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Property Law for the Anthropocene Era

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Human activity has replaced nature as the principal force shaping our planet. As a result, we stand at the dawn of a new geological epoch: the Anthropocene. Fundamental changes in American law will be required to mitigate and adapt to the negative environmental impacts produced in this new era. These changes will go far beyond the traditional scope of environmental law to encompass property law and other subjects.

This Article analyzes how American property law should respond to the Anthropocene challenge. It demonstrates the need to transition from a property law system based on stability to a more dynamic system that accommodates large-scale environmental disruption. It argues that we must develop a new vision of ownership in which property rights are more flexible and less categorical than in the past, and that we must implement this transition in a manner that does not violate the Takings Clause. The Article proposes four overarching principles to guide the evolution of our property law system in the coming decades.

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INTRODUCTION

The historic foundation of American property law is eroding. In 2016, scientists officially acknowledged that we have entered a new geological epoch: the Anthropocene.[1] This era is characterized by the reality that human activity—not nature—is the dominant force transforming the physical world.[2] The magnitude and speed of this transformation are unprecedented in the history of our planet.[3] As a result, we must shift from a property law system premised on stability to a more dynamic system that accommodates large-scale change. The most important challenge confronting property law today is how to adjust to the Anthropocene era in the coming decades.

Our property law system evolved over centuries when the physical conditions affecting land were relatively stable. Changes produced by nature were usually minor and gradual, while human impacts on the physical world were limited and localized.[4] The fee simple absolute and other property rights that emerged in this environment, first in England and later in the United States, reflected this stability. The temporal and spatial dimensions of these rights were comparatively rigid; and the substantive content of these rights tended toward absolutism, relatively free from government constraints.[5] Because these property

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1. *See* Damian Carrington, *The Anthropocene Epoch: Scientists Declare Dawn of Human-Influenced Age*, THE GUARDIAN (Aug. 29, 2016), https://www.theguardian.com/environment/2016/aug/29/declare-anthropocene-epoch-experts-urge-geological-congress-human-impact-earth.

2. *Anthropocene*, OXFORD ENGLISH DICTIONARY (2014).

3. *See* JEREMY DAVIES, THE BIRTH OF THE ANTHROPOCENE 2–4 (2016); J.R. MCNEILL & PETER ENGELKE, THE GREAT ACCELERATION: AN ENVIRONMENTAL HISTORY OF THE ANTHROPOCENE SINCE 1945, at 4–6 (2014).

4. For discussions of gradual changes in the natural environment of Britain before the Anthropocene epoch, see ROBIN H. BEST, LAND USE AND LIVING SPACE 10–13 (1981) and NEIL ROBERTS, THE HOLOCENE: AN ENVIRONMENTAL HISTORY 143–53 (1989). During the Anthropocene epoch, in contrast, human activity has disrupted the environment to an unprecedented extent. *See infra* text accompanying notes 28–45.

5. *See infra* text accompanying notes 64–85.

systems developed in an era of stability, they did not include mechanisms that could adjust property rights in response to major external changes.[6]

Today, at the dawn of the Anthropocene era, human activities have already begun to change the Earth's climate, geology, and ecosystems. Since the middle of the twentieth century, the human impact on our planet has accelerated dramatically.[7] For example, human-caused emissions of toxic substances have contaminated large regions;[8] greenhouse gases are changing the climate, causing sea levels to rise;[9] desertification has transformed the planet's surface;[10] and many non-human species are becoming extinct.[11] Scholars conventionally view legal responses to developments like these as falling within the ambit of environmental law. But this narrow view is outdated and counterproductive. The Anthropocene era may endure for thousands of years[12] and will necessitate fundamental changes in many areas of law, including property law.

In this new era, when humans are reshaping the natural world in fundamental ways, our static property law system is increasingly obsolete. As the world changes, the rights of different property owners will increasingly conflict, and the respective rights of particular owners will collide with the rights of society more frequently. Our property law system must be retooled to accommodate and manage the conflicts that will arise in a rapidly changing world, but in a manner that does not violate the Takings Clause. In fact, we have already begun to shift toward a more dynamic system, at least in piecemeal fashion.[13] The current challenge is to develop overarching principles that can guide the future evolution of property law.

This Article explores how American property law will be transformed for the Anthropocene era. Part I examines the challenge posed by the Anthropocene—an era of extraordinary global change in terms of intensity, scale, and speed. Part II explains how stable environmental conditions contributed to England's rigid system of absolutist property rights, without mechanisms to accommodate substantial change. Part III analyzes how American law developed doctrines that inject a degree of flexibility into the static property law system inherited from

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6. *See infra* text accompanying notes 71–84.

7. *See* Colin N. Waters et al., *The Anthropocene is Functionally and Stratigraphically Distinct from the Holocene*, 351 SCIENCE 2622-1 (2016); DAVIES, *supra* note 3, at 2–4; MCNEILL & ENGELKE, *supra* note 3, at 4–6.

8. *See* MCNEILL & ENGELKE, *supra* note 3, at 28–29; JOHN G. SPRANKLING & GREGORY S. WEBER, THE LAW OF HAZARDOUS WASTES AND TOXIC SUBSTANCES IN A NUTSHELL 3–4, 105–07, 273–76 (2d ed. 2007); Waters et al., *supra* note 7, at 2622-5.

9. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: SYNTHESIS REPORT 42 (2015); JERRY M. MELILLO ET AL., EDS., CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT 582–83 (2014).

10. *See* DAVID SHERIDAN, DESERTIFICATION IN THE UNITED STATES 121 (1981).

11. *See* Waters et al., *supra* note 7, at 2622-8.

12. The previous geological epoch, the Holocene, lasted for 12,000 years. *See* JEDEDIAH PURDY, AFTER NATURE: A POLITICS FOR THE ANTHROPOCENE 1 (2015).

13. *See infra* Part III.

England. It also demonstrates how these doctrines can serve as the foundation for future reforms in a manner that is consistent with the Takings Clause. Finally, Part IV proposes broad principles to reshape property rights for the Anthropocene era in four key areas: (1) exclusivity; (2) use; (3) time; and (4) geography.

I. THE ANTHROPOCENE CHALLENGE

A new word appeared in the venerable *Oxford English Dictionary* in 2014: *Anthropocene*, defined as "[t]he era of geological time during which human activity is considered to be the dominant influence in the environment, climate, and ecology of the Earth."[14] This designation received preliminary scientific approval in 2016, when scientists recommended to the International Geological Congress that the Anthropocene be designated as a new geological epoch.[15]

Scholars agree that the Anthropocene should be viewed as a distinct period in the history of the Earth.[16] Over the last 12,000 years, humans lived in the Holocene epoch—an era when the Earth was predominately shaped by natural forces.[17] But today, humans are the most important influence on the physical condition of the planet.[18] Accordingly, the new epoch is named for us: the age of humans.[19] With hindsight, most authorities now place the beginning of the Anthropocene in the mid-twentieth century.[20]

From the geological perspective, the decision to recognize the Anthropocene as a discrete period hinges on a technical question: "Have humans changed the Earth system to such an extent that recent and currently forming geological deposits include a signature that is distinct from those of the Holocene and earlier epochs, which will remain in the geological record?"[21] There seems to be a consensus that this standard is met.[22] The byproducts of mining, waste disposal, construction, and urbanization "are accompanied by many new forms of 'rock,' in the broad sense of geological materials with the potential for long-term persistence."[23] This is particularly true for deposits stemming from the Great Acceleration of industrialization, population growth, and resource consumption that began in the mid-twentieth century.[24] Plastics, pesticide residues, heavy metal emissions, crop pollens, concrete, aluminum, mine tailings, fertilizers, radioactive fallout from nuclear-weapons tests, particulates from fossil-fuel combustion,

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14. *Anthropocene*, *supra* note 2.
15. Carrington, *supra* note 1.
16. *See, e.g.*, DAVIES, *supra* note 3; MCNEILL & ENGELKE, *supra* note 3; PURDY, *supra* note 12.
17. PURDY, *supra* note 12, at 1.
18. *See Anthropocene*, *supra* note 2.
19. DAVIES, *supra* note 3, at 6.
20. Carrington, *supra* note 1.
21. Waters et al., *supra* note 7, at 2622-1.
22. *See* Carrington, *supra* note 1.
23. Waters et al., *supra* note 7, at 2622-3.
24. *Id.* at 2622-1.

chemical wastes, and other substances evidencing human activity have formed a distinct geological layer that will persist for eons.[25]

In a broader sense, scientific acceptance of the Anthropocene as a distinct era marks the boundary between the first 4.5 billion years of the Earth's history, when our planet was almost exclusively governed by natural forces, and the future, when it will be predominantly shaped by human activity. Thus, the substantive scope of the Anthropocene extends beyond geological change to encompass humanity's impact on the climate, ecology, environment, and other aspects of the natural world.[26] As Jedediah Purdy summarizes, "[t]he familiar divide between people and the natural world is no longer useful or accurate. Because we shape everything, from the upper atmosphere to the deep seas, there is no more nature that stands apart from human beings."[27]

Human activity has disrupted our planet's natural systems to an extent that is unprecedented in intensity, speed, and scale.[28] The most prominent example is humanity's impact on the climate system. Greenhouse-gas emissions have begun to alter the global climate:[29] ice and snow are melting,[30] sea levels are rising,[31] the oceans are acidifying,[32] drought is growing,[33] wildfires are intensifying,[34] freshwater flooding is increasing,[35] diseases are spreading,[36] and agricultural productivity is falling.[37] But climate change is merely one aspect of a larger phenomenon: humans are broadly impairing the Earth's biological, chemical, and physical systems.

Consider some of the negative impacts produced by the combination of population growth, industrialization, and resource consumption, mainly over the past 70 years. More than half of the Earth's surface has been transformed by intensive human uses, most commonly for agriculture.[38] Excessive irrigation, overgrazing, and poor farming practices have converted some formerly fertile areas into artificial deserts.[39] Radioactivity from nuclear-weapons testing and accidental releases have contaminated soils.[40] Excessive removal of groundwater

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25. *Id.*
26. MCNEILL & ENGELKE, *supra* note 3, at 4–6.
27. PURDY, *supra* note 12, at 2–3.
28. DAVIES, *supra* note 3, at 2–4; MCNEILL & ENGELKE, *supra* note 3, at 4–6.
29. MELILLO ET AL., *supra* note 9, at 7–9.
30. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 9, at 2–4.
31. *Id.* at 42; MELILLO ET AL., *supra* note 9, at 582–83.
32. MELILLO ET AL., *supra* note 9, at 10.
33. *Id.* at 71–75.
34. *Id.* at 177–78.
35. *Id.* at 75.
36. *Id.* at 222–25.
37. *Id.* at 152–57.
38. Waters et al., *supra* note 7, at 2622-3, 2622-8.
39. SHERIDAN, *supra* note 10, at 121 (observing that millions of acres in the United States suffer from severe desertification).
40. MCNEILL & ENGELKE, *supra* note 3, at 28–29; Waters et al., *supra* note 7, at 2622-5.

has caused widespread subsidence.[41] Over the last century, increasing fertilizer use has doubled the levels of nitrogen and phosphorous in soils, producing run-off that imperils aquatic life.[42] Billions of pounds of toxic chemicals are released into the environment each year, contaminating soils and drinking water.[43] Transboundary air pollution by particulate matter, heavy metals, and other contaminants causes injuries thousands of miles away from emission sites.[44] The increasing eradication of non-human species signals the sixth mass-extinction event in the Earth's history; 75% of non-human species may be extinct within a few centuries.[45]

More importantly, the pace of these Anthropocene transformations is accelerating.[46] The Holocene epoch and its predecessors were characterized by gradualism. Over tens of thousands of years, change occurred slowly: sea levels fluctuated, glaciers inched, and temperatures varied.[47] By contrast, the rate of human-caused change during the Anthropocene has soared.[48] Humans have transformed the planet more in the last 70 years than nature did in the prior 10,000 years, causing a cascade of cumulative changes.[49] For example, since 1950, the world's use of nitrogen fertilizer has increased by 2,500%, while the production of plastics has increased by 30,000%.[50] Both have caused major harm to the world's oceans.[51] While humanity's capacity to modify conditions on a planetary scale will undoubtedly increase in the future, we cannot predict the precise scope and intensity of the adverse changes that will occur as we move toward a post-natural world. The only certainty is that major reforms to our legal system will be necessary, including new approaches to property law.

The Anthropocene era poses challenges in four main areas that will affect land ownership—and accordingly, impact our property law system. First, external forces may have adverse physical impacts on a particular parcel of land that prevent use of the land for its historic or anticipated function, whether it be for agricultural, industrial, residential, or other purposes. This use-elimination scenario might be caused by widespread flooding, toxic contamination, desertification, excessive temperature, or other factors. In this context, we must develop mechanisms to modify the owner's property rights or to adapt the parcel for new uses, potentially over the owner's objection.

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41. *See, e.g.*, Lisa M. Krieger, *California Drought: Parts of Central Valley Sinking 2 Inches a Month*, MERCURY NEWS (Aug. 19, 2015), http://www.mercurynews.com/2015/08/19/california-drought-parts-of-central-valley-sinking-2-inches-a-month/.

42. Waters et al., *supra* note 7, at 2622-4.

43. SPRANKLING & WEBER, *supra* note 8, at 3–4, 105–07, 273–76.

44. Agnieszka Galuszka et al., *Assessing the Anthropocene with Geochemical Methods*, *in* A STRATIGRAPHICAL BASIS FOR THE ANTHROPOCENE 221, 231 (C.N. Waters et al., eds., 2014).

45. Waters et al., *supra* note 7, at 2622-8.

46. MCNEILL & ENGELKE, *supra* note 3, at 4–5.

47. *See* PURDY, *supra* note 12, at 1; ROBERTS, *supra* note 4, at 62–64, 88.

48. *See supra* text accompanying notes 38–46.

49. *See supra* text accompanying notes 38–46.

50. MCNEILL & ENGELKE, *supra* note 3, at 4–5.

51. *Id.*

Second, external forces may create off-site conditions under which it becomes substantially more difficult—though not impossible—to use land for its normal purpose, especially when the rights of owners conflict. This use-reduction scenario could be caused by physical changes that preclude or hamper access to the parcel; a shortage of water due to pollution, drought, or groundwater depletion; or other factors. In this situation, we will need novel approaches to mediate the conflicting claims of different owners.

Third, activities on a piece of land may cause or contribute to cross-border physical changes that substantially harm other parcels, in either a direct or cumulative sense. This negative-externality scenario might arise from activities such as deforestation, air or water pollution, flooding, or uncontrolled fires. In this scenario, it will be necessary to develop innovative techniques to restrict and potentially prohibit certain land uses to prevent or mitigate off-site impacts, even if this impairs traditional property rights.

Finally, the preservation of a particular parcel in its natural condition may help to mitigate general Anthropocene impacts that would harm other parcels or society in general. This mitigation-value scenario would apply, for example, where forest land serves as a "sink" to absorb carbon dioxide to mitigate climate change or where a wetland parcel provides habitat for an endangered species. In this situation, techniques that discourage or prevent owners from destroying the mitigation value of their lands—through development or otherwise—will be needed.

Contemporary property law is not equipped to deal with these challenges. This law evolved in an era that was characterized by relatively stable physical conditions, when there was no need to accommodate negative external forces on a large scale. Accordingly, it failed to develop robust mechanisms that could restructure property rights in response to systemic changes in the physical world. Even so, our property law tradition contains doctrines that can serve as raw material to develop overarching principles that respond to the Anthropocene era.

II. THE ENGLISH PROPERTY LAW FOUNDATION

A. Static Conception of Property

Utilitarian theory justifies the existence of private property as necessary to maximize the overall utility of all citizens.[52] In this sense, the goal is to allocate and define property rights in the manner that best promotes the general welfare of the entire society. More specifically, Richard Posner and other law and economics scholars view property law as a mechanism to allocate finite resources in an efficient, market-driven manner.[53] From this perspective, strong property rights are

52. *See* GREGORY S. ALEXANDER & EDUARDO M. PEÑALVER, AN INTRODUCTION TO PROPERTY THEORY 17 (2012).

53. *See generally* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW (9th ed. 2014).

vital. Each entitlement must be perpetual in duration[54] and absolute in scope; the owner must be able to exclude others from the land; and state interference with the owner's use should be minimal.[55]

Under these circumstances, Posner would argue that (1) owners enjoy sufficient stability of title to invest in enhancing the productivity of their lands for the benefit of all citizens and (2) the free transferability of title ensures that land is devoted to its highest and best use.[56] The property-rights system that emerges from this model functions best in an unchanging world—one where stability is prized at the expense of flexibility. In such a setting, there is no need for government action to adjust or reallocate property rights.

With hindsight, we can see that this model somewhat describes the final stage in the evolution of English property law. It is axiomatic that physical conditions, such as geography and climate, influence how law evolves.[57] This is particularly true in the development of property law, which historically dealt almost exclusively with rights in land.[58] English property law developed over centuries of relative stability, largely free from the threat of environmental changes caused by human or non-human forces.[59] Humans did not have the ability to harm the Earth's biological, climate, chemical, or physical systems on a planetary scale in a manner that impaired property rights. Moreover, the era was characterized by a lack of major change caused by natural forces, such as extreme temperature variations, glacial movement, or flooding.[60] As a result, the property law system that emerged was primarily characterized by rigidity and absolutism.

B. Rigidity and Absolutism

Thousands of years ago, England was a wilderness, mainly covered by forests. Yet by 1086 A.D., most of this wilderness had disappeared due to human activity, as recorded in the famous Domesday Book.[61] Even before Europeans discovered North America, virtually the entire land surface in England was in productive agricultural use as cropland, pasture, woodlot, or the like.[62] During the

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54. As Robert Ellickson observes, the ideal property entitlement has an "infinite time-horizon." Robert C. Ellickson, *The Costs of Complex Land Titles: Two Examples from China*, 1 BRIGHAM-KANNER PROPER. RTS. CONF. J. 281, 293 (2012).

55. POSNER, *supra* note 53, at 40–42.

56. *Id.* at 78–84.

57. *See, e.g.*, Bernhard Grossfeld, *Geography and Law*, 82 MICH. L. REV. 1510 (1984).

58. *See* JOHN G. SPRANKLING, UNDERSTANDING PROPERTY LAW 11 (4th ed. 2017).

59. *See supra* note 4.

60. *See supra* note 4.

61. A NEW HISTORICAL GEOGRAPHY OF ENGLAND 39, 47–62 (Henry C. Darby ed., 1973).

62. BEST, *supra* note 4, at 14.

period between roughly 1400 and 1776, there was little change in the physical landscape, aside from a gradual reduction of forests.[63]

Because the landscape remained virtually static for centuries, the English conception of property was largely designed to perpetuate the status quo, decade after decade.[64] Accordingly, it was not an approach that facilitated adaptation to major changes in external environmental conditions. The English system implicitly assumed that no fundamental shifts in regional conditions would occur over time—the soil would always be productive, rain would regularly fall, flooding would be rare, and the climate would remain relatively constant.[65] In sum, the core aspects of property rights under English law were static.

For example, English law conceptualized the fee simple absolute, the principal estate in land, as endless.[66] The main involuntary limitation on the duration of this estate was adverse possession.[67] If *O* owned a fee simple absolute in Blackacre, but failed to place the land in productive use, he or she might lose title to the adverse possessor who did put the land to use. But as a general rule, property rights were seen as perpetual.[68] English courts had no power to curtail the infinite duration of these rights.

Moreover, English law declared the geographic position that a fee simple absolute encompassed—its boundaries on the land surface, its airspace, and its subsoil—to be equally changeless.[69] The vertical and horizontal dimensions of *O*'s estate in Blackacre would endure forever, unless *O* or *O*'s successors consented to change. *O* literally owned all the airspace "to the heavens," all of the subsurface

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63. JOHN PERLIN, A FOREST JOURNEY: THE ROLE OF WOOD IN THE DEVELOPMENT OF CIVILIZATION 163–227 (1989).

64. John G. Sprankling, *The Antiwilderness Bias in American Property Law*, 63 U. CHI. L. REV. 519, 524–25 (1996).

65. In this sense, the English property law system rested on an assumption of *stationarity*—the concept that "natural systems fluctuate within an unchanging envelope of variability." P.C.D. Milly et al., *Stationarity is Dead: Whither Water Management?*, 319 SCIENCE 573, 573 (2008). In the Anthropocene era, the concept of stationarity is—by definition—increasingly irrelevant.

66. *See* RESTATEMENT OF PROPERTY § 14 (AM. LAW INST. 1936); 2 THOMPSON ON REAL PROPERTY § 17.02 (David A. Thomas ed., 2014). The same assumption underpinned the doctrine of ameliorative waste, under which any change in the natural condition of land by a tenant was deemed to be unlawful waste—even if it increased the market value of the land.

67. *See, e.g.*, Limitation Act 1623, 21 Jac. I, c. 16 (Eng.).

68. Indeed, English law even accepted various forms of speculative future interests that might, in theory, endure forever, such as the reversion, right of entry, and possibility of reverter. Only the infamous Rule Against Perpetuities provided a partial check on the infinite duration of future interests.

69. Blackstone's famous eighteenth-century treatise on English law illustrates the point. Although it devotes over 300 pages to summarizing English property law, the only doctrines it mentions for modifying the dimensions of a particular parcel without the owner's consent deal with the movement of water-based boundaries, such as where a stream gradually shifts its course. 2 WILLIAM BLACKSTONE, COMMENTARIES *262.

"to the center of the earth,"[70] and the entire land surface enclosed within the Blackacre boundaries.

The corollary of this static conception was an absolutist view of property rights. Thus, Blackstone grandly defined *property* as "that sole and despotic dominion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe."[71] *O*, as the owner of Blackacre, had the absolute right to exclude any person from the land. In a similar vein, *O* had the virtually unfettered right to use the land in any way he or she saw fit—or not to use it at all.[72] Land use was essentially viewed as a private matter, not a public concern.

Yet English property law was not wholly static. Over time, the resilient common law developed various exceptions to the rigid and absolutist approach. Exceptions arose because property entitlements that were too strong might impair the productive use of land in certain situations. These exceptions generally shared the feature of preventing or limiting voluntary human actions that would impede productivity. For instance, English law banned total restraints on alienation of a fee simple absolute[73] and restricted the duration of contingent future interests to enhance marketability and hence, productive use.[74] Similarly, the law slowly recognized that certain types of easements could be created without the affirmative consent of the servient owner to ensure reasonable use of the dominant parcel.[75]

One reason that the English system functioned adequately for centuries is that human activity rarely caused negative impacts to owners, so conflicts were rare.[76] Where conflicts did occur, the controversy could usually be mediated by the nuisance doctrine, another exception that mitigated the rigidity of the system.[77] Courts would intervene where one owner's land use produced a serious negative externality—a nontrespassory and substantial interference with another owner's use.[78] Another occasional problem—land subsidence due to activities by another owner—simply reinforced the traditional static rule: each owner was entitled to the lateral and subjacent support of his or her property, as long as it remained in its

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70. *See, e.g.*, John G. Sprankling, *Owning the Center of the Earth*, 55 UCLA L. REV. 979, 982–89 (2008).

71. 2 BLACKSTONE, *supra* note 69, at *2.

72. The principal limitation on this right was adverse possession. If *O* failed to place Blackacre in productive use, he or she might well lose title to a long-term trespasser who did put the land to productive use.

73. *See* SPRANKLING, *supra* note 58, at 134.

74. *Id.* at 204.

75. 2 BLACKSTONE, *supra* note 69, at *264.

76. One indication that such conflicts were rare is the late evolution of the nuisance doctrine. Until the sixteenth century, a property owner could not bring a civil nuisance action against another owner. WILLIAM L. PROSSER & W. PAGE KEETON, PROSSER AND KEETON ON THE LAW OF TORTS 618 (5th ed. 1984). This suggests that there was little or no need for such a doctrine in prior decades.

77. *See* SPRANKLING, *supra* note 58, at 503–04.

78. *Id.* at 503.

natural, undeveloped condition.[79] As a general rule, each parcel of land was treated as an island rather than part of an integrated regional landscape because conflicts between landowners were unusual.[80] Accordingly, there was no pressure on the English legal system to adopt new doctrines to reconcile and accommodate the conflicting interests of property owners.

The second important factor in the perpetuation of this approach was the absence of adverse impacts caused by non-human factors, such as environmental changes on a large scale. Major changes in climate, geography, topography, and other natural background conditions that had a substantial negative effect on a landowner almost never occurred.[81] During the formative period of English property law, the physical conditions that affected property rights were relatively stable. As a result, there was no need to develop legal doctrines that could respond to major environmental shifts. The principal exception to this was the risk that a water boundary between parcels could move over time, as streams or other bodies of water may change location. The common-law solution was the distinction between accretion and avulsion.[82] A water-based boundary line would move due to accretion—i.e., when the stream or other body of water slowly shifted due to the gradual build-up of soil.[83] But a boundary line would not move due to avulsion—i.e., when there was a sudden and permanent change in the location of the body of water, usually due to a flood or other major event.[84] Thus, when a water boundary changed due to accretion, the geographic location of the land subject to an estate also changed.

In sum, the property law system that evolved in England was characterized by rigidity and absolutism. As a general rule, English courts had no ability to fundamentally readjust property rights. Yet when property rights actually conflicted in a significant manner due to unusual local conditions, doctrines such as nuisance and accretion injected a trace of flexibility into the system.

III. THE EVOLUTION OF AMERICAN PROPERTY LAW

A. Inching Toward a More Dynamic System

As legal historian Morton Horwitz summarized, the English view of property that the newly independent United States inherited was a "static agricultural conception,"[85] which was designed to perpetuate the status quo decade after decade. It implicitly assumed that neither human activity nor the forces of nature would necessitate major changes to property rights in the future. Over the late eighteenth and early nineteenth centuries, American courts began to adjust

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79. *See, e.g.*, Harris v. Ryding, 151 Eng. Rep. 27 (Ex. 1839).

80. *See* 2 BLACKSTONE, *supra* note 69, at *261; PROSSER & KEETON, *supra* note 76, at 618.

81. *See supra* note 4.

82. 2 BLACKSTONE, *supra* note 69.

83. *Id.*

84. *Id.*

85. MORTON J. HORWITZ, THE TRANSFORMATION OF AMERICAN LAW 1780–1860, at 31 (1977).

English property law to meet the needs of a nation bent on developing its wilderness lands through changes such as rejecting the ameliorative-waste doctrine.[86] Yet the core rigidity and absolutism of English property law remained in place. Property rights were generally viewed as rigid in both geography and time;[87] courts enforced the owner's virtually absolute right to exclude;[88] and government interference with private land-use decisions was rare.[89]

Over time, however, American courts began to modify the traditional property rights of landowners in response to pressure from human forces, in the interest of social and economic development. For example, as the Supreme Court explained in the 1926 decision of *Village of Euclid v. Ambler Realty Co.*, the rapid urbanization and population growth of the era necessitated "additional restrictions in respect of the use and occupation of private lands in urban communities . . . [that] a century ago, or even half a century ago, probably would have been rejected as arbitrary and oppressive."[90] Accordingly, American courts and legislatures began to develop new, more flexible property law doctrines that could accommodate conflicts between property owners.[91] The historic approach began to fray somewhat in response to these human-caused impacts.

B. Embryonic Flexibility Themes

In the twentieth century, new legal tools emerged to adjust property rights under limited circumstances. The external pressures generating change were minor compared to the eventual impacts of the Anthropocene era, and the scope of these tools was accordingly narrow. Yet these doctrines can serve as seeds for the evolution of broader themes, providing helpful precedents for the more daunting task of developing principles to reshape property rights for the Anthropocene era in four key dimensions: (1) the right to exclude; (2) the right to use; (3) time limits; and (4) geographic limits.

In fact, Anthropocene era pressures have already affected American property law to some extent, principally by constraining land use.[92] As we reexamine what we belatedly recognize as the first portion of the Anthropocene, patterns in these legal changes begin to emerge. New statutes and decisions that curtailed the scope and content of traditional ownership rights were often seen as developments within the newly created field of environmental law.[93] Yet, to the

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86. *See generally* Sprankling, *supra* note 64.

87. The principal exception was the abolition of fee tail, done primarily for ideological reasons.

88. In recent decades, however, the trespass doctrine has been curtailed for public policy reasons. *See* SPRANKLING, *supra* note 58, at 518.

89. Comprehensive zoning ordinances were not adopted in the United States until the 1920s. *See id.* at 629. Before this era, "[l]egislation restricting land use was both rare and fragmentary." *Id.*

90. 272 U.S. 365, 386–87 (1926).

91. *See infra* text accompanying notes 95–143.

92. *See, e.g.*, text accompanying notes 121–23.

93. For example, the Endangered Species Act (the Act), 16 U.S.C §§ 1531–1543 (2012), is conventionally seen as environmental law. *See, e.g.*, PHILIP WEINBERG & KEVIN

extent that these changes affected property rights, they are more appropriately viewed as property law.[94] With hindsight, we can discern how property law has been altered since the mid-twentieth century by incremental responses to major human impacts on the natural environment.

1. The Right to Exclude

American property law constrains the absolutism of the traditional common-law right to exclude through legislative and judicial action in a variety of situations, ranging from landlord–tenant law to easements to flood water to groundwater rights. The flexibility doctrines in this category are linked by the common theme of equitable sharing. Rather than strictly enforcing the right to exclude, the law mandates that affected parties share the resource—at least in certain situations—based on equitable principles.

In the landlord–tenant context, for example, the federal Fair Housing Act bars a landlord from refusing to rent a dwelling to a tenant based on race, gender, national origin, or other protected categories.[95] Similarly, the modern trend in case law is that commercial landlords can no longer refuse an assignment or sublease in their sole discretion where the lease requires landlord consent, but does not specify a standard; rather, landlords may exclude the new tenant only if they have a commercially reasonable objection.[96]

Another illustration is the American expansion of the English law governing nonconsensual easements, effectively allowing the benefited owner to obtain an easement over the objection of the servient owner.[97] In effect, both owners share the servient land to some extent. Familiar examples include the prescriptive easement,[98] the implied easement based on preexisting use,[99] the easement by necessity,[100] and most recently, the easement by estoppel.[101] In each

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A. REILLY, UNDERSTANDING ENVIRONMENTAL LAW 378–81 (3d ed. 2013) (discussing the Act as an environmental-law doctrine). But the Act substantially curtails the ability of property owners to develop lands that serve as the habitat for endangered species. *See, e.g.*, Babbitt v. Sweet Home Chapter of Communities for a Greater Oregon, 515 U.S. 687 (1995) (upholding regulation promulgated under the Act which effectively banned logging in certain privately-owned forests to protect habitat of endangered species).

94. "The boundary line between property law and environmental law is imprecise—and perhaps nonexistent. Many environmental-law doctrines affect how property can be used; and property law concepts are sometimes applied to solve environmental problems." JOHN G. SPRANKLING & RAYMOND C. COLETTA, PROPERTY: A CONTEMPORARY APPROACH 857 (3d ed. 2013).

95. 42 U.S.C. §§ 3601–3631 (2012).

96. *See, e.g.*, Kendall v. Ernest Pestana, Inc., 709 P.2d 837 (Cal. 1985).

97. For example, the easement-by-necessity doctrine under English law required, *inter alia*, strict necessity. *See, e.g.*, Collins v. Prentice, 15 Conn. 39, 43–44 (1842) (discussing the strict necessity requirement in English law). Many American states have now liberalized this requirement.

98. *See, e.g.*, O'Dell v. Stegall, 703 S.E.2d 561 (W. Va. 2010).

99. *See, e.g.*, Van Sandt v. Royster, 83 P.2d 698 (Kan. 1938).

100. *See, e.g.*, Berge v. Vermont, 915 A.2d 189 (2006).

101. *See, e.g.*, Kienzle v. Myers, 853 N.E.2d 1203 (Ohio App. 2006).

instance, the strong public policy favoring the productive use of land predominates over the servient owner's right to exclude—even though he or she receives no compensation for the new encumbrance. Indeed, the current trend to expand the scope of the easement-by-necessity doctrine by requiring only reasonable necessity—an easement which is beneficial or convenient to the dominant owner—demonstrates that the scope of the right to exclude is narrowing.[102]

The law governing freshwater flooding is another example. Many American courts initially adopted the common-enemy approach to diffuse surface water, under which owners were permitted to exclude flood water from their lands by any manner, even if this caused injury to lands owned by others.[103] Yet today most states[104] have jettisoned this approach in favor of the reasonable-use standard, under which owners may not exclude flood water through an unreasonable use of their lands.[105]

The same equitable-sharing approach is also seen in principles for allocating subsurface resources—such as water, oil, and natural gas—by which each owner of land over a common pool is entitled to extract a reasonable share of the resource. For example, some states follow the correlative-rights approach to groundwater ownership, under which each owner of land overlying an aquifer is entitled to a fair share of the groundwater below.[106] Similarly, most states with extensive oil and gas production have adopted the correlative-rights system:[107] each owner is entitled to a fair share of the oil and gas under his or her land. Indeed, most states utilize forced pooling statutes, which allow an owner whose correlative oil or gas entitlement is threatened by the operation of another owner's well to share in the production from that well.[108]

An equitable-sharing regime also applies to some extent to rights in surface water. Under the riparian approach, predominating in the eastern United States,[109] the right of a riparian owner to withdraw water from a river or other watercourse is limited. The owner is only entitled to water that he or she uses in a reasonable manner, considering the needs of other riparian owners.[110] Similarly, under the prior-appropriation doctrine, generally predominating in the western United States,[111] a person who diverts water from a watercourse obtains property rights only when the water is devoted to a beneficial use, such as agricultural,

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102. *See, e.g.*, RESTATEMENT (THIRD) OF PROPERTY: SERVITUDES § 2.15 (AM. LAW INST. 2000).

103. *See, e.g.*, Yonadi v. Homestead Country Homes, 127 A.2d 198 (N.J. Super. Ct. App. Div. 1956).

104. *See* SPRANKLING, *supra* note 58, at 533.

105. *See, e.g.*, Westland Skating Ctr., Inc. v. Gus Machado Buick, Inc., 542 So. 2d 959 (Fla. 1989).

106. *See, e.g.*, Olson v. City of Wahoo, 248 N.W. 304, 308 (Neb. 1933).

107. *See, e.g.*, Eliff v. Texon Drilling Co., 210 S.W.2d 558 (Tex. 1948).

108. *See, e.g.*, 58 PA. CONS. STAT. § 408 (2008).

109. *See* SPRANKLING, *supra* note 58, at 530.

110. *See, e.g.*, Mason v. Hoyle, 14 A. 786 (Conn. 1888).

111. *See* SPRANKLING, *supra* note 58, at 530.

industrial, or municipal use.[112] Although the reasonable-use and beneficial-use standards differ somewhat, both share the same core: the amount of water taken cannot unreasonably injure other water users.

Finally, an early Anthropocene era modification to the absolutist view of exclusivity is found in the modern case law dealing with subsurface trespass. A number of courts refuse to impose trespass liability when water or other materials injected into the subsurface to facilitate oil recovery intrude into the subsurface below adjacent properties.[113] Some courts have taken the same approach to trespass by liquid wastes which are injected underground for storage, but migrate over time into subsurface regions owned by others. For example, in *Chance v. BP Chemicals, Inc.*, the Ohio Supreme Court rejected such a trespass claim, observing that "ownership rights in today's world are not so clear-cut as they were before the advent of airplanes and injection wells."[114]

2. The Right to Use

The twentieth century radically transformed the absolutist common-law approach to land use, beginning with the widespread enactment of local zoning ordinances in the United States in the 1920s.[115] Historically, the manner in which a landowner chose to use property was a private matter,[116] except in the rare instance where a nuisance arose.[117] However, with the industrialization, population growth, and urbanization of the early twentieth century, the danger of negative externalities increased. Early zoning ordinances regulated where a particular use could be located in the interest of preventing nuisance-like impacts in a more comprehensive manner than case-by-case adjudication.[118]

Over decades, however, *zoning* evolved into a robust system of generalized land-use regulation,[119] serving new purposes such as protecting property values, preserving neighborhood character, encouraging economic development, and preventing environmental degradation.[120] Additionally, in response to early Anthropocene era impacts, federal statutes imposed a layer of land-use regulation, ranging from the Clean Air Act[121] to the Endangered Species Act,[122] which in many cases were supplemented by state statutes.[123] Today it is

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112. *See, e.g.*, New Mexico *ex rel.* Office of State Eng'r v. United States, 296 P.3d 1217, 1222 (App. 2012), *cert. denied*, 299 P.3d 862 (2013).

113. *See, e.g.*, Raymond v. Union Tex. Petroleum Corp., 697 F. Supp. 270 (E.D. La. 1988); Baumgarner v. Gulf Oil Corp., 168 N.W.2d 510 (Neb. 1969).

114. 670 N.E.2d 985, 992 (Ohio 1996).

115. *See* SPRANKLING, *supra* note 58, at 629–31.

116. *Id.* at 628.

117. *Id.* at 500.

118. *Id.* at 631–32.

119. *See* Zwiefelhofer v. Town of Cooks Valley, 809 N.W.2d 362 (Wis. 2012) (discussing differences between zoning and land-use regulation).

120. *Id.* at 368–69.

121. 42 U.S.C. §§ 7401–7671q (2012).

122. 16 U.S.C. §§ 1531–1544 (2012).

universally acknowledged that the police power affords government broad power to restrict land use by private owners.

At the local level, it is axiomatic that both cities and counties may prohibit certain land uses altogether and regulate how permitted uses are implemented. For example, if *O* owns an undeveloped 50-acre tract called Greenacre, a county ordinance may restrict its use to farming and raising livestock, thus prohibiting *O* from engaging in more intensive uses such as housing or industry. Similarly, if industrial use is permitted on Greenacre, local law may restrict the location, height, size, square footage, parking, noise emissions, operating hours, visual appearance, and other aspects of *O*'s factory.

In addition, a variety of federal statutes adopted to serve environmental goals in response to Anthropocene pressures are implemented through land-use restrictions. Together these statutes constitute what may be viewed as a body of federal property law. For example, the Clean Water Act[124] imposes limitations on whether *O*'s factory may emit wastes into navigable waters, while the Comprehensive Environmental Response, Compensation, and Liability Act[125] may force *O* to clean up past toxic contamination on Greenacre.

Finally, various legal doctrines might be used to prohibit any construction on Greenacre, thus ensuring that it remains in natural condition. For example, if Greenacre consists of wetlands, the public-trust doctrine[126] and the federal Clean Water Act will probably prevent any construction on the land. Similarly, the federal Endangered Species Act may prevent construction if this would harm endangered or threatened species that use Greenacre as habitat.[127]

In sum, the theme linking these examples is that government today has wide power to regulate private land use. However, the ultimate constraint on this power is the Takings Clause.

3. Time Limits

American property law imposes time limits in special situations on otherwise infinite property rights. Thus, to some degree the law recognizes that the duration of a particular right may be curtailed over the owner's objection for utilitarian reasons, without any obligation to compensate the owner. England recognized this concept through the adverse-possession doctrine, which terminated

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123. *See, e.g.*, California Endangered Species Act, CAL. FISH & GAME CODE §§ 2050–2089 (2013).

124. 33 U.S.C. §§ 1251–1388 (2012).

125. 42 U.S.C. §§ 9601–9675 (2012).

126. *See, e.g.*, Nat'l Audubon Soc'y v. Superior Court, 658 P.2d 709 (Cal. 1983).

127. Under the Act, it is illegal to "take" an endangered species in the United States without a permit. 16 U.S.C. § 1538(a)(1)(B) (2012). Land development that eliminates habitat areas for an endangered species is an illegal taking of that species, absent a permit. *See, e.g.*, Babbitt v. Sweet Home Chapter of Communities for a Greater Oregon, 515 U.S. 687 (1995).

the rights of the idle owner and vested title in the industrious squatter.[128] But American law has progressed well beyond this point.

Consider the impact of the recording acts.[129] Assume *O* conveys a fee simple absolute in Blackacre to *A*, who fails to record or take possession of the property for two years; *O* then conveys to *B*. If *B* is a bona fide purchaser for value who records first, all jurisdictions assign title to *B* due to the important policy goals that the recording acts serve. As a result, the duration of *A*'s fee simple absolute is reduced to two years by operation of law.

Another example is the marketable title acts adopted in many states.[130] If an owner has a clear record chain of title back to a root of title, such as a deed, for a period varying between 20 and 40 years in different states, then the owner's title is deemed to be free and clear of all rights or interests that were recorded before the root of title. Thus, if *E* records both a private easement and a restrictive covenant burdening Blackacre, but fails to re-record them within the statutory period after *B* obtains title, the law will nullify these rights.

Involuntary time limits on property rights appear in a variety of other contexts. A city can terminate a nonconforming use without any obligation to pay compensation as long as a sufficiently long amortization period is permitted—for example, normally three to five years for a billboard.[131] Similarly, a restrictive land-use covenant cannot be enforced as an equitable servitude if conditions in the neighborhood have changed so much that the benefits of the covenant can no longer be obtained.[132] In effect, whether by direct regulation, involuntary relinquishment, or changed circumstances, many time limits are imposed on otherwise infinite property rights.

4. Geographic Limits

American law imposes new geographic limits on property rights in some instances, again typically without any compensation to the affected owner. This trend is evident in modern restrictions on the vertical and horizontal dimensions of land ownership, which go far beyond the English doctrine of accretion.

For example, the classic view was that the landowner's title extended upward "to the heavens."[133] American courts regularly espoused this absolutist view of airspace ownership until the invention of the airplane. It became apparent that this approach would effectively prohibit air travel because it was impossible to obtain every landowner's consent each time an airplane flew over private land. In this new environment, as the Supreme Court remarked in *United States v. Causby*,

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128. *See supra* note 67.

129. *See, e.g.*, CAL. CIV. CODE § 1214 (2007).

130. *See* Walter E. Barnett, *Marketable Title Acts—Panacea or Pandemonium?*, 53 CORNELL L. REV. 45, 46–47 (1967).

131. *See, e.g.*, Grant v. Mayor of Baltimore, 129 A.2d 363 (Md. 1957).

132. RESTATEMENT (THIRD) OF PROPERTY: SERVITUDES § 7.10 (AM. LAW INST. 2000).

133. 2 BLACKSTONE, *supra* note 69, at *18.

the ancient doctrine that the surface owner held title to the heavens had "no place in the modern world."[134] Instead, the Court explained, the surface owner "owns at least as much of the space above the ground as he can occupy or use in connection with the land."[135]

Similarly, American law has begun to restrict the geographic scope of an owner's title to the subsurface. Traditional theory proclaimed that title extended downward from the surface to the "center of the earth."[136] But some decisions suggest that—by analogy to airspace—the owner's title is limited to the land he or she can effectively use. As a New York court summarized in *Boehringer v. Montalto*, "the title of an owner of the soil will not be extended to a depth below ground beyond which the owner may not reasonably make use thereof."[137]

One hallmark of the early Anthropocene era was the further de facto reduction of the geographic limits of the fee simple absolute as to both the airspace and the subsurface by eliminating the only known economic use for these regions: waste disposal. For example, a series of federal statutes—beginning with the landmark 1970 amendments to the federal Clean Air Act—were adopted to combat different forms of widespread air pollution, ranging from criteria pollutants such as sulfur dioxide, to ozone-depleting chemicals such as CFCs, to greenhouse gases.[138] These statutes heavily regulate or abolish the owner's right to emit gases into airspace. Likewise, laws in some regions restrict the burning of wood, crop waste, and other combustibles, sometimes even to the point of banning home fireplaces.[139] In a parallel manner, similar pressures reduced the rights of the surface owner to emit wastes into the subsurface. Other than mineral exploitation, the principal potential use for deep subsurface areas is as a site for the disposal of various industrial wastes—most commonly, toxic and hazardous substances that are expensive to store on the surface. If surface owners truly owned title "to the center of the earth," as the common-law mantra indicated, they should be able to freely inject such wastes. But since the 1980s, the federal Resource Conservation and Recovery Act[140] and Safe Drinking Water Act[141] have prohibited such injections as a general matter. The stringency of these new geographic limits was mitigated by the creation of a new de facto form of property rights: governmental permits to emit into the airspace or subsurface. Rather than retaining the broad common-law right to use these regions as the owner wishes, the law authorized emissions only under narrow conditions.

The geographic scope of the owner's rights to the land surface is also impacted by modern law. The principal doctrines governing land boundaries—

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134. 328 U.S. 256, 260–61 (1946).
135. *Id.* at 264
136. 2 BLACKSTONE, *supra* note 69, at *18.
137. 254 N.Y.S. 276, 278 (Spec. Term. 1931).
138. *See, e.g.*, 42 U.S.C. §§ 7401–7671q (2012).
139. *See, e.g.*, Bay Area Air Quality Mgmt. Dist. Reg. 6-3-306, Requirements for New Building Construction (2015).
140. 42 U.S.C. §§ 6901–6922 (2012).
141. 42 U.S.C. § 300f–j (2012).

agreed boundary line, acquiescence, and estoppel—effectively transfer title from one owner to another in limited situations.[142] The law governing encroachments provides another illustration. Suppose that *A* builds his or her home in a manner that encroaches on land owned by neighbor *B*. If *A* acted in good faith, the court will refuse to order that the encroaching portion be removed, effectively transferring title to the disputed land from *B* to *A*.[143] Both vertically and horizontally, then, American law imposes new restrictions on the geographic rights of owners with no compensation.

C. Dynamism and the Takings Clause

The ultimate limit on our ability to reshape property rights for the Anthropocene era is the Takings Clause: government may not *take* private property without just compensation.[144] Unsurprisingly, the Supreme Court jurisprudence interpreting this clause generally reflects the historic view that property rights are rigid and absolute.[145] However, as discussed above, American courts and legislatures have adjusted property rights for decades without any serious argument that those changes violated the Clause. Accordingly, new techniques for modifying property rights that are rooted in existing legal doctrines—like those discussed above—are more likely to survive constitutional scrutiny than those that are not. Yet the circumstances under which a substantial readjustment of property rights would constitute a taking remain somewhat unclear.

It is well-settled that executive or legislative action may constitute a regulatory taking under some circumstances. But the outer limits of this doctrine remain notoriously murky. The total and immediate abrogation of a core property right would almost certainly be a taking. For example, in *Kaiser Aetna v. United States*, the Supreme Court held that the Army Corps of Engineers engaged in a taking where it effectively converted a privately owned pond into a public aquatic park because it wholly eliminated the "fundamental" right to exclude.[146] Eight years later, in *Hodel v. Irving*, the Court determined that legislation which abolished Native Americans' right to pass on their property by devise or descent constituted a taking.[147] Calling the legislation "extraordinary," the Court stressed

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142. *See* SPRANKLING, *supra* note 58, at 537–38.

143. *See, e.g.*, Proctor v. Huntington, 238 P.3d 1117 (Wash. 2010).

144. "[N]or shall private property be taken for public use, without just compensation." U.S. CONST. amend. V. For a general discussion of Supreme Court decisions on environmental issues relating to land ownership, see JONATHAN Z. CANNON, ENVIRONMENT IN THE BALANCE: THE GREEN MOVEMENT AND THE SUPREME COURT 200–30 (2015).

145. *Cf.* J. Peter Byrne, *The Cathedral Engulfed: Sea-Level Rise, Property Rights, and Time*, 73 LA. L. REV. 69, 72 (2013) (noting that the "Supreme Court's conservative majority has pursued an ideal of essential, or natural, property rights unchangeable without compensation . . . .").

146. 444 U.S. 164, 179–80 (1979).

147. 481 U.S. 704, 705 (1987).

that it entirely abrogated a right that had been "part of the Anglo-American legal system since feudal times."[148]

The Court returned to this theme five years later, this time examining a substantial restriction on the right to use. *Lucas v. South Carolina Coastal Council* involved a South Carolina statute enacted to protect life and property, which effectively precluded the plaintiff from building homes on two lots he owned.[149] Writing for the majority, Justice Scalia acknowledged that the scope of property rights could be altered by legislation—at least to some extent—without compensation. In particular, he observed that a property owner "necessarily expects the uses of his property to be restricted, from time to time, by various measures newly enacted by the State in legitimate exercise of its police powers."[150] Conversely, if a regulation proscribed "all economically beneficial use of land," as it did in this case, Scalia reasoned that it would be a taking, unless justified by pre-existing principles of property or nuisance law.[151] Justice Stevens, in dissent, lamented that the majority's approach denied the legislature's "traditional power to revise the law governing the rights and uses of property."[152] Yet Scalia's approach implicitly acknowledged that new legislation grounded in traditional principles of property law would not be a taking, even if it eliminated all economic use.

The Scalia–Stevens dispute in *Lucas* resurfaced 18 years later in *Stop the Beach Renourishment, Inc. v. Florida Department of Environmental Protection*, where the issue was whether judicial action that allegedly eliminated two minor property rights could constitute a taking.[153] The case is notable for two reasons. First, a majority of the Court agreed that judicial action which eliminates or substantially impairs an "established property right"[154] would violate the Constitution, though some justices reached this result under the Takings Clause[155] while others did so under the Due Process Clause.[156]

Second, the decision revealed substantial disagreement about the permissible outer limits of judicial adjustment of property rights. In his plurality opinion, Justice Scalia proclaimed that if a court "declares that what was once an established right of private property no longer exists, it has taken that property . . . ."[157] Scalia rejected the assertion that the common law traditionally allowed courts to modify property rights, calling it an "astounding" proposition.[158]

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148. *Id.* at 716.
149. 505 U.S. 1003, 1039 (1992).
150. *Id.* at 1027.
151. *Id.* at 1029.
152. *Id.* at 1068–69 (Stevens, J., dissenting).
153. 560 U.S. 702 (2010). The alleged property rights at issue were that of owners of ocean-front land to receive accretions to their property and to have the "contact of their property with the water remain intact." *Id.* at 711.
154. *Id.* at 715.
155. *Id.*
156. *Id.* at 735 (Kennedy, J., concurring).
157. *Id.* at 715.
158. *Id.* at 722.

From this perspective, property law is viewed as frozen in time, perpetually the same.

By contrast, Justice Kennedy responded that "[s]tate courts generally operate under a common-law tradition that allows for incremental modifications to property law," such that an incremental modification would not trigger a duty to compensate affected owners.[159] As an example, Kennedy explained that a judicial change in the common-law rule governing liability when the roots of an owner's tree cause damage to an adjacent property might not violate the Constitution because "owners may reasonably expect or anticipate courts to make certain changes in property law."[160] In fact, Kennedy's assertion that judges have routinely modified property rights without violating the Constitution is fully supported by the historical record. While rejecting the proposition that judicial action could violate the Takings Clause, Kennedy suggested that a court would be "on strong footing in ruling that a judicial decision that eliminates or substantially changes established property rights, which are a legitimate expectation of the owner," violates the Due Process Clause.[161]

In short, Scalia viewed property law as static, while Stevens and Kennedy envisioned it as at least somewhat dynamic. Under the Stevens–Kennedy approach, legislatures and courts retain the power to alter property rights to some extent without any payment to affected owners.[162] Taken together, *Lucas* and *Stop the Beach Renourishment* provide helpful guidance about how to structure changes to property law in light of the Anthropocene challenge to minimize the risk of takings liability. Legislation and regulation should be grounded in traditional principles of property law to the fullest extent possible. Similarly, judicial action should focus on gradually redefining property rights by making incremental changes in existing doctrines.

IV. RESHAPING AMERICAN PROPERTY LAW FOR THE ANTHROPOCENE ERA

A. A New Vision of Ownership

The traditional view of property rights as rigid and absolute is obsolete in the Anthropocene era. Consistent with the utilitarian approach that underpins American property law, it is time to move toward a new vision of ownership, characterized by property rights that are more flexible and less absolute. This transition may be reflected to a certain degree in voluntary transactions, such as where parties to a sale anticipate the future risk of Anthropocene change and structure their relationship accordingly. Yet much of the transition will be

159. *Id.* at 736 (Kennedy, J., concurring).

160. *Id.* at 738.

161. *Id.* at 737.

162. Five justices embraced this approach in the recent case of *Murr v. Wisconsin*. 137 S. Ct. 1933 (2017). Writing for the Court, Justice Kennedy stressed that "[a] central dynamic of the Court's regulatory takings jurisprudence . . . is its flexibility." *Id.* at 1937.

involuntary, as legislatures and courts redefine the nature and extent of property rights, thus reducing the traditional autonomy of individual owners.

Almost 100 years ago, in *Euclid v. Ambler Realty Co.*, the Supreme Court acknowledged the need for fundamental modifications to property rights in response to the unprecedented pressures of urbanization and population growth.[163] To paraphrase the *Euclid* Court, today the Anthropocene era necessitates "additional restrictions in respect of the use and occupation of private lands . . . [that] a century ago, or even a half century ago, probably would have been rejected as arbitrary and oppressive."[164]

Perpetual property rights tied to a rigid geographic location are counterproductive in the Anthropocene era. The stable external environment that shaped the evolution of the infinite fee simple absolute and other property rights in England no longer exists. In a more dynamic world, the duration and location of property rights must be more flexible than those that evolved centuries ago. Similarly, the notion that property rights are absolute in scope is outdated. Granting owners the broad right to exclude others from their lands and minimizing government regulation of land use arguably made sense in an era of stability when conflicts between owners were rare. But today, it is an anachronism.

B. Four Principles for the Anthropocene Era

It is impossible to anticipate the precise effects that large-scale human activities will have on the natural world a decade into the future, let alone in a century or more. But even at this early stage, we can develop tentative principles to reshape property law for the Anthropocene era. Inevitably, it will be necessary to recalibrate these approaches in light of future events. But the overall theme is likely to remain the same: a shift toward property rights that are more flexible and less categorical.

Major legal change is difficult to implement, for reasons that are both prudential and practical. This is particularly true when the change affects property rights. Consistent with utilitarian theory, our legal system has long stressed the importance of protecting property rights to give owners the confidence to invest in improving their lands—thus facilitating economic growth.[165] Indeed, the Supreme Court is particularly reluctant to overturn prior decisions involving property rights because of the reliance interests that stem from those precedents.[166]

Accordingly, the shift to a property law system attuned to the Anthropocene era will be incremental and will preserve traditional doctrine to the extent possible. Four broad principles should guide this transition: (1) equitable

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163. 272 U.S. 365 (1926).

164. *Id.* at 386–87.

165. *See* SPRANKLING, *supra* note 58, at 19–21.

166. *See, e.g.*, Leegin Creative Leather Prods., Inc. v. PSKS, Inc., 551 U.S. 877, 906 (2007) (quoting State Oil Co. v. Kahn, 522 U.S. 3, 20 (1997) (observing that "reliance on a judicial opinion is a significant reason to adhere to it . . . especially 'in cases involving . . . property rights'")).

sharing should mitigate the right to exclude; (2) more intensive restrictions should constrain the right to use; (3) time limits on property rights should be imposed; and (4) geographic limits on property rights should be more flexible. The subsection below discusses how these principles could be applied to deal with examples of potential Anthropocene impacts.

1. Equitable Sharing Should Mitigate the Right to Exclude

More extensive sharing of resources among owners—and hence a narrowing of the right to exclude—will be a core technique in the Anthropocene era for confronting the use-reduction and use-elimination scenarios.[167] Major external changes that will disrupt traditional arrangements in areas ranging from road access to freshwater allocation can be mitigated by equitable sharing. Presumably, market-driven approaches will be voluntarily adopted in certain situations. But involuntary sharing will also be necessary.

Parties to consensual transactions will mitigate the risk of Anthropocene impacts to some extent through planning. For example, if *A* obtains an express access easement over *B*'s land, *A* might well bargain to include the right to have the easement relocated if it becomes unusable in the future due to flooding, contamination, or other adverse impacts—an entitlement that we might call a *relocatable easement*. Similarly, given the likelihood that in some regions, freshwater allocations may be reduced in the Anthropocene era, the sale of water rights may be restructured. For example, if *C* chooses to sell part of a water entitlement to *D*, *C* might transfer a percentage of the entitlement to *D* rather than a fixed quantity of water, so that *C* retains a certain amount of water for personal use if the overall allocation is reduced.

Involuntary equitable sharing should also be utilized. Modern American law substantially constricts the owner's traditional right to exclude in a variety of situations without consideration.[168] Examples include limiting the landlord's ability to reject a potential tenant,[169] overcoming the servient owner's right to refuse an access easement,[170] and imposing a correlative-rights restriction on an owner's ability to take subsurface water, oil, or gas.[171]

One starting point would be to allow the dominant owner to relocate an easement when Anthropocene impacts make it appropriate. The modern trend is to allow the servient owner to relocate the route for a nonconsensual easement if this does not lessen the easement's utility or frustrate its purpose.[172] In a similar manner, where the existing route of an express or nonconsensual easement becomes untenable due to chronic flooding or other factors, the dominant owner

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167. *See* discussion of these scenarios *supra* Part I.

168. *See* discussion *supra* Section III.B.1.

169. *See supra* text accompanying notes 95–96.

170. *See supra* text accompanying notes 98–102.

171. *See supra* text accompanying notes 106–12.

172. M.P.M. Builders, LLC v. Dwyer, 809 N.E.2d 1053, 1058 (Mass. 2004); RESTATEMENT (THIRD) OF PROPERTY: SERVITUDES § 4.8 (AM. LAW INST. 2000).

also should be permitted to change the location, under the same terms that govern the servient owner's right.[173]

A more controversial change would be to allow an owner to obtain a new easement over the objection of the servient owner when Anthropocene impacts make it appropriate. The easement by necessity traditionally arose when title to land held in common ownership was severed, creating strict necessity—the lack of any legal right to access a landlocked parcel over the land surface.[174] However, an increasing number of states also recognize such an easement where it is beneficial or convenient to the dominant owner.[175] The scope of this easement might be extended so that it also arises when the necessity occurs after the severance of title. Suppose, for example, that *A* subdivides his or her land into two parcels and sells one to *B* at a time when *B* has a legal right of access over *C*'s land to reach a public road. If *B*'s easement route becomes unusable due to contamination that pervades *C*'s entire parcel, *B* would be entitled to claim an easement over *A*'s retained land—perhaps with compensation.[176]

Another approach is to restrict the ability of owners of coastal lands to repel rising sea levels and minimize erosion by building dikes or berms around their properties, a technique called *armoring*. This concept is reminiscent of the common-enemy doctrine that many states historically applied to diffuse surface water—an owner could exclude the water from his or her land in any manner, even if this harmed other owners.[177] Just as states have abandoned the common-enemy doctrine in the context of freshwater flooding, the same concept could be rejected as applied to seawater.[178] If certain landowners are permitted to armor their lands, this harms owners who do not armor by exacerbating the inundation of their lands.

Finally, the same equitable-sharing approach could be used to fairly allocate the shrinking supplies of freshwater resulting from climate change that will occur in some regions. For example, because rights to surface water in prior appropriation states are ranked in order of priority[179]—much like mortgages—a

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173. This proposal would be consistent with *Kaiser Aetna v. United States*, 444 U.S. 164 (1979), because the servient owner has already waived her right to exclude in part and such relocation does not wholly abrogate the right to exclude. *See* discussion *supra* Section III.C. In the same vein, the categorical rule in *Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419 (1982), that any permanent physical occupation authorized by government is a taking, would not be implicated due to the servient owner's prior waiver. More to the point, making this change through judicial action—rather than legislation or regulation—would probably insulate it from attack based on the Takings Clause.

174. *See* SPRANKLING, *supra* note 58, at 554–55.

175. *Id.* at 556.

176. The technique would be to redefine the scope of the easement by necessity through judicial action, thus minimizing the risk of takings liability. *See* discussion *supra* Section III.C.

177. *See* 2 THOMPSON ON REAL PROPERTY, *supra* note 66, § 50.20(g).

178. A few states have already banned or restricted such armoring. *See, e.g.*, CAL. PUB. RES. CODE § 30253(b) (2007); OR. ADMIN. R. 736-020-0010(6) (2017).

179. *See* A. DAN TARLOCK, LAW OF WATER RIGHTS AND RESOURCES § 5:32 (2016).

water shortage in a particular region does not affect all users equally: senior users may continue to take their full shares, while junior users receive nothing. Yet historic doctrines such as the reasonable-use restriction on surface water in riparian states, the beneficial-use requirement on surface water in prior appropriation states, and the correlative-rights approach to groundwater, oil, and gas all recognize that equitable sharing of finite resources, such as water, may be appropriate.[180] This approach might well be applied to ensure a more just allocation of freshwater in an era of shortage. For example, Eric Biber suggests that water rights be altered to "ensure minimum levels of water access for all," while Holly Doremus endorses "restrictions on water diversion for low-value historic uses . . . ."[181] Goals like these should be reached by incremental judicial redefinition of the scope of water rights—such as narrowing the definition of *beneficial use*—rather than by a wholesale reallocation of rights.[182]

2. More Intensive Restrictions Should Constrain the Right to Use

More intensive land-use restrictions will be the principal approach to the negative-externality scenario in the Anthropocene era.[183] The current level of regulation will be inadequate to accommodate the magnitude and pace of future Anthropocene pressures,[184] and voluntary restrictions imposed by individual owners, while helpful, will inevitably be insufficient.[185] Accordingly, it will sometimes be necessary to impose severe restrictions on land use through government action, ideally at the local or regional level.

Government already has broad authority to minimize adverse impacts stemming from land development, such as by regulating density and clustering structures to avoid sensitive lands.[186] But in some situations, it will be appropriate to prohibit many non-natural uses of land to protect people and property on or near the land. For instance, new construction of permanent improvements should be banned on undeveloped land that is likely to be submerged by coastal flooding caused by climate change; inundated by freshwater flooding resulting from more intensive rainfall; contaminated by migrating toxic waste; particularly susceptible to increased wildfire danger; or otherwise unusually vulnerable to other

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180. *See supra* text accompanying notes 106–08.

181. Eric Biber, *Law in the Anthropocene Epoch* 44 (UC Berkeley Public Law Research Paper No. 2834037, 2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2834037; Holly Doremus, *Climate Change and the Evolution of Property Rights*, 1 U.C. IRVINE L. REV. 1091, 1122 (2011).

182. *See* discussion *supra* Section III.C.

183. *See* discussion of this scenario *supra* Part I.

184. For example, the current level of regulation would expose the homes of almost five million Americans to inundation as sea levels rise due to global climate change. *See* MELILLO ET AL., *supra* note 9, at 9–10.

185. *Cf.* Biber, *supra* note 181, at 27 (observing that the most effective methods to deal with general Anthropocene impacts will involve "significant public coercion").

186. *See* discussion *supra* Section III.B.2.

Anthropocene impacts.[187] Existing law would justify such a ban for lands that are subject to the public-trust doctrine or are habitat for endangered species.[188] But meaningful construction bans will require a larger geographic scope, encompassing lands beyond these narrow categories. For example, virtually all undeveloped land within the immediate coastal zone is subject to potential inundation but not currently subject to public-trust or endangered-species constraints.

The Wisconsin Supreme Court famously opined in *Just v. Marinette County* that "[a]n owner of land has no absolute and unlimited right to change the essential natural characteristic of his land so as to use it for a purpose for which it was unsuited in its natural state and which impairs the rights of others."[189] Yet modern law has not endorsed this principle.[190] Accordingly, any construction ban should be accompanied by carefully tailored measures that mitigate its impact on owners to the extent reasonably possible.

Where undeveloped land likely to be subject to negative Anthropocene impacts has viable non-intensive uses—such as farming, grazing, or recreation—a construction ban will have only a minor impact on owners. Even where land is suitable for intensive uses that require construction, such as housing or industry, limited construction bans may be implemented with relative ease. For example, where only one portion of a parcel is particularly vulnerable to Anthropocene impacts, construction should be prohibited only on that portion.[191] A more difficult situation is where all the structures in a particular area are destroyed by an Anthropocene impact that is likely to recur, such as widespread flooding. Here it would be appropriate to ban any future construction to protect lives and property. This is particularly true where the affected properties are covered by flood

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187. Any ban on new construction in coastal regions must encompass areas that will be affected by future sea level rise. For example, the General Plan for Mendocino County, California, provides that new structures must be set back from the edges of coastal bluffs "a sufficient distance . . . to ensure their safety from bluff erosion and cliff retreat during their economic life spans." MENDOCINO COUNTY GENERAL PLAN § 3.4–7 (2009). The formula for computing the required setback distance considers the rate at which coastal bluffs will retreat in the future due to ocean action: "Setback (meters) = Structure life (years) x Retreat rate (meters/year)." *Id.*

188. The owner of land subject to the public-trust doctrine may not utilize it in a manner that impairs its use by the public. *See* SPRANKLING, *supra* note 58, at 534. Similarly, the owner of land that serves as habitat for an endangered species may be unable to develop it for non-natural uses. *See, e.g.*, Babbitt v. Sweet Home Chapter of Communities for a Greater Oregon, 515 U.S. 687 (1995).

189. 201 N.W.2d 761, 768 (Wis. 1972).

190. *But see generally* J. Peter Byrne, *Green Property*, 7 CONST. COMMENT. 239 (1990) (advocating an ecological approach to ownership); Eric T. Freyfogle, *The Owning and Taking of Sensitive Lands*, 43 UCLA L. REV. 77 (1995) (same).

191. For example, in *Palazzolo v. Rhode Island*, 533 U.S. 606, 631 (2001), the Supreme Court held that a state law protecting coastal wetlands that barred the petitioner from building on almost all of his 18-acre parcel was not a taking because it permitted him to construct a home on part of the land.

insurance, such that affected owners can receive monetary compensation for their lost opportunity to rebuild.

A more difficult scenario arises when vulnerable undeveloped land would normally be devoted to more intensive use in the future and has no substantial non-intensive uses.[192] One mitigation technique here would be to implement a construction ban in phases. In the first phase, for example, the law might allow a landowner to install portable structures, such as a mobile home or a prefabricated cabin on the property, which could be devoted to personal use for a set period established in advance—such as five, ten, or twenty years—based on the length of time before the land is subject to Anthropocene harms. In the second phase, the owner would be required to remove the structures, which could not be replaced. This phased approach would permit beneficial use of the affected land for the maximum possible time.[193]

The most challenging situation is the mitigation-value scenario,[194] where the public interest requires that privately owned land be preserved in its natural condition not to avoid negative externalities, but rather to mitigate general Anthropocene impacts that would otherwise harm other properties or society in general.[195] For instance, the impact of climate change can be mitigated by retaining forests, grasslands, and certain other lands in natural condition; these "sinks" absorb carbon dioxide that otherwise would contribute to climate change.[196] A local ordinance requiring that the privately owned forests in a region be preserved in perpetuity might well eliminate all viable uses and thus constitute a taking.[197] Laws that safeguard mitigation-value land from development should be

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192. In *Lucas v. S.C. Coastal Council*, 505 U.S. 1003 (1992), for instance, the Supreme Court suggested that a regulation that eliminated all beneficial use would be a taking, unless justified by background principles of property or nuisance law. However, as the Court subsequently noted in *Murr v. Wisconsin*, 137 S. Ct. 1933 (2017), in regulatory takings cases "it may be relevant that [at the time of purchase] the property is located in an area that is subject to, or likely to become subject to, environmental or other regulation." *Id.* at 1945–46; *see* discussion *supra* Section III.C.

193. This approach might well avoid takings liability under the *Lucas* test, because no amortization-like period was provided in that situation. *See* discussion *supra* Section III.C.

194. *See* discussion of this scenario *supra* Part I.

195. This scenario produces the same effect that the federal Endangered Species Act already has on certain properties. It is undisputed that the government has the inherent power, as a general matter, to prohibit any change in the natural condition of privately owned lands. As Justice Scalia observed in his dissent in *Babbitt v. Sweet Home Chapter of Communities for a Greater Oregon*, 515 U.S. 687, 714 (1995), the majority's interpretation of the Act may "impose[] unfairness . . . upon the simplest farmer who finds his land conscripted to national zoological use."

196. *See* Imke Sagemüller, *Forest Sinks under the United Nations Framework Convention on Climate Change and the Kyoto Protocol: Opportunity or Risk for Biodiversity?*, 31 COLUM. J. ENVTL. L. 189, 194–200 (2006).

197. *See Lucas*, 505 U.S. at 1016 n.7 (suggesting that a regulation that required an owner to leave 90% of a "rural tract in its natural state" would be a taking of the affected portion).

adopted more broadly, ideally at the regional level to avoid the problem of piecemeal regulation. At the same time, these laws must be carefully tailored to avoid eliminating all viable uses on an affected parcel.[198]

3. Time Limits on Property Rights Should Be Imposed

Limiting the duration of property rights in the Anthropocene era offers substantial benefits in certain situations. It may provide greater flexibility in light of changing external conditions, allocate resources efficiently, and potentially help to safeguard owner expectations, particularly in the use-reduction and use-elimination scenarios.[199] One market-oriented approach would be to legitimatize a new time-limited freehold estate. More importantly, it will be appropriate to impose involuntary time limits under narrow circumstances.

Inevitably, increasing market uncertainty will surround the purchase of particular lands in the future. For example, buyers might be reluctant to purchase property that may be subject to future desertification or inundation. In this setting, it may be beneficial to expand the use of voluntary time limits.[200] For example, legislatures or courts could permit parties to create a time-limited form of fee simple absolute, which might be called *fee simple finite*.[201] This would be a freehold estate that lasts for a period of years—e.g., 50 years—that is agreed upon in advance, something of a hybrid between the fee simple absolute and the term of years tenancy.[202] When the term ends, the seller regains title. Such an estate might include the buyer's option to renew it for one or more terms in return for a payment made pursuant to a formula agreed on in advance. The fee simple finite would effectively shift the risk of value loss caused by future Anthropocene changes from the buyer to the seller, thus facilitating transactions. Government approval of this new estate would be crucial to allowing sellers, buyers, lenders, insurers, and other participants in the land sales market to accept the innovation.[203]

Formal acceptance of the fee simple finite would be consistent with the traditional policy favoring freedom of disposition, which respects the autonomy of property owners to transfer their lands as they wish.[204] The principal objection to this concept would be the *numerus clausus* principle which seeks to restrict the creation of new forms of property rights in the interest of efficiency, mainly to

198. *See* discussion *supra* Section III.C.

199. *See* discussion of these scenarios *supra* Part I.

200. Voluntarily created, time-limited interests are common in property law. *See generally* TIME-LIMITED INTERESTS IN LAND (Cornelius van der Merwe & Alain-Laurent Verbeke eds., 2012).

201. *Cf.* Lee Anne Fennell, *Fee Simple Obsolete*, 91 N.Y.U. L. REV. 1457, 1482–86 (2016) (proposing the "callable fee," a time-limited fee simple that could be terminated by the seller over the buyer's objection, to facilitate urban redevelopment).

202. It would be impractical to use the term of years tenancy for this purpose due to lack of market acceptance. Buyers, sellers, insurers, lenders, and other market participants are accustomed to transactions involving freehold estates, not leases.

203. *See* Fennell, *supra* note 201, at 1505–08 (discussing the need for government approval of new freehold estates).

204. *See* SPRANKLING & COLETTA, *supra* note 94, at 27.

minimize transaction costs.[205] Yet today almost all land in the United States is held in fee simple absolute, with a small amount held in absolute life estates.[206] Defeasible freehold estates and defeasible life estates in land are vanishing species.[207] In this setting, the costs of recognizing one new type of fee simple estate would be negligible.

Involuntary time limits will also be a helpful tool under certain circumstances, when constitutionally and politically feasible. American law has long recognized that limits may be imposed on the duration of property rights for policy reasons in certain situations over the objection of an affected owner, without payment of compensation.[208] Examples of this technique include adverse possession,[209] marketable title acts,[210] amortization of nonconforming uses,[211] and the changed-conditions defense to enforcement of restrictive covenants.[212]

One approach would be to adopt time-limited zoning ordinances at the local level—by analogy to the amortization approach to eliminate nonconforming uses—that terminate the property rights of affected owners after an extended period, especially in the use-elimination scenario. Such an approach may survive constitutional scrutiny because it is not an immediate transfer of title and would be utilized under conditions in which the land value is either zero or almost zero.[213] This approach would both prevent future negative impacts that harm other owners and preserve public funds that would otherwise be used to provide emergency services to the few holdout owners who might remain.

For instance, where chronic flooding caused by intensified storm activity largely devastates a residential area and these conditions will recur, it may be appropriate for the city to both prohibit rebuilding the destroyed homes and allow the owners of unaffected homes to occupy them for a specified period before terminating their titles. Alternatively, imagine an agricultural region that has become almost unsuitable for farming, its only potential use, due to increasing toxic contamination or desertification. Here the county might permit continued use of the lands for a set period before terminating the titles of affected owners. In each situation, the owners retain the opportunity to benefit from their lands for a longer time, just as in the classic amortization situation where, for example, the owner of a nonconforming billboard can use it for perhaps three to five more years. This approach honors the good-faith expectations of property purchasers: that they will be allowed to benefit from their lands to some extent—and certainly

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205. *See generally* Thomas W. Merrill & Henry E. Smith, *Optimal Standardization in the Law of Property: The* Numerus Clausus *Principle*, 110 YALE L. REV. 1 (2000).

206. *See* SPRANKLING, *supra* note 58, at 115, 121.

207. *Id.* at 130.

208. *See* discussion *supra* Section III.B.3.

209. *See* SPRANKLING, *supra* note 58, at 466–77.

210. *See supra* text accompanying note 130.

211. *See supra* text accompanying note 131.

212. *See supra* text accompanying note 132.

213. *See* discussion *supra* Section III.C. Alternatively, such a technique might require a modification of current takings doctrine. *See* discussion *infra* Section IV.C.

more than if an immediate confiscation occurred. In each situation, government would now be able to manage and preserve the affected lands to avoid spillover effects on other parcels. Government would also be free from the burden of providing services such as emergency or long-term medical care for holdout owners who are injured, for example, by flooding or by toxic substances.

Another approach would be to eventually terminate property rights in the use-elimination scenario where the strength of the owner's connection to the property has waned over time to the point where it is essentially nonexistent, by analogy to doctrines such as adverse possession and marketable-title acts. For example, this technique might be used to end an estate in coastal land that is becoming submerged due to rising sea levels. As coastal land is gradually transformed into seabed, it initially becomes subject to the ebb and flow of the tides and is accordingly governed by the public-trust doctrine which greatly curtails an owner's rights.[214] Once inundation is complete, title is transferred to the state under the doctrine of accretion.[215]

Under the public-trust doctrine, partially inundated lands are subject to a servitude held by the sovereign, such that the public may use them for commerce, fishing, navigation, and other purposes.[216] The doctrine effectively prevents the owner from utilizing such land as an owner normally would because this would interfere with the protected public uses.[217] As a practical matter, the owner's entitlement in this situation has no substantive content; for example, the owner cannot exclude others or sell the title because it is largely worthless.[218] Indeed, the property may have negative value because the owner is still subject to potential personal-injury liability, for instance, if a member of the public is injured by part of a submerged structure. As a matter of property theory, at some point an owner can lose so many of the rights that constitute *property* that he or she no longer owns any "property."[219] This doctrine may apply to such submerged land through accretion even in advance of the transfer of title. In any event, where Anthropocene era changes clearly leave land with no value the public-trust doctrine might be extended to provide that any residual title in the owner has been terminated. This will both facilitate government management of such lands on a

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214. *See, e.g.*, Michaelson v. Silver Beach Improvement Ass'n, 173 N.E.2d 273, 280 (Mass. 1961) (indicating that the area of privately owned land above the low-water mark, but below the high-water mark, is subject to the public trust doctrine).

215. *See, e.g.*, Marks v. Whitney, 491 P.2d 374 (Cal. 1971) (noting that the boundary line between state ownership and private ownership is the mean high-tide line, which can shift over time).

216. For example, in California the public trust also encompasses uses such as swimming, wildlife habitat, and scientific study. Nat'l Audubon Soc'y v. Superior Court, 658 P.2d 709, 719 (Cal. 1983).

217. *See* SPRANKLING, *supra* note 58, at 534.

218. Owners of land subject to the public-trust doctrine cannot exclude the public from its use. *Id.* Accordingly, while they are free to use the land themselves, their rights as *owners* are no greater than the rights of the general public, so logically their rights would have little or no value.

219. RESTATEMENT OF PROPERTY § 10 cmt. c (1936).

regional basis to avoid negative externalities and minimize the litigation costs inherent in eminent-domain proceedings.

4. Geographic Limits on Property Rights Should Be More Flexible

Greater flexibility in the geographic location of property entitlements may be useful in the Anthropocene era. In the use-reduction and use-elimination scenarios,[220] a partial or total shift in the location of the land surface subject to the entitlement can be an appropriate tool to allocate resources equitably and minimize disruption. In addition, continuing the modern trend of shrinking the airspace and subsurface components of ownership may help to minimize negative externalities. Although the voluntary use of location flexibility devices may prove useful in the marketplace to a degree, it is likely that involuntary changes will be necessary.

In the context of facilitating urban growth, Lee Anne Fennell urges the recognition of the *floating fee*, a fee simple estate that "is not immutably moored to a fixed set of geographic coordinates, but instead represents a portable claim over equivalent property."[221] Under this proposal, a resident holding a floating fee could be forced to move—over his or her objection—to a new property. The reverse approach might be used to minimize Anthropocene era impacts. The parties to a sales transaction who wish to shift the risk of loss in the use-reduction scenario from the buyer to the seller could utilize such an estate, particularly if the seller owns a sufficiently large portfolio of fungible properties. For example, under this approach, a buyer who concludes that the region around his or her condominium has become subject to unacceptable long-term risks of contamination, disease, tornadoes, or wildfires could choose to transfer the floating fee to another condominium that the seller owns in a different region.[222]

Involuntary changes in the surface location of property entitlements should also be considered, by analogy to other relocation doctrines in property law.[223] For example, the contemporary doctrines governing land boundaries that effectively implement such location changes might be expanded to facilitate a forced land swap between two owners. Owners of adjoining rural parcels might both be better off by exchanging portions of their lands in the use-reduction scenario, based on the topography of contaminated or flooded portions of their respective lands. If the owners were both rational maximizers, they would agree to the exchange; but imagine instead that one owner irrationally objects. In this situation, the law should be able to impose an exchange at the request of the other owner.[224] Similarly, just as a boundary line traditionally moves with accretion, it

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220. *See* discussion of these scenarios *supra* Part I.

221. Fennell, *supra* note 201, at 1490.

222. The main potential objection to this approach is the *numerus clausus* doctrine. *See* Section IV.B.3, *supra*, which addresses this objection in the analogous context of the proposed fee simple finite.

223. *See* discussion *supra* Section III.B.4.

224. This might trigger concern under the public-use component of the Takings Clause. As the Supreme Court noted in *Kelo v. City of New London*, 545 U.S. 469, 477 (2005), government may not "take the property of *A* for the sole purpose of transferring it to

may be appropriate to recognize that it also shifts in response to other gradual and unforeseen shifts in the external environment, such as changes in the location of groundwater basins, if this does not cause substantial adverse impacts on adjacent owners.

Additionally, the nuisance doctrine might be used in the negative-externality scenario to shift title to all or part of a parcel to government, particularly where the owner is unresponsive or unknown.[225] For example, under the Comprehensive Environmental Response, Compensation, and Liability Act, the government is authorized to enter private land to remediate hazardous substance contamination.[226] Where such contamination poses a long-term threat to adjacent properties and the owner fails to act after due notice, the land could be declared a common-law nuisance to allow a government entity to obtain title to the land so it can effectively manage the threat on a regional basis.[227] A similar approach might be utilized where all or part of a parcel produces severe, uncontrolled nuisance-like impacts such as flooding or hazardous dust.

Finally, the modern trend of shrinking the vertical dimensions of ownership should continue. Owners should no longer be permitted to utilize the airspace above the land surface for airborne waste disposal, except in extreme circumstances. In a similar manner, it would be desirable to reduce the downward extent of property ownership, perhaps to a set distance such as 1,000 feet, which would accommodate virtually all surface uses and simultaneously allow concerted management of subsurface contamination.[228]

C. Reinterpreting the Takings Clause for the Anthropocene Era

Based on current doctrine, there is a substantial risk that major readjustment of property rights would violate the Takings Clause, unless permitted by the logic of *Lucas*[229] or *Stop the Beach Renourishment*.[230] Ultimately, it may be necessary to reappraise takings jurisprudence in light of the Anthropocene challenge. As we shift from a relatively stable world to one characterized by massive and rapid shifts in the external environment, the Supreme Court's

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another private party *B*, even though *A* is paid just compensation" because this is not a public use. However, this proposal can comply with the public-use test if it is adopted as part of a comprehensive program intended to facilitate the use of land on a regional or statewide basis, rather than one that solely concerns two particular owners.

225. *See* discussion of this scenario *supra* Part I.

226. 42 U.S.C. §§ 9601–9675 (2012).

227. This would require a modification to current takings doctrine to avoid the rule in *Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419 (1982), that any permanent physical occupation authorized by government is a categorical taking.

228. *See generally* Sprankling, *supra* note 70, at 1032–38. This could be accomplished by judicial action over time, which would minimize the risk of taking liability. *See* discussion *supra* Section III.C.

229. Lucas v. S.C. Coastal Council, 505 U.S. 1003 (1992).

230. Stop the Beach Renourishment, Inc. v. Fla. Dep't of Envtl. Prot., 560 U.S. 702 (2010).

interpretation of the Takings Clause may well evolve toward a more flexible and less absolutist vision of property rights.[231]

As Justice Holmes explained in *Pennsylvania Coal v. Mahon*, "[g]overnment hardly could go on if to some extent values incident to property could not be diminished without paying for every such change in the general law."[232] This is particularly true in the Anthropocene era. The magnitude of government readjustment of property rights that becomes necessary in the future might well be so large that full payment is impossible. As it becomes necessary to rethink our foundational assumptions about the takings doctrine, two themes are helpful: (1) the reasonable expectations of owners; and (2) the emergency exception.

First, the existence of a taking is determined—to some extent—by the reasonable expectations of property owners. This theme initially surfaced in *Penn Central Transportation Co. v. City of New York*, where the Court adopted a new three-factor test for determining whether a taking had occurred;[233] it explained that one of the relevant factors was "the extent to which the regulation has interfered with distinct investment-backed expectations . . . ."[234] In the same vein, the Court's later opinion in *Lucas* observed that the test for defining the parcel subject to the Takings Clause stemmed from "how the owner's reasonable expectations have been shaped by the State's law of property . . . ."[235] Concurring in *Lucas*, Justice Kennedy stressed that "[t]he expectations protected by the Constitution are based on objective rules and customs that can be understood as reasonable by all parties involved . . . in light of the whole of our legal tradition."[236] He observed that "[t]he State should not be prevented from enacting new regulatory initiatives in response to changing conditions."[237]

This analysis might suggest that government could evade takings liability by enacting legislation that weakens property rights—and thereby lowers the reasonable expectations of future owners. But writing for the majority in *Palazzolo v. Rhode Island*, Kennedy rejected the argument that "by prospective legislation the State can shape and define property rights . . . and subsequent owners cannot claim any injury from lost value. After all, they purchased or took title with notice of the limitation."[238] Nonetheless, as Justice O'Connor observed in her concurring opinion, the lack of reasonable expectations is still an important component in the

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231. *Cf.* Byrne, *supra* note 145, at 85–108 (discussing how the Takings Clause would apply to various regulatory responses to rising sea levels produced by climate change).

232. 260 U.S. 393, 413 (1922).

233. 438 U.S. 104, 124 (1978).

234. *Id.*

235. Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1016 n.7 (1992).

236. *Id.* at 1035 (Kennedy, J., concurring).

237. *Id.*

238. 533 U.S. 606, 626 (2001).

takings inquiry: "the regulatory regime in place at the time the claimant acquires the property at issue helps to shape the reasonableness of those expectations."[239]

As government responds to the cascading impacts of the Anthropocene era, it seems likely that virtually all owners will reasonably anticipate that the nature and scope of their property rights will be limited by future laws, regulations, and decisions. In particular, owners who purchase their properties after widespread Anthropocene impacts become apparent may not be successful in claiming that they had any reasonable expectation of avoiding future legal controls. For example, today it is broadly understood that rising sea levels threaten to inundate many coastal properties.[240] Public knowledge about the magnitude of this risk will expand as sea levels rise and new restrictions on coastal construction are imposed. At some point, a person who purchases an undeveloped ocean-front lot will not be able to convincingly assert that he or she had a reasonable expectation of being able to build a home on the land. Under the O'Connor approach, this would substantially reduce the likelihood that such an owner could establish a compensable taking because the expectation would be unreasonable. Indeed, even Kennedy would presumably concede that government must be able to adopt new legislation and regulations in "response to changing conditions" stemming from Anthropocene impacts without paying compensation.[241]

Second, it is well-settled that government is not obligated to compensate under the Takings Clause when it intentionally destroys property in an emergency. This rule arises most commonly where the purpose of the destruction is to prevent the spread of fire to other properties.[242] But it has also been applied in other situations, such as preventing disease[243] or ensuring that valuable property is not captured by a wartime enemy.[244] As the Supreme Court observed in *Lucas*,

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239. *Id.* at 633 (O'Connor, J., concurring). In *Murr v. Wisconsin*, the Court embraced Justice O'Connor's approach. 137 S. Ct. 1933 (2017) Writing for the majority, Justice Kennedy observed that "[a] reasonable restriction that predates a landowner's acquisition . . . can be one of the objective factors that most landowners would reasonably consider in forming fair expectations about their property." *Id.* at 1945. He explained that "[i]n particular, it may be relevant that the property is located in an area that is . . . likely to become subject to . . . environmental . . . regulation." *Id.* at 1945–46.

240. *See* MELILLO ET AL., *supra* note 9, at 9–10.

241. *Lucas*, 505 U.S. at 1035 (Kennedy, J., concurring). Subsequently, in *Murr*, Justice Kennedy returned to this flexibility theme in his majority opinion. He explained that the Court's regulatory taking jurisprudence sought to "reconcile two competing objectives": "the individual's right to retain the interests and exercise the freedoms at the core of private property ownership" and "the government's well-established power to 'adjust rights for the public good.'" *Murr*, 137 S. Ct. at 1943 (quoting Andrus v. Allard, 444 U.S. 51, 65 (1979)). He concluded that "adjudicating regulatory takings cases" required "a proper balancing of these principles." *Id.*

242. *See, e.g.*, United States v. Pacific R.R., 120 U.S. 227, 238–39 (1887). *See generally* Brian Angelo Lee, *Emergency Takings*, 114 MICH. L. REV. 391 (2015).

243. *See, e.g.*, Juragua Iron Co. v. United States, 212 U.S. 297 (1909).

244. *See, e.g.*, United States v. Caltex, Inc., 344 U.S. 149 (1952).

destruction to save buildings from fire or "to forestall other grave threats to the lives and property of others" is an exception to takings liability.[245]

The scope of the emergency exception could be expanded beyond the destruction of tangible items to also encompass the modification or destruction of property rights, at least where lives and property are at risk. The principal difficulty with this approach is the need to revise the definition of *necessity*—which typically connotes an unforeseen and immediate need—so that it encompasses negative impacts that are anticipated and may emerge gradually.[246] Yet the core logic underpinning the exception is the government's inability to fully compensate owners due to the scale of the emergency, a rationale which applies equally to long-term Anthropocene impacts.

Alternatively, Brian Angelo Lee proposes the concept of fiscal-noncompensation necessity, which "arises when limitations on the relevant party's available wealth restrict its ability to pay full compensation."[247] This approach responds to Justice Holmes' *Pennsylvania Coal* dictum that government is practically unable to compensate owners on every occasion when its actions affect property value. In this situation, Lee argues that partial compensation may still be appropriate to the extent that it is fiscally possible.[248] Local governments, in particular, may be unable to respond to Anthropocene impacts under some circumstances due to fiscal constraints—full compensation to landowners might literally force them into bankruptcy. Such a modified approach to compensation would be necessary for these governments to meet their duty to safeguard the public.

CONCLUSION

The Anthropocene era marks a profound transition in the relationship between humanity and the planet. Humans have replaced nature as the dominant force transforming the Earth. This reality will necessitate a variety of major social, cultural, economic, and other changes, including conceptual changes to our traditional view of property rights.

Today, at the dawn of the Anthropocene era, it is impossible to fully anticipate how human-caused changes will alter the planet in the future. Indeed, based on recent history, the scale and intensity of change are likely to accelerate. It would be premature to speculate about how this process will affect specific property doctrines. At this point, however, we can predict that property law will

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245. *Lucas*, 505 U.S. at 1029 n.16.

246. This approach is supported by the Court's interpretation of the Takings Clause in *Miller v. Schoene*, 276 U.S. 272, 277 (1928). The case involved a statute requiring the destruction of red cedar trees that could spread a plant disease called cedar rust, which could threaten local apple orchards. The Court upheld the statute despite the absence of any imminent harm, explaining that "the state does not exceed its constitutional powers by deciding upon the destruction of one class of property in order to save another which, in the judgment of the legislature, is of greater value to the public." *Id.* at 279.

247. Lee, *supra* note 242, at 406.

248. *Id.* at 409–10.

evolve in response to the Anthropocene challenge by moving toward a more dynamic system. The rigid and absolutist approach to property rights, which still largely prevails in American property law, must be replaced by new standards based on property rights that are both more flexible and less categorical. The overarching principles discussed above—potentially supplemented by modified Takings Clause jurisprudence—will help guide this evolution.