

ECOSYSTEM SERVICES AND THE CLEAN WATER ACT: STRATEGIES FOR FITTING NEW SCIENCE INTO OLD LAW

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This Article explores the administrative reform potential that exists for integrating new knowledge about ecosystem services into Clean Water Act (CWA) regulatory programs as an example for all environmental laws. Part II of the Article reviews the relevant general rules of federal administrative law governing agency interpretation of the policy space available under statutory authority for integrating new science into decision making. Part III then explores the strategies an agency such as the United States Environmental Protection Agency can use under those rules to integrate the concept of ecosystem services into regulatory programs by searching for statutory provisions to support what I call “direct protection” authority and “performance metric” authority. Part IV of the Article turns to the dredge and fill permit program of section 404 of the CWA and the water quality standards and total maximum daily load program of section 303 of the CWA as its case studies, showing how opportunities for and obstacles to the two integration strategies arise in the structure and text of the statute. The Article closes with some thoughts on a more overarching agenda for working ecosystem services into existing federal environmental protection programs.

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I. INTRODUCTION

The Clean Water Act (CWA)¹ has proven to be a remarkably effective and adaptive law over its forty-year history. It is widely credited with being the catalyst for the great strides our nation has achieved in improving water quality and protecting public health.² But it is an old law, and it has not been updated through significant legislative reform in over two decades.³ In that time, it has become apparent that the statute's statutory structure has failed to keep pace with scientific advances, one prominent example being research on ecosystem services.⁴

Ecosystem services flow to human communities in four streams: 1) provisioning services are commodities such as food, wood, fiber, and water; 2) regulating services moderate or control environmental conditions, such as flood control by wetlands, water purification by aquifers, and carbon sequestration by forests; 3) cultural services include recreation, education, and aesthetics; and 4) supporting services, such as nutrient cycling, soil formation, and primary production, make the other three service streams possible.⁵ As research that has emerged and burgeoned over the past decade has shown, aquatic resources provide bountiful supplies of ecosystem services to human populations, including through groundwater recharge, storm and flood mitigation, sediment control, water purification, climate

¹ Federal Water Pollution Control Act, 33 U.S.C. §§ 1251–1387 (2006).

² See generally William L. Andreen, *Water Quality Today—Has the Clean Water Act Been a Success?*, 55 ALA. L. REV. 537 (2004) (explaining how the CWA combined technology-based limits and environmental quality-based standards to curb water pollution).

³ The last set of significant amendments was enacted in 1987. Water Quality Act of 1987, Pub. L. No. 100-4, 101 Stat. 7 (codified as amended in scattered sections of 33 U.S.C.).

⁴ Ecosystem services are economically valuable benefits humans derive from ecological resources directly, such as storm surge mitigation provided by coastal dunes and marshes, and indirectly, such as nutrient cycling that supports crop production. Natural capital consists of the ecological resources that produce these service values, such as forests, riparian habitat, and wetlands. For descriptions of natural capital and ecosystem services, see MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING (2005), available at <http://www.maweb.org/documents/document.356.aspx.pdf>, NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS (Gretchen C. Daily ed., 1997), and Robert Costanza et al., *The Value of the World's Ecosystem Services and Natural Capital*, 387 NATURE 253 (1997). For coverage of the emergence of the ecosystem services concept in law and policy, see J.B. RUHL, STEVEN E. KRAFT & CHRISTOPHER L. LANT, THE LAW AND POLICY OF ECOSYSTEM SERVICES 85–168 (2007), J.B. Ruhl & James Salzman, *The Law and Policy Beginnings of Ecosystem Services*, 22 J. LAND USE & ENVTL. L. 157 (2007), and James Salzman, *A Field of Green? The Past and Future of Ecosystem Services*, 21 J. LAND USE & ENVTL. L. 133 (2006).

⁵ This typology of ecosystem services is developed in MILLENNIUM ECOSYSTEM ASSESSMENT, *supra* note 4, at vi.

regulation, water supply, and recreation.⁶ The connections between the CWA, the central objective of which is “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters,”⁷ and the conservation of ecosystem services thus seem obvious and numerous, yet nowhere in the CWA are these connections made explicit.⁸ This Article addresses the questions of whether, where, and how those connections can be drawn so that new knowledge about ecosystem services can be integrated into decision making under the CWA.

To be sure, the CWA is not the only environmental law that has fallen behind the times in this respect. Ecologists and economists have been forging the theory and application of the ecosystem services concept since the mid-1990s,⁹ but only in the past few years has the concept begun to register in any meaningful way in federal environmental policy.¹⁰ Many of the environmental laws Congress passed in the 1970s have undergone little more than superficial reforms, if any, in the past twenty years,¹¹ meaning new scientific concepts such as ecosystem services often find no clear home in existing statutes. This gradual scientific atrophy of environmental statutes has put tremendous pressure on administrative agencies such as the United States Environmental Protection Agency (EPA) to adapt regulatory programs to stay up to date with new knowledge and emerging policy challenges. In some cases agencies have carried out sweeping reforms at the administrative policy level, such as the broad reforms the United States Department of the Interior accomplished for the Endangered Species Act (ESA)¹² in the 1990s.¹³ But the latitude agencies have to engage in substantive administrative reform in the absence of substantive legislative reform depends on the text and interpretations of the existing statutes on the books.¹⁴ Each statute thus presents its own specialized “policy space” within which an agency could, if so inclined, adjust the regulatory program through administrative reform to reflect new knowledge.

⁶ See MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: WETLANDS AND WATER (2005), available at <http://www.maweb.org/documents/document.358.aspx.pdf>.

⁷ Federal Water Pollution Control Act, 33 U.S.C. § 1251(a) (2006).

⁸ See Robin Kundis Craig, *Justice Kennedy and Ecosystem Services: A Functional Approach to Clean Water Act Jurisdiction after Rapanos*, 38 ENVTL. L. 635, 636–37 (2008).

⁹ See Harold A. Mooney & Paul R. Ehrlich, *Ecosystem Services: A Fragmentary History*, in NATURE’S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS, *supra* note 4, at 11, 11; Ruhl & Salzman, *supra* note 4, at 158–61.

¹⁰ See RUHL, KRAFT & LANT, *supra* note 4, at 127–57; Ruhl & Salzman, *supra* note 4, at 163–64.

¹¹ See Richard J. Lazarus, *Congressional Descent: The Demise of Deliberative Democracy in Environmental Law*, 94 GEO. L.J. 619, 621–32 (2006).

¹² Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2006).

¹³ See John D. Leshey, *The Babbitt Legacy at the Department of the Interior: A Preliminary View*, 31 ENVTL. L. 199, 211–16 (2001); J.B. Ruhl, *Endangered Species Act Innovations in the Post-Babbittian Era—Are There Any?*, 14 DUKE ENVTL. L. & POL’Y F. 419, 430–34 (2004); Joseph L. Sax, *Environmental Law at the Turn of the Century: A Reportorial Fragment of Contemporary History*, 88 CAL. L. REV. 2375, 2380–82 (2000).

¹⁴ See WILLIAM N. ESKRIDGE, JR., PHILIP P. FRICKEY & ELIZABETH GARRETT, LEGISLATION AND STATUTORY INTERPRETATION 219–387 (2d ed. 2006) (discussing theories and rules of statutory interpretation, including rules of judicial deference to agency interpretations).

This Article explores the administrative reform potential that exists for integrating new knowledge about ecosystem services into CWA regulatory programs as an example for all environmental laws. Part II of the Article reviews the relevant general rules of federal administrative law governing agency interpretation of the policy space available under statutory authority.¹⁵ Part III then explores the strategies an agency such as EPA can use under those rules to integrate the concept of ecosystem services into regulatory programs by searching for statutory provisions to support what I call “direct protection” authority and “performance metric” authority. Part IV of the Article turns to the dredge and fill permit program of section 404 of the CWA¹⁶ and the water quality standards and total maximum daily load (TMDL) program of section 303 of the CWA¹⁷ as its case studies, showing how opportunities for and obstacles to the two integration strategies arise in the structure and text of the statute. The Article closes with some thoughts on a more overarching agenda for working ecosystem services into existing federal environmental protection programs.

II. DEFINING POLICY SPACE FOR ADMINISTRATIVE REFORM

Initiating regulatory reform in the context of stale statutory authority can be a significant challenge for an agency. Social and economic interests entrenched in and benefitted by the status quo are likely to attempt to bring political pressure on the agency to protect their interests.¹⁸ On the other hand, whatever conditions have prevented Congress from acting for so long in the relevant field are likely also to dampen the prospect of legislation negating the agency’s regulatory reform.¹⁹ Much of the action in this context thus plays out in court as interests opposed to the agency’s reform agenda, whatever form it takes, seek judicial review and rejection of the agency’s decision as inconsistent with existing substantive and procedural requirements.²⁰

Although judicial review of agency action can take many forms and involves numerous matters for judicial consideration, the key questions in the regulatory reform context are, as Table 1 summarizes, whether the proposed reform is consistent with the Constitution, authorized by relevant statutory authority, and compatible with the agency’s existing regulations.²¹ If the answer to all three of those questions is affirmative, then all the agency

¹⁵ Part II is not exhaustive in this respect. It is intended to familiarize lawyers and non-lawyers who have not delved into administrative law with the core doctrine of judicial review of agency statutory interpretations.

¹⁶ Federal Water Pollution Control Act, 33 U.S.C. § 1344 (2006).

¹⁷ *Id.* § 1313(d).

¹⁸ See Kathryn A. Watts, *Proposing a Place for Politics in Arbitrary and Capricious Review*, 119 YALE L.J. 2, 67–68 (2009).

¹⁹ Mark Seidenfeld, *The Psychology of Accountability and Political Review of Agency Rules*, 51 DUKE L.J. 1059, 1075–76 (2001).

²⁰ Watts, *supra* note 18, at 49.

²¹ See Richard J. Pierce, Jr., *Seven Ways to Deossify Agency Rulemaking*, 47 ADMIN. L. REV. 59, 84–85 (1995).

need do, if even, is announce the agency's position through what is loosely described as "guidance."²² Although there is a point at which a substantial change in approach could be deemed to require promulgation of new legislative agency regulation,²³ the reality is that agencies can accomplish a tremendous amount of incremental regulatory reform through guidance and other "gray law" mechanisms.²⁴

Table 1.

Constitution allows?	Existing statute allows?	Existing regulations allow?	Action needed
Yes	Yes	Yes	New guidance
Yes	Yes	No	New regulation
Yes	No	No	Statutory amendment, then new regulation
No	No	No	Constitutional amendment, then new statute and regulation

Significant regulatory innovation, however, is often going to require more significant changes to the existing regulatory regime for which mere guidance will not suffice as the sole or even primary implementation mechanism. At one extreme, agency reform action that is inconsistent with constitutional principles would require an amendment to the Constitution, which is a highly unlikely prospect. The more salient issue, therefore, is whether a proposed regulatory reform requires new statutory authorization or only a new agency regulation.

From the agency's perspective, being able to carry out the initiative without need of new legislation may often be preferable, but it is not always clear whether the existing statute will allow it. If the new proposed

²² "Guidance" has no formal definition, but generally consists of non-legislative agency pronouncements found in memoranda, training manuals, policy statements, and, of course, documents labeled as guidance. See Robert A. Anthony, *Interpretive Rules, Policy Statements, Guidances, Manuals, and the Like—Should Federal Agencies Use Them to Bind the Public?*, 41 DUKE L.J. 1311, 1315 (1992).

²³ The line between when it is permissible for an agency to use non-legislative guidance to nudge policy incrementally and when it must use a legislative administrative rulemaking is fuzzy. See Sam Kalen, *The Transformation of Modern Administrative Law: Changing Administrations and Environmental Guidance Documents*, 35 ECOLOGY L.Q. 657, 674–75 (2008).

²⁴ Guidance is the predominant form of agency policy expressions. See Connor N. Raso, *Strategic or Sincere? Analyzing Agency Use of Guidance Documents*, 119 YALE L.J. 782, 788 (2010); Peter L. Strauss, *The Rulemaking Continuum*, 41 DUKE L.J. 1463, 1469 (1992).

regulation extends, departs from, or conflicts with prior agency regulations and practice, the agency thus must predict whether the proposal is permissible under the existing statute. In making this prediction, the agency must walk the line between two types of error: a false positive, in which the agency incorrectly concludes existing laws allow a new regulatory innovation, and a false negative, in which the agency incorrectly believes existing laws do not allow the regulatory innovation.

One of the key principles of federal administrative law provides considerable latitude for agencies in navigating between these two types of regulatory reform error. In *Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc.* (*Chevron*),²⁵ the United States Supreme Court held that ambiguities in statutes within an agency's jurisdiction to administer are congressional delegations of authority to the agency to fill the statutory gap in a reasonable fashion.²⁶ Filling these gaps, the Court explained, involves difficult policy choices that agencies are better equipped to make than courts.²⁷ Thus, if a statute is ambiguous, and if the implementing agency's construction is reasonable, *Chevron* requires a federal court to defer to the agency's construction of the statute, even if the agency's reading differs from what the court believes is the best statutory interpretation.²⁸

Chevron has many nuances²⁹ and has received considerable favorable and critical attention in legal and policy scholarship,³⁰ but its core principle remains quite active and enforced in the courts in the context of an agency regulatory promulgation interpreting the agency's organic statutes. Indeed, more recently the Supreme Court explained that *Chevron* applies even when an agency is not merely extending existing policy, but also when it has completely changed directions under its statute.³¹ In *National Cable & Telecommunications Association v. Brand X Internet Services* (*Brand X*), the Court held that

if the agency adequately explains the reasons for a reversal of policy, "change is not invalidating, since the whole point of *Chevron* is to leave the discretion provided by the ambiguities of a statute with the implementing agency." "An initial agency interpretation is not instantly carved in stone. On the contrary,

²⁵ 467 U.S. 837 (1984).

²⁶ *Id.* at 843–44; see also H. Miles Foy, III, *On Judicial Discretion in Statutory Interpretation*, 62 ADMIN. L. REV. 291, 315–17 (2010) (discussing judicial deference to agency interpretation of statutes).

²⁷ *Chevron*, 467 U.S. at 844.

²⁸ *Id.* at 845.

²⁹ See, e.g., *United States v. Mead Corp.*, 533 U.S. 218, 231 (2001) (explaining circumstances in which *Chevron* does not apply).

³⁰ See, e.g., Jack M. Beermann, *End the Failed Chevron Experiment Now: How Chevron Has Failed and Why It Can and Should Be Overruled*, 42 CONN. L. REV. 779, 782 (2010) (describing *Chevron* as "administrative law's most highly analyzed doctrine" and criticizing its theoretical bases and practical applications). A Westlaw journals & law reviews (JLR) database search of "*Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc.*" on November 20th, 2010 yielded over 3100 results.

³¹ *Nat'l Cable & Telecomms. Ass'n v. Brand X Internet Servs.*, 545 U.S. 967, 981 (2005).

the agency . . . must consider varying interpretations and the wisdom of its policy on a continuing basis,” for example, in response to changed factual circumstances, or a change in administrations.³²

The *Brand X* Court went even further to hold that “[a] court’s prior judicial construction of a statute trumps an agency construction otherwise entitled to *Chevron* deference only if the prior court decision holds that its construction follows from the unambiguous terms of the statute and thus leaves no room for agency discretion,”³³ and thus “[o]nly a judicial precedent holding that the statute unambiguously forecloses the agency’s interpretation, and therefore contains no gap for the agency to fill, displaces a conflicting agency construction.”³⁴

Hence, in predicting whether a proposed regulatory reform requires new legislation or only new regulation, an agency deciding that a new regulation will suffice can take safe harbor in *Chevron* and *Brand X*. Only if it is clear from the statute that the agency has no authority to carry out the reform through regulation as a reasonable interpretation of the statute must the agency depend on legislative reform to implement the policy. The next section applies these principles to devise strategies for integrating ecosystem services into agency decision making.

III. STRATEGIES FOR INTEGRATING ECOSYSTEM SERVICES INTO EXISTING REGULATORY PROGRAMS

When taken together, *Chevron* and *Brand X* provide agencies like EPA the room to experiment with regulatory innovations based on new knowledge, such as the now well-established and growing body of knowledge on ecosystem services. It is not always necessary, however, to rest on *Chevron*, as some statutes may clearly authorize use of ecosystem services concepts in agency decision making. But the 2008 Farm Bill,³⁵ which requires the United States Department of Agriculture to “establish technical guidelines that outline science-based methods to measure the environmental services benefits from conservation and land management activities in order to facilitate the participation of farmers, ranchers, and forest landowners in emerging environmental services markets,”³⁶ is at present the only such example at the federal level. At the other extreme, some statutes may make

³² *Id.* (alteration in original) (citations omitted) (quoting *Smiley v. Citibank* (South Dakota), N.A., 517 U.S. 735, 742 (1996), and *Chevron*, 467 U.S. at 863–64); see also Darren H. Weiss, Casenotes, *X Misses the Spot: Fernandez v. Keisler and the (Mis)Appropriation of Brand X by the Board of Immigration Appeals*, 17 GEO. MASON L. REV. 889, 892 (2010) (arguing that *Brand X* is potentially injurious to the legal system because it allows agencies to avoid statutory interpretations that they find unfavorable).

³³ *Brand X*, 545 U.S. at 982.

³⁴ *Id.* at 982–83.

³⁵ Food, Conservation, and Energy Act of 2008, H.R. 2419, 110th Cong. (2008).

³⁶ *Id.* § 1245(a). For developments in this program, see U.S. Dep’t of Agric., USDA Office of Environmental Markets, <http://www.fs.fed.us/ecosystemservices/OEM/index.shtml/index.shtml> (last visited Nov. 20, 2010).

it clear that ecosystem services cannot be taken into consideration. When deciding whether to list a species under the ESA, for example, the United States Fish and Wildlife Service must take only the biological status of the species into account, and thus could not consider as a reason to list the species the economic benefits of ecosystem services that would be provided once the species and its habitat came under the statute's protection.³⁷ When a statute is not clear in either of these directions, however, *Chevron* and *Brand X* are controlling.

If an agency such as EPA were to decide to integrate ecosystem services concepts into its regulatory program, therefore, the challenge would be to locate provisions in the relevant statute that can provide the platform for reasonable interpretations that using ecosystem services science in decision making is within the scope of the agency's authority. Two different approaches seem promising in this respect. First, a statute may contain provisions suggesting that the agency can directly protect and manage natural resources for the purpose of conserving the flow of ecosystem services to human populations. For example, if a statute mandated that an agency manage or protect natural resources for, among other things, the "public welfare," one could reasonably make the argument that ecosystem services, because of their economic value and importance to human health and well being, enhance public welfare and thus maintaining or enhancing the flow of ecosystem services can be the direct focus of regulatory efforts under the statute. Declines in the flow of ecosystem services thus could be used under this "direct protection" authority to justify changes in the resource management protocol specifically for the purpose of restoring those flows.

The other approach—a fallback in the event no statutory hook credibly supports the direct protection strategy—is to locate terms in a statute that would reasonably support using ecosystem services as a criterion for determining whether the directives of the statute are being adequately fulfilled. For example, if a statute mandated that an agency manage or protect natural resources for the purposes of maintaining "environmental quality," one could reasonably argue that a credible way of determining if environmental quality is maintained is to examine trends in the flow of ecosystem services from the resource. Declines in the flow of ecosystem services thus could be used under this "performance metric" authority for deciding how to implement management changes for the resource, the incidental consequence of which would be restoring or enhancing the ecosystem services.

³⁷ The ESA requires that species listing determinations be made "solely on the basis of the best scientific and commercial data available." Endangered Species Act of 1973, 16 U.S.C. § 1533(b)(1)(A) (2006). Congress added this provision to the statute in 1982 specifically to overturn the Reagan administration's policy of applying economic impact analysis to species listing decisions. See H.R. CONF. REP. NO. 97-835, at 20 (1982), *reprinted in* 1982 U.S.C.A.N. 2860, 2861 ("[E]conomic considerations have no relevance to determinations regarding the status of species and the economic analysis requirements of Executive Order 12291 . . . will not apply to any phase of the listing process.").

Using this two-pronged strategy, the challenge for agencies hoping to integrate ecosystem services into regulatory programs under statutes that do not clearly authorize or prohibit doing so is to search for provisions that reasonably can be interpreted to provide either direct protection authority or performance metric authority. While direct protection authority may be preferable for agencies hoping to establish ecosystem services as a secure focal point of regulatory policy, the advantage of the performance metric authority strategy is that it may present more flexibility for creative statutory interpretation, as Congress is less likely to put statutory sideboards on how agencies measure regulatory performance than it is on the scope of agencies' regulatory authority.³⁸ The next section provides two case studies under the CWA illustrating this searching and interpretation process.

IV. THE CLEAN WATER ACT

The appropriate place to start with a holistic inquiry into the scope of the CWA, as with any statute, is with its statement of purpose—"to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."³⁹ One will search the statutory text in vain, however, for clues as to what "chemical, physical, and biological integrity" means. Some hints may be found in the laundry list of goals and policies Congress appended to its statement of purpose for the CWA, which include eliminating discharges of pollutants,⁴⁰ establishing interim water quality goals for fish, wildlife, and recreation,⁴¹ and controlling nonpoint sources of pollution.⁴² But these do not put meat on the bones of "integrity" and if anything broaden more than narrow the potential reach of the statute. When one turns to the operative language of the CWA, moreover, matters get no less ambiguous. As Professor Robert Adler has observed in his probing review of the meaning behind what he calls the "water quality trilogy" of chemical, physical, and biological integrity, the statute's provisions are riddled with anomalies and inconsistencies in this respect.⁴³

But Adler does find evidence of two overarching themes. First, his review of the legislative history concludes that

both houses of Congress seem to have given the concept of aquatic ecosystem integrity due deliberation, indicating that the Act's opening phrase was not intended as a mere rhetorical flourish. It does appear the Act's chief sponsors in the House of Representatives and the Senate disagreed on the precise

³⁸ Timothy A. Wilkins & Terrell E. Hunt, *Agency Discretion and Advances in Regulatory Theory: Flexible Agency Approaches Toward the Regulated Community as a Model for the Congress-Agency Relationship*, 63 GEO. WASH. L. REV. 479, 481 (1995) (discussing how Congress neglects to focus on agency performance).

³⁹ Federal Water Pollution Control Act, 33 U.S.C. § 1251(a) (2006).

⁴⁰ *Id.* § 1251(a)(1).

⁴¹ *Id.* § 1251(a)(2).

⁴² *Id.* § 1251(a)(7).

⁴³ See Robert W. Adler, *The Two Lost Books in the Water Quality Trilogy: The Elusive Objectives of Physical and Biological Integrity*, 33 ENVTL. L. 29, 39-43 (2003).

meaning of the statutory objective, as is true of many other provisions of the Act. The Senate Committee's understanding of the concept of integrity seems to suggest a return to pristine, natural ecological conditions, while the House Committee suggested that the concept of integrity implies a return to natural ecosystem structure and functions.⁴⁴

So there is support for the proposition that the CWA is amorphously ecological in scope, with natural conditions and functions on ecosystem scales being an intended implementation yardstick. The problem Adler detects, however, is that the regulatory teeth of the statute and of EPA's implementation for the most part have been sharpened on the chemical component of the water quality trilogy through a focus on controlling pollutants, with not enough attention to addressing the broader problem of pollution.⁴⁵ As he observes,

while progress has been made in moving toward "chemical" integrity, and while significant resources and programs have been directed at discharges of chemical pollutants, both the "physical" and "biological" integrity books in the trilogy have remained largely hortatory. Empirical evidence shows measurable gains in reducing chemical pollution, but in the thirty years since the law was passed, the overall health of the nation's freshwater aquatic ecosystems has declined dramatically.⁴⁶

Adler thus concludes that "neither the federal nor the state agencies charged with implementing the CWA have taken full advantage of their existing legal authority to address the physical and biological books in the water quality trilogy," and hence "[i]t is time for EPA to revisit its virtually exclusive focus on chemical impairments to our aquatic ecosystems."⁴⁷ That is precisely the objective in exploring how to work ecosystem services science into the statute. The two case studies that follow illustrate that the CWA presents ample opportunities for doing so, if one thinks creatively.

⁴⁴ *Id.* at 46–47 (footnote omitted).

⁴⁵ *See id.* at 34–39.

⁴⁶ *Id.* at 31. The CWA's definition of "pollutant" identifies a long and wide list of specific waste streams, such as dredged spoil, solid waste, incinerator residue, garbage, chemical wastes, heat, and sand. 33 U.S.C. § 1362(6) (2006). By contrast, the definition of "pollution" is "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." *Id.* § 1362(19). Adler's study focuses on the distinctions between the two terms as used in the operative provisions of the statute and the untapped potential of provisions addressing pollution. *See* Adler, *supra* note 43, at 34–35.

⁴⁷ Adler, *supra* note 43, at 32. EPA recently has expressed agreement on this score, conceding that "as EPA's water quality protection program has evolved, it has become apparent that chemical criteria alone, without the criteria for the biological and physical/habitat components of water bodies, are insufficient to fully achieve the goals of the CWA." U.S. Env'tl. Prot. Agency, Water Quality Handbook – Introduction, <http://www.epa.gov/waterscience/standards/handbook/intro.html> (last visited Nov. 20, 2010).

A. Section 404 Dredge and Fill Program—The Direct Protection Approach

Section 404(a) of the CWA authorizes the Secretary of the Army, through the United States Army Corps of Engineers (Corps), to “issue permits . . . for the discharge of dredged or fill material in the navigable waters of the United States at specified disposal sites.”⁴⁸ Although the Corps is the front-line regulatory agency for administering this permit program, pursuant to section 404(b)(1) of the CWA, EPA must promulgate substantive permitting standards focused on environmental factors, known as the “404(b)(1) Guidelines,” which the Corps must follow when issuing permits for disposal of dredged or fill material.⁴⁹ Under section 404(c), EPA also may deny, or “veto,” any disposal site if the discharge “will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas.”⁵⁰ Thus, under the section 404, and subject to specified exceptions, wetlands subject to federal jurisdiction may be filled only if the Corps grants a permit in accordance with EPA’s 404(b)(1) Guidelines. These permits, known ubiquitously as “404 permits,” “wetland permits,” or “Corps permits,” have become the cornerstone for federal protection of wetland resources.⁵¹

When a land development project involves filling of wetland areas regulated under section 404 of the CWA, the Corps usually requires compensatory mitigation for the loss of wetland resources as a condition of permit approval.⁵² The compensatory mitigation program suffered withering criticism for decades on a number of bases, however, one being that it failed to account for displacement of ecosystem services between fill sites and compensatory mitigation sites.⁵³ Critics thus urged the agencies to incorporate ecosystem services into the array of resources directly protected under section 404.⁵⁴

⁴⁸ 33 U.S.C. § 1344(a), (d) (2006).

⁴⁹ *Id.* § 1344(b).

⁵⁰ *Id.* § 1344(c).

⁵¹ For background on the scope of federal wetlands regulation, see Douglas R. Williams & Kim Diana Connolly, *Federal Wetlands Regulation: An Overview*, in *WETLANDS LAW AND POLICY: UNDERSTANDING SECTION 404*, at 1–26 (Douglas R. Williams et al. eds., 2005).

⁵² 33 C.F.R. pt. 332 (2009) (establishing standards and criteria for compensatory mitigation through permits issued by the Corps pursuant to section 404 of CWA); see JESSICA WILKINSON & JARED THOMPSON, ENVTL. L. INST., 2005 STATUS REPORT ON COMPENSATORY MITIGATION IN THE UNITED STATES (2006), available at http://water.epa.gov/lawsregs/guidance/wetlands/upload/2006_06_01_wetlands_ELIMitigation2005.pdf (discussing comprehensive history and background on the compensatory mitigation program).

⁵³ Rebecca L. Kihlsinger, *Success of Wetland Mitigation Projects*, 30 NAT’L WETLANDS NEWSLETTER (Envtl. Law Inst.), no. 2, Mar.–Apr. 2008 at 14, 14–15 (surveying and summarizing literature assessing the performance of federal and state wetland programs). For the most prominent of these critical studies, see COMM. ON MITIGATING WETLAND LOSSES ET AL., *COMPENSATING FOR WETLAND LOSSES UNDER THE CLEAN WATER ACT* (2001).

⁵⁴ J.B. Ruhl et al., *Implementing the New Ecosystem Services Mandate of the Section 404 Compensatory Mitigation Program—A Catalyst for Advancing Science and Policy*, 38 STETSON L. REV. 251, 256–59 (2009) (summarizing the studies advancing this criticism and providing an overview of the new rule, but not exploring its statutory grounding).

Responding to this criticism, in 2008 the Corps and EPA jointly published final legislative regulations defining standards and procedures for authorizing compensatory mitigation of impacts to aquatic resources for the Corps permits under section 404 of the Clean Water Act.⁵⁵ Prior to the rule, the section 404 compensatory mitigation program had been administered under a mish-mash of guidance, inter-agency memoranda, and other policy documents issued over the span of seventeen years.⁵⁶ Although motivated primarily by the need to bring the program under one coherent regulatory umbrella, the new rule also for the first time introduced ecosystem services into the mitigation program standards, requiring that “compensatory mitigation . . . should be located where it is most likely to successfully replace lost . . . services.”⁵⁷

EPA and the Corps thus adopted the direct protection approach to integration of ecosystem services into the section 404 program. The question that EPA and the Corps had to contemplate, of course, was whether this is a permissible interpretation of section 404, especially in light of the facts that section 404 does not mention ecosystem services at all and that for nearly two decades EPA and Corps rules for section 404 compensatory mitigation had not mentioned ecosystem services. Enter *Chevron* and *Brand X*.

Clearly, nothing in the language of section 404 unambiguously prohibits EPA and the Corps from incorporating ecosystem services into the compensatory mitigation program, so the question under *Chevron* is whether doing so is a reasonable application of the statute. Piecing together such a case begins with the statute’s directive that the 404(b)(1) Guidelines “shall be based upon criteria comparable to the criteria applicable to the territorial seas, the contiguous zone, and the ocean under section 1343(c) of this title.”⁵⁸ That provision in turn specifies that the guidelines address the following criteria, with emphases added to point to the hooks upon which to hang ecosystem services:

- (A) the effect of disposal of pollutants on *human health or welfare*, including but not limited to plankton, fish, shellfish, wildlife, shorelines, and beaches;
- (B) the effect of disposal of pollutants on marine life including the transfer, concentration, and dispersal of pollutants or their byproducts through biological, physical, and chemical processes; changes in *marine ecosystem*

⁵⁵ Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. 19,594 (Apr. 10, 2008) (codified at 33 C.F.R. pts. 325 & 332, and 40 C.F.R. pt. 230). For a thorough review and assessment of the regulation, see Royal C. Gardner et al., *Compensating for Wetland Losses Under the Clean Water Act (Redux): Evaluating the Federal Compensatory Mitigation Regulation*, 38 STETSON L. REV. 213 (2009).

⁵⁶ See generally Palmer Hough & Morgan Robertson, *Mitigation Under Section 404 of the Clean Water Act: Where It Comes From, What It Means*, 17 WETLANDS ECOLOGY & MGMT. 15 (2009), available at <http://www.springerlink.com/content/ag615v755494325v/fulltext.pdf> (discussing comprehensively the collection of policies).

⁵⁷ 33 C.F.R. 332.3(b) (2008). Further details of the rule and its implications are explored comprehensively in Ruhl et al., *supra* note 54.

⁵⁸ Federal Water Pollution Control Act, 33 U.S.C. § 1344(b)(1) (2006).

diversity, productivity, and stability; and species and community population changes;

(C) the effect of disposal, of pollutants on *esthetic, recreation, and economic values* . . .⁵⁹

Through this incorporation of regulatory goals, including human health and welfare, marine ecosystem diversity, productivity, and stability, and recreation and economic values, section 404 gives EPA and the Corps ample room to include ecosystem services among the resources that the program is designed to protect. Ecosystem services from wetland resources support human health and welfare;⁶⁰ the diversity, stability, and productivity of marine ecosystems support their capacity to supply those ecosystem services;⁶¹ and providing esthetic, recreation, and other economic values is the policy objective of incorporating ecosystem services knowledge into decision making.⁶² Given the strength of these connections, it would be futile under *Chevron* to argue that EPA and the Corps misconstrued section 404 and unreasonably incorporated ecosystem services as a protected resource, and *Brand X* dispenses with any objection that the abrupt change in policy is impermissible.

B. Section 303 Water Quality Standards and TMDL Program—The Performance Metric Approach

Whereas section 404 expressly focuses agency decision making on impacts to aquatic ecosystem health, thus providing the base of support for the direct protection strategy for incorporating ecosystem services into decision making, the section 303 program presents much less opportunity for pursuing that strategy. The performance metric approach, however, seems well suited to section 303.

The section 303 water quality standards and TMDL program work in tandem with the permitting provisions of the CWA found in section 402, which authorizes EPA to issue permits “for the discharge of any pollutant” other than discharges covered in provisions such as section 404.⁶³ Discharge is defined in the CWA so as to limit section 402 to pollutants emitted from “point sources,” which are defined as confined and discrete conveyances, such as pipes and ditches.⁶⁴ For such discharges, section 402 sets up an

⁵⁹ *Id.* § 1343(c)(1)(A)–(C) (emphasis added).

⁶⁰ MILLENNIUM ECOSYSTEM ASSESSMENT, *supra* note 6, at 47.

⁶¹ *See id.* at 41–45.

⁶² Thus, the typology of ecosystem services developed in the MILLENNIUM ECOSYSTEM ASSESSMENT, *supra* note 4, at vi fig.A.

⁶³ 33 U.S.C. § 1342(a)(1) (2006). The other permitting provision applies to discharges from aquaculture. *See id.* § 1328. The Supreme Court has made it clear that these three permitting provisions are distinct and nonoverlapping in terms of agency jurisdiction. *See Coeur Alaska, Inc. v. Se. Alaska Conservation Council*, 129 S. Ct. 2458, 2467 (2009).

⁶⁴ 33 U.S.C. § 1362(16) (2006) (defining “discharge”); *id.* § 1362(12) (defining “discharge of pollutant”); *id.* § 1362(14) (defining “point source”). Agricultural stormwater discharges and

extensive technology-based effluent control standards and a permitting program known as the National Pollutant Discharge Elimination System (NPDES).⁶⁵

Section 303 enters the picture when the technology-based effluent limits imposed on NPDES dischargers under section 402, even with full compliance, are inadequate to meet water quality goals for specific water bodies. Section 303(c) requires states to prepare and present for EPA approval water quality standards consisting of “the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses.”⁶⁶ To assist states in this function, section 304 requires EPA to develop guidelines for establishing water quality criteria “accurately reflecting the latest scientific knowledge.”⁶⁷ Section 303(d)(1)(A), in turn, requires states to identify waters for which the technology-based effluent limitations imposed through section 402 permits are not adequate to attain an applicable water quality standard,⁶⁸ and section 303(d)(1)(C) requires states to establish and implement for such listed waters the “total maximum daily load . . . for . . . pollutants” as a means of reducing discharges to levels that will attain the water quality standard.⁶⁹

Nothing in these provisions overtly addresses ecosystem services science one way or the other; hence, as with section 404, EPA would have to dig deeper into them to search for and interpret authority for the agency to incorporate ecosystem services science into the section 303 program. At the threshold level of such an inquiry, section 303 divides into two distinct components—the section 303(c) water quality standards component and the section 303(d) TMDL and load allocation component. The load allocation component is the regulatory branch of section 303 and thus where one would search for direct protection authority. But section 303(d) is a set of dry technical provisions devoid of opportunities for creative interpretation along these lines. All the policy space in section 303 lies instead in the water quality standards component, which is fundamentally about establishing the criteria for assessing the performance of technology-based effluent standards imposed on dischargers under section 402 NPDES permits. Hence, if there is ecosystem services gold to be mined in the section 303 program, it

irrigation return flows are excluded from point sources even if conveyed through ditches, pipes, and other means normally considered a point source. *Id.* § 1362(14).

⁶⁵ See JAMES SALZMAN & BARTON H. THOMPSON, JR., ENVIRONMENTAL LAW AND POLICY 150–61 (3d ed. 2010) (overview of the point source permit program).

⁶⁶ 33 U.S.C. § 1313(c)(2)(A) (2006). EPA must establish water quality standards if a state fails to do so adequately. See *id.* § 1313(c)(3). EPA regulations define “designated uses” as “those uses specified in water quality standards for each water body or segment whether or not they are being attained,” 40 C.F.R. § 131.3(f) (2010), and “water quality criteria” as “elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use.” *Id.* § 131.3(b).

⁶⁷ 33 U.S.C. § 1314(a)(1) (2006).

⁶⁸ *Id.* § 1313(d)(1)(A).

⁶⁹ *Id.* § 1313(d)(1)(C).

will come by searching for provisions in section 303(c) that can reasonably be interpreted to provide performance metric authority.⁷⁰

The first such provision is a potential bonanza for the performance metric approach: section 303(c)(2)(A) requires that water quality standards “shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this chapter.”⁷¹ The provision goes on to require that the standards take into consideration the “use and value” of the water body for, among other things, “public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes.”⁷² Furthermore, EPA’s authority under section 304 to develop guidelines the states are to use to designate water quality standards under section 303(c) requires that EPA consider “all identifiable effects on health and welfare, including, but not limited to . . . shorelines, beaches, esthetics, and recreation which may be expected from the presence of pollutants in any body of water,”⁷³ as well as “the effects of pollutants on biological community diversity, productivity, and stability.”⁷⁴

As with section 404 (through its incorporation of section 403), these provisions contain strong connections to ecosystem services, opening the door wide to incorporating ecosystem services science broadly into water quality standards formulation. By using ecosystem services such as groundwater recharge and flood control to describe designated uses of water bodies, and by specifying levels of ecosystem service flows to human populations as water quality criteria, EPA could move the section 303 program closer to Adler’s vision of the trilogy of physical, chemical, and

⁷⁰ Professor Robin Craig has correctly suggested that water quality standards already implicitly capture some ecosystem service values by designating uses such as recreation and provision of drinking water. See Craig, *supra* note 8, at 638. Like many environmental laws, however, these extend only to provisioning and cultural services, not to the regulating and supporting services such as sediment control, flood suppression, and nutrient cycling that are generally treated as public goods. See RUHL, KRAFT & LANT, *supra* note 4, at 23–30 (discussing the distinction between the different categories). My proposal extends her reasoning to build the regulating and supporting flows of ecosystem services more explicitly and pervasively into the section 303(c) water quality standards program. Indeed, in general I find little to be gained in domestic public or private resource management contexts by describing commodities such as water or timber as provisioning services and activities such as hunting and fishing as cultural services. Markets obviously already exist for these ecosystem services in the private resources context, and public policy has for decades hashed out how they are delivered on public lands. See GEORGE CAMERON COGGINS ET AL., *FEDERAL PUBLIC LAND AND RESOURCES LAW* 2 (6th ed. 2007). The challenge is how to incorporate regulating and supporting services into market and regulatory institutions.

⁷¹ 33 U.S.C. § 1313(c)(2)(A) (2006). EPA regulations define “serve the purposes of the Act” to

mean[] that water quality standards should, wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes including navigation.

⁴⁰ C.F.R. § 131.2 (2010).

⁷² 33 U.S.C. § 1313(c)(2)(A) (2006).

⁷³ *Id.* § 1314(a)(1)(A).

⁷⁴ *Id.* § 1314(a)(1)(C).

biological water quality goals. For example, if adequate capacity for flood control were described as a water quality standard for a water body, pollutants degrading the aquatic vegetation contributing to that flood control capacity could trigger an impairment finding and the appropriate responses under the TMDL component of section 303. The language of sections 303 and 304 surely would support doing so under *Chevron*, and the fact that the agency has not done so in the past would present no obstacle given *Brand X*.

The hitch, as noted above, is that as a performance metric program, the water quality standards component of section 303 depends entirely on the load allocation component of section 303(d) for its regulatory implementation. Also, although nonpoint sources such as agriculture, urban runoff, and unspecified sources are significant contributors to water quality impairment,⁷⁵ EPA is limited under 303(d) in its ultimate reach to regulating discharge of pollutants from point sources subject to section 402 NPDES permits.⁷⁶ Nevertheless, states must identify a water body that fails to meet water quality standards as impaired even if nonpoint sources are contributing to the impairment, and the load allocation must include such nonpoint sources.⁷⁷ If states choose not to regulate nonpoint sources and thereby fail adequately to implement the TMDL program, EPA can withdraw federal grant money from the state.⁷⁸

Hence, although it is true that “[b]y limiting the effective control mechanisms to total maximum daily loads of pollutants, Congress included in section 303(d) no direct mechanisms to redress other sources of pollution,”⁷⁹ there is still good reason to include ecosystem services as one of the performance metrics of water quality standards. EPA recently has claimed to be committed to modernizing the section 303 program by busting the water quality standards regime out of its chemical focus and moving it closer to Adler’s trilogy vision.⁸⁰ Using ecosystem services science to do so

⁷⁵ See OFFICE OF WATER, U.S. ENVTL. PROT. AGENCY, NATIONAL WATER QUALITY INVENTORY: REPORT TO CONGRESS 2004 REPORTING CYCLE at 12, 16, 20 (2009), *available at* <http://www.epa.gov/owow/305b/2004report/> (click on “Findings”) (finding impairment to rivers and streams, lakes, ponds, reservoirs, bays, and estuaries from nonpoint sources).

⁷⁶ 33 U.S.C. § 1342(a)(1) (2006).

⁷⁷ See *Pronsolino v. Nastri*, 291 F.3d 1123, 1138 (9th Cir. 2002).

⁷⁸ See *id.*

⁷⁹ Adler, *supra* note 43, at 42.

⁸⁰ EPA has recently stated:

EPA will be developing methodologies and criteria in areas beyond the traditional chemical-specific type criteria of the past. Areas of scientific examination and potential regulatory controls include criteria to protect wildlife, wetlands, and sediment quality; biological criteria to better define desired biological communities in aquatic ecosystems; and nutrient criteria Implementation of these various types of criteria will be influenced by the environmental concerns in specific watersheds.

. . . .

In an expanded effort to protect ecology, there will be increasing emphasis on the watershed approach by assessing all potential and actual threats to a watershed’s integrity. . . .

will allow EPA to regulate point source discharges in water bodies with impaired ecosystem services, will call attention to the contribution of nonpoint sources to ecosystem services impairment, and will put pressure on states to address those nonpoint sources. *Chevron* and *Brand X* do not allow EPA to overcome the structural limits of regulatory authority under section 303(d), but they could pave the way for EPA to use sections 303(c) and 304 as a platform for making ecosystem services an important performance metric of the section 303 program.

V. CONCLUSION

Speaking about one of the CWA's siblings, the Clean Air Act,⁸¹ the Supreme Court recently observed that Congress understood when it designed the statute "that without regulatory flexibility, changing circumstances and scientific developments would soon render the Clean Air Act obsolete," and hence "[t]he broad language of [the statute] reflects an intentional effort to confer the flexibility necessary to forestall such obsolescence."⁸² This principle, of course, is not limited to the Clean Air Act—the CWA embodies the very essence of employing broad language to impart the flexibility needed to incorporate scientific developments. Indeed, Congress made doing so an explicit command.⁸³

The science of ecosystem services has emerged as a powerful organizing principle of interdisciplinary ecological, economic, and social research, and has begun to take hold in policy formulation. Within EPA, for example, the Office of Research and Development's Ecosystem Services Research Program

is transforming the way we account for the type, quality, and magnitude of nature's goods and services so that they can be considered in environmental management decisions. The research is providing the data, methods, models, and tools needed by states, communities, and tribes to understand the cost and benefits of using ecosystem services.⁸⁴

Over the next few years, there will be more emphasis on developing effective risk reduction strategies that include both traditional and non-traditional controls and approaches.

Future program directions in criteria development and then adoption and implementation of water quality standards will be based on the principle of ecological and human health risk reduction through sound and implementable science.

U.S. Env'tl. Prot. Agency, *supra* note 47. In July 2010 EPA announced its plan to propose a limited set of changes to its water quality standards regulations by Summer 2011. Office of Water, U.S. Env'tl. Prot. Agency, Water Quality Standards Regulatory Changes Fact Sheet, http://water.epa.gov/lawsregs/lawsguidance/wqs_factsheet.cfm (last visited Nov. 20, 2010).

⁸¹ 42 U.S.C. §§ 7401–7671q (2006).

⁸² *Massachusetts v. U.S. Env'tl. Prot. Agency*, 549 U.S. 497, 532 (2007).

⁸³ *E.g.*, Federal Water Pollution Control Act, 33 U.S.C. 1314(a)(1) (2006) (directing EPA to develop water quality guidelines "accurately reflecting the latest scientific knowledge").

⁸⁴ Office of Research & Dev., U.S. Env'tl. Prot. Agency, Ecosystem Services Research Program, <http://epa.gov/ord/esrp/> (last visited Nov. 20, 2010).

Clearly this is the type of scientific advancement that Congress contemplated agencies would incorporate into administration of environmental statutes such as the CWA. The judicial review principles embodied in *Chevron* and *Brand X* facilitate this incorporation process by allowing agencies to adapt statutory provisions to new knowledge and by relieving agencies of the concern that change is impermissible because “that’s not how we’ve done it.” As Adler’s work emphasizes, the narrow chemical pollutant focus EPA has taken with its CWA authority is neither demanded by the statute nor consistent with contemporary scientific perspectives on aquatic ecosystem health and integrity. Incorporating ecosystem services science into the CWA programs as broadly as possible will be one important component of moving the statute forward in this respect.

This Article has laid out the strategies for so incorporating ecosystem services science and illustrated their application with two cases studies of discrete CWA programs. Agencies like EPA and the Corps, if they are committed to staying scientifically relevant, need not and should not wait for Congress to graft new science into statutes. Instead, agencies should scour statutes like the CWA and other environmental laws for opportunities to interpret the existence of direct protection and performance metric authority as leverage points for incorporating new science into evolving regulatory programs. To be sure, the science of ecosystem services should not be sitting on the shelf waiting to be dropped into the CWA and other environmental statutes. Further research on ecosystem services tailored to regulatory programs such as section 404 and section 303 will be needed, which fortunately has begun at EPA,⁸⁵ and numerous policy design questions must be addressed.⁸⁶ But by no means should the existing set of environmental statutes themselves be seen as insurmountable obstacles simply because they were designed before the concept of ecosystem

⁸⁵ EPA’s Office of Research and Development in 2007 initiated its Ecosystem Services Research Program (ESRP) to focus on policy-relevant ecosystem services research. See OFFICE OF RESEARCH & DEV., U.S. ENVTL. PROT. AGENCY, RESEARCH TO VALUE ECOSYSTEM SERVICES: IDENTIFYING, QUANTIFYING, AND ASSESSING NATURE’S BENEFITS (2007), available at <http://epa.gov/ord/esrp/pdfs/ESRP-overview-fact-sheet-final.pdf> (discussing the importance of ecosystem services in researching wetlands). This research provides a foundation to enable the assessment of an array of core ecosystem services provided by freshwater and coastal wetlands. See *id.* (stating that this research will determine how the position of wetlands on the landscape alters the provision of ecosystem services). In addition, ESRP research is developing methods to quantitatively assess other regulating and supporting services from wetlands, including flood control and storm surge protection, maintenance of water quality, nutrient cycling, and carbon storage and sequestration. See OFFICE OF RESEARCH & DEV., U.S. ENVTL. PROT. AGENCY, ECOSYSTEM SERVICES RESEARCH FOCUSES ON WETLANDS (2007), available at http://www.epa.gov/ORD/npd/pdfs/erp-place-based-research_wetlands-factsheet.pdf (discussing the range of benefits gained from wetland ecosystems that contribute to human well-being); Office of Research & Dev., U.S. Envtl. Prot. Agency, Ecosystem Services Research Program: Basic Information, <http://epa.gov/ord/esrp/basic-info.htm> (last visited Nov. 20, 2010) (discussing the future research of the ESRP and how it is designed to measure and assess these ecosystem services).

⁸⁶ See Barton H. Thompson, Jr., *Ecosystem Services & Natural Capital: Reconceiving Environmental Management*, 17 N.Y.U. ENVTL. L.J. 460 (2008) (outlining policy design issues for ecosystem services).

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services took hold in the scientific community. Fitting new science into old laws will take political will and some creative interpretations of stale laws, but it will be necessary if our environmental statutes are to remain relevant and effective. As this Article has shown, the new science of ecosystem services presents just such an opportunity.