

ECOSYSTEM SERVICES AND THE VALUE OF LAND

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ABSTRACT

The concept of clear title to land is much more recent than is generally recognized in the United States. Less than 200 years ago, the basis of property rights for land was still being worked out, including the details of surveying, appraisal, and legal language for deeds. The transformation of the relatively abstract notion of land ownership into a precisely measured quantity recorded in a legal instrument was quietly revolutionary. Title to land serves as a fundamental element of our economic system—delineated ownership of land serving as collateral for borrowing—but it is such a commonplace element that it is largely taken for granted.

While clear title solidified the value of land as a place to build on, it also augmented value of land as a place from which to take resources. Though natural resource harvesting and extraction is ancient human behavior, modern forms of property rights have facilitated enormous investment and wealth creation. One example of the way in which policy regarding land ownership determines a pattern of wealth creation comes from the gold rush era, when questions of measurement were central to the legal and physical conflicts that shaped the settlement of the American West.

The concept of ecosystem services—the financial value of the measurable productivity of natural systems—represents a third way of valuing land and rewarding private landowners and land managers. As with real estate and natural resource extraction, ecosystem service revenue depends on the transformation of an abstract notion of ownership through the application of science. Measurable units of

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ecosystem service production that support climate stability, water quality and biological resiliency are the basis for a revolution in our understanding of value that has profound implications for policy and for investment.

INTRODUCTION

While the most recent financial crisis has focused attention on the flaws and failures of regulation for mortgage-backed securities and other real estate derivatives, the principle that we can own land, build on it, and take resources from it is still a rock on which the world economy stands. Trillions of dollars in mortgages depend on a refined system of surveying and appraisal, along with legal instruments that reflect these measurement techniques.

It is commonly assumed that the financial value of land is derived from building on it or extracting from it. The major conservation efforts of the past century to provide a countervailing force to the ecological damage created by development and extraction have involved taking property *out of the economy* by creating categories of protected legal status, including parks, wilderness areas, national wildlife refuges, conservation easements and so on.

Just because land is taken out of private ownership, however, does not mean it is truly disconnected from economic pressures. Of the lands owned and managed by the federal government, at least 66 percent are available to produce revenue from extraction or harvesting of natural resources.¹ And despite the great success of various private land conservation efforts, the total amount of land actually conserved by all of the NGOs and land trusts in the U.S. is only 37 million acres, or 1.6 percent of the land base of the country.²

And of course sprawl and development continue to impact privately owned land across the United States in a dramatic fashion. Deforestation and loss of agricultural land occurs at the rate of two

1. See U.S. GEN. ACCOUNTING OFFICE, LAND OWNERSHIP: INFORMATION ON THE ACREAGE, MANAGEMENT, AND USE OF FEDERAL AND OTHER LANDS 2 (1996), available at <http://www.gao.gov/archive/1996/rc96040.pdf> (stating that 272 million acres of the 622.8 million acres (roughly 44%) currently managed by federal agencies were held primarily for conservation purposes, thus allowing 66% to be available for resource extraction and related activities).

2. See Land Trust Alliance, *2005 National Land Trust Census*, <http://www.landtrustalliance.org/about-us/land-trust-census> (stating that total acres conserved by local, state, and national land trusts doubled to 37 million acres. Dividing that by the total 2.26 billion acres of U.S. land equals 1.6 percent of the land base of the country).

million acres each year,³ and natural resource extraction continues to expand significantly despite recent energy conservation and recycling successes.⁴ Nor is there any end in sight to these trends, as the population of the U.S. is anticipated to reach almost 400 million over the next twenty years.⁵

The fundamental response of environmental law to the impacts from development, harvesting and natural resource extraction has been to try to stop the most egregious damage. The entire “alphabet soup” of environmental law—the Clean Air Act, the Clean Water Act, the Endangered Species Act, the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation and Liability Act, the Surface Mining Control and Reclamation Act, and so on—was developed over the past fifty years in response to one warning shot across the bow after another. Disasters ranging from the California Condor to the burning Cuyahoga sparked federal statutes, and most kinds of development now routinely submit to a host of planning and siting requirements.⁶

Still, government sends a profoundly contradictory message to investors looking at real estate and natural resources. In addition to laws that prohibit and restrict impacts, there are ongoing subsidies for resource extraction and active promotion for many forms of economic development.⁷ States openly compete to host manufacturers and jobs, massive public infrastructure projects enable development, and a host of laws from the 1872 Mining Act to natural

3. RALPH J. ALIG, *DEFORESTATION RESEARCH IN THE UNITED STATES: EVIDENCE TO INFORM THE AVOIDED DEFORESTATION DISCUSSION 2* (2007), available at <http://www.docstoc.com/docs/23563543/Deforestation-Research-in-the-United-States-Evidence-To-Inform>.

4. See generally JOHN SAWHILL & RICHARD COTTON, *ENERGY CONSERVATION: SUCCESSES AND FAILURES 1–8* (The Brookings Inst. ed., 1986) (discussing many of the energy conservation successes of the past several decades).

5. U.S. CENSUS BUREAU, *INTERIM PROJECTIONS OF THE TOTAL POPULATION FOR THE U.S. AND STATES: APRIL 1, 2000 TO JULY 1, 2030* (2005), available at <http://www.census.gov/population/projections/SummaryTabA1.pdf>.

6. See, e.g., Office of Gen. Counsel, U.S. Dep’t of Energy, DOE NEPA Documents, http://www.gc.energy.gov/NEPA/DOE_NEPA_documents.htm (last visited May 30, 2010) (listing the variety of potential regulations and requirements for development under merely one of these statutes•NEPA).

7. See Simon H. Ginsberg, *Comment: Economic and Environmental Challenges to Natural Resource Trade*, 10 EMORY INT’L L. REV. 297, 297 (1996) (discussing the problems with natural resource subsidies in the context of U.S. trade policy); U.N. Env’t Programme GEO-2000, *Alternative Policy Study: Resource Use in North America*, <http://www.unep.org/Geo2000/aps-america/index.htm#subsidy> (last visited May 30, 2010).

resource depletion allowances directly support environmentally damaging activities.

The overarching effect of these two forces—environmental protection and economic development—has resulted in a legal framework in which the most significant environmental impacts are no longer the result of illegal activities, but the result of the cumulative effects of perfectly legal activities. While there are ongoing attempts to make additional impacts illegal—notable current examples include the suspension of the “nationwide permit” for mountaintop removal coal mining⁸ and the proposed regulation of greenhouse gas emissions by the U.S. Environmental Protection Agency⁹—the pool of global investment capital is still rewarded more for damaging activities than for restorative ones. This pool of capital—now estimated by the International Monetary Fund at \$83 trillion—is over four times larger than the annual budgets of all the governments in the world combined.

There are two new factors on the scene that are combining to create a tremendous opportunity. One is the rapidly growing recognition by the scientific community of the value of natural systems for what they *do*—in terms of measurable outputs of clean water, climate stability and biodiversity *in addition to* the ability of land to provide traditional “natural resources.” The other is the *government innovation* of market mechanisms and incentives that reward conservation, stewardship, and restoration actions taken by landowners and land managers to produce these outputs.

These two factors—scientifically verifiable metrics for ecosystem service production and market mechanisms that reward this production—create a new dynamic of supply and demand. New techniques and tools improve our ability to measure the scarcity of natural systems in relation to actual human numbers and human needs. At the same time, regulatory innovations like “cap and trade” are driven by the absolute need to respond to new knowledge of scarcity with effective policy.

8. Eric Bontrager, *MINING: Army Corps Moves to End Streamlined Mountaintop Permitting*, GREENWIRE, July 15, 2009, available by subscription at <http://www.eenews.net/Greenwire/print/2009/07/15/19>.

9. U.S. Env't Prot. Agency, *Climate Change-Regulatory Initiatives, Advance Notice of Proposed Rulemaking: Regulating Greenhouse Gas Emissions under the Clean Air Act*, <http://www.epa.gov/climatechange/anpr.html> (last visited May 30, 2010).

New market mechanisms and incentive programs to recognize and reward protection of natural systems are based on an old truth: people react to prices. We know what trees are worth in terms of board feet of timber or tons of pulp. As more landowners can see what they are worth, still standing, as tons of carbon, they are beginning to think about leaving them standing.¹⁰ The new common denominator between extraction value and conservation value is the fact that there *is* a denominator. If the “natural value” of a tree standing has no measure, it cannot compare with the value of the tree cut down for production of lumber or paper. Thus, the fundamental innovation in pricing conservation today is the pricing of *units of conservation* that are *different than the units used for development or for natural resources*.

These new measures include tons of carbon, of course, but also more complex indicators of ecosystem productivity. For example, the concept of “functional acres”—the measure of land area multiplied by a factor that reflects how much that land area produces in ecosystem services—is being used to create fair and verifiable connections between land impacts and required mitigation.¹¹ While methods for these calculations are still comparable to early methods used for surveying, there are already excellent examples that track single attributes, like wetlands hydrology or forest carbon, and more complex ones that track multiple attributes like the General Crediting Protocol for the Willamette Basin.¹²

These methods provide the basis for *natural accounting*, which allows credits and debits to reflect impacts and related offsets more accurately and objectively than do previous methods. The current levels of accuracy and objectivity, although imperfect, are sufficient to provide a direction for the compass of future environmental policy; by counting and pricing both impacts and the results of conservation, we are reconnecting economy with ecology.

10. See BARNEY DICKSON ET AL., U.N. ENV'T PROGRAMME, CARBON MARKETS AND FOREST CONSERVATION: A REVIEW OF ENVIRONMENTAL BENEFITS OF REDD MECHANISMS 6 (2009), available at http://www.unep-wcmc.org/climate/pdf/Env%20benefits%20from%20REDD%20091204_FINAL%20FOR%20COP15.pdf.

11. To see how these functional acres are applied in practice, see, e.g., WILLAMETTE PARTNERSHIP, ECOSYSTEM CREDIT ACCOUNTING—PILOT GENERAL CREDITING PROTOCOL: WILLAMETTE BASIN VERSION 1.1, at 6 (2009), available at <http://willamettepartnership.org/ecosystem-credit-accounting/willamette-ecosystem-marketplace-documents/General%20crediting%20Protocol%207.20.09.pdf>.

12. See *id.*

The article that follows provides some analysis and thought on three major issue areas where ecosystem services theory is moving into practice in the United States. The first of these is land regulation and the use of incentives to motivate private landowners, as well as improving the process of siting and permitting infrastructure, energy, and other development projects. The second is the prospect of making federal expenditures more effective and accountable in producing environmental results through the Farm Bill, regional environmental initiatives, and direct management of federal lands. The last is the way in which policy is leading to the creation of an ecosystem services “asset class” from the perspective of private and institutional investors.

I. BACKGROUND

In order to apply ecosystem services metrics to real life land management problems, one must address fundamental questions about the process of quantifying ecosystem services and how the protection and provision of these services results from land management decisions. The following section explains some of these underlying issues and provides background on the evolution and current uses of the ecosystem services model in various regulatory programs in the United States.

A. The Beginning of Offset-based Regulation

The development of modern environmental regulations throughout the twentieth century was catalyzed by the increasing visibility of pollution produced by the dramatic growth in the chemical, plastics, petroleum, automotive, aviation and munitions sectors and the deleterious effect of this pollution on public health.¹³ The early efforts of the fledgling Environmental Protection Agency (“EPA”), in turn, focused on public health and minimizing the impact of industrial pollution as the driving policy goals of environmental legislation and regulation.¹⁴ These goals have remained much the

13. See, e.g., Richard D. Cudahy, *Thirtieth Anniversary Edition Essays: Coming of Age in the Environment*, 30 ENVTL. L. 15, 15–18 (2000) (stating that the modern American environmental movement began after World War II when a rapidly proliferating automobile culture, mounting air pollution, suburban sprawl, widely publicized environmental disasters, and concern about the side effects of pesticide use on public health triggered the formation of the Environmental Protection Agency and the promulgation of early environmental regulation).

14. See generally William D. Ruckelshaus, *Environmental Regulation: The Early Days at EPA*, EPA Journal (1988), available at <http://www.epa.gov/history/topics/regulate/02.htm>

same over the past forty years,¹⁵ but methods for increasing the effectiveness of environmental regulation have continued to evolve.¹⁶

One of the most significant ideas to emerge has to do with the creation of incentives that align economic interest with environmental outcomes. More than twenty years ago the rationale for this theory was given both form and substance by a remarkable policy innovation process that became known as Project 88.¹⁷ This bipartisan effort was led by Democratic Senator Tim Wirth and Republican Senator John Heinz, and some of the language they used to describe environmental problems could have been written yesterday: “We face a huge Federal deficit, growing costs for each new increment of pollution control, and the challenges of new and even more daunting problems in the coming decades . . . While conventional regulatory approaches have been effective, they need to be supplemented. Setting uniform standards or requiring specific control technologies is increasingly a difficult and expensive method to achieve environmental improvements.”¹⁸

(detailing the early actions taken by the new Agency were an effort to stop hot water discharges from power plants, a program to close 5,000 open dumps, and to file suit against the cities of Detroit, Cleveland, and Atlanta for polluting their rivers with sewage).

15. *See generally* ROBERT W. COLLIN, *THE ENVIRONMENTAL PROTECTION AGENCY: CLEANING UP AMERICA’S ACT*, 1–51 (2006) (asserting that of the major statutes administered by the EPA are nearly all aimed at stopping pollution and minimizing deleterious public health consequences. These statutes are: the Asbestos Hazard Emergency Response Act, the Atomic Energy Act, the Chemical Safety Information, Site Security and Fuels Regulatory Relief Act, the Clean Air Act, the Clean Water Act (including the Federal Water Pollution Control Act amendments), the Comprehensive Environmental Response, Compensation and Liability Act (“Superfund”), the Emergency Planning and Community Right to Know Act, the Endangered Species Act, the Energy Policy Act, the Federal Food, Drug and Cosmetic Act, the Federal Insecticide, Fungicide and Rodenticide Act (my personal favorite), the Food Quality Protection Act, the Lead Contamination Control Act, the Marine Protection, Research and Sanctuaries Act, the National Environmental Policy Act, the National Environmental Education Act, the National Technology Transfer and Advancement Act, the Nuclear Waste Policy Act, the Occupational Safety and Health Act, the Oil Pollution Act, the Pollution Prevention Act, the Resource Conservation and Recovery Act, and the Safe Drinking Water Act).

16. *See infra* p. 7-20 (discussing the development of market-based “offset” regulation).

17. KATHY MCCAULEY, BRUCE BARRON & MORTON COLEMAN, *CROSSING THE AISLE TO CLEANER AIR: HOW THE BIPARTISAN “PROJECT 88” TRANSFORMED ENVIRONMENTAL POLICY* 2–3, (2008), *available at* <http://www.iop.pitt.edu/documents/Case%20Studies/Crossing%20the%20Aisle%20to%20Cleaner%20Air.pdf>.

18. ROBERT STAVINS ET AL., *PROJECT 88: HARNESSING MARKET FORCES TO PROTECT THE ENVIRONMENT 2* (1988), *available at* http://www.hks.harvard.edu/fs/rstavins/Monographs_&_Reports/Project_88-1.pdf.

One of the major issues of the late 1980s was acid rain caused by pollution from burning coal.¹⁹ Previously, in order to address this, the 1977 amendments to the Clean Air Act (“CAA”) contained provisions that required the installation of pollution-controlling scrubbers at all new power plants, but ten years later, many metropolitan areas around the country were still not in compliance. In response, the EPA prepared to impose sanctions while members of Congress considered relaxing requirements and pushing back timelines.²⁰ The CAA was essentially stuck, and the cost of containing acid rain was the main sticking point.²¹

Following directly on the recommendations in the Project 88 report, the CAA amendments of 1990 created the first offset-based regulation program.²² Under this system the government allocated permits to all regulated parties that limited the amount of permissible sulfur dioxide that they could emit.²³ Then, these companies were given the option to meet their compliance obligations by either installing the requisite pollution control technology or by purchasing “allowances” from third parties whose emissions were below their permitted amount.²⁴ The market created for “outsourced compliance” credits that followed provided impetus for successful political progress in moving the bill.²⁵ Even more importantly, it changed the way that policymakers thought about environmental regulation by creating a model within which *every measureable unit of environmental improvement had economic value*.²⁶

19. See MCCAULEY ET AL., *supra* note 17, at 7–8 (stating that the “acid rain debate” was one of the main stumbling blocks to reaching consensus when the Clean Air Act was revisited in debates throughout the 1980s).

20. *Id.*

21. See, e.g., MCCAULEY ET AL., *supra* note 17, at 7 (stating that more than 70 bills on acid rain were introduced before 1989 but none of them passed); Philip Stabecoff, *Senators Announce Accord on Acid Rain Bill*, N.Y. TIMES, July 14, 1988, at A30.

22. See, e.g., MCCAULEY ET AL. *supra* note 17, at 21–22 (discussing the novelty of a regulatory system with market-based economic incentives for compliance and how Senator Heinz went to the editorial boards of all the top American publications to convince them of the viability of such a program).

23. *Id.* at 30.

24. *Id.* at 33.

25. See generally *id.* at 19–31 (discussing the legislative history surrounding the passage of the CAA amendments of 1990 and asserting that the use of a program with market-based economic incentives for compliance was primarily what helped break the impasse that had formed to previous attempts at amendment).

26. See *id.* at 34–38 (noting that regulations using carbon offsets became an attractive alternative to traditional command and control environmental regulation).

The first trades for air pollution reduction took place in Southern California and basic elements of the program demonstrated several fundamental principles that must be present for this type of program to work effectively. The first was that for offset trading to be acceptable to the community, critics needed assurance that the overall environmental goal—reduced air pollution—would in fact be achieved.²⁷ The market-based incentives proposed by Project 88 relied on regulators' ability to measure and monitor emissions of specific compounds at hundreds of facilities, and enforcement grounded in good science would be critical.²⁸

A second element was government accountability.²⁹ More than 300 facilities in the program, covering all types of industry in the Los Angeles basin including power plants, refineries, cement plants, dye plants, and paper mills were on the hook to meet the requirements of the regulation, but the government was on the hook itself for the overall program result.³⁰ For this to be credible, the government needed to provide transparency.³¹ Trading data was available to the public on a regular basis and annual reports were released.³²

The third element was that the program had to make economic sense. There was no point putting together a sophisticated trading system if the traditional form of regulation produced just as much public benefit for the same cost.³³ Prior to the launch of the program, a March 1, 1989 analysis showed that the cost to utilities of using command-and-control to curb sulfur dioxide emissions by 9 million tons would be \$6-\$7 billion per year.³⁴ When the final Clean Air Act Amendments of 1990 were signed into law, they actually required reductions of 10 million tons per year, but *because trading provisions allowed those who could reduce most cost effectively to provide a higher proportion of overall compliance*, the actual costs for the

27. See, e.g., *id.* at 25–32 (describing environmental activists initial suspicion of market-based initiatives because they wanted to ensure that overall pollution levels were in fact being reduced).

28. See *id.* at 38.

29. See *id.*

30. See *id.* at 36.

31. *Id.*

32. See South Coast Air Quality Management District, RECLAIM Trading Credits (RTCs) Trade Information, http://www.aqmd.gov/reclaim/rte_main.html (last visited April 23, 2010).

33. See MCCAULEY ET AL., *supra* note 17, at 39.

34. The analysis was conducted by ICF Resources International for the EPA's Office of Policy, Planning and Evaluation. *Id.* at 24.

program turned out to be dramatically lower: in the range of \$1.0-\$1.4 billion per year.³⁵

These three elements—enforcement grounded in good science, government accountability, and economic results—are common to each of the major initiatives that now use, or have the potential to use, ecosystem services as an organizing principle. Most analysis of cap and trade programs to date has focused on the fact that this approach can produce the same result for less total cost, and while this is both true and important, the real power of the idea is that it creates an incentive for private actors to go *beyond the standards set for compliance*.³⁶

B. Connecting Ecosystem Impacts to Offsets: Current Mitigation and Credit-trading Programs

A baseline for environmental performance set by regulation, and an economic incentive to provide performance beyond that baseline—this is the common principle behind all environmental offset and credit-trading programs.³⁷ In the twenty years since the passage of the CAA amendments in 1989, these principles have been applied in efforts to solve a wide range of environmental problems. A representative sample of these programs are described below.

1. Wetlands

Remarkably, the Project 88 document not only paved the way for successful passage of Clean Air Act amendments, but it also dealt rigorously with the application of market forces to a wide range of environmental issues, including public land management and wetland conservation.³⁸ While the report stopped short of recommending a formal mechanism like the advanced compensatory structure we find today in the rules issued jointly by the EPA and the US Army Corps

35. Envtl. Def. Fund, *The Cap and Trade Success Story*, <http://www.edf.org/page.cfm?tagID=1085> (last visited May 30, 2010).

36. *See, e.g., id.* (explaining that, in the 1990s, the U.S. acid rain cap-and-trade program allowed power plants to take advantage of the allowance banking provisions, reducing SO₂ emissions twenty-two percent below mandated levels for the first phase of the program).

37. *See generally* Envtl. Def. Fund, *The Four Elements of Good Carbon Cap Legislation*, <http://www.edf.org/article.cfm?contentID=9201> (last visited May 30, 2010) (explaining that the value in a carbon offset program comes from the allowance of effective management of cost at a baseline level without the need for a safety valve).

38. MCCAULEY ET AL., *supra* note 17, at 14.

of Engineers (“Army Corps”) that govern mitigation banking,³⁹ it did call for “a comprehensive plan for wetland conservation [including] *self-enforcing inducements for people to take into account the full social value of wetlands.*”⁴⁰

Wetlands are the poster children of U.S. markets for conservation-related credits because they have been so badly damaged here⁴¹ and because they provide such a remarkable array of services.⁴² There were approximately 215 million acres of wetlands in the continental U.S. at the time of European settlement, and by the mid-1970s less than half of that remained.⁴³ In 1988, wetland losses were still averaging 60,000 acres per year, while recognition of the role of wetlands in providing habitat for waterfowl and other game, nurseries for fish, flood control and water quality improvement was rapidly increasing.⁴⁴

Section 404 of the Clean Water Act, which requires mitigation for all unavoidable impacts resulting from “discharge of dredged or fill material into the navigable waters of the United States,”⁴⁵ enables wetland mitigation banking. In 1981, the *U.S. Fish and Wildlife Service Mitigation Policy* was published,⁴⁶ and in 1983 U.S. Fish and

39. See generally U.S. Env'tl. Prot. Agency, Wetlands—Compensatory Mitigation, <http://www.epa.gov/wetlandsmitigation/#regs> (last visited Apr. 23, 2010) (noting the number of comprehensive federal statutes that create a formal mechanism governing mitigation banking).

40. STAVINS *supra* note 18, at 72.

41. See, e.g., OFFICE OF WATER & OFFICE OF WETLANDS, OCEANS AND WATERSHED, U.S. ENV'TL PROT. AGENCY, THREATS TO WETLANDS 1 (2001), available at www.epa.gov/owow/wetlands/pdf/threats.pdf (explaining that U.S. wetlands continue to be drained or developed at a rate of 60,000 acres per year).

42. See, e.g., *id.* (warning that destroying or degrading wetlands can lead to serious consequences, such as increased flooding, extinction of species, and decline in water quality). But see James Salzman & J.B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 STAN. L. REV. 607, 662–63 (2000) (noting that there is a fungibility problem in trading credits for wetlands ecosystem services because each wetland, and the services it provides, are specific to the context in which they occur).

43. See U.S. ENVTL. PROT. AGENCY, *supra* note 39, at 1.

44. THOMAS E. DAHL, U.S. FISH & WILDLIFE SERV., WETLANDS LOSSES IN THE UNITED STATES: 1780'S TO 1980'S 1 (1993), available at http://www.fws.gov/wetlands/_documents/gSandT/NationalReports/WetlandsLossesUS1780sto1980s.pdf (explaining that although wetlands cover only about 3.5 percent of U.S. land area, more than one-third of the United States' threatened and endangered species live exclusively in wetlands).

45. See Clean Water Act §404, 33 U.S.C. § 1344 (2007) (requiring entities to obtain a permit in most situations before they can dump dredged or fill material into watersheds).

46. See U.S. Fish & Wildlife Serv., *Mitigation Policy: Notice of Final Policy*, 46 Fed. Reg. 7,656 (Jan. 23, 1981), available at <http://www.fws.gov/policy/A1501fw2.html>.

Wildlife Service (“USFWS”) followed this with “interim guidance” on mitigation banking.⁴⁷

Essentially, wetland banks must invest in conservation and restoration activities *in advance* of selling credits to offset impacts from projects that affect wetlands, and they can only sell credits within the watershed where they are located.⁴⁸ In order to create a credit, a bank must meet stringent ecological success criteria for restoration actions, it must provide permanent protection for the underlying land in the form of a conservation easement or deed restriction, and it must provide financial assurance similar to a bond tied to project success.⁴⁹

The first commercial mitigation bank was formed in 1982 as a pilot project, the first sale of a “credit” providing CWA Section 404 compliance to a third party occurred in 1986, and the first permit for an entrepreneurial wetland mitigation bank was issued in 1992.⁵⁰ Since that time, the mundane, technical sounding language of compensatory mitigation has led to billions of dollars in transactions that provide one of the premier examples of aligning economy with ecology through the creation of legally-based incentives.⁵¹

Progress in refining regulation in support of this alignment continues.⁵² The July 2008 regulations issued by the EPA and the Army Corps require a hierarchy for compliance that prioritizes

47. U.S. Env'tl. Prot. Agency, Wetlands: Mitigation Banking Factsheet, <http://www.epa.gov/owow/wetlands/facts/fact16.html> (last visited May 30, 2010).

48. *See id.*; Ecosystem Marketplace, U.S. Wetland Banking: Market Features and Rules, http://www.ecosystemmarketplace.com/pages/dynamic/web.page.php?section=biodiversity_market&page_name=uswet_market (last visited June 1, 2010). *But see* 33 CFR 332.1 (2010) (some very rare exceptions to this are allowed by the U.S. Army Corps of Engineers).

49. *See, e.g.*, U.S. Env'tl. Prot. Agency, Wetlands Compensatory Mitigation Factsheet, <http://www.epa.gov/owow/wetlands/pdf/CMitigation.pdf> (last visited May 20, 2010).

50. *See* Palmer Hough & Lynda Hall, U.S. Env'tl Prot. Agency, National Forum on Synergies Between Water Quality Trading and Wetland Mitigation Banking, Background: The History and Status of Wetland Mitigation Banking and Water Quality Trading, Banking “First” 11 (2005), *available at* http://www.eli.org/Program_Areas/events/wqt_forum.cfm (follow “Lynda Hall, U.S. Environmental Protection Agency: Power Point Presentation” hyperlink).

51. *See, e.g.*, Wetlands Restoration: Get Involved, *available at*, <http://planetgreen.discovery.com/travel-outdoors/wetlands-restoration.html> (referencing the BBC Series, Nature Inc.).

52. *See, e.g.*, Adam Davis, *Wetlands Expose Misses the Mark*, Ecosystem Marketplace (2009) (reviewing CRAIG PITTMAN & MATTHEW WAITE, *PAVING PARADISE: FLORIDA'S VANISHING WETLANDS AND THE FAILURE OF NO NET LOSS* (2009)), *available at* http://64.27.23.230/pages/article.opinion.php?component_id=6796&component_version_id=10250&language_id=12.

completed projects that meet rigorous ecological success criteria⁵³ over alternatives such as permittee responsible (“do it yourself”) mitigation or use of “in lieu” fees.⁵⁴ Currently, approximately 70 percent of all Section 404 compliance is provided by permittee responsible mitigation.⁵⁵

When we create policy that explicitly values each scientifically verifiable unit of ecosystem production from private land, we actually send *two* different price signals. For development, infrastructure, or land-conversion projects that impact natural systems, a clear *cost* for each unit of impact is created.⁵⁶ So, the better the siting process is at avoiding and minimizing impacts, the lower the cost for the project.⁵⁷ For landowners and land managers who have important natural features on their property, a clear *benefit* for each incremental unit of protection and restoration is created.

Departments of Transportation, infrastructure development of all kinds, residential and commercial developers, even individual owners of shoreline property wanting to put in boat ramps; all are now buyers of outsourced compliance under the Clean Water Act. The latest figures available show that the annual market for compensatory mitigation under Section 404 is approximately \$3 billion.⁵⁸

2. Streams

Future demand growth for mitigation bank credits will be greatly enhanced by the fact that the 2008 rule also requires impacts to streams and other water bodies to provide compensatory mitigation, expanding the requirement now most commonly applied to wetland impacts.⁵⁹ Stream mitigation was previously required unevenly due to

53. See 40 C.F.R. § 230.91 (2009) (expanding the Section 404(b)(1) guidelines to include comprehensive standards for all three mechanisms for providing compensatory mitigation through a joint rulemaking of the EPA and the U.S. Army Corps of Engineers).

54. See ENVTL. LAW INST., THE STATUS AND CHARACTER OF IN-LIEU FEE MITIGATION IN THE UNITED STATES 1 (2006), available at http://www.elistore.org/Data/products/d16_04.pdf (explaining a form of mitigation wherein instead of doing actual mitigation, the regulated entity pays a fee to get their permit “in lieu” of compliance).

55. ENVTL. LAW INST., Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities, October 2007, Washington, D.C.

56. See *id.* at 617.

57. See *id.* at 620.

58. ENVTL. LAW INST., MITIGATION OF IMPACTS TO FISH AND WILDLIFE HABITAT: ESTIMATING COSTS AND IDENTIFYING OPPORTUNITIES 2 (2007), available at http://www.elistore.org/Data/products/d17_16.pdf.

59. See 40 C.F.R. § 230.93 (2009); 33 C.F.R. § 332.3 (2009).

variation in legal interpretation by individual Army Corps districts.⁶⁰ An informal survey of EPA regional regulatory staff suggests that in many regions 50 percent or more of the individual permits issued by the Corps every year are for impacts to streams, but only 4 percent of the compensatory mitigation supplied by mitigation banks in FY 2003 was for stream impacts.⁶¹

Stream Mitigation Banking (“SMB”) is a subset of the larger category of “mitigation banking” and was first implemented in the St. Louis District of the Army Corps of Engineers, which approved the Fox County Stream Mitigation Bank in 2000.⁶² Over the last nine years the practice of stream banking has become increasingly common, and there are now 90 stream banks in the United States.⁶³

3. Endangered Species

Endangered Species Act (“ESA”) credit demand is driven by permit requirements to provide compensation for impacts to endangered species and their habitat.⁶⁴ Specifically, section 7 requires federal agencies to consult with the USFWS regarding potential impact to threatened and endangered species,⁶⁵ and section 10 requires “incidental take permits”⁶⁶ and “habitat conservation plans” for those impacts.⁶⁷ The USFWS is the principal agency that administers the ESA with respect to terrestrial and freshwater species, while the National Marine Fisheries Service (“NMFS”) is the lead agency with respect to marine and anadromous species.⁶⁸

60. See ENVTL. LAW INST, *supra* note 58, at 24.

61. *Id.*

62. Rebecca Lave, Morgan M. Robertson & Martin W. Doyle, *Why You Should Pay Attention to Stream Mitigation Banking*, ECOLOGICAL RESTORATION 287, 287 (2008).

63. Personal communication with U.S. Army Corps of Engineers District public information officers, Jan.–June, 2009.

64. Cf. Christoph M. Gross et al., *Nitrogen Trading Tool to Facilitate Water Quality Credit Trading*, 63 J. SOIL & WATER CONSERVATION 44A (2008), available at <http://ddr.nal.usda.gov/bitstream/10113/21718/1/IND44122483.pdf> (showing a comparable system used in nitrogen trading).

65. See 16 U.S.C. § 1536(a)(2) (2007) (requiring all federal agencies to consult with the National Marine Fisheries Service (“NMFS”) for marine and anadromous species, or the United States Fish and Wildlife Services (“FWS”) for fresh-water and wildlife, if they are proposing an “action” that may affect listed species or their designated habitat).

66. 16 U.S.C. § 1539(a)(1)(B) (2007).

67. See *id.*

68. News Release, U.S. Fish & Wildlife Serv., Fish and Wildlife Service and National Marine Fisheries Service Announce Policy for Evaluation of Conservation Efforts when Making ESA Listing Decision (Mar. 31, 2003), available at <http://www.fws.gov/news/newsreleases/r3/6120F5C2-EFE9-49A1-B7B95275ECF82A8C.html>.

In May 2003, the USFWS released the official federal guidance for the establishment, use, and operation of conservation banks.⁶⁹ “This guidance was closely modeled after the State of California’s guidance for conservation banks, which had been in place since 1995.”⁷⁰ California is a leader in conservation banking, and in addition to federal ESA requirements it uses a state Endangered Species Act to facilitate conservation banking with the California Department of Fish & Game (“DFG”) as the enforcing agency.⁷¹

Growth of conservation banks providing outsourced compliance with ESA requirements has been rapid. There are now 119 banks in the U.S. providing credits that effectively create incentive for private investment in restoration and transfer legal liability to privately financed conservation projects for impacts on 92 different species.⁷²

4. Carbon: The Emerging Opportunity

While international carbon markets are the largest environmental markets in the world, they are not yet the most significant in terms of their impact on land management, particularly here in the United States. Markets for greenhouse gas emission offsets have grown exponentially since the Kyoto Protocol came into force in 1997, reaching a 2008 volume of approximately four billion tons of CO₂e worth over \$118 billion.⁷³ Within this large and rapidly growing market, the vast majority of payments are for allowances or offsets derived from destruction of GHG gases, energy efficiency or renewable energy, and the latest comprehensive data from 2007 indicates that there were only 55 forest carbon projects worldwide

69. Guidance for the Establishment, Use, and Operation of Conservation Banks, 68 Fed. Reg. 24,753 (May 8, 2003).

70. Ecosystem Marketplace, U.S. Conservation Banking, http://www.ecosystemmarketplace.com/pages/dynamic/web.page.php?section=biodiversity_market&page_name=uscon_market (last visited May 30, 2010).

71. *Id.*

72. Species Banking Home Page, <http://www.speciesbanking.com/> (last visited May 30, 2010).

73. Stephen Johnston, *Harvesting Carbon Credits—the Prairies Next Big Crop?*, CARBON OFFSETS DAILY, Nov. 9, 2009, available at <http://www.carbonoffsetsdaily.com/press-release/harvesting-carbon-credits-the-prairies-next-big-crop-28767.htm>.

that sold a total of \$38.3 million in offsets.⁷⁴ Of these, approximately twenty forestry projects were located in the U.S.⁷⁵

Despite the ongoing delay in the development of a national regulatory framework requirement for greenhouse gas emission reductions in the U.S., there are still markets in various stages of development that are paying landowners and land managers for carbon offsets from forestry and agricultural projects.⁷⁶ Innovators in crafting comprehensive voluntary standards managed under contractual arrangements like the Chicago Climate Exchange and the Voluntary Carbon Standard, as well as the state-driven Climate Action Registry (“CAR”) and Regional Greenhouse Gas Initiative (“RGGI”), are now underway and are providing at least some revenue to land conservation and reforestation projects.⁷⁷

Because the only legal requirements in the U.S. today are found in CAR⁷⁸ and RGGI,⁷⁹ voluntary commitments are a significant portion of market volume, and there are at least 10 different standards in use that comprise the voluntary market.⁸⁰ All of these markets in the U.S. are at some risk of being supplanted by a national system, which limits the growth potential of these current efforts.⁸¹

Looking forward, both the Waxman-Markey and Kerry-Boxer bills set overall parameters for carbon cap and trade policy in the U.S.; while it is not yet clear what exactly forest or farm projects would need to do in order to create valid carbon credits, the language

74. ECOSYSTEM MARKETPLACE, STATE OF THE FOREST CARBON MARKETS 2009: TAKING ROOT AND BRANCHING OUT (2009), available at http://moderncms.ecosystemmarketplace.com/repository/moderncms_documents/SFCM_2009_small_r.pdf.

75. *Id.* at 17.

76. Ricardo Bayon, California Leading: New Thinking on Carbon Accounting, Ecosystem Marketplace, http://www.ecosystemmarketplace.com/pages/dynamic/article.page.php?page_id=641§ion=home&eod=1 (last visited Apr. 13, 2010) (discussing examples that include the Climate Action Registry, Regional Greenhouse Gas Initiative, Chicago Climate Exchange and Voluntary Carbon Standard).

77. *See id.*

78. *See generally* California Climate Action Registry, Overview, <http://www.climateregistry.org/about.html> (last visited May 30, 2010).

79. *See generally* Regional Greenhouse Gas Initiative, Home Page, <http://www.rggi.org/home> (last visited June 1, 2010).

80. *See* Ecosystem Marketplace, Voluntary Over-the-Counter Offset (OTC) Market, http://www.ecosystemmarketplace.com/pages/dynamic/web.page.php?section=carbon_market&page_name=otc_market (last visited June 1, 2010).

81. Lauren Teigland-Hunt & Sara Hayes, *Understanding Emissions Trading: Navigating the Regional Greenhouse Gas Initiative*, COMPLINET, Sept. 21, 2009, at 3, www.teiglandhunt.com/webcp/assets/rtarticles/pdf/64.pdf.

in these bills at least provides an opportunity to understand the likely intellectual architecture for national standards.⁸²

5. Fisheries: Catch Shares as a Form of Cap and Trade

Catch Share programs are designed to create clear incentives for the long-term health of fish populations and for the economic vitality of fishing communities.⁸³ The term encompasses more specific programs defined in legislation such as limited access privilege programs and individual fishing quotas.⁸⁴

Under catch share programs, property rights to a share of a given fishery are allocated and individual fishers then own rights to catch a proportion of the legal limit for the fishery.⁸⁵ These rights can be sold or traded, and clear legal title to a proportion of annual production aligns financial interest with the long-term health of the fishery.⁸⁶

A recent study in *Science* looked at over 11,000 individual fisheries from 1950 to 2003 and found that by providing individual incentives for sustainable harvest, “[i]mplementation of catch shares halts, and even reverses, the global trend toward widespread collapse.”⁸⁷

6. Natural Resources Damage Assessments

Superfund⁸⁸ is structured to include a clean up phase and a natural resource restoration phase. Entities that are responsible for the release of toxins, known as “potentially responsible parties (“PRPs”), must meet clean-up standards on polluted sites,⁸⁹ but *also*

82. See Bill Chameides, *What's Different? Waxman-Markey Vs. Kerry-Boxer Climate Bills*, THE GREEN GROK, Oct. 2, 2009, <http://nicholas.duke.edu/thegreengrok/waxmanmarkey-vs-kerryboxer>.

83. NOAA Office of Sustainable Fisheries, *Catch Shares, NOAA Proposes Draft Catch Share Policy*, http://www.nmfs.noaa.gov/sfa/domes_fish/catchshare/index.htm (last visited June 1, 2010).

84. *Id.*

85. Env'tl. Def. Fund, *Catch Shares (LAPPs): A Promising Solution*, <http://www.edf.org/page.cfm?tagID=3332> (last visited June 1, 2010).

86. Christopher Costello, Steven D. Gaines & John Lynham, *Can Catch Shares Prevent Fisheries Collapse?*, 321 SCIENCE 1678, 1678–81 (2008), available at <http://www.sciencemag.org/cgi/reprint/321/5896/1678.pdf>. and Erik Stokstad, *NOAA Moves Forward with Catch Shares*, SCIENCE, May 22, 2009, <http://blogs.sciencemag.org/scienceinsider/2009/05/noaa-moves-forw.html>.

87. Costello et al., *supra* note 86, at 1678.

88. Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601–9675 (2007); see also U.S. Env'tl. Prot. Agency, *About Superfund*, <http://www.epa.gov/superfund/about.htm> (last visited Apr. 13, 2010).

89. see 42 U.S.C. § 9607 (2007).

must compensate for natural resource injuries that resulted from their actions.⁹⁰

There are billions of dollars in outstanding Natural Resource Damage Assessment (“NRDA”) liability under current claims against PRPs, including injuries to land, fish, wildlife, biota, air, water, groundwater, and drinking water.⁹¹ The NRDA provisions of the law are managed by public “trustees” of the natural resources—usually the National Oceanic and Atmospheric Administration (“NOAA”) as the “lead agency,” along with state environmental agencies, tribal nations and federal fish and wildlife agencies.⁹²

In order to address the long delays in achieving public benefits from NRDA, natural resource trustees working with NOAA have developed an accounting framework and a legal structure that is analogous to the transfer of liability mechanism in the CWA or the ESA’s compensatory mitigation banking.⁹³ The development of this crediting approach followed a ten year effort known as the cooperative assessment process (“CAP”).⁹⁴ CAP is intended to streamline coordination, increase data sharing, and provide a quicker route to an overall solution for resolving liability.⁹⁵

Under the new approach, the amount of compensatory restoration required from each PRP is determined through a habitat equivalency analysis (“HEA”), which is analogous to the types of analysis required for stream and wetland impact mitigation requirements.⁹⁶ The HEA process determines the measurable amount of impact to plant and animal communities, and then uses a

90. David MacDonald, *New Environmental Pitfalls in Land Development*, SUSTAINABLE LAND DEVELOPMENT TODAY, July 1, 2005, <http://www.sldtonline.com/content/view/219/71>.

91. *Id.*

92. See DEP’T OF ENERGY, CERCLA INFORMATION BRIEF, NATURAL RESOURCE DAMAGE ASSESSMENT: PREASSESSMENT SCREENING AND INTEGRATION WITH CERCLA ECOLOGICAL EVALUATIONS, *available at*, <http://homer.ornl.gov/nuclearsafety/env/guidance/cercla/nrda2.pdf>.

93. See Authorization to Send Notification of Potential Liability Letters to Potentially Responsible Parties (“PRPs”) on the Lower Duwamish River and Invitation to Engage in Discussions with Trustees to Resolve Their Natural Resource Damage Liability. Elliott Bay Trustee Council, December 16, 2009. http://www.darrp.noaa.gov/northwest/lowerduwamishriver/pdf/EB_TC_Resolution_2009-05.pdf.

94. See Damage Assessment, Remediation & Restoration Program at <http://www.darrp.noaa.gov/partner/cap/index.html>.

95. *Id.*

96. NOAA DAMAGE ASSESSMENT AND RESTORATION PROGRAM, HABITAT EQUIVALENCY ANALYSIS: AN OVERVIEW 1 (2006), *available at* www.darrp.noaa.gov/library/pdf/heaoverv.pdf.

“discount rate” approach to determine the combined effect of this impact over time—back to the date of the original release of toxins.⁹⁷ The result is a unit of measure called a discounted service acre year (“DSAY”), which functions as the equivalent of a wetland or stream credit under Clean Water Act mitigation banking regulations. The NRDA Trustees for the Duwamish River Superfund site in Seattle recently approved the first DSAY credit protocol in the nation.⁹⁸

7. Water Quality and Quantity Trading

Both total maximum daily load (“TMDL”) requirements under the CWA and environmental water sales are creating demand for land-based actions that reduce pollution or increase flows for aquatic species.⁹⁹ There are now over 20,000 water bodies in the U.S. characterized as “impaired” due to some form of pollution by the EPA, and trading programs which enable potentially liable parties to purchase offsets are in development across the country.¹⁰⁰

Sales of water rights with the specific goal of improving environmental conditions such as in-stream flow volume during seasonal salmon migration have taken place throughout the western United States.¹⁰¹ “This market sector has increased steadily since 1990 when less than \$500,000 was spent on water purchases . . . expenditures for environmental water acquisitions throughout the Western United States are currently estimated at \$20 million per year.”¹⁰²

In the Ohio River Basin, an interstate coalition of stakeholders is now forming to pursue the development of a regional trading program for reducing nutrient load in the river.¹⁰³ High demand for

97. *See id.* at 2.

98. Natural Resource Restoration and Enhancement Credit Protocol, *available at* <http://www.darrp.noaa.gov/northwest/lowerduwamishriver/pdf/Bluefield%20Protocol.Executed%20052409.pdf>.

99. U.S. Env'tl. Prot. Agency, Overview of Impaired Waters and Total Maximum Daily Loads Program, <http://www.epa.gov/owow/tmdl/intro.html> (last visited Mar. 30, 2010).

100. *See* VA. NATURAL RES. LEADERSHIP INST., TOTAL MAXIMUM DAILY LOADS: BALANCING WATER QUALITY AND LAND USE 1 (2009), *available at* <http://www.virginia.edu/ien/vnrli/docs/briefs/TMDL%202009.pdf>.

101. WEST WATER RESEARCH LLC, REVIEW OF WESTERN U.S. ENVIRONMENTAL WATER LEASING PROGRAMS 1 (2003), *available at* <http://www.ecy.wa.gov/programs/wr/instream-flows/Images/pdfs/WaterLeasingReview2003.pdf>.

102. *Id.*

103. *See* ELEC. POWER RESEARCH INST., REGIONAL WATER QUALITY TRADING IN THE OHIO RIVER BASIN 2 (2008), *available at* mydocs.epri.com/docs/public/00000000001019305.pdf.

water quality trading credits is anticipated from several sectors of dischargers regulated under the National Pollutant Discharge Elimination System (“NPDES”), including power companies and wastewater treatment plants.¹⁰⁴ An ample supply of low cost credits resulting from changes in farm management practices and restoration actions from agriculture appears achievable.

8. Integrating Multiple Incentives for Regional Results

In addition to the programs described so far—each one of which addresses a single type of pollution or damage using a single law—there are also a number of efforts that are targeting multiple types of incentives for restoration and protection actions to address complex environmental problems on a regional scale.

The leading example of this phenomenon is the Willamette Partnership, which is creating a crediting protocol that can apply to multiple types of restoration actions, and be used for compliance for impacts under a number of specific regulations.¹⁰⁵ Credit types and their tradable units now being tested under a pilot program are: wetland (functional acre); salmonid habitat (functional linear foot); upland prairie habitat (functional acre); and water temperature (kcal/day).¹⁰⁶ Additional environmental benefits for which credits are being developed include water quality, stream habitat and carbon sequestration. Signatories to the “Agreement in Concept” for the accounting system include EPA, Army Corps, USDA Forest Service and NRCS, NMFS, along with state agencies, various cities, and environmental groups.¹⁰⁷ Additional efforts intended to utilize this “multiple incentive” approach for the Chesapeake Bay¹⁰⁸ and the Puget Sound are in various stages of development.¹⁰⁹

104. Charles Abdalla et al., *Water Quality Credit Trading and Agriculture: Recognizing the Challenges and Policy Issues Ahead*, CHOICES, (2007), available at <http://www.choicesmagazine.org/2007-2/grabbag/2007-2-06.pdf>.

105. Willamette Partnership, Ecosystem Credit Accounting, <http://www.willamettepartnership.org/ecosystem-credit-accounting> (last visited June 1, 2010).

106. *Id.*

107. COUNTING ON THE ENVIRONMENT WORKING GROUP MEMBERS, AGREEMENT IN CONCEPT ON ECOSYSTEM CREDIT ACCOUNTING SYSTEM 2-3, (2009), available at <http://willamettepartnership.org/ecosystem-credit-accounting/willamette-ecosystem-marketplace-documents/Agreement%20in%20Concept%20signed.pdf>.

108. See Margaret Walls & Virginia McConnell, *Incentive-Based Land Use Policies and Water Quality in the Chesapeake Bay*, 2 (Res. for the Future, Discussion Paper No. 04-20, 2004).

109. Puget Sound Partnership Resource Center, <http://www.psparchives.com/index.php> (last visited Mar. 30, 2010).

C. *Issues of Measurement and Terms of Valuation for Ecosystem Services*

Sustainability requires balancing the need for ecosystem services to support life-sustaining ecological activities with the development needs of a modern industrialized society.¹¹⁰ Recognizing the financial value of natural systems is a practical approach to achieving this balance, because the greater the impacts from human activity, the more valuable the remaining ecosystem service.¹¹¹ The scarcer critical ecosystem services become, the more likely that the value provided by conservation or restoration on an ecosystem will outweigh the value of the same land for development, harvesting or extraction.¹¹²

1. Balancing the Value of Ecosystem Services with the Development Value of Land

One of the reasons we do not automatically recognize services being provided by intact natural systems is that they occur over vast areas of land and are often produced slowly. This is the challenge for policy makers; how can incentive structures be created for the management of natural forces that allow individual land owners to use an ecosystems services lens to see what is valuable? In order for this to happen, real people in real places need to be paid for the measurable ecological results of their actions, and the first step in determining how much value is being created is to ensure that there is a legal baseline for required action.

Policy that recognizes these issues begins, of course, with traditional conservation policy. The Federal Wilderness Act was passed in 1964, and today covers over 52 million acres.¹¹³ This is 2.7 percent of the total 1.9 billion acres of land area that makes up the United States.¹¹⁴ Is this “enough” wilderness? How would we know the answer to the fundamental question: what do we need in the way of ecosystem services?

One way of exploring this comes from the process of connecting compensatory mitigation to land impacts. When environmental policy allows an impact, the goal of compensatory mitigation is to

110. See J.B. Ruhl & James Salzman, *The Law and Policy Beginnings of Ecosystem Services*, 22 J. LAND USE & ENVTL. L. 157 (2007).

111. *Id.* at 165.

112. *Id.*

113. See *Wilderness.net*, *U.S. National Wilderness Preservation System Map*, <http://www.wilderness.net/index.cfm?fuse=NWPS> (last visited June 1, 2010).

114. See *id.* at 1.

require related conservation and restoration actions that offset the extent and duration of the impact.¹¹⁵ As the historical trajectory of environmental regulation makes clear, however, land area by itself is not a sufficient metric for assessing impact; the *sensitivity and uniqueness* of the parcels proposed for development must also be measured.

A variety of regulatory approaches are evolving to recognize sensitivity and uniqueness in allowing impacts and requiring associated mitigation. A recent Washington State Department of Fish and Wildlife approach that divides state lands into four zones for wind projects exemplifies such a scheme.¹¹⁶ Class I habitats are considered the highest priority for conservation and cannot be developed without a detailed and negotiated settlement agreement.¹¹⁷ Class II and III habitats can be developed with pre-agreed levels of compensatory mitigation as a starting point for needed permits.¹¹⁸ Low habitat value lands (“Class IV”) have *no* mitigation requirement, with the explicit intention of motivating project developers to locate in previously disturbed areas.¹¹⁹

This type of big-picture division of the landscape into categories is just a starting point. Sophisticated scoring systems for ecological function are being developed for determining compliance with a wide range of environmental laws and are increasingly based on functional assessments—literally scorecards that a scientist can take into the field—that measure the presence or absence of specific geological, hydrological or biological features.¹²⁰

Despite the intimidating complexity of “scoring” natural systems, this exercise is remarkably similar to processes we use to evaluate excellence, productivity, and worth every day. It begins by

115. *See id.*

116. *See* WASH. DEP’T OF FISH AND WILDLIFE, WIND POWER GUIDELINES 9 (2009), available at http://www.wdfw.wa.gov/hab/engineer/windpower/final_wind_power_guidelines_2009.pdf (“Class I habitats have a greater number of associated Species of Greatest Conservation Need (SGCN) than the Class II habitats and Class II habitats have a greater number of associated SGCN than the Class III habitats. Class IV habitats are generally low value habitats.”).

117. *See id.*, at 19 (requiring “additional consultation” for proposed modification of Class I habitats in “excellent condition”).

118. *See id.*

119. *See id.* at 8–9.

120. *See, e.g.*, FRANK W. DAVIS ET AL., A FRAMEWORK FOR SETTING LAND CONSERVATION PRIORITIES USING MULTI-CRITERIA SCORING AND AN OPTIMAL FUND ALLOCATION STRATEGY 12–13 (2003), available at http://www.nceas.ucsb.edu/nceas-web/projects/4040/TerrBiod_framework-report.pdf.

developing an understanding of *what is needed or desired* for a particular purpose.¹²¹ If water quality is a particular concern, then the water purification function of an ecosystem is the “valued component” given consideration; songbird habitat would focus on different functions.

Because functions depend on the absence or presence of specific physical or biological elements, *indicators* of these elements are used to compare absence or presence to a reference site.¹²² Scores for multiple indicators can be weighted to reflect professional judgment or outcome-based criteria reflecting relative worth.¹²³

This is not dissimilar from the way aspects of “value” are reflected in prices for all sorts of things. An assessment is made of the quality and abundance of elements and the way in which these elements combine to produce a desirable result.¹²⁴ The price of a car, for example, is made up of thousands of individual judgments about features and benefits; the price of a share of stock is the result of the behavior of thousands of employees making myriad decisions. Prices contain objective measures of cash flow and cost, but also judgment about the value of intangible assets like reputation. Similarly, the ecological scores for parcels of land in these new scoring systems reflect both objective measures of what is physically present *and* a weighting of these measures to reflect judgments—often regionally informed professional opinion—about what is most unique or important.¹²⁵

So while one cannot see ecosystem services being produced in a literal sense, one can use functional assessments to score the presence or absence of indicators that give us critical information about those services.¹²⁶ This is analogous to the dashboard of a car, which gives us distilled high-level information that we can use to drive without every driver having to know everything about the way a modern internal combustion engine works.

But for these indicators to make sense—for landowners to understand the value of the services being produced and to act

121. *Id.* at 12.

122. *Id.* at 26.

123. *See id.*

124. *See generally, id.* (discussing different factors to be considered in developing a framework for conservation priorities).

125. *See generally, id.* (discussing need for flexibility in creation of conservation frameworks).

126. *Id.*

accordingly—every land impact needs to be understood in the context of *how much land we actually have*, and *how much natural or ecologically well-managed land we need*.

2. Current Development and Management of Private Land

Currently, most land use regulation in the United States does not take into consideration the financial value of ecosystem features such as classifications of vegetation, natural communities, or habitat types.¹²⁷ The Endangered Species Act, for example, is structured such that species must be in dire straits before authority can be exercised on their behalf,¹²⁸ and the Clean Water and Clean Air Acts are primarily focused on minimizing emission of pollutants.¹²⁹ Other major federal laws like CERCLA¹³⁰ and SMCRA¹³¹ concentrate on cleaning up the mess we have already made.

Interestingly, many types of land development never trigger permit requirements under federal law at all.¹³² Three votes on a City or County Council usually gets a conditional use permit for a project, and even when NEPA, CEQA, or some other regulatory line is crossed, the impacts of a given project are assessed within political boundaries, making it very difficult to manage cumulative impacts that show up in phenomena like urban sprawl and fragmentation.¹³³ In sum, current environmental statutes and regulations fail to effectively control many of the problems that affect U.S. ecosystems.¹³⁴

127. See REED F. NOSS, ET AL., ENDANGERED ECOSYSTEMS OF THE UNITED STATES: A PRELIMINARY ASSESSMENT OF LOSS AND DEGRADATION (1995), available at <http://biology.usgs.gov/pubs/ecosys.htm> (citing 261 major types of terrestrial ecosystems in the United States).

128. See Joy Nicholopoulos, *The Endangered Species Listing Program*, XXIV ENDANGERED SPECIES BULLETIN 6 (1999), available at <http://www.fws.gov/endangered/bulletin/99/11-12/6-9.pdf>.

129. Andrew Jackson Heimert, *Keeping Pigs out of Parlors: Using Nuisance Law to Affect the Location of Pollution* (pt. 1), 27 ENVTL. L. 403, 416 (1997).

130. See 42 U.S.C. §§ 9601–9675 (2007) (providing federal authority to respond to releases or threatened releases of toxic substances).

131. Surface Mining Control and Reclamation Act, 30 U.S.C. § 1202 (2007) (establishing a structure to address environmental damages from coal mining operations).

132. See, e.g., Ruhl & Salzman, *supra* note 110, at 170 (“[T]he nature of land use regulation as a legal institution implemented primarily at the local level has led to fundamental misconceptions of its capacity to participate in complex public policy problems.”).

133. ZHAO MA, DENNIS R. BECKER & MICHAEL A. KILGORE, THE INTEGRATION OF CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENTS AND STATE ENVIRONMENTAL REVIEW FRAMEWORKS 49–50 (2009), available at <http://www.forestry.umn.edu/publications/staffpapers/Staffpaper201.pdf>.

134. See generally C.D. Clark & C.S. Russell, *Ecological Conservation: The Problems of Targeting Policies and Designing Instruments*, 1 J. NATURAL RES. POL’Y RESEARCH 21–34

Urban sprawl is a phenomenon that illustrates the policy challenges to effective management of ecosystem services and the need to balance the relationship between population growth and the need for and allocation of these services.¹³⁵ Over half the world's people now live in cities.¹³⁶ Yet a century ago, this was true for less than five percent of the world population.¹³⁷ In the U.S. the figure is approximately 80 percent,¹³⁸ and while logically this concentration of people should be good for land conservation, in actuality the pattern of sprawl and suburbanization has continued apace within metropolitan areas.¹³⁹

Despite the relative density of American development patterns, U.S. cropland acreage declined from 420 million acres in 1982 to 368 million acres in 2003, a decrease of about 12 percent.¹⁴⁰ "The total area of cropland, pastureland and rangeland decreased by 76 million acres . . . from 1982 to 2003, while the total area of developed land increased by 36 million acres or 48 [percent]."¹⁴¹ Recent development is consuming land at an increasing rate per person as well. From 1982 to 2003 a 48 percent increase in developed land was fueled by a population increase of only 26 percent.¹⁴² In other words, every one of the 62 million new Americans from 1982-2003 required nearly

(2009) available at <http://www.informaworld.com/smpp/content~content=a906544265&db=all> (stating that current policy frameworks fail to properly address ecological diversity).

135. See Clean Water Action Council, Land Use & Urban Sprawl, <http://www.cwac.net/landuse/index.html> (last visited June 1, 2010).

136. See Celia W. Dugger, *Half the World's Population Will Live in Cities Next Year*, *UN Report Says*, N.Y. TIMES, June 27, 2007, available at http://www.nytimes.com/2007/06/27/world/asia/27iht-27city.6363039.html?_r=1 (reporting the United Nation's prediction that 3.3 billion people would live in either towns or cities in 2008).

137. *Cities Now Home to Half of All People* (VOA News radio broadcast Oct. 9, 2009), transcript available at <http://www.voanews.com/specialenglish/2009-10-09-voa3.cfm>.

138. See U.N. POPULATION DIV., WORLD URBANIZATION PROSPECTS tbl A.1 (2007), available at http://www.un.org/esa/population/publications/wup2007/2007WUP_Highlights_web.pdf (listing the percent of the United States population living in cities at 81.4 percent).

139. See, e.g., Ohio State Univ., *Study Shows Urban Sprawl Continues to Gobble Up Land*, SCIENCE DAILY, Dec. 24, 2007, <http://www.sciencedaily.com/releases/2007/12/071217171404.htm>.

140. Nat'l. Res. Conservation Serv., National Resources Inventory, 2003 Annual NRI, <http://www.nrcs.usda.gov/technical/NRI/2003/nri03landuse-mrb.html>.

141. Junjie Wu, *Land Use Changes: Economic, Social, and Environmental Impacts*, CHOICES (2008), available at <http://www.choicesmagazine.org/magazine/article.php?article=49>.

142. See Encyclopedia of the Nations, United States: Population, <http://www.nationsencyclopedia.com/Americas/United-States-POPULATION.html> (last visited June 1, 2010) (citing population of U.S. in 2003 of 294,043,000); NationMaster, People Statistics: Population (1982) by country, http://www.nationmaster.com/graph/peo_pop-people-population&date=1982-01-01 (last visited June 1, 2010) (citing population of U.S. in 1982 of 231,664,000).

twice as much land as those that were here already. Today, 2,450 acres of open space are lost to residential or commercial development every day,¹⁴³ and the U.S. population is projected to reach 400 million by 2039.¹⁴⁴

Forest land is particularly important in providing ecosystem services, and forestland in particular is under incredible pressure from fragmentation.¹⁴⁵ Due to the shift in ownership from integrated pulp and paper companies to timber investment management organizations (“TIMOs”) and real estate investment trusts (“REITs”), non-federal forestland¹⁴⁶ has moved rapidly from being a place to grow trees to being real estate for development.¹⁴⁷ In 1996, about 95 percent of the industrial forestland in the country was owned by traditional, vertically integrated forest products firms.¹⁴⁸ By 2006, at least one-half of that acreage was estimated to be under TIMO or REIT ownership.¹⁴⁹ Over 27 million acres were transferred from traditional forest products companies to institutional investor organizations in the 2001-2007 period alone.¹⁵⁰ Nationally, another 29

143. Forest Serv., U.S. Dep’t of Agric., Forest Disturbance Processes: Fragmentation and Land Use Change, http://www.nrs.fs.fed.us/disturbance/land_use_fragmentation/ (last visited June 2, 2010).

144. Press Release, U.S. Dep’t. of Commerce Pub. Info. Office, An Older and More Diverse Nature by Midcentury (Aug. 14, 2008), available at <http://www.census.gov/Press-Release/www/releases/archives/population/012496.html>.

145. Kurt H. Riitters et al., *Fragmentation of Continental United States Forests*, 5 ECOSYSTEMS 815, 816 (2002), available at http://www.mrlc.gov/pdf/ecosystems_riitters02.pdf.

146. See U.S. Dep’t of Agric., Natural Res. Conservation Serv., Acres of Non-Federal Forest Land, 1982, <http://www.nrcs.usda.gov/technical/NRI/maps/meta/m5979.html> (last visited June 2, 2010).

147. See Susan M. Stein et al., *Forests on the Edge: Evaluating Contributions of and Threats to America’s Private Forest Lands*, Proceedings of the Seventh Annual Forest Inventory & Analysis Symposium 135, 138 (2005), available at http://www.nrs.fs.fed.us/pubs/gtr/gtr_wo077/gtr_wo077_135.pdf (“Watersheds with the greatest percentage of private forest land are generally in New England, the Southeast, and the Pacific Northwest. . . . Development threats to private forest land area are concentrated in southern New England and the Southeast, although some are also found in the Pacific Northwest.”).

148. John C. Bliss, Erin C. Kelly, & Jesse Abrams, *Disintegration of the Industrial Forest Estate and the Future of Small-Scale Forestry in the United States* 3 (Rural Studies Program Working Paper No. 08-03, 2008), available at http://ruralstudies.oregonstate.edu/sites/default/files/pub/pdf/rsp_reports/rsp-08-03.pdf.

149. *Id.*

150. *Id.*

million acres of forestland will be subsumed by urbanization by 2050, an area approximately the size of Pennsylvania.¹⁵¹

The loss of forest land and forest cover leads to degraded watershed conditions, including increased runoff and sedimentation, higher peak stream flows, loss of riparian vegetation, and higher stream temperatures, with long-term adverse effects on water quality and on essential biological functions.¹⁵² Loss of forest land results in direct loss of wildlife habitat, including the habitats of many threatened or endangered species and migratory birds, and can have adverse effects on aquatic habitats and fish, particularly cold-water fish such as trout and salmon.¹⁵³ Loss of forest cover also reduces the country's ability to sequester carbon, thereby reducing our nation's ability to mitigate the effects of climate change at a time when the role of forests in the global carbon balance is being recognized.¹⁵⁴

3. Supply and Demand of Ecosystem Services

How would development of agricultural or forestland be different if ecosystem services were more explicitly recognized in law? While this question cannot yet be definitively answered, we are now at least aware that we are in need of the functions provided by large intact landscapes.¹⁵⁵

One suggested goal for U.S. ecosystem management policy has been conserving representative and sustainable ecosystem types.¹⁵⁶ Efforts to evaluate annual U.S. conservation spending find, however, that even focusing on that kind of specific objective reveals a funding gap of between \$5.8 billion and \$9.45 billion each year.¹⁵⁷

151. David J. Nowak & Jeffrey T. Walton, *Projected Urban Growth (2000–2050) and Its Estimated Impact on the US Forest Resource*, J. FORESTRY, Dec. 2005, at 383, available at http://www.fs.fed.us/ucf/supporting_docs/Nowak_Walton_JoF_Dec_2005.pdf.

152. See U.N. Conference on Env't and Dev., June 3–14, 1992, *Agenda 21*, ¶ 11.10 (“The impacts of loss and degradation of forests are in the form of soil erosion, loss of biological diversity, damage to wild habitats and degradation of watershed areas, deterioration of the quality of life, and reduction of the options for development.”).

153. See W.A. Rodgers, *Patterns of Loss of Forestry Biodiversity—a Global Perspective*, in CONSERVATION OF FOREST ECOSYSTEMS 7, 23 (World Forestry Cong., 1997).

154. *Id.* at 24.

155. See Susan Ruffo & Peter Kareiva, *Using Science to Assign Value to Nature*, 7 FRONTIERS IN ECOLOGY & ENV'T 3, 3 (2009), available at <http://www.esajournals.org/doi/abs/10.1890/1540-9295-7.1.3>.

156. Robert W. Dietz & Brian Czech, *Conservation Deficits for the Continental United States: an Ecosystem Gap Analysis*, 19 CONSERVATION BIOLOGY 1478–87 (2005).

157. Frank Casey, *Contours of Conservation Finance in the United States at the Turn of the Twenty-First Century*, in FROM WALDEN TO WALL STREET 37, 40 (James N. Levitt ed., 2005).

Another perspective comes from Reed Noss et al., who define ecosystems as critically endangered if they've experienced greater than 98 percent decline, endangered if between 85-98 percent decline, and threatened if *only* a 70-84 percent decline.¹⁵⁸ Using this taxonomy, Reed and his colleagues identified more than 30 critically endangered, 58 endangered, and more than 38 threatened ecosystems in the U.S.¹⁵⁹

Up until now, statutes have managed the problem through the use of the overarching approaches of conservation and environmentalism; that is, through acquiring and setting aside land under government stewardship¹⁶⁰ or through law which limits the impact of development or commerce.¹⁶¹ There is now increasing recognition of the potential to use scientifically based accounting as the basis for clear property rights related to protection and restoration by establishing the indicators for measuring ecosystem service production on private land.¹⁶²

As ecosystem services theory is effectively put into practice, indicators for the carbon sequestration, water purification, and resiliency provided by our woods and fields will be increasingly available for each unit of protection or improvement provided by landowners.

II. USING ECOSYSTEM SERVICES TO BETTER CONNECT SCIENCE AND SPENDING

The development of offset and credit trading programs has created the need for improvement of indicators for ecosystem service production. If a credit is to be used for compliance purposes, its characteristics need to be well-defined and its ownership accounted for. Functional assessments, scoring systems and formal registries have all advanced substantially over just the past five years to meet

158. Reed F. Noss, Edward T. LaRoe III & J. Michael Scott, *Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation*, in NAT'L BIOLOGICAL SERV., BIOLOGICAL REPORT 28 (1995), available at <http://biology.usgs.gov/pubs/ecosys.htm>.

159. *Id.*

160. See, e.g., MARGARET WALLS, FEDERAL FUNDING FOR CONSERVATION AND RECREATION: THE LAND AND WATER CONSERVATION FUND 1 (2009) available at http://www.rff.org/RFF/Documents/RFF-BCK-ORRG_LWCF.pdf.

161. See generally Craig A. Arnold, *The Structure of the Land Use Regulatory System in the United States*, 22 J. LAND USE & ENVTL. LAW 441 (2007) (discussing various ways in which the laws regulates land use).

162. See generally WILLAMETTE PARTNERSHIP, *supra* note 11 (providing an example of scientific accounting as the basis for an ecosystem services system).

the needs of ecosystem service based offset and credit trading programs.¹⁶³ The measurement discipline required for these incentive programs will also have implications for the effectiveness and accountability of public spending on regional environmental initiatives, and for the environmental outcomes from management of federal lands.¹⁶⁴

A. Metrics for Environmental Spending

Public spending on environmental initiatives in the U.S. is comprised of direct expenditure under federal budgets for environmental and land management agencies (\$21.6 billion),¹⁶⁵ habitat restoration and environmental projects done by the Army Corps and Department of Transportation (\$3.8 billion),¹⁶⁶ and state and local ballot measures for land conservation (\$2.5 billion).¹⁶⁷ This can be compared to the annual conservation spending of approximately \$540 million by the country's largest non-profit groups.¹⁶⁸

163. See, e.g., *id.*

164. Barton H. Thompson, Jr. *Ecosystem Services & Natural Capital: Reconceiving Environmental Management*, 17 N.Y.U. ENVTL. L.J. 460, 486–87 (2008).

165. See U.S. ENVTL. PROT. AGENCY, FY 2011 EPA BUDGET IN BRIEF (2010), available at www.epa.gov/budget/2011/2011bib.pdf; Press Release, Bureau of Land Mgmt., Dep't of the Interior, President Proposes \$1.1 Billion for BLM in Fiscal Year 2011 to Protect Resources and Manage Uses of Public Lands (Feb. 1, 2010), available at www.blm.gov/or/news/files/2-01-10_BLM_Budget_Press_Release.pdf; Nat'l Park Serv., Dep't of the Interior, Fiscal Year 2011 Greenbook, <http://home.nps.gov/applications/budget2/fy11gbk.htm> (last visited June 2, 2010); U.S. Fish & Wildlife Serv., Dep't of the Interior, Fiscal Year 2011 Budget Justifications, www.fws.gov/budget/2011/toc%202011.html (last visited June 2, 2010); U.S. Forest Serv., Dep't of Agric., Budget, <http://www.fs.fed.us/aboutus/budget/> (last visited June 2, 2010).

166. See Jeffery T. More, *The Grey and the Green: The Built Infrastructure and Conservation Investment*, in FROM WALDEN TO WALL STREET: FRONTIERS OF CONSERVATION FINANCE 172, 173 (James N. Levitt ed., 2005) (citing figures for DOT financing); Office of Mgmt. & Budget, The Federal Budget: Fiscal Year 2011—The U.S. Army Corps of Engineers, http://www.whitehouse.gov/omb/factsheet_department_corps/ (last visited June 2, 2010).

167. This is the average expenditure per year over the past 22 years from state and local ballot measures. See Trust for Pub. Land, TPL Landvote Database, <https://www.quickbase.com/db/bbqna2qct?a=dbpage&pageID=10> (last visited June 2, 2010).

168. This figure is not inclusive of all non-profit conservation spending, but includes “conservation activities and actions.” The Nature Conservancy, Consolidated Financial Statements 4 (2009), available at http://www.nature.org/aboutus/annualreport/files/fs_fy2009.pdf (indicating expenses in FY 2008–2009 for “conservation activities and actions” of \$386 million); see also The Conservation Fund, Combined Financial Statements 19 (2009), available at http://www.conservationfund.org/sites/default/files/The%20Conservation%20Fund_Financials_2007_2008.pdf (indicating total program expenses of \$153 million for 2008 and 2007).

What are we buying with all this money? Let's approach this question by examining two major types of government environmental expenditure: *regional environmental initiatives* and *farm bill conservation title spending*.

1. Regional Environmental Initiatives

"U.S. calls for more action to restore Chesapeake Bay" is a November 10, 2009 headline from the Baltimore Sun.¹⁶⁹ "Acting in response to a presidential executive order declaring the bay a national treasure, federal environmental agencies proposed a sweeping plan to re-energize the lagging restoration effort with more water quality regulations, financial and technical aid for farmers and plans to promote more voluntary cleanup efforts with creation of a conservation corps."¹⁷⁰ The article goes on to say that if states fail to make progress, the federal government "may impose sanctions to be specified later, such as withholding federal funds or denying permits for new development or businesses."¹⁷¹

The new legislation "gives state and local governments of the Chesapeake Bay Watershed Area strong new enforcement tools and more than \$1.5 billion in new grant authority to restore the Bay's health and—for the first time—sets a firm deadline of May 2020 for all restoration efforts to be in place."¹⁷² Although an exact figure is elusive, it appears that at least \$12 billion has been spent on restoration of the Bay since 1995.¹⁷³

Meanwhile, across the country in the Puget Sound, a parallel regional effort has been taken up by a coalition of entities charged by the Governor of Washington State with restoring the health of the Sound by 2020.¹⁷⁴ This coalition, called the Puget Sound Partnership, has developed an action agenda, promotes public education and outreach, and is supposed to "hold partners accountable for

169. Timothy B. Wheeler, *U.S. Calls for More Curbs on Chesapeake Bay Pollution*, BALTIMORE SUN, Nov. 10, 2009, at A3.

170. *Id.*

171. *Id.*

172. Press Release, Senator Benjamin Cardin, Cardin Announces Details of Draft Chesapeake Bay Reauthorization, Including New Funding for States and New Enforcement Provisions (Sept. 8, 2009), available at <http://cardin.senate.gov/news/record.cfm?id=317548>.

173. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO REPORT NO. 06-96, CHESAPEAKE BAY PROGRAM: IMPROVED STRATEGIES ARE NEEDED TO BETTER ASSESS, REPORT AND MANAGE RESTORATION PROGRESS at 22, 29 (2005).

174. See Puget Sound Partnership, About the Partnership, <http://www.psp.wa.gov/aboutthepartnership.php> (last visited June 2, 2010).

delivering results.”¹⁷⁵ Current spending on protection and restoration of the Sound is estimated to be over \$2 billion per year.¹⁷⁶

In California, the state legislature recently approved a series of bills to “overhaul the state’s troubled water system” that include \$1.7 billion in proposed spending on ecological restoration across 21 watersheds.¹⁷⁷ “The plan calls for a comprehensive ecosystem restoration in the Sacramento-San Joaquin River Delta — a collection of channels, natural habitats, and islands at the confluence of the Sacramento and San Joaquin Rivers that is a major source of the state’s drinking water.”¹⁷⁸

But what confidence can we have that all this spending and good intention will actually result in healthy ecosystems? The track record of past performance, combined with projected increases in population and related development, is not encouraging.

In the Chesapeake region, the population essentially doubled between 1950 and 2007,¹⁷⁹ and another 3.4 million people will arrive between now and 2030.¹⁸⁰ “Federal lawmakers have been trying since 1983 to restore the bay. Their efforts, which include pollution reduction, fish harvest reductions and conservation, have done little to solve the bay’s problems,” writes the Daily Press.¹⁸¹ Despite the \$12 billion in recent spending, the fundamental problems are not adequately being addressed. The effect of nutrient runoff on water quality is one indicator. In 2008, an estimated 283 million pounds of

175. Puget Sound Partnership, Fact Sheet, http://www.psp.wa.gov/downloads/FACT-SHEET_v2-2008.pdf (last visited June 2, 2010).

176. See Puget Sound Partnership, Action Agenda: Financing Strategy, Funding Strategy, Estimates of Spending Related to Puget Sound 4 (2009), available at <http://www.psp.wa.gov/downloads/AAAPX/funding.pdf>.

177. Jennifer Steinhauer, *California Water Overhaul Caps Use*, N.Y. TIMES, Nov. 4, 2009, at A16, available at <http://www.nytimes.com/2009/11/05/us/05water.html>.

178. *Id.*

179. The population increased from 8,385,982 to 16,797,132 between 1950 and 2007. CBO Data Center, Chesapeake Bay Program Indicator Framework: Reporting Level Indicators, Indicator and Data Survey, available at <http://archive.chesapeakebay.net/status/status08/population2008.doc>.

180. See, e.g., TOM HORTON, GROWING! GROWING! GONE! THE CHESAPEAKE BAY AND THE MYTH OF ENDLESS GROWTH 2 (2008) abell.org/pubsitems/env_growing_808.pdf (noting that approximately 1.7 million people move into the Bay area every 10 years).

181. Cory Nealon, *Record \$50m Ok'd for Restoration*, DAILY PRESS, Nov. 2, 2009, http://articles.dailypress.com/2009-11-02/news/0911010041_1_bay-s-problems-restore-federal-affairs-director.

nitrogen and 16.3 million pounds of phosphorus reached the Bay, according to computer models.¹⁸²

In the Puget Sound region, the population is projected to increase by over 31 percent by 2025.¹⁸³ Despite the work done by the participants in the Puget Sound Partnership process to “ensure a thriving natural system that exists in harmony with a vibrant economy,” it is not clear how the panoply of proposed measures from the action agenda, in the context of this population growth, will stop the “alteration and loss of habitat and the ongoing input of pollutants [that] are the top two immediate and pervasive threats facing Puget Sound.”¹⁸⁴

And California, of course, which is already home to one out of every eight Americans,¹⁸⁵ will continue to grow too. By 2030 there will be about 46.5 million of us here in the Golden State,¹⁸⁶ and the Bay Area will be 30 percent larger than it is now, with over 8.7 million residents.¹⁸⁷ The last major effort at “fixing” the Bay Delta, called CalFed, was an “\$8.6 billion, seven-year plan sketched out by state and federal officials . . . to reinvigorate the supremely valuable Bay-Delta estuary,”¹⁸⁸ but the actual results have been disappointing to many stakeholders.

According to a review by the Associated Press, “[t]he mighty river delta that supplies water to two-thirds of California’s population and serves as one of the most important wildlife habitats on the West Coast is in worse shape than ever despite \$4.7 billion in government

182. Rex Springston, *EPA Adjusts Chesapeake Bay Pollution Figures*, RICHMOND TIMES-DISPATCH, Nov. 27, 2009, http://www2.timesdispatch.com/rtd/news/state_regional/article/BAY27_20091126-222205/308146.

183. The population is projected to grow by 1.6 million before 2040. PUGET SOUND REGIONAL COUNCIL, VISION 2020+20 UPDATE: ISSUE PAPER ON REGIONAL DEMOGRAPHICS AND GROWTH TRENDS i (2005), <http://www.psrc.org/assets/2026/appIF8-demographics.pdf>.

184. PUGET SOUND PARTNERSHIP, PUGET SOUND ACTION AGENDA: PROTECTING AND RESTORING THE PUGET SOUND ECOSYSTEM BY 2020 2, 4 (2008), available at www.psp.wa.gov/downloads/ACTION_AGENDA_2008/Action_Agenda.pdf.

185. See US Census Bureau, Data Finder, <http://www.census.gov/> (last visited June 2, 2010).

186. The Census Bureau estimates there will be 46,444,861 people in California in 2030. See City-Data.com, Census Bureau’s 2030 Population Projections for 50 states and DC, <http://www.city-data.com/forum/general-u-s/468856-census-bureaus-2030-population-projections-50-a.html> (last visited June 2, 2010).

187. Bay Area Alliance for Sustainable Communities, Snapshot of the Bay Area, <http://www.bayareaalliance.org/snapshot.html> (last visited June 2, 2010).

188. Michael Doyle, *No Cash Flows for Water Plan: Future of Cal-Fed in Doubt*, SACRAMENTO BEE, June 14, 2000, available at www.calwater.ca.gov/Admin_Record/F-002692.pdf.

spending.”¹⁸⁹ The AP’s review of CalFed spending reveals how the agency has been unable to deal with the delta’s most basic problems, even as it slides further toward collapse.¹⁹⁰ Joe Grindstaff, CalFed’s director for the past two years, acknowledged the program’s many shortcomings. “Fundamentally, the system we devised didn’t work,” he said.¹⁹¹

The same challenges face other regions of the country as well of course: the Everglades, the Mississippi, the Great Lakes, the remaining prairies . . . how are we to improve environmental quality while we accommodate 100 million new people over the next twenty years?

We are simply going to have to do a better job of targeting spending so that we can incentivize behaviors that create scientifically verifiable results and produce the desired outcomes. Below are brief descriptions of two innovative approaches that are beginning to make use of indicators, metrics, registries and incentives to target spending and drive results at a regional scale.

a. The Willamette Partnership and the Bay Bank

The Willamette Partnership and the Bay Bank project of the Pinchot Institute are developing parallel ecosystem service registries that allow the benefits from conservation and restoration programs to be verified and used for compliance purposes.¹⁹² In the case of the Willamette Partnership, credit protocols for wetlands, prairies, salmon habitat and stream temperature reduction have been developed.¹⁹³ The near-term priorities for additional credit-type development include nitrogen, phosphorus, and sediment indicators for water quality, carbon, stream habitat, and rare habitat.¹⁹⁴ In the case of the Bay Bank the program will track carbon sequestration,

189. Samantha Young and Erica Werner, *Results Few After \$4.7 Billion Calif. Water Plan*, ASSOC. PRESS, Oct. 12, 2007, available at <http://www.msnbc.msn.com/id/21269067>.

190. *See id.* (noting that CalFed programs “have done almost nothing to achieve the main goals state and federal lawmakers laid out”).

191. *Id.*

192. *See, e.g.*, Press Release, Bay Bank, Pinchot Institute-Willamette Partnership Joint RFQ Now Available (July 2, 2009), available at <http://www.thebaybank.org/?p=402> (announcing that the Pinchot Institute and Willamette Partnership seek to develop an Ecosystem Service Crediting Platform).

193. Willamette Partnership, Counting on the Environment: Workshop #3, Ecosystem Credit Calculator 14 (Apr. 17, 2009), available at <http://willamettepartnership.org/ecosystem-credit-accounting/willamette-ecosystem-marketplace-documents/April%20Counting%20Workshop%20Materials.pdf>.

194. *Id.*

water quality protection, forest conservation, and habitat conservation.¹⁹⁵

In each case the registry depends on a rigorous verification system that measures units of improvement above a baseline in a manner that allows an independent accounting system to track credits and debits, and enables credits to address environmental liability under a variety of laws and regulations.¹⁹⁶ The Markit Environmental Registry was selected to manage credits for both regional initiatives, including an auditing process for credits to ensure they have received the appropriate accreditation and to check that they have not been previously issued.¹⁹⁷ Each credit is given a unique reference number so that it can be monitored through its entire life cycle, and the registry holds retired credits so they can be viewed on the registry, ensuring the same credits are never reissued or sold at a later date.¹⁹⁸

Signatories to the “Agreement in Concept” for the Willamette Partnership accounting system include EPA, USACE, USDA Forest Service and NRCS, NMFS, along with State agencies, various cities, and environmental groups.¹⁹⁹ The Bay Bank project is also supported by EPA, USDA Forest Service and NRCS, as well as the Maryland Department of Natural Resources, the Delaware Forest Service and various environmental groups.²⁰⁰ In short, the concept of a “regional registry” is being used by government to measure specific services that result from restoring and protecting parcels of land, and to create incentive for this activity by allowing verified credits to be used for compliance where appropriate.

195. Kathryn Maloney, *An Ecosystem Service Marketplace for the Chesapeake Bay*, THE BAY BANK, Jan. 4, 2008, available at http://www.na.fs.fed.us/specialinitiatives/080103%20FP%20Bay%20Bank_final.pdf.

196. Willamette Partnership, *supra*, note 193, at 24.

197. Willamette Partnership, Counting on the Environment, <http://willamettepartnership.org/ongoing-projects-and-activities/nrcs-conservation-innovations-grant-1/counting-on-the-environment> (last visited June 2, 2010).

198. Markit, Markit Environmental Registry, <http://www.markit.com/en/products/registry/markit-environmental-registry.page> (last visited June 2, 2010).

199. Joint Statement of Agreement for an Ecosystem Credit Accounting System, in Willamette Partnership, Counting on the Environment: Workshop #5, at 5 (2009), available at <http://willamettepartnership.org/ecosystem-credit-accounting/willamette-ecosystem-marketplace-documents/Workshop%20-5%20Materials.pdf>.

200. Pinchot Inst. for Conservation, The Bay Bank: A Marketplace of Opportunity, http://www.pinchot.org/current_projects/baybank (last visited June 2, 2010).

2. The Conservation Title of the Farm Bill

Conservation issues have been addressed in farm legislation since the 1930s, but formal conservation titles have only been added to the Farm Bill since 1981.²⁰¹ The range of issues covered has grown since then, from an original focus on soil erosion to include concerns about water quality and wildlife habitat.²⁰² In the first decade of conservation title implementation, approximately \$30 billion was spent on conservation and water quality programs.²⁰³

Departmental conservation programs now account for expenditures of more than \$4.5 billion a year, nearly double what was spent annually for those programs prior to the 2002 farm bill.²⁰⁴ For FY 08, these include:²⁰⁵

Conservation technical assistance programs – \$862 million

CRP – \$1.865 billion

Environmental improvement programs

EQIP – \$1.2 billion

WHIP – \$85 million

Stewardship programs

Conservation stewardship program – \$305 million

Easement programs

Forest legacy program – \$52 million

Wetlands reserve – \$184 million

Farm and ranchland protection – \$97 million

Grassland reserve – \$40 million

Targeting these programs for cost-effectiveness is not a new idea. Some are aimed at “problem regions” like watersheds with water quality issues.²⁰⁶ And since 1990, the CRP bid assessment process, for example, has explicitly ranked each parcel of land according to an index of environmental benefits that includes multiple criteria and

201. Margot Anderson, *Conservation, the Environment, and the Farm Bill*, 101 UNIV. COUNCIL ON WATER RES. 4, 4 (1995).

202. HOUSE COMM. ON AGRIC, 2007 FARM BILL CONSERVATION TITLE: INVESTING IN CONSERVATION PROGRAMS THAT PRESERVE NATURAL RESOURCES 1 (2008), *available at* agriculture.house.gov/republicans/farmbill/title2factsheet.pdf.

203. Anderson, *supra* note 216, at 4–5.

204. Craig Cox, *Foreword to ENVIRONMENTAL BENEFITS OF CONSERVATION ON CROPLAND: THE STATUS OF OUR KNOWLEDGE* vii (Max Schnepf & Craig Cox eds., 2006).

205. ExpectMore.gov, Programs Related to Natural Resources and the Environment, http://www.whitehouse.gov/omb/expectmore/topic/Natural_Resources_and_the_Environment.html (last visited June 2, 2010).

206. *Id.*

selects the parcel with the highest environmental benefit per dollar of rental payment.²⁰⁷ The CRP enrolls land for ten to fifteen years, and annual rental payments are now running approximately \$1.7 billion.²⁰⁸

The current scoring system used to assess properties for possible inclusion in the CRP is called the Environmental Benefits Index, and it includes metrics for:

- Wildlife habitat benefits resulting from plantings on contract acreage;
- Water quality benefits from reduced erosion, runoff, and leaching;
- On-farm benefits from reduced erosion;
- Benefits that will likely endure beyond the contract period; and
- Air quality benefits from reduced wind erosion.²⁰⁹

Using these metrics, the USDA Farm Service Agency “collects performance information on all CRP contracts, including the conservation practices installed, acreage enrolled, location of land relative to national and state priority areas, and other characteristics of the land.”²¹⁰

In the most thorough analysis of conservation spending under these Conservation Title programs to date, however, the editors conclude that, “[a] more intensive effort to translate science into practice would pay large dividends for taxpayers, agriculture, and the environment. The benefit, for example, of more precise targeting of conservation practices emerges in these pages as perhaps the biggest short-term opportunity to increase the effectiveness of our efforts.”²¹¹

There are major efforts underway to better align all this spending with measurable outcomes, and these look remarkably like the system of functions and indicators being developed for measuring effectiveness of various offset programs. The Conservation Effects Assessment Project (“CEAP”), for example, has the stated goal of

207. Ralph E. Heimlich & Tim Osborn, *Buying More Environmental Protection with Limited Dollars, When Conservation Reserve Program Contracts Expire: The Policy Options*, Conference Proceeding, (Feb. 10–11, 1994).

208. *Id.*

209. See Andrea Cattaneo et al, *The CRP Balancing Act: Trading Off Costs and Multiple Environmental Benefits*, AM. AGRIC. ECON. ASS'N 30 (2002), available at ageconsearch.umn.edu/bitstream/19810/1/sp02ca03.pdf.

210. ExpectMore.gov, Program Assessment: Conservation Reserve Program, <http://www.whitehouse.gov/omb/expectmore/summary/10003008.2005.html> (last visited June 2, 2010).

211. Cox, *supra* note 204, at vii.

quantifying “the environmental benefits of conservation practices,” and has conducted a number of activities since 2003, including detailed national and regional assessments of cropland, grazing land, wetlands and wildlife habitat.²¹²

Most recently, the Conservation Management Tool to determine priority spending under the Conservation Stewardship Program now ranks projects based on actual performance measures.²¹³ This program enrolls up to 12.8 million acres,²¹⁴ and the tool ranks potential participants by:

- The extent of the baseline level of conservation on the ground at the time of enrollment;
- The degree to which the proposed new conservation activities address the priority resources and improve conservation outcomes over baseline levels;
- The total number of priority resource concerns that are addressed to meet or exceed the stewardship threshold level; and
- The extent to which other natural resource concerns, in addition to those identified as priority resource concerns, are addressed to a level that will improve and conserve them by the end of the contract period.²¹⁵

The kind of ranking technique, along with CEAP analyses, is an example of how quantitative assessment of environmental performance can help to drive effectiveness and accountability for public spending.

B. The Practical Uses of the Ecosystem Services Concept

The evidence continues to mount that the nations’ life support systems are in serious decline,²¹⁶ despite fifty years of what is arguably

212. U.S. Dep’t. of Agric., Natural Res. Conservation Serv., CEAP Background, <http://www.nrcs.usda.gov/technical/nri/ceap/about.html> (last visited June 2, 2010).

213. Nat’l Sustainable Agric. Coal., Conservation Stewardship Program, <http://sustainableagriculture.net/publications/grassrootsguide/conservation-environment/conservation-stewardship-program/> (last visited June 2, 2010).

214. *See id.*

215. *Id.*

216. *See* Millennium Ecosystem Assessment, Guide to Millennium Assessment Reports, <http://www.millenniumassessment.org/en/index.aspx> (last visited June 2, 2010); *see generally* H. JOHN HEINZ III CTR FOR SCIENCE, ECON. & ENV’T, THE STATE OF THE NATION’S ECOSYSTEMS: 2008, MEASURING THE LANDS, WATERS AND LIVING RESOURCES OF THE UNITED STATES (2008).

the most comprehensive set of environmental laws in the world²¹⁷ and substantial public and philanthropic support. According to the preeminent annual scorecard for the state of U.S. ecosystems, the Heinz Center “State of the Nation’s Ecosystems” report, “[t]he nation’s environmental monitoring and reporting enterprise . . . is not matched to the problems, concerns, and decision-making needs of the 21st Century.”²¹⁸

It is not only “monitoring and reporting” techniques that need to be updated: there is a need for clear metrics for regulatory compliance goals, federal spending and federal land management as well. According to a 2009 NY Times article, “More than 20 percent of the nation’s water systems have violated provisions of the Clean Water Act over the past five years,”²¹⁹ and land management choices by upstream farmers, ranchers and foresters are a big part of the solution for downstream water users.²²⁰ U.S. farms and forests will have to play a significant role if national greenhouse gas emission reduction commitments are to be met, and some or all of the habitat for 85 percent of federally protected species is on private land.²²¹

As techniques used in offset and trading programs begin to converge with those used to direct and evaluate federal environmental spending, a consistent message about the financial value of ecosystem services is emerging.²²² The need to deliver results with the money we spend through the EPA on the Chesapeake Bay or the Puget Sound are aided by the innovations underway in Farm Bill Conservation Title spending. Regional restoration efforts inform

217. See Richard Cudahy, *Coming of Age in the Environment*, 30 ENVTL. L. 15 (2000) (tracing the development of environmental law throughout the twentieth century); see also Carol Rose, *Expanding the Choices for the Global Commons: Comparing Newfangled Tradable Allowance Schemes to Old-Fashioned Common Property Regimes*, 10 DUKE ENVTL. L. & POL’Y F. 45, 47 (2000) (“By now, of course, we have seen a whole generation of Leviathan’s solutions to environmental problems, taking the form of command-and-control regulations.”); Ruhl & Salzman, *supra* note 110, at 166 (reviewing the “current status of ecosystem services in environmental law.”).

218. H. JOHN HEINZ III CTR., *supra* note 216, at 1.

219. Charles Duhigg, *Millions in U.S. Drink Dirty Water, Records Show*, N.Y. TIMES, Dec. 8, 2009, at A1, available at <http://www.nytimes.com/2009/12/08/business/energy-environment/08water.html>.

220. Chapika Sangkapitux et al., *Willingness of Upstream and Downstream Resource Managers to Engage in Compensation Schemes for Environmental Services*, 22 INT. J. OF THE COMMONS, available at <http://www.thecommonsjournal.org/index.php/ijc/article/viewArticle/123/60>.

221. Adena Rissman et al., *Conservation Easements: Biodiversity Protection and Private Use*, 21 CONSERVATION BIOLOGY 709, 710 (2007).

222. Salzman & Ruhl, *supra* note 42, at 607.

the goals we have for spending on management of public lands and the techniques we use for regulation of private land.

There is an urgent need to continue and expand this kind of cross-pollination of best practices. To add to our current water quality, habitat, and land-based carbon problems, environmental impacts from energy, transportation, and other infrastructure projects are going to be significant in the coming years.²²³ In just the next twenty to thirty years, over 100,000 oil and gas wells with a footprint of roughly two million acres are anticipated.²²⁴ Millions of acres of wind farms will be built, as will new concentrated solar energy facilities and transmission lines to serve them.²²⁵ Extensive highway and pipeline and water treatment projects will be required, and residential development will continue to meet demand from our growing population.²²⁶

As the pressure for real greenhouse gas solutions continues, we are going to be grappling with what it really means to reduce emissions in an ambitious manner such as “17 percent [below 2005 levels] by 2020 and 83 percent by 2050, compared to a 2005 baseline.”²²⁷ Every conceivable option will be needed for this goal to be realized, and adding clear carbon management metrics to the goals for federal forest and agricultural land will be essential.

The current mission statements of the federal land management agencies cover a disparate set of goals and objectives and lack the fundamental alignment needed to organize activity at the scale and with the sense of urgency now required. These mission statements would be more coherent if language were added that made it clear that in addition to current objectives, federal land management agencies will prioritize a stable climate, clean water, and resilient living systems for the benefit of the American people.

223. See generally JESSICA B. WILKINSON ET AL., *THE NEXT GENERATION OF MITIGATION: LINKING CURRENT AND FUTURE MITIGATION PROGRAMS WITH STATE WILDLIFE ACTION PLANS AND OTHER STATE AND REGIONAL PLANS* (2009).

224. *Id.* at 1.

225. COMM. ON ENVTL. IMPACTS OF WIND-ENERGY PROJECTS, *ENVIRONMENTAL IMPACTS OF WIND-ENERGY PROJECTS* (2007).

226. See INTERAGENCY TRANSP. INFRASTRUCTURE STREAMLINING TASK FORCE, *ENVIRONMENTAL STEWARDSHIP AND TRANSPORTATION INFRASTRUCTURE PROJECT REVIEWS 3-4* (2004), available at <http://www.dot.gov/execorder/13274/annualreport04/annualreport04.pdf> (discussing infrastructure improvements required to meet the needs of a growing population).

227. John M. Broder, *Obama Offers Targets to Cut Greenhouse Gas*, N.Y. TIMES, Nov. 26, 2009, at A1.

Finally, we are going to need to develop a legal rationale for the defense and support of ecosystems as our life support systems.²²⁸ An example of the problem comes from the current EPA ruling on the health and safety impacts of greenhouse gasses.²²⁹ While this ruling was issued for important political reasons, it nonetheless needed to reference health issues like asthma and allergens as the fundamental reasons to regulate the emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.²³⁰ The EPA relies on this unlikely rationale because current legal arguments depend entirely on making a clear link to immediate physical health if an emission is to be regulated as a pollutant.²³¹

As bad as Lyme's disease or asthma can be, these conditions hardly represent the fundamental reasons we need to regulate greenhouse gasses, but a regulatory rationale for protecting earth's "life support systems" is lacking. We need to develop a clear line of legal reasoning that enables restrictions and incentives to be more effectively put in place to the extent that these services are shown to be essential for life.²³² If a vandal went into a hospital and damaged a dialysis machine or a breathing tube, they would be prosecuted even if they never touched the actual patient. Similarly, the reason that the EPA should have the power to regulate greenhouse gasses is *not* because they can be linked to allergies, but because their continued emission is damaging the planetary mechanism for climate homeostasis.

Ecosystem services provide us with an organizing principle that allows us to buy more accurately the things we really need from those who manage natural systems.²³³ This same principle provides a clear basis for legal protection for our life support systems that does not

228. See J.B. Ruhl, *The Background Principles of Natural Capital and Ecosystem Services—Did Lucas Open Pandora's Box?*, 22 J. LAND USE & ENVTL. L. 525, 525–26 (2007) (“[A]lthough there is much yet to be learned about the ecology, geography, and ecology of natural capital and ecosystem services, what is already known demands attention from the discipline of the law.”).

229. See Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 18,886 (proposed Apr. 24, 2009) (to be codified at 40 C.F.R. pt. 1) (stating that greenhouse gases from motor vehicle emissions contribute to air pollution which endangers public health).

230. *Id.* at 18,901.

231. 42 U.S.C. § 7408(a)(1)(A) (2007) (“[T]he Administrator shall... publish . . . a list which includes each air pollutant— emissions of which, in his judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health”).

232. See *supra* note 228 and accompanying text.

233. Ruhl, *supra* note 228, at 527 n.9.

rely on a need to prove direct physical harm.²³⁴ And finally, as we will discuss in the last section of this article, ecosystem services also give us a clear manner of enabling private capital investment in public goods through the rigorous and consistent enforcement of laws that align profit with environmental performance.²³⁵

C. Ecosystems Services as an Asset Class: The Potential to Use Policy to Enable Significant Capital Investment in Conservation and Restoration

For most U.S. landowners, governmental regulation of environmental features on private land is a “minus” on the balance sheet.²³⁶ Despite the public benefits rationale for such regulation, it prevents free economic use of the parcel and often confers some financial obligation.²³⁷ If, however, ecosystem services and the financial value of benefits provided by conservation were recognized in the appraisal process or through ecosystem markets, the entire issue of regulatory “takings” would be at least in part neutralized. In fact, environmental regulations could instead begin to have a positive effect on the value of natural features on private land.²³⁸

While it may seem quite abstract at first to argue that the value of conservation or restoration actions could outweigh the value of development or extraction, this exact pattern is already becoming reality for specific parcels of American land.²³⁹ Demand for credits produced by conservation and restoration actions on private land has been created by policy that allows purchase of outsourced compliance with a wide range of environmental laws.²⁴⁰ The value of credits sold for the Clean Water Act and the Endangered Species Act has grown

234. *See id.* at 527–28 (arguing that the better understanding of natural capital and ecosystem services can and will supplant a harm based approach that currently dictates common law protections).

235. *See id.* at 532.

236. William K. Jaeger, *The Effects of Land-Use Regulations on Property Values*, 36 *Env'tl. L.* 105, 112–13 (2006).

237. *See* Heritage Foundation, *The Negative Economic Impact of Environmental Regulations*, *Opposing Views*, Jan. 30, 2009, <http://www.opposingviews.com/i/the-negative-economic-impact-of-environmental-regulations>.

238. Jaeger, *supra* note 258, at 105.

239. *See id.* at 126 (“[L]and-use regulations can, and often do, have positive effects on land values in settings where amenity effects, scarcity effects, or both kinds of effects are at work. There is also abundant empirical evidence that documents how land-use regulations have raised rather than lowered property values in many cases”).

240. *See, e.g.*, Salzman & Ruhl, *supra* note 42, at 609–10 (noting that regulators shape the trading factors).

steadily over the past two decades, and is estimated at over \$3 billion annually.²⁴¹ The total annual value of projects regulated under section 10 of the Safe Harbors & Rivers Act and Section 404 of the Clean Water Act exceeds \$220 billion.²⁴² Credits are also being sold for water quality, Natural Resource Damage Assessment, and compliance with local land use requirement of many kinds.²⁴³

These credit-based systems are continually advancing in sophistication, and their use is expanding. The new rules for Clean Water Act compliance, for example, recently established by the EPA and USACE, will improve both the quality of compliance credits and the scale of market activity because they: 1) prioritize the use of projects requiring up front investment (called mitigation banks) over payments to non-profit groups or “do it yourself” mitigation; 2) add streams to the aquatic resources required to be mitigated if unavoidably impacted; and 3) mandate specific processes and timelines for mitigation bank approval.²⁴⁴

Opportunities for project investment will emerge from the need to sequester greenhouse gasses as well. Both the Waxman-Markey²⁴⁵ and Kerry-Boxer climate bills in the House and Senate contain language that will create clear value for each scientifically verifiable ton of carbon sequestered in forestland and farmland.²⁴⁶ The rules for verification and the specific management actions that will be required in order to obtain clear title to a fungible credit for compliance with climate law have yet to be firmly established.²⁴⁷

241. ENVTL LAW INST., MITIGATION OF IMPACTS TO FISH AND WILDLIFE HABITAT: ESTIMATING COSTS AND IDENTIFYING OPPORTUNITIES 2 (2007).

242. Interview with Jon E. Soderberg, Senior Program Mgr., U.S. Army Corps of Engineers, Directorate of Civil Works (Nov. 3, 2008).

243. See, e.g., Salzman & Ruhl, *supra* note 42, at 609; Elliott Bay Trustee Council, Lower Duwamish River Resolution 2009-05 (2009), available at http://www.darrp.noaa.gov/northwest/lowerduwamishriver/pdf/EB_TC_Resolution_2009-05.pdf; Rick Pruetz, Beyond Takings and Givings, About TDR, <http://www.beyondtakingsandgivings.com/tdr.htm> (last visited June 2, 2010).

244. Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. 19,594, 19,595 (Apr. 10, 2008) (to be codified at 40 C.F.R. pt. 230).

245. JOHN LARSEN ET AL., BRIEF SUMMARY OF THE WAXMAN-MARKEY DISCUSSION DRAFT 4 (2009), available at <http://www.wri.org/stories/2009/04/brief-summary-waxman-markey-discussion-draft>.

246. *Id.*

247. See American Clean Energy and Security Act of 2009, H.R.2454, 111th Cong. § 507 (2009) (assessing §507, which governs the certification of offset credits, revealing the lack of provisions for clear title).

But make no mistake: these carbon credits, along with wetland credits, species credits, and other new forms of environmental compliance credits are *new forms of wealth* that are *tied directly to environmental performance on the land*. Demand for these credits is created by law, but the science elucidating the increasing scarcity of ecosystem services is compelling, and the logic behind the policy which creates financial value for the measurable results of conservation and restoration inexorable.

1. Early Evidence of an Ecosystem Services Asset Class

As statutes and regulations successfully create clear title to property rights that create wealth *tied directly to environmental performance*, private land will attract new entrepreneurial investment that augments existing public and philanthropic spending.²⁴⁸ Even in these early phases of recognition of the financial value of water, carbon and biodiversity produced by private land management, there are significant institutional investors engaging in these conservation-related markets.²⁴⁹ Aligning return on investment with high-quality conservation and restoration has the potential to create an entirely new asset class of socially responsible investment (“SRI”) in the real estate or alternative assets categories.²⁵⁰

SRI investing, known alternatively as “impact investing”, “mission related investing” or “double bottom line investing” has proven to be a significant economic force over the past twenty years.²⁵¹ A particular subset of SRI investing known as cleantech is perhaps most comparable to the emerging ecosystem services asset class, because it is defined by investment in a somewhat disparate set of environmental companies that produce clear benefits across a range of transportation, recycling and waste, and energy generation, storage, and efficiency activities.²⁵² Similarly, the “Eservices sector”

248. See Salzman & Ruhl, *supra* note 42, at 611–12 (noting governmental measures that impact the investment in wetlands and other preserves).

249. See *id.*

250. Chris Lott, Ritchie Lowry, & Reid Cooper, Subject: Strategy - Socially Responsible Investing, The Investment FAQ, Mar. 23, 2001, <http://invest-faq.com/cbc/strat-sri.html>.

251. See Green Century Capital Management, What Is Green Investing: Historical Overview of Socially Responsible Investing (SRI), <http://www.greencentury.com/greeninvesting/how-it-works/Historical-Overview-of-Socially-Responsible-Investing> (last visited June 2, 2010) (giving an overview of the history of socially responsible investing).

252. Andrew Thomson, *Cleantech: The Future, Now*, INVESTMENT WEEK, May 18, 2009, available at <http://www.investmentweek.co.uk/investment-week/feature/1376836/cleantech-future>.

includes multiple related activities including land-based carbon sequestration, wetland and stream banking, conservation banking, and water quality or natural resources damage credits from land management.²⁵³

Capital flows to cleantech investment totaled over \$16 billion in the 2001-2007 period,²⁵⁴ and annual investment grew seven-fold during that period. The Eservices Sector is currently at an investment level comparable to cleantech in 2001, with at least \$800 million now committed to various firms for investment in conservation and restoration projects that meet government standards, and another \$650 million currently being raised.²⁵⁵

Table 1: Cleantech Investment²⁵⁶

2007: \$5.18 billion
2006: \$3.6 billion
2005: \$2.5 billion
2004: \$1.8 billion
2003: \$1.7 billion
2002: \$899 million
2001: \$714 million
Energy Generation: \$2.75 billion; 172 deals
Energy Storage: \$471 million; 20 deals
Transportation: \$445 million; 20 deals
Energy Efficiency: \$356 million; 41 deals
Recycling & Waste: \$291 million; 17 deals

253. See European Investment Bank, The European Investment Bank Proposes Two New EIBURS Sponsorships Within Its EIB-Universities Research Action, July 3, 2009, <http://www.eib.org/about/news/two-new-eiburs-sponsorships-within-eib-universities-research-action-2009-2012.htm> (noting developments in Europe).

254. See Greentech Group LLC, Cleantech Investments Reach New Apex of \$5.18 Billion Over 2007 and Sixth Consecutive Year of Growth, Jan. 17, 2008 <http://cleantech.com/about/pressreleases/011708.cfm>.

255. Personal communication, Adam Davis, with individual fund Managers from 11/09 through 5/10

256. Greentech Group, *supra* note 254.

Table 2: Current Investment Firms in the Eservices Sector

Timbervest Crossover Assets Fund
Eco-Products Fund
Resource Environmental Solutions
Beartooth Capital
Ecosystem Investment Partners
Rock Creek Capital
Biological Capital
Bluefield Holdings
Falling Springs, LLC
EKO Asset Partners
Terra Global Capital
Wildlands
Westervelt
Working Lands Investment Partners

The opportunity for policymakers to continue to align ecology with economy by creating clear standards for investment success is significant. By enabling private capital to obtain competitive risk-adjusted return on investment from conservation and restoration related activities, the gap between what we need to spend for our life support systems and what we are spending now can begin to be closed.

III. A PARTING THOUGHT ON ECOSYSTEM SERVICES AND WEALTH CREATION

We are entering into an era when the relative scarcity of ecosystem services is creating demand for protection and restoration at a scale and pace which simply cannot be achieved without capital investment. And capital investment cannot proceed without policy support from the federal government.

As the tenets of English property law evolved new forms of property like those created by the Homestead Act in Colonial America,²⁵⁷ it would have been impossible to imagine the great wealth that would ultimately be created. The act of applying scientific understanding in the form of surveying transformed the abstract idea

257. HERNANDO DE SOTO, *THE MYSTERY OF CAPITAL: WHY CAPITALISM TRIUMPHS IN THE WEST AND FAILS EVERYWHERE ELSE* 110–11 (Basic Books 2000).

of owning land into clear units of measure (acres) that formed the basis of a deed.²⁵⁸

What follows here is a statement appearing in a book from 1688; John Love's *Geodaesia: or, The Art of Surveying and Measuring of Land Made Easie*:

- - - and if you ask, why I write a Book of this nature, since we have so many very good ones already in our own Language? I answer, because I cannot find in those Books, many things, of great consequence, to be understood by the Surveyor. I have seen Young men in America, often nonplus'd so, that their Books would not help them forward, particularly in Carolina, about Laying out Lands, when a certain quantity of Acres has been given to be laid out five or six times as broad as long. This I know is to be laught at by a Mathematician; yet to such as have no more of this Learning, than to know how to Measure a Field, it seems a Difficult Question: And to what Book already Printed of Surveying shall they repair to, to be resolved?²⁵⁹

At some point in the future, scholars will look back at the language currently under development by the Willamette Partnership for its ecosystem credit accounting protocols,²⁶⁰ by the Voluntary Carbon Standard for its AFOLU and REDD project verification standards,²⁶¹ or by the Ohio River Basin Trading Project for its Watershed Analysis Risk Management Framework . . . and they will think it is just as quaint and funny as this statement made by John Love.

258. *See id.*

259. JOHN LOVE, *GEODAESIA: OR, THE ART OF SURVEYING AND MEASURING OF LAND MADE EASIE* (1688), excerpted at [Surveyhistory.org](http://www.surveyhistory.org), Surveying Books Used in the United States (1600's-1700's), http://www.surveyhistory.org/surveying_books_1600s_-_1700s.htm (last visited Apr. 23, 2010).

260. Willamette Partnership, *supra* note 193.

261. Voluntary Carbon Standard, Frequently Asked Questions, <http://www.v-c-s.org/faq.html> (last visited June 2, 2010).