the sea level rises, however, depends on how people use land that is currently dry and, as such, outside federal jurisdiction. Nevertheless, those who administer, interpret, or comply with coastal wetland protection laws should stop ignoring the fact that the sea level is rising. Everything that these laws have accomplished will be for naught if the government fails to develop a strategy for allowing wetlands to migrate inland**C**eventually the wetlands that these laws are protecting will all be under water.

The time has come for Americans to decide how much of our natural shoreline we intend to retain. If we wait until all our coastal areas have been developed before we confront this problem, the solutions will be more expensive, less likely to succeed, and more likely to force a showdown between environmentalists and landowners**C**a showdown that can be avoided by acting now when decades of lead time make it possible for cooler heads to prevail.

II. ANALYSIS OF POLICIES TO SAVE THE TIDELANDS

A. Background

*1. The Shores of the United States.***C**The coastal zone of the United States includes portions of thirty states.[16] Because the Great Lakes are not hydraulically connected to the sea,[17] the issues discussed in this Article

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14. RALPH E. BOYER ET AL., THE LAW OF PROPERTY ' 1201, at 430 (4th ed. 1991).

15. *See, e.g.*, Gibbons v. Ogden, 22 U.S. (9 Wheat.) 1, 217-18 (1824) (holding that the federal government has exclusive jurisdiction over commerce in the coastal waters); *see also infra* note 311.

16. *See* 3 WORLDMARK ENCYCLOPEDIA OF THE NATIONS 341 (Jane Hoehner ed., 8th ed. 1995) (presenting cartographically the political and geographical boundaries of the United States).

17. Four of the Great Lakes are above Niagara Falls. *See, e.g.*, GEOLOGICAL SURVEY, U.S. DEP'T OF THE INTERIOR, THE NATIONAL ATLAS OF THE UNITED STATES OF AMERICA 2-3, 6-7 (1970). Lake Ontario is also separated from the ocean but by smaller waterfalls. *See, e.g.*, Thomas E. Croley II & Holly C. Hartmann, *Effects of Climate Changes on the Laurentian Great Lakes Levels*, *in* OFFICE OF POLICY, PLANNING, & EVALUATION, U.S. ENVTL. PROTECTION AGENCY, THE POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE ON THE UNITED STATES app.

primarily concern the twenty-four states with shores along the Atlantic and Pacific Oceans, the Gulf of Mexico, and, in the case of Pennsylvania, the tidal Delaware River.[18] Nevertheless, many of the legal doctrines and responses to coastal erosion are equally applicable to shores along the Great Lakes.

Along the Gulf Coast and the Atlantic Coast south of Cape Cod, sandy public beaches dominate.[19] For the most part, the coast is lined with barrier islands and barrier spits.[20] In all of these states, other than Mississippi, at least some of the barrier islands are developed with recreational beach resorts.[21] Along the southern half of California's Pacific Coast, as well as portions of the Atlantic and Gulf Coasts, there are sandy mainland beaches rather than barrier islands.[22] Rock and cliff

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A 4-1, 4-3 (Joel B. Smith & Dennis A. Tirpak eds., 1989) [hereinafter POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE]. Therefore, a rise in sea level does not cause higher levels in the Great Lakes. In fact, scientists assessing the implications of global warming have generally concluded that increased evaporation from warmer temperatures would cause Great Lakes levels to drop. *See, e.g.*, Stewart J. Cohen, *The Effects of Climate Change on the Great Lakes*, 3 EFFECTS OF CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE 163, 168, 176 (James G. Titus ed., 1986) (stating that a three or four degree Celsius warming facilitates a 7-18% increase in evaporation, which more than offsets a 1-6% increase in precipitation, thereby causing Lakes Erie, Michigan, and Huron to drop 0.44 to 0.83 m, and Lake Superior to drop about 0.25 m); Croley & Hartmann, *supra*, at 4-24 (estimating that over the next 70 years, Lake Superior could fall 1.3 mm/yr.; Lakes Huron, Michigan, and Erie could fall 5.9 to 6.6 mm/yr.; and Lake Ontario could fall 9.3 mm/yr., but predicting that within 80 years, flows out of Ontario would drop enough to make it impossible to meet the requirements of the water management implementation plan).

18. *See* 3 WORLDMARK ENCYCLOPEDIA OF THE NATIONS, *supra* note 16, at 341.

19. *See, e.g.*, MARINE BD., NATIONAL RESEARCH COUNCIL, RESPONDING TO CHANGES IN SEA LEVEL: ENGINEERING IMPLICATIONS 40-45 (1987) [hereinafter MARINE BOARD REPORT]. For a thorough discussion of the shoreline of any particular part of the nation, refer to the appropriate volume from the *Living with the Shore* series published by Duke University Press under the general editorship of William J. Neal and Orrin H. Pilkey, Jr. *See, e.g.*, WAYNE F. CANIS ET AL., LIVING WITH THE ALABAMA-MISSISSIPPI SHORE 109-11, 120 (Orrin H. Pilkey, Jr. & William J. Neal eds., 1985); WILLIAM J. NEAL ET AL., LIVING WITH THE SOUTH CAROLINA SHORE (Orrin H. Pilkey, Jr. & William J. Neal eds., 1984); LARRY G. WARD ET AL., LIVING WITH THE CHESAPEAKE BAY AND VIRGINIA'S OCEAN SHORES (Orrin H. Pilkey, Jr. & William J. Neal eds., 1989).

20. MARINE BOARD REPORT, *supra* note 19, at 40-45. Barrier islands and spits are long narrow islands and peninsulas with an ocean on one side and a bay on the other. COASTAL BARRIERS TASK FORCE, U.S. DEP'T OF THE INTERIOR, FINAL ENVIRONMENTAL IMPACT STATEMENT: UNDEVELOPED COASTAL BARRIERS A-18 (1983). For a discussion on the evolution of barrier islands and barrier spits, see NEAL ET AL., *supra* note 19, at 21-26, or any of the other books in the same series. For an easy-to-read introduction to beach dynamics, see WILLARD BASCOM, WAVES AND BEACHES 11-23, 158-235 (1964).

21. *See* CANIS ET AL., *supra* note 19, at 109-11, 120 (stating that Mississippi has four barrier islands, three of which are part of the Gulf Islands National Seashore); COASTAL BARRIERS TASK FORCE, *supra* note 20, at IV-14 (providing a table with the status of coastal barriers by state).

22. MARINE BOARD REPORT, *supra* note 19, at 40-45.

coasts are more common in Maine, Washington, Oregon, and northern California, but even there, one finds occasional pocket beaches.[23] In at least some parts of most coastal states, there is easy access to the beach every 500 to 1000 feet.[24] In these areas, the beaches are truly open to the public, and they attract tens of millions of swimmers and sunbathers every year.

Bay shores, most of which are along estuaries, comprise over eighty percent of the nation's shoreline.[25] The estuarine coast includes the shores along large embayments such as Chesapeake, Delaware, and San Francisco Bays, smaller embayments like Biscayne Bay, and many small Aback-barrier bays@ that lie between barrier islands and the mainland.[26] The various types of estuarine shores are put to a wide variety of uses. Marshes and swamps purify water and provide food and nurseries for fish, birds, and terrestrial animals.[27] Small crafts navigating the inland waterways may be beached for repairs, overnight rests, or refuge from storms. Fishermen who do not own boats cast their lines from these shores. Many people visit these waterfronts to shop, have dinner, or watch the sun set. Horseshoe crabs lay their eggs on estuarine beaches,

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23. *See, e.g.*, BASCOM, *supra* note 20, at 14-15 (noting the construction of pocket beaches on the California-Oregon coast); MARINE BOARD REPORT, *supra* note 19, at 44-45 (stating that although rock and cliff beaches are predominant in California, Washington, and Oregon, pockets of sandy beaches can be found).

24. For example, in Ocean City, Maryland, the public has access to the beach on every block. The same is true for much of the New Jersey shore. The U.S. Army Corps of Engineers will not undertake a beach nourishment project unless the beach is open to the public. Personal Communication with John Van Fossen, Project Manager, Baltimore District, U.S. Army Corps of Engineers (Sept. 10, 1997); *see infra* note 373.

25. *See, e.g.*, NORDSTROM, *supra* note 5, at 1 (citing a 1967 estimate by K.O. Emery that over 80% of the Atlantic and Gulf of Mexico Coasts, as well as 10-20% of the Pacific Coast, are in estuaries). There are also a number of large embayments that are not estuaries, because of their high salinities, but whose wetlands and beaches are similar due to the relatively calm waves, such as Mississippi Sound, Puget Sound, Long Island Sound, and numerous coastal bays in Maine. *See id.* at 4. In Maryland and Virginia, over 95% of the tidal shores are along estuaries. *See id.* at 1.

26. These bays are also called Aback bays.@ *See, e.g.*, CANIS ET AL., *supra* note 19, at 113-15 (describing Mississippi's Biloxi Back Bay area); *see also* COASTAL BARRIERS TASK FORCE, *supra* note 20, at A-5 to A-8 (discussing general types of back-barrier environments).

27. 2 U.S. DEP'T OF THE INTERIOR, THE IMPACT OF FEDERAL PROGRAMS ON WETLANDS: A REPORT TO CONGRESS BY THE SECRETARY OF THE INTERIOR 31 (1994) (AWetlands provide habitat for many species of fish and wildlife, including migratory birds, endangered species, commercially and recreationally important finfish, shellfish, and furbearers, and many species of wild plants. . . . Between 60% and 90% of U.S. commercial fisheries use coastal wetlands as spawning grounds and nurseries.@). For a useful and easy-to-read overview of coastal wetlands, see generally JOHN & MILDRED TEAL, LIFE AND DEATH OF THE SALT MARSH (1969).

providing an important source of food for many shorebirds.[28] Estuarine beaches are also an important habitat for terrapins and some endangered species such as the tiger beetle and the least tern.[29]

Until the second half of the twentieth century, the narrow beaches along Chesapeake and Delaware Bays served recreational needsCneeds that are now met mostly by ocean beach resorts.[30] In some cases, the proximity of these shores to population centers has ensured their continued use. This is particularly true for Asian Americans, African Americans, and other minorities.[31] Nevertheless, these shores are still largely undeveloped, unlike the barrier islands and other ocean shores.[32]

Figure 2 illustrates some key terminology. Along sandy shores, the *wet beach* lies between *mean high water* and *mean low water*. The *dry beach* extends from mean high water inland to the seaward edge of the dune grass or other terrestrial plant life, sometimes called the *vegetation line*.[33] The dune grass generally extends inland from the point where a storm

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28. *See, e.g.*, NORDSTROM, *supra* note 5, at 105-27 (noting that estuarine beaches are important feeding and spawning areas for marine fish, foraging birds, and horseshoe crabs, as well as important locations for small-craft launching, fishing, and swimming).

29. *See, e.g.*, James G. Titus, *Fragile Beaches Being Replaced by Armored Shore*, BALT. SUN, May 25, 1997, at K6, *available in* 1997 WL 5513564 [hereinafter *Armored Shore*] (citing public comments by environmental experts from the U.S. Army Corps of Engineers and the Environmental Protection Agency).

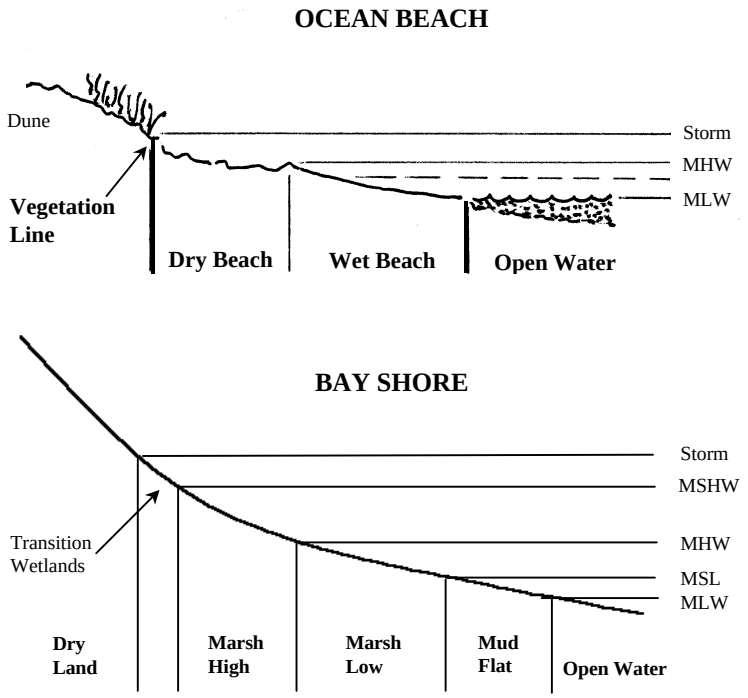
30. *See* Tom Stuckey, *Another Bay Ridge Inn to Close*, WASH. POST, Oct. 18, 1997, at F1, *available in* 1997 WL 14707832 (stating that many bay resorts have closed due to the popularity of Atlantic beaches); *Armored Shore*, *supra* note 29 (describing the decline of the Chesapeake Beach and the increasing popularity of ocean beach resorts).

31. The postwar sunbathing fad never caught on among Asian and African Americans, who continued to fish and swim along bay shores. Personal Communication with Stephen P. Leatherman, Geography Dep't, University of Md. (Oct. 18, 1996). The lack of financial resources for transportation and vacation housing may also play a role. In Maryland, the majority of people along the beach at Ocean City are white, while the majority of people along the beaches at Sandy Point and Fort Smallwood parks are African American or Asian American. *See Armored Shore*, *supra* note 29.

32. No state has undertaken an assessment of the *linear* portion of its estuarine shores that are developed. EPA studies, however, have assessed the *area* of coastal lands that are developed. *See, e.g.*, James G. Titus et al., *Greenhouse Effect and Sea Level Rise: The Cost of Holding Back the Sea*, 19 COASTAL MGMT. 171, 189-92, 200 (1991) [hereinafter *Holding Back the Sea*] (estimating that of the 5000-10,000 square miles of land that could be inundated by a one-meter rise in sea level, about 6000-7000 square miles are currently developed). While the reported results do not distinguish estuarine shores from land along the ocean, they make clear that the vast majority of coastal low lands are along bays rather than the open ocean. *See id.* at 194, 199 (estimating that only 705 square miles of land near the ocean is within five feet of sea level, and that the land in such proximity consists largely of the bay sides of barrier islands).

33. *See* David C. Slade et al., *Lands, Waters and Living Resources Subject to the Public Trust Doctrine*, *in* PUTTING THE PUBLIC TRUST DOCTRINE TO WORK 13, 59 (1990) (explaining that the Avegetation line@ has been recognized as the Aordinary mean high water line@ and as the Ahigh water line@).

FIGURE 2
LEGAL AND GEOLOGICAL TIDELAND ZONATION



MSL = Mean Sea Level
MLW = Mean Low Water
MHW = Mean High Water
MSHW = Mean Spring High Water
Storm = Average Annual Storm Tide

The area below mean high water is usually publicly owned, and in all cases is subject to public access for fishing and navigation. Along the ocean, the dry beach above mean high water may be privately owned, but in several states the public has an easement; along the bay, the high marsh above mean high water is also privately owned, but wetland protection laws generally discourage development. See *infra* Part IV for additional details.

in the last year struck with sufficient force to erode the vegetation,[34] which is well above mean high water.[35] Along marshy shores, mudflats are found between mean low water and mean sea level,[36] *low marsh* is found between mean sea level and mean high water, and *high marsh* extends from mean high water to *mean spring high water*.[37] Collectively, the lands between mean high water and mean low water (mudflats, low marsh, and wet beaches) are commonly known as *tidelands*.[38]

*2. The Public's Interest in the Shore.*C The body of common law that collectively describes the public's ownership and access along the shore is known as the public trust doctrine and is discussed in Part IV below. In most states, the public owns these tidelands, while private parties own

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34. *Cf.* ORRIN H. PILKEY, JR. ET AL., LIVING WITH THE EAST FLORIDA SHORE 25-28 (Orrin H. Pilkey, Jr. & William J. Neal eds., 1984) (explaining that storms erode the beach and dunes by washing sand offshore but that after the storm subsides, fair-weather waves rebuild the beach and dunes). The vegetation line tracks the inland reach of severe storms, because recently eroded dunes and beaches lack vegetation during the time that is required for the vegetation to reappear. *Id.* at 25.

35. *Cf.* Stephen P. Leatherman, *Coastal Geomorphic Responses to Sea Level Rise*, *in* GREENHOUSE EFFECT AND SEA LEVEL RISE: A CHALLENGE FOR THIS GENERATION 151, 165 (Michael C. Barth & James G. Titus eds., 1984) (explaining that the highest storm tide would occur when the storm surge corresponds with an astronomical high tide).

36. Tides are determined primarily by the moon. *See* BASCOM, *supra* note 20, at 83-87 (explaining why the moon has a greater effect on tides even though the sun has 150 times more gravitational pull); NATIONAL OCEAN SERV., U.S. DEP'T OF COMMERCE, TIDE TABLES 1985, HIGH AND LOW WATER PREDICTIONS, EAST COAST OF NORTH AND SOUTH AMERICA, INCLUDING GREENLAND 1 (1984) (noting that tide frequencies depend primarily on changes in the moon's distance and phase). When the moon and sun are lined upCi.e., full and new moonsCthe resulting Aspring tides@ are more extreme. *See* BASCOM, *supra* note 20, at 87-88 (explaining spring tides); NATIONAL OCEAN SERV., *supra*, at 199-234 (listing mean and spring tide ranges along the east coast of North and South America). For example, at Sandy Hook, New Jersey, mean high water is 2.4 feet above the mean sea level (MSL), while mean spring high water is 3.3 feet above MSL. *Id.* at 64-67, 213.

37. See, for example, Timothy W. Kana et al., *Charleston Case Study*, *in* GREENHOUSE EFFECT, SEA LEVEL RISE AND COASTAL WETLANDS 37, 41-45 (James G. Titus ed., 1988) [hereinafter *Charleston Case Study*], and Timothy W. Kana et al., *New Jersey Case Study*, *in* GREENHOUSE EFFECT, SEA LEVEL RISE AND COASTAL WETLANDS, *supra*, at 61, 72 [hereinafter *New Jersey Case Study*], which illustrate the general rule of wetland zonation for case study sites near Charleston, South Carolina, and Long Beach Island, New Jersey. In some warmer areas, mangroves rather than marshes exist. *See* Thomas V. Armentano et al., *Impacts on Coastal Wetlands Throughout the United States*, *in* GREENHOUSE EFFECT, SEA LEVEL RISE AND COASTAL WETLANDS, *supra*, at 87, 114 (projecting that climatic warming would enable mangroves in Florida to advance north). Cypress swamps are found in some freshwater areas. *See* LOUISIANA WETLAND PROTECTION PANEL, U.S. ENVTL. PROTECTION AGENCY, SAVING LOUISIANA'S COASTAL WETLANDS: THE NEED FOR A LONG-TERM PLAN OF ACTION 35-37 (1985) (noting that cypress swamps cannot tolerate saltwater and hence are being destroyed as rising sea level and other processes enable salt water to penetrate into these swamps).

38. *See infra* Part IV.

the dry beach and the high marsh.[39] In a few states, the public owns the dry beach, at least in some areas, because of either court rulings or acquisitions.[40] However, in five states, the public only owns the area seaward of the mean low water mark.[41] By definition, low tide is lower than mean low water during half the days of the year.[42] Therefore, even in those states where tidelands are privately owned, there is often a wet beach or mudflat along which one can walk without trespassing.[43] Thus, the shore[44] itself is publicly owned whether or not the adjacent dry land is open to the public.

Ownership, however, is only part of the picture. In the five states where the tidelands are privately owned, the public still has an easement along the tidelands for at least some purposes—for example, hunting, fishing, and navigation. In several states, the public has access along the dry beach for recreational use as well.[45] The right to access *along* the shore, however, does not mean that the public has a right to cross private land to get *to* the shore.[46] Unless there is a public road or path to the shore, access along the shore is thus only useful to those who either reach the shore from the water or have permission to cross private land. Although the public has easy access to most ocean beaches[47] and a few

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39. *See infra* note 359 and accompanying text.

40. *See infra* notes 360-364 and accompanying text.

41. These five states are Maine, Massachusetts, Pennsylvania, Delaware, and Virginia. *See* Slade et al., *supra* note 33, at 69 n.22.

42. *See, e.g.*, George M. Cole, *Tidal Water Boundaries*, 20 STETSON L. REV. 165, 171 (1990) (defining mean low water as the average height at all of the low tides over a 19-year tidal epoch).

43. This statement assumes that no bulkhead has been constructed.

44. Recall that this Article uses the term Ashore@ to refer to the interface between land and water. *See supra* note 8.

45. *See* Slade et al., *supra* note 33, at 69 n.23.

46. This right to cross private land is also known as perpendicular access. *See* David C. Slade et al., *Lands, the Public Trust Doctrine and Access to Public Trust Lands and Waters*, *in* PUTTING THE PUBLIC TRUST DOCTRINE TO WORK, *supra* note 33, at 161, 162, 165 nn.1-2 (citing cases to support the Anearly universal rule@ that the public trust doctrine does not grant perpendicular access to the shore across private land). New Jersey is an exception. *See infra* note 362.

47. Interview with Bill Millhouser, Office of Ocean and Coastal Resources Management, Nat'l Ocean and Atmospheric Admin. (Oct. 29, 1997) (on file with author). A draft report on public access revealed that most states have some sort of policy to promote access, but few if any states know what the policy is accomplishing. *Id.* North Carolina and California are notable exceptions. *Id.* In most of Ocean City, Maryland, the public has access to the ocean beach at every block. *See supra* note 24 and accompanying text.

large embayments,[48] the access points to most bay shores are widely dispersed.[49]

In the last few decades, state and federal statutes have added to the public's interests in the shore. Perhaps most importantly, section 404 of the Clean Water Act requires property owners to obtain a permit from the U.S. Army Corps of Engineers (Corps) before filling high marsh and other coastal wetlands.[50] This statute, along with

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48. Access to the beach is plentiful along the shores of Long Island Sound, Mississippi Sound, Puget Sound, and Delaware Bay. Interview with Bill Millhouser, *supra* note 47. The San Franciso Bay Area Conservation and Development Commission is particularly vigilant about creating new areas of access. *Id.* It appears that AChesapeake Bay may be the `odd man out.'@ *Id.*

49. Although some states have a policy of Auniversal access@Can access point every mile or soCMaryland does not have a policy that provides access to most of the shores of Chesapeake Bay. E-mails Between the Staff of the U.S. Office of Ocean and Coastal Resources Management and James G. Titus (Oct. 29, 1997) (on file with author) [hereinafter Office of Ocean and Coastal Resources Management E-mails]. The many different possible meanings of the word Aaccess@ may have led some federal coastal zone management officials to assume incorrectly that Maryland has such a policy to promote access. *Id.*; *cf.* Nollan v. California Coastal Comm'n, 483 U.S. 825, 838-39 (1987) (finding that the Commission's argument had confused visual perpendicular access with pedestrian access along the shore). Communications with five staff members of Maryland's Coastal Zone Management Program and Program Open Space revealed that no one in those programs knew how many new access points had been added by their own programs or other programs. Office of Ocean and Coastal Resources Management E-mails, *supra*. In the last 10 years, Maryland has acquired land along tidal waters at 23 locations. Telephone Interview with Bob Elsworth, Program Open Space (Nov. 4, 1997) (on file with author). The total increase in the number of access points is less than 23, however, because in an unknown number of casesCperhaps the majorityCthe acquisition expanded an existing state park or forest. *Id.*

The primary state program related to public access is Program Open Space, managed by the Department of Natural Resources. Interview with Chip Price, U.S. Dep't of Natural Resources (Oct. 29, 1997) (on file with author). This program uses its funds primarily to upgrade or create Acomplete parks,@ often with boat ramps and other facilities. *Id.* The Program lacks the funds to create the hundreds of new parks that would be required to provide universal access to the Bay. *Id.* Although such universal access could be created by purchasing land for paths to the water, the State does not favor universal access, because it prefers only to create access points that it can manage. Without such management, the people visiting the shores would tend to trespass on adjacent private property and leave trash on the beach. *Id.*

The State has no program to obtain public access when new shorefront developments are subdivided. *Id.* In many cases, these subdivisions include small private parks for the use of property owners in the subdivision. Occasionally, community associations seek state funding to upgrade their own facilities. *Id.* When the State informs the property owners that they will have to give public access if they accept state money, the associations generally withdraw their requests for state funds. *Id.*

50. Clean Water Act ' 404, 33 U.S.C. ' 1344(a) (1994). In the case of tidal wetlands, this authority was also provided in the Rivers and Harbors Appropriations Act of 1899, 33 U.S.C. '' 403, 409 (1994). That statute was not used to protect large amounts of coastal wetlands, however, until the 1970s. *See, e.g.*, Comment, *Discharging New Wine into Old Wineskins: The Metamorphosis of the Rivers and Harbors Act of 1899*, 33 U. PITT. L. REV. 483, 486-89 (1972)

federal regulations[51] and companion state laws,[52] discourages private landowners from filling high marsh to create dry land. It does not, however, prevent owners from erecting structures on pilings[53] driven into the marsh.[54]

The section 404 program does not always prevent people from filling wetlands. The Corps can issue a permit to fill a large area of wetlands, as long as the property owner Amitigates@ this destruction by either creating new wetlands or enhancing other wetlands that have been degraded.[55] The Corps has also issued a number of general permits that allow activities within narrowly defined categories to fill wetlands. For example, the Corps has issued a general nationwide permit that allows the owner of a lot to fill up to one-half of an acre of wetlands.[56] Theoretically, the Corps ensures that these activities do not have a major cumulative adverse effect upon the environment, but the general permits do not indicate how.[57]

(explaining that the difficulty in developing and enforcing standards to govern the conduct of individual water polluters led federal officials to revive the Refuse Act of 1899).

51. *See, e.g.*, 40 C.F.R. pt. 230 (1997) (providing guidelines for the control of disposal sites of dredged or fill material).

52. *See, e.g.*, MD. CODE ANN., ENVIR. ' 16-202 (Supp. 1997) (requiring a person to obtain a license prior to dredging or filling state wetlands); MASS. GEN. LAWS ch. 131, ' 40 (Supp. 1997) (stating that no person shall remove, fill, or dredge or alter any area subject to protection under the section without authorization); R.I. GEN. LAWS ' 2-1-22 (Supp. 1997) (mandating that no person may change, add, take from, or otherwise alter any fresh water wetland without first obtaining approval of the director of the department of environmental management).

53. Pilings are wooden cylinders similar to telephone poles. They are driven into the ground or the sea floor with large hammers known as Apiledrivers.@ They have long been used in the construction of wooden docks. More recently, pilings have been used to elevate homes.

54. *See* Interview with Sandy Zelen, Chief, Enforcement Section, Baltimore District, Army Corps of Engineers (Oct. 22, 1997) (on file with author); *see also* Proposed Rule for the Clean Water Act Regulatory Programs of the Army Corps of Engineers and the Environmental Protection Agency, 57 Fed. Reg. 26,894 (1992) (to be codified at 34 C.F.R. pts. 323, 328 and at 40 C.F.R. pts. 110, 112, 116, 117, 122, 230, 232, 401) (clarifying when the placement of pilings is considered to result in a discharge of fill material).

55. *See generally* U.S. Envtl. Protection Agency & U.S. Army Corps of Eng'rs, Mitigation Memorandum of Agreement (Feb. 6, 1990) (explaining the federal policy on wetland mitigation under section 404(b)(1) of the Clean Water Act).

56. Issuance of Nationwide Permit for Single-Family Housing, 60 Fed. Reg. 38,650, 38,662 (1995).

57. *See* 33 U.S.C. ' 1344(e)(1) (1994) (stating that the Secretary of the Army may issue general permits for any category of activities involving discharges of dredged or fill material if the Secretary determines that the activities in such category are similar in nature, will cause only minimal adverse environmental effects when performed separately, and will have only minimal cumulative adverse effects on the environment); 60 Fed. Reg. at 38,654 (promising that District Engineers will take measures to avoid a significant cumulative impact from a nationwide permit that allows property owners to fill up to one-half of an acre for single family homes).

Federal regulations also provide exceptions for bulkheads and other erosion control structures.[58] The Corps has issued a general nationwide permit that allows people to erect erosion control structures along shorelines, as long as no vegetated wetlands are filled and no more than a modest amount of fill material is placed below mean high water.[59] In Maryland, however, the Corps has delegated its permit approval to the state,[60] which tolerates a greater impact on wetlands and tidal waters. For example, property owners who erect an erosion control structure in Maryland can obtain a permit to fill vegetated wetlands[61] and to fill beaches and tidal waters up to ten feet seaward of mean high water.[62] In addition, Maryland's statute allows anyone whose property has eroded

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58. *See* 61 Fed. Reg. 30,779, 30,787-88 (1996) (explaining that construction of erosion control structures is authorized, as long as they meet certain conditions).

59. *See id.* (authorizing nationwide wetland permits). The nationwide permit allows property owners to place one cubic yard of fill below the mean high water mark for every foot of shoreline that is protected. *Id.* at 30,788. Thus, for example, if a bulkhead were to raise the land below mean high water by 4.5 feet, a property owner could fill no more than 6 feet seaward of mean high water.

60. States can apply to assume the entire section 404 program. *See* 33 U.S.C. ' 1344(g)-(*l*) (1994). To qualify, they must meet a variety of criteria and obtain EPA approval under guidelines promulgated at 40 C.F.R. pt. 233. The Corps' delegation of the program to Maryland, however, has taken the form of a statewide general permit under 33 U.S.C. ' 1344(e). *See* Baltimore Dist., U.S. Army Corps of Engineers, Dep't of the Army, Maryland State Programmatic General Permit ' ' 1-5 (May 6, 1996) [hereinafter Maryland General Permit]. The legal justification for this permit is in doubt because general permits are only allowed for classes of similar activities with minimal impact. 40 C.F.R. ' 230.7(a). However, the Maryland General Permit does not explain why the Corps of Engineers believes that the armoring of 15 miles of shoreline per year has a minimal adverse impact; it does not provide a detailed analysis to justify the assumption that, collectively, all of the permits issued by the State of Maryland to fill wetlands will have a minimal impact; and it does not explain how all of the various activities that result in the filling of tidal and nontidal wetlands can be collectively viewed as similar in nature. *See* Sixty Day Notice of Civil Action Challenging the Maryland State Programmatic General Permit, Letter from Jan Goldman-Carter, Counsel Representing Nat'l Wildlife Fed'n to Togo D. West, Sec'y of the Army, William M. Daley, Sec'y of Commerce, Bruce Babbitt, Sec'y of the Interior, Carol Browner, Administrator, Envtl. Protection Agency, and Jane Nishida, Sec'y, Md. Dep't of the Env't (Apr. 22, 1997) (detailing the National Wildlife Federation's opposition to the Maryland State Programmatic General Permit).

61. *See* MD. CODE ANN., ENVIR. ' 16-201 (1996); Maryland General Permit, *supra* note 60, app. at I-24, I-31. Along sheltered waters, the state encourages property owners to control erosion by planting vegetation. For this purpose, one can fill up to 35 feet seaward of mean high water. *See* MD. CODE ANN., ENVIR. ' 16-202(a)(3)(iii) (Supp. 1997). Along Chesapeake Bay and other waters with significant waves, hard structures are generally employed. *See* Interview with Rick Ayella, Director, Md. Dep't of the Env't, Tidal Waters Division (Oct. 10, 1996) (on file with author).

62. MD. CODE ANN., ENVIR. ' 16-202(a)(2).

to fill wetlands and other tidal waters in order to reclaim any land that the owner has lost since the early 1970s.[63]

3. Coastal Erosion and Rising Sea Level.—Although some shores are accreting, coastal erosion is far more common.[64] The average ocean shore along the Atlantic and Gulf Coasts is eroding two and four feet per year, respectively.[65] Although most of California's coast is not eroding, about fifteen percent of it is eroding by at least five feet per year.[66] National assessments of wetland erosion are unavailable, but assessments of particular areas,[67] and informal opinions of professional observers,[68] suggest that estuarine shores are generally eroding as well. Blackwater National Wildlife Refuge on Maryland's Eastern Shore has lost about half of its wetlands in the last fifty years,[69] as shown in Figure 3.

Coastal erosion is caused by a variety of factors, which broadly fall into two categories. First, sand often migrates along the shore, causing some areas to erode and others to accrete.[70] Second, rising sea level

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63. MD. CODE ANN., ENVIR. ' 16-201.

64. *See* MARINE BOARD REPORT, *supra* note 19, at 46-51 (discussing the prevalence of erosion along sandy coasts).

65. *Id*. at 50.

66. *See id*. (reporting that standard deviation of erosion rate is 1.5m/yr.). Assuming that erosion rates are normally distributed, then about 16% of the shores are eroding more rapidly than 1.5m/yr. *See* RONALD J. WONNACOTT & THOMAS H. WONNACOTT, ECONOMETRICS 418 tbl.4 (1970) (presenting a table of standard normal distribution).

67. *See, e.g.*, Michael S. Kearney & J. Court Stevenson, *Sea Level Rise and Marsh Vertical Accretion Rates in Chesapeake Bay, in* 2 COASTAL ZONE `85, at 1451, 1456 tbl.1 (Orville T. Magoon et al. eds., 1985) (stating that the area of marsh in the Blackwater National Wildlife Refuge declined 59.2% between 1938 and 1985).

68. Personal communications with employees of the majority of state coastal zone programs confirm that estuarine shores are eroding. Memorandum from ICF Kaiser, Inc. to Jim Titus, Work Assignment Manager, Envtl. Protection Agency (Oct. 31, 1996) [hereinafter ICF Kaiser] (deliverable under EPA contract #68-W6-0056).

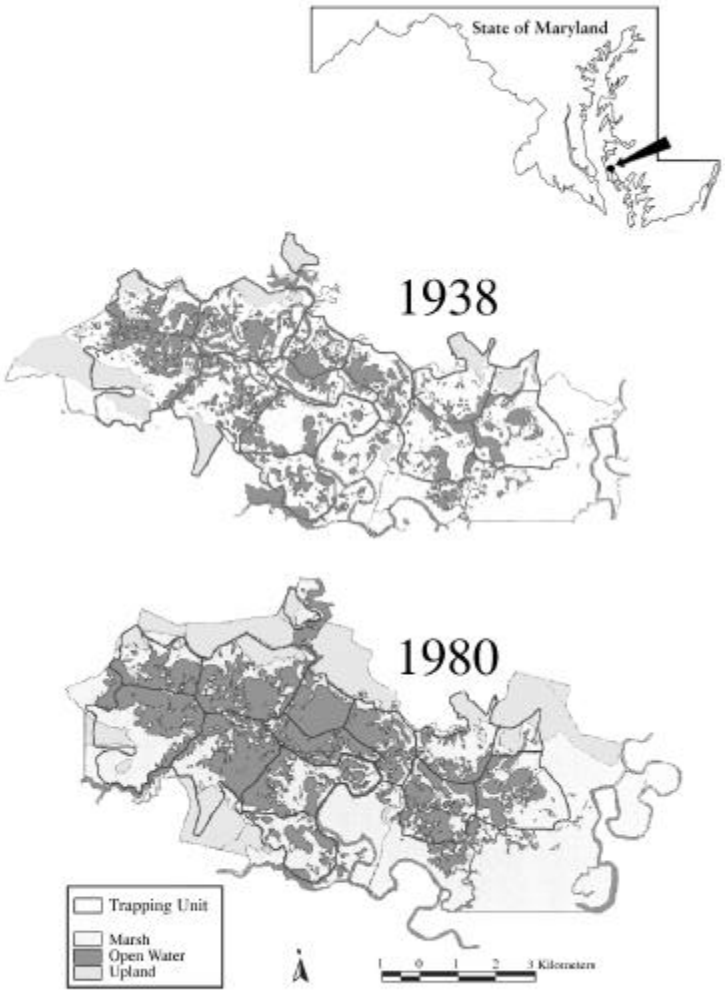
69. Kearney & Stevenson, *supra* note 67, at 1456 tbl.1.

70. Natural headlands tend to erode and sand tends to collect in some types of indentations along the coast. Jetties and other structures also tend to trap sand. *See* Timothy W. Kana et al., *The Physical Impact of Sea Level Rise in the Area of Charleston, South Carolina, in* GREENHOUSE EFFECT AND SEA LEVEL RISE, *supra* note 35, at 105, 109 (noting that jetties at the entrance to Charleston Harbor have caused up to 300 meters of deposition to the north and extensive erosion to the south, including over 500 meters of erosion along Morris Island).

One observer notes:

> Since the stabilization of Ocean City Inlet with jetties in 1934-35, there has been a pronounced alteration of the adjacent shorelines for several miles in each direction. Updrift of the jetties at south Ocean City, a large amount of sedimentation . . . . has necessitated the lengthening of the Ocean City fishing pier, and the north jetty is now impounded to capacity. . . . Since little of this sand is bypassing Ocean City Inlet, the northern portion of Assateague Island is being starved of sediment and pushed landward.

FIGURE 3
THE CONVERSION OF MARSH TO OPEN WATER AT BLACKWATER NATIONAL WILDLIFE REFUGE IN DORCESTER COUNTY, MARYLAND



Source: Court Stevenson, University of Maryland. The shape of the refuge has changed slightly due to land acquisitions. Because the boundaries of the individual trapping units have not changed, the extent of the wetland loss is most evident to the reader who compares the conditions of a given trapping unit in 1938 with the condition in 1980. Although a more recent map is not available, the loss has continued, according to Court Stevenson.

causes virtually all shores to erode.[71] As shown in Figure 4, sea level has risen approximately one foot in the last century along most of the U.S. coast. Using a model first developed by Danish coastal engineer Per Bruun, coastal geologists have estimated that a one-meter rise in sea level will cause beaches to erode 50 to 100 meters from New England to Maryland, 200 meters along the Carolinas, 100 to 1000 meters along the Florida coast, and 200 to 400 meters along the California coast.[72] These model calculations are roughly consistent with the observed rate of erosion.[73]

Recognizing the value of ocean beaches, states have taken a variety of measures to protect them. Densely developed resorts periodically pump sand onto their beaches—a process known as beach nourishment.[74] While expensive, this engineering solution permits the continued existence of the beach in approximately its current location.[75] In lightly developed areas, where beach nourishment is often too expensive, states focus on preventing structures that impede the natural erosion of the shore: Texas courts recognize the public beach as a rolling easement that migrates inland with the shore.[76] North Carolina and many other states

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Stephen P. Leatherman, *Geomorphic Effects of Sea Level Rise on Ocean City, Maryland*, *in* JAMES G. TITUS ET AL., POTENTIAL IMPACTS OF SEA LEVEL RISE ON THE BEACH AT OCEAN CITY, MARYLAND 33, 37 (1985) (citations omitted).

71. MARINE BOARD REPORT, *supra* note 19, at 53-57 (discussing the Bruun Rule's demonstration that rising sea level causes sandy beaches to erode). There are two important exceptions: Rocky coasts with no protective beach may not erode, and shores that would otherwise be accreting may simply accrete more slowly as sea level rises. *Id.* at 57.

72. *Holding Back the Sea*, *supra* note 32, at 178 (summarizing studies by Kyper & Sorensen, Leatherman, Kana et al., Bruun, and Wilcoxen, respectively).

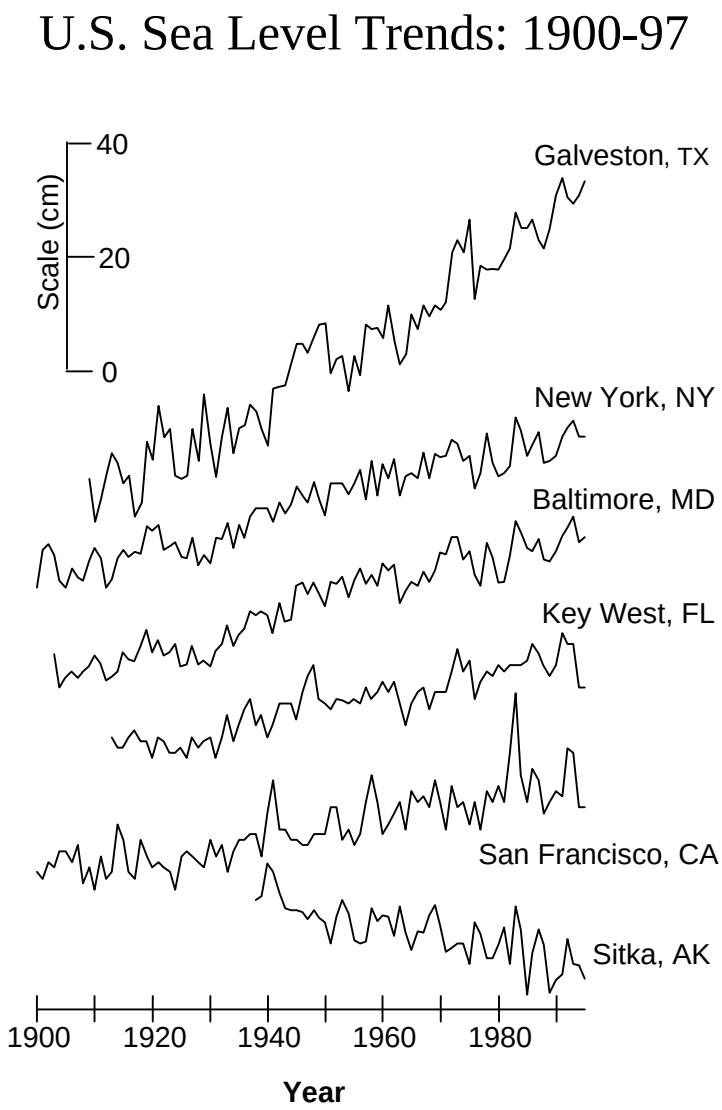
73. *See supra* notes 64-66 and accompanying text (discussing the rates of erosion along the Atlantic, Gulf, and California coasts).

74. *See* MARINE BOARD REPORT, *supra* note 19, at 75-79 (discussing the uses of beach nourishment).

75. *See* U.S. ARMY CORPS OF ENG'RS, *supra* note 7, at 47 (noting that beach nourishment is now accepted as the primary means of shore protection). Beach nourishment is the approach that the State of Maryland and the Corps of Engineers are using to stop Ocean City's shore from eroding. Personal Communication with John Van Fossen, *supra* note 24. The State employed this method partly because rising sea level prompted a shift away from the hard structures that were favored until the mid-1980s. Larry Rosenthal, *Doubled Erosion Seen for Ocean City Series: P*, WASH. POST, Nov. 14, 1985, at M7, *available in* 1985 WL 2084622. States with relatively strict coastal land-use policies tend to rely less on beach nourishment. For example, of $670 million in total expenditures for federal beach nourishment projects during 1950-1993, only $8 million was spent in South Carolina. U.S. ARMY CORPS OF ENG'RS, *supra* note 7, at 37-38.

76. *See infra* notes 398-399 and accompanying text (discussing how Texas courts have recognized the beach as a rolling easement, because otherwise, the area of public access would eventually disappear as the shore erodes).

FIGURE 4



Source: National Oceanic and Atmospheric Administration.

prohibit new seawalls and bulkheads.[77] Several states require new construction to be set back from the shore by forty to one-hundred times the annual rate of erosion.[78] Maine employs all of these approaches.[79] These policies, coupled with the high cost of holding back the ocean, seem likely to ensure the survival of ocean beaches in all but a few locations.

The response to bay-beach erosion is very different. Beach nourishment along these shores is exceedingly rare.[80] Because the seas are relatively calm, bulkheads are able to hold back the bay and are much less expensive than the seawalls that are needed to hold back the ocean.[81] Bayfront developments usually provide no public access to the shore, so officials tend not to think of the bay shore as a community asset.[82] As a result, estuarine shores are gradually being armored in most developed areas.[83]

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77. *See infra* notes 400, 404, 407 and accompanying text (detailing state regulations that prohibit new erosion control structures within certain zones of the ocean coast).

78. *See* COMMITTEE ON COASTAL EROSION ZONE MANAGEMENT, NATIONAL RESEARCH COUNCIL, MANAGING COASTAL EROSION 94-98 (1990) (discussing different types of state requirements for erosion setbacks for new construction).

79. *See* MARINE LAW INST., MAINE STATE PLANNING OFFICE & MAINE GEOLOGICAL SURVEY, ANTICIPATORY PLANNING FOR SEA-LEVEL RISE ALONG THE COAST OF MAINE 5-5, 5-6 (1994) (100 year setback for new construction); *id.* at 5-9 (removal of a structure if a wetland encroaches up to the structure for six months or more); *id.* at 5-8 (prohibition of new seawalls).

80. A notable exception is Mississippi, where the barrier islands are undeveloped and the primary beach resorts are along the bays behind the barrier islands. There, the public has access to most of the bay shoreline. *See* U.S. ARMY CORPS OF ENG'RS, *supra* note 7, at 43 (showing that Corps of Engineers projects have placed 5.7 million cubic yards of sand along Mississippi shores); Laura S. Howorth & Sondra Simpson, *Sea Level Rise: Policy Implications for the Mississippi Coast*, *in* LONG TERM IMPLICATIONS OF SEA LEVEL CHANGE FOR THE MISSISSIPPI AND ALABAMA COASTLINES 18, 20 (David D. Burrage ed., 1990) (noting that most of Mississippi's beaches are Aman-made@).

81. *Compare* Robert M. Sorensen et al., *Control of Erosion, Inundation and Salinity Intrusion Caused by Sea Level Rise*, *in* GREENHOUSE EFFECT AND SEA LEVEL RISE, *supra* note 35, at 179, 188 (noting that seawalls used along shores with large waves can cost $3000 per foot or more) *with id.* at 191-92, 195-97 (stating that bulkheads and revetments used along inland waters cost about $125-$300 per foot). Bulkheads are vertical structures that are usually made of wood that can stop erosion in calm waters but not in the face of substantial waves. *Id.* at 195-97. Revetments are sloped structures generally made of rock that can withstand greater wave forces. *Id.* at 191-92. Seawalls are vertical walls that can withstand ocean waves. *Id.* at 195. Along Chesapeake Bay, revetments comprise the vast majority of new erosion control structures. *See* WETLANDS ADMIN., STATE OF MD., REPORT ON TIDAL WETLANDS ACTIVITIES AND LICENSES FOR FISCAL YEAR 1993, at 3 (1993).

82. *See supra* note 5 and accompanying text. The lack of perpendicular access to the shore and the lack of public concern over the status of estuarine shores are probably mutually reinforcing. *See supra* note 5 and accompanying text.

83. ICF Kaiser, *supra* note 68, at 3. Although the gradual armoring of estuarine shores is self-evident along eroding shores developed more than 20 years ago, no one has conducted a comprehensive assessment of estuarine shoreline armoring. *See id.* at 1. An EPA contractor

Nevertheless, attitudes about the need to maintain natural estuarine shorelines vary among the states. At one extreme are Rhode Island and Maine, which prohibit, to some extent, the erection of bulkheads inland of wetlands, because these structures would prevent wetland migration.[84] At the other extreme is Maryland, where some scientists, and many officials, believe that the elimination of natural shores may be good for Chesapeake Bay.[85] Currently, Maryland recognizes a statutory right to hold back the sea,[86] and fifteen to twenty-five miles per year have been armored over the last two decades.[87]

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that contacted each of the state coastal zone offices found that two-thirds of the states had no data. *Id.* at 2-3. Nevertheless, the state officials were able to provide the following estimates of shoreline armoring: California (San Francisco Bay)**C**66% of the shoreline; Mississippi**C**42.4 miles of the shoreline; North Carolina**C**no data, but armoring is a standard practice; Rhode Island**C**very little armoring of the shoreline; Texas**C**most privately developed bay shores were armored; Virginia part of Chesapeake Bay**C**19% of the 383 miles of shoreline was armored, and armoring was increasing by about 1.2 miles per year; Washington State**C**30% of Puget Sound's shoreline was armored, and 4-5 miles of armoring was added each year. *Id.* at 3-5 app. 1-7; *see also infra* Appendix 2 (showing that permits were issued for armoring nearly 330 miles of the Maryland shoreline during 1978-1994).

84. *See infra* notes 406, 416 and accompanying text (explaining that Rhode Island and Maine have prohibited hard structures specifically so that wetlands can migrate inland as sea level rises).

85. Michael Kearney of the University of Maryland believes that shoreline erosion may be responsible for about 50% of the new sediment entering the Bay. Personal Communication with Michael Kearney, Geography Dep't, University of Md. (Feb. 20, 1997). The turbidity caused by sediments decreases the amount of sunlight that is able to penetrate the water to support the photosynthesis of submerged aquatic vegetation. CHESAPEAKE BAY PROGRAM, U.S. ENVTL. PROTECTION AGENCY, THE STATE OF THE CHESAPEAKE BAY 22 (Robert Magnien et al. eds., 1995). The proponents of shoreline hardening argue that natural erosion did not cause excess turbidity several decades ago, because the oysters filtered all the water in the Bay every three days, but that today only enough oysters exist to filter the water every 10 months. *See* Roger I.E. Newell, *Ecological Changes in Chesapeake Bay: Are They the Result of Overharvesting the American Oyster*, Crassostrea Virginica?, *in* UNDERSTANDING THE ESTUARY: ADVANCES IN CHESAPEAKE BAY RESEARCH 536 (Maurice P. Lynch & Elizabeth C. Krome eds., 1988) (estimating a decline of oyster filtration, but not addressing the shoreline hardening issue). Others argue that natural erosion has always existed, that turbidity is a problem of the last few decades, and that increased sedimentation was caused by changes in land use that promoted soil erosion throughout the watershed. Personal Communication with Michael Kearney, *supra*. Even if shore erosion caused 50% of the new sediment in the Bay, a large fraction of the turbidity is caused by resuspension of sediment from the floor of the Bay and its tributaries. *Id.*

86. *See infra* note 402 and accompanying text.

87. *See infra* Appendix 2. Maryland's high rate of shoreline armoring may result more from the state's unique history than from environmental insensitivity. *See* Board of Pub. Works v. Larmar Corp., 277 A.2d 427, 431-37 (Md. 1971) (summarizing the history of riparian rights in Maryland). An 1862 statute granted a riparian owner the right to fill navigable waters in Maryland, Alimited only to the extent that he could not obstruct navigation.@ *Id.* at 436 (citing 1862 Md. Laws ch. 129). Today, riparian owners in Maryland have a statutory right to hold back the sea and reclaim land lost by erosion since the early 1970s. *See* MD. CODE ANN., ENVIR. ' 16-201 (1996). This right is much more favorable to the property owner and less

Most states allow bulkheads where they are necessary to protect property, but they have not formally granted a right to hold back the sea.[88] When bulkheads are built inland of a marsh, with the land behind them raised a few feet with fill, there is still marsh seaward of the bulkhead. At that point, the state has not given away the shore. Later, when the marsh erodes up to the bulkhead, the state can say: A`Twas the sea, not we, who did the tidelands in.@[89] Only Maryland has published estimates of the total amount of shoreline that has been armored.[90]

4. Greenhouse Effect and Accelerated Sea Level Rise. **C** A less immediate but ultimately more serious concern is that rising global temperatures resulting from the greenhouse effect could raise the sea several more feet. Scientists have known for more than a century[91] that carbon dioxide and some other gases keep the earth warmer than it would otherwise be, by absorbing infrared radiation that emanates from the earth's surface.[92] The average concentration of carbon dioxide has increased from around 280 parts per million before the industrial revolution, to 315 parts per million when precise monitoring stations were set up in 1958, and to 358 parts per million in 1994.[93] The earth's average surface temperature has increased by about 0.3 to 0.6 degrees Celsius in the last century.[94] Assuming that no major action is enacted to curtail the use of fossil fuels, the earth's average temperature is projected to rise 1.0 to 3.5 degrees Celsius in the next century.[95]

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favorable to the environment and the public than the law in most states. *See infra* Part IV. But by repealing the longstanding right to fill most tidal waters, *see Larmar Corp.*, 277 A.2d at 440, the existing law is much more favorable to the environment and the public interest than the riparian rights that had prevailed for the previous century.

88. *See infra* notes 394-405 and accompanying text.

89. Similarly, the federal wetland protection program prevents most wetlands from being filled, but it does not enable their migration inland as the sea erodes their outer boundaries. Personal Communication with Gregory Peck, Office of Wetland Protection, U.S. Envtl. Protection Agency (Dec. 1995); *see also* POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE, *supra* note 17, at 142 (ASection 404 of the Clean Water Act discourages development of existing wetlands, but it does not address development of areas that might one day be necessary for wetland migration.@).

90. *See infra* Appendix 2.

91. *See* Jesse H. Ausubel, *Historical Note*, *in* CARBON DIOXIDE ASSESSMENT COMM., NATIONAL RESEARCH COUNCIL, CHANGING CLIMATE: REPORT OF THE CARBON DIOXIDE ASSESSMENT COMMITTEE 488 (1983) (citing pre-1900 studies about the implications of rising carbon dioxide levels in the atmosphere).

92. *See* IPCC 1995, *supra* note 2, at 56-60 (discussing the general effect of greenhouse gases).

93. *See id.* at 78.

94. *Id.* at 4.

95. *Id.* at 6.

Since 1983, the U.S. Environmental Protection Agency (EPA) has been warning coastal states and communities about the risks of rising sea level.[96] EPA's first study crudely estimated that sea level could rise two to twelve feet by the year 2100.[97] From 1985 to 1991, EPA-sponsored publications generally projected that global temperatures would rise four degrees Celsius by the year 2060, causing a four-foot rise in sea level by the year 2100.[98] More recent refinements in climate modeling suggest that the global warming will only be about half as great. As a result, sea level estimates have come down as well.[99]

With these refinements, scientists can now estimate a probability distribution of future sea level rise. For purposes of valuing interests in land that depend on the risk of the land being inundated, the use of probability information is helpful. The value of an easement that vests when the sea rises two feet, for example, would depend greatly on how likely such a rise is to occur by various years. Table 1 shows EPA's most recent estimates for sea level rise at New York City. EPA estimates a 50% chance that sea level will rise one foot by 2050, two feet by 2100, and four feet by 2200, as well as a one-in-forty chance that the sea will rise 1.5 feet by 2050, 3.5 feet by 2100, and over 11 feet by 2200.[100]

What are the expected impacts? At first, most of the major effects would concern wetlands and property along the shore. Most waterfront homes are within 100 to 200 feet of the high water mark, and most shores erode 100 to 200 feet for every foot of sea level rise.[101] Thus, a one-foot rise would force officials to choose between moving these houses and replacing the tidelands with a wall.

Larger rises in sea level would have a potential to inundate much larger areas. A four-foot rise could bring the sea several miles inland in some areas and would inundate 7000 square miles of dry land**C**an area

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96. In the 1980s, EPA sponsored numerous conferences and sent form letters to approximately 50,000 coastal officials, scientists, and active citizens briefly explaining the impact of rising sea level and offering reports on the subject. As a result, property owners may have been constructively notified that the sea is rising.

97. JOHN S. HOFFMAN ET AL., U.S. ENVTL. PROTECTION AGENCY, PROJECTING FUTURE SEA LEVEL RISE: METHODOLOGY, ESTIMATES TO THE YEAR 2100, & RESEARCH NEEDS 38 (2d ed. 1983).

98. EPA 1995, *supra* note 2, at 139 & n.12.

99. *See id.* at 135-38 (explaining that estimates of sea level rise have declined primarily because the warming estimates have declined).

100. These estimates are consistent with the nonprobabilistic projections published by an international collaboration of scientists organized under the United Nations. *See* IPCC 1995, *supra* note 2, at 381 (estimating that global sea level is likely to rise 20 to 86 cm by the year 2100).

101. *See Holding Back the Sea*, *supra* note 32, at 178 (citing various studies of erosion due to sea level rise in the United States).

TABLE 1
PROJECTED SEA LEVEL RISE AT NEW YORK CITY
FOR VARIOUS PROBABILITIES
(Compared with 1990 Levels (inches))

Cumulative Probability	Sea Level Projection By Year					
	2025	2050	2075	2100	2150	2200
10	3	6	9	12	18	24
20	4	8	11	16	23	31
30	5	9	13	18	27	37
40	5	10	15	20	31	42
50	6	10	16	22	34	48
60	6	11	17	24	38	53
70	7	12	18	26	43	61
80	7	13	20	29	49	72
90	8	15	24	33	59	91
95	9	17	26	38	70	113
97.5	10	19	29	42	83	139
99	11	20	31	48	100	181
Mean	6	11	16	22	37	54
s	6	10	15	21	36	54

SOURCES: (1) JAMES G. TITUS & VIJAY K. NARAYANAN, U.S. ENVTL. PROTECTION AGENCY, THE PROBABILITY OF SEA LEVEL RISE 144-45 (1995). (2) James G. Titus & Vijay Narayanan, *The Risk of Sea Level Rise: A Delphic Monte Carlo Analysis in Which Twenty Researchers Specify Subjective Probability Distributions for Model Coefficients Within Their Respective Areas of Expertise*, 33 CLIMATIC CHANGE 151, 206 (1996). The estimates in this table are based on the data and procedures found on page 145 of the EPA report. Cumulative probability refers to the likelihood that the sea will rise less than the amount indicated in the table. For example, there is a 95 percent chance that the sea will rise less than 38 inches by 2100.

the size of Massachusetts.[102] In most developed areas, holding back the sea would be cost-effective,[103] but it would prevent new wetlands from forming in the newly inundated area. For example, if shores are not armored, a two-foot rise in sea level would decrease U.S. wetland acreage by 17% to 43%, but if shores are protected, the loss would be 38% to 61%.[104] These estimates may understate the impact, because estuarine beaches and the narrow strips of vegetated wetlands found along many

102. *See id.* at 187.
103. *See id.* at 189, 190.
104. *Id.* at 190. For example, a nationwide computer modeling study found that a 2.8-foot rise in sea level would result in virtually a total loss of the existing wetlands at two sites along Chesapeake Bay, but the net loss would be only 25% if new wetlands were able to form inland. Armentano et al., *supra* note 37, at 130-39.

shores could be entirely lost.[105] As a result, Aprotecting all mainland shores could result in wetlands being confined to a small number of isolated reserves, a situation that humanity has already imposed on many terrestrial species.@[106]

A consensus is emerging that Maryland is particularly vulnerable to rising sea level.[107] Because Chesapeake Bay has a tidal range of approximately two feet, its coastal wetlands are generally within one or two feet of sea level.[108] Farmers in Somerset County are already reporting a gradual loss of arable land as the bay water penetrates inland, leaving soils too salty for cultivation.[109] In the next century, rising seas could entirely inundate Smith Island and eliminate its unique subculture of watermen who have populated that island for over three centuries.[110] As Figure 5 shows, shores could retreat inland by a few miles in parts of Somerset, Dorchester, and Worcester counties.

Maryland's current coastal zone and environmental protection policies, statutes, and regulations would ensure almost complete elimination of the state's bay beaches and coastal wetlands in developed areas. The narrow dimensions of bay beaches and the low wetland elevations imply that a very modest rise in sea level would remove these ecosystems from their current locations.[111] The state's recognition of a right to protect shores with hard structures[112] will prevent these ecosystems from migrating inland. The lack of public access to most shores, combined with the absence of a policy to create access to

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105. *See* NORDSTROM, *supra* note 5, at 6 (stating that beaches are generally less than 5 meters (16 feet) wide along narrow estuaries with small tidal ranges, and upwards of 20 meters (75 feet) wide along large estuaries with large tidal ranges); *supra* note 72 and accompanying text (explaining that most shores will erode more than 100 feet with a one-foot rise in sea level).

106. *Holding Back the Sea*, *supra* note 32, at 201.

107. *See Conference Statement: Changing Climate, Rising Sea Level, and Chesapeake Bay: Questions and Answers* 2 (1996) (visited Aug. 21, 1998) <http://www.climate.org/-conferences/ChesapeakeConfStatement.html> (summarizing a conference of approximately 140 scientists, property owners, and governmental officials who met to discuss the implications of rising sea level and climate change for Chesapeake Bay).

108. *See supra* notes 36-37 and accompanying text.

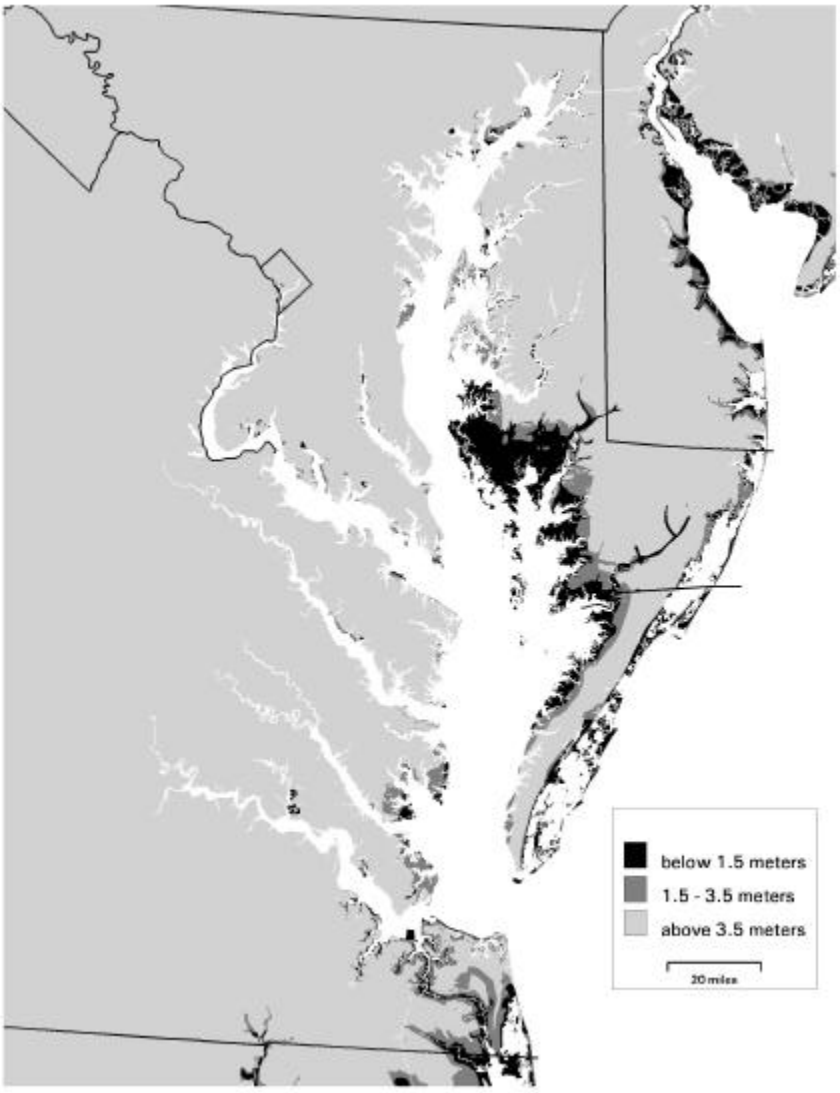
109. *Conference Statement*, *supra* note 107, at 2.

110. *Id*.

111. *See supra* note 104 (discussing a model that indicates that a 2.8-foot rise in sea level could result in virtually a total loss of the existing wetlands at two sites along the Chesapeake Bay); *cf. supra* notes 71-73 and accompanying text (discussing a different model that indicates that a one-foot rise in sea level will cause beaches in Maryland to erode 50 to 100 feet).

112. *See, e.g.*, MD. CODE ANN., ENVIR. ' 16-201 (1996) (allowing a property owner to hold back the sea and reclaim land lost by erosion); *supra* note 87 and accompanying text (discussing Maryland's statutes concerning shoreline armoring).

FIGURE 5
MARYLAND'S VULNERABILITY TO A RISE IN SEA LEVEL



This map shows the land that is below the 5-foot and 10-foot contours. The 5-foot contour, for example, is 5 feet above the 1929 sea level. Given the typical 2-foot tidal range and the 8-inch rise in sea level taking place since 1929, these contours represent the land that would be inundated by high tide if sea level were to rise 3-1/2 and 8-1/2 feet, respectively.

inaccessible shores,[113] will help to ensure that the public does not even comment on permits to eliminate those shores.

B. Possible Options to Protect Natural Shores

Society has two fundamental ways to retain its wetlands and beaches as sea level rises: (1) use technology to enable the shore to keep pace with the rising sea level, or (2) allow nature to take its course and adapt to the retreating shores. The most common technology is to add sand directly to a beach, thereby raising its elevation.[114] This process is commonly employed along ocean shores—generally at public expense.[115] Estuarine beaches, by contrast, are rarely nourished, and the technology for artificially elevating wetlands is still in its infancy.[116]

Allowing nature to take its course appears at first glance to be a more straightforward approach. But private property owners generally do not wish to give up their homes or even their land—especially along estuarine shores, where they can hold back the sea with a bulkhead for a small fraction of the value of the land or structures that would otherwise be lost. Thus, if society wants to retain its natural shorelines, then governments will have to induce property owners to yield their land to the sea.

Previous analyses have suggested several different policies for ensuring that human activities do not impede the natural inland migration of shorelines as sea level rises.[117] These approaches generally fall into three categories:

1. Prevent Development or otherwise decrease the property owner's economic motivation to hold back the sea;[118]

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113. *See supra* notes 48-49 (discussing Maryland's lack of a policy providing access to most of the shores of Chesapeake Bay).

114. *See supra* notes 74-75 (discussing the process of beach nourishment).

115. *See* COMMITTEE ON COASTAL EROSION ZONE MANAGEMENT, *supra* note 78, at 56-57 (explaining the beach nourishment process).

116. *See* LOUISIANA WETLAND PROTECTION PANEL, *supra* note 37, at 51 (discussing a relatively new technique that involves periodic spraying of sediment on the marsh to help increase the rate of accretion).

117. *See* POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE, *supra* note 17, at 141-42 (outlining different approaches to preserve wetland shorelines as sea level rises); James G. Titus, *Greenhouse Effect and Coastal Wetland Policy: How Americans Could Abandon an Area the Size of Massachusetts at Minimum Cost*, 15 ENVTL. MGMT. 39, 44-46 (1991) [hereinafter *Coastal Wetland Policy*] (same). For the first legal analysis of these options, see Robert L. Fischman, *Global Warming and Property Interests: Preserving Coastal Wetlands as Sea Levels Rise*, 19 HOFSTRA L. REV. 565, 570-74 (1991).

118. *See* 1 OFFICE OF TECH. ASSESSMENT, U.S. CONGRESS, PREPARING FOR AN UNCERTAIN CLIMATE 199-204 (1993) (analyzing the effects of denying governmental subsidies such as infrastructure, flood insurance, mortgage insurance, and the income tax deduction for mortgage interest payments, and concluding that while these strategies could discourage

2. Create *Rolling Easements*, a policy that allows development, but explicitly prevents property owners from holding back the sea;[119] and

3. Defer Action, continue current policies, and deal with the problem later.

Each of these policies can, in turn, be subdivided according to whether the government or the property owner absorbs the loss. Table 2 lists a number of examples for implementing each of the general approaches. The following sections briefly examine how these approaches might work for areas that are currently undeveloped.[120]

1. Preventing Development. Policy makers have two ways to decrease a property owner's motivation to erect a bulkhead: (1) increase the cost, or (2) decrease the benefit of erecting such a structure. Perhaps the most important way by which governments have increased the cost (to property owners) of these structures has been to reduce the subsidies for their construction.[121] Removing subsidies for development can decrease the incentive to build homes that might later require protection.[122] On the other hand, subsidized beach nourishment has decreased the need

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development, they would not necessarily prevent it).

119. Previous reports have used inconsistent terminology to describe this idea. *See id.* at 192 (AThe `Maine Approach'@); Fischman, *supra* note 117, at 574 (Abulkhead prohibitions@); Lisa A. St. Amand, *Sea Level Rise and Coastal Wetlands: Opportunities for a Peaceful Migration*, 19 B.C. ENVTL. AFF. L. REV. 1, 3 (1991) (Apresumed mobility@); *Holding Back the Sea*, *supra* note 32, at 182 fig.6 (AEnforce Public Trust Doctrine@); *Coastal Wetland Policy*, *supra* note 117, at 44 (Apresumed mobility@); James G. Titus, *Greenhouse Effect, Sea Level Rise, and Coastal Zone Management*, 14 COASTAL ZONE MGMT. J. 147, 166 (1986) (Ain effect, purchase an option@).

120. This Article focuses on coastal lands that are undeveloped today, because in areas that are already developed, setbacks are generally inapplicable, and plans to allow shores to retreat are likely to be politically infeasible. For example, the primary coastal policy document authorized by the Governor of New Jersey suggested that even mentioning the term Aretreat@ would divide people and impede meaningful discussion of appropriate policies. *See* COASTAL REPORT TASK FORCE, NEW JERSEY DEP'T OF ENVTL. PROTECTION, NEW JERSEY COASTAL REPORT: A FRAMEWORK DOCUMENT FOR A COASTAL MANAGEMENT PARTNERSHIP 19 (1997) (AThe mere use of the word serves to divide people . . . . `[R]etreat' can mean government-imposed prohibition on construction or reconstruction of oceanfront development . . . . [which] often fuels the divisive `retreat' debate . . . .@).

121. Until the early 1990s, for example, Maryland offered interest-free loans to anyone who built a bulkhead or revetment to control erosion. Interview with Rick Ayella, *supra* note 61.

122. The Coastal Barrier Resources Act curtails federal expenditures and financial assistance that would encourage further development of designated coastal areas. *See* 16 U.S.C '' 3501-3510 (1994). Until its repeal, the Upton-Jones Amendments of the National Flood Insurance Program denied federal flood insurance to homes that are about to collapse into the sea due to erosion, and authorized subsidies for the removal of these homes to other locations. *See* 42 U.S.C. ' 4013(c)(2)(B) (repealed 1994).

TABLE 2
POLICIES TO PROTECT TIDELANDS AS SEA LEVEL RISES

A. Protecting Tidelands

	(a) Taxpayers Pay	(b) Coastal Landowners Pay
1. Prevent Development	Buy land now. Buy nondevelopment easement now.	Subdivide land with deeper lots. Setbacks that prohibit new construction below a given elevation or within a certain distance of the shore. Dedicate land as part of permit for coastal development.
2. Defer Action	Buy land and structures when property threatened.	Evict people from their homes.
3. Rolling Easements	Buy Texas rolling easement. Buy reversionary interest. Buy purchase option.	Pass a statute declaring that all future development is subject to the rolling easement. Prohibit bulkheads, seawalls, etc. Require individual structures to be subject to rolling easement as condition for building permit. Require entire development to be subject to rolling easement as condition for subdivision, or for activities that require wetlands to be filled. Texas Open Beaches Act.
4. Hybrids		Density Restrictions (1 & 2). Cluster Developments (1 & 2). Maine Dune Rules (1, 2, & 3). South Carolina Beachfront Management Act (1 & 3).

B. Protecting Future Alongshore Access When Bulkheads Are Built Today

1. Immediate Dedication	Buy easement to narrow strip above bulkhead.	Dedicate easement *above* bulkhead as condition for bulkhead permit.
2. Defer Dedication	Give shoreline to owner today and buy back easement later.	Wait until beach erodes away, then require owners to dedicate easement above bulkhead.
3. One-Step Easement	Buy access right that vests only when shore erodes away land below bulkhead.	Grant bulkhead permit on condition of public access along shore *above* bulkhead once shore *below* bulkhead has eroded.

to build seawalls along ocean shores[123] and would presumably have the same effect if applied along estuarine shores. Nevertheless, these measures are unlikely to reduce substantially the nationwide rate of bulkhead construction along estuarine shores. Even without subsidies, riparian owners in many areas continue to erect bulkheads, and no state is considering a comprehensive program of beach nourishment along estuarine shores.[124]

Policies that prevent development also decrease the benefits of building bulkheads, and such policies can conserve natural shorelines in a wider variety of situations.[125] The most common way to prevent development in vulnerable areas is to require a Asetback,@ which prohibits construction seaward of a setback line.[126] Setbacks can be based on elevation, erosion rates, or estimates of how the shore might change in the future.[127] Land subdivision policies requiring deeper lots along the shore can help to ensure that setbacks do not leave shorefront owners without permissible building sites. Building codes can require houses to be moveable or small.[128]

Setbacks and other development restrictions can protect natural shores for two reasons. First, they may reduce the value of the vulnerable land below the point where the land is worth protecting from the sea. For example, if an owner has a large lot and the setback requires her to build her house at the landward edge of the

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123. *See* U.S. ARMY CORPS OF ENG'RS, *supra* note 7, at 37-46 (providing data on 56 federally funded beach nourishment projects).

124. *See* ICF Kaiser, *supra* note 68, at 3-4 (discussing how different states are currently managing coastal erosion).

125. In developed areas, the analogous restriction would be regulations that prevent redevelopment or reconstruction of storm-damaged houses. *See* MARINE LAW INST. ET AL., *supra* note 79, at 5-6 to 5-7 (discussing the Maine Coastal Sand Dune Rules' requirement for a permit to rebuild a house that is more than 50% damaged by a storm, and speculating that such a permit may be difficult to obtain); *see also infra* note 266 and accompanying text; *cf.* 1 OFFICE OF TECH. ASSESSMENT, *supra* note 118, at 180 (discussing a federal program that purchases storm damaged properties Ato break the damage-rebuild-damage cycle that accounts for many damage claims@ submitted to the federal flood insurance program).

126. *See* 1 OFFICE OF TECH. ASSESSMENT, *supra* note 118, at 187 (listing 15 states and territories that have implemented setbacks).

127. *See* COMMITTEE ON COASTAL EROSION ZONE MANAGEMENT, *supra* note 78, at 62-64 (discussing how coastal states have applied various setback requirements).

128. *See* MARINE LAW INST. ET AL., *supra* note 79, at 5-8 to 5-9 (explaining that Maine's regulations discourage the construction of large buildings in areas that will be affected by a three-foot rise in sea level, but do not prevent construction of small structures Abased on the assumption that the smaller structures are moveable, and would be moved if threatened by coastal erosion@).

lot, the setback, from the owner's perspective, may reduce the value of the seaward land to zero.[129]

Second, these restrictions may prevent the owner from increasing the value enough to make the land worth protecting. Consider a proposed $100,000 house on a $20,000 agricultural lot, for which a bulkhead costs $40,000. Once the house is built, the combined $120,000 property is worth protecting, but if a setback prevents construction, the land alone may not be worth protecting.[130] Alternatively, if the house is built, but is designed so that it can be moved for $5000, the land may still not be worth protecting.[131]

Policies that prevent development in areas vulnerable to erosion have generally been implemented through regulations that do not compensate landowners.[132] At least conceptually, the mechanics of such policies would be essentially the same if the government compensated property owners by purchasing nondevelopment easements.[133] In some cases, governments might choose simply to purchase coastal lands, thereby achieving other objectives as well, e.g., preserving natural habitat.

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129. For example, having a shorter walk to (or better view of) the water may be as valuable to the owner as having a larger backyard.

130. In this case, the setback does not reduce the market value of the land. In either event, it is $20,000.

131. In this case, the homeowner is better off by spending $20,000 for a new lot plus $5000 to move the house than spending $40,000 for the bulkhead.

132. Setbacks have sometimes been challenged as takings without compensation. *See infra* Part III (discussing the successful challenge of the South Carolina setback). *But see* COMMITTEE ON COASTAL EROSION ZONE MANAGEMENT, *supra* note 78, at 99 (AStates rarely have been challenged for a taking of property when imposing erosion setback regulations.@).

133. Such easements could be purchased either with cash or transferable development rights, i.e., the right to develop other properties more intensely than would otherwise be the case. For simplicity of exposition, this discussion assumes that states either compensate everyone or compensate no one. Nevertheless, some states might benefit from implementing a hybrid in which some, but not all, property owners are compensated. For example, South Carolina has a 40-year setback along its ocean coast, but the courts have required the State to compensate owners whose lots fell entirely seaward of the setback. To avoid this compensation, the State decided to allow development in those cases. *See infra* Part III.

If a state develops a policy to minimize shoreline armoring along its bay shores, however, the different circumstances might lead the legislature to conclude that the policy would be undermined by exempting property completely seaward of the setback line. For example, the legislature might decide that instead of protecting all of the coast with a 40-year setback, it would be more realistic only to protect half of the state's estuarine shores, but to ensure protection for at least 200 years. Such protection could leave the setback line a mile from the shore in some areas. To avoid unfairness to owners in the protected area, as well as takings challenges, the legislature might compensate those landowners.

2. Rolling Easements.—A more narrowly tailored way to ensure that natural shorelines survive rising sea level is simply to create a rule to guarantee this result. This Article borrows the term Arolling easement@ from the common law of Texas to describe a broad collection of arrangements under which human activities are required to yield the right of way to naturally migrating shores.[134] Rolling easements can be implemented with (a) eminent domain purchases of options, easements, covenants, or defeasible estates that transfer title if a bulkhead is built or the sea rises by a certain degree, or (b) statutes that accomplish the same result.[135]

The simplest way to implement rolling easements throughout a state would be to prohibit bulkheads or any other structures that interfere with naturally migrating shores.[136] Another approach would be for the government to purchase a property right to take possession of privately owned land whenever the sea rises by a particular amount.[137] Alternatively, the deed to the property could specify that the boundary between publicly owned tidelands and the privately owned dryland will migrate inland to the natural high water mark, whether or not human activities artificially prevent the water from intruding. A government could also obtain a rolling easement by passing a statute that simply Aclarified@ existing property law by stating that all coastal land is subject to a rolling easement.[138]

Rolling easements might also be implemented on a more limited geographical scale. For example, if the Corps of Engineers decided to address the adverse environmental impact of armoring twenty miles of shoreline along Chesapeake Bay, it might create a mitigation program.[139] Under the current approach, the Corps or the state might calculate the total area of the wetlands that are lost—a narrow strip of land twenty miles long and a few feet wide would only count as a few acres of

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134. *Cf. infra* note 398 (discussing the term Arolling easement@ as used in Texas).

135. *See infra* notes 414-418 (detailing states that have enacted rolling easement policies).

136. *See infra* note 406 and accompanying text.

137. Such an interest might be characterized as the government's taking an executory interest (or perhaps, because the King was the original owner of the land, as an implied reserved possibility of reverter). *See infra* Part IV.

138. *See, e.g.*, TEX. NAT. RES. CODE ANN. ' 61.011(c) (West 1978 & Supp. 1998). The common law of Texas already applied a rolling easement along the Gulf Coast; this statute explicitly states that houses must be torn down as the shore approaches. *See infra* notes 414-415 and accompanying text.

139. *See, e.g.*, 40 C.F.R. 230.1(d) (1997) (stating that the destruction of special aquatic sites Amay represent an irreversible loss of valuable aquatic resources@); 40 C.F.R. 230.10(d) (granting permits to fill wetlands if the property owner mitigates the destruction); U.S. Envtl. Protection Agency & U.S. Army Corps of Eng'rs, *supra* note 55, at 1 (discussing the federal program for wetland mitigation).

wetlands.[140] But the true impact of losing twenty miles of beach and wetland shore is very different from the impact of losing a few acres of marsh. Currently, governmental institutions only consider the *area* of habitat lost, thereby devaluing the importance of long narrow strips.[141] A rolling easement along twenty miles of shoreline, by contrast, would ensure the preservation of the resource values that are lost by armoring twenty miles of shoreline.[142] The private sector could also play a role. For example, a land trust or an environmentally concerned owner selling coastal property could retain a rolling easement when selling the property, or donate the rolling easement to a conservancy.

While recognizing that the mechanics of rolling easements would vary,[143] Figure 6 illustrates a Awetland prototype policy@ with the following characteristics:

- Bulkheads and any filling of privately owned land are prohibited except to the extent necessary to keep the property useful, e.g., to build a driveway.
- No one needs to abandon a house if it is safe and on private property. Houses on high marsh would probably be safe.144 Those in front of an ocean dune would often be unsafe or would interfere with preexisting easements.

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140. Interview with Sandy Zelen, *supra* note 54 (discussing the mitigation process in Maryland).

141. *Id.* (AThe regulatory program is not always scientifically based. Mitigation offsets are not always based on the science.@). When enough scientific theory and research is put before the Corps, however, the Corps can modify its policies to be consistent with the science. *Id.*

142. Currently, small projects sometimes purchase credits for wetland mitigation from wetland mitigation banks. *Id.* A Abank@ might create 100 acres of wetlands and receive a mitigation credit. *See id.* Individuals who obtain permits to fill small amounts of wetlands then buy wetland mitigation credits from the bank to offset the wetlands they destroyed. *Id.* An analogous procedure would be for someone to purchase a rolling easement along a suitable shoreline and then sell mitigation credits to people who armor shorelines. The primary difference is that these mitigation credits would be measured according to the shoreline length, rather than the area of wetlands filled. *Cf. infra* notes 424-468 and accompanying text (discussing the unique opportunity offered by rolling easements for actions by the private sector).

143. This variation would occur because the rights of coastal property owners vary, and because there are many ways by which rolling easements might be implemented. *See supra* Part II.A.2, *infra* Part IV.

144. Owners often elevate coastal houses on pilings due to flood control regulations. See, e.g., 44 C.F.R. ' 9.11(d)(2) (1997) (requiring new construction in coastal high-hazard areas, when allowed, to be elevated on pilings); 44 C.F.R. ' 60.3(c)(2)-(3) (1997) (requiring new structures to be elevated above the base flood level). The cost of a catwalk would be similar to the cost of the bulkhead that must otherwise be built. Cf. supra note 81 (discussing the costs of bulkheads). Rather than forcing an owner to leave her house, this approach simply prevents engineering measures. People who like marshes displace those who prefer lawns; eventually the combination of rent and tidal flooding may lead people to leave voluntarily.

- During the first decade a house is on public land, no one is forced out of the house, but the state charges rent.

This prototype simply preserves the existing allocation of rights.[145] High marsh and dry beach areas, for example, remain privately owned.

The first significant impact of a rolling easement is that the knowledge that the land might *eventually* have to be abandoned leads an owner to avoid major capital expenditures to expand or otherwise upgrade the home.[146] Later, this expectation leads the owner to avoid major repairs (e.g., replacing roofs) in favor of stop-gap measures (e.g., repairing leaky roofs).

Eventually the sea rises enough to flood the yard severely whenever an extremely high tide occurs. Without a rolling easement, the homeowner would have the right to use fill to elevate the backyard, and possibly to install a bulkhead as well. But the rolling easement prevents these shore protection options, which would impair the ability of wetlands to migrate inland. To keep the property useful, the homeowner is allowed to haul in gravel or otherwise elevate the driveway. When the sea rises enough for spring high tide to flood much of the yard, high marsh vegetation takes over,[147] but the property is still privately owned. Assuming that the house is on pilings or otherwise elevated, it continues to be useful.

Finally, if enough of the property is inundated by mean high tide for the house to be on public land,[148] the homeowner is free to move

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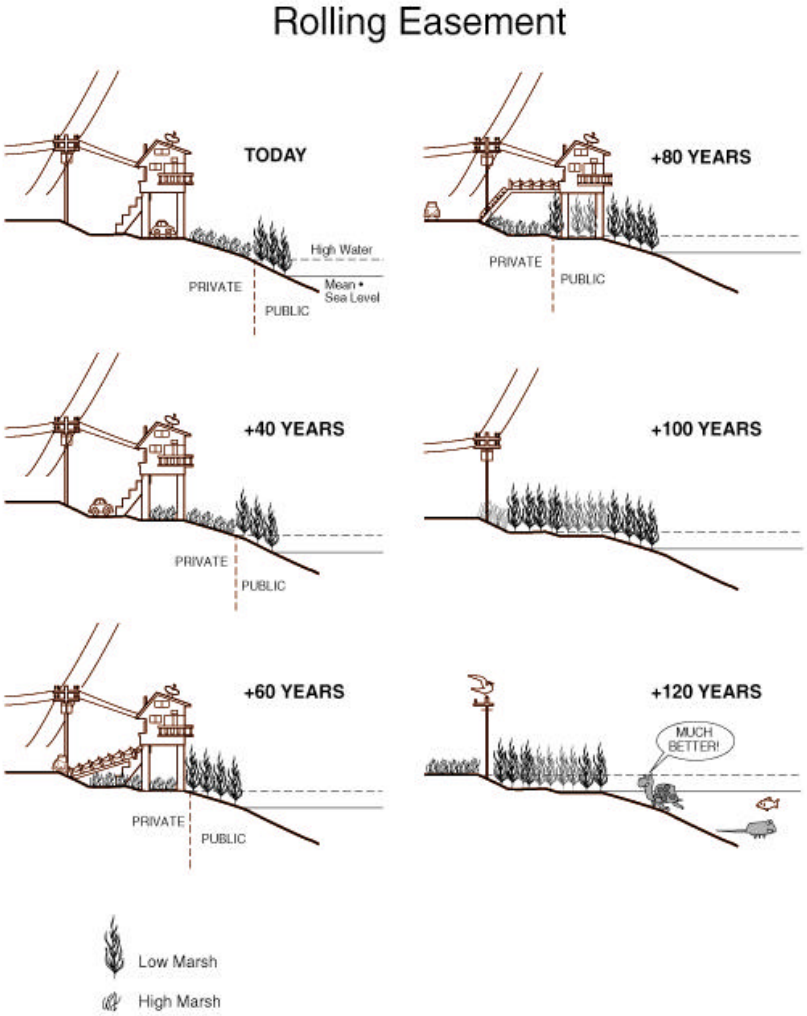
145. The reader may logically ask: Why not require houses to be removed when high marsh takes over a lot? People currently have the right to build on private high marsh if they do not fill it. Recently, the Corps has decided that owners of single-family homes can even fill up to half an acre of high marsh. 60 Fed. Reg. 38,651, 38,662 (1995). The focus of this Article is how to save the wetlands and beaches that are already in the public domain. There is a world of difference between ensuring that development does not cause a contraction of that domain as shores erode, and expanding that domain inland to include the high marsh, dry beach, and dunes. Setbacks *expand* the public domain as a means for guarding against developmental encroachment, thereby raising suspicions as to whether the inland expansion is actually the end and not merely the means. *See infra* Part III.A (analyzing the *Lucas* case and the results from that particular setback). By contrast, rolling easements can be tailored to expand, contract, or maintain existing public rights. *Cf. infra* Part II.B.5 (discussing a rolling easement that only protects public access). Hence, we focus on a scenario in which existing public rights are maintained.

146. *See* fig.8.

147. *See* Kana et al., *supra* note 70, at 123-24, 130-34 (reporting that high marsh is found in areas above mean high water but below mean spring high water); *id.* at 130-34 (showing how Charleston-area wetlands could migrate inland as sea level rises).

148. In Maine, Massachusetts, Pennsylvania, Delaware, and Virginia, where the public only owns up to mean low water, this scenario would not apply until the sea rises enough for the house to be inundated at low tide. *See* Slade et al., *supra* note 33, at 69-70 nn.22-23

FIGURE 6
THE LANDWARD MIGRATION OF WETLANDS ONTO PROPERTY
SUBJECT TO A ROLLING EASEMENT



A rolling easement allows construction near to the shore, but requires the property owner to recognize nature's right of way to advance inland as sea level rises. In this case, the high marsh reaches the footprint of the house 40 years hence. Because the house is on pilings, it can still be occupied (assuming that it is hooked to a sewerage treatment plant**C**a flooded septic system would probably fail). After 60 years, the marsh has advanced enough to require the owner to park the car along the street and construct a catwalk across the front yard. After 80 years, the marsh has taken over the entire yard; moreover, the footprint of the house is now seaward of mean high water and hence on public property. At this point, additional reinvestment in the property is unlikely, and the state might charge rent for continued occupation of the home. Twenty years later, the particular house has been removed, although other houses on the same street may still be occupied. Eventually, however, the entire area returns to nature.

the house and clean up the site. Alternatively, the homeowner can stay for a number of years and pay rent to the state, which owns the land on which the house sits. To mitigate financial hardship, the annual rent might start out at a fraction of its fair market value and increase annually. This rent would generate the funds with which to clean up the sites of houses that are abandoned.

One might also consider a beach prototype policy for property along sandy beaches and relatively large bodies of water, where property is more likely to be lost to erosion than to a gradual inundation and conversion to marsh. As with the wetland prototype, the existence of the rolling easement would discourage reinvestment as the shore approaches. The primary restriction of the rolling easement would be the prohibition of bulkheads. Fill would be less of an issue here, because these shores are often well above sea level.[149] As the shore erodes, eventually the house would be at least partly on the public beach. If access along the shore is extremely important, the owner could be required to move the house at that point. If access is not important, the owner could simply be required to pay rent.

Along either wetland shores or beaches, owners—especially new owners—would probably tend to convert their properties to rental uses as the sea approached. Would-be landlords are more willing than would-be homeowners to buy a house with only a five- to ten-year life expectancy, as long as the property pays for itself. Moreover, renters are often willing to tolerate conditions that homeowners would not.

3. Deferring Action.—Setbacks and rolling easements are anticipatory planning policies in which shorelines remain natural, because society takes action today. The other fundamental policy option is to take no action today and deal with the problem later. Measures for dealing with the problem later include ordering people to remove their homes

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(summarizing cases that discuss the public trust doctrine under different scenarios in these five states).

149. *See* MARINE BOARD REPORT, *supra* note 19, at 74 (explaining that bulkheads are often used to provide protection for land that is well above sea level). As a result, property owners might be allowed to hold back the sea with beach nourishment. Along wetland shores, elevating the land with fill—even without a bulkhead—prevents new areas from being flooded and new marsh from forming inland as sea level rises. *Id.* at 64-71, 74-75. Thus, elevating land causes a net loss of wetlands unless the marshes are elevated as well—something that will probably not occur. *Id.* at 70-71. By contrast, along sandy beaches, the beach will tend toward a characteristic shape and return to that shape even if it is disrupted through the addition of sandy material or rising sea level. *Id.* at 75-76.

without compensation[150] and buying people out. For purposes of this Article, the principal difference between rolling easements and deferred action is that rolling easements provide advanced *notice* to property owners that their land must give way to the sea.

4. Hybrid Policies.—Successful policies may also involve combinations of preventing development, deferring action, and rolling easements. Existing setback policies involve combinations of preventing development in the most vulnerable areas and deferring action to address what will happen once the shore erodes up to the setback line.[151] Density restrictions are hybrid approaches that defer the bulkheading decision but diminish the benefits of bulkheads by limiting development.[152] A promising approach would be to require houses to be set back enough to protect them from the expected erosion over the next several decades—while creating rolling easements to ensure that future generations do not simply build bulkheads along the setback line. However, no state has yet instituted such a policy.

5. Protecting Access Along the Shore in Developed Areas.—Setbacks, rolling easements, and various hybrid policies can enable any state to preserve its natural shorelines. Nevertheless, abandoning homes and businesses to the sea will not always be a realistic option. Because beach nourishment costs are often high,[153] many of the older coastal towns will require protection with hard structures even in states that enact land-use

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150. *See* St. Amand, *supra* note 119, at 8-12, 16-18 (discussing the adoption of this approach along the open coast of Massachusetts and North Carolina).

151. In Maryland, for example, new houses must be set back 100 feet along Chesapeake Bay, *see* MD. REGS. CODE tit. 27, ' 01.09.01C(1) (Supp. 1 1995), but homeowners can armor their shores, *see* MD. CODE ANN., ENVIR. ' 16-201(a) (1996). In South Carolina, by contrast, new construction along the ocean must be set back, *see infra* Part III, but the State has not decided what it will do when the shore erodes up to the structures that are currently out of harm's way. Interview with William C. Eiser, S.C. Office of Ocean and Coastal Resources Management (Aug. 13, 1997). Eiser suggests that the most likely scenario is that in a few isolated areas, houses will be abandoned and the shore will retreat. *Id.* More densely developed areas where the shores are open to the public will be protected by publicly funded beach nourishment projects. *Id.* Private communities with no public access will not be eligible for publicly funded beach nourishment, and hence will either have to fend for themselves or dedicate easements so that they become eligible for beach nourishment. *Id.*

152. *See, e.g.*, MD. CODE ANN., NAT. RES. II ' 8-1807 (Supp. 1997) (limiting densities in areas within 1000 feet of the tidelands).

153. Beach nourishment projects generally cost millions of dollars. *See, e.g.*, U.S. ARMY CORPS OF ENG'RS, *supra* note 7. Moreover, the turbidity caused by beach nourishment may harm local marine environment. *See* LYNNE T. EDGERTON, THE RISING TIDE 38 (1991) (AConcerns for the local fauna—especially coral formations—inhibit many beach nourishment schemes in Florida.@).

planning measures to ensure the survival of wetlands and beaches in newly developed areas.

The armoring of the coast need not mean that the state gives away its claim to the shore. If the citizens want to retain this public property, states can reserve an easement just inland of any new bulkheads, which is where the publicly owned wet beach would be if the bulkhead was not built. Figure 7 illustrates two coastal communities along the western shore of Chesapeake Bay in Calvert County, Maryland. Along Atlantic Avenue in North Beach, the public has access along a narrow walkway between the homes and the revetment. Half a mile to the south at Chesapeake Beach, however, the public is excluded from the shore.

Part B of Table 2 lists several options for retaining access along armored shores. These measures are analogous to the means by which natural shores can be protected. As part of a bulkhead permit, landowners could be required to dedicate an easement just above the bulkhead, so that when the shore erodes up to the bulkhead, the public can still walk along the shore for fishing and other purposes. Alternatively, a rolling easement could be created that only protects public access. Let us call this a Aone-step easement.@ In such a case, until the bulkhead eliminates the wet beach, the public continues to have access only along that beach. At that point, the alongshore easement Asteps over@ the bulkhead, giving the public access along the shore just inland of the bulkhead.[154]

C. Ability of the Three Options to Satisfy Various Criteria

Table 3 summarizes the economic efficiency, performance under uncertainty, perceived fairness, political feasibility, and risk of backsliding for each of the options for protecting tidelands.[155] For simplicity's sake, this analysis assumes that land ownership currently entitles coastal property owners to develop their parcels, erect bulkheads, and remain forever,[156] and that regulations to the contrary diminish property values.

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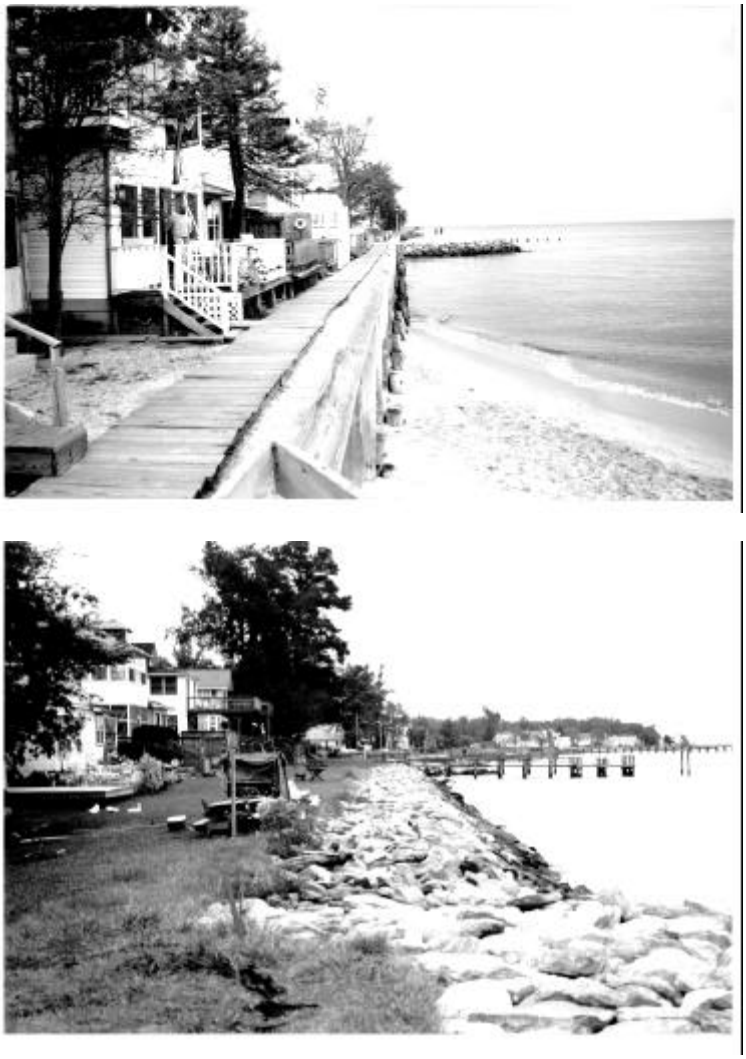
154. *See* fig.9. Unlike the options to retain tidelands in general, it may still be possible to retain public access in areas that have already been developed.

155. These issues are also examined in *Coastal Wetland Policy*, *supra* note 117, at 47-55. The discussion in that paper does not focus on those measures that protect access only; such an analysis, however, would be largely parallel to the analysis presented here.

156. Part IV suggests that this assumption is not always true, but the distinction is unimportant for our purposes here.

FIGURE 7
THE POTENTIAL FOR RETAINING PUBLIC ACCESS ALONG THE SHORE AS SEA LEVEL RISES, EVEN WHERE THE SHORE IS ARMORED



Both photos were taken in Calvert County, Maryland, along the western shore of Chesapeake Bay. The top photo shows Atlantic Avenue in North Beach. Here, the homes are protected by a wooden bulkhead. Although the shore has eroded up to the bulkhead along most of Atlantic Avenue, the public still has access along the shore, just inland of the bulkhead. The lower photo shows the rock revetment that replaced the beach at Chesapeake Beach. Although a public easement along the shore would be as feasible here as in North Beach, the state chose not to retain public access along this shore. (Photos taken October 24, 1997.)

TABLE 3
ABILITY OF TIDELAND PROTECTION POLICIES TO SATISFY DESIRABLE CRITERIA

Option	Who Pays?	Cost to Taxpayer	Economic Efficiency	Cumulative Social Cost of Sea Level Rise	Present Value of Social Cost	Performance Under Certainty	Perceived Fairness	Political Feasibility	Risk of Back-sliding	Probability of Success if Sea Rises <2 ft	Probability of Success if Sea Rises >4 ft
Prevent Development											
#1a	Public	Premium	Poor	Land	Premium + <1% of Current Use	Poor	Fair	Possible in a Few Areas	Very Low	Very High	Very Low
#1b	Owner	None	Poor	Land	Premium + <1% of Current Use	Poor	Unfair	Possible in Some Areas	Low	High	Very Low
Defer Action											
#2a	Public	Land + House - Cost of Bulkhead	Medium	Land + House	<1% of Land + <1% of House	Good	Fair	Rare	Very High	Low	Very Low
#2b	Owner	None	Medium	Land + House	<1% of Land + <1% of House	Good	Very Unfair	Rare	Very High	Low	Very Low
Rolling Easement											
#3a	Public	<1% of Land + Moving Cost	Optimal	Land + Moving Cost	<1% of Land + <1% of Moving Cost	Good	Fair	Possible in Some Areas	Very Low	Very High	Very High
#3b	Owner	None	Optimal	Land + Moving Cost	<1% of Land + <1% of Moving Cost	Good	Pretty Fair	Possible in Most Areas	Mediu m	High	High

Notes: Costs are measured relative to no sea level rise.
"Premium" is the difference between the value of the land if it can be developed and the value under the current use.
"Moving cost" refers to the cost of moving the house to another site or the remaining value of the house after it is strategically depreciated, whichever is less.
"<1%" refers to the values of the land, house, or moving cost, discounted by the rate of return compounded over however many years are likely to pass before the property is under sea level.

1. Economic Efficiency and Social Cost.—Assuming that each policy is applied to retain the same amount of tidelands, the most cost-effective approach is the approach with the least social cost—measured at a discounted present value—regardless of whether the public or the coastal property owners bear the cost.[157]

In general, preventing development will have a higher social cost than rolling easements, because the former prevents the property from being used between now and whenever the sea rises enough to erode it, which may be decades or centuries in the future.[158] If a property owner wants to build in spite of the knowledge that the house will have to be abandoned a few decades hence, her reason may be that the rental value of a bayfront house—even for a short period of time—exceeds the cost of the structure.[159]

Consider a numerical example. A coastal lot would become tideland if sea level rises three feet.[160] It is worth $20,000 as a site for a $180,000 house and $10,000 in an alternative use. Preventing development would thus impose a net cost of $10,000. A rolling easement, by contrast, would allow rent to be collected on the property for many decades. Assume further that the cost of moving the house (and

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157. Government economists generally define Acost-effective@ as the cheapest way of accomplishing a goal. *See, e.g.*, EDWARD M. GRAMLICH, BENEFIT-COST ANALYSIS OF GOVERNMENT PROGRAMS 46 (1981) (AThis technique of finding the cheapest way of doing something has become known as `cost-effectiveness' analysis in the Defense Department (where the benefits of a program can almost never be quantified).@). In defining a cost-effective action, economists often ignore the question of who pays, not because that question is irrelevant, but because a compensation scheme can in theory be designed to tax winners and compensate losers. *Id.* at 41-43. Thus, governmental cost-benefit analysis looks for the policy with the greatest net social benefit, regardless of who pays. *Id.* This approach is sometimes called the Kaldor-Hicks criterion of economic efficiency. *Id.* In general parlance, many writers shorten this to the term Aeconomic efficiency.@ *Id.* at 42. *But cf. infra* note 170 (defining Pareto efficiency, which is concerned about the distribution as well as the total economic benefits).

158. This ignores other potential benefits of setbacks. Locating a house farther from the shore can also reduce (i) water pollution runoff from impervious surfaces and septic systems, (ii) vulnerability to storms, and (iii) adverse impacts on dune and wetland ecology resulting from physical presence and trampling by residents and their pets. *See, e.g.*, St. Amand, *supra* note 119, at 4-18 (discussing those three advantages of setbacks under various state programs); COMMITTEE ON COASTAL EROSION ZONE MANAGEMENT, *supra* note 78, at 55, 65, 67, 126 (discussing setback requirements). In a new neighborhood, there may also be an aesthetic benefit to setting houses back from the shore. This is true because everyone has a view of a natural shoreline, rather than just the water and adjacent houses.

159. Unfortunately, it may also be a case of gaming the system—that is, a calculated risk that if one develops the property, the government will not actually require it to be abandoned. *See infra* Part II.C.5.

160. If the tidelands are marsh, land three feet above high tide would be tideland with a three-foot rise in sea level. If the tidelands are a typical sandy beach that erodes one to two feet per foot of sea level rise, then land within 300 to 600 feet of the shore would become tideland, regardless of elevation. *See supra* Parts II.A.1, II.A.3.

cleaning up the site) would be $30,000, while the cost of a bulkhead would be $10,000. Given these assumptions, the bulkhead restriction would cost the property owner a total of $40,000 when the sea rises three feet.[161] At a 5% interest rate, the impact of a rolling easement on the market value would thus be $300 if a three-foot rise was certain to occur in 100 years. But given EPA's estimate that such a rise has only a 5% probability,[162] the expected cost would be $15. In this case, a rolling easement costs 1/666 as much as a setback, i.e., 0.075% of the value of the land. If the property was four feet above mean high water, the rolling easement would cost only $3, or 0.015% of the land value.[163]

Setbacks are not always economically inefficient. If locating a house at the landward end of a given lot allows the house to last for sixty instead of thirty years, the long-term benefit is probably greater than the initial aesthetic cost a buyer attributes to being farther from the water.[164] In those areas that are likely to be inundated soon, the cost of forgoing the use of the land would be small. But the setback implied by a four-foot rise in sea level would place an area the size of Massachusetts off limits to development,[165] preventing any development on many parcels of land.

Measured by present value, deferring action is less costly than preventing development, because land can be put to its most beneficial use between now and the time that the land must give way to the sea.[166]

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161. The owner would lose the land worth $20,000 and would have to pay the $30,000 to move the house, but a bulkhead would have cost $10,000. At a 5% discount rate, the present value of $40,000 is $300.

162. *See* tbl.1; *see also* EPA 1995, *supra* note 2, at 126.

163. The probability that sea level will rise four feet in the next century is only 1%, one-fifth the probability of a three-foot rise. *See* tbl.1; *see also* EPA 1995, *supra* note 2, at 126.

164. Theoretically, a well-informed property owner would make this choice anyway. But because homebuyers are often poorly informed about potential hazards, state and local governments have adopted building codes and safety standards. *See, e.g.*, HOWARD KUNREUTHER, DISASTER INSURANCE PROTECTION: PUBLIC POLICY LESSONS 6-7, 235-36 (1978) (explaining that home owners have limited knowledge of flood risks and that few voluntarily bought flood insurance until the National Flood Insurance Act of 1968, Pub. L. No. 90-448, 82 Stat. 572 (1968) (codified as amended in scattered sections of 42 U.S.C.), conditioned the receipt of FHA and VA loans on the purchase of federal flood insurance).

165. *See Holding Back the Sea*, *supra* note 32, at 187 (estimating that a one-meter rise in global sea level would inundate 7700 square miles of dry land, an area the size of Massachusetts).

166. If one looks only at the cost of land and structures lost to the sea, deferring action might appear to be more costly, because both the structure (or the cost of its removal) and the land must be lost, whereas only vacant land is lost if development is prevented. But more than vacant land is lost when development is prevented: Someone is also losing the opportunity to live in a house on that land. The measure of the impact on today's landowner is present value. As shown in the text, losing (or moving) a house in the distant future will have a present value of a few tens of dollars, while the cost of forgoing development will be in the tens of thousands of dollars.

Nevertheless, rolling easements would cost even less, primarily because the market would have better information. Knowing that a house must eventually be removed, the owner is more likely to design it so that it can be moved and less likely to build bulkheads and other long-term improvements that would not completely pay for themselves before the house had to be moved, as shown in Figure 8. In the decade or so before the property must be abandoned, it can be converted to rental property and be strategically depreciated,[167] and real estate markets can directly incorporate information about future rates of erosion and sea level rise. Without a recognition that the property must eventually be vacated, by contrast, property owners are more likely to make improvements and remain psychologically attached to the property, while governments are more likely to invest in major infrastructure or allow changes in zoning to more intensive uses.[168]

National assessments of the costs of sea level rise have not sought to estimate the cost of protecting shores with rolling easements. Nevertheless, the published research is sufficient to generate a rough estimate. Appendix 1 roughly calculates that rolling easements could protect U.S. tidelands in undeveloped areas for a total cost of $0.4 to $1.2 billion; 99% of the cost would apply to land threatened with a rise

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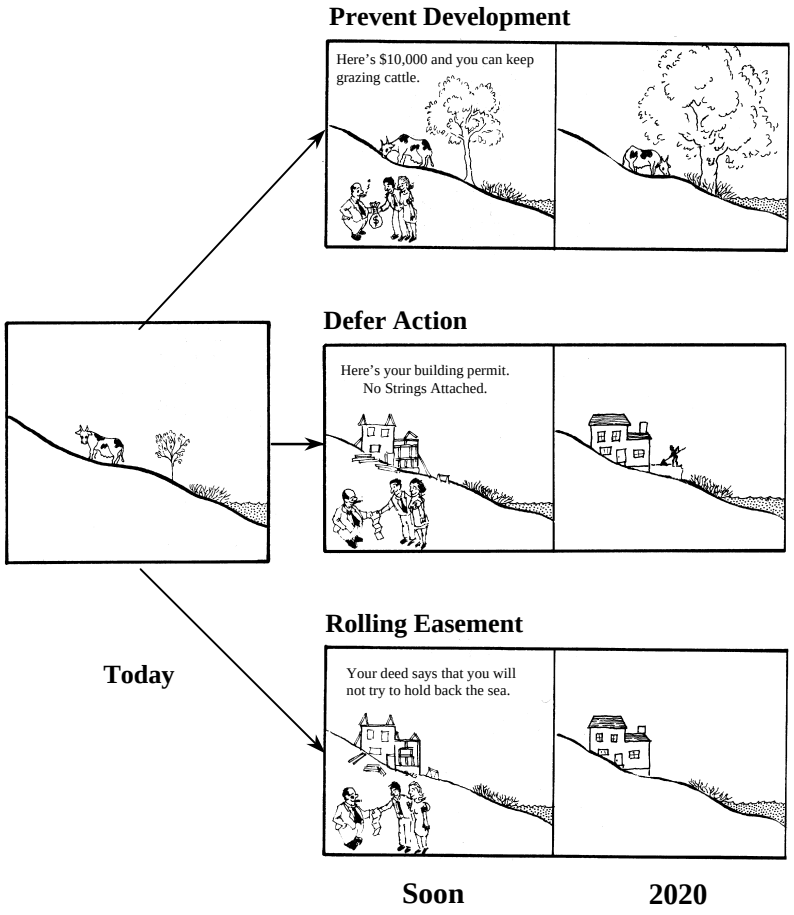
167. A study funded by the Electric Power Research Institute addressed this issue. *See* Gary Yohe et al., *The Economic Cost of Greenhouse-Induced Sea-Level Rise for Developed Property in the United States*, 32 CLIMATIC CHANGE 387, 392 (1996). The study quantified the extent to which the cost to property owners from eroding shores could be reduced if, decades before their property was threatened, owners understood the need to abandon the shore. *Id.* at 390-92.

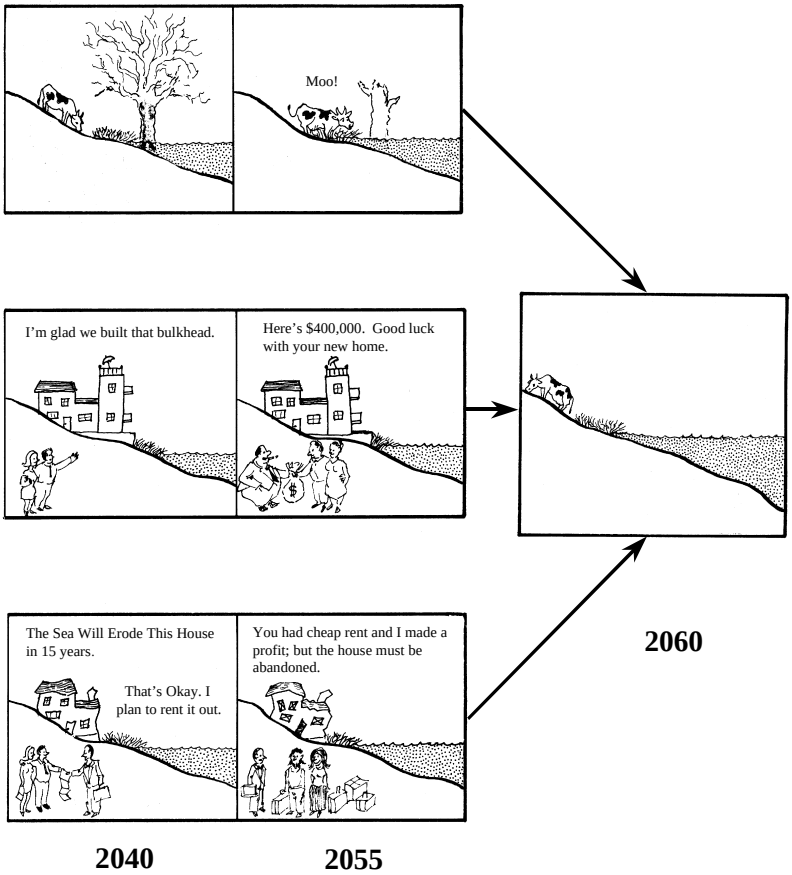
The Ano-foresight@ scenario discussed in the study assumed that property owners are uncertain Aabout the rate of future sea level rise and/or [do not believe] . . . that existing property would actually be abandoned.@ *Id.* at 392. Another scenario, labeled Apure foresight,@ assumed that Athe economic value of structures . . . depreciate[s] over time as the threat of impending inundation and abandonment becomes known.@ *Id.* at 391. The study estimated that with no foresight, the nationwide cost of a one-meter rise in sea level would be $45.4 billion, but with pure foresight, it would be only $36.1 billion. *Id.* at 403-05. The nationwide figures, however, include the cost of beach nourishment and other measures for holding back the sea. *Id.* at 392-93, 405. In several of the sites where holding back the sea is unlikely, the certainty of knowing what would happen to the shore would decrease the cost of sea level rise by 50% to 75%. *See id.* at 397-98 (estimating that 30 years of notice decreases the cost of sea level rise about 75% for areas around Apalachicola, Florida; Grand Chenier, Louisiana; Long Bay, North Carolina; Sullivans Island, South Carolina; and Palacios, Texas, and by about 25% to 50% in Barataria, Louisiana; Pass Christian, Mississippi; Dorchester, South Carolina; Mt. Pleasant, South Carolina; and Suffolk, Virginia).

168. *Cf.* COASTAL BARRIERS TASK FORCE, *supra* note 20, at iii-vi (examining the implications of a congressionally mandated end to federal subsidies for construction on vulnerable coastal barriers).

FIGURE 8
OPTIONS FOR ENABLING WETLANDS TO MIGRATE INLAND:
WHY ROLLING EASEMENTS ARE THE LEAST EXPENSIVE



In each case, the land starts and ends as vacant farmland. This figure assumes that the public rather than the property owner bears the cost. Under the Prevent Development approach, the value of using the land for development is signified by the upfront cost of buying a nondevelopment easement. Under the Defer Action approach, it is ultimately necessary to buy the entire land and structure. With rolling easements, a house must be eventually abandoned as well, but the eventuality has been incorporated into the expectations of the owner, who forgoes renovations. The cartoon does not include the cost of purchasing the easement, because its present cost would be trivial..


Moo!
I'm glad we built that bulkhead.
Here's $400,000. Good luck with your new home.
The Sea Will Erode This House in 15 years.
That's Okay. I plan to rent it out.
You had cheap rent and I made a profit; but the house must be abandoned.
2040
2055
2060

in sea level of less than two feet. Given the low probability and remote nature of a larger rise in sea level, the cost of protecting all of the undeveloped land in the U.S. coastal zone will only be a few million dollars greater than the cost of protecting the land within three feet of mean high water.

2. Performance Under Uncertainty.—A serious limitation of setbacks and land purchases is that they prevent either too much or too little development. Future sea level rise is uncertain, and if the sea rises less than expected, society will have unnecessarily removed thousands of square miles of valuable coastal land from development. Yet, if the sea rises more than expected, the shore will erode up to the setback line and the tidelands will be lost anyway. In fact, unless development is kept out of an extremely large area, even if sea level rise is accurately projected, the shore will eventually erode up to the setback line.

Rolling easements, by contrast, are not tied to a specific scenario. If sea level does not rise, they cost nothing. If it does rise, the wetlands and beaches will be protected. Rolling easements also perform better than setbacks given economic uncertainty. Although undeveloped and lightly developed shorefront land is rarely protected today, coastal land values could rise enough in the future for property owners to have an incentive to protect even undeveloped land—especially along estuarine shores.

Uncertainties regarding future coastal development and legal rights are important disadvantages of relying on deferred action. No policy can avoid the fact that abandoning the coast will cost more if coastal property becomes more valuable. Nevertheless, if taxpayers must bear the cost, then purchasing either land or rolling easements is less risky than deferring action and buying people out later, because the compensation can be fixed today. If property owners bear the cost, then the legal uncertainty is greatest if action is deferred.[169]

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169. By definition, purchases of land, development rights, and rolling easements do not even implicate the Constitution's prohibition against taking property without just compensation. *See infra* Part V. Regulatory creation of rolling easements has a good chance of withstanding court challenges if enacted several decades before property has to be abandoned. *See infra* Parts III, IV.

Deferred action has the greatest legal uncertainty. Prohibiting shore protection without advance warning might be rejected as a taking—especially in states like Maryland, where the government has stated or implied that land ownership includes a right to hold back the sea. *See* MD. CODE ANN., ENVIR. ' 16-201 (1996) (stating that a beachfront property owner Amay make improvements into the water in front of the land to . . . protect the shore of that person against erosion@). Yet, the public trust doctrine may imply a longstanding governmental property right to prohibit bulkheads, and courts may hold that the right to hold back the sea is not constitutionally protected until someone actually builds a bulkhead. *See infra* Part IV.

*3. Perceived Fairness.*CEconomic efficiency and performance under uncertainty primarily concern the total cost to society, rather than the cost to individuals. But legislatures represent individuals. No matter how worthy a policy may be, few people are enthusiastic about bearing its costs, and many will vehemently oppose policies if they feel that the costs they must bear are unfair. The Italian economist Vilfredo Pareto proposed as an equity criterion the condition in which it is not possible to make anyone better off without making someone worse off, a criterion that is now known as APareto efficiency.@[170]

To avoid the perception of unfairness, policy makers would ideally enact Pareto improvementsCthat is, policies with no losers. However, for new issues such as sea level rise, defining a Pareto improvement is stymied by the lack of agreement among the various parties about what the baseline would be without the proposed policy.[171] Owners assume that land lasts forever, and taxpayers assume the beaches always belong to the people anyway.[172] Even winners may perceive themselves as losers.

A regulatory setback policy prohibiting development in low areas would single out some farmers and other land holders to subsidize society's concern about the future environment. At the same time, similarly situated landholders on higher ground could profit from the development that such setbacks would rechannel

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Moreover, whatever the law is today, it could change over the next several decades.

Setbacks are more likely to be (and have been) rejected as unconstitutional takings. *See infra* Part III. However, they do not create much long-term legal uncertainty. The only fruitful time to challenge them is before one builds. So even if setbacks are rejected as unconstitutional takings, the rejection will come early and will afford policy makers plenty of time to implement other options. *See infra* Part III.A (discussing South Carolina's implementation of rolling easements in cases where setbacks would be unconstitutional takings).

170. *See, e.g.*, HAL R. VARIAN, INTERMEDIATE MICROECONOMICS 15-16 (1987) (discussing Pareto efficiency).

171. *Cf.* David Hawkins, Speech to the Administrative Conference of the United States (Apr. 23, 1990), *reprinted in* Marshall J. Breger et al., *Providing Economic Incentives in Environmental Regulation*, 8 YALE J. ON REG. 463, 483-84 (1991) (stating that existing arrangements are usually employed as the baseline for economic incentive approaches, but other baselines might be more appropriate).

172. Property owners assume that they have the right to use their property, and they would find preventing development or subsequent eviction inequitable. Other taxpayers would question the equity of compensation, because people have no inherent right to bulkhead property at the expense of public lands. Nuisance theory leaves this problem indeterminate as well: The ideal of minimizing transaction costs suggests a no-bulkhead rule in undeveloped areas and a pro-bulkhead rule in heavily developed areas. *See infra* Part IV.C.1.b.

inland. In this context, those who own undeveloped land less than five feet above mean high water would be big losers.

No legislation can eliminate the resentment that arises when two groups have long assumed that they possess rights that are in fact mutually exclusive.[173] But purchasing or legislatively creating rolling easements can minimize the conflict by laying out the rules of the game at least a generation before they take effect. People's ideas of fairness depend mostly on their expectations. Accordingly, a policy is easier to accept if people never expected anything else.[174] If future conditions necessitate policy changes, a common baseline will make it easier to agree on how much the new policy costs particular individuals (even if people continue to disagree on how much other people should pay). For this reason, enacting a policy today that decides which shores should be armored will almost certainly improve the likelihood of success, even if changing circumstances prompt future generations to modify the plan.

The intergenerational nature of this problem also favors rolling easements, because such a policy is Pareto-superior to deferring action. Both approaches cost the current generation nothing, but rolling easements leave future generations better prepared. Preventing development through land purchases or large-scale setbacks is not a Pareto-improvement over deferring action. Instead, such policies would force our generation to pay a price for the sake of future generations.[175]

4. Political Feasibility.—The economic, legal, and technical merits of a policy are largely irrelevant if the political process cannot adopt or enforce it. Along ocean shores, coastal setbacks have been feasible because of the widespread interest in ocean beaches and because the

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173. For example, recent agreements between Israel and the Palestinian Liberation Organization have not removed the resentments between those Zionists who believe that Israel should occupy all of Judea and Samaria (the West Bank of the Jordan River) and those Palestinians who believe that the State of Israel has no right to exist at all, let alone occupy the West Bank. *See* Edward T. Canuel, Note, *Nationalism, Self-Determination, and Nationalist Movements: Exploring the Palestinian and Quebec Drives for Independence*, 20 B.C. INT'L & COMP. L. REV. 85, 104-06 (1997) (discussing the conservative Israelis' and the nationalist Palestinians' continued resentment following the Palestinian Peace Accords).

174. Moreover, agreeing on what is fair is easiest when the judges of fairness are somewhat removed. No matter how difficult it is to decide whether property owners or taxpayers should pay for saving the tidelands, deciding will be more difficult later, when the costs are greater and people know precisely who wins and who loses.

175. In our hypothetical example, deferring action may be Pareto-superior to setbacks. If the $10,000 cost of a setback comes out of investment, then in 100 years, the total cost will have compounded to $1.3 million, more than enough to rebuild the house inland.

setbacks are usually less than 200 feet.[176] Preventing development in an area the size of Massachusetts in order to protect estuarine shores seems less likely. There is no evidence that federal or state governments are willing to spend tens or hundreds of billions of dollars to buy all the necessary coastal lands, or even the smaller sums necessary to buy nondevelopment easements. Even if the United States Constitution would permit a blanket prohibition of development without compensation, our political process would not.[177] Density restrictions would be more politically feasible than total prohibitions on development, but if minimum lot sizes are too large, they could hurt land values enough to meet strong opposition as well. Deferring action is feasible today, but it would require future politicians to choose between more stringent[178] versions of the regulatory and land-purchase options that are presently infeasible.

Rolling easement policies are the most politically feasible approach for protecting tidelands on a broad scale. The cost would be small compared with the other options.[179] Perhaps more importantly, this

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176. Multiplying the typical erosion rate, *see* MARINE BOARD REPORT, *supra* note 19, at 50, by the time horizon of erosion setbacks for states that have them, *see* COMMITTEE ON COASTAL EROSION ZONE MANAGEMENT, *supra* note 78, at 96-97, results in the following typical setbacks: Florida**C**typically no setbacks, but in areas where the erosion rate is one standard deviation above the norm, the setback is 36 meters; New Jersey**C**50 meters; New York**C**no setback in the typical case, 66-88 meters in areas with the highest observed erosion; North Carolina**C**the minimum setback is 60 feet, and 60-80 meters in areas where erosion is one standard deviation above the norm; South Carolina**C**80 meters; Rhode Island**C**no setback in the typical case, and 20 feet in areas with the highest observed erosion. Most other states have a fixed setback that is not based on the erosion rate. *Id.* at 97. A typical fixed setback appears to be about 100 feet. *See, e.g., id.* at 64 (100 feet in Delaware); *supra* note 151 (100 feet in Maryland along Chesapeake Bay and its tributaries). *But see infra* note 177 (50 feet along back-barrier bays in Worcester County, Maryland).

177. For example, beginning in 1989, the comprehensive plan of Worcester County, Maryland included a 100-foot setback for purposes of decreasing non-point source runoff. Personal Communication with Planning Staff of the Worcester County Zoning Comm'r (Apr. 1994). In 1992, the Commission adopted an interim setback of 85 feet from the mean high water mark. *Id.* However, the political consensus in the county was unable to support such a large setback, and the final setback was established at 50 feet. *See* WORCESTER COUNTY, MD., CODE OF PUBLIC LOCAL LAWS ' ZS-1-304(s)(1) (1994); Personal Communication with Planning Staff of the Worcester County Zoning Comm'r (Apr. 1994).

178. In terms of the actual cost faced when the decision is made, buying property owners out (or forcing them out) would be more expensive in the future than today, because some land that is vacant today would be developed. *Coastal Wetland Policy*, *supra* note 117, at 48, 54-55. Note that when discussing the impact on today's property value or net social cost, one must focus on present discounted value. However, when looking at the risk of backsliding and the political feasibility of enforcing a required abandonment, the key consideration is the cost perceived at the time the property is vacated.

179. *Compare* Appendix 1 (illustrating that rolling easements are unlikely to cost more than $300-$1100 million) *with Holding Back the Sea*, *supra* note 32, at 200 (estimating the value of the undeveloped land that could be inundated by a 50- to 200-centimeter rise in sea level at

approach takes advantage of the long-term[180] and uncertain nature of the phenomenon. The setback approach polarizes the political climate and encourages developers to challenge regulations (or governmental estimates of market value) by disputing the underlying science and the projections that the sea level will rise. Rolling easement policies, by contrast, foster political consensus by forcing developers to concede that sea level rise is likely before they can argue that the regulation will affect property values.[181]

5. Risk of Backsliding.—Even if a tideland protection policy is enacted, a subsequent repeal will always be possible. The effectiveness of a tideland protection policy depends upon whether the repeal occurs because the policy turns out to be unneeded or because those with narrow interests who gambled and lost are able to persuade policy makers to backslide and bail them out. Where development is prevented, the risk of backsliding is fairly low. If government buys a no-

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$13 to $120 billion). Deferring action would eventually cost more than rolling easements, because the former requires the loss of land and structures, while the latter affords property owners the opportunity to depreciate their structures or avoid developing land likely to be inundated, whichever is most cost-effective. *Cf., e.g.*, Yohe et al., *supra* note 167, at 391 ("[T]he economic value of structures can be expected to depreciate over time as the threat of impending inundation and abandonment becomes known.").

180. An unusual aspect of this approach is that because most of the costs are in the distant future, using a high discount rate makes rolling easements more feasible. This approach stands in stark contrast to the many environmental policies where near-term action produces benefits over many decades, and thus economic viability depends on a low discount rate. Environmental economists have long pondered how to discount appropriately the value of future benefits to present value. *See, e.g.*, GRAMLICH, *supra* note 157, at 107, 112-13 n.22. The most popular candidates are the rate of return on private investment, often about 7% to 10%, and a lower rate representing the risk-free rate of return or a pure rate of time preference, generally 1.5% to 3%. *Id.* at 107-09; WORKING GROUP III, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995: ECONOMIC AND SOCIAL DIMENSIONS OF CLIMATE CHANGE 130-32 (1996). It is axiomatic among economists that if an environmental policy has benefits over many decades, a high discount rate tends to discourage policies to protect the environment. *See* WILLIAM R. CLINE, INST. FOR INT'L ECONS., THE ECONOMICS OF GLOBAL WARMING 235-36 (1992) (predicting that with a discount rate of 5% to 10%, the effects of global warming 100 to 200 years hence are very unimportant); GRAMLICH, *supra* note 157, at 130 (explaining that high discount rates result in too little investment to protect the environment). Rolling easements are an important exception.

181. Consider once again the numerical example discussed in Part II.C.1. In response to a setback preventing development on a particular parcel, a developer might say that the sea probably will not rise and that any possible impacts are so far in the future that the discounted benefits of taking action today are trivial; yet, the developer is having to bear a substantial near-term cost. By contrast, with a rolling easement that takes over the parcel when the sea rises three feet, these arguments imply that the regulation is not likely to affect the property and that the present value of the regulation's impact is $15. Developers would probably not change tacks and claim that the sea is going to rise *more* than the government expects, because such an assertion would scare away potential buyers.

development easement (or imposes such a condition by regulation), the owner of the remaining estate has little reason to clamor for the government to allow her to develop a property just when it is about to be inundated. If the government buys the land outright, then there is no private owner at all.

If action is deferred, by contrast, the likelihood of backsliding is very high. Few tasks would be more distasteful to a state legislator than to require people to abandon bayfront homes when the property owners themselves are willing to spend the money necessary to protect their property from the sea. Admittedly, governments *have* required property owners to abandon *oceanfront* homes as the shore retreats.[182] However, the ocean shore has a large constituency of people who use the public beach that a seawall would obstruct. Furthermore, private seawalls are generally unable to hold back the ocean during a severe storm, which creates a potential safety hazard.[183]

Rolling easements pose intermediate enforcement problems.[184] Backsliding would be somewhat more likely with a no-bulkhead regulation than with a government purchase of a rolling easement, because the public can more easily accept relaxation of a regulation than the relinquishment of a public property interest for which the government has paid.[185] Private conservancies that bought rolling easements would seem even less likely to allow private individuals to erect bulkheads that eliminate natural shores. There is no guarantee,

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182. *E.g.*, Matcha v. Mattox, 711 S.W.2d 95, 97 (Tex. App. 1986, writ ref'd n.r.e.) (affirming a trial court order to Aremove the beach house, sand piles, plantings, and any other obstructions or barrier to the public's use of the beach area@).

183. *See, e.g.*, Gary Griggs & Lauret Savoy, *Shoreline Protection and Engineering*, *in* LIVING WITH THE CALIFORNIA COAST 46, 58-61 (Gary Griggs & Lauret Savoy eds., 1985) (explaining that wooden bulkheads tend to fail in high-energy environments).

184. The economics study by Yohe and his colleagues implies that a rolling easement policy would result in a greater number of people voluntarily allowing the shore to retreat. Yohe et al., *supra* note 167, at 343-406. If people doubt the sea will rise or expect the government to protect them, they will make imprudent investments that later require protection. *Id.* at 388-90, 394-96. In the Aperfect foresight@ case, 45% of the shore is abandoned if sea level rises one meter, simply because the economics do not support holding back the sea. *Id.* at 403. Without foresight, however, only 30% is abandoned, because 15% of these communities develop or redevelop even thoughConce the costs of shore protection are considereddthe development is not economically justified. *Id.* To the extent that rolling easements force people to recognize the inevitability of abandoning the shore, they lead to the better investment decisions characterized by Yohe's Awith foresight@ scenario. *See id.* at 394-96, 403-05. Because it is not cost-effective to hold back the sea in these cases, the risk of backsliding is minimized. *Id.* at 388-90, 406.

185. *See infra* Part III.A (recounting a case in which South Carolina resisted a property owner's request for permission to build a semi-hard structure, because, among other things, the State had effectively paid several hundred thousand dollars for a rolling easement on that property).

however, that a century from now conservancies would not decide to sell the easements to property owners and use the proceeds to protect more critical habitat.

The risk of backsliding would tend to be greatest in those areas where: (a) property owners are either unaware of the rolling easements or are lulled into believing that they will not be enforced, and (b) the cost of holding back the sea is small compared with the benefits of doing so. The former consideration suggests that public awareness must be a key component of any effort to ensure the survival of estuarine shores.[186]

The latter consideration favors some hybrid approaches that, when combined with rolling easements, would probably have a smaller risk of backsliding than a plan that relied solely on rolling easements. Limiting density to one-acre zoning would increase the cost of protecting a given home with a bulkhead. Requiring new homes to be moveable would decrease the cost of not holding back the sea, because the structures themselves would not be lost. Limiting house size would have a similar effect and would also decrease the potential benefits of a bulkhead, even if the house could not be moved. At least along marshy shores, requiring the house to be elevated on pilings would also decrease the need to build a bulkhead by ensuring the utility of the house during those early years when water levels periodically reach the house. It would also reduce public sympathy for people desiring to build a bulkhead.

In a thoughtful commentary on previous EPA analyses of this issue, Professor Joseph Sax, a pioneer of environmental law, warned that even with a purchased easement, success Aturns on the assumption that people will play by the rules of the game. It is this assumption I wish to question.@[187] Sax suggested the creation of a trust fund to compensate property owners when the time comes to abandon

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186. Public awareness serves at least four different purposes. First, as long as homebuyers know about the potential loss of property to a rolling easement, the market will lower values as the shore approaches the property. *Cf.* Yohe et al., *supra* note 167, at 391-92 (estimating that if markets are equipped with information, property values could decline to zero by the time the property is inundated). Second, the discount will lead the public to see the riparian owners not as victims, but as unscrupulous investors who seek to profit from the revision of a government regulation. Third, the public will have little sympathy for those who protest their ignorance of rolling easements. Fourth, the market may reflect *higher* prices for beach homes in the second row, because they will eventually have a waterfront view. *See id.* at 391 (explaining that as sea level rises, premiums associated with being close to the shore will migrate inland). As the biggest losers from governmental backsliding, this class might become a countervailing voice. *Id.* at 391-92.

187. Joseph L. Sax, *The Fate of Wetlands in the Face of Rising Sea Levels: A Strategic Proposal*, 9 UCLA J. ENVTL. L. & POL'Y 143, 148 (1991).

their properties.[188] While this approach may be appropriate in some areas, there is also the risk that it will take us back to the political infeasibility of deferred action: If the government would not be willing to buy out whole towns just to protect some tidelands, would it be willing to spend the proceeds of a trust fund to buy out whole towns just to protect some tidelands?

Rolling easements would leave future generations with the flexibility to keep their tidelands or give them up. Sax was correct that we cannot guarantee that they will choose the tidelands.[189] Perhaps we should be satisfied if we preserve the choice.

III. WOULD OPTIONS TO PROTECT TIDELANDS REQUIRE COMPENSATION?

According to the Bill of Rights, private property cannot be taken Awithout due process of law; nor shall private property be taken for public use, without just compensation.@[190] Common sense suggests two literal meanings of this ATakings Clause@: (1) all of the tideland protection policies require compensation, because they eventually deprive owners of their property; and (2) none of the policies require compensation, because the public does not use the private land when it prevents development or denies a permit to build a bulkhead. Neither of these views would prevail in the United States Supreme Court.

A. *A Case Study Involving Setbacks and Rolling Easements*

Consider a story that involved both setbacks and rolling easements, a story that included one of the most important Supreme Court rulings involving shorefront development: *Lucas v. South Carolina Coastal Council*.[191] In 1984, EPA and the South Carolina Sea Grant program sponsored a conference in Charleston, South

188. *Id.* at 153-60. Charging rent for houses and bulkheads that are on public trust land would be a possible source of funds. *Cf.* MISS. CODE ANN. ' 29-1-107(3) (1990) (requiring that those who developed tidelands after 1973 Ashall pay an annual rental based on the fair market value as determined by the assessed valuation of the property@).

189. Sax, *supra* note 187, at 147-60 (discussing landowners' likely behavior when the sea level rises).

190. U.S. CONST. amend. V. Although this proscription of government behavior originally applied only to the federal government, today it also applies to the states. *See* U.S. CONST. amend. XIV, ' 1 (ANo State shall . . . deprive any person of . . . property, without due process of law . . . .@).

191. 505 U.S. 1003 (1992).

Carolina to present the results of a study[192] on the impacts of future sea level rise on the city and the surrounding barrier islands, with the latter organization mailing 10,000 brochures to people in the area. Shortly thereafter, the South Carolina Coastal Council commissioned a Blue Ribbon Committee to address the problem of rising seas and eroding shores.[193] In 1987, the Committee issued its report, which recommended a setback equal to forty times the annual erosion rate.[194]

In 1986, a developer named David Lucas paid $975,000 for two oceanfront lots on the Isle of Palms in South Carolina.[195] The lots were about 300 feet from the beach,[196] but because they were near an inlet, the shore had advanced and retreated several times in the preceding few decades, with much of the lot on the active beach as recently as 1973.[197] In 1988, the South Carolina legislature responded to the Blue Ribbon report by enacting a Beachfront Management Act that prohibited construction seaward of an erosion setback line.[198] Because his lot was seaward of the line,[199] the setback left Lucas with a worthless lot.[200] Lucas then sued for compensation.[201]

The trial court decided that the setback was a taking because it deprived Lucas of any reasonable economic use of the property.[202] In 1990, this decision and Hurricane Hugo prompted the South Carolina legislature to replace the prohibition of development with

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192. The study was published later that year as GREENHOUSE EFFECT AND SEA LEVEL RISE, *supra* note 35, which estimated the future sea level rise, its effects, and the value of policies that prepare for these changes.

193. *Lucas*, 505 U.S. at 1037 (Blackmun, J., dissenting); *accord* Klarin & Hershman, *supra* note 6, at 305 (explaining that the Blue Ribbon Committee was motivated in part by the sea level conference).

194. *Lucas*, 505 U.S. at 1038 n.2 (Blackmun, J., dissenting). The Committee justified this proposed erosion setback based on both existing erosion rates and the EPA's estimate that the sea level would rise one foot in the following 40 years. *See* Report of the South Carolina Blue Ribbon Comm. on Beachfront Management (Mar. 1987) [hereinafter Report on Beachfront Management] (citing the predictions of a 1983 EPA study).

195. *Lucas*, 505 U.S. at 1006.

196. *Id.* at 1008.

197. *Id.* at 1038 (Blackmun, J., dissenting) (citing trial transcript).

198. *Id.*; *accord* S.C. CODE ANN. ' 48-39-290 (West Supp. 1997). *See generally id.* ' 48-39-250 (explaining the legislature's motivation for enacting the Beachfront Management Act).

199. *Lucas*, 505 U.S. at 1008. For practical purposes, the setback line was either 40 times the annual erosion rate plus 20 feet inland from the crest of the primary dune, or 20 feet inland of the most landward position of the mean high water line over the last 40 years, whichever was the farthest inland. *See* S.C. CODE ANN. ' 48-39-280(A), (B) (West Supp. 1997).

200. *Lucas*, 505 U.S. at 1009.

201. *Id.*

202. *Id.*

rolling easements for lots seaward of the setback line.[203] Thus, by the time the Council appealed to the South Carolina Supreme Court, the lots were eligible for building permits. Accordingly, the Council argued that the case was no longer ripe for judicial review.[204] The court Ashrugged off the possibility of further administrative and trial proceedings@[205] and reversed on the merits, holding that the regulation was designed to avoid a serious public harm and thus could not be a taking.[206]

Lucas appealed, and the United States Supreme Court granted certiorari.[207] The Court treated the case as a claim for a temporary taking between the setback's enforcement in 1988 and its conversion to a rolling easement in 1990.[208] For this period, at least, it accepted the trial court's finding that the State deprived Lucas of any reasonable economic use of his property.[209] With these assumptions, the Supreme Court reversed, holding that the Fifth Amendment's requirement to pay compensation cannot be avoided simply by characterizing the erosion hazard as a nuisance.[210] A regulation that prohibits all productive use is a taking unless property law had already given the State the power to prevent the nuisance.[211] The Court remanded the controversy to the South Carolina Supreme Court to decide whether the State had that power.[212]

On remand, the South Carolina Supreme Court chose not to conduct such an analysis.[213] It simply said that it knew of no basis in the common law for preventing construction on Lucas's property and remanded the case for a trial on the damages.[214] However, the parties

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203. *See* S.C. CODE ANN. ' 48-39-290(D)(1) (creating a special permit, which is a hybrid between a setback and a rolling easement, rolling only up to the setback line).

204. *Lucas*, 505 U.S. at 1011.

205. *Id.*

206. *Id.* at 1010.

207. Lucas v. South Carolina Coastal Council, 502 U.S. 966 (1991).

208. *Lucas*, 505 U.S. at 1010-13.

209. *Id.* at 1011-13 & n.3.

210. *Id.* at 1024-27.

211. *Id.* at 1029.

212. *Id.* at 1031-32.

213. The Coastal Council proposed to brief the South Carolina Supreme Court on the Abackground principles of nuisance and property law that prohibit the uses [that Lucas] intended.@ South Carolina Coastal Council, Motion to Clarify Remand at 4, Lucas v. South Carolina Coastal Council, 424 S.E.2d 484 (S.C. 1992) (No. 90-38). Perhaps feeling that at this point the Council needed to concede defeat, the Court never took them up on this offer and instead urged the Council to settle. Interview with Cotton Harness, Former General Counsel, S.C. Coastal Council (Mar. 14, 1994) (on file with author).

214. Lucas v. South Carolina Coastal Council, 424 S.E.2d 484, 486 (S.C. 1992), *on remand from* 505 U.S. 1003 (1992).

settled before trial, with the Council paying Lucas $1.5 million for title to the property. The Council resold the lots to John C. Gwinn for $850,000, with the condition that a rolling easement would govern any construction.[215]

The State's resolve to enforce the rolling easement was soon tested.[216] The erosion-and-accretion cycle switched from accretion to erosionCas much as fifteen feet per month. By the time Mr. Gwinn had completed construction on one of the lots, the shoreline was threatening the swimming pool that he had built seaward of the new house. Even though the Beachfront Management Act prohibited new structures from holding back the sea, the State allowed Gwinn and nearby owners to use sand bags.[217]

The property owners then petitioned the Coastal Council for permission to install geotectile containersCessentially ten-foot sandbags weighing about 6000 pounds. The Council denied this request, but gave the owners permission to create artificial dunes by bulldozing sand from the wet part of the beach. Gwinn and the other owners filed suit, seeking an injunction to compel the State to allow installation of the geotectile containers. Before the case could be decided, the erosion cycle reversed again and the shore began to accrete. After almost a decade of tenacious enforcement by South Carolina's coastal agencies, the Beachfront Management Act has saved the beach along the Lucas-Gwinn property.[218]

The holding in *Lucas v. South Carolina Coastal Council* implies that in some situations, setbacks *will* require compensation.[219] The legislature's replacement of setbacks with rolling easementsConly where setbacks were likely to be takingsCsuggests an assumption that rolling easements *will not* require compensation. But the United States Supreme Court did not address rolling easements or bulkhead prohibitions.

The remainder of this Part examines the general theory by which a court could decide whether a tideland policy requires compensation, assuming, for the sake of argument, that a property owner has the right

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215. Personal Communication with William C. Eiser, S.C. Coastal Council (Mar. 8, 1994).

216. Interview with William C. Eiser, *supra* note 151.

217. Stanley R. Riggs, *Conflict on the Not-So-Fragile Barrier Islands*, GEOTIMES, Dec. 1996, at 14, 16, 18.

218. *See* Interview with William C. Eiser, *supra* note 151.

219. *See* Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1027 (1992) (AWhere the State seeks to sustain regulation that deprives land of all economically beneficial use, we think it may resist compensation only if the logically antecedent inquiry into the nature of the owner's estate shows that the proscribed use interests were not part of his title to begin with.@).

TABLE 4
SUMMARY OF PART III: IS THE TIDELAND POLICY A TAKING?

Type of Governmental Exercise of Power	Case or Doctrine	Hypothetical Policy	Is the Policy a Taking if Coastal Lots Are Rendered Economically Unproductive?		
			#1--Prevent Development or Immediate Dedication	#2--Deferred Action	#3--Rolling Easement
Physical Invasion:		Basic*	---	Yes	---
Physical Invasion in Return for Permit: Illegitimate Uses of Government Power	*Nollan / Dolan*	Access Protection Policy	Probably not	---	No
	Nollan / Dolan	Dedicate wetland reserve for subdivision development permit	Maybe not if showing	---	No
Regulatory Taking: Parcel as Whole	*Lucas*	Subdivision with deep lots	No	---	---
Regulatory Taking: Temporal Partitioning	Nonconforming Use	Basic*	---	Yes	No
	Mahon	Basic*	Yes	Yes	---
	Bituminous Coal	Basic*	---	Probably	No
Regulatory Taking: Nuisance Versus Public Use	*Lucas*	Basic	Yes	Probably	Probably not

Basic = (#1) Prohibit Development; (#2) Similar to #3 except need to abandon announced without warning; (#3) Prototype rolling easement policy discussed in Part II.

Access Protection Policy = (#1) Immediate Dedication; (#2) Deferred Dedication, Protection; (3) One-step easement. *See* fig.8.

Need Showing = No taking if government can show that the condition offsets the adverse impact of the permitted activity.

to build a home and to protect it from the sea.[220] The Takings Clause applies to both physical invasions and regulations that deny *all* beneficial use to the owner. Parts III.B and III.C of this Article examine these two types of governmental action. Table 4 summarizes the author's best guess regarding the takings implications of the doctrines discussed in these sections, and how they relate to the policy options presented in Part II.

B. Physical Invasions: Implications for Protecting Access Along the Shore

The most common example of a physical invasion is an eminent domain acquisition. Nevertheless, even installing a cable television box[221] or requiring public access along a private beach or waterway[222] is enough of an invasion to be a taking. An invasion by the sea due to natural factors is not a constitutional taking.[223] If a government dam directly floods someone's property, it is a taking,[224] but if a project merely causes riparian land to erode away slowly, it is not.[225]

1. Permit Conditions: Illegitimate Uses of Governmental Power.—Not every physical invasion is a taking. For example, there is no taking when, in return for a permit to develop property, a local government requires a private developer to dedicate land for roads or other public infrastructure directly necessitated by the development

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220. Part IV examines how the validity of that assumption varies from state to state.

221. *See* Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 438 (1982) (holding that the installation of a cable television box, which involved the Adirect physical attachment of plates, boxes, wires, bolts, and screws to the building,@ constituted a taking).

222. *See* Nollan v. California Coastal Comm'n, 483 U.S. 825, 831 (1987) (holding that requiring homeowners Ato make an easement across their beachfront available to the public on a permanent basis in order to increase public access to the beach@ was a taking); Kaiser Aetna v. United States, 444 U.S. 164, 179-80 (1979) (holding that requiring access to a waterway was a taking because the federal navigation servitude does not apply to waters made navigable by private efforts).

223. *See* Cinque Bambini Partnership v. State, 491 So. 2d 508, 519-20 (Miss. 1986) (en banc) (citing the rule that where the forces of nature raise the sea level, the public lands expand inland without compensation), *aff'd sub nom.* Phillips Petroleum Co. v. Mississippi, 484 U.S. 469 (1988); *see also infra* Part IV.B.2.

224. *See* Pumpelly v. Green Bay & Miss. Canal Co., 80 U.S. (13 Wall.) 166, 181 (1871) (A[W]here real estate is actually invaded by superinduced additions of water . . . it is a taking . . . .@).

225. *See* Pitman v. United States, 457 F.2d 975, 977 (Ct. Cl. 1972) (holding that erosion caused by a Corps of Engineers jetty was not a taking unless the Corps either raised the water level or entered the property), *overruled on other grounds*, Owen v. United States, 851 F.2d 1404 (Fed. Cir. 1988). *See generally* Oliver A. Houck, *Land Loss in Coastal Louisiana: Causes, Consequences, and Remedies*, 58 TUL. L. REV. 3 (1983) (discussing the extreme example of coastal Louisiana, where landowners were not compensated for the 30 to 40 square miles of land lost per year, largely as a result of federal flood and navigation structures).

itself.[226] However, if the conditions of a permit are designed to save the government money on projects the government intended to embark upon anyway, rather than simply to offset the consequences of granting the permit, then the government has exceeded its power. In *Nollan v. California Coastal Commission*,[227] the Commission refused to give the Nollans a permit to replace their small bungalow with a large oceanfront house unless the Nollans gave the state an easement permitting public access along the dry beach behind their house.[228] The increased access to the beach, the Commission argued, would counteract the decreased Avisual access@ for those traveling along the street in front of the Nollans' house.[229]

The Court found no Aessential nexus@ between the easement and the objective of preserving the view of the water.[230] A permit condition must be the means to an end that the government could already achieve by denying the permit.[231] In this case, preserving visual access would have been a legitimate end.[232] However, the fact that both the impact and the condition included the word Aaccess@ did not imply that improving access along the shore would compensate for a loss of visual access.[233] The Court indicated that requiring the Nollans to set aside part of their land

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226. *See* Dolan v. City of Tigard, 512 U.S. 374, 389-90 & n.7 (1994) (citing cases in several states that require a reasonable relationship or a direct connection between proposed development and required dedication).

227. 483 U.S. 825 (1987).

228. *Id.* at 828 (explaining that the proposed permit was conditioned on granting the public an easement across the Nollans' private property between the mean high water mark and a seawall that separated the beach from the rest of the Nollans' property). As in all but a few states, the public already had access along the wet beach, but the dry beach was not open to the public other than in particular areas. *See infra* Part IV (discussing the right to access along the shore).

229. *Nollan*, 483 U.S. at 838.

230. *Id.* at 837-39. The Court also noted that the Commission had an ongoing program of acquiring the dry beach, *id.* at 841, essentially extending the public trust inland from the mean high water mark to the seawall that divided the beach from the rest of the Nollans' property, *id.* at 828. The opinion closed by advising that eminent domain is the proper way to convert private land to public beach. *Id.* at 841-42.

231. *Id.* at 836. The Court added:

> [T]he lack of nexus between the condition and the original purpose of the building restriction converts that purpose to something other than what it was. The purpose then becomes, quite simply, the obtaining of an easement to serve some valid governmental purpose, but without payment of compensation. . . . [U]nless the permit condition serves the same governmental purpose as the development ban, the building restriction is . . . Aan out-and-out plan of extortion.@

Id. at 837 (quoting J.E.D. Assocs. v. Town of Atkinson, 432 A.2d 12, 14-15 (N.H. 1981), *overruled on other grounds by* Town of Auburn v. McEvoy, 553 A.2d 317 (N.H. 1988)).

232. *Id.* at 838.

233. *Id.*

for viewing the beach would have passed this test.[234] Unfortunately, the Court did not comment on cases in which the Commission required an easement along the dry beach in return for a seawall permit.[235] In such cases, because both the adverse impact and the condition involve lateral access, an essential nexus would exist. The question would then become: Is the connection between the impact and the condition sufficient? The *Nollan* Court did not develop a test for how tight the connection must be, because in that case, there was no nexus at all.[236]

The required connection between the impact and the condition was at issue in *Dolan v. City of Tigard*.[237] Mrs. Dolan wanted to build a parking lot and expand her business on a parcel adjacent to a floodplain and planned bike path.[238] The City granted a permit for the expansion, but only on the condition that she dedicate land for a floodway and the bike path.[239] The Court found a nexus between the impacts of the development and each of the permit conditions. First, the development would increase runoff and hence flooding—problems that a floodway could ameliorate. Second, the business expansion would increase traffic—a problem that a bike path could diminish.[240]

Because there was a nexus between the impacts and the conditions, the Court had to formulate a test for deciding "whether the degree of the exactions demanded by the city's permit conditions bear the required relationship to the projected impact of [the]

234. *See id.* at 836.

235. *Compare* Barrie v. California Coastal Comm'n, 241 Cal. Rptr. 477, 485 (Ct. App. 1987) (finding a reasonable nexus between a dry beach dedication requirement and a permit for a seawall) *and* Whalers' Village Club v. California Coastal Comm'n, 220 Cal. Rptr. 2, 14 (Ct. App. 1985) (finding a reasonable nexus between a dry beach dedication requirement and a permit for a seawall, because seawalls in general cause erosion, which in turn necessitates additional access along the shore) *with* Surfside Colony, Ltd. v. California Coastal Comm'n, 277 Cal. Rptr. 371, 376 (Ct. App. 1991) (finding an insufficient nexus between a beach dedication and a permit for a seawall because the Commission did not show that the particular seawall would cause erosion, and because the post-*Nollan* requirement for substantial nexus requires a site-specific showing). Erosion caused by seawalls was the narrow focus of the California courts. This question is irrelevant if the shore is eroding: It does not matter whether the seawall causes the erosion, because a retreating shore will eventually reach the seawall. Considering the latter nexus would lead to a different result in *Surfside*, because seawalls always eliminate eroding beaches by blocking their landward migration, even if they do not accelerate the erosion. *See* figs.1, 8.

236. *See* Dolan v. City of Tigard, 512 U.S. 374, 386 & n.7 (1994).

237. 512 U.S. 374 (1994).

238. *Id.* at 379.

239. *Id.* at 379-80.

240. *Id.* at 387-88.

petitioner's proposed development.@[241] The Court adopted what it called a A`rough proportionality'@ test based on a rule already adopted by a majority of state courts.[242] As an example of this test, the Court favorably cited a Nebraska case holding that Aa city may not require a property owner to dedicate private property for some future public use as a condition of obtaining a building permit when such future use is not `occasioned by the construction sought to be permitted.'@[243] In adopting this test, the Court rejected the more stringent A`specifi[c] and uniquely attributable'@ test, which requires that Athe local government . . . demonstrate that its exaction is directly proportional to the specifically created need.@[244] Nevertheless, this test is still relevant in coastal states where it has been adopted as a matter of state law.[245]

Applying the rough proportionality test, the Supreme Court held that dedicating a floodway was not roughly proportional to the increased flooding. In reaching this conclusion, the Court reasoned that the increased flooding could be mitigated just as effectively by preventing development without granting the public access to that land.[246] The bike path was a closer case. The Court acknowledged that a bike path Acould@ offset the traffic impact but held that the City had to show that it Awould@ offset the impact.[247]

*2. When Is a Policy That Protects Access a Taking?*CFigure 9 illustrates four alternatives for protecting access along the shore.[248] Because all of these measures protect the same alongshore access that a bulkhead

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241. *Id.* at 388 (citing Nollan v. California Coastal Comm'n, 483 U.S. 825, 834 (1987)).

242. *Id.* at 391.

243. *Id.* at 390 (quoting Simpson v. City of North Platte, 292 N.W.2d 297, 302 (Neb. 1980)).

244. *Id.* at 389-90 (alteration in original). This test had been adopted by Illinois, New Hampshire, New Jersey, Rhode Island, and Ohio. *See id.* at 389-90, 389 n.7.

245. *See, e.g.*, Divan Builders, Inc. v. Planning Bd., 334 A.2d 30, 40 (N.J. 1975) (applying the specifically and uniquely attributable test); Frank Ansuini, Inc. v. City of Cranston, 264 A.2d 910, 912-13 (R.I. 1970) (holding that state case law embodies the specifically and uniquely attributable test). A New Hampshire case that Justice Scalia quoted fondly in the *Nollan* decision, *Nollan*, 483 U.S. at 837, held that the New Hampshire State Constitution required the specifically and uniquely attributable test. J.E.D. Assocs. v. Town of Atkinson, 432 A.2d 12, 15 (N.H. 1981) (holding that the specifically and uniquely attributable test is required by the New Hampshire State Constitution), *overruled on other grounds by* Town of Auburn v. McEvoy, 553 A.2d 317 (N.H. 1988). The *McEvoy* case did not overrule the requirement for the specifically and uniquely attributable test.

246. *Dolan*, 512 U.S. at 392-95.

247. *Id.* at 395 (endorsing the dissent in Dolan v. City of Tigard, 854 P.2d 437, 447 (Or. 1993) (in banc) (Peterson, J., dissenting), *rev'd*, 512 U.S. 374 (1994)).

248. *See also supra* Part II.B.5 and tbl.2 (explaining the one-step easement and other policies for protecting access where shores are armored).

might otherwise destroy, they all have the essential nexus that was lacking in *Nollan*.

The most straightforward case is the one-step easement. Such a permit condition is narrowly tailored: It protects access along the shore at both the same time and the same place that the bulkhead destroys access.[249] As a result, one-step easements would pass even the more stringent Aspecific and uniquely attributable test@ that some states require.[250]

Requiring immediate dedication[251] of an easement above the bulkhead as a condition for a bulkhead permit is not quite as narrowly tailored in time, because the condition takes effect immediately to offset a problem that the bulkhead will cause in the future.[252] Nevertheless, an immediate dedication may still pass the specific and uniquely attributable test, because the easement dedicated is Adirectly proportional to the specifically created need.@[253] It certainly would pass the rough proportionality test, because the dedication is necessitated by the construction being permitted.

California has sometimes required property owners to dedicate dry beach in return for a seawall permit.[254] This policy would probably fail the specific and uniquely attributable test, because such a condition does not specifically offset the problem created by the seawall. At the outset, there is temporal discontinuity. Because seawalls eliminate all of the dry beach before eliminating any of the wet beach, such a condition increases access only during those early years when the seawall would not have diminished public access anyway. In Figure 9, for example, the

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249. *See* fig.9.

250. *See supra* note 244 and accompanying text (defining the Aspecific and uniquely attributable@ test).

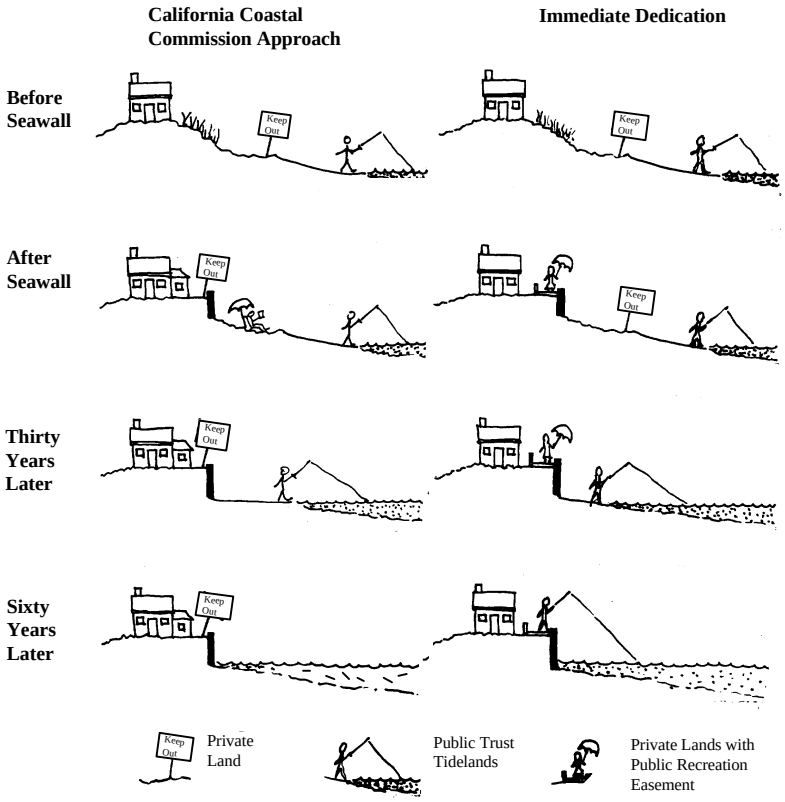
251. *See supra* Part II.B.5 and tbl.2 (explaining the option of immediate dedication of an easement when a bulkhead permit is issued).

252. This discussion assumes that the right to protect one's home does not mean a right to protect every square foot of the backyard. Deferring dedication until the beach is lost would be difficult unless the owner seeks a permit to rebuild the seawall just as the beach is about to be lost. By then, the home, rather than just the yard, may also be threatened. Given our assumption that the owner has the right to protect her home, this would diminish any state authority to deny a seawall permit.

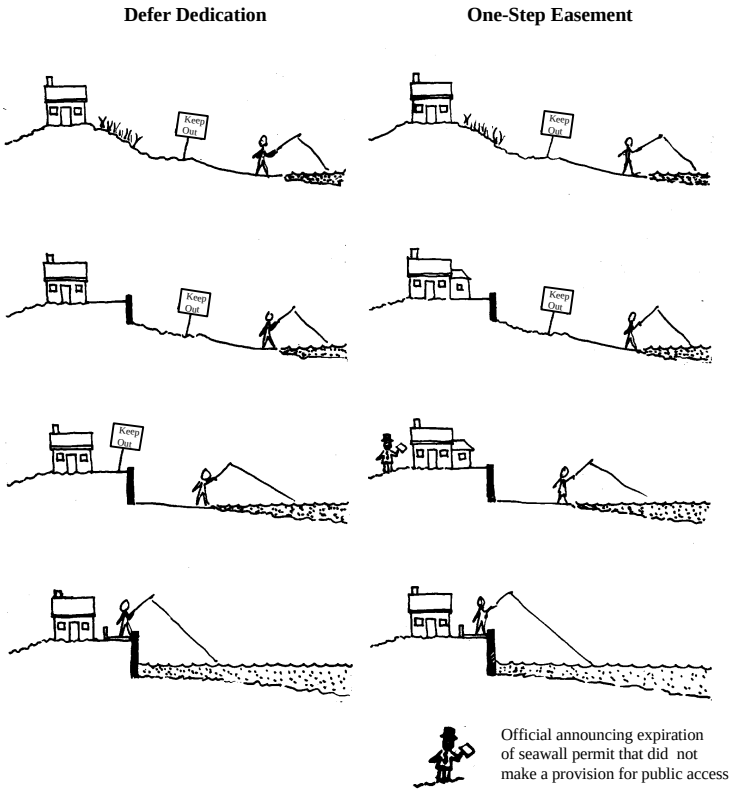
253. Dolan v. City of Tigard, 512 U.S. 374, 390 (1994). Ignoring transaction costs, the present value of immediately dedicating an easement has a greater cost to the owner than making it available to the public a few decades later. *Cf. supra* Part II.C.1 (explaining why the present value of acquiring an interest that vests in the future is far less than the present value of an interest that vests immediately). However, when administrative costs are included, the total cost may be less: The deferred dedication would require surveyors and coastal geologists to monitor the erosion and make a determination when the wet beach has been completely eroded, but immediate dedication avoids that cost.

254. *See supra* note 235.

FIGURE 9
FOUR APPROACHES TO PROTECTING ACCESS WHEN GRANTING A PERMIT TO BUILD A BULKHEAD: IS THERE A SUFFICIENT NEXUS UNDER *NOLLAN / DOLAN*?



The California policy of requiring dedication of *dry* beach access in return for a seawall permit has a nexus with the impact of the permit, because the seawall eventually impairs *wet* beach access. But the condition does not directly *offset* the impact of the seawall, because the seawall eliminates the dry beach (and hence the access created by the condition) before it eliminates the wet beach. A one-step easement, by contrast, is narrowly tailored to restore access along the shore at the exact time when the seawall would otherwise eliminate it, and hence would pass even the "specifically and uniquely attributable" test. Immediate dedication of an easement above the seawall should meet the court's "rough proportionality test" because the long-term effect is to protect the access along the shore that the seawall eliminates. Deferred action, like a one-step easement, offsets only the access that is lost, but it fails to make the dedication part of the initial permit. Therefore, it might not be viewed as mitigation of a permit at all and hence could be judged as an ordinary physical invasion.


Defer Dedication
One-Step Easement
Keep Out
Keep Out
Keep Out
Keep Out
Keep Out
Keep Out
Official announcing expiration of seawall permit that did not make a provision for public access

permit condition increases public access only for the next thirty years in return for the partial loss of access caused by the seawall between thirty and sixty years hence as well as the total loss of access thereafter. Just as the bicycle path in *Dolan* would not have directly offset the particular traffic generated by the expansion of the business,[255] dry beach dedication today does not directly offset the loss in access from eventual loss of the wet beach.

The *Dolan* opinion, however, implies that one may be able to step away from the particular time and place where access is preserved and look at the total amount of beach to which the public has access. In a state where new seawalls are continually causing the loss of the wet beach to which the public has access, a policy of dry beach dedication *could* prevent the overall amount of beach area to which the public has access from declining. The Court in *Dolan* indicated that the dedication for a bike path would not have been a taking if the City had proven that the bike path actually *would* offset the increase in traffic caused by the store. It did not require proof that customers would all take their bikes to the store or even that the traffic reduction had to occur on the same day.[256] Thus, if a state agency can show, for example, that the increase in pedestrian traffic along the beach created by a dry beach dedication will offset the loss in traffic resulting from the elimination of the wet beach, the dry beach dedication policy would probably pass the *Dolan* test.

A final possibility is to defer action today and then require dedication of an easement above the bulkhead at a later date. For example, eventually the seawall might need to be rebuilt. Some of the same arguments for an immediate dedication would still apply.[257] However, deferring action and requiring a dedication later would present two additional problems. First, if the beach is already lost, it may be more difficult to convince a court that the impact of the permit is the loss of the beach (even though, strictly speaking, denial of the permit would eventually cause the bulkhead to be destroyed and the beach to reappear).[258] Second, the political difficulties of

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255. *See Dolan*, 512 U.S. at 395 ("[T]he city has not met its burden of demonstrating that the additional number of vehicle and bicycle trips generated by petitioner's development reasonably relate to the city's requirement for a dedication of the pedestrian/bicycle pathway easement.").

256. *See id.* at 395-96 (holding that to support the dedication of land for a bike path, the City must quantify the extent to which the path is likely to offset the increased traffic resulting from business expansion).

257. *See supra* Part II.B.5.

258. Given the assumption that people have the right to build and defend their homes, this hurdle may be particularly severe. The hypothetical permit denial leading to the beach

requiring conditions for renewing a permit would be much greater than requiring the condition when the seawall is built the first time.[259]

C. Regulations That Deny Beneficial Use

In theory, courts decide whether a regulation is a taking by weighing its importance, economic impact, and interference with Ainvestment-backed expectations.@[260] Because such balancing is subjective,[261] the Court has identified two types of per se takings: physical invasions and property regulations that deny all beneficial use.[262] Although the Supreme Court has never precisely defined how much must be taken to constitute a loss of Aall economically beneficial or productive use of land,@[263] at least two lower courts have found wetland-protection regulations to be takings when they prevented development and decreased property values by roughly ninety percent.[264]

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regeneration might also destroy the property owner's home, thus implying that denial of the permit would be essentially a taking of the home. In such a case, arguing that the access being protected is something that the state could protect by denying the permit would be even more difficult: Given the assumption in Part III that an owner has the right to build a home, not only is access already gone but the state could not deny the permit anyway.

259. *See supra* Part II.C.4.

260. Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 124 (1978); *accord* Gazza v. New York State Dep't of Envtl. Conservation, 605 N.Y.S.2d 642, 644 (Sup. Ct. 1993) (AThe rationale behind *Lucas* is not to punish the `original' landowner, but to prevent a windfall to sophisticated subsequent purchasers.@), *aff'd*, 634 N.Y.S.2d 740 (App. Div. 1995), *aff'd*, 679 N.E.2d 1035 (N.Y.), *cert. denied*, 118 S. Ct. 58 (1997). The *Gazza* court stated that the state's Tidal Wetlands Act was one of the Abundle of limitations@ accompanying the property. *Id.* The court concluded: AHe cannot reasonably argue that his investment-backed expectations were impacted by legislation which had long been in place when he purchased the property.@ *Id.* at 645 (citation omitted).

261. *Cf.* Loveladies Harbor Inc. v. United States, 15 Cl. Ct. 381, 388-89 (1988) (acknowledging that balancing a governmental interest in preserving wetlands against a private property interest reveals a private interest deserving compensation, but stating that the Acourt is most reluctant to hold that a taking has occurred on this basis alone@).

262. *See* Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1015 (1992) (AWe have . . . described at least two discrete categories of regulatory action as compensable without case-specific inquiry . . . . The first encompasses regulations . . . [creating] a physical `invasion' of . . . property. . . . [and] [t]he second . . . is where regulation denies all economically beneficial or productive use of land.@).

263. *Id.*

264. *See* Florida Rock Indus. v. United States, 18 F.3d 1560, 1570 n.27 (Fed. Cir. 1994) (stating that a 95% decline in value would be a taking, but if the decline is closer to 60%, Athe correct outcome is no longer clear@); Formanek v. United States, 26 Cl. Ct. 332, 340 (1992) (finding that an 88% decline in property value frustrated investment-backed expectations even though the remaining value of the property was still greater than the purchase price).

Must a property owner suffer such an overwhelming loss to be entitled to compensation? The balancing test suggests that less important regulations would warrant a lower threshold. If preventing wetlands from being filled is the only way to prevent their immediate destruction, only a large impact on property values would be a taking. However, if preventing *future* destruction is found to be less important, then a smaller impact on property values could be a taking. Setbacks may be particularly vulnerable to a balancing test, because there is a lower cost measure that can provide the same protection: rolling easements.[265]

The next two sections examine two issues that courts would have to consider when plaintiff landowners claim that a regulation has deprived them of the use of their property: (1) whether, for the purpose of a taking, property can be physically or temporally partitioned, and (2) which actions the government can regulate even when doing so destroys the property's value. These issues would not arise with tidelands policies designed to protect access only. Because the owner can build a house, the property's overall utility is not substantially diminished, let alone destroyed, either temporarily or permanently.[266] Nevertheless, these questions may be important for policies that attempt to ensure the continued survival of the tidelands themselves.

1. Partitioning the Estate for Takings Purposes.—When deciding whether an owner has lost all beneficial use of the property, what portion of the estate must one consider? This question contains both geographic and temporal components. A setback of one foot, for example, might deny all beneficial use to that first foot of land, yet barely impair the use of the remaining land. By contrast, a rolling easement might deny all beneficial use after the year 2100, yet barely affect current property values today.

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265. *See Florida Rock*, 18 F.3d at 1571 (explaining that courts must engage in ad hoc balancing and must consider, among other factors, whether the government Alimit[ed] the constraints on property ownership to those necessary to achieve the public purpose@). The balancing test provides an opportunity for courts to find a taking when the diminution in value is less than total. *See id.* Nevertheless, some commentators are skeptical about whether this capability survives *Lucas*. *See* Richard A. Epstein, Lucas v. South Carolina Coastal Council: *A Tangled Web of Expectations*, 45 STAN. L. REV. 1369, 1377 (1993) (A[T]he Court has provided an effective blueprint for confiscation . . . .@).

266. Furthermore, however an estate might be partitioned in theory for takings purposes, the right to exclude others from one particular part of the property is not a subparcel that, if destroyed, would automatically trigger a taking. *See* Dolan v. City of Tigard, 512 U.S. 374, 391 (1994) (adopting a new test to clarify when a regulation can require dedication of land or an easement without triggering a taking).

a. Geographic Partitioning.—Unlike physical invasions, a regulation may not be a taking when it destroys the economic utility of one part of a lot, as long as the parcel as a whole remains valuable.[267] Although *Lucas* was an exception, oceanfront setbacks have often avoided the takings problem because the lots were deeper than the setback.[268] However, protecting thousands of square miles by preventing development would often require larger setbacks and thereby increase the likelihood of a taking. Nevertheless, the likelihood of a taking can be minimized if setbacks are established before large lots are subdivided. Although prohibiting bulkheads to protect homes may deny all use, denying permits to protect eroding backyards does not.

b. Temporal Partitioning.—By allowing development while requiring it to be eventually removed, rolling easements partition an estate temporally rather than geographically. Here too, the law has only been partly settled. For example, if a regulation unconstitutionally prevents the productive use of land for a year, after which the regulation is repealed, the state must compensate the owner for the temporary taking.[269] But when the regulation prevents the use of

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267. *See, e.g.*, *Florida Rock*, 18 F.3d at 1568-69 (stating that per se partial takings apply only to physical invasions, but noting that the Supreme Court has not yet considered partial regulatory takings in detail). For an analysis of the anomalies that can result from not recognizing partial regulatory takings, see Epstein, *supra* note 265, at 1387-92, and William W. Fisher III, *The Trouble with* Lucas, 45 STAN. L. REV. 1393, 1404-05 (1993). Some partial regulatory takings, such as street setbacks, may be justified by the resulting mutual benefit. *See infra* note 324 (explaining that no compensation is required under an eminent domain partial taking when the part not taken appreciates in value by more than the value of the portion taken as a direct result of the project for which the land was taken). To a point, a mutual benefit also results from waterfront setbacks, because a single house built close to the water blocks everyone's view of the shoreline. *Cf.* WARD ET AL., *supra* note 19, at 48 (noting that Aconstruction setback lines. . . . allow[] natural shoreline processes to operate without interference and preserve[] the recreational and aesthetic values of the beach@). Beyond that, however, the owners are not the beneficiaries. *See* St. Amand, *supra* note 119, at 11 (describing the anger of property owners in North Carolina after the enactment of the Coastal Area Management Act and supporting guidelines that together created an erosion setback line).

268. *Cf.* St. Amand, *supra* note 119, at 11 (discussing how North Carolina Agrandfathered@ small lots in its setback program).

269. *See* First English Evangelical Lutheran Church v. County of Los Angeles, 482 U.S. 304, 321 (1987) (holding that Awhere the government's activities have already worked a taking of all use of property, no subsequent action by the government can relieve it of the duty to provide compensation for the period during which the taking was effective@); *see also supra* notes 208-209 and accompanying text.

property at the *end* of a long period of time, the takings implications are less clear.[270]

Zoning has often phased out nonconforming uses by allowing such uses to continue for only a specified period of time,[271] but usually there are alternative uses for the property.[272] Although a policy that required land to be abandoned fifty years hence would often allow no productive use when the deadline finally arrived, it would have a trivial impact on the current value of the parcel.[273] Thus, the doctrine of nonconforming use argues against the necessity of compensation for rolling easements.[274]

Two Supreme Court cases concerning coal mining in Pennsylvania, when read together, imply that a regulation that eventually curtails the useful lifetime of real property is less likely to be a taking than a regulation requiring an immediate curtailment. Both *Pennsylvania Coal Co. v. Mahon*[275] and *Keystone Bituminous Coal Ass'n v.*

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270. *Cf.* Esposito v. South Carolina Coastal Council, 939 F.2d 165, 170 (4th Cir. 1991) (holding that a taking does not occur when a regulation today removes from the bundle of property rights the right to rebuild a house should it ever be destroyed by a storm, because existing uses can continue and the impact on those uses is speculative). The long-term contingent prohibition of bulkheads required by a rolling easement is much more remoteCand restricts less essential uses of propertyCthan the potentially near-term contingent prohibition of post-storm construction. Moreover, if a regulation that prohibits bulkheads also allowed for nonstructural shore protection such as beach nourishment, the impact on use would be even more Aspeculative.@

271. *See, e.g.*, Oswalt v. County of Ramsey, 371 N.W.2d 241, 246 & n.3 (Minn. Ct. App. 1985) (holding that municipalities can phase out a nonconforming use without paying compensation and that limiting repairs of partially destroyed structures is an acceptable method to phase out nonconforming uses, but declining to decide whether a regulation prohibiting the reconstruction of houses in a floodplain is a taking); Harbison v. City of Buffalo, 152 N.E.2d 42, 47 (N.Y. 1958) (noting that a right to continue a nonconforming use may be terminated after a reasonable period, during which the owner may have a fair opportunity to amortize his investment and make future plans).

272. *See, e.g.*, Naegele Outdoor Advertising Co. v. Village of Minnetonka, 162 N.W.2d 206, 213 (Minn. 1968).

273. *See supra* Part II.C.1 (explaining why the impact is trivial).

274. Extending this analogy, deferred action would be analogous to laws that require removal of nonconforming uses without a fair opportunity to amortize the investment. *See Oswalt*, 371 N.W.2d at 246. Hence, compensation would generally be required regardless of this particular interpretation.

Along sandy public beaches, rolling easements may be viewed as physical invasions, similar to the possibility of reverter for a defeasible estate. Courts have held that taking a possibility of reverter does not require compensation when the condition that triggers the reversion is not imminent. *See* B. Glenn, Annotation, *Rights in Condemnation Award Where Land Taken Was Subject to Possible Rights of Reverter or Re-entry*, 81 A.L.R.2D 568 (1962). In those cases, however, the rule did not benefit the government, but rather the current estate holders, who were compensated for the full value of the estate. *See id.*

275. 260 U.S. 393 (1922).

DeBenedictis[276] involved split estates, in which coal companies owned subsurface coal while other parties owned surface rights to the land.[277] In each case, the surface owner had conveyed the Asupport estate,@ contractually accepting the risk of any subsidence resulting from mining.[278]

When construction that was vulnerable to subsidence replaced preexisting land uses, the Pennsylvania legislature became concerned about potential risks to public health and safety, and enacted the Kohler Act of 1921,[279] which prohibited mining whenever it threatened homes with subsidence.[280] Because the Act destroyed the value of the plaintiff's support estate, the *Mahon* Court found it to be a taking.[281]

Several decades later, the legislature passed the Bituminous Mine Subsidence and Land Conservation Act of 1966,[282] which also sought to prevent serious subsidence by limiting the amount of coal that could be extracted, but allowed mining to continue until subsidence became a threat.[283] In *Bituminous Coal*, the coal companies alleged that by limiting the coal that they could remove, the State had taken their coal for public use and completely destroyed the support estate.[284] This time, the Court viewed the mineral estate as a whole and found no taking.[285]

Comparing these two cases is similar to comparing deferred action and rolling easements. Just as the Kohler Act destroyed the plaintiff's mineral estate to avoid an imminent risk posed to adjacent

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276. 480 U.S. 470 (1987).

277. *See Mahon*, 260 U.S. at 412; *Bituminous Coal*, 480 U.S. at 500.

278. *See Mahon*, 260 U.S. at 412; *Bituminous Coal*, 480 U.S. at 481-82.

279. The Kohler Act of 1921 was one of the Pennsylvania legislature's first attempts at dealing with the problem of subsidence. *See* The Kohler Act, 1921 Pa. Laws 445 (codified as amended at PA. STAT. ANN. tit. 52, ' 661 (West 1998)) (regulating the mining of anthracite coal).

280. *See Mahon*, 260 U.S. at 412-13.

281. *See id.* at 414-16. The Court also criticized the motives of the legislature as being disingenuous. *See id.* at 398 (remarking that the purpose of the Kohler Act was Anot to protect the lives or safety of the public generally but merely to augment the property rights of a favored few@).

282. 1966 Pa. Laws 1 (codified as amended at PA. STAT. ANN. tit. 52, '' 1406.1-1406.21 (West 1998)). The 1966 Act, which regulated the mining of bituminous coal and declaring a public interest in the support of surface structures, was more favorably received. *See infra* note 285.

283. *Bituminous Coal*, 480 U.S. at 476-77.

284. *Id.* at 498-500.

285. *See id.* at 500-01. The Court also had nicer things to say about this statute compared with the Kohler Act. *See id.* at 488 (A[T]he Commonwealth is acting to protect the public interest in health, the environment, and the fiscal integrity of the area.@ (citing the Bituminous Mine Subsidence and Land Conversation Act)).

properties from sinking land,[286] deferred action could destroy shorefront land values by preventing bulkheads to avoid imminent tideland loss from the rising sea. Likewise, just as the Subsidence Act put mining companies on notice but allowed mining to continue until it threatened neighboring property,[287] rolling easements also put owners on notice but allow homes to remain by the sea until continued occupation threatens elimination of the neighboring public lands. If anything, a rolling easement would be less of a taking than the Subsidence Act's limitation on mining.[288] While the coal companies paid for the support estate that was taken,[289] coastal landowners generally have not paid the state (the owner of the tidelands) for the right to erect a bulkhead.[290] Moreover, the impact of a rolling easement on present property values would generally be less than the one- to nine-percent reductions caused by the Subsidence Act.[291]

2. *Nuisance Versus Public Use: Before and After* Lucas.C

a. Before Lucas.CCourts have long viewed regulations that abated nuisances differently than those that secured public benefits. In *Mahon*, Justice Brandeis's dissenting opinion emphasized the importance of this distinction, declaring that a Arestriction imposed to protect the public health, safety, or morals from dangers threatened is not a taking. . . . Restriction upon use does not become inappropriate as a means, merely because it deprives the owner of the only use to which the property can then be profitably put.@[292] Justice Holmes's majority opinion did not

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286. *See Mahon*, 260 U.S. at 398-99 (noting that the Kohler Act protected the surface rights of the property owners whose right of subjacent support had been withheld or waived).

287. *See Bituminous Coal*, 480 U.S. at 501 (APetitioners may continue to mine coal profitably even if they may not destroy or damage surface structures at will in the process.@).

288. Admittedly, the Subsidence Act merely hastened the closure of mines that would have to close eventually anyway, while rolling easements affect fee simple property, which theoretically lasts forever. Nevertheless, rolling easements only take effect if the shore erodes. Therefore, rolling easements merely hasten the removal of structures that would eventually have to be removed anyway.

289. *See Bituminous Coal*, 480 U.S. at 478 (noting that coal companies acquired or retained estates in land, but severed title between the coal underneath the surface and the surface estate).

290. *See infra* note 366 and accompanying text (discussing how the common law of erosion transfers title from a riparian owner to the state when the land is flooded by mean high water).

291. *Compare* Appendix 1 (estimating the cost of rolling easements at typically less than 1% of coastal property values) *with Bituminous Coal*, 480 U.S. at 496 & n.24 (noting that the Subsidence Act would reduce average coal production of 13 mines by about 1.8%, with three mines having to leave at least 4% of the total coal in the ground).

292. Pennsylvania Coal Co. v. Mahon, 260 U.S. 393, 417-18 (1922) (Brandeis, J.,

dispute this distinction, but noted that the Fifth Amendment's protection is even more fundamental: AWhen this seemingly absolute protection is found to be qualified by the police power, the natural tendency of human nature is to extend the qualification more and more until at last private property disappears. . . . [I]f regulation goes too far it will be recognized as a taking.@[293]

This distinction has given courts substantial flexibility, because many regulations can be characterized either way.[294] Tort theory suggests a cost-benefit test: If the harm is greater than the abatement cost, the property owner has a duty to abate the nuisance.[295] Yet, if that principle is applied to the essential bundle of rights implied by ownership, we quickly reach the point where Aat last private property disappears.@[296] Nevertheless, some courts have conducted this type of analysis even when these essential uses are involved.[297]

b. After Lucas.**C**Justice Scalia's majority opinion in *Lucas* cleared away some of this analytical underbrush. The fact that a regulation

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dissenting).

293. *Mahon*, 260 U.S. at 415.

294. *See* Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1024 (1992) (A[T]he distinction between `harm-preventing' and `benefit-conferring' regulation is often in the eye of the beholder.@); *id.* at 1018 (A[R]egulations that leave the owner of land without economically beneficial or productive options for its use . . . carry with them a heightened risk that private property is being pressed into some form of public service under the guise of mitigating serious public harm.@).

295. *Cf.* RESTATEMENT (SECOND) OF TORTS ' 826 (1979) (providing the general rule that an activity may be a nuisance if the gravity of the harm outweighs the utility of the actor's conduct).

296. *Mahon*, 260 U.S. at 415. If regulations that pass a cost-benefit test never required compensation, the public would never have to purchase land for nature reserves and other open space. Assuming that the government is rational, decisions to buy land always mean that the value to society is greater if the land is kept in its natural condition. Therefore, developing the land would have a greater harm than benefit, and would thus be a nuisance.

297. *See, e.g.*, McDougal v. County of Imperial, 942 F.2d 668, 676 (9th Cir. 1991) (stating that if landowners are denied all use of their property, takings claims must balance the public interest against the private deprivation); Turnpike Realty Co. v. Town of Dedham, 284 N.E.2d 891, 900 (Mass. 1972) (asserting that the social benefit of avoiding construction in a floodplain outweighs an 88% reduction in property value resulting from prohibited development). The balancing test from *Penn Central* allows courts to *find* a taking if the loss is *less* than 100%. *See* Penn Cent. Transp. Co. v. New York City, 438 U.S. 104, 130-31 (1978) (indicating that when the Court is Adeciding whether a particular governmental action has effected a taking, . . . [the focus is] on the character of the action and on the nature and extent of the interference with rights in the parcel as a whole . . . .@). By contrast, the balancing associated with a nuisance analysis allows a court to *avoid* finding a taking when the deprivation *equals* 100%. *Cf.* Keystone Bituminous Coal Ass'n v. DeBenedictis, 480 U.S. 470, 491 & n.20 (1987) (describing A[t]he Court's hesitance to find a taking when the State merely restrains uses of property that are tantamount to public nuisances@).

controls a noxious use, he wrote, Acannot be the basis for departing from our categorical rule that total regulatory takings must be compensated. . . . [To hold otherwise] would essentially nullify *Mahon*'s affirmation of [the] limits to the noncompensable exercise of the police power.@[298] Instead, a state can avoid compensating the property owner only if Athe proscribed use interests were not part of his title to begin with.@[299]

Justice Scalia's elaboration leaves room for interpretation, but the general thrust provides several avenues by which tideland policies could escape the need to pay compensation. First, if the regulation merely reaffirms a preexisting common law duty or power of the state to limit construction, it is not a taking.[300] Second, if the existing common law has not addressed the issue, but Acommon-law principles would have prevented the erection@ of the structures on the land, then the regulation is not a taking.[301] Third, if statutes or regulations have been in force long enough to have been factored into investment-backed expectations of property owners, their enforcement does not require compensation.[302]

Would the background principles of property law allow a state to retain the tidelands as shores retreat? One must consider both general property law and the unique attributes of coastal property law.

c. General Background Principles of Property Law. CA few states have adopted the view that title to property does not include the right to fill wetlands.[303] That rule, however, does not address dry land that may

298. *Lucas*, 505 U.S. at 1026.

299. *Id.* at 1027.

300. *See id.* at 1029 (AAny limitation so severe cannot be newly legislated or decreed (without compensation), but must inhere in the title itself, in the restrictions that background principles of the State's law of property and nuisance already place upon land ownership.@)

301. *Id.* at 1031.

302. *See id.* at 1035 (Kennedy, J., concurring in judgment) (AThe Takings Clause does not require a static body of state property law . . . . Coastal property may present such unique concerns for a fragile land system that the State can go further in regulating its development and use than the common law of nuisance might otherwise permit.@); Gazza v. New York State Dep't of Envtl. Conservation, 605 N.Y.S.2d 642, 644-45 (Sup. Ct. 1993) (holding that no taking had occurred because wetland regulation was already factored into the investment-backed expectations of the property owner), *aff'd*, 634 N.Y.S.2d 740 (App. Div. 1995), *aff'd*, 679 N.E.2d 1035 (N.Y.), *cert. denied*, 118 S. Ct. 58 (1997).

303. *See, e.g.*, Just v. Marinette County, 201 N.W.2d 761, 768 (Wis. 1972) (declaring that an owner has Ano absolute . . . right to change the essential natural character of his land . . . . [and Government can limit] the use of private property to its natural uses@). This widely cited statement probably understates the bundle of rights included in land ownership: Housing, farming, and commercial land uses all destroy natural habitat and alter regional hydrology. *See, e.g.*, NATIONAL RESEARCH COUNCIL, RESTORATION OF AQUATIC ECOSYSTEMS:

become wet in the future. No court has yet contradicted the South Carolina Supreme Court's holding on remand in *Lucas* that nuisance law would not empower a state to impose setbacks that render a parcel economically unproductive. Rolling easements, by contrast, do not impair the property's use today,[304] and by the time they must be enforced, many decades may have passed. As a result, the rolling easement will have plenty of time to become part of the investment-backed expectations in areas that are developed in the future,[305] and perhaps even in areas that have already been developed.[306]

Deferred action will probably be a taking, except where the unique aspects of coastal property law provide government with a basis for taking over shorefront property as the shore erodes. Conceivably, a twenty-foot rise in sea level will eventually occur, causing future generations to consider homes on retreating shorelines to be as irresponsible as Justice Scalia considers Aa nuclear generating plant . . . that . . . sits astride an earthquake fault,@[307] in which case the common law might respond by allowing the police power to require a massive relocation of coastal homes without compensation. But prudence does not warrant policies that depend on such a speculative eventuality.

SCIENCE, TECHNOLOGY, AND PUBLIC POLICY 21 (1992) (describing a side effect of agricultural and urban uses of land as Athe degradation of aquatic ecosystems@).

304. *See supra* notes 288-291 and accompanying text; *cf.* Esposito v. South Carolina Coastal Council, 939 F.2d 165, 170 (4th Cir. 1991) (finding that a taking does not occur when a regulation eliminates the right to rebuild a house if a future storm should destroy it, because the existing use continues and the regulation's impact on the land's use is speculative).

305. In this case, the land will already be subject to a rolling easement before the land is subdivided, developed, and sold.

306. Lower courts generally assume that the expectation of just compensation for a prior regulatory taking is extinguished upon transfer. *See Gazza*, 605 N.Y.S.2d at 644-45 (holding that just compensation is not required for a denial of a wetland permit for a buyer who should have known that the permit would be denied). In areas where rolling easements are likely to be politically feasible, most houses will not have to be moved until several decades after the rolling easements are enacted. *See supra* note 158 and accompanying text. Because most houses change hands at least once in the course of several decades, most of the property that has to be vacated will be owned by people who bought their homes after the regulations were enacted, and thus will have no takings claim. Nevertheless, exempting current owners for several decades may be desirable, both to prevent takings claims and to protect preexisting investments in the minority of properties where bulkheads will be needed soon. With or without such grandfather clauses, the apparent nontransferability of the takings claim (or exemption) would tend to discourage transfers, because the ability to sue for a taking (or maintain a property free of the rolling easement) vanishes upon transfer, thereby effectively creating a transfer tax equal to the present value of an exemption.

307. *Lucas*, 505 U.S. at 1029.

*d. Background Principles of Property Law Unique to the Coast.*CA body of law has gradually developed to address the unique problems and opportunities found along the coast. According to the law of accretion and reliction (hereinafter the Alaw of erosion@), ownership migrates inland when shores erode.[308] Moreover, the public trust doctrine requires the state to hold the tidelands in trust for the people,[309] and the Commerce Clause of the United States Constitution[310] transfers a concurrent interest known as the federal Anavigation servitude.@[311] Federal statutes authorize the Corps of Engineers to regulate and deny permits to fill navigable waterways, including wetlands.[312] Finally, statutes and the police power enable states to limit threats to health or safety due to construction in floodplains[313] or septic tank discharges[314] in areas with high water tables.

All of these doctrines diminish the rights of coastal lowland owners, compared with the rights of noncoastal dryland owners. While some of these doctrines may have imposed takings when first implemented,[315] the

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308. *See infra* note 338 and accompanying text (discussing the history of the law of erosion).

309. *See infra* notes 440-444 and accompanying text (discussing the state's responsibility toward the tidelands).

310. U.S. CONST. art. I, ' 8, cl. 3.

311. *See* Gibson v. United States, 166 U.S. 269, 276 (1897) (holding that riparian property is subject to a dominant federal servitude); Zabel v. Tabb, 430 F.2d 199, 215 (5th Cir. 1970) (holding that the navigation servitude includes the power to deny a permit to fill the marsh below mean high water without compensating landowners); Coastal Petroleum Co. v. United States, 524 F.2d 1206, 1211 (Ct. Cl. 1975) (holding that the navigation servitude includes a power to mine limestone and build levees on land below mean high water without compensating landowners).

312. *See* The Clean Water Act of 1977, ' 404, 33 U.S.C. ' 1344 (1994) (regulating the manner in which dredge or fill material can be disposed of in navigable waterways); *accord* The Rivers and Harbors Act of 1899, ' 10, 33 U.S.C. '' 403, 409 (1994) (declaring it unlawful to fill navigable waterways without the permission of the Corps of Engineers).

313. *Compare* Krahl v. Nine Mile Creek Watershed Dist., 283 N.W.2d 538, 542-43 (Minn. 1979) (finding no taking when a regulation restricted filling land in a floodplain, because the fill narrowed the remaining floodway and would thereby increase flooding elsewhere) *with* Dooley v. Town Plan & Zoning Comm'n, 197 A.2d 770, 773-74 (Conn. 1964) (finding a taking when floodplain regulation prevented residential development and reduced property values by 75%) *and* Morris County Land Improvement Co. v. Township of Parsippany-Troy Hills, 193 A.2d 232, 239-41 (N.J. 1963) (finding a taking when regulation prevented development in order to preserve a natural floodwater detention basin).

314. *See, e.g.*, Lenawee County Bd. of Health v. Messerly, 331 N.W.2d 203, 205-07 (Mich. 1982) (denying a claim for rescission of a contract when, due to an irreparably defective septic tank, rental property was effectively rendered worthless by the Board of Health, which condemned the property and obtained a permanent injunction proscribing human habitation).

315. *Compare supra* note 264 (discussing how a new wetland regulation can be a taking) *with infra* note 316 and accompanying text (discussing how wetland regulation is not a taking

older doctrines have become background principles of coastal property law, and the newer statutes are now part of the investment-backed expectations of those who purchase coastal land.[316] Under at least some conditions, any of these principles might allow a state to enjoin activities that threaten tidelands.[317]

3. When Is a Tideland-Protection Policy a Taking?—The following discussion briefly applies the doctrines introduced earlier in this Part to the three basic policies for protecting tidelands, maintaining the assumption that property owners have a right to hold back the sea.

a. Rolling Easements.—A statute or regulation that declares the existence of rolling easements in undeveloped areas[318] is unlikely to be a taking, even in a state that recognizes a right to hold back the sea.[319] In general, rolling easements would not deny all productive use. Although productive use would eventually end if and when the sea level rises to a particular elevation, the regulation itself does not prevent productive use when instituted.[320] Moreover, because the contingency would generally be decades—perhaps centuries—away, the impact on property values would be very small.[321] If included as a condition for a subdivision or building permit, rolling easements

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when such regulation is already incorporated into investment-backed expectations). *Compare Gibson*, 166 U.S. at 271-72, 276 (holding that the congressional power to regulate navigable waterways under the Commerce Clause implies a navigation servitude, so that the government's interference with private riparian rights along inland navigable waterways does not require compensation) *with* Kaiser Aetna v. United States, 444 U.S. 164, 180 (1979) (holding that the same congressional power does *not* exempt the government from having to compensate riparian owners along waterways that were not navigable until private efforts connected them to the sea).

316. *See, e.g.*, Gazza v. New York State Dep't of Envtl. Conservation, 605 N.Y.S.2d 642, 644 (Sup. Ct. 1993) (holding that a property owner who bought wetlands at a discount because of known restrictions on development did not suffer a taking when a building permit was denied), *aff'd*, 634 N.Y.S.2d 740 (App. Div. 1995), *aff'd*, 679 N.E.2d 1035 (N.Y.), *cert. denied*, 118 S. Ct. 58 (1997).

317. See *infra* Part IV for a discussion of the oldest of these principles, the law of erosion and the public trust doctrine.

318. *See supra* Part II.B.2 (discussing rolling easements as a means of prohibiting bulkheads or any other structures that interfere with naturally migrating shores).

319. *See infra* Part IV.C.2 (explaining that, in undeveloped areas, rolling easements allow the state to take over lands to which the state is already entitled under the law of erosion, so that no taking results); *infra* Part VI.A.3 (same).

320. *See supra* notes 143-149 and accompanying text (discussing how rolling easements are consistent with private land use until the rising tide renders the land public).

321. *See infra* Part V (noting that the required compensation is minimal even if a rolling easement is a taking).

should pass the *Nollan-Dolan* test for the same reason that a one-step easement passes this test.[322]

The most likely situation in which a court would find a taking would be when someone buys shorefront property *before* a regulation to protect tidelands is enacted and then is forced to abandon that property. The more common scenario would involve people who purchase property *after* the regulation is issued. These people would find it almost impossible to successfully challenge the regulation as a taking, because the regulation will have been factored into their investment-backed expectations.

The owners of property that is not directly along the shore today would be even less likely to have a valid takings claim. Because the rolling easement would enable these properties to become shorefront for a time before eventually having to become abandoned, the policy might actually increase property values in many cases.[323] This increase would preclude a taking even if the property had not been transferred.[324]

b. Deferring Action. If states avoid addressing the problem of rising sea level, and then prohibit bulkheads at some point in the future, takings claims may succeed more often. If a house could be economically relocated, but there was no room on the existing lot, then denying a bulkhead permit would often deprive the owner of the use of the land. If the house could not be salvaged, then the denial would deprive the owner of the use of the house even if there was room on the lot to build another home. If the home could be moved back and still remain within the same lot, then there would not be an immediate taking, because the property would still be usable. Nevertheless, the continued erosion of the shore would

322. For a discussion of the *Dolan* test, see *supra* notes 237-247 and accompanying text. Just as a one-step easement would pass this test because it only protects public access, *see supra* note 154 and accompanying text, a rolling easement should pass the *Dolan* test because a permit condition that requires a rolling easement simply enables the inland migration of wetlands that would occur if the permit were not issued, *see supra* Part II.B.

323. Increases in value would be most common for the second row of houses along the shore, where the prospect of a waterfront view relatively soon might increase the property value by more than the reduction resulting from the rolling easement's requirement that the property must be eventually abandoned. *See supra* note 186.

324. *See, e.g.*, C.D. Sumner, Annotation, *Eminent Domain: Deduction of Benefits in Determining Compensation or Damages in Proceedings Involving Opening, Widening, or Otherwise Altering Highway*, 13 A.L.R.3D 1149, 1153 (1967) (explaining the general rule that when only part of a property is taken by eminent domain, any benefit to the remaining property can be offset against the required compensation).

eventually make the property unusable, and therefore, the ability to relocate the house might merely delay the finding of a taking.[325]

c. Preventing Development.—Most policies that prohibit development in an area likely to be inundated by a rising sea would involve at least some takings, because thousands of square miles of land could be inundated.[326] Consider, for example, a new setback that prohibited development below the five-foot contour. Someone who had just bought a small lot that was useful only as a building site, but was entirely below that elevation, would be deprived of beneficial use in the same way that David Lucas was deprived.[327] Someone else with a lot that was partly above the contour could still build a home; it would just have to be on the high ground. In agricultural areas, where lots have not yet been subdivided, developers who bought farms entirely below the five-foot contour and paid a substantial premium for the land might have a takings claim because they assumed that the property could be subdivided.[328] However, those who bought parcels that were partly above the five-foot contour would probably not have a viable claim as long as they could make an economically viable use of the parcel as a whole. As long as farming remained viable, the farmers who bought the land based on its agricultural value would not have a claim.[329]

Setbacks do not involve dedicating land to the state. Therefore, they do not present a *Nollan-Dolan* issue.[330] This issue would arise,

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325. Deferring action in this case would require an analysis similar to declaring today that rolling easements are in effect in areas that are already developed. The property is not rendered immediately useless, but owners are told that the lifetime of their property has been shortened. The main difference between rolling easements and the choice to defer action is that, in the latter case, when owners are finally told that they cannot hold back the sea, they must immediately spend money moving the house away from the shore.

326. *See supra* Part II.A.3-4.

327. *See* Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1009, 1011-13 (1992) (stating that a setback regulation had deprived Lucas of all beneficial use of his property); *see also supra* Part III.A (discussing *Lucas*).

328. *See supra* note 260 and accompanying text (noting the relevance of investment-backed expectations in a takings analysis).

329. *See supra* notes 260-262 (discussing the rule that there cannot be a regulatory taking unless investment-backed expectations are frustrated). Farmers generally invest in farmland with the expectation of farming; hence, limiting the land use does not generally frustrate their investment-backed expectations. However, equity, economic efficiency, political feasibility, and the difficulty of deciding how much land to protect, may be more important reasons for avoiding an exclusive reliance on setbacks and other strategies that prevent development. *See supra* Part II.C.

330. *See supra* Part III.B.2 (explaining the *Nollan-Dolan* doctrine in the context of policies to protect access along the shore when bulkhead permits are issued).

however, if a permit condition required a developer to *dedicate*[331] part of the parcel's lowlands[332] to ensure that wetlands were able to migrate inland. A takings challenge to such a requirement would be more likely to succeed than if the permit simply prohibited development in those lowlands.[333] Nevertheless, it could probably pass the *Nollan-Dolan* test with the proper showing that the condition is designed to address the effect of the permit itself.[334] Perhaps the key showing would be that the dedication is genuinely designed to offset eventual wetland loss rather than to serve an immediate purpose such as a park or nature reserve.[335] Dedicating land within five feet of mean high water would probably pass such a test, but dedicating a parcel that was mostly more than twenty feet above sea level would probably not.[336] Although a rational policy maker might prepare for

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331. *See supra* notes 251-253 and accompanying text.

332. This Article uses Alowlands@ to refer to lands that are dry today but are low enough to be tidally flooded if sea level rises significantly.

333. *Compare* Part III.C.1 (explaining that there is generally no taking when only a fraction of a parcel is placed off-limits to development) *with* Part III.B.1 (discussing cases where there was a taking when permit conditions required dedication of part of a parcel).

334. *See supra* note 247 and accompanying text. At first glance, requiring an immediate dedication of land might appear to have some similarity to the dedication of the floodway that the Court rejected in *Dolan v. City of Tigard*, 512 U.S. 374, 394-95 (1994). Just as the dedication of a floodway was unnecessary when a nondevelopment restriction would suffice, *see id.* at 393, so one might think that dedicating lowland for wetland migration is unnecessary. There is, however, a difference. The City of Tigard's proposed dedication would have increased its total land holdings. *See id.* at 380. By contrast, setting aside part of a parcel for wetland migration merely diminishes the extent to which the development decreases the intertidal (and publicly owned) wetlands in the long run. Thus, requiring a dedication of coastal land for wetland migration is more analogous to the *Dolan* bike path, which was intended to counteract the effect of the property owner's development on the publicly owned streets. *See id.* at 395 (ADedications for streets, sidewalks, and other public ways are generally reasonable exactions to avoid excessive congestion from a proposed property use.@). However, unlike the City of Tigard's convoluted and unsuccessful attempt to show that the bike path mitigated the transportation problems caused by the store at issue, *see id.* at 381, the showing necessary to justify wetland dedication would be straightforward, *see infra* note 335 and accompanying text.

335. *Compare Dolan*, 512 U.S. at 395-96 (holding that a taking could be avoided by showing that the required dedication would actually avoid the problem associated with issuing the construction permit) *with* Nollan v. California Coastal Comm'n, 483 U.S. 825, 841-42 (1987) (holding that private property had been taken after having noted that the State had an ongoing program of purchasing the same type of beach access that was being required as a permit condition, but that dedication would not avoid the problem associated with issuing the construction permit). Thus, a permit condition with respect to wetlands can be justified, but only by an actual intent to offset the wetland loss created by the proposed development.

336. The Environmental Protection Agency estimates that along much of the United States coast, a four-meter rise in sea level has a 1% chance of occurring by the year 2200. EPA 1995, *supra* note 2, at iii, 145. Even a disintegration of the West Antarctic Ice Sheet would only raise sea level about 20 feet. *Id.* at 89 (citing H.W. Menard & Stuart M. Smith, *Hypsometry of Ocean Basin Provinces*, 71 J. GEOPHYSICAL RES. 4305 (1966)). Furthermore, such an occurrence is generally thought to be unlikely over the next several centuries. *See id.* at 85, 113-14

a very unlikely event occurring over a very long time period, courts are skeptical about whether such foresight is really the rationale when more immediate explanations are apparent.[337]

IV. DO PROPERTY OWNERS HAVE A COMMON LAW RIGHT TO ELIMINATE WETLANDS AND BEACHES?

For over one thousand years riparian property lines have retreated whenever shores have eroded.[338] Consequently, in undeveloped areas, the Alaw of erosion@ always recognized a rolling easement. But suppose a bulkhead prevents the shore from retreating: Should the boundary move inland anyway? If not, is the bulkhead a nuisance?

To analyze this question, consider a situation in which the tidelands are owned by a private party. If the owner of the adjacent dry land builds a bulkhead, and thereby prevents the property line from migrating inland, the bulkhead would reallocate land ownership from the tideland owner to the dryland owner. The tideland owner could argue that because the dryland owner took away her land, she should be compensated. However, if a house had been built, the dryland owner could counter that the bulkhead benefitted society in that the private house is worth more than a wetland or a beach. A common law court

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(discussing the impact of the Antarctic ice sheet on sea level); IPCC 1995, *supra* note 2, at 364, 389 (noting the impossibility of estimating the likelihood of a collapse of the West Antarctic Ice Sheet over the next 100-1000 years, but concluding that such an occurrence by 2100 is very unlikely).

337. *See, e.g.*, City of Cleburne v. Cleburne Living Ctr., 473 U.S. 432, 449-50 (1985) (finding no rational basis for denying a permit to build a home for the mentally retarded in a 500-year floodplain when plaintiff alleged that the denial was motivated by discrimination against the mentally retarded).

338. *See, e.g.*, County of St. Clair v. Lovingston, 90 U.S. (23 Wall.) 46, 66-69 (1874) (quoting the Institutes of Justinian, Code Napoleon, and Blackstone for the universal rule that a boundary shifts with the shore); Ford v. Turner, 142 So. 2d 335, 340 (Fla. Dist. Ct. App. 1962) (AThe boundary lines of land . . . restrict[] as that margin gradually changes or shifts by reason of accretion or erosion.@); Department of Natural Resources v. Mayor of Ocean City, 332 A.2d 630, 638 (Md. 1975) (ALand inundated by mean high water reverts to State ownership . . . . when, as a result of gradual erosion, fast land becomes submerged.@); Cinque Bambini Partnership v. State, 491 So. 2d 508, 519-20 (Miss. 1986) (en banc) (stating that where the forces of nature raise sea level, the public lands expand inland without compensation), *aff'd sub nom.* Phillips Petroleum Co. v. Mississippi, 484 U.S. 469 (1988).

The *Lovingston* Court noted: A`The question is well-settled at common law . . . . Every proprietor whose land is thus bounded is subject to loss by the same means which may add to his territory, and as he is without remedy for his loss in this way he cannot be held accountable for his gain.'@ *Lovingston*, 90 U.S. (23 Wall.) at 68 (quoting Mayor of New Orleans v. United States, 35 U.S. (10 Pet.) 662, 717 (1836)); *accord* Shively v. Bowlby, 152 U.S. 1, 35 (1894) (AThe rule, everywhere admitted . . . is equally applicable to lands bounding on tide waters or on fresh waters . . . .@).

deciding whether the law of erosion should only apply to undeveloped areas would have to weigh the value of protecting tidelands against the value of encouraging development.[339]

When tidelands are owned by the public, however, the common law replaces this balancing with a per se rule known as the Apublic trust doctrine@: The state retains ownership of the tidelands unless it decides otherwise.[340] This Adoctrine@ is really two doctrines: (1) the Aproperty doctrine,@ which is a universally accepted set of principles regarding the ownership of submerged lands at the time of statehood and subsequent changes in ownership, and (2) an Aexpansive doctrine,@ which is a controversial theory of substantive due process that invalidates even legislative grants of submerged lands.[341] Subpart A below describes the origins of the public trust doctrine, and subpart B explains the relationship between the law of erosion and the property portion of the public trust doctrine. Subpart C examines the implications of these doctrines for the three tideland protection policies. This Article focuses on the Aproperty doctrine@ because its tideland-protection features apply to every coastal state. Nevertheless, subpart D examines the takings implications of the more expansive doctrine. Although the focus here is state law, most of the reasoning applies equally to the federal government's navigation servitude.

A. Evolution of the Public Trust Doctrine[342]

In 1820, Robert Arnold, a waterfront property owner found Benajah Mundy collecting oysters from the mudflats on his property in Perth Amboy, New Jersey.[343] Showing surveys and titles to those lands dating back to a grant from Charles II to the Duke of York, the property owner sued in trespass.[344] The shellfish collector defended on the grounds that

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339. *See infra* Part IV.C.1.b (applying the common law of nuisance to bulkhead construction).

340. *See infra* Part IV.B.1 (explaining that tidelands are publicly owned under the common law); *infra* Part IV.D (explaining that in some states the public trust doctrine invalidates legislative grants of tidelands, and in other states the doctrine is a rule of construction with a presumption that the legislature has not permanently placed tidelands into private hands unless the statute indicates an explicit intention to do so).

341. *See generally* Richard J. Lazarus, *Changing Conceptions of Property and Sovereignty in Natural Resources: Questioning the Public Trust Doctrine*, 71 IOWA L. REV. 631 (1986) (discussing the economic and environmental pitfalls from relying on the expansive doctrine). Like most critics of the public trust doctrine, Lazarus accepts the validity of the property doctrine.

342. Although the focus in this and the following three subparts is on state law, most of the reasoning applies equally to the federal government's navigation servitude. *Cf. id.* at 636-37 (discussing the federal navigation servitude as an early application of the public trust doctrine in the United States).

343. Arnold v. Mundy, 6 N.J.L. 1, 1-2 (Sup. Ct. 1821).

344. *Id.* at 2-3.

the mudflats were incapable of ownership.[345] The New Jersey Supreme Court reviewed the civil law, the Magna Carta, and subsequent English cases and concluded that before the American revolution, the King had no authority to grant ownership of tidelands to private individuals:

> [T]he ports, the bays, the coasts of the sea, including both the water and the land under the water, for purpose of passing and repassing, navigation, fishing, fowling, sustenance, and all the other uses of the water and its products (a few things excepted) are common to all the citizens, and . . . each has a right to use them according to his necessities . . . .[346]

In so holding, the New Jersey court recognized a doctrine that since at least sixth century Rome had given the public the right to enter any beach and fish, construct cottages, land boats, and off-load cargo.[347] In the following decades, the United States Supreme Court stated that all thirteen original states followed the public trust doctrine[348] and that new states were also granted submerged lands upon statehood.[349]

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345. *Id.* at 2-4.

346. *Id.* at 76-77.

347. The Institutes of Justinian state:

> All persons therefore are as much at liberty to bring their vessels to the bank, to fasten ropes to the trees growing there, and to place any part of their cargo there, as to navigate the river itself. But the banks of a river are the property of those whose land they adjoin; and consequently the trees growing on . . . them are also the property of the same persons. . . .
>
> Any person is at liberty to place on [the shore] a cottage, to which he may retreat, or to dry his nets there, and haul them from the sea.

J. INST. 2.1.4, 2.1.5.

348. *See* Martin v. Lessee of Waddell, 41 U.S. (16 Pet.) 366, 410 (1842) (AFor when the revolution took place, the people of each state became themselves sovereign; and in that character hold the absolute right to all their navigable waters, and the soils under them, for their own common use . . . .@). Chief Justice Taney pointed out that submerged lands had originally been Aheld by the king . . . as the representative of the nation, and in trust for them.@ *Id.* at 409. Thus,

> A[T]he dominion and propriety in the navigable waters, and in the soils under them, passed, as a part of the prerogative rights annexed to the political powers conferred on the Duke;@ and Ain his hands they were intended to be a trust for the common use of the new community . . . a *public trust* for the benefit of the whole community, to be freely used by all for navigation and fishery, as well for shell fish as floating fish,@ C*and not as* Aprivate property, to be parcelled out and sold . . . .@

Shively v. Bowlby, 152 U.S. 1, 16 (1894) (emphasis added) (quoting *Martin*, 41 U.S. (16 Pet.) at 411-13).

349. Pollard v. Hagan, 44 U.S. (3 How.) 212, 229-30 (1845). A century later, the Supreme Court held that the federal government had retained tidelands along the ocean coasts of all new states. *See* United States v. California, 332 U.S. 19, 38-41 (1947). Congress overruled this decision with the Submerged Lands Act of 1953, 43 U.S.C. " 1301-1356 (1994 & Supp. I 1995), which grants the states the ocean floor out to the three-mile limit, *see* 43 U.S.C. ' 1312 (1994).

B. Interrelationships Between the Law of Erosion and the Public Trust Doctrine

1. The Public Trust Doctrine of Property Law. According to the public trust doctrine, navigable waters and the underlying lands were publicly owned at the time of statehood, and grants of riparian land do not reduce the public's right to use submerged lands unless the state's intent to do so is unambiguous.[350] Early courts justified this doctrine on the ground of the sanctity of preexisting arrangements.[351] Commentators have emphasized that from an economic standpoint, navigable waters and roadways are logically public goods: Most land is privatized because the administrative costs of having private property (e.g., title keeping and rent collection) are small compared with the benefits (e.g., privacy, more efficient use, and avoiding a tragedy of the commons).[352] Along beaches, waterways, and roads, by contrast, the likelihood of a tragedy of the commons and a need for privacy is much less.[353] Up to a point, there may even be safety benefits from additional users.[354]

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350. *See Martin*, 41 U.S. (16 Pet.) at 410; *see also* David C. Slade et al., *The Conveyance of Public Trust Land and the Nature of the Remaining Servitude*, *in* PUTTING THE PUBLIC TRUST DOCTRINE TO WORK, *supra* note 33, at 175, 180-81 nn.5-10 (discussing judicial limitations on the ability of states to convey public trust lands to private parties); *cf.* United States v. Denver & Rio Grande Ry. Co., 150 U.S. 1, 14 (1893) (AIt is . . . the well-settled rule of this court that public grants are construed strictly against the grantees, but they are not to be so construed as to defeat the intent of the legislature . . . .@).

351. *See, e.g.*, *Martin*, 41 U.S. (16 Pet.) at 410 (AThe question must be regarded as settled in England, against the right of the king, since Magna Charta, to make such a grant [of public trust lands].@); *Arnold*, 6 N.J.L. at 73-78 (stating that the existence of the public trust doctrine since the Magna Carta implies that the king had no power to sell public trust lands).

352. *See, e.g.*, Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711, 715-23 (1986) (suggesting why certain types of property are vested in the public Awhere many persons desire access to or control over a given property, but they are too numerous and their individual stakes too small to express their preferences in market transactions@).

353. *See id.* at 722-30 (discussing the traditional doctrines of prescription, public trust, and custom as justifications for the public ownership of roads and waterways). Given this common law justification for the public trust doctrine, a possible justification for privatizing estuarine shores in some areas might be that, compared with the ocean coast, the estuarine tidelands are no longer important for Apassing and repassing, navigation, fishing, fowling, sustenance, and all the other uses of the water and its products.@ *Arnold*, 6 N.J.L. at 77. Newly recognized uses of the tidelands, such as recreation and environmental habitat may provide countervailing reasons to keep these tidelands in public hands. *See supra* Part II.A (explaining the uses of estuarine shores).

354. In cases where additional people did pose a crowding problem, such as port construction, even the expansive public trust doctrine allowed a certain amount of privatization. *See* Illinois Cent. R.R. v. Illinois, 146 U.S. 387, 405-11 (1892) (citing an 1869 legislative grant of a portion of the Lake Michigan shore to a railroad company). By the same token, many communities charge beach user fees, but only for the relatively crowded ocean beaches and only during peak periods of use. *See, e.g.*, Matthews v. Bay Head Improvement

FIGURE 10
THE NEED FOR ROLLING EASEMENTS ALONG THE TEXAS COAST

Failure to enforce the rolling easement policy impairs transportation along the shore, a traditional use of the beach in Texas. In the area depicted, authorities have been forced to restrict traffic to one-way only. Photo taken near Access Road 3 along the northern portion of San Padre Island, Texas, March 29, 1998.

Ass'n, 471 A.2d 355, 358-60 (N.J. 1984) (discussing a municipal association's use of fees and restrictions to provide access to the beach for its residents in light of overcrowding).

Cases invoking the public trust doctrine usually refer to Anavigable waters,@ but Anavigable@ includes areas subject to the ebb and flow of the tide whether or not they are truly navigable.[355] Tidelands are usually included because of the needs associated with hunting, fishing,[356] transportation along the shore (see Figure 10),[357] and landing boats for rest or repairs. Most states own the land up to the high water mark,[358] which is usually construed as mean high water; therefore, the public trust includes mudflats, low marsh, and wet beachCbut not high marsh or dry beach.[359] Hawaii, New York, Oregon, Washington, and Louisiana include the dry beach as well.[360] In Maine, Massachusetts, Pennsylvania, Delaware, and Virginia, publicly owned land extends only up to the low water mark, but the public has access to the tidelands for fishing, hunting, and navigation (see Figure 11).[361]

In several states the public now has the right to access along all or part of the privately owned dry beach. The New Jersey Supreme Court has expanded the public trust doctrine to include access along the dry beach for recreation as well as the traditional public trust purposes.[362]

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355. *See* Phillips Petroleum Co. v. Mississippi, 484 U.S. 469, 476 (1988) (A[T]he States have interests in lands beneath tidal waters which have nothing to do with navigation. . . . It would be odd to . . . suggest that the sole measure of the expanse of such [public trust tide]lands is the navigability of the waters over them.@ (citations and footnote omitted)).

356. *See supra* notes 347-348 and accompanying text.

357. *See, e.g.*, Texas Open Beaches Act, 31 TEX. ADMIN. CODE ' 15.7(h) (West 1997) (AA local government shall not . . . close a public beach to pedestrian or vehicular traffic without prior approval of the General Land Office.@).

358. *See, e.g.*, Board of Pub. Works v. Larmar Corp., 277 A.2d. 427, 437 (Md. 1971) (AIt is well established that the title of land below the highwater mark, as well as rivers or streams within the ebb and flow of the tide, belong to the public.@); Slade et al., *supra* note 33, at 44 n.58 (listing cases from all 23 tidewater state courts defining the landward boundary of the public trust).

359. *See* fig.2.

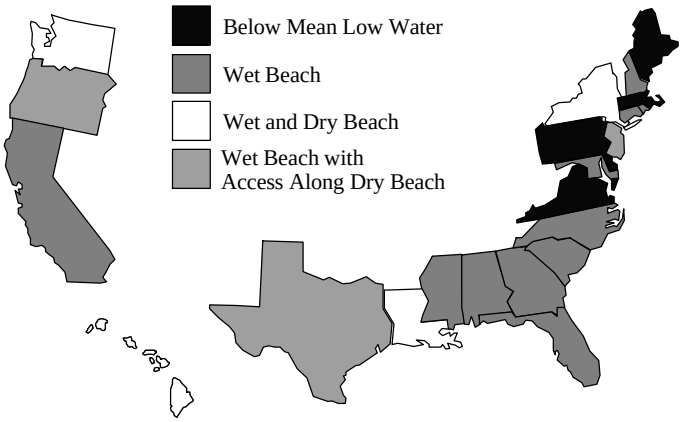
360. *See* LA. CIV. CODE ANN. art. 451 (West 1980) (ASeashore is the space of land over which the waters of the sea spread in the highest tide during the winter season.@); WASH. REV. CODE ANN. ' 90.58.030(2)(b) (West Supp. 1998) (defining ordinary high water mark with respect to the vegetation line); *In re* Ashford, 440 P.2d 76, 77 (Haw. 1968) (defining the seaward boundary mark to be the vegetation line); Dolphin Lane Assocs. v. Town of Southampton, 333 N.E.2d 358, 360 (N.Y. 1975) (locating the high water line by reference to the line of vegetation); State *ex rel.* Thornton v. Hay, 462 P.2d 671, 674 (Or. 1969) (construing high water mark as equal to the vegetation line). The vegetation line is well inland and above the mean high water. *See* fig.2.

361. Slade et al., *supra* note 33, at 69 n.22, 70 n.23.

362. *See* Matthews v. Bay Head Improvement Ass'n, 471 A.2d 355, 358 (N.J. 1984) (expanding the public trust inland along the ocean by recognizing a right to sunbathe and otherwise enjoy the dry beach between mean high water and the vegetation line). The court declared that in New Jersey the public trust doctrine also includes a right of access *to* the shore: ATo say that the public trust doctrine entitles the public to swim in the ocean and to use the foreshore in connection therewith without assuring the public of a feasible access route would seriously impinge on, if not effectively eliminate, the rights of the public trust doctrine.@ *Id.* at 364.

FIGURE 11
THE PUBLIC'S COMMON LAW INTEREST
IN THE SHORE OF THE VARIOUS COASTAL STATES

The Public Owns:



Part of Florida's beaches are also open to the public under the doctrine of custom. In addition to the common law interest, the public has obtained the right to access along many shores through voluntary assignment of easements by riparian owners, as well as public purchases of shorefront lands and easements. *See supra* notes 362-365 and accompanying text.

The public has access along the dry beach in Oregon, Texas, and parts of Florida based on the doctrine of customary use.[363] A number of states have gradually obtained access in particular areas through purchases or voluntary assignment by the property owners in return for proposed beach nourishment.[364] However, the Supreme Judicial Court of Maine invalidated as a taking a legislative effort to expand the existing right of access along the wet beach to include recreational activities.[365]

2. The Law of Erosion. The property lines between private and public land move inland with eroding shores and seaward with advancing shores,[366] assuming that the shoreline change is natural. When riparian landowners cause the shorelines to advance seaward, virtually all courts have held that, under the common law, the riparian owner does not get title to the new lands.[367] A majority of

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363. *See Hay*, 462 P.2d at 673, 676-77 (holding that the public has access to the privately owned dry beach based on the doctrine of custom); Matcha v. Mattox, 711 S.W.2d 95, 97 (Tex. App. 1986, writ ref'd n.r.e.) (affirming a trial court holding that the public has acquired access to the beach seaward of the natural vegetation line through prescription, dedication, and custom); *see also* City of Daytona Beach v. Tona-Rama Inc., 294 So. 2d 73, 78 (Fla. 1974) (holding that in the particular area under consideration, the public had an easement to the privately owned dry sand beach based on the doctrine of custom).

364. Beach nourishment projects sponsored by the Corps of Engineers often motivate the creation of public access along the shore. *See, e.g.*, *infra* note 373 (discussing the federal policy of providing beach nourishment only for beaches that are open to the public); *supra* note 151 (suggesting that communities in South Carolina may open their beaches to the public to obtain beach nourishment). For example, during the 1980s, the State of Maryland had to obtain access along the dry beach before the Corps of Engineers could undertake the beach nourishment project there. *See infra* note 373; *see also* Nollan v. California Coastal Comm'n, 483 U.S. 825, 841 (1987) (mentioning an ongoing program by the California Coastal Commission of acquiring dry beach access).

365. *See* Bell v. Town of Wells, 557 A.2d 168, 176-77 (Me. 1989) (holding a statute that Aimposed upon all intertidal land . . . an easement for use by the general public for `recreation' without limitation@ to violate the Takings Clauses of the Maine and United States Constitutions).

366. *See* MD. CODE ANN., ENVIR. ' 16-201(a) (1996) (AA person who is the owner of land bounding on navigable water is entitled to any natural accretion to the person's land . . . .@); Ford v. Turner, 142 So. 2d 335, 340 (Fla. Dist. Ct. App. 1962) (stating that the boundary lines of land located on the bed of a stream or other body of water extend or restrict as the water line shifts by reason of accretion or erosion and that Anewly formed land belongs to the owner of the land to which it is an accretion@); Carolina Beach Fishing Pier, Inc. v. Town of Carolina Beach, 177 S.E.2d 513, 517 (N.C. 1970) (holding that, because property boundary shifts with advancing and retreating shore, the town's construction of a sand berm at a location that was no longer above mean high water did not constitute a taking because the erosion had divested the landowner of title to the land); *see also supra* note 338.

367. *See, e.g.*, Patton v. City of Wilmington, 147 P. 141, 142 (Cal. 1915) (holding that artificial accretions accrue to the state). *But see* California *ex rel.* State Lands Comm'n v. United States, 457 U.S. 273, 285 (1982) (holding that, under federal common law, accretions along the ocean beach accrue to the upland owner, whether or not such accretions are artificial and whether or not the riparian owner is responsible for presence of the structure causing the

states award the riparian owner the artificially formed land if she is not responsible for the accretion (e.g., a federal navigation jetty causing the shore to advance seaward).[368] The minority rule, however, vests the state public trust with the new land.[369]

The majority rule has two practical advantages. Determining what portion of a shoreline change resulted from artificial causes, such as sedimentation from a jetty or a river diversion, is much more difficult than determining how much the shoreline changed when the owner filled some wetlands.[370] Moreover, the majority rule prevents the state from depriving shorefront owners of their riparian access by pumping sand onto the beach and creating new

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accretions). *See generally* Annotation, *Waters: Rights in Respect of Changes by Accretion or Reliction Due to Artificial Conditions*, 134 A.L.R. 467, 472 (1941) (AIn general, a riparian owner cannot claim title to land added by accretion or formed by reliction as a result of creating by himself an artificial condition causing the accretion or reliction.@). The Court in *State Lands Commission* applied federal common law because the federal government was the riparian owner. *State Lands Comm'n*, 457 U.S. at 283-84.

In Maryland, an 1862 statute repealed the common law rule and awarded property owners title to any land created by filling tidal waters. *See* 1862 Md. Laws ch. 129, ' 1 (AThe proprietor of land bounding on any of the navigable waters of this State, is hereby declared to be entitled to all accretions to said land by the recession of said water, whether heretofore or hereafter formed or made by natural causes or otherwise . . . .@); Board of Pub. Works v. Larmar Corp., 277 A.2d 427, 436 (Md. 1971) (concluding that under the 1862 statute, a riparian owner had the right to make artificial landfill in navigable waters in front of his shore). Although that right was curtailed in 1970, *see id.* at 442 & n.6 (noting that after July 1, 1970, a party desiring to alter its shoreline had to obtain a license pursuant to the Wetlands Act of 1970), property owners are still awarded title to land created by erosion control activities, as well as land created to offset shoreline erosion that has occurred since January 1, 1972, *see* MD. CODE ANN., ENVIR. ' 16-201 (1996).

368. *See, e.g.*, H.K. Porter Co. v. Board of Supervisors, 324 So. 2d 746, 750 (Miss. 1975) (holding that when accretion is caused by the Corps of Engineers or another stranger without the complicity of the upland owner, artificial accretion goes to the upland owner); *see also* Slade et al., *supra* note 33, at 105-08 (listing cases holding that artificial accretions caused by a third party accrue to the dryland owner in Alabama, Alaska, Illinois, Massachusetts, Mississippi, Nebraska, New Hampshire, New Jersey, New York, and Wisconsin); Annotation, *supra* note 367, at 468 (AGenerally, a riparian owner is not precluded from acquiring land by accretion or reliction, notwithstanding the fact that the accumulation is brought about partly by artificial obstructions erected by third persons, where the riparian owner had no part in erecting the artificial barrier.@); *infra* note 369.

369. *See* Slade et al., *supra* note 33, at 105-08 (listing cases holding that artificial accretions caused by a third party do not accrue to the dryland owner in California, Florida, Hawaii, and Texas).

370. The shoreline change caused by filling can be ascertained simply by comparing surveys from before and after the land was filled, and the change is often obvious to the naked eye because the fill is a different material than found naturally on the beach. By contrast, if a shore slowly accretes as a result of an artificial structure, the newly created land will be made from the same sediments that are already found on the shore. For example, if a structure catches whatever sand is washing along the beach, the material caught will, by definition, be the same as the material already found on the beach.

land.[371] That Aadvantage@ can also create a problem: Beach nourishment reduces the vulnerability of all oceanfront homes to erosion and storms.[372] These public projects may be delayed, however, if a few of the owners insist upon reaping the additional benefit of title to the newly created beach.[373]

When a shore retreats, the boundaries retreatCregardless of whether the erosion is natural or anthropogenic.[374] Were it otherwise, the public trust rights, such as lateral beach access, would be routinely eliminatedCeven on the ocean shore, where jetties and groins regularly cause pockets of erosion.

From the standpoint of traditional property law, the law of erosion is like the law of defeasible estates, in which title to land changes hands when a specific condition occurs.[375] Courts have long dealt with conditional grants in which a landowner conveys a piece of land but only

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371. *See, e.g.*, *Larmar Corp.*, 277 A.2d at 432 (AIf an intervening party were permitted to gain title to accretions . . . the riparian landowner would be deprived of his valuable water-access rights.@).

372. *See* NATIONAL RESEARCH COUNCIL, BEACH NOURISHMENT AND PROTECTION app. E at 257-58 (1995) (discussing beach nourishment costs and benefits).

373. The State of Maryland and the Corps of Engineers had to address this issue before undertaking a large beach nourishment project at Ocean City, Maryland. Personal Communication with John Van Fossen, *supra* note 24. The state law authorizing the beachfill project specified that any land created by the project would belong to the State. *See* MD. CODE ANN., NAT. RES. II ' 8-1103 (1990). Before the project was undertaken, the State also obtained public easements to what remained of the dry beach, which was then privately owned. Personal Communication with John Van Fossen, *supra* note 24. Property owners were willing to provide these easements, because without the beachfill project, they would have soon lost their dry beachCand perhaps their homesCto the sea. *Id.* These easements were required by the longstanding Corps policy of only providing government erosion control assistance for beaches that are open to the public. *See, e.g.*, U.S. ARMY CORPS OF ENG'RS, DIGEST OF WATER RESOURCES POLICIES AND AUTHORITIES 14-1 (1996) (explaining that Public Law No. 84-826 authorized federal erosion control assistance only for publicly owned shores, or for private shores if such protection would result in public benefits); *see also* Act of July 28, 1956, Pub. L. No. 84-826, 70 Stat. 702, 702 (codified as amended at 33 U.S.C. ' 426) (AShores other than public will be eligible for Federal assistance if there is benefit such as that arising from public use or from the protection of nearby public property . . . .@); Act of August 13, 1946, Pub. L. 79-727, ' 1, 60 Stat. 1056 (codified as amended at 33 U.S.C. ' 426) (declaring U.S. policy to protect shores that are owned by states, municipalities, or other political subdivisions).

374. *See, e.g.*, Pitman v. United States, 457 F.2d 975, 977 (Ct. Cl. 1972) (holding that a boundary migrated inland even though erosion was caused by a Corps of Engineers jetty); *see also supra* note 338 (suggesting that boundaries have retreated with an eroding shore since the Institutes of Justinian).

375. *See* CURTIS J. BERGER, LAND OWNERSHIP AND USE ' 3.4 (3d ed. 1983) (discussing defeasible estates).

for so long as it is used for a church,[376] a park,[377] a railroad,[378] or a school,[379] or until the occurrence of a specified event.[380] The law of erosion reaches the same result as would occur if the sovereign had conveyed coastal property only for so long as erosion processes do not submerge it, reserving for the public a reversionary interest that vests when the land is below mean high water.

C. Takings Implications of Tideland Policies

Could efforts to ensure that tidelands migrate landward as sea level rises be enforced at common law? The answer is yes, at least for rolling easements, and possibly for deferred action. With a rolling easement, the granting sovereign tells the riparian owner today that she will not be allowed to eliminate the public's reversionary interest by building a bulkhead.[381] With deferred action, the sovereign enforces the reversion eventually, but without having warned the riparian owner that it would do so.[382] In the context of nuisance law, people usually are not allowed to interfere with (let alone destroy) a neighbor's property without the owner's permission, and the public trust doctrine holds that the sovereignCwho owns the neighboring tidelandsCgenerally will deny the permission to destroy the tidelands.[383] These arguments are less likely to justify setbacks.

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376. *See, e.g.*, First Universalist Soc'y v. Boland, 29 N.E. 524, 524-25 (Mass. 1892) (discussing a deed that granted land to the plaintiff for so long as it was A`devoted to the uses, interests, and support of those doctrines of the Christian religion'@).

377. *See, e.g.*, People v. City of Long Beach, 19 Cal. Rptr. 585, 587 n.2, 594 (Dist. Ct. App. 1962) (discussing a deed that required land to be used Afor a park, playground, recreational center and/or beach used for recreational purposes, and for no other purposes whatsoever@).

378. *See, e.g.*, Preseault v. ICC, 494 U.S. 1, 9 (1990) (holding that where land had been granted for so long as it was used as a railroad, the federal government had authority to convert rails to trails, but that doing so might be a taking that required compensation).

379. *See, e.g.*, Hagaman v. Board of Educ., 285 A.2d 63, 65 (N.J. Super. Ct. App. Div. 1971) (discussing a deed that stated that it was the Aunderstanding@ of the parties that the land conveyed would be Aused for the erection and maintenance of a public school@).

380. *See, e.g.*, Rosecrans v. Pacific Elec. Ry., 134 P.2d 245, 246-48 (Cal. 1943) (in bank) (requiring a railroad to forfeit land for failure to comply with a grant condition requiring it to run 18 local passenger trains per day); Baker v. Weedon, 262 So. 2d 641, 642 (Miss. 1972) (discussing a will conveying a home to a widow as long as she lived, after which time the home would be transferred to the grandchildren from a previous marriage if the widow had no children at the time of her death).

381. *See supra* Part II.B.2 (explaining that rolling easements ensure that public tidelands will not be eliminated).

382. *See supra* Part II.B.3 (emphasizing that lack of notice is the primary way by which deferred action differs from rolling easement policies).

383. *See* David C. Slade et al., *State Powers, Duties, Limitations and Prohibitions Under the Public*

1. Deferring Action.—Must the public's right to the tidelands give way to a private owner's desire to maintain his premises? Simple symmetry, nuisance principles, and analogous cases concerning ocean coasts suggest that the public's rights are superior.

a. Is the Law of Erosion Symmetric?—The natural effect of erosion is to reduce the estate of the dryland owner. A bulkhead shifts the loss onto the tidelands owner. Given that the law of erosion does not allow a riparian owner to expand her holdings by bulkheading and filling seaward, allowing the same owner to retain the saved land by bulkheading and filling landward would be an asymmetry. Similarly, a landowner does not generally *lose* the right to exclude the public when she lowers dry land to become navigable water.[384] It would be asymmetric to allow the landowner to *gain* the right to exclude the public by elevating dry land so that it does not become navigable water.

The law of erosion is generally symmetric.[385] The general principles are that shoreline ownership advances and retreats with the gradual changes of the sea, and those boundaries are not altered by the private activities of a landowner that change the shoreline itself. Even if the equivalence between filling navigable waters and preventing their encroachment by elevating dry land has not been recognized by reported cases, common law courts have the ability to rectify inconsistencies in the law that are brought to their attention.[386]

Trust Doctrine, *in* PUTTING THE PUBLIC TRUST DOCTRINE TO WORK, *supra* note 33, at 213, 215 (noting that courts require the state, as public trustee, to prevent the destruction of land subject to the public trust).

384. *See* Kaiser Aetna v. United States, 444 U.S. 164, 172-73 (1979) (holding that requiring public access to newly navigable waters is a taking, because a federal navigation servitude does not apply to waters made navigable by private effort).

385. In Maryland, statutes modify the symmetry by entitling property owners to reclaim land lost to erosion since the early 1970s. *See* MD. CODE ANN., ENVIR. ' 16-201 (1996).

386. A federal court evaluating a takings claim would often tend to take the state law as it finds it even if there appear to be inconsistencies. *See* Rules of Decision Act, 28 U.S.C. ' 1652 (1994) (requiring federal courts to decide cases based on state law unless they are preempted by federal statutes, the U.S. Constitution, or treaty); Erie R.R. Co. v. Tompkins, 304 U.S. 64, 73-78 (1938) (construing Astate laws@ in the Rules of Decision Act as including state common law). A state court, by contrast, would have the ability to clarify the property law as part of a takings claim. *See, e.g.*, Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1031-32 (1992) (remanding a takings case to state court for determination of rights under state property law). In some states, a federal court could certify the question of state law for a decision by the state's highest court. *See, e.g.*, JACK H. FRIEDENTHAL ET AL., CIVIL PROCEDURE 221 (1985). To the extent that asymmetries and ambiguities in the law appear to leave room for concluding that a property owner can indirectly eliminate the tidelands even though she cannot do so directly, plaintiffs might be best advised to bring cases in federal courts. *See, e.g.*, *id.* at 219-20 (showing a lack of consensus among federal circuits on whether federal courts interpreting

b. Nuisance Principles.—Many commentators have suggested that nuisance law maximizes social wealth by minimizing social costs, including transaction costs.[387] In an undeveloped area—or even in a developed area as long as the house is set back from the shore—structures that change land ownership without creating new land produce no social benefit. If the law treats them as a nuisance, they will not be built; if they are not treated as a nuisance, the owner who benefits will want to build them in spite of the net cost to society. As a result, resources will be wasted on negotiations to prevent their construction. In this context, the rationale for denying riparian owners any land created by bulkhead and fill projects applies equally to bulkheads that stop erosion and those that fill navigable waters.[388]

When the shoreline approaches a home, this balance might change. If the cost of moving the house plus the value of the dry land is greater than the cost of the bulkhead plus the value of the lost tidelands, social welfare is maximized by building the bulkhead. In cases where moving a house costs at least as much as a bulkhead,[389] a common law court might find bulkheads not to be a nuisance, unless the tidelands are more valuable than the dry land.

In the case of publicly owned tidelands, however, this balancing has already taken place: The public trust doctrine's requirement that tidelands must not be privatized unless the sovereign indicates otherwise[390] is effectively an ancient determination that tidelands *are more*

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state law are bound by precedent no matter how antiquated it may be, or should consider possible future revisions of the state law even if doing so requires federal court A`to psychoanalyze state court judges'@ (quoting Polk County v. Lincoln Nat'l Life Ins. Co., 262 F.2d 486, 489 (5th Cir. 1959))).

387. For example, Guido Calabresi and A. Douglas Melamed showed that economic efficiency is promoted when the law treats an activity as a nuisance if and only if it can be avoided at a cost less than the total harm of the nuisance to society. *See* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1115-24 (1972); *accord* Epstein, *supra* note 265, at 1389 (AIt is preferable for 5 percent of the cases to involve the purchase of an easement to create a nuisance than for 95 percent to involve the purchase of a restrictive covenant to prevent one. Such an allocation properly reflects a world with positive transaction costs . . . .@).

388. *Cf.* Lummis v. Lilly, 429 N.E.2d 1146, 1149-50 (Mass. 1982) (stating that when an erosion control structure causes a neighbor's land to erode, a court deciding whether the structure is a nuisance should follow the reasonable use rule and weigh the various costs and benefits of the structure).

389. *See* POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE, *supra* note 17, at app. B 3-37, 3-75 (reporting that houses at Long Beach Island, New Jersey can be moved for $10,000 per house and that bulkheads cost at least $130 per foot).

390. *See* Slade et al., *supra* note 350, at 175-77 (noting that a state has the power to convey its *jus privatum* interest in public trust lands to private ownership through specific legislation). A possible counterargument to this reasoning is that nuisances are broad classes of activities. *See supra* note 387.

valuable to society as public lands. Because this doctrine preceded the original grants of land from the King of England,[391] it can also be viewed as an intention of the original grantor and grantee in titles to coastal property.

A bulkhead that protects one's own land by reducing the size of an adjacent lot is like a dam that diverts floodwater onto a neighbor's land. In most states, a landowner has no right to protect her land from floodwater with a structure that floods a neighbor instead;[392] thus, it follows that no one has an automatic right to build a bulkhead that causes the public's tidelands to disappear.[393]

*c. Ocean Coasts: Case Law.*CSome states have explicitly addressed the conflict between owners defending their homes from erosion and the public's right to use the beach. Although courts have rarely been asked to rule directly on the right to protect one's property,[394] they have come close in California and Texas. In *Whalers' Village Club v. California Coastal Commission*,[395] a California appellate court rejected the property owners' claim that riparian ownership includes a A`right' to construct a revetment or seawall to protect one's dwelling from destruction.@[396] Nevertheless, the actual holding was narrower,

391. *See* Matthews v. Bayhead Improvement Ass'n, 471 A.2d 355, 360 (N.J. 1984) (AThe genesis [of the public trust doctrine] is found in Roman jurisprudence . . . .@ (citing J. INST. 2.1.1)).

392. *See* 50 AM. JUR. 2D *Levees and Flood Control* ' 16, at 266 (1995) (A[A]lthough a riparian landowner may take measures to protect himself or herself from the harmful effects of floodwaters, he or she may not, by erecting a dam, dike, or levee, change or divert the natural flow of a watercourse without being chargeable in damages to persons and property injured thereby.@); *see also* Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1029 (1992) (A[T]he owner of a lakebed, for example, would not be entitled to compensation when he is denied the requisite permit to engage in a landfilling operation that would have the effect of flooding others' land.@); Biberman v. Funkhouser, 58 A.2d 668 (Md. 1948) (reaffirming that Maryland follows the civil law rule that no one can substantially change the flow of rainwater runoff so as to flood a neighbor). *But see* Martin J. McMahon, Annotation, *Liability for Diversion of Surface Water by Raising Surface Level of Land*, 88 A.L.R.4TH 891, 897-98 (1991) (noting that some jurisdictions follow the Acommon-enemy doctrine,@ under which every landowner Ahas an unqualified right to fend off surface waters as the landowner sees fit without being required to take into account the consequences to other landowners@).

393. To argue that the rising sea, not the bulkhead, causes the tidelands to vanish is merely semanticsClike blaming a flood on the rain rather than on the dam.

394. The political process generally protects people from losing their homes as long as they do not need a subsidyCand sometimes even when they do. When houses fall into the water along the ocean, it is usually because individualized erosion protection is not feasible.

395. 220 Cal. Rptr. 2 (Ct. App. 1985).

396. *Id.* at 8.

enabling the Coastal Commission to impose conditions on seawall permits, not to deny them entirely.[397]

The public trust rights are even more established in Texas. State courts have held that under both statutory and common law, property along the Gulf of Mexico is subject to a Arolling easement.@[398] People have been prevented from *repairing* storm-damaged houses and have been required to remove structures when erosion left a portion of the structure seaward of the vegetation line.[399]

d. Bay Coasts: Case Law. Even if state common law originally had a property right sufficient to prevent construction of bulkheads, one must consider whether that right has been given away. Along the

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397. This pre-*Lucas* case included some dicta suggesting that the State could prevent a seawall: A`one may not do with his property as he pleases; his use if subject to reasonable restraints to avoid societal detriment.'@ *Id.* (quoting People v. Byers, 153 Cal. Rptr. 249 (Ct. App. 1979)). However, *Lucas* has largely nullified this approach. *Lucas*, 505 U.S. at 1024-27 (rejecting the theory that regulations are not takings if they prevent social harm, in favor of a rule that when a regulation destroys a property's value, the state can avoid compensation only if the proscribed use was not already part of the bundle of rights associated with owning the property).

398. *See* Feinman v. State, 717 S.W.2d 106, 111 (Tex. App. 1986, writ ref'd n.r.e.) (recognizing the beach as a rolling easement because otherwise the area of public access would disappear as the shore erodes); Matcha v. Mattox, 711 S.W.2d 95, 100 (Tex. App. 1986, writ. ref'd n.r.e.) (A[B]ecause legal title shifts with the natural movements of the beach, this Court has concluded that the public easement also shifts with the natural movements of the beach.@ (citations omitted)). The reader may logically ask: Why are we discussing rolling easements in a subpart focused on deferred action? Recall from Part II.B that this Article uses the term Arolling easement@ to signify the entire collection of policies in which property owners are warned in advance of their inability to erect bulkheads, and that deferred action policies are essentially the same except for the lack of substantial advance notice. The Texas rolling easement cases involved situations more like the deferred action alternative: their reasoning was that riparian owners never had a right to stop the inland migration of tidelands, and the only notice the property owners had about the need to abandon shorefront structures was the fact that shores are eroding; i.e., the court did not indicate that the government had put property owners on general notice that the structures would have to be abandoned.

399. *See, e.g.*, Arrington v. Mattox, 767 S.W.2d 957, 958 (Tex. App. 1989, writ denied) (holding that the statute requiring removal of structures seaward of the vegetation line merely enforced a common law public right, and hence was not a legislative taking); *Matcha*, 711 S.W.2d at 99-101 (holding that as the vegetation line moves inland, the State can enjoin reconstruction of a storm-damaged house that is left seaward of the vegetation line). In these cases, a violent hurricane left private property seaward of the natural vegetation line, thereby triggering a transfer of that property. *Arrington*, 767 S.W.2d at 957; *Matcha*, 711 S.W.2d at 96. Consequently, the court did not address whether someone had the right to protect her property from impending erosion. Because a bulkhead or seawall would impair public access and eventually be seaward of the vegetation line, these cases imply that they could be ordered removed as well. Beach nourishment, by contrast, would not impair public access and could stop the vegetation line from retreating. *See* NATIONAL RESEARCH COUNCIL, *supra* note 372, at 1-2 (discussing beach nourishment as an engineering alternative for shore protection).

ocean coast, state regulations often discourage or prohibit seawalls.[400] Storms and the many people walking on the beach put oceanfront homeowners on notice that stopping erosion with seawalls may be technically and politically infeasible. Ocean coast property owners have little reason to assume that the state has given them a right to protect homes at the expense of the beach.[401]

The quiet bayfront shores, by contrast, provide little reason to expect an invasion by either the sea or people demanding access. Most state governments do not put property owners on notice either. Maryland, for example, recognizes a right to protect one's backyard from erosion by filling wetlands where necessary.[402] In other states, courts have held that the state can waive the public trust doctrine where people filled wetlands in the past.[403] North Carolina sometimes protects the public trust by requiring bulkheads to be placed a foot or two inland of mean high water,[404] but the State does not require the bulkheads to be removed if the shore retreats.[405] The most important exception may be Rhode Island, whose coastal zone management plan specifically prohibits hard structures inland of the marsh in some areas so that wetlands can migrate inland as sea level rises.[406] This policy, however, does not explicitly require homes to be relocated.

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400. *See, e.g.*, S.C. CODE ANN. ' 48-39-290(B)(2)(a)-(b) (West Supp. 1997) (prohibiting any new erosion control structures seaward of the setback line, as well as the repair of any such structures suffering more than a certain percentage of damage from a storm).

401. Similarly, if protection is allowed, property owners have no basis to expect public access to also be eliminated. During several trips to Great Britain, the author has observed that much of the English coast has been bulkheaded, but there is invariably a walkway just above the wall. In Maryland, along Atlantic Avenue in North Beach, the public has access along a narrow walkway between several homes and Chesapeake Bay. *See* fig.7.

402. *See* MD. CODE ANN., ENVIR. ' 16-201 (1996) (granting the right Ato reclaim fast land lost by erosion@).

403. City of Berkeley v. Superior Ct., 606 P.2d 362, 373 (Cal. 1980); Opinion of the Justices, 437 A.2d 597, 604-10 (Me. 1981); Opinion of the Justices to Senate, 424 N.E.2d 1092, 1099-1100 (Mass. 1981).

404. *See* N.C. ADMIN. CODE tit. 15A, 07H.0208(b)(7)(B) (Apr. 1996) (requiring bulkheads to be constructed Alandward of significant marshland or marshgrass fringes@); Webb v. North Carolina Dep't of Env't, Health & Natural Resources Coastal Resources Comm'n, 404 S.E.2d 29, 30-32 (N.C. Ct. App. 1991) (upholding the validity of a permit issued for a bulkhead constructed two feet inland of the mean high water line).

405. According to Doug Huggett of North Carolina's Division of Coastal Management, AIt would be political suicide to require people to take down these bulkheads.@ Interview with Doug Huggett, Assistant Major Permits Coordinator, Div. of Coastal Management, Dep't of Envtl. and Natural Resources (Oct. 29, 1997) (on file with author).

406. Rhode Island Coastal Resource Management Program ' 210(B)(4) (1993) (ABulk-heading and filling along the inland perimeter of a marsh prevents inland migration of wetland vegetation as sea level rises.@); *id.* ' 210.3(C)(3) (AIn Type 1 waters, structural shoreline protection may be permitted only when the primary purpose is to enhance the site as a conservation area and/or a natural buffer against storms.@).

States appear to have a common law right to require shorefront owners to abandon property as shores erode. Because some states may be waiving those rights,[407] however, their ability to defer action and still protect tidelands without a taking may be less than would have been the case under the common law.[408]

2. Rolling Easements.—Deferred action lets the state indulge property owners with the wishful thinking that their estates will last forever. Rolling easements, by contrast, remind them that the law of erosion holds otherwise.[409] Regardless of whether owners of developed bayfront property have a basis to assume that they have a vested right to erect a bulkhead, owners of undeveloped lands should have no such expectation. To the extent that the state ever had a right to take over lands as they were flooded, rolling easements simply indicate that the public is not relinquishing that right.[410]

Analogizing to water law, rolling easements reject Afirst in time, first in right,@ in favor of Areasonable use.@[411] Under the common law, if the shore retreats fifty feet, an owner cannot regain title by filling the shore

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407. In Maryland, the State has probably not waived the right to prohibit bulkheads and revetments along the shore, except when bulkheads have been built. Courts have long held that the additional riparian rights provided by statute should be viewed as licenses, which are not constitutionally protected property rights. *See, e.g.*, Board of Pub. Works v. Larmar Corp., 277 A.2d 427, 439 (Md. 1971) (holding that an unused riparian right to fill tidal waters was a license that could be revoked by the legislature). This view is consistent with the public trust doctrine cases, which have narrowly construed any purported legislative grants of tidal waters to private parties. *See, e.g.*, *City of Berkeley*, 606 P.2d at 369 (A[S]tatutes purporting to abandon the public trust are to be strictly construed; the intent to abandon must be clearly expressed . . . and if any interpretation of the statute is reasonably possible which would retain the public's interest in tidelands, the court must give the statute such an interpretation.@). By contrast, where people have already erected an erosion control structure, the owner clearly has a property interest in the bulkhead or revetment. *See* MD. CODE ANN., ENVIR. ' 16-201 (A[A] person may make improvements into the water in front of the land to . . . protect the shore of that person against erosion. After an improvement has been constructed, the improvement is the property of the owner of the land to which the improvement is attached.@). Given the court's distinction between used and unused riparian rights in *Larmar Corp.*, 277 A.2d at 439, a court might also conclude that in such a case there is a vested right to hold back the sea.

408. *But cf. infra* Part IV.D (noting that in a few states, under the expansive public trust doctrine, the government cannot engage in a wholesale transfer of tidelands even by explicit intention, much less by waiver).

409. *See* fig.6 (illustrating that the notice provided by rolling easements leads the property owner to avoid construction when the easement is likely to take over property soon); fig.9 (same for one-step easement); *see also supra* Part II.B.3 (explaining that notice is the main difference between rolling easements and deferred action).

410. *See supra* notes 398-399 and accompanying text.

411. *See* DAVID H. GETCHES, WATER LAW IN A NUTSHELL 7-21, 47-51, 74-82 (2d ed. 1990) (discussing the Areasonable use@ and Aprior appropriation@ doctrines of water use law).

back out to its previous location.[412] Thus, with a rolling easement, the location of the public trust boundary does not depend on whether the erosion or the bulkhead comes first. As sea level rises, rolling easements prevent riparian owners from indirectly creating land for themselves at the expense of the public trust, something that they have never been entitled to do directly with a stable sea level.[413]

A few states have already enacted rolling easement policies along the ocean coast. The Texas Open Beaches Act[414] goes beyond the rolling easement policy of the state's common law by putting those who build new houses on notice that the houses must be removed if they encroach upon or interfere with an area of the beach to which the public has acquired an easement through prescription, dedication, or continuous use.[415] Maine's Coastal Sand Dune Rules[416] explicitly presume the mobility of any structures that would interfere with the landward migration of sand dunes or wetlands with a rise in sea level.[417] South Carolina applies a rolling easement under special circumstances.[418]

Although state governments have only applied rolling easements to the ocean coast, the public trust doctrine does not distinguish the ocean from the bay.[419] Thus, rolling easement policies along oceans and bays would be equally constitutional.

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412. *See Larmar Corp.*, 277 A.2d at 434 (stating that artificial fill was not within the established meaning of accretion at common law). Although a Maryland statute recognizes a right to reclaim land lost to erosion, *see* MD. CODE ANN., ENVIR. ' 16-201, the statute does not include a guarantee from the Corps of Engineers that it will grant the necessary permit. *See* Maryland General Permit, *supra* note 60, cat. III, at 9 (stating that the Corps may authorize projects undertaken to fill wetlands only Aafter review by the Corps and coordination with appropriate federal resource agencies@).

413. *See supra* note 367 and accompanying text (noting that under the common law in most states, owners do not get title to extra land created by their own efforts).

414. TEX. NAT. RES. CODE ANN. '' 61.001-.178 (West 1978 & Supp. 1998).

415. *Id.* ' 61.011 (West 1978 & Supp. 1998) (stating that if the public has acquired a right of use by prescription, easement, or continuous use, the public shall have unrestricted access between mean low water and the vegetation line). *But cf.* fig.10.

416. CODE ME. R. ch. 355, ' 3(B)(1) (1993).

417. *See id.* ' 3(B)(1)(b) (AIf the shoreline recedes such that the coastal wetland . . . extends to any part of the structure, including support posts, for a period of six months or more, then the approved structure . . . shall be removed and the site shall be restored to natural conditions within one year.@).

418. *See supra* Part III.A (discussing changes in South Carolina law, prompted by the decision in *Lucas* and by Hurricane Hugo, which created a hybrid between a setback and a rolling easement).

419. *See supra* Part IV.B.1 (identifying the land owned by the state in trust for the people under the public trust doctrine in various states, with no distinction made between oceans and bays).

*3. Preventing Development: Applying the Doctrine of Waste.*CBoth the nuisance and defeasible-estate arguments have less force for efforts to prevent development. The houses themselves are not the nuisanceCthey just raise the possibility that some day in the future the owners may want to build a bulkhead. The public trust doctrine applies to tidelands, but not to dry land.[420] Still, the background principles of property law might occasionally enable states to curtail development under the doctrine of waste,[421] if courts are willing to treat the law of erosionCor the creation of a rolling easementCas equivalent to a condition on a defeasible estate.[422]

Private riparian owners retain title to land for only so long as the land remains above high water, after which time it reverts to the state.[423] In states that recognize a rolling easement,[424] land reverts to the state even if a seawall is built to keep the shore from retreating. Although this reversion occurs by operation of law rather than the explicit wording of a conveyance, it is identical to a fee simple determinable.[425] When the ownership of land is temporally split between a current owner and a remainderman who may eventually get title to the land, the doctrine of waste prevents the current owner from unfairly harming the value of the remainderman's interest.[426] The current estate holder may not, for

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420. *See supra* notes 355-360 and accompanying text (explaining that the public trust doctrine applies to tidal waters and tidelands, with the inland boundary of the public trust usually being mean high water, but extending up to the vegetation line or highest storm surge of the average year in some states).

421. The doctrine of waste is an equitable doctrine of property law designed to prevent someone in temporary possession of a piece of property, such as a life tenant, from using the property in a way that unfairly harms the value of the estate that will eventually be transferred to a reversionary interest holder. *See* RESTATEMENT OF PROPERTY: FUTURE INTERESTS " 189, 193 (1936) (detailing the action that the owner of a future interest can take when the owner of the present estate engages in threatening conduct); *see also* BERGER, *supra* note 375, at 675-76 (explaining the history of the doctrine of waste).

422. This discussion does not prove that a court would enjoin coastal construction under the doctrine of waste. Rather, its purpose is to illustrate that the background principles of property law are consistent with such an injunction, in which case a court faced with a statute prohibiting the development might be able to avoid a taking.

423. *See* Feinman v. State, 717 S.W.2d 106, 110 (Tex. App. 1986, writ ref'd n.r.e.) (AThe division between public and private ownership under the common law . . . is the mean high tide line.@).

424. *See id.* (recognizing that Texas case law approves the Aconcept of a rolling easement@).

425. A fee simple determinable is an interest in land in which the owner loses title automatically upon the occurrence of a condition. The previous owner's interest is known as a Apossibility of reverter,@ because the estate reverts back to him if the condition occurs. *See* BERGER, *supra* note 375, at 183-84.

426. *See* RESTATEMENT OF PROPERTY: FUTURE INTERESTS " 139, 140, 189 (declaring that the remainderman of a life estate can obtain an injunction if the life tenant impairs the property

example, strip-mine fertile farmland and leave the remainderman with a barren wasteland.[427] The doctrine of waste has also prevented transitory owners from making improvements that would *increase* a property's value when the remaindermen objected to an irreversible aesthetic impact.[428]

The case for applying the doctrine of waste would be weakest along the ocean coast. Experience has shown that as the shore retreats, oceanfront homes do not impair the value of the public beach for long: Houses are moved out of harm's way or destroyed by storms, but the beach survives.[429] Without a permanent impact on the beach, the doctrine of waste would not enable a tideland owner to stop home construction.[430] The doctrine seems no more applicable to construction along estuarine shores, because houses can be removed as sea level rises.

The doctrine of waste may apply, however, when the development truly impairs the value of the reversionary interest. Courts weigh the harm of an activity to the reversionary interest against the utility to the current owner[431] and require less of a duty when the contingent interest

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value, accelerates the termination of the remainderman's estate, or breaches any other duty of the life tenant to the remainderman); *id.* ' 193(c) (declaring that the contingent owner of a defeasible estate can obtain an injunction against waste if it is Awanton or unconscionable@). The greater the probability that the contingent owner's estate will vest, the greater the duty of the current estate owner to avoid harming the value of the contingent owner's estate. *Id.* ' 193 cmt. f; *accord* J.W. Oler, Annotation, *Right of Owner of Contingent or Defeasible Future Interest to Maintain Action for Relief in Respect of Property*, 144 A.L.R. 769, 785-90 (1943) (explaining that equity will not allow a wrong to go without a remedy, but that its readiness to protect contingent estates is tempered by the power to withhold relief when the interest is unlikely to vest). Because sea level rise is very likely, a court applying this type of analysis could hold that the duty to the public trust's future interest is almost as great as a life tenant's duty to the remainderman. *But cf.* Williams v. Ramey, 41 S.E.2d 159, 159 (Ga. 1947) (stating that authorities are split on the issue of whether a conditional remainderman is able to obtain an injunction to stop waste).

427. *See* BERGER, *supra* note 375, at 675 n.5 (explaining that the doctrine of waste usually applies when the current holder strips the land of its resources).

428. *See* Brokaw v. Fairchild, 237 N.Y.S. 6, 20 (Sup. Ct. 1929) (preventing a life estate holder from replacing a money-losing historic mansion with a profitable apartment building), *aff'd per curiam*, 245 N.Y.S. 402 (App. Div. 1930), *aff'd per curiam*, 177 N.E. 186 (N.Y. 1931).

429. This statement assumes that the beach is not armored with a seawall.

430. *Cf.* Lucas v. South Carolina Coastal Council, 424 S.E.2d 484, 486 (S.C.) (rejecting the notion of a common law basis for preventing the development of coastal land), *on remand from* 505 U.S. 1003 (1992).

431. The *Restatement* implies that if the contingent interest is likely to vest, the current estate holder's duty to the reversionary interest holder is essentially to manage the property as if she were the owner of the entire estate. *See, e.g.*, RESTATEMENT OF PROPERTY: FUTURE INTERESTS '' 140, 193 cmt. h (requiring conduct similar to that of the most recent owner of the entire estate, and encouraging conduct from someone who owned both estates). This standard suggests that in areas where beaches are important, a riparian owner might not be allowed to eliminate the shore, but that in areas where beaches are not important, eliminating the shore would be allowed.

is remote.[432] Thus, if the future interest is likely to vest soon, even a moderate harm may justify an injunction.[433] If the harm is relatively remote, it might still be enjoined if it is severe.[434]

Courts are also suspicious of self-serving conduct that defeats the intention of the grantor.[435] If *A* has a remainder conditional on *A*'s outliving *B*, and *A* murders *B*, the murderer generally will not get the estate any sooner due to *B*'s death, if at all.[436] For analogous reasons, a project that bulkheads and fills high marsh or dry land, and thus prevents the public trust's interest in the land from vesting, may also be suspect.[437] If the purpose of the law of erosion had been to encourage erosion control, such a project would further the granting sovereign's intention. However, if the purpose of the law is to ensure that retreating

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432. *See supra* note 426. Courts occasionally prohibit all productive uses of land if the productive uses ruin the estate of the remainderman. *See, e.g.*, *Brokaw*, 237 N.Y.S. at 20 (denying the only proposed profitable use of property to a life tenant who was losing $70,542 on the property's current use). Nevertheless, an equity court would be more likely to prevent land from being filled than to prevent all development, because the former protects the tideland owner's reversionary interest without destroying the value of the dry land estate.

433. For example, filling some land that would otherwise be tideland within five years may justify an injunction.

434. For example, a hazardous waste site or construction that would subsequently make tidelands unusable to the public trust due to replacement of natural soils with materials unsuitable to vegetated wetlands may justify an injunction.

435. *Cf., e.g.*, Lippman v. Sears Roebuck & Co., 280 P.2d 775, 781 (Cal. 1955) (awarding a landlord damages when a lease specified that rent was based on a percentage of sales, and the tenant had no sales because the premises were used as a warehouse after the tenant relocated the store).

436. *See* Burton v. Moses (*In re* Estate of Moses), 300 N.E.2d 473, 480 (Ill. App. 1973) (denying a son who murdered his mother the benefits of premature reversion); Eisenhardt v. Siegel, 119 S.W.2d 810, 813 (Mo. 1938) (denying reversion to a grantor who murdered his grantee after having conditioned his reversion on the grantee dying first); RESTATEMENT OF RESTITUTION ' 188 cmt. c (1937) (declaring that when a remainderman murders a life tenant, and the murderer's interest is contingent on surviving the life tenant, the remainderman can be compelled to surrender the entire interest). *But cf.* G.H. Fischer, Annotation, *Murder of Life Tenant by Remainderman or Reversioner as Affecting Latter's Rights to Remainder or Reversion*, 24 A.L.R.2D 1120, 1120-22 (1952) (listing cases in which murderers received early reversions of life estates).

437. *Cf.* RESTATEMENT OF PROPERTY ' 135 (1936) (finding a duty to avoid causing or accelerating the termination of a defeasible estate). Wetlands taking cases have not considered this argument, because wetlands law prohibits filling high marsh due to the immediate impact on the wetlands, rather than due to any eventual impact on the public trust low marsh. Another difficulty is that federal and state programs sometimes encourage developers to fill dryland to prevent flooding. *See, e.g.*, 44 C.F.R ' 60.3(c)(2)-(3) (1997) (requiring new structures to be elevated above the base flood level). Although houses are usually elevated on pilings, fill is often brought in as well. The author has observed that in Ocean City, Maryland, for example, the highest ground on the barrier island is the sewerage treatment plant where fill was brought in to elevate the facility to flood levels.

shores do not alter ownership of the beach, it would defeat the sovereign's intention and could be enjoined.

Even here, however, the devaluation of the public trust could be avoided by re-levelling the site later.[438] A court of equity might still decide that the future interest holder is entitled to an assurance that the re-levelling will actually take place. But under these circumstances, the court would be ordering a rolling easement, not preventing development.

D. The Expansive Public Trust Doctrine[439]

1. The Doctrine. In some states, courts have limited the ability of even legislatures to sell lands beneath navigable waters. California courts protect the reliance interest of property owners on past grants of tidelands, but have held that future sales of tidelands by the legislature will be void.[440] Illinois law also limits the legislature's power.[441] The United States Supreme Court has upheld state court decisions in which the doctrine allowed a state to recover land that

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438. The standard technique for creating coastal wetlands is to excavate coastal land to bring it down to the elevation necessary for wetlands to form. *See* NATIONAL RESEARCH COUNCIL, RESTORATION OF AQUATIC ECOSYSTEMS: SCIENCE, TECHNOLOGY, AND PUBLIC POLICY 290-92 (1992) (providing a comprehensive review of the techniques for creating and restoring wetlands); Stephen W. Broome, *Creation and Restoration of Tidal Wetlands of the Southeastern United States*, *in* WETLAND CREATION AND RESTORATION 37, 42-44 (Jon A. Kusler & Mary E. Kentula eds., 1990) (discussing the grading of upland sites to elevations appropriate for marsh formation in the Southeastern United States); Roy R. Lewis, III, *Creation and Restoration of Coastal Plain Wetlands in Florida*, *in* WETLANDS CREATION AND RESTORATION, *supra*, at 73, 83 (discussing similar grading issues for Florida); Joseph K. Shisler, *Creation and Restoration of Coastal Wetlands of the Northeastern United States*, *in* WETLANDS CREATION AND RESTORATION, *supra*, at 143, 152-53 (discussing similar grading issues for the Northeastern United States); Interview with Dennis King, University of Md. Ctr. for Envtl. & Estuarine Studies, Solomons Island (Sept. 4, 1997) (on file with author) (asserting that 60% of the cost of wetland creation is excavation).

439. Joseph L. Sax rekindled scholarly interest in this traditional view of the public trust doctrine. *See generally* Joseph L. Sax, *The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*, 68 MICH. L. REV. 471 (1970). Sax has never suggested that the doctrine should be employed to enable a landward migration of wetlands, but he has recommended that trust funds should buy out riparian owners as the sea rises. *See* Sax, *supra* note 187, at 148-49; *see also supra* Part II.C (discussing the risk of backsliding).

440. *See* City of Berkeley v. Superior Ct., 606 P.2d 362, 373 (Cal. 1980) (A[T]he appropriate resolution is to balance the interests of the public . . . against . . . landowners who hold property under these conveyances.@).

441. *See, e.g.*, Lake Mich. Fed'n v. United States Army Corps of Eng'rs, 742 F. Supp. 441, 445 (N.D. Ill. 1990) (mem.) (applying state law to invalidate a grant by the Illinois legislature of submerged lands to expand a university located along Chicago's lakefront).

another party claimed.[442] However, the Court has never directly limited a state's power to sell tidelands.

Several states recognize this expansive doctrine in principle but make exceptions for people who filled tidelands in the past.[443] In so doing, courts have often said that states can extinguish the trust on a fraction of lands but not on the majority.[444] But the opinions have generally not indicated whether the doctrine would prohibit privatizing most of the shore, or whether privatizing the shore would be permissible because the tidelands constitute a small fraction of the navigable waters. While the logic of the doctrine suggests the former, actual practice suggests the latter.[445] In other states, courts have been willing to treat tidal waters like any other state-owned property.[446] Finally, in some states the public trust doctrine allows grants of tidelands, but only when a statute expressly indicates that the legislature intends to do so.[447]

2. Takings Implications. Although the public trust doctrine is based on a limitation of state power, its most famous application was a takings case. In 1873, the Illinois legislature decided that it had been too hasty in 1869 when it sold a three-mile stretch of Chicago's lakefront to the Illinois Central Railroad.[448] This stretch of coast had become very valuable, because the Army Corps of Engineers had subsequently decided to build breakwaters to protect it from the waves of Lake

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442. *See* Phillips Petroleum Co. v. Mississippi, 484 U.S. 469, 484-85 (1988) (holding that the state never gave up tidelands); Illinois Cent. R.R. v. Illinois, 146 U.S. 387, 463 (1892) (holding that a state can renege on a sale of trust lands, because it lacks the power to sell them).

443. For example, after *Phillips Petroleum*, Mississippi enacted legislation that awarded title to those who filled tideland before 1973. *See* M. Casey Jarman & Richard J. McLauglin, *A Higher Public Purpose? The Constitutionality of Mississippi's Public Trust Tidelands Legislation*, 11 MISS. C. L. REV. 5, 13 (1990) (explaining the Mississippi legislature's justification that the Aswift resolution of uncertainty over [land] title served a higher public purpose than protecting the state's interest in its public trust tidelands@). Courts in Massachusetts, Maine, and California have employed similar justifications. *See supra* note 403 and accompanying text.

444. *See, e.g.*, *Illinois Central*, 146 U.S. at 453 (AThe control of the State for the purposes of the trust can never be lost, except as to such parcels as are used in promoting the interests of the public therein . . . .@).

445. *See* fig.9 (showing how shoreline armoring can lead to a privatization of the shore); *supra* note 83 (describing estimates by various state officials of the rate of shoreline armoring).

446. *See, e.g.*, Board of Pub. Works v. Larmar Corp., 277 A.2d 427, 444 (Md. 1971) (explaining that under Maryland law, the State can sell any property, including the inland waters and the land beneath those waters).

447. *See, e.g.*, Slade, *supra* note 383, at 219-21 (listing cases from Alaska, California, Massachusetts, Michigan, New Hampshire, and Texas in which courts held that public trust lands cannot be conveyed to private parties without the authorization of the legislature).

448. *Illinois Central*, 146 U.S. at 405-11.

Michigan.[449] The railroad challenged the State's attempt to retrieve the waterfront as a taking without compensation.[450] The United States Supreme Court was unsympathetic, ruling that the state holds submerged lands Ain trust for the people.@[451] The legislature could withdraw the conveyance because it never had the authority to permanently grant away the shore that had later become Chicago's outer harbor.[452]

Would a resurrection of this doctrine help states protect tidelands at common law? Because the doctrine does not apply to dryland, it would not justify setbacks.

The expansive doctrine would, however, justify deferred action. The best argument that these policies are takings under the property version of the public trust doctrine is that the government may have signaled to landowners that the shore will be privatized. Under the expansive doctrine, the government has no power to convey the shore. Nevertheless, the precise meaning of the restraint on state power needs further clarification: Does the inability of the state to give away the shore also mean that it cannot pretend that the forces of nature placed the shore in private hands?

Like rolling easements, the expansive doctrine is motivated by a policy of preventing the shore from becoming privatized, so a rolling easement policy might be viewed in these states as primarily a reaffirmation that the expansive doctrine still applies. Thus, a rolling easement policy may be easier to implement in a state with the expansive public trust doctrine. Once the state declares that it will not allow the shore to be privatized (i.e., enacts a rolling easement policy), a doctrine holding that the state has no power to privatize the shore is unnecessary. Nevertheless, this doctrine might imply that in those areas where bulkheads have been or will be constructed, the public still has a right to access along the shore.[453]

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449. *Id.* at 409-13.

450. *Id.* at 418.

451. *Id.* at 452. The state can sell off parcels for wharves and docks, provided that doing so helps commerce and does not Asubstantially impair the public interest in the lands and waters remaining . . . . But that is . . . very different . . . from . . . the abdication of the general control of the State over lands under the navigable waters of an entire harbor or bay.@ *Id.* at 452-53.

452. *See id.* at 460 (AThere can be no irrepealable contract in a conveyance of property by a grantor in disregard of a public trust, under which he was bound to hold and manage it.@).

453. See *supra* Part IV.B.5 and fig.9., which describe ways to retain public access along armored shores.

V. THE ACQUISITION ALTERNATIVE: JUST COMPENSATION AND A POSSIBLE ROLE FOR THE FEDERAL AND PRIVATE SECTORS

Parts III and IV showed that many of the policies for allowing wetlands and beaches to survive rising sea level, particularly rolling easements, would not be takings under the Fifth and Fourteenth Amendments of the United States Constitution. Nevertheless, governments may choose to bypass the takings issue through eminent domain purchases of property or rolling easements. How much would this cost?

The formula for just compensation is usually the impact on the fair market value[454] of what the government takes.[455] Under a policy of preventing development, this impact would approach or equal the current land value in those cases that would be ruled a taking.[456] In cases that would not be ruled a taking, by contrast, the impact would be the reduction in the land value resulting from the development restriction.[457] Similarly, just compensation would be the value of the land plus the net cost of moving the structure[458] under deferred action. For rolling easements, the fair market value is the value of the land plus the net cost of moving the structure, discounted by both the probability of the sea rising and by the rate of return compounded over many decades.[459]

The greatly reduced cost of just compensation for rolling easements has several implications. Perhaps most important, these lower costs suggest that at least in some areas, states that want to retain natural shores should simply purchase the rolling easements necessary to do so. Such an approach would be fair to coastal landowners, and it would solve an environmental problem at a

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454. Part II.D and Appendix 1 discuss the cost of a rolling easement.

455. Courts have generally found that no compensation is due for eminent domain takings of a reversionary interest. *See* Glenn, *supra* note 274, at 570-76. In those cases, the government bought the entire estate, and the beneficiaries of the rule were the current estate holders. *Id.* Lacking a way to value the contingency, courts have assigned a value of zero. *Id.* But when the government purchases only the reversionary interest, such action demonstrates that the value is greater than zero.

456. This is true because a regulation is a taking only if it essentially destroys the ability of the owner to put the land to beneficial use. *See supra* Part III.

457. *See supra* Part III (explaining that, as a general rule, a reduction in land value is not considered a taking).

458. The net cost of moving the structure would be (1) the value of the structure or the cost of moving it to another location, whichever is less, minus (2) the cost of the bulkhead that is avoided by not holding back the sea. *See supra* note 389 and accompanying text.

459. *See supra* Part II.C (discussing how the cost to property owners would generally be less than one percent of the current property value for any property that would not be threatened until the sea rises at least two feet).

modest cost.[460] An acquisition would increase the certainty that the policy would succeed compared with other means of obtaining rolling easements: The fact that the state had paid for the easement would make the public less likely to tolerate backsliding, and it would almost totally eliminate the risk that a future court might find a regulatory taking to have occurred.

The modest cost may also enable the federal government to protect wetlands of national importance without having to wait for states to act. The federal government has the power to buy rolling easements by eminent domain, whether or not the property law in a particular state recognizes the rolling easement.[461] Purchasing easements may be more appropriate for the national government than relying on the federal navigation servitude: Principles of federalism argue strongly against extending wetland regulation to include dry land, whose regulation is traditionally a state and local matter.[462] Moreover, the nation as a whole contributed to the causes of greenhouse warming, and compared to the cost of decreasing carbon dioxide emissions,[463] the cost of purchasing wetland easements would be small.[464]

Rolling easements also provide a unique opportunity for private sector actions. Developers seeking permitsCfor shorefront development or even projects a few miles inlandCcan Asweeten the pie@ by reserving rolling easements and turning them over to conservation groups. The theoretical reasons for viewing rolling easements as economically efficient[465] suggest that this approach would often be an inexpensive way

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460. Such a policy would be a APareto improvement@: It would be fair to everyone because the public's interest would be better offCwithout the private landowners being worse offCthan if no policy was enacted. *See supra* notes 170-175 and accompanying text.

461. *See* United States v. Little Lake Misere Land Co., 412 U.S. 580, 603 (1973) (ruling that federal land purchases for wildlife refuge purposes need not be defined according to state law); United States v. Albrecht, 496 F.2d 906, 911 (8th Cir. 1974) (holding that 16 U.S.C. ' 718d(c) (1958) allowed the United States to acquire wetland areas and interests therein, because easements against draining wetlands Aeffectuate[] an important national concern,@ and holding that the easement is thus a valid conveyance under federal law even if such an easement is prohibited under state law).

462. *See, e.g.*, BOYER ET AL., *supra* note 14, ' 1201, at 430.

463. *See, e.g.*, WORKING GROUP III, *supra* note 180, at 306-07, tbl.9.4 (summarizing existing studies, which suggest that reducing carbon dioxide emissions by 20% would reduce Gross Domestic Product by 0.9% to 1.7%).

464. *See* Appendix 1. A suit at common law by the federal government to enjoin a bulkhead would be more likely to fail than a suit by a state for two reasons. First, the state is the owner of the tidelands whose inland migration is thwarted by the bulkhead. Second, property owners would have a defense that the erosion was caused partly by the same nation that now seeks the riparian owner's land.

465. Such mitigation in the cost would be essentially the public sector equivalent of what Wall Street traders call Aarbitrage.@ Environmentalists have lower discount rates and are more likely to believe that the sea will rise three feet. Accordingly, they would place a higher

to guarantee that the net long-term impact of a project will be beneficial. Environmental organizations and land trusts are sometimes given coastal land that does not fit in with their management objectives.[466] If they sell this land to a developer, they could reserve a rolling easement and thereby not totally forsake the intentions of the party that donated the land. Both developers and environmental groups can seek to purchase rolling easements[467] from riparian farmers who have no intention of developing the land anyway. Concerned citizens with shorefront property who donate a rolling easement to a conservancy may be eligible for a tax deduction.[468]

VI. CONCLUSION AND RECOMMENDATIONS

Development and rising sea levels are eliminating tidelands, but the loss is slow, almost imperceptible.[469] There is no crisis. Addressing the issue is urgent only because there are inexpensive opportunities to solve the problem *now*Copportunities that will be prohibitively costly if we wait until housing developments replace our shorefront farms and forests.

The common law has long assumed that, except for extraordinary circumstances, states will keep their tidal shores in the hands of the

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value (than would a developer) on the right to decide whether to eliminate the tidelands if, and when, the sea rises. *See supra* note 180 (explaining that the private sector requires a discount rate of 7% to 10%, while environmental protection typically requires a rate of about 2%). Moreover, the law of erosion and public trust doctrine may already give the state ownership of a rolling easement, *see supra* Part IV.B, but environmentalists fear that the state will choose not to enforce it, *see supra* notes 184-186 and accompanying text. Turning the easements over to a conservancy group would substantially reduce the risk of backsliding, and hence would have a higher present value to environmentalists than turning them over to the state. *See supra* notes 184-186 and accompanying text.

466. *See* Melissa Waller Baldwin, *Conservation Easements: A Viable Tool for Land Preservation*, 32 LAND & WATER L. REV. 89, 98 (1997) (cautioning property owners who donate land to choose a land trust with compatible Aconservation goals and projects@).

467. Some care is necessary to avoid the common law Arule against perpetuities,@ which holds that a contingent interest is void if it is not guaranteed to vest within 21 years of the death of someone currently alive. BERGER, *supra* note 375, at 161-62. As long as the rolling easement is implemented as an easement, the rule does not apply. However, if it is viewed as a defeasible estate, where the land changes hands upon the occurrence of a condition, then the rule might apply. Because reversionary interests are generally exempt from the rule, *see id*. at 164-68, the rule would not apply if a developer reserves a rolling easement and then donates it. But when the interest is obtained from a third party, it is void unless it either fits into a statutory exemption, or is viewed as something other than a defeasible estate. *Id.*

468. *See* I.R.C. ' 170(f)(3)(B) (1994) (allowing landowners to deduct the value of deed restrictions or donations of contingent interests in land for conservation purposes).

469. *See supra* notes 64-89 and accompanying text.

public.[470] This policy has been reaffirmed in the last few decades by state and federal laws prohibiting the filling of wetlands both above and below the mean high water mark.[471] The failure to consider rising sea level and coastal erosion would frustrate these policies.

Part II presented three general approaches for protecting tidelands as shores retreat: preventing development, rolling easements, and deferring action. Because history provides little or no evidence that the tidelands will be protected by a policy of deferring action, the real choice is among rolling easements, preventing development, and losing the tidelands. But even where shores are bulkheaded and our bay beaches and wetlands are lost, states need not automatically terminate the public's right to access along the shore.

The rising sea has put two legal interests on a collision course. Advancing inland is the public interest in access for navigation, fishing, and hunting, as well as the environmental, recreational, and aesthetic benefits of tidal marshes, swamps, and sandy beaches.[472] In the past, as these interests migrated inland, they met little resistance as long as most of the land was undeveloped. But as land is developed, homeowners increasingly assert a commonly assumed (if legally unproven) right to defend their property.[473] In doing so, they cannot help but assert that their interest is superior to that of the public.

This conflict could be settled piecemeal under various common law doctrines, but unless policy makers confront the issue directly, current trends suggest that some ocean shores and the overwhelming majority of estuarine shores will be eliminated.[474] The type of comprehensive shoreline plan necessary to protect natural shores *in perpetuity* would probably involve a combination of setbacks, density restrictions, building codes, and rolling easements. In many cases, states may prefer to compensate coastal landowners for the impact of these policies. Nevertheless, any legislative or regulatory response is likely to raise the question: Is the policy a taking?

A. Rolling Easements Will Rarely Be Takings, but Setbacks and Deferred Action Will Often Require Compensation

1. Setbacks and Other Immediate Limitations. Setbacks will not require compensation in areas where the setback line is fairly close to

470. *See supra* notes 350-365 and accompanying text.
471. *See supra* notes 50-63 and accompanying text.
472. *See supra* notes 356-361 and accompanying text.
473. *See supra* notes 394-401 and accompanying text.
474. *See supra* notes 64-113 and accompanying text.

today's high water mark, compared with the size of coastal lots, i.e., where erosion is slow and the land is steep. Moreover, if farming, forestry, and other uses are profitable, the existence of an alternative use may defeat a takings claim.[475]

A taking is more likely in areas where land is held for speculation or lots have been subdivided, because setbacks are more likely to render the property economically unusable. Still, the likelihood of a taking can be minimized if setbacks are incorporated into the subdivision process, because large parcels are more likely to have enough land to develop inland of the setback line.[476]

2. Deferred Action.—In general, the government may not evict people from their homes if they are willing and able to cure any threats to health and safety that their dwellings may pose. The law on the coast is different: Land has always changed hands as the shore eroded, and in at least a few states governments have required the removal of private seawalls that impair public access along the ocean coast. Along bay shores, however, the demand for public access is less, and states have not prohibited shore protection.[477]

The public trust doctrine holds that the state has not given away its tidelands unless it explicitly decided to do so. Would this doctrine allow people to be evicted if the alternative were an unintended privatization of the public shoreline? Because courts have stretched and squeezed the doctrine, this question will probably remain unclear in most states until the problems of the rising sea level are upon us. Regardless of what old cases and statutes say, would a court really resurrect an ancient common law doctrine in order to allow the government to evict people from their homes?

3. Rolling Easements.—The uncertainties regarding the public trust doctrine cut the other way for rolling easements. Because the law of erosion has long held that the public tidelands migrate inland as sea level rises, legislation saying that this law will apply in the future takes nothing. Even without the public trust doctrine and the law of erosion, rolling easements would rarely be takings. They are inexpensive conditions that counteract an inevitable problem caused by coastal development. Rolling easements do not render property economically useless—they merely warn the owner that some day, environmental conditions may render the property useless, and that if this occurs, the

475. *See supra* notes 261-291 and accompanying text.
476. *See supra* notes 267-268 and accompanying text.
477. *See supra* notes 402-406 and accompanying text.

state will not allow the owner to protect her investment at the expense of the public. By the time the sea threatens the property, owners will have had decades and perhaps centuries to factor this expectation into their plansCand into the price they paid for their property.[478]

Rolling easements do not interfere with private economic activities. Instead, they merely allocate the risk of shoreline retreat to the riparian owner. They would be constitutional in most cases even without the public trust doctrine.[479] With that doctrine,[480] a rolling easement policy with a reasonable advance warning is unlikely to be a taking anywhere.

B. Good Policy Is Also Consistent with the Constitution

Setbacks have been the most popular technique to address erosion along the ocean coast. But along bay shores, they seem advisable only in some circumstances. If the land is steep enough for the ten- or twenty-foot contour to be within a hundred feet or so of the high water mark, and if the typical riparian parcel has substantial land above this elevation, setbacks may suffice for two reasons. First, landowners could still develop their property. Second, there would be no need to quibble about how fast the sea will rise or how far into the future the tidelands should be protected.[481]

In many areas, however, the land is too flat for even a one-thousand-foot setback to protect the tidelands into the distant future.[482] The government would have to weigh risks and benefits in locating the setback line. But where should that line be? Landowners would have a strong incentive to dispute the government's scientific projections. Even if everyone agreed to assume, for example, a three-foot rise, purchasing all of that landCor forcing property owners to bear the costCwould be very expensive. Furthermore, eventually the shore would erode up to that line and the tidelands would be eliminated anyway.[483]

Rolling easements, by contrast, face none of these limitations. Landowners are not prevented from using their property; they simply are prevented from protecting it when doing so eliminates tidelands. Thus, there is no need to draw a particular line on the map. Property owners do not suffer large economic deprivations, and the many decades that will pass before the property is lost imply a small present discounted

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478. *See supra* notes 166-167 and accompanying text.
479. *See supra* Part III.
480. *See supra* Part IV.
481. *See supra* notes 129-133.
482. *See* fig.5 (map of Chesapeake and Delaware Bays).
483. *See supra* notes 129-133.

value for whatever future loss one expects. Rolling easements also foster consensus, because only landowners who expect a significant rise in sea level would have a reason to be concerned about their cost. Perhaps most importantly, however, the government could acquire rolling easements through eminent domain for less than one percent of current land values. This makes it possible for governments to avoid hurting property owners and, thus, *avoid* the takings issue.[484]

Setbacks and rolling easements are not mutually exclusive. In some cases, setbacks may be useful for protecting tidelands threatened over the next forty to seventy-five years, while rolling easements could be employed to ensure that bulkheads are not subsequently built at the setback line. It would be premature to conclude that any single approach will be appropriate everywhere. The analysis supporting rolling easements demonstrates, however, that the long-term and uncertain nature of sea level rise need not prevent policy makers from laying out the rules of the game so that social and political institutions will be prepared for a rising sea.[485]

C. Recommendations

The fact that society decided not to eliminate its tidelands during the last part of the twentieth century does not automatically imply that they should be retained during the twenty-first century. But it does imply that their resources are valuable enough to (1) *decide* where tidelands should be eliminated and where they should be retained, and (2) *retain* them wherever the cost of doing so is a tiny fraction of what it would cost to prevent their immediate elimination. Toward those ends, the author presents the following ten recommendations for states, local governments, and the private sector.

States

1. State legislatures should direct the appropriate cabinet officers to undertake long-term public trust tideland planning studies that develop legislative recommendations on which shorelines should be privatized and which should remain in their natural condition as shores erode. These studies should produce maps showing the likely loss of natural shorelines over the next hundred years given current development trends, alternative scenarios of future sea level rise, and alternative

484. *See supra* Part II.
485. *See supra* notes 167-168.

policies of coastal management, such as setbacks, rolling easements, various engineering strategies, and existing policies. They also should examine implementation issues and estimate the costs associated with each policy. Special attention should be given to unique cultural resources, including inhabited islands, lighthouses, forts, and archaeological sites, as well as environmental resources.

In Maryland, a planning study would be particularly useful along Chesapeake Bay. The legislatively recognized right to bulkhead, along with the Critical Area Act's limitation of development along rural bay shores, already provides a skeletal structure for deciding which shores to privatize. But the state's Tidal Wetlands Act contains a statutory right to hold back the sea, a right that could be read as approving an eventual elimination of *all* wetlands and beaches other than those adjacent to conservation areas.

2. State coastal zone agencies should develop access policies for new development along bay shores and otherwise expand the portion of the bay beaches to which the public has access. The constituency for protecting shores will grow if people can reach the water, but it will wither if they cannot. Both the layout of roads and the existence of public paths to the shore could have important long-term implications for coastal access.

Along the ocean coast, roads leading to the sea provide access to the shore, and they ensure that as the beach erodes, all houses will still have road access. Along estuarine shores, by contrast, roads parallel to the shore limit access and may make retreat impossible if they provide the sole access to some properties.

In theory, Maryland has a policy to promote access to the waters of Chesapeake Bay. It does not, however, have a policy to increase substantially the portion of the shore to which the public has access. Nor does it have a policy of retaining public access along the shore when issuing permits for erosion control structures.

3. State legislatures should ask their attorneys general to analyze which tidelands policies can be implemented under state law and whether current development and bulkhead policies are likely to foreclose any options. The success and takings implications of tidelands policies will depend ultimately on the quality of legal advice provided *before* the policy development. Even in areas that are developed, retaining public access along the shore may be worthwhile.

Local Governments

4. Local governments should modify their master plans to indicate explicitly which shorelines will eventually be armored and which will

remain natural. A good initial plan would be to assume that previously developed or subdivided areas will eventually be protected, and areas zoned for agriculture, resource conservation, or otherwise not yet subdivided will retain natural shorelines forever even if rezoned. A possible compromise for undeveloped residential areas would be to maintain access along the shore in perpetuity, even if the shore is eventually armored.

5. Zoning regulations should also specify which shorelines will remain armored and which will remain natural. Because the designated natural shorelines are often agricultural and are not likely to be developed for several decades, local development interests may find these changes to be reasonable. While the natural shoreline designation might be revoked if and when the agricultural lands are rezoned, the inevitable compromises involved in rezoning might lead to their retention. Moreover, the designation would eventually become one of the background principles of land ownership in the county and would alert out-of-town developers about the need to consider tideland preservation.

6. Local governments should factor sea level rise and erosion trends into their guidelines for subdividing coastal property. Setbacks are less costly and less likely to be takings when the coastal lot is relatively deep. Even in areas where shorelines will eventually be armored, a deeper lot will lengthen the life of the natural shoreline environment. In areas where the public wants shorelines to remain natural, subdivision presents a realistic opportunity to warn the property owner of the requirements to protect natural shorelines. Where state law permits, it may be the last opportunity to add covenants or easements to the deed without compensation.

7. In areas likely to be protected, local governments should decide how the shore would be protected, even if erosion will not threaten developed areas for several decades. If the area would be protected by a levee, then setbacks along the shore should be increased to make room for that eventuality. If the area would be raised with fill, the proper height for roads, utilities, and building lots may be different. Environmental officials desiring to protect the tidelands must take an active interest in these related issues. Otherwise, they risk losing credibility among the moderate elements of the community.

Private Sector

8. Builders should reserve or purchase rolling easements when seeking permits for development in coastal counties and donate those easements to conservancies. This temporal extension of wetland

mitigation is a cost-effective way to guarantee that a project will have a positive net impact on the environment. It need not be limited to those who seek to fill a wetland. Privately created rolling easements could also include non-development buffers above the high water mark to limit pollution runoff.

9. Conservancies should reserve rolling easements from lands they sell and consider purchasing rolling easements from farmers who own land along the shore. In addition to the direct benefits, private activities can help to flush out the legal issues and thereby reduce institutional inertia elsewhere.

10. Activists should take regular walks along estuarine shores. The public's failure to visit these often-inaccessible tidelands leads many private property owners to assume incorrectly that they own the shore. This failure also leads many officials to conclude that, as with an abandoned roadway, there is no harm to privatizing the shore.

This Article has focused on state, local, and private arrangements for protecting tidelands. The federal Clean Water Act was the primary motivator for protecting wetlands,[486] and amending the Act to protect these wetlands as sea level rises would be a logical extension. But the federal government's role in wetlands protection was justified by its traditional power to regulate the *waters* of the United States.[487] Although wetlands are part of those waters, setbacks and rolling easements involve *land* use, which has always been a matter for state and local government.[488] Certainly the Army Corps of Engineers and the Environmental Protection Agency should reexamine existing programs so that they are less vulnerable to rising sea level. Environmental Impact Statements associated with expanding access to sewage treatment plants in low areas should acknowledge that these projects will cause a large long-term net loss of wetlands, both because the projects encourage development in low areas and because flooded septic systems will no longer force people to abandon homes as the sea rises. A federal regulatory solution to this problem, on the other hand, is probably impractical and definitely premature.

Although a federal *regulatory* role seems premature, the national government could help the process in its role as a *property owner*. The National Park Service, the Fish and Wildlife Service, and other agencies that purchase lands for conservation purposes in coastal areas could

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486. *See supra* notes 50-54 and accompanying text.

487. *See, e.g.*, Gibbons v. Ogden, 22 U.S. (9 Wheat.) 1, 217-18 (1824) (holding that the federal government has exclusive jurisdiction over commerce of the coastal waters).

488. *See supra* note 462 and accompanying text.

keep shorelines natural through the purchase of rolling easements. Undeveloped farmland is still found along the mainland shores of many bays that lie behind federally owned barrier islands, such as Assateague Island National Seashore along the Atlantic Coast of Maryland. For less than one percent of the cost of buying the land, the federal government could ensure that even if these areas become developed some day, the shore will still be composed of wetlands and beaches.[489]

It is difficult to get people to even think about the next century. Congress and the President, however, have broken that barrier in their efforts to reduce *emissions* of greenhouse gases.[490] So far, this enthusiasm has not extended to addressing the *impacts* of a greenhouse warming. By purchasing rolling easements in critical areas, the nation's largest property owner could motivate states to consider the long-term fates of their coastal zones, while avoiding the harm to property owners that has often accompanied the laws that protect our coastal environment.

489. *See supra* Part II.

490. *See* 1 OFFICE OF TECH. ASSESSMENT, *supra* note 118, at 109-52 (detailing federal efforts to alleviate global warming problems).

APPENDIX 1
ROUGH CALCULATION OF THE NATIONWIDE COST OF PROTECTING TIDELANDS WITH ROLLING EASEMENTS

National assessments of the costs of sea level rise have not sought to estimate the cost of protecting shores with rolling easements. Nevertheless, the published research is sufficient to generate a rough estimate.

Part II presents a numerical example in which a coastal lot (1) would become tideland if the sea level rises three feet, (2) is worth $20,000 as a site for a $180,000 house and $10,000 in an alternative use, and (3) where the cost of moving the house (and cleaning up the site) would be $30,000, (4) while the cost of a bulkhead would be $10,000. Given these assumptions, the bulkhead restriction would cost the property owner a total of $40,000 when the sea rises three feet. (The owner would lose the land worth $20,000 and would have to pay the $30,000 to move the house, but a bulkhead would have cost $10,000.) At a 5% discount rate, the present value of $40,000 in 100 years is $300. Thus, given a 5% interest rate, the impact on the market value of a rolling easement would be $300 if a three-foot rise were certain to occur in 100 years. But given the EPA's estimate that such a rise is only 5% likely,[491] the expected cost would be $15, which is 0.075% times the value of the land. Given the EPA's estimated 1% chance of a four-foot rise along most of the U.S. coast, the cost of a rolling easement for property four feet above high water would only be $3**C**that is, 0.015% of the land value.

Following the previous logic, a rolling easement for land that would be inundated with a five-, six-, or seven-foot rise in sea level would be worth $5.30, $2.65, and $1.30 respectively. These estimates are derived based on the fact that a five-foot rise has a 10% chance by 2150, a six-foot rise has a 5% chance by 2150, and a seven-foot rise has a 2.5% chance by 2150. Discounting $1 over 160 years yields $0.000407. Discounting by the probabilities implies that the $40,000 that will eventually be lost has present values of $1.62, $0.80, and $0.40, which are 0.008%, 0.004%, and 0.002% of the initial $20,000 land values.

For nearer term considerations, a more accurate first-cut estimate is based on the most likely date by which the sea will rise sufficiently to inundate a property. A rolling easement that vests when sea level rises six inches, one foot, or two feet would be worth 28%, 10%, and 1% of the current land values. The basis for that calculation is that a rise of six inches, one foot, and two feet are most likely to occur within 40, 60, and

491. See Table 1, which appears in *supra* Part II.

110 years, respectively. Discounting at a 5% rate and multiplying by two (to reflect the assumption that the net cost of moving the house is the land value), rolling easements for properties that vest with a six-inch, one-foot, and two-foot rise could be valued at 28%, 10%, and 1% of the current land value.

Table A-1 summarizes these calculations along with the results of an EPA study, which estimated the values of the undeveloped land threatened by sea level rise.[492]

TABLE A-1
CALCULATING THE FAIR MARKET VALUE OF ROLLING EASEMENTS FOR THE UNDEVELOPED LAND ERODED OR INUNDATED BY VARIOUS AMOUNTS OF SEA LEVEL RISE

Rise in Sea Level	Value of Lost Undeveloped Land ($ billion)[493]	Increment[494]	Present Value of $1 When Sea Rises	Cost of Rolling Easements ($ million)
6 inches	C	3-9	28	C
1 foot	6-19	3-10	10	300-1000
2 feet	13-34	7-15	1	70-150
3 feet	C	3.5-18.5	0.075	2.6-14
4 feet	21-71	3.5-18.5	0.015	0.5-2.7
5 feet	C	2.7-17	0.008	0.2-1.4
6 feet	C	2.7-17	0.004	0.1-0.7
7 feet	29-121	2.7-17	0.002	0.05-0.4
TOTAL				373-1170

We might reasonably expect that the land that will be lost from the first six inches will not be affected by a rolling easement policyCthat is, that people, for the most part, will not be building houses in areas that are likely to erode away in the next fifty years.

It is also reasonable to assume that the rolling easements for the land that will be inundated with a rise between six and twelve inches will not vest until the sea rises at least one foot. This is because the EPA study reported the amount of land that would be flooded by mean spring high water, i.e., the land that would become high marsh with a rise of a given magnitude. Spring high water is often six inches to two feet above mean high water, and the rolling easements are assumed only to require an

492. *See generally Holding Back the Sea*, *supra* note 32.
493. *See generally id.*
494. The estimates of the increments are based on linear interpolations of four estimates used throughout *Holding Back the Sea*, *supra* note 32.

abandonment of the property when it is flooded by mean low water. Thus, by assuming no abandonment will occur until a one-foot rise, one effectively presupposes that mean spring high water is zero to six inches above mean high water; however, this probably overstates how soon mean low water invades most property. All the same, given the assumption above, the present value would be ten cents on the dollar, a value that implies a total cost of $300 million to $1 billion to buy rolling easements on this land, which has a current value of $3 to 10 billion.

Similarly, one can assume in each case that the rolling easements for the land that would be inundated by a rise in sea level between *X*-1 and *X* feet would not require the lot to be abandoned until the sea rises *X* feet. The table completes this calculation for the various elevations. What is noteworthy is how much less the rolling easements would cost for the higher land. Because inundation of higher ground is less likely to occur and more remote in time, the fair market value of an interest in land based on that contingency is minuscule after the first four feet.

Thus, estimated cost ranges between $373 million and $1170 million. Ninety percent of the cost can be attributed to purchasing rolling easements on the land threatened by a rise in sea level of six to twelve inches; 9% of the cost applies to the land inundated or eroded with a rise of one to two feet; and 1% of the total cost would protect all of the land in the coastal zone that would not be threatened until the sea rose by more than two feet.

APPENDIX 2

ANNUAL SHORELINE ARMORING IN MARYLAND
(miles)

State Permits Issued, 1978-1994

	New Bulkhead	New Revetment	Total New Shore Armoring	Replacement Bulkheads
1978	8.2	6.5	14.7	1.4
1979	5.9	6.5	12.4	2.2
1980	5.7	8.4	14.1	2.6
1981	6.0	9.7	15.7	3.3
1982	5.0	5.8	10.8	2.6
1983	7.6	11.8	19.4	2.0
1984	8.9	8.6	17.5	2.6
1985	10.7	11.8	22.5	3.2
1986	10.8	16.3	27.1	1.6
1987	12.8	12.4	25.2	0.8
1988*	5.6	10.4	16.0	4.7
1989*	6.7	13.3	20.0	6.2
1990*	3.0	10.9	13.9	3.6
1991*	0.9	9.9	10.8	3.5
1992	1.0	9.8	10.8	5.5
1993	0.7	12.4	13.1	4.2
1994	0.5	13.4	13.9	2.6
Total 1979-1994	100.0	177.0	277.9	52.6

Permits Issued by the Board of Public Works Only

1995	0.1	2.4	2.5	3.0
1996	0.2	4.6	4.8	0.4
1997	0.1	3.9	4	0.5

Sources: Report to the Board of Public Works on Activities Under the Maryland Wetlands Act (1978 through 1987). Maryland Board of Public Works, April 1988. Report on Tidal Wetlands Activities and Licenses for Fiscal Year 1989 (and same reports for years 1990-1997). For years marked with an asterisk, the report provides total miles of bulkheads and the fraction of permits that were for new and replacement bulkheads; the number provided here assumes that percentage of total miles for new and replacement bulkheads is equal to the percentage of permits for new and replacement bulkheads.

Note: Since 1995, wetland permitting has been divided between the Tidal Wetlands Division of the Maryland Department for the Environment (MDE) and the Board of Public Works. From 1995 to the present, the Board of Public Works has only kept track of the shoreline armoring resulting from its own permits; MDE published no comparable report. Interview with Harold Cassell, State Wetlands Administrator (Mar. 25, 1997).