THE GEOGRAPHY OF TRADING ECOSYSTEM SERVICES: A CASE STUDY OF WETLAND AND STREAM COMPENSATORY MITIGATION MARKETS

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With the exception of greenhouse gas trading programs, environmental markets are prisoners of their own geography — and with good reason. Climate change is a global phenomenon, and so carbon markets can be geographically all-inclusive — a ton of carbon dioxide emitted in Beijing has the same effect as a ton of carbon dioxide emitted in New York. Other environmental markets are more nuanced. Markets for water quality, biodiversity, endangered species, fisheries, air quality, and aquatic resources, to name a few, must recognize that the commodities they trade exist at particular geographic scales, and set appropriate spatial limits on the redistribution of environmental quality. The size of geographic trading areas has significant implications for the economic viability of markets and the ecological quality of their offsets.

U.S. wetland and stream mitigation markets, which emerged in the 1980s, provide perhaps the most established empirical example of how environmental markets function. This Article presents the first systematic assessment of the federal and state laws, regulations, guidance, and operating practices that shape the geographic size of U.S. wetland and stream markets. This Article first addresses the history of these geographic restrictions under the Clean Water Act, the importance of spatial context for ecosystem functions and services, and the economic-ecological tradeoffs implicated by geographic trading limits. Then, based on the results of the assessment, this Article argues that regulators should increase their transparency and consistency in setting geographic trading limits. It also presents a framework for using more specific geographic limits for different types of wetland and stream offsets to enhance a market's ecological and economic stability. Lessons from setting geographic limits for wetland and stream markets can be applied to other, nascent environmental markets.

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INTRODUCTION

Market mechanisms are an increasingly preferred policy instrument for environmental regulation in place of prescriptive, command-and-control policy measures.[1] Market-based policies are proposed or operated to modulate anthropogenic impacts to air quality,[2] climate change,[3] water quality,[4] endangered species habitat,[5] impervious surfaces,[6] fisheries,[7] and aquatic re-

[1] BENJAMIN CASHORE ET AL., GOVERNING THROUGH MARKETS 10 (2004).

[2] Sam Napolitano et al., *The U.S. Acid Rain Program: Key Insights from the Design, Operation, and Assessment of a Cap-and-Trade Program*, 20 ELECTRICITY J. 47 (2007).

[3] A. Danny Ellerman & Barbara K. Buchner, *The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results*, 1 REV. ENVTL. ECON. & POL'Y. 66 (2007).

[4] Zoé A. Hamstead & Todd K. BenDor, *Overcompliance in Water Quality Trading Programs: Findings from a Qualitative Case Study in North Carolina*, 28 ENV'T & PLANNING C: GOV'T & POL'Y 1 (2010).

[5] J.B. Ruhl et al., *A Practical Guide to Habitat Conservation Banking Law as Policy*, 20 NAT. RESOURCES & ENV'T 26 (2005).

sources,[8] to highlight a few, and the establishment of a federal Office of Environmental Markets in the U.S. Department of Agriculture ("USDA") will likely stimulate further growth and increased specificity for future market-based regulatory schemes.[9]

The spatial expanse of the environmental consequences of land development, industry, and other human activities varies dramatically. While the distribution of some environmental damages, such as those resulting from ultrafine particulate matter,[10] remains quite localized, damages from pollutants such as sulfur dioxide ("SO_2"), mercury, and greenhouse gases spread regionally or globally.[11] Accordingly, market-based regulation must consider how to set appropriate geographic limits on trading, yet the basis for geographic constraints in many emerging markets has received relatively limited scientific research or policy attention.[12]

Identifying the ideal geographic scope for trading requires careful consideration of ecological-economic tradeoffs to promote both adequate market activity and environmental conservation.[13] Given that the commodities

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[6] CLAIRE WELTY ET AL., UNIV. OF MARYLAND-BALTIMORE CNTY COLL. OF ENG'G AND INFO. TECH., FINAL REPORT: USING AN "IMPERVIOUS PERMIT" ALLOWANCE SYSTEM TO REDUCE IMPERVIOUS SURFACE COVERAGE FOR ENVIRONMENTAL SUSTAINABILITY (2005), *available at* http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/7148/report/F.

[7] John H. Annala, *New Zealand's ITQ System: Have the First Eight Years Been a Success or a Failure?*, 6 REVIEWS FISH BIOLOGY & FISHERIES 43 (1996).

[8] *See* NAT'L RESEARCH COUNCIL, COMPENSATING FOR WETLAND LOSSES UNDER THE CLEAN WATER ACT (2001) [hereinafter NRC, COMPENSATING FOR WETLAND LOSSES].

[9] *See* Press Release, Office of the Sec'y, USDA, Secretary's Memorandum 1056-001: Establishment of the Office of Ecosystem Services and Markets (Dec. 15, 2008), *available at* http://www.ocio.usda.gov/directives/doc/SM1056-001.htm; Molly Peters Stanley & Katherine Hamilton, *Seeds of Change for U.S. Environmental Markets*, ECOSYSTEM MARKETPLACE (Mar. 19, 2010), http://www.ecosystemmarketplace.com/pages/dynamic/article.page.php?page_id=7500&section=home.

[10] Margaret Krudysz et al., *Intra-Community Spatial Variability of Particulate Matter Size Distributions in Southern California/Los Angeles*, 9 ATMOSPHERIC CHEMISTRY & PHYSICS DISCUSSIONS 1061, 1061 (2009).

[11] WILLIAM H. SCHLESINGER, BIOGEOCHEMISTRY: AN ANALYSIS OF GLOBAL CHANGE 53–60 (2d ed. 1997).

[12] Research on geographic constraints for environmental markets is primarily limited to the air and water quality emissions trading contexts. *See, e.g.*, R. Scott Farrow et al., *Pollution Trading in Water Quality Limited Areas: Use of Benefits Assessment and Cost-Effective Trading Ratios*, 81 LAND ECON. 191, 191–205 (2005); Ming-Feng Hung & Daigee Shaw, *A Trading-Ratio System for Trading Water Pollution Discharge Permits*, 49 J. ENVTL. ECON. & MGMT. 83, 83-102 (2005); Frank C. Krysiak & Patrick Schweitzer, *The Optimal Size of a Permit Market*, 60 J. ENVT'L ECON. & MGMT. 133, 133-43 (2010); Jonathan Remy Nash & Richard L. Revesz, *Markets and Geography: Designing Marketable Permit Schemes to Control Local and Regional Pollutants*, 28 ECOLOGY L. Q. 569, 569-661 (2001); Tom Tietenberg, *Tradeable Permits for Pollution Control When Emission Location Matters: What Have We Learned?* 5 ENVTL. & RESOURCE ECON. 95, 95-113 (1995).

[13] *See, e.g.*, Compensatory Mitigation for Losses of Aquatic Resources, 33 C.F.R. § 332.8(d)(6)(ii)(A) (2008) [hereinafter Corps Mitigation Rule]; Compensatory Mitigation for Losses of Aquatic Resources, 40 C.F.R. § 230.98(d)(6)(ii)(A) (2008) [hereinafter EPA Mitigation Rule]; James Boyd et al., *Trading Cases: Five Examples of the Use of Markets in Environmental and Resource Management*, *in* THE RFF READER IN ENVTL. AND RESOURCE POLICY 56, 58 (Wallace E. Oates ed., 2d ed. 2006); LEONARD SHABMAN & PAUL SCODARI, RESOURCES

involved in most environmental market transactions originate in different locations, spatial inequalities are a frequent structural concern in the design of these markets.[14] Environmental amenities entail different place-based components that are valuable at specific geographic extents, resulting in commodities that may lack fungibility or exchangeability.[15] For instance, in a water quality market that allows nutrient trading to occur across river basins, the net effect of transactions will be a spatial redistribution of pollution levels; the environmental commodities — in this case nutrient loads — are geographically nonfungible.[16]

There are also distinct consequences of environmental markets that are absent, or less prominent, under command-and-control regulation. Command-and-control scenarios generally distribute the benefits of environmental regulation more evenly because all parties are required to reduce pollution or degradation by a prescribed quantity or use similar pollution reduction technology.[17] In contrast, market approaches seek to reduce overall environmental degradation, or reduce net pollution at a particular location such as a reservoir or estuary, but trading may cause uneven concentration of pollution or degradation in localized areas — "hot spots."[18]

Environmental regulatory programs to date have managed the potential for such spatial externalities through geographic restrictions on transactions; for example, the Clean Air Act Amendments of 1990[19] essentially created trading zones restricting the location of ozone precursor emission offsets. The amended Clean Air Act categorized ozone nonattainment areas based on ozone concentration,[20] and offsets could only be purchased from the same area or an upwind area of an equivalent or more severe ozone category.[21] In addition, regulators for the initial U.S. Acid Rain Program ("ARP") contemplated dividing the United States into two trading zones, although they eventually acquiesced to allow trades throughout the entire continental United States.[22] When trading areas are constrained to the area of ecological harm or benefit associated with a commodity, spatial nonfungibilities are mini-

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FOR THE PAST, PRESENT, AND FUTURE OF WETLANDS CREDIT SALES 22 (2004), *available at* http://www.rff.org/documents/RFF-DP-04-48.pdf; Todd BenDor, Joel Sholtes, & Martin Doyle, *Landscape Characteristics of a Stream and Wetland Mitigation Program*, 19 ECOLOGICAL APPLICATIONS 2078, 2088–90 (2009).

[14] James Salzman & J.B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 STAN. L. REV. 607, 626–29 (2000).

[15] *Id.*

[16] *See* Boyd et al., *supra* note 13, at 59–60.

[17] *See* Nash & Revesz, *supra* note 12, at 581; Tietenberg, *supra* note 12, at 98–99.

[18] *See* Boyd et al., *supra* note 13, at 59–60; Nash & Revesz, *supra* note 12, at 572; Tietenberg, *supra* note 12, at 99.

[19] Pub. L. No. 101-529, 104 Stat. 2468 (1990) (codified in scattered sections of 42 U.S.C. (2006)).

[20] *See* Clean Air Act § 181(a), 42 U.S.C. § 7511(a) (1990) (designating areas exceeding National Ambient Air Quality Standards for ozone).

[21] *See* Clean Air Act § 173(c), 42 U.S.C. § 7503(c) (1990); ARNOLD W. REITZE, JR., AIR POLLUTION CONTROL LAW: COMPLIANCE AND ENFORCEMENT 57 (2001); Tietenberg, *supra* note 12, at 107.

[22] *See* Boyd et al., *supra* note 13, at 58.

mized or eliminated, but if market transactions are allowed to occur across a broader space, trading may result in an uneven dispersal of pollution or degradation.[23] Thus, while markets typically dictate an economically efficient regulatory outcome, certain human populations within a trading area may become more impacted as a result of the trading process.[24]

The potential for pollution hot spots is curtailed by delineating small geographic regions within which trades may occur.[25] However, excessively limiting the geographic scope of markets may subvert the economic[26] and environmental[27] efficacy of market-based policies. Large trading areas, which divide regions into few trading zones, include more market participants; this increases supply and demand for environmental commodities, creates active, thick markets with greater options for trades, and provides more cost-effective regulatory compliance.[28] Spatially inclusive, thick markets may also reduce compliance costs by providing more incentive for developing innovative, low-cost solutions to environmental problems.[29] In contrast, markets divided into many spatially narrow trading zones decrease market participation, potentially resulting in inactive, thin trading regimes.[30] Smaller markets with fewer participants are susceptible to strategic behavior,

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[23] *See* Salzman & Ruhl, *supra* note 14, at 627.

[24] Nash & Revesz, *supra* note 12, at 580–81.

[25] *See* Salzman & Ruhl, *supra* note 14, at 627.

[26] *See* Nash & Revesz, *supra* note 12, at 630–31.

[27] *See* BenDor et al., *supra* note 13, at 2088–90.

[28] THOMAS H. TIETENBERG, EMISSIONS TRADING: AN EXERCISE IN REFORMING POLLUTION POLICY 61–62 (1985).

[29] Proponents of market-based environmental policy mechanisms cite increased incentive for innovation (dynamic cost-effectiveness) as a chief advantage over command-and-control regulation. *See, e.g.*, Adam B. Jaffe & Robert N. Stavins, *Dynamic Incentives of Environmental Regulation: The Effects of Alternative Policy Instruments on Technology Diffusion*, 29 J. ENVTL. ECON. & MGMT. S43, S60–63 (1995); Scott R. Milliman & Raymond Prince, *Firm Incentives to Promote Technological Change in Pollution Control*, 17 J. ENVTL. ECON. & MGMT. 247, 260–61 (1989).

Competition instigated by environmental markets and the subsequent impetus to develop lower-cost compliance options is noted as a primary driver of innovation. *See, e.g.*, Dallas Burtraw, *The SO_2 Emissions Trading Program: Cost Savings Without Allowance Trades*, CONTEMPORARY ECON. POL'Y, July 1996, at 79, 81. Indeed, a substantial portion of the cost savings associated with the ARP is attributed to competition-induced technological innovation. Winston Harrington, Richard O. Morgenstern, & Peter Nelson, *On the Accuracy of Regulatory Cost Estimates*, 19 J. POL'Y ANALYSIS & MGMT. 297, 309–10 (2000). Proponents of entrepreneurial aquatic resource mitigation banking also assert that a "competitive market [for wetland and stream offsets] . . . may encourage innovation in creation and restoration approaches." Lisa M. Schenck, *Wetlands Protection: Regulators Need to Give Credit to Mitigation Banking*, 9 DICKINSON J. ENVTL. L. & POL'Y 103, 138 (2000).

The effect of trading zone size on technological innovation has received little academic attention. However, it is well acknowledged that larger trading zones create more competitive markets. *See, e.g.*, TIETENBERG, *supra* note 28, at 61–62. Increased competitiveness in North Carolina trading areas has promoted innovative methods of creating mitigation credits; for example, Restoration Systems, LLC, a private wetland and stream restoration firm, began selling stream mitigation credits generated from dam removal projects. *See, e.g.*, Josh Shaffer, *Proposal to Remove Dam Raises Concerns*, RALEIGH NEWS & OBSERVER, Apr. 22, 2010, *available at* http://www.newsobserver.com/2010/04/22/448772/in-fight-over-dam-sides-ask-whats.html.

[30] Nash & Revesz, *supra* note 12, at 617.

market manipulation, and unpredictable compliance costs.[31] While market participants often pressure regulators to define expansive trading areas,[32] appropriate spatial trading restrictions must balance the need for market viability, pollution hot spot risk, and thus overall environmental quality.[33]

Environmental markets are generally differentiable into pollution markets and ecosystem service markets.[34] Generally, pollution markets trade emissions rights and are characterized by commodities measured in units of volume or weight.[35] The most successful empirical example of a pollution market is the ARP under the Clean Air Act, which was projected in 2010 to achieve emissions reductions in SO_2 and nitrogen oxide ("NO_x") at less than 50% of the compliance cost originally estimated in 1990.[36] Compared to command-and-control regulation that mandated specific technology standards for SO_2 emitters, the ARP reduced program costs by close to 200%.[37] The ARP also has experienced extremely high compliance levels — over 99% — among regulated entities.[38] Cap-and-trade systems for greenhouse gas emissions, such as those implemented in the European Union Emission Trading Scheme[39] and to be implemented under the California Global Warming Solutions Act of 2006,[40] represent another prominent pollution market. Ecosystem service markets are comparatively older but smaller in scope; these markets trade commodities measured in terms of ecosystem function that are conceived as providing a bundle of beneficial processes associated with intact ecosystems.[41] Markets for ecosystem services often utilize simpler, surrogate metrics such as acres or length to commodify the bundles of ecosystem functions involved in transactions.[42]

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[31] TIETENBERG, *supra* note 28, at 61–62; David A. Malueg & Andrew J. Yates, *Bilateral Oligopoly, Private Information, and Pollution Permit Markets*, 43 ENVTL. & RESOURCE ECON. 553, 553–65 (2009).

[32] Michael J. Bean & Lynn E. Dwyer, *Mitigation Banking as an Endangered Species Conservation Tool*, 30 ENVTL. L. REP. 10537, 10547 (2000).

[33] *See, e.g.*, Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(6)(ii)(A) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(6)(ii)(A) (2008).

[34] Todd K. BenDor & Martin W. Doyle, *Planning for Ecosystem Service Markets*, 76 J. AM. PLANNING ASS'N 59, 60 (2010).

[35] *Id.*

[36] Lauraine G. Chestnut & David M. Mills, *A Fresh Look at the Benefits and Costs of the U.S. Acid Rain Program*, 77 J. ENVTL. MGMT. 252, 255 (2005).

[37] Boyd et al., *supra* note 13, at 58.

[38] Napolitano et al., *supra* note 2, at 53.

[39] Ellerman & Buchner, *supra* note 3.

[40] California Global Warming Solutions Act of 2006, CAL. HEALTH & SAFETY CODE §§ 38500–38599 (West 2007).

[41] 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, 15–33 (2009); J.B. Ruhl, *Stacking and Bundling and Bears, Oh My!*, NAT'L WETLANDS NEWSL. (Envtl. Law. Inst., Washington, D.C.), Jan.–Feb. 2010, at 24–25. The first mitigation banks were actually established in the 1980s, preceding the 1990 Clean Air Act Amendments that initiated the ARP, but trades in the mitigation program were isolated and fairly local in comparison to the nationwide ARP. Indeed, the 2008 Final Compensatory Mitigation Rule represents the first federal codification of the aquatic resource mitigation program. *See infra* Part IV

[42] Salzman & Ruhl, *supra* note 14, at 631.

In recent decades, scientists, economists, and many within the general public have paid considerable attention to ecosystem service markets.[43] Of these, the market for wetland and stream aquatic resources established in the 1980s is arguably the most mature and robust ecosystem service market in the United States.[44] While many studies of ecosystem service markets are speculative,[45] wetland and stream markets provide a principal source of empirical information on how these markets have actually operated and evolved, thus providing the grist for data-based studies in environmental law,[46] policy,[47] economics,[48] and science.[49] Indeed, the regulation of aquatic resources occupies a central role in debates about the scope of federal jurisdiction under the Clean Water Act.[50]

As a mature, robust and well-studied ecosystem service market, the market for wetland and stream aquatic resources provides a useful context in which to evaluate the geographic constraints imposed on environmental trading markets. In aquatic resource markets, private entrepreneurs create, restore, enhance, or preserve large tracts of wetlands and streams ("mitigation banks"), which are subsequently marketed as credits to land developers required to offset aquatic resource impacts with compensatory mitigation

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[43] *See generally, e.g.*, NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS (Gretchen C. Daily ed., 1997); THE NEW ECONOMY OF NATURE: THE QUEST TO MAKE CONSERVATION PROFITABLE (Gretchen C. Daily & Katherine Ellison ed., 2002); Robert Costanza et al., *The Value of the World's Ecosystem Services and Natural Capital*, 387 NATURE 253, 253–60 (1997); Shabman & Scodari, *supra* note 13.

[44] *See* Morgan M. Robertson, *Emerging Ecosystem Service Markets: Trends in a Decade of Entrepreneurial Wetland Banking*, 4 FRONTIERS ECOLOGY & ENV'T 297, 297–98 (2006).

[45] *See, e.g.*, Michael Jenkins et al., *Markets for Biodiversity Services: Potential Roles and Challenges*, 46 ENV'T 32, 32–42 (2006).

[46] *See, e.g.*, J.B. Ruhl & R. Juge Gregg, *Integrating Ecosystem Services into Environmental Law: A Case Study of Wetland Mitigation Banking*, 20 STAN. ENVTL. L. J. 365, 365–92 (2001).

[47] *See, e.g.*, Todd BenDor, Nicholas Brozoric, & Vorkki George Pallathucheril, *The Social Impacts of Wetland Mitigation Policies in the United States*, 4 J. PLAN. LITERATURE 341, 341–57 (2008).

[48] *See, e.g.*, Martin W. Doyle & Andrew J. Yates, *Stream Ecosystem Service Markets Under No Net Loss Regulation*, 69 ECOLOGICAL ECON. 820, 820–27 (2010).

[49] *See, e.g.*, Douglas J. Spieles, Meagan Coneybear, & Jonathan Horn, *Community Structure and Quality After 10 Years in Two Central Ohio Mitigation Bank Wetlands*, 38 ENVTL. MGMT. 837, 837–52 (2006).

[50] Recent U.S. Supreme Court cases on Clean Water Act jurisdiction have centered on the geographic extent of federal regulation over wetlands and streams. *See* Rapanos v. United States, 547 U.S. 715, 715–18 (2006); Solid Waste Agency of N. Cook Cnty. v. U.S. Army Corps of Eng'rs, 531 U.S. 159, 159–61 (2001). Notably, after the Supreme Court vacated and remanded the *Rapanos* civil case, a settlement required the plaintiff (John A. Rapanos) to provide compensatory mitigation for the 54 acres of wetlands he filled without Corps authorization. At a cost of approximately $750,000, Rapanos agreed to create or restore at least 100 acres of wetlands, including a buffer zone. Rapanos also agreed to preserve 135 acres of wetlands and paid a $150,000 civil penalty. *See* Consent Decree, United States v. Rapanos (No. 94-CV-70788-DT, E.D. Mich., Dec. 29, 2008), *available at* http://www.epa.gov/compliance/resources/decrees/civil/cwa/rapanos-cd.pdf; Press Release, U.S. Dep't of Justice, John Rapanos Agrees to Pay for Clean Water Act Violations (Dec. 29, 2008), *available at* http://www.justice.gov/opa/pr/2008/December/08-enrd-1152.html.

under federal, state, or local law.[51] In-lieu fee ("ILF") mitigation programs provide an additional market mechanism for replacement of wetland and stream resources by allowing third-party governments or non-profit organizations to collect fees from developers in advance of consolidated aquatic resource restoration.[52] Developers may also satisfy regulatory obligations through non-market alternatives, such as establishing mitigation banks for internal obligations only, or through project-specific aquatic resource compensation projects, known as permittee-responsible mitigation ("PRM").[53]

Wetlands and streams have well-recognized benefits for society, including water quality improvement, floodwater retention, biodiversity protection, groundwater recharge, and shoreline protection.[54] However, these environmental amenities are generally only beneficial to society relatively nearby a wetland or stream.[55] For environmental law to effectively manage wetland and stream trading, which sanctions transferring aquatic ecosystem functions across the landscape from an impact (development) site to a compensation site, spatial restrictions must be a central tenet of regulation.[56] Ignoring or inadequately managing geographic limits on trades in ecosystem service markets could lead to large-scale inequalities in ecosystem function distribution, net losses in ecosystem services, and could undermine the ecological integrity of mitigation markets.[57]

Geographic restrictions for compensatory mitigation are manifest in two forms: first, in geographic service areas for mitigation banks and ILF programs and second, in spatial constraints limiting where PRM may occur.[58] Geographic service areas delineate trading zones where mitigation banks and ILF programs may sell credits.[59] Spatial restrictions on PRM and geographic service areas address two fundamentally distinct sides of geographically limiting wetland and stream offsets: while regulators decide the location of PRM based on prior knowledge of impacts, service areas delineate where future impacts may occur given prior knowledge of an aquatic

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[51] BenDor & Doyle, *supra* note 34, at 61–62.

[52] Corps Mitigation Rule, 33 C.F.R. § 332.2 (2008); EPA Mitigation Rule, 40 C.F.R. § 230.92 (2008).

[53] *Id.*

[54] William J. Mitsch & James G. Gosselink, *The Value of Wetlands: Importance of Scale and Landscape Setting*, 35 ECOLOGICAL ECON. 25, 27 (2000); Joy B. Zedler, *Wetlands at Your Service: Reducing Impacts of Agriculture at the Watershed Scale*, 1 FRONTIERS ECOLOGY & ENV'T 65, 65–72 (2003).

[55] Mitsch & Gosselink, *supra* note 54, at 28–29.

[56] *See* Dennis M. King & Luke W. Herbert, *The Fungibility of Wetlands*, NAT'L WETLANDS NEWSL., Sept.–Oct. 1997, at 10–13; Salzman & Ruhl, *supra* note 14, at 663.

[57] JAMES BOYD & LISA WAINGER, RESOURCES FOR THE FUTURE, MEASURING ECOSYSTEM SERVICE BENEFITS: THE USE OF LANDSCAPE ANALYSIS TO EVALUATE ENVIRONMENTAL TRADES AND COMPENSATION 3 (2003), *available at* http://ageconsearch.umn.edu/bitstream/10738/1/dp020063.pdf; BenDor et al., *supra* note 13, at 2088–90; King & Herbert, *supra* note 56, at 10–13.

[58] Corps Mitigation Rule, 33 C.F.R. §§ 332.2, 332.3(d) (2008); EPA Mitigation Rule, 40 C.F.R. §§ 230.92, 230.93(d) (2008).

[59] Corps Mitigation Rule, 33 C.F.R. § 332.2; EPA Mitigation Rule, 40 C.F.R § 230.92.

resource restoration program.[60] Nevertheless, the rationale and spatial scale behind these limits are generally very similar and, in some cases, interchangeable.

Given the relative maturity of aquatic resource ecosystem service markets, this Article recounts the legal and policy context that underlies the wetland and stream offset market — compensatory mitigation under section 404 of the Clean Water Act. This Article focuses mainly on the evolution of geographic restrictions for this market and their current status. Since the federal government delegates decision-making for geographic limits in wetland and stream regulation to regional U.S. Army Corps of Engineers ("Corps") bureaucrats, state regulators, and local officials,[61] this Article also presents the results of a comprehensive national study of the patchwork in spatial restrictions for compensatory mitigation. To our knowledge, this is the first study of its kind.[62]

Part I provides essential background on ecosystem service markets by introducing the concepts of ecosystem functions and services, along with the implications of spatial location on functions and services. Part II presents the legal framework for aquatic resource markets and tracks the history of compensatory mitigation, focusing on the growth of third-party mitigation banking, the growth of ILF mitigation, and geographic restrictions for compensatory mitigation. Part III introduces the first federal regulation explicitly governing compensatory mitigation released by the Corps and the U.S. Environmental Protection Agency ("EPA") in April 2008, the Final Compensatory Mitigation Rule ("Mitigation Rule" or "Rule"),[63] with a focus on portions particularly relevant to market-based compensatory mitigation and geographic limits for these offsets. Part III also elaborates considerations pertinent to the geographic framework for compensatory mitigation outlined in the Rule, the watershed approach,[64] including watershed scale, collaborative governance, interagency interaction, and the influence of these

[60] Corps Mitigation Rule, 33 C.F.R. §§ 332.2, 332.3(d); EPA Mitigation Rule, 40 C.F.R. §§ 230.92, 230.93(d).

[61] Corps Mitigation Rule, 33 C.F.R. § 332.8(b); EPA Mitigation Rule, 40 C.F.R. § 230.98(b).

[62] Our research identified mitigation bank service area requirements or preferences for all Corps districts and states with compensatory mitigation siting preferences. Corps or state regulatory practices with respect to mitigation bank service areas are often undocumented, or provide flexibility to deviate from documented service area preferences on a case-by-case basis. Therefore, after we reviewed mitigation bank service area sizes set in published Corps district regulatory guidelines, memoranda of agreement between the Corps and other federal or state agencies, state regulations, state statutes, and state regulatory preferences, we subsequently conducted phone and e-mail interviews with knowledgeable regulatory personnel to clarify or acquire service area procedures. These phone and e-mail interviews are catalogued in Appendix II: Citations for Telephone and E-mail Interviews with U.S. Army Corps of Engineers Regulatory District, State, and other Interagency Review Team Representatives (available online at http://www.law.harvard.edu/students/orgs/elr/vol36_1/appendix2.pdf). Citations to these interviews in this Article are cited directly to their location in Appendix II.

[63] Corps Mitigation Rule, 33 C.F.R. §§ 325, 332; EPA Mitigation Rule, 40 C.F.R. § 230.

[64] Corps Mitigation Rule, 33 C.F.R. § 332.3(c); EPA Mitigation Rule, 40 C.F.R. § 230.93(c); NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 140–49.

processes on spatially limiting mitigation trades. Part IV explains the ecological and economic rationale for setting service area size and the tradeoffs associated with smaller or larger service areas in the compensatory mitigation context. Part V describes the results of our national study of the spatial scales used for geographic restrictions in mitigation markets with a primary focus on geographic service areas utilized for mitigation banks in different Corps districts and states. Part V concludes that Corps districts and states should develop scientifically and economically valid service area criteria that can be consistently and transparently applied to all applicants.

Finally, Part VI presents use of multiple service areas for the different aquatic resource functions and services being marketed as a potential solution to economic-ecologic tradeoffs. Setting multiple service areas could provide superior functional and societal bases for geographic restrictions on trading while also promoting ecologically and economically sound third-party compensation.

I. Biophysical and Economic Background: Spatial Dependence of Ecosystem Functions and Services

Within the field of ecology, over the past few decades a sub-field developed that focused on "ecosystem ecology."[65] Rather than studying individual organisms, biotic communities, or organism interactions, ecosystem ecologists focus on how the entire ecosystem, including biotic and abiotic components, collectively operate.[66] Typically, ecosystem ecologists quantify the stores and fluxes of energy and material into and out of ecosystems.[67] For example, rather than studying the action of all organisms or some organisms in a forest, ecosystem ecologists tend to quantify the mass of stored carbon or flux of phosphorus through the forest over a period of time.

How particular ecosystems, which can vary in spatial scope from a pond to a major river basin, change individual stores and fluxes of material and energy is generally referred to as ecosystem function.[68] Conceptually, functions are detachable from the effects of these biophysical processes on human well-being, though they may incorporate the ecological effects imposed by the physical human environment.[69] However, many functions confer benefits to human society, and the concept of ecosystem services integrates these biophysical processes into the context of human populations to evaluate the social value of ecosystem functions.[70] Typical ecosystem

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[65] Göran I. Ågren & Ernesto Bosatta, Theoretical Ecosystem Ecology 6 (1996).

[66] David M. Post, Martin W. Doyle, & John L. Sabo, *The Problem of Boundaries in Defining Ecosystems: A Potential Landmine for Uniting Geomorphology and Ecology*, 89 Geomorphology 113 (2007).

[67] Ågren & Bosatta, *supra* note 65, at 6.

[68] *See* Jordan S. Rosenfeld, *Logical Fallacies in the Assessment of Functional Redundancy*, 16 Conservation Biology 837, 837 (2002).

[69] Mitsch & Gosselink, *supra* note 54, at 25–26; Rosenfeld, *supra* note 68, at 837.

[70] King & Herbert, *supra* note 56, at 10.

functions that are also normally considered ecosystem services are carbon sequestration, nutrient (e.g., nitrogen, phosphorus) retention, flood attenuation, and soil production, in addition to a multitude of other valuable processes.[71]

A highly functioning ecosystem does not necessarily entail high-value ecosystem services as services necessitate the overlap of functions and societal demand.[72] For instance, pristine wetlands that withhold substantial quantities of floodwater in an unpopulated area provide less social value, in terms of flood moderation, than a marginally functional wetland that retains some floodwaters near a city.[73] Proximity to human populations is not a prerequisite for all ecosystem services; for example, rural regions may provide the best long-term replacement habitats.[74] However, in either case, the spatial context of an ecosystem function is central to its social value. Thus, market transactions in ecosystem services should consider the geographic context of biophysical processes to ensure that buyers and sellers are trading services of equivalent value.

A. Wetland and Stream Ecosystem Functions

During recent decades, national concern for the condition of aquatic ecosystems has garnered considerable attention for the ecosystem functions associated with wetlands and streams.[75] Location is critical to the efficacy of biophysical processes performed by aquatic ecosystems.[76] The magnitude of ecosystem functions occurring in wetlands and streams — such as nutrient cycling, water velocity reduction, water storage, and sustenance of fish and wildlife habitat — depends on the landscape-scale position of the aquatic resource and the relative composition of the surrounding watershed.[77]

The hydrology at a wetland site is the primary cause of its formation, composition, function, and permanence.[78] Wetlands form in areas where interplay between hydrogeology and climate causes the accretion and detainment of surface and/or subsurface water inputs.[79] Geologic characteristics, including topography, soil properties, groundwater, and stratigraphy, climatic influences such as precipitation and temperature, and vegetative con-

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[71] Brander et al., *The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature*, 33 ENVTL. & RESOURCE ECON. 223, 226 (2006).

[72] Mitsch & Gosselink, *supra* note 54, at 25.

[73] King & Herbert, *supra* note 56, at 12.

[74] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(ii) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(ii) (2008).

[75] Matthew A. Wilson & Stephen R. Carpenter, *Economic Valuation of Freshwater Ecosystem Services in the United States: 1971–1997*, 9 ECOLOGICAL APPLICATIONS 772, 772–83 (1999).

[76] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 46–47.

[77] *See id.* at 46–57.

[78] *See id.* at 28.

[79] Barbara L. Bedford, *The Need to Define Hydrologic Equivalence at the Landscape Scale for Freshwater Wetland Mitigation*, 6 ECOLOGICAL APPLICATIONS 57, 59 (1996).

ditions all vary regionally, but can also vary significantly over relatively small areas.[80] These spatially variant environmental characteristics produce geographic diversity in wetland type and formation.[81] The accompanying ecosystem functions are therefore dependent upon the spatial context of the wetland.[82]

Many of these same biophysical drivers also affect stream functions.[83] Underlying geologic structure, precipitation regime, and regional vegetation characteristics all play formative roles in the morphology of streams.[84] In addition, stream form and processes vary tremendously within a single watershed, and consequently many stream functions such as nutrient retention or flood attenuation will also vary throughout the watershed.[85]

While local hydrology regulates whether a wetland can develop and be sustained, other spatial relationships between a wetland and its surrounding landscape influence the quality of the ecosystem functions that develop at a site.[86] In order for a wetland to moderate peak water flows, it must be located at a topographically lower position than major upland sources of water.[87] The same principle applies to nutrient and sediment removal functions: wetlands must be located topographically below lands contributing nutrients or sediment, such as farms or cities, to improve water quality.[88] Headwater riparian wetlands or buffer zones, which intercept nutrients and sediment before they influence mainstream water quality, are particularly effective at improving water quality.[89] Similarly, headwater streams are disproportionately capable of nitrogen and phosphorus retention compared to downstream, larger rivers.[90]

Many wetland faunal communities are dependent upon alternative, nearby wetlands for dispersion in instances of hydrologic stress. Most wetland animals cannot fly and thus require terrestrial connectivity corridors. Some faunal communities, including amphibians, also rely on maintenance of upland areas bordering a wetland.[91] Habitat fragmentation arguably implicates more severe consequences for stream ecosystems, particularly for

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[80] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 47–48; Mark M. Brinson, *Changes in the Functioning of Wetlands Along Environmental Gradients*, 13 WETLANDS 65, 65–74 (1993); *see also* Bedford, *supra* note 79, at 58–60.

[81] Bedford, *supra* note 79, at 58-60.

[82] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 46–59.

[83] LUNA B. LEOPOLD & THOMAS MADDOCK, JR., U.S. GEOLOGICAL SURVEY ("USGS"), THE HYDRAULIC GEOMETRY OF STREAM CHANNELS AND SOME PHYSIOGRAPHIC IMPLICATIONS 1–57 (1953).

[84] S.A. Schumm & R.W. Lichty, *Time, Space, and Causality in Geomorphology*, 263 AM. J. SCI. 110, 112 (1965).

[85] Richard B. Alexander et al., *Effect of Stream Channel Size on the Delivery of Nitrogen to the Gulf of Mexico*, 403 NATURE 758, 758–61 (2000); Joel Sholtes & Martin Doyle, *Impact of Stream Restoration on Flood Waves*, 137 J. HYDRAULIC ENG'G, 196, 202–06 (2010).

[86] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 46–59.

[87] *Id.* at 48.

[88] *Id.* at 49.

[89] *Id.*

[90] Alexander et al., *supra* note 85, at 759–60.

[91] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 51.

dispersal of exclusively aquatic species, since in linear, dendritic stream systems fragmentation at one specific point can completely disconnect segments of a stream network.[92] Disconnected river-creek systems may exhibit low-quality ecological function, as stream ecosystems are dependent on upstream and downstream locales for source communities of organisms.[93] Upstream-migrating anadromous fish, such as salmon or shad, present an obvious example, but these fish also illustrate the importance of intact smaller headwater streams to the function of downstream, large river ecosystems.[94]

The location of aquatic resource functions in relation to urban or suburban development also affects their functional quality.[95] As noted, pollution assimilation functions of wetlands and streams may improve near development. Conversely, wetlands and streams heavily encroached upon by development and its associated limits on hydrology, increased pollution, higher susceptibility to non-native species, and lack of terrestrial connectivity typically cannot function as effectively as pristine systems.[96] Urban development also limits the size of available compensation sites, making consolidated, large compensation projects such as mitigation banks difficult to establish. Large wetlands provide some functional advantages over smaller, fragmented wetlands, including contiguous habitat for larger animals and a greater overall capability for pollutant removal;[97] similarly, large restored streams may provide higher functionality than smaller, fragmented projects.[98] As urban setting and wetland and stream size influence biophysical processes, aquatic resource trades should account for their spatial implications when choosing compensatory mitigation sites, particularly when heavily impacted areas, or areas with projected high impacts, may undermine restoration effectiveness.

Holistic management of aquatic resource trading should attempt to site compensation projects where they provide optimal functional improvements in local and regional hydrologic and biotic processes. However, functional improvement should not be the exclusive spatial concern of section 404 regulators; regulators should also be concerned with maintaining and enhancing

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[92] William F. Fagan, *Connectivity, Fragmentation, and Extinction Risk in Dendritic Metapopulations*, 83 ECOLOGY 3243, 3246 (2002).

[93] *Id.*; Mary F. Willson & Karl C. Halupka, *Anadromous Fish as Keystone Species in Vertebrate Communities*, 9 CONSERVATION BIOLOGY 489, 495 (1995).

[94] Willson & Halupka, *supra* note 93, at 495.

[95] Mitsch & Gosselink, *supra* note 54, at 28–29.

[96] Tracy Boyer & Stephen Polasky, *Valuing Urban Wetlands: A Review of Non-Market Valuation Studies*, 24 WETLANDS 744, 745 (2004); Mitsch & Gosselink, *supra* note 54, at 28–29; Christopher J. Walsh et al., *Effects of Urbanization on Streams of the Melbourne Region, Victoria, Australia. I. Benthic Macroinvertebrate Communities*, 46 FRESHWATER BIOLOGY 535, 547 (2001).

[97] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 36–37.

[98] Martin W. Doyle et al., *Hydrogeomorphic Controls on Phosphorus Retention in Streams*, 39 WATER RESOURCES RES. 1147, 1157 (2003).

the beneficial effects of these aquatic resource functions for human populations.[99]

B. Wetland and Stream Ecosystem Services

In addition to landscape determinants of the functional capacities of a wetland or stream, valuation of these biophysical processes requires inclusion of a suite of geographic considerations relating aquatic functions to the benefits they provide to society. Spatial influences on the social value of ecosystem services include the distance between an aquatic resource and the population valuing the wetland or stream, as measured through spatial or geographic discounting, the relative abundance or scarcity of other aquatic resources or substitute resources nearby a wetland or stream, and the population density of nearby communities.[100]

Central to discerning the spatial role in ecosystem services valuation is geographic or spatial discounting — the concept that the distance between a positive or negative environmental effect and a human population determines the value of the environmental amenity to that population.[101] Spatial discounting is conceptually analogous to the extensive economic literature on temporally discounting the value of future consumption,[102] asserting that as the geographic distance between a non-market good and a population grows the value of the good decays exponentially.[103] This principle applies equally to positive and negative environmental services; for instance, a population far from a landfill will tend to undervalue the harmful effects of the landfill while a population far from a wetland will tend to undervalue the positive ecosystem services provided by the wetland.[104] Similar to temporal discounting, economists can specify a spatial discount rate to describe how a service's value decays exponentially over space.[105] Just as a high temporal discount rate that exceeds the rate of capital growth may cause intergenerational inequity, passing on costs of current consumption to future generations, a high spatial discount rate that exceeds the rate of geographic dispersion of an environmental effect may cause intragenerational inequity,

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[99] 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 (2009).

[100] Boyd & Wainger, *supra* note 57, at 32; Bruce Hannon, *Sense of Place: Geographic Discounting by People, Animals, and Plants*, 10 ECOLOGICAL ECON. 157, 158 (1994); Mitsch & Gosselink, *supra* note 54, at 28.

[101] Hannon, *supra* note 100, at 158; Charles Perrings & Bruce Hannon, *An Introduction to Spatial Discounting*, 41 J. REGIONAL SCI. 23, 23–26 (2001). Environmental effects often do not decay "smoothly, continuously, and monotonically" over space. For instance, effluent discharged into rivers or streams may become particularly concentrated in sinks below the original point source. However, in general, the assumption that environmental effects decrease as they disperse over space is valid. *Id.* at 27.

[102] Perrings & Hannon, *supra* note 101, at 25–26.

[103] Hannon, *supra* note 100, at 158–165.

[104] Perrings & Hannon, *supra* note 101, at 24–25.

[105] *Id.* at 25.

passing the costs of current consumption to other communities. The "ethically neutral" spatial discount rate would equal the rate at which the environmental effect is physically transported from its source.[106] In addition, spatial discount rates will likely differ among the various bundled ecosystem services associated with aquatic resources;[107] for instance, the spatial discount rate for distant water quality improvement at a wetland site may differ from the spatial discount rate for habitat conservation at the same wetland.

When applied to valuation of ecosystem services provided by wetlands and streams, spatial discounting implies that populations and individuals closer to these aquatic resources place higher values on the services they provide.[108] Research examining the effect of distance to wetlands on property values seemingly supports this contention. One study found that simply increasing wetland area by one acre in the survey section surrounding a house raised property values by an average of $42.66 (1989 USD) in Ramsey County, Minnesota.[109] Follow-up analysis in the same study area by Doss and Taff (1996) found that locating houses 200 meters closer to wetlands raised property values by $960 (forested wetlands) to $2900 (scrub-shrub wetlands).[110] A similar hedonic approach to wetland valuation in Portland, Oregon also isolated an increase of $436.17 (1994 USD) in housing value for every 1,000 feet a home was closer to wetlands, beginning from a distance of one mile.[111] The same study showed a property value increase of $24.39 per one-acre expansion of the closest wetland and a $258.81 increase for every 1,000 feet a home was closer to a stream.[112] Streiner and Loomis also noted $4,500 to $19,000 (1995 USD) increases in property values nearby California urban stream restoration projects.[113]

More central to setting geographic restrictions for the reallocation of aquatic resources across the landscape, however, would be utilization of an ethically acceptable spatial discount rate for ecosystem services in setting geographic service areas or designating locations for off-site PRM. Integrating the value of aquatic resource restoration or impacts over space, as determined by the spatial discount rate, would provide regulators with a quantitative before-and-after depiction of the redistribution of ecosystem services resulting from compensatory mitigation trades.[114] While it is highly

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[106] *Id.* at 27.

[107] *See generally id.* at 23–29.

[108] *Id.*

[109] Frank Lupi, Jr., Theodore Graham-Tomasi, & Steven J. Taff, *A Hedonic Approach to Urban Wetland Valuation* 21 (Univ. Minn. Dep't Agric. & Applied Econ., Staff Paper P91-8, 1991), *available at* http://ageconsearch.umn.edu/bitstream/13284/1/p91-08.pdf.

[110] Cheryl R. Doss & Steven J. Taff, *The Influence of Wetland Type and Wetland Proximity on Residential Property Values*, 21 J. AGRIC. & RESOURCE ECON. 120, 128 (1996).

[111] Brent L. Mahan, Stephen Polasky, & Richard M. Adams, *Valuing Urban Wetlands: A Property Price Approach*, 76 LAND ECON. 100, 106–09 (2000).

[112] *Id.* at 106.

[113] Carol F. Streiner & John B. Loomis, *Estimating the Benefits of Urban Stream Restoration Using the Hedonic Price Method*, 5 RIVERS 267, 267 (1995).

[114] C. Patrick Heidkamp, *A Theoretical Framework for a 'Spatially Conscious' Economic Analysis of Environmental Issues*, 39 GEOFORUM 62, 69 (2008).

unlikely that regulators could in fact allocate sufficient resources to determine spatial discount rates and the subsequent social value associated with project-by-project transfers of wetlands and streams, general recognition of the concept could lessen undervaluation or overvaluation of the ecosystem services involved in landscape-scale transactions.[115]

Just as the distance between a human population and an aquatic resource affects the social value of its ecosystem functions, the population density of settlements nearby a wetland or stream also influences its value.[116] Assuming constant functional capacity, a wetland or stream located in a densely populated area will serve more people, and thus provide higher-value services than a wetland or stream of similar size located far from a population.[117] The exact distance necessary for an aquatic resource to serve a dense population center will vary by function and the socioeconomic factors affecting accessibility of a function.[118]

Increased valuation of ecosystem services in areas of dense population may also be partially caused by increased scarcity of these services.[119] Conventional economics dictates that when a good or service is increasingly scarce, it becomes more valuable, and this classic principle may affect aquatic resources.[120] Applied to wetlands and streams, if aquatic resources and feasible substitutes for their services are lacking in a particular area, the marginal value of any remaining services should be high.[121] For instance, values of restored wetlands in the Chicago area have exceeded $110,000 per acre, compared to those in other urban and suburban areas where values are approximately $54,000.[122] Substitutes can influence the scarcity of inputs to or outputs from ecosystem services; for instance, wetlands that recharge groundwater supplies could be substituted with engineered groundwater recharge systems, affecting inputs, or could be substituted with other ulti-

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[115] However, it is encouraging to note the development of several prominent multi-ecosystem service valuation tools; some of these tools operate on geospatial platforms, model the spatial extent at which specified ecosystem services operate, and use the human populations affected by a service to estimate their value. These tools could feasibly be used in future permit decisions to model spatial effects of ecosystem service trading. *See* SISSEL WAAGE, EMMA STEWART, & KIT ARMSTRONG, BUSINESS FOR SOCIAL RESPONSIBILITY, MEASURING CORPORATE IMPACT ON ECOSYSTEMS: A COMPREHENSIVE REVIEW OF NEW TOOLS 10–16 (2008), *available at* http://www.bsr.org/reports/BSR_EMI_Tools_Application.pdf.

[116] Luke M. Brander, Raymond J.G.M. Florax, & Jan E. Vermatt, *The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature*, 33 ENVTL. & RESOURCE ECON. 223, 237–41 (2006).

[117] *Id.*; King & Herbert, *supra* note 56, at 12–13; Mitsch & Gosselink, *supra* note 54, at 28.

[118] King & Herbert, *supra* note 56, at 11–13.

[119] Mitsch & Gosselink, *supra* note 54, at 26; *see generally* Paul C. Sutton & Robert Costanza, *Global Estimates of Market and Non-Market Values Derived from Nighttime Satellite Imagery, Land Cover, and Ecosystem Service Valuation*, 41 ECOLOGICAL ECON. 509 (2002).

[120] Mitsch & Gosselink, *supra* note 54, at 26.

[121] Nancy E. Bockstael et al., *On Measuring Economic Values for Nature*, 34 ENVTL. SCI. & TECH. 1384, 1385 (2000); James Boyd & Lisa Wainger, *Landscape Indicators of Ecosystem Service Benefits*, 84 AM. J. AGRIC. ECON. 1371, 1373 (2002).

[122] Robertson, *supra* note 44, at 301.

mate sources of water, such as irrigation infrastructure.[123] Boyd and Wainger utilize geospatial evaluations of wetland scarcity and substitutes to ascertain the relative value of certain ecosystem services.[124] Pure wetland scarcity is measured by identifying the percentage of land area covered by wetlands in a circular area surrounding a site of interest, or in the immediate watershed.[125] Scarcity through substitutability is similarly measured through an inventory of other nearby land uses relevant to the ecosystem service of concern.[126] For example, the percentage of a watershed in a natural state is used to identify alternative lands capable of groundwater recharge and provision of open space recreation.[127] Aquatic resource mitigation markets should assess the scarcity of wetlands and streams being traded, which is inherently dependent on their geographic surroundings, to prevent trades that may result in net losses of ecosystem services.[128]

Much of the literature examining ecosystem functions, ecosystem services, and their dependence upon geographic location has evolved concurrently with the compensatory mitigation regulatory program, and only relatively recently has this literature become influential in mitigation decision-making.[129] Part II characterizes the regulatory regime motivating compensatory mitigation and the history of geographic constraints on trading in functions and services.

II. Regulatory Background

Wetlands and streams, along with all "waters of the United States," are regulated under the 1972 Federal Water Pollution Control Act and the 1977 Revisions, known as the Clean Water Act.[130] Section 301 of the Clean Water Act makes "the discharge of any pollutant by any person . . . unlawful" and this sweeping prohibition on aquatic resource degradation includes preventing unauthorized filling of wetlands or streams under federal jurisdiction.[131] Section 404 of the Clean Water Act provides an exception to this exclusion, assigning EPA and the Corps joint regulatory oversight of permitting select

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[123] Boyd & Wainger, *supra* note 57, at 32.
[124] *See generally id.* at 36–128.
[125] *Id.* at 75, 90.
[126] *Id.* at 90–115.
[127] *Id.* at 90, 114.
[128] *See id.* at 117.
[129] *See* Ruhl et al., *supra* note 99, at 252.
[130] Federal Water Pollution Control Act, 33 U.S.C. §§ 1251–1387 (2006) [hereinafter Clean Water Act]. The geographic scope of federal jurisdiction under the Clean Water Act, including which wetlands and streams are considered "waters of the United States," is a highly contentious issue for which the legal scholarship is vast. *See, e.g.*, Jonathan H. Adler, *Reckoning with* Rapanos*: Revisiting 'Waters of the United States' and the Limits of Federal Wetland Regulation*, 14 Mo. Envtl. L. & Pol'y Rev. 1 (2006); James Murphy, *Muddying the Waters of the Clean Water Act:* Rapanos v. United States *and the Future of America's Water Resources*, 31 Vt. L. Rev. 355 (2007).
[131] Clean Water Act § 301(a), 33 U.S.C. § 1311(a) (2006); Ruhl & Gregg, *supra* note 46, at 368.

dredge-and-fill activities in wetlands and streams.[132] Section 404(a) charges the Secretary of the Army, through the Corps, with administration of permit issuance for specific "discharge[s] of dredged or fill material" into "navigable waters."[133] Under section 404(b)(1), EPA must promulgate environmental criteria, referred to as "404(b)(1) Guidelines," which the Corps must adhere to in operating the section 404 permit program.[134] Section 404(c) also gives EPA authority to reject any Corps-granted section 404 permit that EPA deems "unacceptable."[135] Enforcement authority for violations of section 404 is shared between the Corps and EPA.[136] Section 404 permits are necessary for many conventional land development practices and permit applicants generally must satisfy the process of mitigation as a precondition for receiving a section 404 permit.[137]

Mitigation, now a centerpiece of section 404 permit decisions, was not originally envisioned as a condition of dredge-and-fill permitting.[138] Wetland mitigation developed as a result of initial reluctance by the Corps and EPA to exercise their full regulatory power under section 404.[139] The Corps resisted denying section 404 permits for dredge-and-fill projects involving significant environmental impacts and EPA similarly resisted vetoing these permits.[140] In the Clean Water Act's 1977 amendments, Congress confirmed that it intended the section 404 permit program to allow for considerable aquatic resource damages when it sanctioned the use of Corps General Permits.[141] Thus, in order to meet the Clean Water Act's principal objective of "restor[ing] and maintain[ing] the chemical, physical, and biological integrity of the Nation's waters,"[142] mitigation emerged as a method of alleviating ecological damage from large-scale wetland losses.[143] Though the effectiveness of early mitigation was poor indeed,[144] and mitigation recommendations were not initially seen as obligatory, federal agencies began to recommend

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[132] Clean Water Act § 404, 33 U.S.C. § 1344.

[133] *Id.* at § 1344(a); Ruhl & Gregg, *supra* note 46, at 368.

[134] Clean Water Act § 404(b)(1), 33 U.S.C. § 1344(b)(1); Ruhl & Gregg, *supra* note 46, at 368.

[135] Clean Water Act § 404(c), 33 U.S.C. § 1344(c).

[136] Hough & Robertson, *supra* note 41, at 16.

[137] Ruhl & Gregg, *supra* note 46, at 369.

[138] Hough & Robertson, *supra* note 41, at 17.

[139] *Id.*

[140] *Id.*

[141] *Id.* Corps General Permits, which include both Regional and Nationwide Permits, are streamlined, categorical permits for similar activities that "will cause only minimal environmental harm when evaluated either individually or cumulatively." *Id.* at 18.

[142] Clean Water Act § 101(a), 33 U.S.C. § 1251(a) (2006).

[143] Hough & Robertson, *supra* note 41, at 17.

[144] *See*, *e.g.*, Kevin L. Erwin, *Wetland Evaluation for Restoration and Creation*, *in* WETLANDS CREATION AND RESTORATION: THE STATUS OF THE SCIENCE 239 (Jon A. Kusler & Mary E. Kentula eds., 1990); Margaret Seluk Race, *Critique of Present Wetlands Mitigation Policies in the United States Based on an Analysis of Past Restoration Projects in San Francisco Bay*, 9 ENVTL. MGMT. 71, 71 (1985).

use of "compensatory replacement mitigation" to restore lost aquatic resource functions.[145]

Sequencing requirements for mitigation are central to the section 404 permit program and provide the basis for aquatic resource mitigation markets.[146] Mitigation sequencing preferences similar to those followed today first appeared in the Council on Environmental Quality ("CEQ")'s 1978 National Environmental Policy Act ("NEPA") regulations and were subsequently refined in the section 404 context by the Corps-EPA 1990 Memorandum of Agreement ("MOA") on mitigation, which clarified EPA's 404(b)(1) Guidelines.[147] EPA's 404(b)(1) Guidelines sort the mitigation process into three sequential processes utilized in evaluating applications to fill wetlands or streams: first, the Guidelines require applicants to *avoid* aquatic resource impacts altogether; second, applicants must *minimize* the extent of unavoidable damage to aquatic resources; and third, permittees must provide *compensation* for unavoidable damages to aquatic resources.[148] Compensatory mitigation includes restoration, creation, enhancement, or preservation of wetlands or streams to account for lost aquatic resources.[149] Historically, regulatory agencies have emphasized compensation over avoidance and minimization.[150] The three-step mitigation process of avoidance, minimization, and compensation was documented in use as early as 1982.[151] The last step in the mitigation process, the regulatory requirement for compensatory mitigation, creates the demand for the burgeoning market in wetland and stream mitigation credits.[152]

The guiding policy for aquatic resource regulation at the federal level is to prevent net losses of aquatic resource acreage or functions.[153] Coined "no-net-loss," this overarching goal was a central recommendation of the 1987 National Wetlands Policy Forum and was subsequently endorsed by

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[145] Hough & Robertson, *supra* note 41, at 17; William L. Kruczynski, *Mitigation and the Section 404 Program: A Perspective*, *in* WETLANDS CREATION AND RESTORATION: THE STATUS OF THE SCIENCE, *supra* note 144, at 549, 551.

[146] Ruhl & Gregg, *supra* note 46, at 369.

[147] *See* Hough & Robertson, *supra* note 41, at 18–19.

[148] Correction of Memorandum of Agreement Between Department of Army and the Environmental Protection Agency Concerning the Clean Water Act Section 404(b)(1) Guidelines, 55 Fed. Reg. 9210, 9211-12 (Mar. 12, 1990) [hereinafter 1990 Mitigation MOA]; *see also* Hough & Robertson, *supra* note 41, at 19.

[149] *See* Corps Mitigation Rule, 33 C.F.R. § 332.2 (2008); EPA Mitigation Rule, 40 C.F.R. § 230.92 (2008).

[150] *See* James Murphy et al., *New Mitigation Rule Promises More of the Same: Why the New Corps and EPA Mitigation Rule Will Fail to Protect our Aquatic Resources Adequately*, 38 STETSON L. REV. 311, 315 (2009).

[151] *See* Margaret Seluk Race & Donna R. Christie, *Coastal Zone Development: Mitigation, Marsh Creation, and Decision-making*, 6 ENVTL. MGMT. 317, 318 (1982).

[152] *See* BECCA MADSEN ET AL., ECOSYSTEM MARKETPLACE, STATE OF BIODIVERSITY MARKETS: OFFSET AND COMPENSATION PROGRAMS WORLDWIDE 12 (2010), *available at* http://www.ecosystemmarketplace.com/documents/acrobat/sbdmr.pdf.; Ruhl & Gregg, *supra* note 46, at 369.

[153] BenDor & Doyle, *supra* note 34, at 61; *see also* Hough & Robertson, *supra* note 41, at 25–27, 29.

President George H.W. Bush during his 1988 presidential campaign.[154] Successive presidents have affirmed and enhanced President Bush's commitment to no net loss of aquatic resources, with the Clinton and George W. Bush administrations advocating net gains in wetland acreage.[155] The no-net-loss policy does not necessarily promote preservation of existing wetlands and streams. This especially accentuates the significance of compensatory mitigation as a method for balancing the ecological consequences of authorized aquatic resource losses.[156] No-net-loss objectives for acreage and functions each require distinctive considerations. Simple metrics of aquatic resource abundance, such as acreage for wetlands or linear feet for streams reveal little about their actual functional quality.[157] Additionally, if no-net-loss is applied to ecosystem services, functions restored where they provide fewer benefits to human populations cause reductions in services.[158]

While no-net-loss is generally evaluated on a national or state level, it inherently requires specification of an ecologically and socially appropriate scale at which losses and gains of wetlands and streams will be balanced.[159] The entire United States may achieve a goal of no-net-loss, but this would be ineffective if certain regions become devoid of aquatic resources and other, distant regions equalize these losses through gains in aquatic resources. This distributional inequity is precisely the problem geographic constraints on ecosystem service markets are designed to solve and should be central to any assessment of no-net-loss. The challenge for regulators is to assess the appropriate scale at which no-net-loss will be evaluated and quantified.

A. *Types of Compensatory Mitigation*

1. *Permittee-responsible Mitigation*

Compensatory mitigation under section 404 is separable into two types of third-party, market-based compensation providers (mitigation banks and ILFs) and project-specific compensation options (generally referred to as PRM). Unlike most mitigation banks and ILF programs, PRM does not entail a monetary transaction to a third party in exchange for liability for com-

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[154] Hough & Robertson, *supra* note 41, at 26.

[155] Press Release, EPA, Clean Water Action Plan (Feb. 19, 1998), *available at* http://www.epa.gov/history/topics/cwa/03.html; *cf.* EPA & U.S. ARMY CORPS OF ENG'RS, NATIONAL WETLANDS MITIGATION ACTION PLAN 1 (2002), *available at* http://www.epa.gov/owow/wetlands/pdf/map1226withsign.pdf (discussing the Bush administration's goal to "begin increasing the overall functions and values of our wetlands" in the near future).

[156] *See* Hough & Robertson, *supra* note 41, at 26; Murphy et al., *supra* note 150, at 312.

[157] Morgan M. Robertson, *The Neoliberalization of Ecosystem Services: Wetland Mitigation Banking and Problems in Environmental Governance*, 35 GEOFORUM 361, 368 (2004); Ruhl & Gregg, *supra* note 46, at 367; Salzman & Ruhl, *supra* note 14, at 657–59.

[158] *See* Phillip H. Brown & Christopher L. Lant, *The Effect of Wetland Mitigation Banking on the Achievement of No Net Loss*, 23 ENVTL. MGMT. 333, 343–44 (1999).

[159] Todd BenDor et al., *Assessing the Socioeconomic Impacts of Wetland Mitigation in the Chicago Region*, 73 J. AM. PLANNING ASS'N 263, 275–76 (2007).

pensatory mitigation. Instead, a PRM permittee maintains all responsibility for achieving ecological performance standards at a compensation site.[160] However, PRM continues to be the leading compensatory mitigation method, providing 59.1% of wetland and stream mitigation in 2008.[161] Although it is not a market-based compensation option per se, PRM still provides competition for mitigation banks and ILF programs.[162]

2. *Mitigation Banking*

Mitigation banks accumulate compensatory mitigation credits based on the quality and quantity of aquatic resources restored at a bank site.[163] If bank credits meet applicable administrative and ecological standards, permittees may purchase credits from a mitigation bank to fulfill their section 404 compensation obligations.[164] As part of the transaction, liability for the performance of the compensation site is transferred from the permittee to the mitigation banker. In fact, no real property changes hands in the mitigation market; rather, the commodity being exchanged is liability.[165] Mitigation banks produce large, consolidated wetland and stream sites and thus can capture economies of scale to provide lower-cost compliance for compensatory mitigation obligations.[166] Mitigation banks are also temporally preferable to PRM and ILF programs, as compensation is generally initiated in advance of credit transactions.[167]

Federal policy envisioned mitigation banks as early as 1981 and the U.S. Fish and Wildlife Service ("FWS") issued the first federal guidance specifically addressing mitigation banking in 1983.[168] Wetland mitigation banks first appeared in the early 1980s as single-user methods of providing advance compensation for expected internal wetland impacts. Port development authorities, state departments of transportation ("DOTs"), and other permittees with significant compensatory mitigation obligations under sec-

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[160] *See* Corps Mitigation Rule, 33 C.F.R. § 332.2 (2008); EPA Mitigation Rule, 40 C.F.R. § 230.92 (2008).

[161] Madsen et al., *supra* note 152, at 11.

[162] *See* TODD BENDOR, J. ADAM RIGGSBEE, & GEORGE HOWARD, A NATIONAL SURVEY OF FEDERAL MITIGATION REGULATIONS AND THEIR IMPACTS ON WETLAND AND STREAM BANKING 5 (2009), *available at* http://ecosystemmarketplace.com/documents/cms_documents/Mitigation_Survey_Analysis_Distribute_Final_11-13-09.pdf.

[163] Corps Mitigation Rule, 33 C.F.R. § 332.8(o); EPA Mitigation Rule, 40 C.F.R. § 230.98(o).

[164] Corps Mitigation Rule, 33 C.F.R. § 332.3(b)(2); EPA Mitigation Rule, 40 C.F.R. § 230.93(b)(2).

[165] Morgan M. Robertson, *Discovering Price in All the Wrong Places: The Work of Commodity Definition and Price Under Neoliberal Environmental Policy*, 39 ANTIPODE 500, 518 (2007).

[166] William W. Sapp, *The Supply-Side and Demand-Side of Wetlands Mitigation Banking,* 74 OR. L. REV. 951, 971–81 (1995).

[167] *See* BenDor et al., *supra* note 13, at 2089.

[168] U.S. Fish and Wildlife Service Mitigation Policy, Notice of Final Policy, 46 Fed. Reg. 7644, 7656–60 (Jan. 23, 1981); FWS, Interim Guidance on Mitigation Banking, Ecological Service Instructional Memorandum No. 80 (June 1983); Hough & Robertson, *supra* note 41, at 20.

tion 404 operated single-user banks in which they would debit impacts from banked quantities of aquatic resource credits.[169] A 1988 mitigation banking study from the FWS identified thirteen banks in the United States with FWS involvement; of the thirteen banks, ten were administered by port authorities and state DOTs.[170] On February 2, 1986, the Tenneco Oil Company's LaTerre mitigation bank in Southern Louisiana arranged the first third-party transaction for section 404 compensatory mitigation credits.[171] However, Tenneco had established the LaTerre Bank in 1982 predominantly to satisfy internal demand for compensatory mitigation and infrequently marketed credits to external developers.[172] Single-user banks set the stage for realization of entrepreneurial, market-based mitigation banking, which emerged most prominently in the 1990s.[173]

Impetus for the expansion of mitigation banking to for-profit entities occurred following several significant studies demonstrating the poor administrative and ecological record of on-site and off-site PRM.[174] The Millhaven Bank in Georgia received the first permit for an entirely entrepreneurial wetland mitigation bank on December 18, 1992, on January 4, 1994 the Pembroke Pines Bank in Florida completed the first entrepreneurial sale of compensatory mitigation credits, and on March 17, 1994,[175] the Otter Creek Bank in Illinois obtained the first approved banking instrument, a regulatory document guiding bank operation, for a purely for-profit bank.[176] Under the 1995 Mitigation Banking Guidance jointly issued by the Corps, EPA, the National Oceanic and Atmospheric Administration ("NOAA"), the Natural Resources Conservation Service ("NRCS"), and the FWS, in order to sell compensation credits, banks needed approval from an interagency Mitigation Bank Review Team ("MBRT").[177] Local Corps district regulators generally chaired MBRTs and the Chair of an MBRT held final decision-making authority on bank instruments.[178] Following the 1995 Banking Guidance, private investors sensed adequate regulatory approval of private mitigation banking, and entrepreneurial banking enterprises increased substantially.[179]

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[169] Hough & Robertson, *supra* note 41, at 24; *see* CATHLEEN SHORT, FWS, MITIGATION BANKING, BIOLOGICAL REPORT 88(41), at 39–42 (1988).

[170] SHORT, *supra* note 169.

[171] Hough & Robertson, *supra* note 41, at 24.

[172] *Id.*

[173] *See id.* at 24–25.

[174] *See generally, e.g.*, Wendy P. Elliot, *Implementing Mitigation Policies in San Francisco Bay: A Critique*, 4 SYMPOSIUM ON COASTAL AND OCEAN MANAGEMENT 920 (1985); Erwin, *supra* note 144; Race, *supra* note 144.

[175] Hough & Robertson, *supra* note 40, at 25.

[176] Palmer Hough & Lynda Hall, EPA, The History and Status of Wetland Mitigation Banking and Water Quality Trading, Presentation at the National Forum on Synergies Between Water Quality Trading and Wetland Mitigation Banking (July 11, 2005), *available at* http://www.eli.org/Program_Areas/events/wqt_forum.cfm.

[177] Federal Guidance for the Establishment, Use and Operation of Mitigation Banks, 60 Fed. Reg. 58,605, 58,610 (Nov. 28, 1995) [hereinafter 1995 Banking Guidance].

[178] *Id.*

[179] ENVTL. LAW INST., BANKS AND FEES: THE STATUS OF OFF-SITE WETLAND MITIGATION IN THE UNITED STATES 14 (2002).

In 2000, the first stream mitigation bank was established at the Fox Creek Stream Mitigation Bank in St. Louis County, Missouri.[180] In 2009, a national database reported the presence of 797 mitigation banks, with 431 active banks and 182 banks pending approval; mitigation banks also accounted for 35.3% of total compensation credits sold in 2008.[181] In addition, 70.4% of mitigation banks in a 2005 survey were privately run, for-profit ventures.[182]

3. *In-lieu Fee Mitigation*

ILF mitigation also grew in the 1990s[183] and was sanctioned as acceptable through brief mention in the 1995 Banking Guidance[184] and subsequent Corps Federal Register notices,[185] one of which granted individual Corps districts case-by-case authority to determine the adequacy of agreements governing ILF operation.[186] Accordingly, approved ILF programs in different Corps districts during this time period were highly variable, with some operating under agreements similar to mitigation bank instruments and others acting under informal, ad-hoc agreements with little instruction as to how compensatory mitigation would be achieved.[187] Money entrusted to ILF programs was often not spent or was improperly reallocated by state governments in financial straits.[188] Because ILF programs must take in fees based on estimates of the projected costs of restoration some time in the future, these programs have been plagued by undercharging fees.[189] Shortfalls in some ILF program budgets were subsequently reconciled with state treasury funding, effectively creating a state subsidy for cheap stream or wetland destruction. Others were simply counted as an ecological loss.[190] Moreover, when ILF money was spent on environmental projects, it often funded less effective work, such as environmental education, monitoring, or research.[191]

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[180] Rebecca Lave, Morgan M. Robertson, & Martin W. Doyle, *Why You Should Pay Attention to Stream Mitigation Banking*, 26 ECOLOGICAL RESTORATION 287, 287 (2008).

[181] BENDOR ET AL., *supra* note 162.

[182] JESSICA WILKINSON & JARED THOMPSON, ENVTL. LAW INST., 2005 STATUS REPORT ON COMPENSATORY MITIGATION IN THE UNITED STATES 7 (2006).

[183] Royal C. Gardner, *Money for Nothing? The Rise of Wetland Fee Mitigation*, 19 VA. ENVTL. L. J. 1, 18–37 (2000); Hough & Robertson, *supra* note 41, at 25.

[184] *See* 1995 Banking Guidance, 60 Fed. Reg. 58,605, 58,613 (Nov. 28, 1995).

[185] *See* Proposal to Issue and Modify Nationwide Permits, Notice, 64 Fed. Reg. 39,252, 39,272–73, 39,368 (July 21, 1999); Proposal to Issue and Modify Nationwide Permits, 63 Fed. Reg. 36,040, 36,045, 36,051, 36,053–54, 36,063, 36,075 (July 1, 1998); Final Notice of Issuance, Reissuance, and Modification of Nationwide Permits, 61 Fed. Reg. 65,874, 65,922 (Dec. 13, 1996); Gardner, *supra* note 183, at 14–17.

[186] Final Notice of Issuance, Reissuance, and Modification of Nationwide Permits, 61 Fed. Reg. at 65,910.

[187] Gardner, *supra* note 183, at 19–38; Hough & Robertson, *supra* note 41, at 25.

[188] Gardner, *supra* note 183, at 33–38; Hough & Robertson, *supra* note 41, at 25.

[189] BenDor et al., *supra* note 13, at 2080.

[190] James E. Shiffer, *Pay-and-pave System Leaves Wetlands Behind*, RALEIGH NEWS & OBSERVER, Jan. 20, 2002 (on file with authors).

[191] Gardner, *supra* note 183, at 18–38; Hough & Robertson, *supra* note 41, at 25.

To clarify federal ILF policy, the Corps, EPA, NOAA, and the FWS released guidance on the administration of ILF programs in 2000.[192] The 2000 ILF guidance, among other suggestions, promoted review of ILF agreements similar to that of mitigation bank instruments, described appropriate situations for use of ILF credits, advocated advanced watershed planning and well-informed site selection, and noted that ILF funds should only finance compensatory mitigation activities.[193] As with mitigation banking, ILF programs can take advantage of economies of scale to reduce credit prices.[194] In 2005, 42 active ILF programs existed nationwide[195] and in 2008 ILFs sold 5.6% of all mitigation credits.[196]

B. Development of Spatial Restrictions Prior to 2008

This section narrates the history of the development of geographic limits for compensatory mitigation under section 404 of the Clean Water Act. Given the maturity of wetland and stream compensatory mitigation relative to other ecosystem service markets, an understanding of the history of the market's geographic limits is useful for an analysis of present-day wetland and stream geographic service areas. Lessons from the section 404 compensatory mitigation program's experience with setting geographic limits for offsets may also be informative for other emerging environmental markets.

As compensatory mitigation became increasingly common in the 1970s and 1980s, the FWS began incorporating spatial preferences for locating aquatic resource replacement projects.[197] In the 1970s and 1980s, mitigation was often requested in comments from the FWS and the National Marine Fisheries Service ("NMFS") on section 404 permits based on agency authority under the Fish and Wildlife Coordination Act ("FWCA") and the Endangered Species Act ("ESA"); however, mitigation recommendations provided to the Corps under the FWCA are merely advisory and the FWS often lacked a mechanism to compel the Corps to use its mitigation recommendations.[198] At this time, the FWS had also developed a much more advanced mitigation program than either the Corps or EPA and, accordingly, regulatory preferences for "in-kind" compensatory mitigation emerged in

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[192] Federal Guidance on the Use of In-Lieu Fee Arrangements for Compensatory Mitigation Under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, 65 Fed. Reg. 66,914 (Nov. 7, 2000) [hereinafter 2000 ILF Guidance].

[193] *Id.* at 66,915–16.

[194] Scott R. Templeton, Christopher F. Dumas, & William T. Sessions, *Estimation and Analysis of Expenses of Design-Bid-Build Projects for Stream Mitigation in North Carolina* 19–20 (Dep't of Applied Econ. & Statistics, Clemson Univ., Research Report RR 08-01, 2008), *available at* http://cherokee.agecon.clemson.edu/curr0801.pdf.

[195] WILKINSON & THOMPSON, *supra* note 182, at 15.

[196] BENDOR ET AL., *supra* note 162.

[197] *See* U.S. Fish and Wildlife Service Mitigation Policy, Notice of Final Policy, 46 Fed. Reg. 7644, 7644, 7656, 7659 (Jan. 23, 1981).

[198] John Studt & Robert D. Sokolove, *Federal Wetland Mitigation Policies*, *in* MITIGATION BANKING: THEORY AND PRACTICE 37, 40 (Lindell L. Marsh, Douglas R. Porter, & David A. Salvesen eds., 1996); Hough & Robertson, *supra* note 41, at 17, 20.

the 1981 Fish and Wildlife Service Mitigation Policy.[199] In-kind mitigation objectives promote compensation that replaces wetland or stream types similar to those damaged at an impact site.[200] While not an explicit geographic limitation on the location of compensatory mitigation, in-kind requirements inherently limit the geographic scope of compensatory mitigation options; for example, permitted impacts to coastal wetlands typically cannot be replaced with compensatory mitigation in freshwater areas. The FWS' 1981 Mitigation Policy classified habitat resources into four separate categories based on their habitat value, with category 1 representing the highest-value habitats and category 4 grouping low-value habitats.[201] This policy recommends "no loss of existing habitat value" for category 1 resources, that category 2 losses be replaced with in-kind compensation, and that in-kind losses of category 3 resources be minimized.

Regulatory preferences for locating compensatory mitigation on or adjacent to permitted aquatic resource damages ("on-site") emerged at the federal level in the FWS' 1983 Interim Guidance on Mitigation Banking ("1983 Banking Guidance"); this guidance stated that "all on-site mitigation alternatives must be pursued first."[202] Furthermore, subject to the preference for on-site replacement, the 1983 Banking Guidance instituted geographic limits for the use of mitigation banks.[203] Following the habitat resource categorization scheme established in their 1981 Mitigation Policy, the FWS noted that category 2 resources could be replaced by in-kind mitigation bank credits in the same Bailey's Ecoregion[204] and state as impacts, and that category 3 resources could be replaced by mitigation banks, preferably with in-kind credits but possibly with out-of-kind credits, in the same Bailey's Ecoregion and state as impacts.[205] Category 4 resources were also acceptable for replacement at mitigation banks, with a less stringent preference for in-kind offsets.[206] However, as the FWS policies were not binding on section 404 permits, preferences for on-site and in-kind compensatory mitigation did not become obligatory for aquatic resource fill activities until 1990[207] and geographic restrictions for mitigation banks were not introduced explicitly in the section 404 context until 1995.[208]

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[199] U.S. Fish and Wildlife Service Mitigation Policy, Notice of Final Policy, 46 Fed. Reg. at 7657–58.

[200] *See id.* at 7663.

[201] *Id.* at 7657–58.

[202] ENVTL. LAW INST. & INST. FOR WATER RES., NATIONAL WETLAND MITIGATION BANKING STUDY: WETLAND MITIGATION BANKING 15–16, 161, 169 (1994).

[203] *Id.* at 161.

[204] This term is defined and promulgated by the United States Forest Service. *See infra* notes 352–53 and accompanying text.

[205] ENVTL. LAW INST., *supra* note 202, at 161; *see also* U.S. Fish and Wildlife Service Mitigation Policy, Notice of Final Policy, 46 Fed. Reg. at 7651, 7657–58.

[206] ENVTL. LAW INST., *supra* note 202, at 161; *see also* U.S. Fish and Wildlife Service Mitigation Policy, Notice of Final Policy, 46 Fed. Reg. at 7658.

[207] Hough & Robertson, *supra* note 41, at 20, 27.

[208] 1995 Banking Guidance, 60 Fed. Reg. 58,611 (Nov. 28, 1995).

In addition to formalizing mitigation sequencing, the 1990 Corps-EPA MOA officially introduced spatial restrictions to guide section 404 compensatory mitigation, incorporating the regulatory preferences for on-site, in-kind compensation first designed by the FWS.[209] The 1990 MOA also established that when on-site compensation was impracticable, off-site compensatory mitigation should be sited "in the same geographic area if practicable (i.e. in close proximity, and, to the extent possible, in the same watershed)."[210] Significant to the emergence of third-party mitigation providers and compensatory mitigation markets, the Corps and EPA also acknowledged mitigation banking in the MOA, stating that use of an approved mitigation bank fulfilled the MOA's compensatory mitigation objectives "regardless of the practicability of other forms of compensatory mitigation."[211] The MOA therefore essentially put mitigation banking, which is inherently off-site and potentially provides out-of-kind replacement, on equal footing with on-site, in-kind PRM. Methods for geographically constraining use of mitigation bank credits are not articulated in the MOA's cursory reference to banking.

Geographic limits specific to mitigation bank sales for section 404 compensation emerged in the 1995 Federal Mitigation Banking Guidance, which introduced geographic service areas used to delimit where a mitigation bank could market compensation credits.[212] Service areas were to be specified in a bank's instrument, were subject to MBRT review, and "should be based on consideration of hydrologic and biotic criteria."[213] The 1995 Banking Guidance specifies that U.S. Geological Survey ("USGS") Hydrologic Unit Codes ("HUCs") with eight digits ("HUC-8s"), ecoregions as delineated by James M. Omernik of the EPA, or ecoregion sections defined by Robert G. Bailey of the United States Forest Service ("USFS") should inform service areas when environmentally preferable.[214] Service area definitions could also utilize state or regional environmental assessments and could be more expansive when larger service areas were supported by regional natural resource management plans or for banks designed to compensate for linear project (e.g., DOT) impacts dispersed throughout multiple watersheds.[215]

Mitigation banks were relegated to a status slightly below on-site compensatory mitigation in the 1995 Banking Guidance, which stated that mitigation bank "credits may only be authorized when on-site compensation is either not practicable or use of a mitigation bank is environmentally preferable to on-site compensation";[216] the guidance also published criteria for eval-

[209] 1990 Mitigation MOA, 55 Fed. Reg. 9210, 9212 (Mar. 12, 1990).

[210] *Id.*

[211] *Id.*

[212] 1995 Banking Guidance, 60 Fed. Reg. at 58,608–09, 58,611.

[213] *Id.* at 58,611.

[214] *Id.* For more information on Bailey's Ecoregions see *infra*, notes 352–53 and accompanying text.

[215] 1995 Banking Guidance, 60 Fed. Reg. at 58,611.

[216] *Id.* at 58,607.

uating when a mitigation bank would be desirable over on-site replacement.[217] Similarly, the guidance maintains that in-kind compensation is preferable to out-of-kind compensation, but that out-of-kind offsets may be ecologically acceptable for specific mitigation banks, such as banks designed as part of resource management plans.[218]

As part of the 2000 Federal ILF Guidance, vague geographic standards were introduced for operation of ILF programs. The 2000 guidance noted that ILF agreements should designate geographic service areas,[219] and though no further description of service areas is provided, the guidance maintained that terms used for ILFs have the same significance as those in the 1995 Banking Guidance unless specifically mentioned otherwise.[220] The 2000 ILF guidance also asserted that ILF programs should undergo review similar to that required for mitigation banks and that the MBRT should assess ILF agreements to ensure their similarity to mitigation banking instruments.[221] However, in practice ILF service areas were sometimes more inclusive than mitigation bank service areas or were nonexistent.[222] Finally, in most cases, the ILF guidance established a preference for on-site compensation and mitigation banks over ILF mitigation.[223]

C. State and Local Influence on Geographic Constraints

In addition to federal guidance and regulations governing compensatory mitigation under section 404 of the Clean Water Act, state and local governments can implement legislation, regulations, or regulatory preferences to shape geographic limitations for compensation projects. States may assume control of section 404 permitting in waters not involved in interstate or international commerce,[224] though this has only been accomplished in Michigan and New Jersey.[225] Additionally, states that choose to implement section 401 of the Clean Water Act programs are authorized to issue permits for aquatic resource impacts to ensure that "discharge[s]" into "waters of the United States" will occur in compliance with state water quality standards.[226] Through section 401 aquatic resource anti-degradation certifications, which are required before an authorized aquatic resource impact can occur, state resource agencies may predicate issuing certifications on certain siting preferences for compensatory mitigation.[227] Geographic standards imposed

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[217] *Id.*
[218] *Id.* at 58,611.
[219] 2000 ILF Guidance, 65 Fed. Reg. 66,914, 66,917 (Nov. 7, 2000).
[220] *Id.*
[221] *Id.* at 66,915.
[222] *See infra* note 450; *infra* Part IV.D.3.
[223] *See* 2000 ILF Guidance, 65 Fed. Reg. at 66,915–16.
[224] Clean Water Act § 404(g)-(*1*), 33 U.S.C. § 1344(g)-(*l*) (2010).
[225] ENVTL. LAW INST., STATE WETLAND PROTECTION: STATUS, TRENDS & MODEL APPROACHES 11 (2008).
[226] Clean Water Act § 401, 33 U.S.C. § 1341 (2006).
[227] *See* ENVTL. LAW INST., *supra* note 225, at 6.

through section 401 certifications may be prompted through a state statute, regulation, or guidance. States can also introduce statutes or regulations that specify additional geographic standards required for compensatory mitigation projects.[228] Accordingly, state legislation introduced to protect waters left without federal oversight following the Supreme Court cases *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers*[229] and *Rapanos v. United States*[230] may have implications on the watershed scale used to plan mitigation.[231] Finally, state resource agencies may sign MOAs with relevant Corps districts or EPA regions stating best practices for geographically constraining aquatic resource impacts and compensatory mitigation projects.[232]

Beyond state influence on compensatory mitigation, local governments may pass ordinances requiring compensatory mitigation to remain within local jurisdiction, or may discourage offsets outside of local jurisdiction by requiring more offsets for compensation provided outside of local boundaries.[233] Indeed, government agencies involved in dredge-and-fill permitting at all levels generally attempt to coordinate their geographic constraints on compensation to avoid duplicative compliance requirements for permittees.

III. 2008 Corps-EPA Final Compensatory Mitigation Rule

On April 10, 2008, the Corps and EPA jointly released federal regulations governing compensatory mitigation, as required by Section 314 of the FY04 National Defense Authorization Act ("NDAA").[234] The NDAA mandated that the Corps promulgate regulations that create "performance standards and criteria for the use" of the different compensatory mitigation mechanisms (PRM, ILF, mitigation banks) under section 404.[235] The NDAA also directed the Corps to institute regulations that, "[t]o the maximum extent practicable . . . maximize available credits and opportunities for mitigation, provide flexibility for regional variations in wetland conditions, functions, and values, and apply equivalent standards and criteria to each type of compensatory mitigation."[236] The Rule supersedes the preceding 1995 Banking Guidance, 2000 ILF Guidance, 2002 Regulatory Guidance Letter 02-02, and specified portions of the 1990 Corps-EPA MOA on mitiga-

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[228] *See id.*

[229] 531 U.S. 159 (2001).

[230] 547 U.S. 715 (2006).

[231] Todd BenDor & Nicholas Brozovic, *Determinants of Spatial and Temporal Patterns in Compensatory Wetland Mitigation*, 40 Envtl. Mgmt. 349, 350–51 (2007).

[232] *See* Wis. Dep't of Natural Res. et al., Guidelines for Wetland Compensatory Mitigation in Wisconsin 10, 35 (2002), *available at* http://dnr.wi.gov/org/es/science/publications/wetland_mitig.pdf; Appendix II, note 65.

[233] BenDor & Brozovic, *supra* note 231, at 352.

[234] Pub. L. No. 108-136, 117 Stat. 1430 § 314 (2003).

[235] *Id.* § 314(b)(1).

[236] *Id.*

tion.[237] It is worth noting that the Rule represents the first time the Corps and EPA have issued binding regulations specifically governing compensatory mitigation, as all other agency publications were guidance, and thus made compliance discretionary. Though the Rule primarily regulates compensatory mitigation, it also affirms EPA's section 404(b)(1) sequencing requirement for avoidance and minimization prior to compensation.[238]

A full review of the compensatory mitigation standards established in the 2008 Final Mitigation Rule is beyond the scope of this Article. This Part specifically addresses the Rule's central changes affecting market-based compensatory mitigation and geographic service areas for aquatic resource compensation.

A. "Leveling the Playing Field"

In order to advance a level playing field for competing providers of compensatory mitigation and to promote more ecologically sound compensation, the 2008 Mitigation Rule mandates twelve broad criteria that must be addressed in mitigation plans for mitigation banks, ILF programs, and PRM replacement projects: "objectives; site selection criteria; site protection instruments (e.g., conservation easements); baseline information (for impact and compensation sites); credit determination methodology; mitigation work plan; maintenance plan; ecological performance standards; monitoring requirements; long-term management plan; adaptive management plan; and financial assurances."[239] While standards applied to the different compensatory mitigation mechanisms are not identical due to fundamental differences in their timing and development, the Rule attempts to equalize requirements across the three mitigation mechanisms when possible.[240] Corps district engineers are also given considerable discretion to determine details of the twelve criteria.[241] These standards are designed to address shortcomings of the section 404 permit program identified by the National Research Council's 2001 review of compensatory mitigation ("NRC 2001").[242] The Rule also seeks to improve the performance of ILF programs by extending many of the administrative processes used in mitigation bank approval and oversight to ILF programs; both mitigation banks and ILF programs must have a

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[237] Corps Mitigation Rule, 33 C.F.R. § 332.1(f) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.91(e) (2008).

[238] Corps Mitigation Rule, 33 C.F.R. § 332.1(c); EPA Mitigation Rule, 40 C.F.R. § 230.91(c).

[239] Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. 19,594, 19,616 (Apr. 10, 2008); Palmer Hough & Mark Sudol, *New Regulations to Improve Wetland and Stream Compensatory Mitigation*, NAT'L WETLANDS NEWSL., July–Aug. 2008, 1, 3.

[240] Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. at 19,616; Hough & Sudol, *supra* note 239.

[241] Corps Mitigation Rule, 33 C.F.R. § 332.4(c); EPA Mitigation Rule, 40 C.F.R. § 230.94(c).

[242] Hough & Sudol, *supra* note 239, at 1, 3–4.

rigorous governing instrument and undergo evaluation from an Interagency Review Team ("IRT").[243]

Central to the structure of market-based compensatory mitigation, the Rule establishes a hierarchical preference among the compensation mechanisms, sequentially favoring use of mitigation banks, ILF programs, and then various types of PRM.[244] Mitigation banks are deemed advantageous because they are the only type of compensatory mitigation that must satisfy standards for acquiring, protecting, and developing compensation sites prior to aquatic resource impacts, thus lowering the risk of inadequate mitigation and reducing temporal loss of aquatic resources.[245] Mitigation banks also generally are established on large, consolidated compensation sites, which typically entail more thorough scientific evaluation and planning than PRM sites and can increase regulatory efficiency.[246] While they do not provide the temporal advantages of mitigation banks, ILF programs are given priority over PRM because they usually involve more rigorous scientific planning and are adept at targeting high-priority compensation sites.[247] In contrast to past regulatory guidance and practice,[248] PRM is relegated behind third-party compensation credit providers.[249] However, while the Rule clearly approves of third-party compensatory mitigation, Corps district engineers are given authority to modify the preference structure when defensible from an ecological perspective;[250] this has led to the perception among mitigation bankers that the mitigation hierarchy is "soft" and may lead to little change in current permitting practices.[251]

B. The Watershed Approach in the 2008 Rule

The 2008 Rule endorses a dramatic shift from traditional geographic limitations to compensatory mitigation through implementation of a "water-

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[243] The IRT is analogous to the MBRTs established under the 1995 Banking Guidance. *See* Corps Mitigation Rule, 33 C.F.R. § 332.2; EPA Mitigation Rule, 40 C.F.R § 230.92; 1995 Banking Guidance, 60 Fed. Reg. 58,605, 58,610 (Nov. 28, 1995); Hough & Sudol, *supra* note 239, at 4.

[244] Corps Mitigation Rule, 33 C.F.R. § 332.3(b); EPA Mitigation Rule, 40 C.F.R. § 230.93(b).

[245] Corps Mitigation Rule, 33 C.F.R. §§ 332.3(b)(2), 332.8(m); EPA Mitigation Rule, 40 C.F.R. §§ 230.93(b)(2), 230.98(m).

[246] Corps Mitigation Rule, 33 C.F.R. § 332.3(b)(2); EPA Mitigation Rule, 40 C.F.R. § 230.93(b)(2).

[247] Corps Mitigation Rule, 33 C.F.R. § 332.3(b)(3); EPA Mitigation Rule, 40 C.F.R. § 230.93(b)(3).

[248] *See, e.g.*, 1995 Banking Guidance, 60 Fed. Reg. at 58,607; NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 82–83.

[249] Corps Mitigation Rule, 33 C.F.R. § 332.3(b)(3), (6); EPA Mitigation Rule, 40 C.F.R. § 230.93(b)(3), (6).

[250] Corps Mitigation Rule, 33 C.F.R. § 332.3(b); EPA Mitigation Rule, 40 C.F.R. § 230.93(b).

[251] Todd BenDor et al., *A Survey of Mitigation Banker Perceptions and Experiences Under the 2008 Federal Mitigation Regulations*, NAT'L WETLANDS NEWSL., Mar.–Apr. 2010, at 11, 12.

shed approach" to selecting the location of offsets.[252] Largely guided by the conclusions of NRC 2001 and recognition of the spatial dependence of ecosystem functionality, the Rule directs district engineers to integrate watershed-scale resource considerations into section 404 permitting.[253] The overarching goal of the watershed approach is to strategically site compensation projects where they will most effectively preserve and improve aquatic resource functions in a watershed.[254]

NRC 2001 recommended integrating watershed-scale concerns into section 404 permitting through use of a watershed approach to the mitigation process and concluded that the existing "preference for on-site and in-kind mitigation should not be automatic, but should follow from an analytically based assessment of the wetland needs in the watershed and the potential for the compensatory wetland to persist over time."[255] A watershed approach expands the temporal and spatial scope of permitting decisions through recognition that reproducing the landscape pattern of historically damaged watersheds may not optimize restoration of watershed function,[256] encouraging regulators to permit off-site and/or out-of-kind compensatory mitigation when environmentally preferable.[257] NRC also stated that "[t]hird-party compensation approaches (mitigation banks, in-lieu fee programs) offer some advantages over permittee-responsible mitigation" due to the broader focus of these third-party mitigation providers on watershed-scale restoration priorities.[258]

The Rule adopts the NRC's recommendations, supplanting static regulatory preferences for on-site, in-kind mitigation with a holistic watershed approach to compensatory mitigation.[259] A watershed approach, as specified in the 2008 Rule, utilizes aquatic resource inventories and other appropriate data to identify "immediate and long-term aquatic resource needs within watersheds that can be met through permittee-responsible mitigation projects, mitigation banks, or in-lieu fee programs."[260] District engineers are instructed to evaluate the "landscape position and resource type of compensatory mitigation projects" while concurrently considering important species habitat needs, habitat loss, present development trends, and causes of water-

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[252] Corps Mitigation Rule, 33 C.F.R. § 332.3(c); EPA Mitigation Rule, 40 C.F.R. § 230.93(c).

[253] Corps Mitigation Rule, 33 C.F.R. § 332.3(c); EPA Mitigation Rule, 40 C.F.R. § 230.93(c); Hough & Sudol, *supra* note 239, at 4.

[254] Hough & Sudol, *supra* note 239, at 4.

[255] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 4.

[256] *Id.* at 10.

[257] Corps Mitigation Rule, 33 C.F.R. § 332.3(c); EPA Mitigation Rule, 40 C.F.R. § 230.93(c).

[258] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 9.

[259] Corps Mitigation Rule, 33 C.F.R. § 332.3(c); EPA Mitigation Rule, 40 C.F.R. § 230.93(c).

[260] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(iv); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(iv).

shed impairment.[261] The Rule emphasizes that compensation projects should not solely focus on restoring particular watershed functions, but should address the entire suite of functions lost through an aquatic resource impact.[262] Achieving this goal may result in use of off-site compensation, on-site compensation, or both on-site and off-site compensation.[263] For instance, the Rule suggests that habitat compensation may be best located in undisturbed, distant areas while adequate compensation for floodwater retention and water quality enhancement will likely need replacement closer to impacts.[264]

The watershed approach supports the new compensation hierarchy for third-party compensatory mitigation under the presumption that mitigation banks and ILF programs are, in general, more likely than PRM to address watershed-scale needs and select self-sustaining compensation sites.[265] The hierarchical preference further divides PRM into three categories, giving PRM under a watershed approach preference followed by traditional on-site, in-kind PRM, and lastly, off-site and/or out-of-kind PRM.[266]

The watershed approach and preference hierarchy represent uncharted territory for geographic constraints imposed on section 404 compensatory mitigation.[267] Though past guidance has promoted establishment of third-party mitigation credit providers, it had only allowed their use in certain environmentally advantageous situations while on-site, in-kind preferences generally drove the location of compensation projects.[268] In stark contrast, the 2008 Rule actively advocates use of third-party mitigation banks and ILF programs, which are inherently off-site in nature, and requires Corps regulators to consider the location of compensatory mitigation projects based on a comprehensive suite of factors contributing to watershed health.[269] The regulatory flexibility to accommodate broad ecological objectives invoked by a watershed approach is promising, but district engineers must consistently apply appropriate geographic limits to off-site compensatory mitigation.[270]

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[261] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(i); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(i).

[262] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(i); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(i).

[263] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(iii); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(iii).

[264] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(ii); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(ii).

[265] Corps Mitigation Rule, 33 C.F.R. § 332.3(b); EPA Mitigation Rule, 40 C.F.R. § 230.93(b); NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 9.

[266] Corps Mitigation Rule, 33 C.F.R. § 332.3(b)(4)-(6); EPA Mitigation Rule, 40 C.F.R. § 230.93(b)(4)-(6).

[267] Prior to the Rule, preferences for on-site mitigation, which is almost entirely PRM, minimized the use of broader, watershed-scale limits for compensation. The shift in compensatory mitigation decision-making from traditional, on-site geographic preferences to watershed-scale evaluation, and the new preference for third-party (off-site) compensation lend increased significance to geographic trading limits.

[268] 1990 Mitigation MOA, 55 Fed. Reg. 9210, 9212 (Mar. 12, 1990).

[269] Corps Mitigation Rule, 33 C.F.R. § 332.3(c); EPA Mitigation Rule, 40 C.F.R. § 230.93(c).

[270] *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.

C. Watershed Scale

Implementation of a holistic watershed approach to compensatory mitigation requires specifically defining a most fundamental term: "watershed."[271] The Rule defines a watershed as "a land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean."[272] As is immediately evident from the Rule's broad description, watersheds may exhibit tremendous range in spatial scale. The land area that drains to an isolated wetland will encompass at most a few square miles, while the land area that drains to the Mississippi River delta covers 1.15 million square miles, representing over a third of the contiguous United States.[273] Contemporary use of the term watershed, which coincides with that in the Rule, corresponds with a hydrologic drainage basin.[274] A drainage basin includes the source land area for falling water that accumulates, flows through a network of streams and rivers, and leaves the area at a single point.[275] Drainage basins may discharge into lakes, oceans, or larger rivers, and are divided by borders of high elevation that serve as barriers to water flow.[276] Drainage basins also contain nested sub-basins, which similarly represent a smaller surface area that flows to a single point located inside the surrounding drainage basin.[277] It is thus understood that aquatic characteristics at one point in a drainage basin are typically a product of inputs topographically upgradient in the watershed.[278] The topographical boundaries of drainage basins and sub-basins thus serve as logical units for managing and locating the hydrologic functions provided by compensatory wetlands and streams due to their chemical, physical, and biological interdependence.[279] However, while watersheds are generally appropriate spatial units for managing aquatic resources, many hydrologic functions of wetlands and streams operate at different drainage scales or locations (e.g., flood attenuation vs.

REV. 213, 223 (2009) ("It is essential to identify the watershed scale that best suits the mitigation process.").

[271] *Id.*

[272] Corps Mitigation Rule, 33 C.F.R. § 332.2; EPA Mitigation Rule, 40 C.F.R. § 230.92.

[273] NRC, COMPENSATING FOR WETLAND LOSSES, *supra* note 8, at 15; NAT'L RESEARCH COUNCIL, NEW STRATEGIES FOR AMERICA'S WATERSHEDS 37–38 (1999) [hereinafter NRC, NEW STRATEGIES].

[274] Drainage basins may also be referred to as drainage areas, but both terms are essentially the same; drainage areas are mapped boundaries of a drainage basin. NRC, NEW STRATEGIES, *supra* note 273, at 39; *see also*, Corps Mitigation Rule, 33 C.F.R. § 332.2; EPA Mitigation Rule, 40 C.F.R. § 230.92.

[275] NRC, NEW STRATEGIES, *supra* note 273, at 39.

[276] *Id.*

[277] *Id.*

[278] *Id.* at 40; James M. Omernik & Robert G. Bailey, *Distinguishing Between Watersheds and Ecoregions*, 33 J. AM. WATER RESOURCES ASS'N 935, 937 (1997).

[279] NRC, NEW STRATEGIES, *supra* note 273, at 40; ENVTL. LAW INST., *Compensatory Wetland Mitigation and the Watershed Approach: A Review of Selected Literature*, *in* NATIONAL SYMPOSIUM ON COMPENSATORY MITIGATION AND THE WATERSHED APPROACH 82 (2004), *available at* http://www.eli.org/pdf/wsSymposium/selectedliterature.pdf; Post et al., *supra* note 66, at 111, 117.

nutrient retention),[280] and many non-hydrologic aquatic resource functions (e.g., endangered terrestrial species habitat) operate at unique drainage scales or non-watershed scales.[281]

The distinct spatial scales implicated by various ecosystem functions of wetlands and streams create difficulties for synthesizing watershed approach considerations to a single geographic area.[282] The suite of factors affecting biogeochemical cycling, sediment retention, ecosystem biodiversity, shoreline protection, groundwater recharge, and flood-peak moderation almost inevitably will not align geographically.[283] Some ecosystem services provided by wetlands and streams, such as important species habitat and aesthetic or recreational values, are less site dependent and may operate on ecological or social scales instead of watersheds.[284] In contrast, compensation for hydrologic functions such as water quality improvement, groundwater recharge, and floodwater retention is properly sited using watersheds, though the exact watershed size and structure may vary between these factors.[285] NRC 2001 concluded that no single scale should be prescribed for the watershed approach and that the watershed scale utilized for a particular project should be selected based on the aquatic resource functions slated for replacement with compensatory mitigation.[286] The 2008 Mitigation Rule endorses the NRC conclusion by rejecting a uniform scale for the watershed approach and encouraging district engineers to designate watershed extent based on the scope of aquatic resource impacts.[287]

A functional definition of a watershed for the purposes of compensatory mitigation, whether chosen on a project-by-project basis or standardized across many aquatic resource permit decisions, must select the optimal spatial scale for geographically limiting data that informs a watershed ap-

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[280] NRC, New Strategies, *supra* note 273, at 42–43.

[281] NRC, New Strategies, *supra* note 273, at 41; Post et al., *supra* note 66, at 115–16.

[282] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(i) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(i) (2008); NRC, Compensating for Wetland Losses, *supra* note 8; NRC, New Strategies, *supra* note 273, at 37–38, 41–47; Karen A. Poiani et al., *Biodiversity Conservation at Multiple Scales: Functional Sites, Landscapes, and Networks*, 50 BioScience 133, 134–36 (2000).

[283] King & Herbert, *supra* note 56, at 12; Post et al., *supra* note 66, at 115–16; Eric M. Preston & Barbara L. Bedford, *Evaluating Cumulative Effects on Wetland Functions: A Conceptual Overview and Generic Framework*, 12 Envtl. Mgmt. 565, 571 (1988).

[284] *See, e.g.*, NRC, New Strategies, *supra* note 273, at 41; King & Herbert, *supra* note 56, at 12; Preston & Bedford, *supra* note 283, at 571; Timothy William Brass, Who is Affected by Wetland Mitigation Banking? A Social and Geographic Evaluation of Wetland Mitigation Banking in Benton, Lane, Linn and Polk Counties, Oregon 14–15 (June 2009) (unpublished M.C.R.P. thesis, University of Oregon), *available at* http://scholarsbank.uoregon.edu/jspui/bitstream/1794/9853/1/Brass_Timothy_William_mcrp2009sp.pdf.

[285] NRC, New Strategies, *supra* note 273, at 37–47; Barbara L. Bedford & Eric M. Preston, *Developing the Scientific Basis for Assessing Cumulative Effects of Wetland Loss and Degradation on Landscape Functions: Status, Perspectives, and Prospects*, 12 Envtl. Mgmt. 751, 756 (1988).

[286] NRC, Compensating for Wetland Losses, *supra* note 8, at 144.

[287] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(4); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(4).

proach.[288] Watershed scale may be delineated based on established national, regional, state, or local hydrological assessments or may be surveyed on a project-specific basis.[289] A watershed approach may also utilize biogeographic or geomorphic assessments such as ecoregions or physiographic provinces when appropriate to locate compensation for aquatic resource losses.[290] Moreover, to maintain ecosystem services that are more valuable near human population centers, a watershed approach may adopt city limits, county boundaries, or other social or political boundaries.[291] The various existing assessments used for geographic limitations on compensatory mitigation trading are described in detail in Part IV. Spatial definitions of watershed scale are particularly important for designating a suitable extent for geographic service areas for mitigation banks and ILF programs, which additionally invoke consideration of economic and social criteria relevant to the ecosystem services restored at compensation sites.

D. Geographic Service Areas

The hierarchical prioritization of mitigation banks and ILF programs makes geographic constraints on third-party credit sales, which are almost entirely addressed through geographic service areas, of principal significance to achieving the Rule's mandate for watershed-based compensatory mitigation. Similar to the flexible watershed scale designation, the Rule rejects establishing a nationwide service area preference and delegates service area decisions for mitigation banks and ILF programs to the IRT and ultimately to the Corps district engineer.[292] The 2008 Mitigation Rule states "service area[s] must be appropriately sized to ensure that the aquatic resources provided will effectively compensate for adverse environmental impacts across the entire service area."[293] Concerns regarding the "economic

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[288] *Id.*

[289] *See, e.g.*, Dean Djokic & Zichuan Ye, *DEM Preprocessing for Efficient Watershed Delineation*, *in* HYDROLOGIC AND HYDRAULIC MODELING SUPPORT WITH GEOGRAPHIC INFORMATION SYSTEMS 65 (David Maidment & Dean Djokic eds., 2000); USGS & NRCS, *Federal Guidelines, Requirements, and Procedures for the National Watershed Boundary Dataset*, *in* U.S. GEOLOGICAL SURVEY TECHNIQUES AND METHODS BOOK 11, COLLECTION AND DELINEATION OF SPATIAL DATA (2009), *available at* http://pubs.usgs.gov/tm/tm11a3/pdf/TM11-A3.pdf; Peter T. Wolter, Carol A. Johnston, & Gerald J. Niemi, *Land Use Land Cover Change in the U.S. Great Lakes Basin 1992 to 2001*, 32 J. GREAT LAKES RES. 607, 611 (2006); *River Basin Water Supply Planning*, DIV. OF WATER RES., N.C. DEP'T OF ENVTL. & NATURAL RES., http://www.ncwater.org/basins/ (last visited Jan. 18, 2012) (on file with the Harvard Law School Library); *Conservation Areas in the Upper Bolin Creek Watershed*, TOWN OF CARRBORO, http://www.ci.carrboro.nc.us/gis/downloads/printmap/Conservation.pdf (last visited Jan. 18, 2012) (on file with the Harvard Law School Library).

[290] *See, e.g.*, Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(6)(ii)(A); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(6)(ii)(A); James M. Omernik, *Ecoregions of the Coterminous United States*, 77 ANNALS ASS'N AM. GEOGRAPHERS 118 (1987).

[291] BenDor et al., *supra* note 159, at 276; King & Herbert, *supra* note 56, at 12.

[292] Corps Mitigation Rule, 33 C.F.R. §§ 332.3(c)(4), 332.8(b)(4), 332.8(d)(6)(ii)(A); EPA Mitigation Rule, 40 C.F.R. §§ 230.93(c)(4), 230.98(b)(4), 230.98(d)(6)(ii)(A).

[293] Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(6)(ii)(A); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(6)(ii)(A).

viability" of a bank or ILF program may also be reflected in service area size.[294] The Rule also stipulates that the delineation of geographic service areas must "consider any locally developed standards and criteria that may be applicable" and that the reasoning for the granted service area must be documented in the instrument.[295] General examples of two moderately sized watershed scales from the USGS's national, hierarchical watershed delineation system — the smaller HUC-8 in urban areas or the larger six-digit Hydrologic Unit Code ("HUC-6") in rural areas — are presented as potentially acceptable service areas in the Rule.[296] Additionally, the Rule excludes banking instruments and service areas approved before July 9, 2008 from compliance with new standards.[297]

The Rule targets ILF programs for marked improvements in compensatory mitigation and existing ILFs must update operations to comply with the Rule's new standards.[298] Service areas are central to the revitalized ILF program policy, which requires accounting for credit sales and corresponding impacts by service area.[299] ILF programs must create compensation planning frameworks that adopt a "watershed-based rationale"[300] for service area limits, analyze past losses and current status of aquatic resources within service areas, present methods to counteract threats to aquatic resources by service area, and generate objectives for each service area.[301] Geographic service area preferences and their consequences for compensatory mitigation are discussed in further detail in Part IV.

E. Interagency Review Team

The IRT is the decision-making body that assigns geographic service areas to third-party mitigation providers.[302] Compensatory mitigation requirements involved in setting geographic service areas may intertwine a number of federal, state, and local authorities that vary in complexity across the United States.[303] The 2008 Mitigation Rule promotes collaborative, interagency solutions to these disparate legal requirements through the IRT

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[294] *Id.*
[295] *Id.*
[296] *Id.* HUCs and the HUC system are discussed in detail *infra* Part IV.
[297] Corps Mitigation Rule, 33 C.F.R. § 332.8(v)(1); EPA Mitigation Rule, 40 C.F.R. § 230.98(v)(1).
[298] Corps Mitigation Rule, 33 C.F.R. § 332.8(v)(2); EPA Mitigation Rule, 40 C.F.R. § 230.98(v)(2); Hough & Sudol, *supra* note 239, at 3.
[299] Corps Mitigation Rule, 33 C.F.R. § 332.8(i); EPA Mitigation Rule, 40 C.F.R. § 230.98(i).
[300] Corps Mitigation Rule, 33 C.F.R. § 332.8(c)(2)(i); EPA Mitigation Rule, 40 C.F.R. § 230.98(c)(2)(i).
[301] Corps Mitigation Rule, 33 C.F.R. § 332.8(c)(2); EPA Mitigation Rule, 40 C.F.R. § 230.98(c)(2).
[302] Corps Mitigation Rule, 33 C.F.R. § 332.8(b), (d)(7), (d)(8); EPA Mitigation Rule, 40 C.F.R. § 230.98(b), (d)(7), (d)(8).
[303] *See* BenDor & Brozovic, *supra* note 231, at 349–50; Appendix I.

process.[304] The multi-agency IRT must evaluate ILF program and mitigation bank instruments before they can sell compensation credits to offset authorized aquatic resource damages.[305] IRTs also maintain authority to review deviations from an approved instrument, such as credit sales outside of a geographic service area.[306] Under the Rule, the Corps district engineer controls the composition of the IRT, but is instructed to include involved federal agencies such as EPA, the FWS, NMFS, and the NRCS, and also relevant tribal, state, and local agency representatives.[307] Public participation in IRT proceedings is also possible through mandatory public comment periods for proposed instrument modifications or submitted third-party prospectuses, which are preliminary versions of an instrument.[308] Corps district engineers or their designees (e.g., personnel from regulatory staff in a Corps district office) are appointed as chair of the IRT and in circumstances where a mitigation bank or ILF program is proposed to satisfy conditions of an additional regulatory program, a representative from the appropriate federal, tribal, state, or local agency may serve as IRT co-chair.[309] For the purposes of section 404 compensation, the Rule grants Corps district engineers final authority for approval of instruments and any deviations from instruments; however, the Rule also incorporates an official dispute resolution process for IRT agencies unsatisfied with the district engineer's final decision regarding an instrument.[310]

The IRT formalizes a growing trend in aquatic resources management into the compensatory mitigation permit program: the use of multilevel, interagency interaction with programmatic public participation as a decision-making process on a watershed scale.[311] These contemporary watershed politics have been labeled "modular environmental regulation,"[312] "collaborative ecosystem governance,"[313] a "watershed approach,"[314] and "pragmatic

[304] Corps Mitigation Rule, 33 C.F.R. § 332.8(b); EPA Mitigation Rule, 40 C.F.R. § 230.98(b); Hough & Sudol, *supra* note 239, at 4.

[305] Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(7), (d)(8), (m); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(7), (d)(8), (m).

[306] Corps Mitigation Rule, 33. C.F.R. § 332.8(g); EPA Mitigation Rule, 40 C.F.R. § 230.98(g).

[307] Corps Mitigation Rule, 33 C.F.R. § 332.8(b)(2); EPA Mitigation Rule, 40 C.F.R. § 230.98(b)(2).

[308] Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(4); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(4).

[309] Corps Mitigation Rule, 33 C.F.R. § 332.8(b)(1); EPA Mitigation Rule, 40 C.F.R. § 230.98(b)(1).

[310] Corps Mitigation Rule, 33 C.F.R. § 332.8(b)(4), (e); EPA Mitigation Rule, 40 C.F.R. § 230.98(b)(4), (e).

[311] Jon Cannon, *Choices and Institutions in Watershed Management*, 25 WM. & MARY ENVTL. L. & POL'Y REV. 379, 379 (2000); Jody Freeman & Daniel A. Farber, *Modular Environmental Regulation*, 54 DUKE L. J. 795, 826, 876–77 (2005); Andrea K. Gerlak, *Federalism and U.S. Water Policy: Lessons for the Twenty-First Century*, 36 PUBLIUS: J. FEDERALISM 231, 242–46 (2005); Hough & Sudol, *supra* note 239, at 4, 21; Bradley C. Karkkainen, *Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism*, 21 VA. ENVTL. L. J. 189, 217–19 (2003).

[312] Freeman & Farber, *supra* note 311, at 795.

[313] Karkkainen, *supra* note 311, at 190.

federalism,"[315] and while the terms exhibit nuanced theoretical differences, in the water resources management context, they all essentially boil down to the same central insight: geographic watershed boundaries do not correspond with political jurisdictions, and government agencies at the federal, state, and local level have different mandates, different expertise, and different budgets, creating a mesh of disparate interests and regulatory obligations.[316] Successful watershed-scale management can merge otherwise segregated objectives into innovative institutional structures which capitalize on agency differences to efficiently achieve goals and avoid overly centralized or decentralized governance.[317] Public stakeholders and non-profit groups are also commonly identified as shaping goals, providing valuable information, and extending resources for these "place-based"[318] regimes.[319] Institutional and regulatory flexibility to tailor agency action to specific cases, as well as increased accountability for government actors, is touted as a distinct advantage of watershed approach politics.[320] Most of these multilevel, inclusive governance practices are articulated to some extent in the section 404 permit program, the 2008 Mitigation Rule, and the IRT process.[321]

The interagency dynamics of the IRT may also urge the main decision-making agency for service areas — the Corps — to more fully evaluate environmental issues that are often secondary to the agency's primary objective of running an efficient permitting program.[322] Agencies such as the Corps that Congress tasks with multiple regulatory objectives almost inevitably face tradeoffs between their different goals.[323] When a decision-making agency underperforms on a secondary goal, the agency's achievement of this goal can be improved by empowering separate "monitoring" agencies[324] — particularly those with expertise in this secondary goal — with the ability to provide input on permitting decisions or even legally restrain or penalize the decision-making agency.[325] Biber frames these interagency solutions to agency underperformance as a spectrum ranging from "agency as lobby-

[314] Cannon, *supra* note 311, at 379.
[315] Gerlak, *supra* note 311, at 242.
[316] Cannon, *supra* note 311, at 387–89; Freeman & Farber, *supra* note 311, at 839–40, 891, 900; Gerlak, *supra* note 311, at 246–47; Karkkainen, *supra* note 311, at 212–17.
[317] Cannon, *supra* note 311, at 419–425; Freeman & Farber, *supra* note 311, at 877–96; Gerlak, *supra* note 311, at 242–47; Karkkainen, *supra* note 311, at 217–25.
[318] Cannon, *supra* note 311, at 379.
[319] *Id.* at 421–23; Freeman & Farber, *supra* note 311, at 894–96; Karkkainen, *supra* note 311, at 218–19.
[320] Freeman & Farber, *supra* note 311, at 799, 879–80.
[321] Corps Mitigation Rule, 33 C.F.R. § 332.8(b) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.98(b) (2008); Hough & Sudol, *supra* note 239, at 4.
[322] *See* Eric Biber, *Too Many Things to Do: How to Deal with the Dysfunctions of Multiple-Goal Agencies*, 33 HARV. ENVTL. L. REV. 1, 41–60 (2009); *see also* Murphy et al., *supra* note 150, at 312 ("[R]ather than focusing on aquatic resource protection, the [Corps] . . . has historically concerned itself with issuing permits. The Corps' history of administering the section 404 program has been laced with poor enforcement, poor monitoring, and poor performance.").
[323] Biber, *supra* note 322, at 2–4.
[324] *Id.* at 5.
[325] *See id.* at 41–60.

ist"[326] to "agency as regulator."[327] "Lobbyist" agencies have the ability to comment on the decision-making agency's effectiveness while "regulator" agencies have legal authority to block the decision-making agency's actions.[328]

All agencies on the IRT can submit comments on draft instruments, which include definition of a mitigation provider's service area,[329] granting them the capacity of "lobbyist" agencies. Alternatively, "regulator" agencies that have the authority to deny section 404 permits can stipulate conditions for the compensatory mitigation attached to permits they approve, such as geographic restrictions on trading.[330] EPA fills an "agency as regulator" role on the IRT based on its section 404(c) veto power over Corps decisions on dredge-and-fill permits.[331] However, in practice, EPA has primarily remained a "lobbyist" agency, as it has only vetoed thirteen section 404 permits since the Clean Water Act was passed in 1972.[332] The "agency as regulator" role extends beyond horizontal interaction among agencies at the federal level. State or tribal resource agencies can stop aquatic resource impacts sanctioned by a Corps section 404 permit by denying the requisite section 401 certification. Moreover, federal and state regulators are under pressure to avoid requiring different compensatory mitigation for the same impact under different regulatory programs. This may give state or tribal agencies that administer section 401 certification or state, tribal, or local agencies that administer their own aquatic resource permitting programs an intermediary position on the "lobbyist" to "regulator" spectrum. For instance, tribal, state, or local agencies could sway the Corps' decisions on service areas by setting their own requirements for the spatial scale used to limit geographic trading in aquatic resources.[333] Since the Corps aims to

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[326] The concept of "agency as lobbyist" was first presented in a statistical analysis of state and federal wildlife agency comments on Federal Energy Regulatory Commission dam licensing. *See* J.R. DeShazo & Jody Freeman, *Public Agencies as Lobbyists*, 105 COLUM. L. REV. 2217 (2005).

[327] Biber, *supra* note 322, at 6, 59–60.

[328] *Id.* at 5–6.

[329] Corps Mitigation Rule, 33 C.F.R. § 332.8(b)(3) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.98(b)(3) (2008). Geographic service areas are part of a draft instrument. Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(6)(ii)(A); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(6)(ii)(A).

[330] For instance, state agencies with section 401 certification programs can stipulate conditions on section 404 permits. *See* Clean Water Act § 404, 33 U.S.C. § 1344 (2006). One example of a state using this authority to institute geographic restrictions on the location of compensatory mitigation is Missouri. *See* WATER POLLUTION CONTROL PROGRAM, MO. DEP'T OF NATURAL RES., STATE OF MISSOURI AQUATIC RESOURCES MITIGATION GUIDELINES (1998), *available at* http://www.dnr.mo.gov/env/wpp/401/mitigation_guidelines.pdf; Appendix II, note 52.

[331] In Biber's framework, EPA would be classified as a "direct regulator" agency. *See* Biber, *supra* note 322, at 46–52.

[332] *Chronology of 404(c) Actions*, EPA, http://water.epa.gov/lawsregs/guidance/wetlands/404c.cfm (last visited Jan. 18, 2012) (on file with the Harvard Law School Library).

[333] For example, Minnesota's Wetland Conservation Act Rules stipulate very explicit geographic limits for compensatory mitigation and service areas; these geographic limits and service areas generally shape the service area size used by the Corps for mitigation banks in

avoid duplicate compensation, their requirements for service areas may converge to this spatial scale. The desire to avoid duplicating compensatory mitigation obligations for permittees may also work in reverse — if the Corps sets a certain service area size, other resource agencies may adopt this spatial scale to avoid conflict.

As the IRT assigns geographic service areas for mitigation banks and ILF programs, the evolution of this consensus-based process and the relative influences of the involved agencies have strong implications for determining spatial restrictions for aquatic resource trading. Our interviews with compensatory mitigation regulators and practitioners indicate that the flexibility of the IRT to regional environmental and regulatory conditions, combined with devolved decision-making to Corps district engineers, is a principal cause of the considerable nationwide variety in regulatory preferences for geographic service area sizes and PRM siting.[334]

IV. Geographic Service Areas in Practice

A. *Geographic Units*

Although aquatic resource compensation sites created by mitigation banks and ILF programs generally replace a suite of ecosystem functions that individually provide benefits at different spatial scales, regulatory practice currently dictates that one spatial extent should define a geographic service area.[335] Corps districts or states often specify certain levels of hydrologic or ecological geographic systems defined nationally or regionally, or combinations of these geographic units, as preferred sizes for mitigation bank and ILF service areas.[336] States and Corps districts also may independently discern regional or local watershed or ecoregion boundaries for service area definitions.[337] Finally, other purely political boundaries may affect sales of compensatory mitigation credits. When counties, cities, or states restrict use of mitigation credits within county or city limits, a mitigation bank or ILF program's geographic market may be restrained by these political entities.[338]

The most common system used to restrict service areas is the nationwide USGS HUC classification scheme, which differentiates aquatic drainage patterns at varying geographic extents.[339] The HUC classification

Minnesota. *See* Minn. R. 8420.0117, 8420.0522(4), 8420.0522(7), 8420.0544 (2011); Appendix II, notes 35, 51.

[334] Appendix II.

[335] Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(6)(ii)(A) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(6)(ii)(A) (2008); *see* Appendix II.

[336] *See* Appendix I.

[337] *See, e.g.*, Mich. Admin. Code r. 281.951(c), (k), (m) (2011); Mich. Admin. Code r. 281.956(3), (4) (2011).

[338] *See, e.g.*, Minn. R. 8420.0522 subpart 7 (2011); BenDor & Brozovic, *supra* note 231, at 352–53; Robertson, *supra* note 44, at 302.

[339] USGS & NRCS, *supra* note 289; *see also* Appendix I.

system divides the nation into drainage areas of decreasing extent, assigning progressively more digits to increasingly specific, and spatially narrow, hydrologic areas.[340] The broadest extent, labeled a two-digit HUC ("HUC-2"), partitions the United States into twenty-one major water resource *regions*, which consist of the drainage basins of major rivers, as with the Missouri region, or joint drainage basins of connected rivers, as with the South Atlantic-Gulf region.[341] The first subdivision, the four-digit HUC ("HUC-4", may be "HUC-3" in regions with a first digit of zero), further segregates the major regions into 221 *subregions*. Subregions generally delineate regions drained by a single river system, a segment of a larger river and the tributaries to that segment, closed drainage basins, or streams that compose a coastal drainage area.[342] The third HUC classification, HUC-6, further divides the United States into 378 *accounting units*; accounting units are typically more detailed than subregions, but in some cases are the same size as a subregion.[343] The fourth HUC classification, HUC-8, provides substantially more detail, delineating 2264 *cataloging units* nested inside of accounting units. Cataloging units depict portions of drainage basins, entire drainage basins, merged drainage basins, or unique hydrologic attributes.[344] The NRCS and the USGS, sometimes with the assistance of state water agencies, have further subdivided cataloging units across the nation into HUC-10s, HUC-11s, HUC-12s, and HUC-14s for increased specificity in water resources management.[345] Generally, HUC-2 or HUC-4 classifications are not used exclusively to define geographic service areas due to their expansive spatial extent; however, the remaining levels of HUC classification are commonly utilized for service areas.[346]

Biotic ecosystem functions provided by third-party compensatory mitigation may be best transferred in service areas that consider ecological characteristics in addition to hydrologic flow patterns.[347] The most common biogeographical system used in service area definitions is the Omernik Ecoregion classification scheme developed by EPA.[348] Similar to the USGS

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[340] *Hydrologic Unit Maps*, USGS, http://water.usgs.gov/GIS/huc.html (last visited Jan. 18, 2012) (on file with the Harvard Law School Library).

[341] *Id.*

[342] *Id.*

[343] *Id.*

[344] *Id.*

[345] At a national level, the USGS and the NRCS are seeking to define fifth-level HUCs with 10 digits ("HUC-10s") and sixth-level HUCs with 12 digits ("HUC-12s"). *See* USGS & NRCS, *supra* note 289, at 10. However, some states still use 11 digits ("HUC-11s") for the fifth level of HUCs and 14 digits for the sixth level of HUCs. *See, e.g.*, *Hydrologic Unit Codes (HUCs) in New Jersey*, N.J. DEP'T OF ENVTL. PROT., http://www.state.nj.us/dep/watershedmgt/hucmap.htm (last visited Jan. 18, 2012) (on file with the Harvard Law School Library).

[346] *See* Appendix I.

[347] For a discussion of the advantages of using ecoregions to delineate watershed scale for a watershed approach to compensatory mitigation, see ENVTL. LAW INST., *supra* note 279, at 82.

[348] James M. Omernik, *Ecoregions of the Conterminous United States*, 77 ANNALS ASS'N AM. GEOGRAPHERS 118 (1987); *Ecoregion Maps and GIS Resources,* EPA, http://www.epa.

HUCs, Ecoregions are hierarchically divided into increasingly detailed classifications based on a combination of biotic and abiotic factors indicative of ecological conformity, including hydrology, land use, soils, climate, vegetation, physiography, geology, and wildlife.[349] Level I Ecoregions result in the broadest divisions, creating 15 ecologically discernable areas in North America, Level II Ecoregions further refine the classification to 50 divisions across the continent, and Level III Ecoregions apportion 182 ecologically similar areas.[350] Level IV Ecoregions, which are only currently evaluated in the continental United States, further segregate the nation into approximately 940 categories, though Level IV assessments in California and New Jersey are in draft stages and Arizona's Level IV study is in progress.[351]

Though largely unused in contemporary service areas, Bailey's Ecoregions developed by the USFS are cited as appropriate for mitigation banks in the 1995 Mitigation Banking Guidance and the 1983 Interim Guidance on Mitigation Banking from the FWS.[352] Bailey's Ecoregions utilize national vegetative and climatic features to divide the United States, from largest to smallest, into domains, divisions, provinces, and sections.[353] Finally, alternative ecoregion assessments, typically regional in scope, are adopted in applicable Corps districts and states.[354] For example, ecoregions defined by Dennis Albert of the USFS ("Albert Ecoregions") in Michigan, Minnesota, and Wisconsin assess regional abiotic factors to further refine Ecoregion sections, subsections, and sub-subsections.[355]

Given that compensatory mitigation replaces both ecological and hydrologic ecosystem functions, regulators must assess which functional basis is most conducive to integrating a watershed approach into geographic service areas. Many holistic aquatic resource studies and management approaches currently adopt watersheds or drainage basins, such as those portrayed in the HUC classification or in similar state-level assessments, as their fundamental units.[356] Watersheds and basins are championed because of their ability to indicate processes occurring hydrologically upgradient, to synthesize nested sub-basins to assess regional trends, and to provide the

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gov/wed/pages/ecoregions.htm (last visited Jan. 18, 2012) (on file with the Harvard Law School Library); *see also* Appendix I.

349 EPA, *supra* note 348; *Level III and IV Ecoregions of the Conterminous United States*, EPA, http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm (last visited Jan. 18, 2012) (on file with the Harvard Law School Library).

350 EPA, *supra* note 348.

351 EPA, *supra* note 349.

352 1995 Banking Guidance, 60 Fed. Reg. 58,605, 58,611 (Nov. 28, 1995); Robert G. Bailey, *Delineation of Ecosystem Regions*, 7 ENVTL. MGMT. 365, 365 (1983); FWS, *supra* note 168.

353 Bailey, *supra* note 352, at 367.

354 *See, e.g.*, MICH. ADMIN. CODE r. 281.951(c), (k), (m) (2011); MICH. ADMIN. CODE r. 281.956(3), (4) (1997).

355 DENNIS A. ALBERT, USFS, REGIONAL LANDSCAPE ECOSYSTEMS OF MICHIGAN, MINNESOTA, AND WISCONSIN: A WORKING MAP AND CLASSIFICATION (1995), *available at* http://nrs.fs.fed.us/pubs/gtr/gtr_nc178.pdf.

356 ENVTL. LAW INST., *supra* note 279, at 82.

context of drainage patterns for evaluating individual project sites.[357] Indeed, as hydrologic patterns drive wetland and stream formation, topographically correct watersheds are particularly insightful for a watershed approach. In response, proponents of using ecoregions claim that holistic environmental management should address all characteristics of ecosystems and that most ecological patterns are loosely or not strictly related to hydrologic drainage.[358] Ecoregion advocates also note that natural geological conditions preclude or hinder watershed delineation in approximately a third of the continental United States and that only about forty-five percent of HUCs actually constitute true topographical watersheds.[359] Ecoregions may be a more suitable spatial framework for a multi-purpose, comprehensive ecosystem approach because they are derived from multiple indicators present in the landscape rather than just topography.[360] Finally, other research suggests combining watershed and ecoregion units to evaluate the multiple functions provided by wetlands and streams.[361] For instance, hydrologic functions such as water quality and floodwater retention would be assessed with watersheds while habitat trends would be assessed with ecoregions.[362] Geographic service areas for mitigation bank and ILF credit sales should reflect an adequate understanding of the applicability of watershed and ecoregion units to third-party aquatic resource compensation.

In addition to functional bases for service area size, a desire to maintain equivalent social values of ecosystem services in trades may promote utilization of political or social boundaries in the service area definition process. Use of city or county boundaries may retain some wetland and stream functions near population centers or areas of higher population density, conserving the value of these services and preventing their translocation to wholly different communities.

B. *Tradeoffs in Geographic Service Area Size*

The generic tradeoffs identified for setting spatial restrictions on trading areas in environmental markets are especially applicable to geographic service areas in compensatory mitigation banking. In particular, the themes of market viability, hot spot risk, spatial and temporal discounting, and the resultant ecological integrity of wetland and stream compensatory mitigation resound in service area decision-making. Additionally, the fundamental

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[357] NRC, NEW STRATEGIES, *supra* note 273, at 40; ENVTL. LAW INST., *supra* note 279, at 82; Omernik & Bailey, *supra* note 278, at 940.

[358] ENVTL. LAW INST., *supra* note 279, at 82; Omernik & Bailey, *supra* note 278, at 941.

[359] Omernik & Bailey, *supra* note 278, at 937; James M. Omernik, *The Misuse of Hydrologic Unit Maps for Extrapolation, Reporting, and Ecosystem Management*, 39 J. AM. WATER RESOURCES ASS'N 563, 564 (2003).

[360] Omernik & Bailey, *supra* note 278, at 941.

[361] *See, e.g.*, Bedford, *supra* note 79, at 63–64; ENVTL. LAW INST., *supra* note 279, at 82; Omernik & Bailey, *supra* note 278, at 943–45.

[362] ENVTL. LAW INST., *supra* note 279, at 82.

characteristics of mitigation markets introduce unique versions of these tradeoffs that should inform service area size.

1. *Thick vs. Thin Markets*

Service area size has strong implications for the supply-and-demand economics of aquatic resource mitigation markets.[363] Market entry for mitigation credit providers is driven by credit demand, which is largely contingent upon both geographic service area size and underlying trends in development.[364] While service areas delineate the geographic extent authorized for credit sales, service areas are not the sole determinant of market activity; the number of participating actors in a mitigation market is necessarily dependent upon the actual demand for section 404 compensation within the service area.[365] For example, a mitigation bank with a geographically narrow service area in Los Angeles could conceivably generate more demand than a mitigation bank with an expansive service area in North Dakota, explaining why most mitigation banks are currently positioned to sell credits to developing population centers.[366] However, regardless of the underlying distribution of development and population, delineating a larger service area will inevitably expand the range where mitigation banks and ILFs can sell credits, and consequently will bolster demand for compensation credits. Conversely, small service areas will decrease demand for compensatory mitigation credits.[367]

Since larger service areas augment demand for mitigation credits, they may also increase supply-side investment in ecological restoration.[368] As in any business venture, entrepreneurs will only invest in marketing a product if there is a reasonable expectation of demand.[369] Accordingly, entrepreneurial restoration companies will likely only pursue mitigation bank sites with sufficient projected credit demand.[370] Since large service areas inherently increase demand for banked mitigation credits, Corps districts, states, or IRTs that grant large geographic service areas may attract increased banker investment and bankers may be reluctant to locate mitigation banks in regions with small service areas.[371]

Furthermore, and quite obviously, larger service areas encompass more land area, increasing the likelihood that multiple mitigation banks or ILFs will compete in the same mitigation market. In contrast, smaller service

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[363] Shabman & Scodari, *supra* note 13, at 13–16, 21–22.

[364] Michael S. Rolband et al., *Wetland Mitigation Banking*, *in* APPLIED WETLANDS SCIENCE AND TECHNOLOGY 181, 193–94 (Donald M. Kent ed., 2d ed. 2000); Schenck, *supra* note 29, at 138–39.

[365] Doyle & Yates, *supra* note 48, at 821–22; Rolband et al., *supra* note 364, at 193–94.

[366] Shabman & Scodari, *supra* note 13, at 16.

[367] *Id.* at 13.

[368] BenDor et al., *supra* note 13, at 2089–90; Doyle & Yates, *supra* note 48, at 821–22.

[369] Shabman & Scodari, *supra* note 13, at 12.

[370] *Id.*

[371] BenDor et al., *supra* note 13, at 2089–90; Shabman & Scodari, *supra* note 13, at 12, 22.

areas limit the spatial extent of markets for compensatory mitigation, resulting in a lower number of existing or potential credit suppliers.[372]

The economic advantages of thick markets over thin markets are well documented. Thick markets, with relatively high demand and supply, increase competition, more efficiently allocate commodities among consumers, reduce strategic behavior among market participants, reduce price risk, and provide incentives to spur innovation.[373] In thick markets, prices are more predictable and less volatile, allowing third-party mitigation providers and developers to more accurately anticipate compliance costs and credit revenues.[374] Increased competition promotes identification of lower-cost compensatory mitigation methods,[375] which benefits permittees but may induce positive or negative ecological consequences.[376] Since ecosystem services are not the actual currency being traded in current compensatory mitigation markets, competition may simply encourage mitigation providers to shirk ecological responsibility to save costs in lax regulatory schemes.[377] However, if the ecological performance standards mandated in the 2008 Mitigation Rule[378] are upheld and these measures of ecological quality are integrated into mitigation credits, competition should promote innovation in wetland and stream restoration methodology and technology as mitigation providers will seek more efficient compensation practices.[379] In addition, when mitigation credits are tied to their environmental quality, larger and more competitive service areas can promote better functioning compensatory aquatic resources.[380] Contrarily, assuming constant ecological performance standards among mitigation credit providers, reduced competition in small service areas may provide less impetus for development of new, innovative aquatic resource restoration methods and result in lower quality compensatory mitigation.[381]

In thin compensatory mitigation markets, excessively narrow geographic service area definitions limit the number of mitigation credit providers and section 404 permittees. In some small service areas, thin markets may cause oligopolistic or oligopsonistic conditions, and taken to their logical extreme, monopoly or monopsony.[382] Theoretically, in small service ar-

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[372] Doyle & Yates, *supra* note 48, at 821–22; Rolband et al., *supra* note 364, at 193–94.

[373] *See supra* notes 29 and 31 and accompanying text.

[374] JOHN R. MIRON, THE GEOGRAPHY OF COMPETITION: FIRMS, PRICES, AND LOCALIZATION 237 (2010).

[375] *See* TIETENBERG, *supra* note 28, at 61–62; Adam Riggsbee & Martin Doyle, *Environmental Markets: The Power of Regulation*, 326 SCIENCE 1061, 1061 (2009).

[376] *See* Margaret A. Palmer & Solange Filoso, *Restoration of Ecosystem Services for Environmental Markets*, 325 SCIENCE 575, 575 (2009).

[377] Salzman & Ruhl, *supra* note 14, at 665–68.

[378] Corps Mitigation Rule, 33 C.F.R. § 332.5 (2008); EPA Mitigation Rule, 40 C.F.R. § 230.95 (2008).

[379] *See supra* note 29 and accompanying text.

[380] Rolband et al., *supra* note 364, at 193–94.

[381] *Id.*; *see also supra* note 29 and accompanying text.

[382] Jean-Jacques Laffont & Jean Tirole, *Environmental Policy, Compliance, and Innovation*, 38 EUR. ECON. REV. 555, 557 (1994); Malueg & Yates, *supra* note 31, at 553–65.

eas dominated by one large-scale developer, a single credit purchaser or collusive credit purchasers could dictate below-market prices to mitigation bankers or ILF programs, resulting in monopsony or oligopsony. However, as credit demand is more likely to come from multiple developers and mitigation banking is still an adolescent industry with relatively few vendors, monopoly and oligopoly are predominant concerns in service area size and could cause unnecessarily high compliance costs for section 404 permittees.[383] Indeed, many of the service areas with banks only contain one mitigation bank.[384]

Strategic behavior among non-market actors in spatially restrained markets may also unnecessarily raise compliance costs for permittees. Small service areas limit the number of locations suitable for mitigation bank or ILF compensation, and when the landowners of these properties realize the distinct qualities of their parcels, they may raise the purchase price of the potential compensation site.[385] These costs are absorbed by third-party mitigation providers and passed on to permittees in the form of higher credit prices.[386]

2. *Hot Spots in Compensatory Mitigation: Urban-to-Rural Migration of Wetlands and Streams*

Movement of aquatic resources across the landscape is a natural by-product of the section 404 compensation process: when developers impact wetlands or streams in one location and replace them elsewhere, these ecosystem functions "migrate" to new locations.[387] Research in varied locations suggests that off-site compensatory mitigation through mitigation banks and ILF programs causes migration of wetlands and streams from higher population density, urban or suburban areas to low population density, rural areas.[388] This robust pattern is clear in studies of compensatory wetland mitigation in Florida,[389] Illinois,[390] North Carolina,[391] and Oregon;[392] similar patterns for geographic reallocation of stream compensation are also observed in North Carolina.[393] ILF programs and mitigation banks in North

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[383] Shabman & Scodari, *supra* note 13, at 22.

[384] *Id.* In addition, much of the nation is not covered by a mitigation bank's service area. This is a principal reason why regulators decided to retain ILFs as a mitigation provider in the 2008 Mitigation Rule. *See* Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. 19,594, 19,599–600 (Apr. 10, 2008).

[385] Shabman & Scodari, *supra* note 13, at 22.

[386] *Id.*

[387] King & Herbert, *supra* note 56, at 11.

[388] BenDor et al., *supra* note 159, at 272; BenDor et al., *supra* note 13, at 2088; Brass, *supra* note 284; King & Herbert, *supra* note 56, at 11; J.B. Ruhl & James Salzman, *The Effects of Wetland Mitigation Banking on People*, NAT'L WETLANDS NEWSL., Mar.–Apr. 2007, at 1, 10–11.

[389] King & Herbert, *supra* note 56, at 11; Ruhl & Salzman, *supra* note 388, at 10–11.

[390] BenDor et al., *supra* note 159, at 272.

[391] BenDor et al., *supra* note 13, at 2088.

[392] Brass, *supra* note 284.

[393] BenDor et al., *supra* note 13, at 2088.

Carolina have also been documented as transferring aquatic resource functions to locations further upstream in a watershed than original impact sites.[394] The processes causing this systematic spatial redistribution of wetlands and streams are quite intuitive; urban land and associated wetlands are high-value locations for development and mitigation bankers or ILF programs can acquire rural compensation sites at lower land prices.[395] In addition, stream restoration is less expensive and more straightforward at smaller sites, which are present higher in a watershed.[396] Acquisition of lower-value, rural land reduces production costs per compensation credit for third-party mitigation sponsors, giving banks or ILF sites in rural areas a comparative advantage over credit vendors in expensive, high-density areas.

The effect of trading aquatic resources from urban to rural locations on the overall value of their ecosystem services is debatable. Wetland and stream migration to rural areas is not necessarily detrimental to the biophysical function of these aquatic resources; for instance, highly urbanized areas often contain fragmented, poor-quality wetlands while compensatory wetlands from banks and ILF programs may provide large, consolidated, and superior habitats.[397] Some ecosystem services that are not as site-specific, such as recreational space for hunting or habitat provision, may also be improved on the fringe of development where they have less urban-suburban interference but are still accessible.[398] However, the translocation of wetland and stream functions to less populated areas may lead to a loss of site-dependent ecosystem services — for instance, when flood moderation, nutrient retention, and sediment retention functions are transferred to areas where they benefit fewer people.[399] The loss of value for site-dependent ecosystem services may be exacerbated by the increased scarcity of some ecosystem services in areas of higher population density.[400] The net change in value of ecosystem services due to urban-to-rural aquatic resource transactions is therefore highly contextual and determined by a complex mix of the effects of landscape setting on functions, the spatial scale of these functions, the population receiving ecosystem services, and the scarcity of these services.

However, degradation hot spots are a distributional concern and not a utilitarian concern: overall gains from trade may exist, but certain populations within a service area, particularly those in urban areas that are losing

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[394] *Id.*

[395] Salzman & Ruhl, *supra* note 14, at 666.

[396] BenDor et al., *supra* note 13, at 2088.

[397] Boyer & Polasky, *supra* note 96, at 745; *see also* Corps Mitigation Rule, 33 C.F.R. § 332.3(b)(2), (3) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(b)(2), (3) (2008); BenDor et al., *supra* note 13, at 2089–90.

[398] *See* Mitsch & Gosselink, *supra* note 54, at 28–29.

[399] *See* Ruhl & Salzman, *supra* note 388, at 11; *see also* BenDor et al., *supra* note 159, at 276; King & Herbert, *supra* note 56, at 12; Mitsch & Gosselink, *supra* note 54, at 28–30.

[400] *See* Boyd & Wainger, *supra* note 57, at 32; Sutton & Costanza, *supra* note 119, at 522. This reveals tradeoffs among a wetland or stream's constituent ecosystem services — the values of some aquatic resource services may rise in a rural setting, while more site-dependent services may lose value when relocated away from urban areas. For more discussion of these tradeoffs see *infra* Parts IV.B.3 and V.

some ecosystem functions and services to rural areas, may be disproportionately adversely affected by the trading process.[401] Of course, a relatively straightforward policy solution exists to halt localized urban losses of aquatic resource functions and/or services. Designating smaller service areas, potentially bounded by city, county, or other population-based boundaries, will geographically constrain compensation where it will not abdicate the ecosystem services available for urbanites, or at least will maintain aquatic resources near population centers.[402] Smaller service areas can also minimize socioeconomic concerns over inequitable redistribution of wetlands and streams.[403]

3. *Spatiotemporal Tradeoffs*

The spatial extent of a geographic service area also determines implicit effects on the temporal quality of compensatory mitigation.[404] Although small service areas compel high spatial quality for aquatic resource replacement, if they are prohibitively small to promote banker investment, the only remaining compensation options, ILF programs or PRM, almost always begin compensatory mitigation after impacts have already occurred.[405] In contrast, mitigation banks must at least acquire a bank site, create a site restoration plan, and institute effective financial mechanisms for long-term site protection, as judged by the IRT and Corps district engineer, prior to selling credits.[406] In some stages, mitigation banks have already satisfied ecological performance standards for compensatory mitigation prior to selling credits.[407] Larger service area sizes can thus provide an ecological advantage by minimizing temporal losses of impacted aquatic resources.[408]

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[401] Ruhl & Salzman, *supra* note 388, at 10.
[402] *See* Salzman & Ruhl, *supra* note 14, at 666–67; *see also* BenDor et al., *supra* note 159, at 276.
[403] BenDor et al., *supra* note 159, at 276.
[404] *See* BenDor et al., *supra* note 13, at 2089–90.
[405] BENDOR ET AL., *supra* note 162, at 10–11.
[406] Corps Mitigation Rule, 33 C.F.R. §§ 332.3(b)(2), 332.8(m) (2008); EPA Mitigation Rule, 40 C.F.R. §§ 230.93(b)(2), 230.98(m) (2008).
[407] Corps Mitigation Rule, 33 C.F.R. § 332.8(o)(8); EPA Mitigation Rule, 40 C.F.R. § 230.98(o)(8); Robertson, *supra* note 43, at 300.
[408] BenDor et al., *supra* note 13, at 2089–90.

Table 1: Aquatic Resource Functions, Services, Site Dependence, and Scale Type

Function	Service	Greater Function Near Population?	Greater Service Near Population?	Scale Type
Flood and flow control	Flood protection	N	Y	Hydrologic; downstream beneficiaries
Storm buffering	Storm surge protection	N	Y	Climatologic; inland beneficiaries
Sediment retention	Storm protection, improved water quality	SD	Y	Hydrologic; downstream beneficiaries
Groundwater recharge/discharge	Water supply	N	Y	Hydrologic (groundwater shed)
Water quality maintenance/nutrient retention	Improved water quality, waste disposal	SD	Y	Hydrologic; downstream beneficiaries
Habitat and nursery for plant and animal species	Commercial fishing and hunting, recreational fishing and hunting, harvesting of natural materials, energy resources	N	SD	Ecological
Biological diversity	Appreciation of species existence, possible other functional benefits via species diversity-function relationships	N	N	Ecological
Micro-climate stabilization	Climate stabilization	N	SD	Climatologic; regional beneficiaries
Carbon sequestration	Reduced global warming	N	N	Global; global beneficiaries
Natural environment	Recreational activities, appreciation of uniqueness to culture/heritage[409]	N	Y	Social; local beneficiaries
Y=Yes; N=No; SD=Site Dependent				

Table adapted from King and Herbert[410]

[409] List of ecosystem functions and services from Brander et al., *supra* note 71, at 226.
[410] King & Herbert, *supra* note 56, at 12.

Weighing the spatial and temporal tradeoffs inherent in service area size also requires specifically considering the spatial dependence of the individual ecosystem services being relocated by a compensatory mitigation transaction. As the functionality and social value of most biophysical processes are contingent upon landscape position and proximity to human populations,[411] the level of this dependency should be a primary determinant of the geographic extent of a service area. In other words, some ecosystem services exhibit more spatial flexibility than others, and this should be recognized in setting service areas and tolerances for temporal losses. For instance, floodwater retention, a service that is most socially valuable near and topographically upgradient of population centers, exhibits low spatial flexibility (high site dependence). As a result, more temporal losses can be accepted, if necessary, to allow for a lower net loss of flood protection services, prompting use of a smaller service area. In contrast, a service such as habitat provision that demonstrates more spatial flexibility (low site dependence) should be paired with compensatory mitigation of higher temporal quality, as promoted through a larger service area, to minimize ecosystem service loss. Regulatory practice currently does not designate multiple service areas for each of the suite of ecosystem services compensated by third-party mitigation providers.[412] However, the principal services that a bank or ILF program purports to restore, or the services that are most scarce in a particular watershed, ecoregion, or community, could inform consideration of the spatial flexibility of the sponsor's credit sales.

Interestingly, economic literature on spatial discounting already recognizes tradeoffs between the spatial and temporal valuation of environmental resources,[413] with insightful implications for trades in aquatic resources. First, the spatial scale at which an ecosystem service operates affects its spatial discount rate and subsequent value.[414] Services that affect smaller geographic areas (higher site dependence) have a higher spatial discount rate and their value decreases more rapidly over space, while services affecting larger geographic areas (lower site dependence) have a lower spatial discount rate and their value decreases at a lower rate over space.[415] Furthermore, there is a direct tradeoff between an ecosystem service's temporal and spatial discount rates: as a service's temporal discount rate increases, the spatial discount rate decreases, and vice versa.[416] Therefore, the economic value of ecosystem services that operate on larger geographic scales will decrease at a lower rate over space and at a higher rate over time, so the temporal quality of compensatory mitigation for these services should be given priority over spatial quality to maintain a higher present value for these ecosystem services. This implies that, for ecosystem services that op-

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[411] King & Herbert, *supra* note 56, at 12; *see also supra* Table 1.
[412] *See* Appendix I.
[413] Perrings & Hannon, *supra* note 101, at 29.
[414] *Id.* at 28–29. Here we reference the "ethically neutral" spatial discount rate.
[415] *Id.*
[416] *Id.* at 29.

erate over larger geographic areas, mitigation banks or other compensatory mitigation that occurs before impacts are preferable to ILF mitigation or PRM. Following the same logic, the present economic value of more localized ecosystem services will be best preserved by prioritizing the spatial quality of compensation over its temporal quality. For these ecosystem services, when mitigation banks cannot be economically viable in small service areas, higher spatial quality compensatory mitigation from ILF programs or PRM is preferable to more distant compensation from banks. The inverse relationship between spatial and temporal discount rates supports use of smaller service areas for ecosystem services of high site dependence and larger service areas for ecosystem services with more spatial flexibility. It also supports use of smaller geographic service areas or geographic constraints for ILF programs and PRM than for mitigation banks.

In some aquatic resource market transactions, potential spatial or temporal losses of ecosystem functions or services can be addressed through use of regulatory credit ratios imposed upon trades.[417] If an aquatic resource impact will cause more damage per acre to ecosystem functions or services than the functions or services restored per acre at a compensation site, regulators can simply condition approval of a credit transaction on a requirement that more acreage be compensated than is impacted.[418] In an ideal case, the credit ratio required will result in offsetting, equivalent losses and gains of aquatic resource functions and/or services.[419] Higher credit ratios are commonly applied to compensatory mitigation transactions that transfer aquatic resources to sites geographically distant from impacts.[420]

V. National Geographic Service Area Study

This Article now moves from a conceptual discussion of the effects of geographic service area size on the ecological and economic efficacy of mitigation markets to a depiction of the actual service area sizes prescribed by regulators following passage of the 2008 Mitigation Rule.

A. Methods

Our research identified mitigation bank service area preferences for all Corps districts and states with compensatory mitigation siting preferences.[421]

[417] Corps Mitigation Rule, 33 C.F.R. § 332.3(f)(2) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(f)(2) (2008); Ruhl & Gregg, *supra* note 46, at 379.

[418] Corps Mitigation Rule, 33 C.F.R. § 332.3(f)(2); EPA Mitigation Rule, 40 C.F.R. § 230.93(f)(2); Ruhl & Gregg, *supra* note 46, at 379.

[419] Brown & Lant, *supra* note 158, at 335.

[420] *See* Appendix I.

[421] States with mitigation siting preferences were identified based on the Environmental Law Institute's fifty-state study of state wetland regulatory protection. *See* ENVTL. LAW INST., STATE WETLAND PROTECTION: STATUS, TRENDS & MODEL APPROACHES: A 50-STATE STUDY BY THE ENVIRONMENTAL LAW INSTITUTE (2008); ENVTL. LAW INST., STATE WETLAND PROGRAM EVALUATION: PHASE 1 (2005); ENVTL. LAW INST., STATE WETLAND PROGRAM EVALUA-

From January to May 2009, we reviewed published documents to reveal Corps district regulatory guidelines, MOAs, state regulations, state statutes, or state regulatory preferences shaping service areas for mitigation banks. Subsequent phone and e-mail contact with knowledgeable regulatory personnel at the Corps district and state level from May to October 2009 clarified available service area criteria or acquired undocumented service area procedures.[422] Results were then grouped by Corps district, with some Corps districts containing multiple service area size preferences for each of their constituent states. Based on both the spatial extent of Corps or state service area preferences and regulatory consistency in applying a particular geographic rationale for service area size, we classified Corps district service area policies as being "hard" and rigorous or "soft" and lenient.

While not a focal point of our research, when available, service area sizes for ILF programs or spatial scale preferences for off-site PRM were recorded. Given the regulatory changes invoked by the 2008 Mitigation Rule, off-site PRM guidelines and particularly ILF service areas were undergoing considerable redefinition during the time period of our study.

B. *Mitigation Bank Service Areas: Analysis and Results*[423]

The exclusion of a top-down approach to defining Corps service area policy in the 2008 Mitigation Rule has elicited considerable nationwide variation in mitigation bank geographic service area preferences.[424] Ecological or hydrologic geographic limits currently applied to primary service areas include HUC-6s, HUC-8s, HUC-10s, HUC-11s, Level IV Ecoregions, Albert Ecoregions, Ecological Drainage Units ("EDUs"), independent Corps district or state watershed assessments, and tidal/non-tidal wetland boundaries.[425] State-defined limits used in service area determinations include New Jersey Watershed Management Areas ("WMAs"), Washington Water Re-

TION: PHASE II (2006); ENVTL. LAW INST., STATE WETLAND PROGRAM EVALUATION: PHASE III (2007); ENVTL. LAW INST., STATE WETLAND PROGRAM EVALUATION: PHASE IV (2007).

[422] Due to their implications for market size and the economic viability of various mitigation providers, service areas are a particularly contentious issue among regulators and mitigation providers. In our study, to encourage open disclosure of the service area criteria used in Corps districts and applicable states, we intentionally did not record the names of our interviewees.

[423] The complete results of our national compilation of Corps and state regulatory requirements and preferences for mitigation bank service areas are available in Appendix I of this Article, which is available at http://www.law.harvard.edu/students/orgs/elr/vol36_1/appendix1.pdf. Appendix I presents a comprehensive catalog of the geographic service area boundary type(s) required or preferred for mitigation banks by Corps regulatory districts, with state regulatory requirements or preferences provided for each of the Corps districts to which they apply. Appendix I includes citations to all source material used for our research on mitigation bank service areas, including published Corps district regulatory guidelines, MOAs between the Corps and other federal or state agencies, state regulations, state statutes, state regulatory preferences, and phone or e-mail interviews, with interviews cited to Appendix II.

[424] Corps Mitigation Rule, 33 C.F.R. § 332.8(d)(6)(ii)(A) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.98(d)(6)(ii)(A) (2008); *see* Appendix I.

[425] *See* Appendix I. Ecological Drainage Units are ecologically based aggregations of HUC-8s Drainage Units. *See infra* note 477.

source Inventory Areas ("WRIAs"), and Wisconsin Geographic Management Units ("GMUs").[426] County boundaries, city boundaries, and simple twenty- or forty-mile radii from bank sites also limit service areas in selected districts and states.[427] The geographic watershed scale preferred most commonly by Corps districts for primary service areas is the HUC-8, with twenty-five of thirty-eight districts utilizing this USGS watershed level in some capacity.[428] In addition, Corps districts in Charleston, Fort Worth, Galveston, Louisville, Savannah, and Vicksburg employ policies for defining secondary service areas where permittees may purchase credits if no mitigation credits are available in their immediate watershed.[429] In applicable districts, secondary service areas are defined by adjacent HUC-8 or HUC-6 watersheds, which may additionally be constrained by the HUC-3, river basin, or Level III Ecoregion of the permitted aquatic resource impact.[430] However, these existing geographic bounds to primary and secondary service areas are often modified to better fit individual bank characteristics.[431]

Both the rigor and specificity of service area preferences exhibit considerable variation across Corps districts and states, resulting in a nationwide amalgamation of strict, "hard" districts and flexible, "soft" districts.[432] Generally, substantially developed regions with established mitigation banking communities and abundant aquatic resources are regulated with more explicit, stringent service area limitations.[433] Corps districts in Alaska, Albu-

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[426] MINN. R. 8420.0117, 8420.0522(4), 8420.0522(7), 8420.0544 (2009); N.J. ADMIN. CODE §§ 7:7A-15.5, 7:7A-15.6, 7:7A-15.25(b)(v), 7:7E-3.15(h) (2009); WIS. DEP'T OF NATURAL RES. ET AL., *supra* note 232, at 10, 35; *Freshwater Wetland Mitigation Banks*, N.J. DEP'T OF ENVTL. PROT., http://www.nj.gov/dep/landuse/fww/mitigate/wmas-map.htm (last visited Jan. 18, 2012) (on file with the Harvard Law School Library); Appendix II, notes 35, 51, 54–55, 65.

[427] CAL. FISH & GAME CODE §§ 1779, 1779.5, 1786(b)(2); CAL. WAT. CODE § 13200; 327 IND. ADMIN. CODE 17-1-5(c) (2005); MINN. R. 8420.0117, 8420.0522(4), 8420.0522(7), 8420.0544 (2009); CHI. DIST., U.S. ARMY CORPS OF ENG'RS, INTERAGENCY COORDINATION AGREEMENT ON MITIGATION BANKING WITHIN THE REGULATORY BOUNDARIES OF THE CHICAGO DISTRICT, CORPS OF ENGINEERS 24 (2008) (on file with authors); WIS. DEP'T OF NATURAL RES. ET AL., *supra* note 232, at 10, 35; Appendix II, notes 3, 6, 35, 40, 44, 49, 51, 65.

[428] While Illinois, which is partially in the Corps' Chicago District, may apply higher ratios for mitigation bank usage outside of a HUC-8, the Chicago District does not use the HUC-8 to define service areas. *See* Appendix I.

[429] CHARLESTON DIST., U.S. ARMY CORPS OF ENG'RS ET AL., JOINT STATE/FEDERAL ADMINISTRATIVE PROCEDURES FOR THE ESTABLISHMENT AND OPERATION OF MITIGATION BANKS IN SOUTH CAROLINA 8 (2002), *available at* http://www.sac.usace.army.mil/assets/pdf/regulatory/mitigation/establishment_operation_mitigation_banks_SC-Sept-2002.pdf; SAVANNAH DIST., U.S. ARMY CORPS OF ENG'RS, GUIDELINES ON THE ESTABLISHMENT, OPERATION AND USE OF WETLAND AND STREAM MITIGATION BANKS IN GEORGIA 6 (2006), *available at* http://www.sas.usace.army.mil/Bank%20Guidelines.pdf; *Regulatory Division: Bank Mitigation*, SAVANNAH DIST., U.S. ARMY CORPS OF ENG'RS, http://www.sas.usace.army.mil/regulatory/banking.html (last visited Jan. 18, 2012) (on file with the Harvard Law School Library); Appendix II, notes 5, 8, 9, 16, 32, 37.

[430] CHARLESTON DIST., U.S. ARMY CORPS OF ENG'RS ET AL., *supra* note 429, at 8; SAVANNAH DIST., U.S. ARMY CORPS OF ENG'RS, *supra* note 429, at 7–9; Appendix II, notes 5, 8, 9, 16, 32, 37.

[431] *See* Appendix I.

[432] Appendix I.

[433] *See* Appendix I.

querque, New England, Philadelphia, Sacramento, and Tulsa administer no consistent service area size to bank applicants while all remaining districts utilize some form of geographic guidelines for service areas.[434] Other "soft" Corps districts such as Baltimore, Galveston, Huntington, and Memphis define specific preferred watershed extents, including HUC-8s, HUC-6s, Level III Ecoregions, or EDUs, but commonly substitute different service area limitations on a case-by-case basis.[435]

IRTs applying "hard" criteria for service area delineation are characterized by varying levels of complexity controlling the mitigation bank options available to permittees. Districts such as Little Rock have strict but simple service area preferences while districts similar to Norfolk have moderately complex service area procedures stipulating appropriate geographic limitations on banked credit sales.[436] Stringency of service area preferences may also vary substantially within Corps districts encompassing multiple states.[437] The most rigorous and detailed compensatory mitigation siting procedures, which holistically incorporate use of PRM, mitigation banking, and ILF programs based on the proximity of available restoration to impacts, are due to strong state regulatory influence on the IRT process. New Jersey and Minnesota are prominent examples of states practicing comprehensive, integrated management of all compensatory mitigation mechanisms with strict service area use restrictions.[438] However, though service area scale preferences and their relative flexibility differ considerably nationwide, nearly all district IRTs will entertain alternative service area proposals from prospective bankers if the proposals have adequate ecological justification.[439]

Aside from IRT flexibility in the initial mitigation bank service area definition process, under exceptional circumstances Corps districts and states may stray from established preferences and allow approved banks to sell released mitigation credits outside of their primary service area. Bank instruments may specifically denote spatial restrictions on where these cred-

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[434] Appendix I.

[435] Appendix II, notes 3, 9, 11, 17.

[436] *See* Norfolk Dist., U.S. Army Corps of Eng'rs, Virginia Off-Site Mitigation Location Guidelines 1 (2008), *available at* http://www.nao.usace.army.mil/technical%20services/Regulatory%20branch/Guidance/Virginia%20Offsite%20Mitigation%20Site%20Selection%20Guidelines.pdf; Appendix II, notes 14, 23.

[437] *See, e.g.*, N.J. Admin. Code §§ 7:7A-15.5, 7:7A-15.6, 7:7A-15.25(b)(v), 7:7E-3.15(h) (2009); Ohio Admin. Code 3745:1-54(D)(2), 3745:1-54(E)(1)(c), 3745:1-54(F) (2003); Ohio Rev. Code Ann. §§ 6111.022, 6111.024 (West 2001); 25 Pa. Code § 105.20a(a)(3) (1991); W. Va. Code R. § 47-5A-6.2(a)(2) (2002); Kan. City Dist. et al., Kansas Stream Mitigation Guidance 9, 20 (2008), *available at* http://www.kaws.org/files/kaws/rpt_SMG_021808_db.pdf; Water Pollution Control Program, Mo. Dep't of Natural Res., *supra* note 330, at 4; N.J. Dep't of Envtl. Prot., *supra* note 426; Appendix II, notes 11, 13, 25–26, 58–59, 64 (referencing the Huntington, Kansas City, Philadelphia and Pittsburgh Corps Districts). The variation of service area criteria within these four Corps districts led us partially to classify them as both "hard" and "soft."

[438] *See* Minn. R. 8420.0117, 8420.0522(4), 8420.0522(7), 8420.0544 (2009); N.J. Admin. Code §§ 7:7A-15.5, 7:7A-15.6, 7:7A-15.25(b)(v), 7:7E-3.15(h) (2009); N.J. Dep't of Envtl. Prot., *supra* note 426; Appendix II, notes 50, 51, 54–55.

[439] *See generally* Appendix I.

its may be sold, as with secondary or tertiary service areas, or Corps regulatory officials or the IRT may consider exceptions case-by-case.[440] Typically, permittees are discouraged from mitigation bank credit use outside of primary service areas through use of higher credit ratios requiring increased wetland or stream compensation. A bank's instrument often defines credit ratios for secondary or tertiary service areas, while case-by-case exemptions are often accompanied by increased ratios of 1.5, 2, 4, or 5.5.[441] Some state compensatory mitigation siting procedures, such as those in Minnesota, explicitly assign higher credit ratio requirements for use of more distant mitigation banks.[442] More rigorous districts may also refuse to allow banks to sell credits outside of their primary service areas.[443]

Though service area preferences are typically uniform for both stream and wetland compensation, some Corps districts and states have finalized or drafted guidelines requiring different siting procedures for compensatory stream mitigation. For example, Tennessee prioritizes compensatory stream mitigation for acceptable impacts to exceptional or outstanding streams at the HUC-12 level.[444] Draft stream mitigation rules in Tennessee would also constrain compensation options to the Level III Ecoregion, HUC-8, and within one stream order of an impact site.[445] North Carolina prefers locating stream compensation within one stream order of an impacted stream, on a stream of a similar habitat designation, and within the same HUC-8 and physiographic province as an impact site.[446] Ohio's draft stream mitigation rules identify higher credit ratios for compensation sited further from an impact site, granting full credit for compensatory mitigation at the HUC-14

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[440] *See generally* Appendix I.

[441] Appendix II, notes 6–9, 12–14, 16–19, 28–29, 32, 35, 39, 43–44, 50–52, 62; *see also e.g.*, FLA. ADMIN. CODE ANN. r. 62-342.600(6) (2001); ILL. ADMIN. CODE tit. 17, §§ 1090.10, 1090.50(c)(8) (1997); 327 IND. ADMIN. CODE 17-1-5(c) (2005); MICH. ADMIN. CODE r. 281.956(4) (1997); MICH. ADMIN. CODE r. 281.925(7)(f) (1988); MINN. R. 8420.522 (2009); MO. DEP'T OF NATURAL RES., *supra* note 330, at 4–5; CHI. DIST., U.S. ARMY CORPS OF ENG'RS, *supra* note 427, at 7, 24; JACKSONVILLE DIST., U.S. ARMY CORPS OF ENG'RS, SECTION 4 — SERVICE AREAS/IN-KIND VS. OUT-OF-KIND DETERMINATION 1 (1998), *available at* http://www.saj.usace.army.mil/Divisions/Regulatory/DOCS/mitigation/jsfmbrtp_sec4.pdf; LOUISVILLE DIST., U.S. ARMY CORPS OF ENG'RS ET AL., INTERAGENCY COORDINATION AGREEMENT ON WETLAND MITIGATION BANKING WITHIN THE STATE OF INDIANA 4, 6 (2002), *available at* http://www.in.gov/idem/files/indica1002.pdf; MOBILE DIST., U.S. ARMY CORPS OF ENG'RS, PROXIMITY FACTOR METHOD 1–4 (2009), *available at* http://www.sam.usace.army.mil/rd/reg/PN/currentPNs/ProximityFactorMethod.pdf; WILMINGTON DIST., U.S. ARMY CORPS OF ENG'RS, REVISED FRAMEWORK FOR MITIGATION REVIEW IN NC 6 (2008) (on file with authors).

[442] MINN. R. 8420.522 (2011); Appendix II, note 51; *see also* ILL. ADMIN. CODE tit. 17, §§ 1090.10, 1090.50(c)(8) (1997); OHIO ADMIN. CODE 3745:1-54(E(1)(c), 3745:1-54(F)(1); Appendix II, notes 43, 58–59.

[443] *See, e.g.*, Appendix II, notes 11, 32.

[444] TENN. COMP. R. & REGS. 1200-04-07-.04(6)(c)(7) (2011); TENN. COMP. R. & REGS. 1200-04-03-.06 (2008); Appendix II, note 62.

[445] DIV. OF WATER POLLUTION CONTROL, TENN. DEP'T OF ENVTL. CONSERVATION, STREAM MITIGATION GUIDELINES 14 (2004), *available at* http://www.state.tn.us/environment/wpc/publications/pdf/StreamMitigationGuidelines.pdf.

[446] WILMINGTON DIST., U.S. ARMY CORPS OF ENG'RS ET AL., STREAM MITIGATION GUIDELINES 15, 16 (2003), *available at* http://www.saw.usace.army.mil/wetlands/mitigation/Documents/Stream/STREAM%20MITIGATION%20GUIDELINE%20TEXT.pdf.

level, half-credit for compensatory mitigation in the same HUC-11 level, and 0.2 credits for compensatory mitigation in the same HUC-8.[447] The Little Rock District Stream Functional Assessment Method prefers compensation for impacts to streams of primary significance in the same HUC-8 watershed and doubles the credit ratio for non-bank compensation outside of the immediate HUC-8, although in instances where bank service areas exceed a HUC-8, stream credits from a bank may be used without the higher ratio.[448] Vicksburg and Omaha are two other Corps districts developing or operating with a similar stream assessment method.[449]

C. ILF Service Areas and Geographic Limits for PRM

Though service area restrictions were not essential for ILF programs in existence prior to the Mitigation Rule, ILF mitigation was already commonly planned at varying watershed scales. Before revision, service area sizes used for targeting ILF resources exhibited tremendous variation, including HUC-12s, HUC-11s, HUC-10s, HUC-8s, HUC-6s, EDUs, Level III Ecoregions, state-defined river basins and marine regions, biophysical regions, physiographic provinces, major land resource areas, municipalities, counties, and states.[450] This national patchwork of ILF service area definitions is undergoing redefinition as many programs design procedures to ensure compliance with new federal compensatory mitigation requirements.[451]

The agencies' hierarchical preference for mitigation banks and ILF programs over PRM has the effect of more locally restricting PRM siting, particularly if it is used instead of more distant, third-party compensatory mitigation.[452] Many Corps districts, states, and local governments previously developed siting guidelines or regulations specifying watershed scales for PRM aquatic resource projects. Similar to mitigation bank and ILF service areas, siting limits for PRM are nationally variable. Applicable regulatory agencies use HUC-12s, HUC-11s, HUC-10s, HUC-8s, HUC-6s, Level III Ecoregions, Corps-defined watersheds, state-defined watersheds/basins, lo-

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[447] Div. of Surface Water, Ohio Envtl. Prot. Agency, Compensatory Mitigation for Stream Impacts in the State of Ohio 71–74 (2004), *available at* http://in.gov/idem/files/headwater_oh_mitigation_guidelines.pdf.

[448] Little Rock Dist., U.S. Army Corps of Eng'rs, Stream Method 4, 13 (2008), *available at* http://www.swl.usace.army.mil/regulatory/permits/littlerockstreammitigation03212008.doc.

[449] Appendix II, notes 24, 37.

[450] Appendix II, notes 1, 5–6, 8–9, 11–17, 19–20, 23–24, 27, 30, 32, 34, 45–46, 48–49, 53, 62, 64; *see also* Kan. City Dist., U.S. Army Corps of Eng'rs et al., *supra* note 437, at 9, 20; Ecosystem Enhancement Program, N.C. Dep't of Env't & Natural Res., North Carolina Department of Environment and Natural Resources' Ecosystem Enhancement Program In-Lieu Fee Program Instrument 5 (2010), *available at* http://www.nceep.net/pages/pdfs/interim_final_instrument_8_2_10.pdf.

[451] *See* Jessica B. Wilkinson, Envtl. Law Inst., In-Lieu Fee Mitigation: Model Instrument Language and Resources 12–17 (2009), *available at* http://www.elistore.org/Data/products/d19-15.pdf.

[452] *See* Corps Mitigation Rule, 33 C.F.R. § 332.3(b)(2) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(b)(2) (2008).

cally defined watersheds, topographic/physiographic provinces, wetland planning regions, biophysical regions, parishes, counties, states, Corps districts, and islands to geographically restrain off-site PRM.[453] Higher credit ratios are also commonly applied to PRM projects located excessively far from aquatic resource impacts.[454]

D. Implications

Use of a proper watershed scale is critical to the watershed approach, the preference for mitigation banking, and the spatial and temporal quality of mitigation projects. In addition, IRTs should strive to consistently consider equivalent criteria when setting service areas for all applicants. Accordingly, Corps districts without service area standards would likely benefit from merely establishing service area criteria, and districts that regularly allow exceptions to service area standards would likely benefit from either reducing the number of exceptions or increasing the ecological validity of these exceptions.

In areas with established service area preferences, our study encountered two troubling realities. First, some permittees offsetting linear impacts (e.g., transportation projects), which are frequently government agencies, were granted geographic exceptions allowing them more latitude to use mitigation banks outside of their service areas. Laws, regulations, or guidance in Florida,[455] Missouri,[456] Ohio,[457] and Washington[458] allow linear projects to

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[453] Ill. Admin. Code tit. 17, §§ 1090.10, 1090.50(c)(8) (1997); La. Admin. Code tit. 43, § 724(J)(4)(d) (2002); Mich. Admin. Code r. 281.925(7) (1997); Minn. R. 8420.0522(4), 8420.0522(7) (2009); N.H. Admin. R. Ann. Env-Wt 803.03 (2007); N.J. Admin. Code §§ 7:7A-15.5, 7:7A-15.6, 7:7A-15.25(b)(v), 7:7E-3.15(h) (2009); 15A N.C. Admin. Code 02H.0506(c)-(e), 02H.0506(h) (1996); 15A N.C. Admin. Code 02H.1305(c)(6)(C), 02H.1305(g)(8) (2003); Ohio Admin. Code 3745:1-54(D)(2), 3745:1-54(E)(1)(c), 3745:1-54(F) (2003); Ohio Rev. Code Ann. §§ 6111.022, 6111.024 (West 2001); 25 Pa. Code § 105.20a(a)(3) (1991); Tenn. Comp. R. & Regs. 1200-04-07-.04(7)(b)(1) (2008); Chi. Dist., U.S. Army Corps of Eng'rs, *supra* note 427, at 24; Honolulu Dist., U.S. Army Corps of Eng'rs, Honolulu District Compensatory Mitigation and Monitoring Guidelines 4 (2005), *available at* http://www.poh.usace.army.mil/pa/publicNotices/SPN2005021404-448.pdf; Little Rock Dist., U.S. Army Corps of Eng'rs, *supra* note 448, at 4, 13; Norfolk Dist., U.S. Army Corps of Eng'rs, *supra* note 436, at 1–3; Omaha Dist., U.S. Army Corps of Eng'rs, The U.S. Army Corps of Engineers' Guidance for Compensatory Mitigation and Mitigation Banking in the Omaha District 13–14, *available at* http://www.nwo.usace.army.mil/html/od-r/guidance-aug05.pdf; Kan. City Dist. et al., *supra* note 437, at 9, 20; Envtl. Law Inst., State Wetland Program Evaluation: Phase IV, *supra* note 421, at 98; Mo. Dep't of Natural Res., *supra* note 330, at 4–5; Freshwater Wetlands Program, N.Y. State Dep't of Envtl. Conservation, Freshwater Wetlands Regulation Guidelines on Compensatory Mitigation 4–5 (1993), *available at* http://www.dec.ny.gov/docs/wildlife_pdf/wetlmit.pdf; *Wetland Planning Area Reports,* Ark. Multi-Agency Wetland Planning Team, http://www.mawpt.org/plan/area_reports.asp (last visited Jan. 18, 2012) (on file with the Harvard Law School Library).

[454] *See, e.g.*, Ill. Admin. Code tit. 17, § 1090.50(c)(8) (1997); Mo. Dep't of Natural Res., *supra* note 330, at 4–5; Appendix II, notes 1–3, 5–12, 14–17, 19, 21, 23–24, 26–30, 32–34, 36–39, 41, 43–45, 47–48, 51–59, 61–62, 64.

[455] Fla. Admin. Code Ann. r. 62-342.600(4)(b) (2001).

[456] Mo. Dep't of Natural Res., *supra* note 330.

consolidate impacts across multiple service areas at a single compensation site, while Minnesota[459] and Virginia[460] specifically grant this ability to government transportation agencies. Allowing impacts to be compensated in other service areas may be ecologically defensible, such as when a permittee consolidates all compensatory mitigation in a high-needs watershed. However, expressly granting service area exceptions to particular permittees or banks without ecological justification undermines one of the primary objectives of the Mitigation Rule — promoting equivalent standards for all mitigation providers.

Government agencies, including transportation agencies in all of the states with listed service area exceptions, often utilize state-run mitigation banks to offset internal demand for wetland and stream credits.[461] This means that public mitigation banks offsetting linear government projects may be allowed more service area exceptions than other banks. Unless public mitigation banks are demonstrably ecologically superior to comparable entrepreneurial banks, regulators should apply equivalent standards to both types of mitigation providers.

Moreover, some ILFs we studied operated under less restrictive service area standards than similarly situated mitigation banks.[462] Unless ILFs provide advance compensatory mitigation of ecological value equal to or greater than that of banks, ILF service area sizes should not exceed, or even equal, bank service areas to avoid subverting the Mitigation Rule's preference for mitigation banks.[463] Service area size is not irrelevant for ILFs — adequate market demand must exist in a service area to justify advance investment in developing a compensation planning framework and the operational procedures required in an instrument. However, as ILFs generally sell wetland or stream offsets to permittees before investing in site-specific land acquisition or mitigation plans, the geographic market size of an ILF is inherently less determinant of its economic viability — if market demand is low in a particular service area, an ILF simply does not undertake as much compensatory mitigation in that service area. Indeed, the ability of ILFs to provide wetland and stream credits in areas without adequate demand for

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[457] OHIO ADMIN. CODE 3745:1-54(D)(2) (2003).

[458] WASH. ADMIN. CODE § 173-700-502 (2009).

[459] MINN. R. 8420.0544 (2009).

[460] VA. CODE ANN. § 62.1-44.15:23(A) (2008).

[461] JOHN A. VOLPE NAT'L TRANSP. SYS. CTR., RESEARCH AND INNOVATIVE TECH. ADMIN., U.S. DOT, ENVIRONMENTAL MITIGATION IN TRANSPORTATION PLANNING: CASE STUDIES IN MEETING SAFETEA-LU SECTION 6001 REQUIREMENTS 35–36 (2009), *available at* http://www.environment.fhwa.dot.gov/integ/pubcase_6001.pdf; *Results of the FHWA Domestic Scan of Successful Wetland Mitigation Programs*, FED. HIGHWAY ADMIN., U.S. DOT, http://www.environment.fhwa.dot.gov/ecosystems/scanrpt/oh.asp (last visited Jan. 18, 2012) (on file with the Harvard Law School Library); *Mitigation Banking*, WASH. STATE DEP'T OF TRANSP., http://www.wsdot.wa.gov/Environment/Wetlands/Mitigation/alternativemitigation.htm (last visited Jan. 18, 2012) (on file with the Harvard Law School Library); *see also* ENVTL. LAW INST., *supra* note 179, at 170–86; WILKINSON & THOMPSON, *supra* note 182, at 29–51.

[462] Appendix II, notes 1, 3, 12, 14, 16, 24, 30, 34, 49.

[463] *See supra* Part IV.B.3.

establishment of mitigation banks was a primary reason for their retention under the Rule.[464]

On the other hand, mitigation banks must invest in land acquisition, protection, and mitigation plans before selling credits to permittees, giving them less geographic flexibility to accommodate market demand after-the-fact and making service area size more central to their economic stability.[465] As ILFs increasingly begin to comply with the new operational standards set forth in the Rule, it will be important to track the size, type, and rigor of ILF service areas.[466]

A common factor in these two service area problems is that governments operate both public mitigation banks and ILFs and may experience conflicts of interest when they also regulate these banks or ILFs through the IRT. Government entities should ensure that agencies responsible for administering mitigation banks or ILFs are not also members of IRTs to reduce self-regulatory conflicts.[467]

Even in Corps districts and states with rigorous, evenly applied service area standards, the current scientific and economic rationale used to set service areas leaves much to be desired. In ten Corps districts, watersheds as defined by HUC-8s or HUC-6s are the sole scale used to define mitigation bank service area preferences.[468] Additional districts rely primarily on watersheds to set service areas,[469] with use of county or city boundaries in some instances. Given the aforementioned disadvantages of relying exclusively on hydrologic drainage basins for water resources management, and more specifically the HUC system, these districts' trading limits likely disregard a number of ecosystem functions and services (e.g., terrestrial habitat provision, biodiversity provision, recreational services).[470]

In addition, California and Wisconsin may impose twenty- or forty-mile radii as part of a bank's service area.[471] While these geographic limits may keep compensation close to impacts, they lack any scientific foundation in hydrology, ecology, physiography, or climatology, and do not necessarily reflect geographic population trends.

Eighteen Corps districts use some combination of hydrologic drainage patterns and ecological considerations to shape mitigation bank service ar-

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[464] Compensatory Mitigation for Losses of Aquatic Resources, 73 Fed. Reg. 19,594, 19,599 (Apr. 10, 2008).

[465] Corps Mitigation Rule, 33 C.F.R. §§ 332.3(b)(2), 332.8(m) (2008); EPA Mitigation Rule, 40 C.F.R. §§ 230.93(b)(2), 230.98(m) (2008).

[466] BenDor et al., *supra* note 162, at 2.

[467] *See, e.g.*, Letter from Derb S. Carter, Jr., Director, N.C./S.C. Office, S. Envtl. Law Ctr. & Geoffrey R. Gisler, Staff Attorney, S. Envtl. Law Ctr. to Todd Tugwell, Wilmington Dist., U.S. Army Corps of Eng'rs 2 (Mar. 23, 2010) (on file with authors).

[468] Buffalo, Huntington, Mobile, New York, Norfolk, Omaha, Pittsburgh, Savannah, Walla Walla, and Wilmington. *See* Appendix I.

[469] *See* Appendix I.

[470] *See supra* Part III.C.

[471] Cal. Fish & Game Code § 1786(b)(2); Wis. Dep't of Natural Res. et al., *supra* note 232, at 10, 35.

eas.[472] In eight of these Corps districts,[473] a combination of watersheds and ecoregions is used to define primary or secondary geographic service areas, though the frequency of use of ecoregions likely varies across these districts. In Arkansas (where three of these Corps districts are located[474]), the state prefers service areas to be no larger than the Arkansas Wetland Planning Region ("WPR"), which is a state-defined geographic limit based on hydrologic units, ecoregions, and other ecological and physiographic considerations. Four different Corps districts state hydrologic drainage units as their preferred service area size, but additionally consider ecological criteria to alter these hydrologic boundaries in certain instances.[475] Further, four more of these eighteen Corps districts use the EDU[476] — an ecologically based aggregation of HUC-8s[477] — in their service area definitions. While EDUs do group smaller hydrologic units based on ecological similarity, this geographic scale is still inherently based on hydrologic drainage patterns and is more expansive, and so likely promotes compensation of a lower spatial quality than the HUC-8 service areas used elsewhere.

Since current regulatory practice generally dictates use of just one service area, geographic service area preferences that merge watersheds and ecoregions may provide the best spatial context for both habitat and hydrologic offsets. For example, the Fort Worth and Galveston Corps districts delineate primary service areas that are the overlap of a HUC-6 and a Level III ecoregion;[478] these service area sizes therefore may be effective in providing proper limitations for a broader suite of functions. However, since HUC-6s and Level III Ecoregions are significantly more expansive than the HUC-8 service areas used in other Corps districts, and HUC-8s are commonly contained within a single Level III Ecoregion, the Fort Worth and Galveston service area policies serve more as examples of geographic limits that merge ecological and hydrologic units than as model service area sizes.

In addition, Corps, state, or local preferences or policies in nine Corps districts limit mitigation bank sales based on a county, city, or parish.[479] While these political boundaries do not necessarily follow geographic population trends, they may help to preserve or restore ecosystem services that are more valuable nearby social centers. These local political limits on com-

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[472] Charleston, Detroit, Fort Worth, Galveston, Jacksonville, Kansas City, Little Rock, Los Angeles, Memphis, Norfolk, Portland, Rock Island, Sacramento, San Francisco, Savannah, Seattle, St. Louis, and Vicksburg. *See* Appendix I.

[473] Charleston, Detroit, Fort Worth, Galveston, Jacksonville, Norfolk, Portland, and Savannah. *See* Appendix I.

[474] Little Rock, Memphis, and Vicksburg. *See* Appendix I.

[475] Los Angeles, Sacramento, San Francisco, and Seattle. *See* Appendix I.

[476] Kansas City, Memphis, Rock Island, and St. Louis. *See* Appendix I.

[477] *Ecological Drainage Units*, THE NATURE CONSERVANCY FRESHWATER INITIATIVE PROGRAM, http://www.2c1forest.org/atlas/metadata/edu_metadata.htm (last visited Jan. 18, 2012) (on file with the Harvard Law School Library).

[478] *See* Appendix I.

[479] Baltimore, Chicago, Detroit, Galveston, Louisville, New Orleans, Sacramento, San Francisco, and St. Paul. *See* Appendix I.

pensatory mitigation trading are illustrative of the impact that local planners can have on ecosystem service provision.

Michigan's state-imposed service area considerations for compensatory mitigation — which utilize state-defined subwatersheds, watersheds, or Albert Ecoregions depending on the spatial dependence of particular functions — include basic elements of a model service area policy.[480] Michigan's regulations allow sufficient flexibility for regulators to accommodate the economic needs of mitigation providers that supply compensation prior to impacts. The regulations also allow use of different hydrologic and ecological limits for ecosystem functions with different geographic considerations, and provide regulators with the explicit authority to require permittees to provide multiple offsets for their impacts to these different functions;[481] these options may facilitate trading of specific aquatic resource functions in more environmentally appropriate service areas.

In the next Part, we expand on the fundamental aspects of Michigan's service area regulations to discuss a potential opportunity to ameliorate economic-ecological tradeoffs in ecosystem service markets.

VI. Potential Solution: Unbundling Service Area Rationale

Compensation credits sold in aquatic resource mitigation markets are designed to replace all "functions and services" lost at an impact site;[482] these "bundled" credits group the many ecosystem services associated with aquatic resources into a single commodity.[483] Parts I and II highlight a fundamental predicament of trading these bundles of functions and services across the landscape: an aquatic resource's individual functions may operate best in different biophysical settings and its individual services may be best located in different biophysical or social surroundings. Regulatory practice often requires compensatory mitigation for the entire bundle of functions and services to occur in just one location;[484] thus, when compensatory mitigation trades a bundled resource across the landscape, the transaction almost inevitably implicates tradeoffs among a wetland or stream's constituent functions and services. When bundled ecosystem functions or services are traded at a single spatial scale, as is the case with most present geographic

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[480] Mich. Admin. Code r. 281.956(3), 281.956(4) (1997); Mich. Admin. Code r. 281.925(7)(f) (1988); Appendix II, note 50.

[481] Mich. Admin. Code r. 281.956(3), 281.956(4) (1997); Mich. Admin. Code r. 281.925(7)(f) (1988); Appendix II, note 50.

[482] Corps Mitigation Rule, 33 C.F.R. § 332.3(d)(2) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(d)(2) (2008).

[483] *See, e.g.*, Jessica Fox, *Getting Two for One: Opportunities and Challenges in Credit Stacking*, *in* Conservation and Biodiversity Banking: A Guide to Setting up and Running Biodiversity Credit Trading Schemes 171, 173 (Nathaniel Carroll, Jessica Fox, & Ricardo Bayon eds., 2008).

[484] Steve Martin et al., *Compensatory Mitigation Practices in the U.S. Army Corps of Engineers* 4–6 (U.S. Army Corps of Eng'rs, Working Paper, Mar. 2004), *available at* http://www.eli.org/pdf/mitigation_forum_2006/Mitigation_Status_2005.pdf.

service areas, certain functions may be sited in an inappropriate spatial context and trades may disregard the effects of human populations on the value of ecosystem services. Trading bundled credits pits some of an aquatic resource's functions and services against each other and complicates finding a compensation site that does not emphasize some functions and services over others. Therefore, use of unbundled, ecosystem function- or service-specific service areas that evade the possible regulatory and ecological pitfalls of creating more detailed environmental commodities present a promising option for improving the section 404 mitigation banking program. Unbundling ecosystem functions or services for section 404 compensation may also prompt increased demand for environmental restoration by providing multiple streams of income for mitigation providers.

As an alternative to bundled credits, economists have proposed the concept of "credit stacking" — the idea that individual ecosystem functions or services generated by the same wetland or stream site can be completely segregated and commodified for sale in different environmental markets.[485] Stacking is conceptually similar to the proverbial "bundle of sticks"[486] that commonly defines U.S. property rights, theoretically allowing a mitigation provider to separate and sell each of the environmental "sticks" associated with a single piece of property.[487] For instance, a mitigation bank or ILF program could restore ten acres of wetlands and sell offsets from that one parcel in markets for wetland compensatory mitigation, endangered species habitat, nutrient loadings, and carbon emissions. Credit stacking is also applicable when limited solely within the section 404 compensation market: in theory, mitigation providers could sell separate credits generated from the same piece of land to permittees offsetting the specific aquatic resource functions or services damaged by their impacts. For example, if an impact only resulted in a wetland losing its ability to retain sediment and moderate floods, a permittee could buy just the "flood moderation" and "sediment retention credits" from a wetland restoration site and the mitigation provider could sell the wetland's remaining services in subsequent transactions.[488] From a spatial perspective, credit stacking, if scientifically tenable, also permits use of different geographic restrictions for each type of stacked credit, allowing application of appropriate functional and social factors on a service-by-service basis.

Unfortunately, credit stacking is currently scientifically and administratively problematic.[489] Fundamentally, many ecosystem services are inseparably intertwined; for instance, forest carbon sequestration can be

[485] Fox, *supra* note 483, at 171.
[486] *Id.* at 173.
[487] *Id.*
[488] *See* Morgan Robertson & Michael Mikota, *Water Quality Trading & Wetland Mitigation Banking: Different Problems, Different Paths?*, NAT'L WETLANDS NEWSL., Mar.–Apr. 2007, at 1, 14.
[489] *See* Fox, *supra* note 483, at 176.

limited by nutrient availability, particularly by nitrogen.[490] In addition, basic stoichiometry provides a biochemical link between the uptake of nitrogen, phosphorus, and carbon.[491] Therefore, selling stacked carbon, phosphorus, and nitrogen offsets from the same site may be scientifically inappropriate, and, in any case, very complex. When nutrients are further linked to ecosystems, as in aquatic resource mitigation markets, complex biological, chemical, and physical webs and feedbacks further complicate attempts to fully separate functions or services into different credits.[492] As ecologists emphasize, "functions do not unstack and restack like so many legos."[493]

In addition, the various commodities included in credit stacking schemes require coordination across a number of international, federal, state, local, and private regulatory agencies, some of which generate demand through compulsory regulations and others of which generate demand through voluntary action.[494] For instance, our hypothetical ten-acre wetland restoration project would, at the very least, implicate the Corps and EPA for section 404 trading, the FWS for endangered species habitat, EPA and/or states for nutrient loading reductions, and international, state, and/or private entities for carbon sequestration.[495] Limiting credit stacking to the section 404 market would probably only marginally reduce its regulatory complexity, as permittees offsetting impacts to specific ecosystem functions or services (e.g., denitrification and carbon sequestration) could acquire these offsets from external markets to provide compensatory mitigation.

Lack of adequate regulatory oversight over credit stacking could allow mitigation providers to "double-dip," where the same type of credit is sold twice from the same piece of land.[496] This typically occurs when bundled and stacked credits overlap and are sold in separate markets — for example, when a mitigation bank sells credits from the same wetland as both section 404 compensatory mitigation and as a nitrogen trading offset.[497] Since the bundled wetland credit includes all of the wetland's functions and services, including its nitrogen loading reductions, by separately selling nitrogen credits without additional ecological improvements, credit suppliers would un-

[490] *See* Ram Oren et al., *Soil Fertility Limits Carbon Sequestration by Forest Ecosystems in a CO_2-enriched Atmosphere*, 411 NATURE 469 (2001).

[491] Alfred C. Redfield, *On the Proportions of Organic Derivatives in Sea Water and Their Relation to the Composition of Plankton*, *in* JAMES JOHNSTONE MEMORIAL VOLUME 177–92 (R.J. Daniel ed. 1934).

[492] *See* Fox, *supra* note 483, at 176.

[493] Robertson & Mikota, *supra* note 488, at 14.

[494] Fox, *supra* note 483, at 175–77.

[495] FWS, GUIDANCE FOR THE ESTABLISHMENT, USE, & OPERATION OF CONSERVATION BANKS (2003), *available at* http://www.fws.gov/ventura/endangered/habitat_conservation_planning/conservation-banking.pdf; Ellerman & Buchner, *supra* note 3, at 66–87; Hough & Robertson, *supra* note 41, at 15–33; Robertson & Mikota, *supra* note 488, at 11; *see also* Fox, *supra* note 483, at 178; Jonathan B. Wiener, *Think Globally, Act Globally: The Limits of Local Climate Policies*, 155 U. PA. L. REV. 1961 (2007).

[496] Fox, *supra* note 483, at 172.

[497] Robertson & Mikota, *supra* note 488, at 14.

dermine the scientific and economic integrity of the involved environmental market(s). While it is unclear if credit stacking is legal for the purposes of section 404 compensatory mitigation, the Rule clearly outlaws double-dipping.[498]

Although a section 404 market that utilizes credit stacking seems unlikely in the foreseeable future, the fundamental idea behind credit stacking, that wetlands and streams can be unbundled into separate commodities, provides a platform for improving the scientific and economic dynamics driving today's geographic service areas. Unbundling does not necessarily imply stacking — wetland and stream mitigation sites can be divided into different credits for different functions or services, but once one type of credit has been sold, that site could be excluded from further credit sales unless the environmental value of the site is subsequently improved.[499] In this scenario, an outright ban on credit stacking can preclude, or at least greatly reduce, the possibility of double-dipping.[500] Unbundling wetland and stream offsets also promotes the recognition that some compensatory mitigation does not supply all of the functions or services it is designed to replace; for instance, compensatory stormwater wetlands in an urban setting often do not provide valuable ecological habitat.[501] Allowing this type of unbundling can provide a middle ground between the spatial tradeoffs that completely bundled credits cause among grouped functions or services and the scientific and regulatory uncertainty associated with credit stacking.

One of the major criticisms of efforts to unbundle ecosystem functions and services is that these systems require sophisticated accounting mechanisms that can separate different credits and track the functional improvements associated with different restoration activities.[502] However, unbundling can be as specific or broad as regulators desire. At its simplest, wetlands or streams could merely be separated into functions that are dependent upon surface hydrology, such as floodwater retention and water quality improvement, and functions that are tied to broader biogeographic patterns, such as provision of terrestrial species habitat.[503] This is certainly feasible today — in fact, some mitigation bankers in California already can opt between selling their credits in markets for endangered species habitat or in markets for aquatic resource offsets.[504] If regulators and mitigation provid-

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[498] The Mitigation Rule states: "[u]nder no circumstances may the same credits be used to provide mitigation for more than one permitted activity." Corps Mitigation Rule, 33 C.F.R. § 332.3(j)(1)(ii) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(j)(1)(ii) (2008).

[499] Steve Martin, *Mitigation: An Alternative to Unbundling Ecosystem Services*, NAT'L WETLANDS NEWSL., Sept.–Oct. 2010, at 27.

[500] *See id.*

[501] *See* Cristina M. Bonilla-Warford & Joy B. Zedler, *Potential for Using Native Plant Species in Stormwater Wetlands*, 29 ENVTL. MGMT. 385, 386 (2002).

[502] *See, e.g.*, Robertson & Mikota, *supra* note 488, at 14.

[503] Shabman & Scodari, *supra* note 13, at 23.

[504] *See, e.g.*, THE CONSERVATION FUND, VAN VLECK RANCH MITIGATION BANK (CALIFORNIA), *available at* http://www.conservationfund.org/sites/default/files/CB_Van_Vleck_FINAL.pdf.

ers unbundle wetland and stream compensation credits, similar distinctions could easily be made between hydrologic- and habitat-based functions and services within the section 404 context. As ecosystem service accounting tools progress, distinctions among unbundled functions or services could become increasingly detailed.[505]

Unbundling aquatic resource ecosystem functions or services allows regulators to better tailor geographic service areas for compensatory mitigation providers to the actual functions or services being offset at a site. Depending on the complexity of unbundling, regulators could set different service areas for individual functions or services, or set different service areas for groups of functions or services that operate at similar geographic scales. For instance, a mitigation bank could sell wetland habitat credits in a service area defined by an ecoregion and sell hydrologic wetland credits in a service area defined by the HUC system. A permittee that impacts wetland habitat and hydrology would then be required to purchase "habitat credits" and "hydrologic credits" that replace each type of function or service in the proper geographic context; if the permittee's impact was within both the habitat service area and the hydrologic service area, they would be allowed to bundle the two credit types. With increased specificity in unbundling of credits, geographic service areas can be further molded to the specific landscape and societal needs of particular ecosystem functions or services.

Again, drawing on mitigation banks in California, designating multiple service areas for mitigation providers is certainly a possibility in aquatic resource markets — in fact, banks that sell credits for both endangered species and aquatic resource compensation use different service areas for credit sales in these separate markets.[506] Some conservation banks authorized to provide compensatory mitigation under the ESA also already utilize different service areas for the different types of habitat and species offsets that they supply.[507] Innovative ecosystem service accounting programs, such as the Willamette Partnership in Oregon, are also pioneering increased specificity in unbundling, and subsequently in service areas.[508] The Willamette Partnership's pilot ecosystem accounting protocol allows market participants to separate credits for environmental improvements to thermal pollution, wetlands, salmonoid habitat, prairie habitat, and nitrogen or phosphorus loadings.[509] This pilot protocol also designates different service areas for sales of these different credits: wetland and salmonoid habitat is sold within a HUC-8, prairie habitat is sold in ecoregions defined by The Nature Conservancy, and water quality credits (temperature, nitrogen, and phosphorus) are sold in

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[505] *Cf.* Willamette P'ship, Ecosystem Credit Accounting Pilot General Crediting Protocol: Willamette Basin Version 1.1 (2009), *available at* http://willamettepartnership.org/General Crediting Protocol 1.1.pdf.

[506] *See, e.g.*, The Conservation Fund, *supra* note 504, at 2.

[507] *Id.*

[508] Willamette P'ship, *supra* note 505, at 11.

[509] *Id.* at 6–7.

the area covered by the applicable Total Maximum Daily Load.[510] While these examples highlight the use of different service areas in separate environmental markets, the same concept could be applied to unbundled resources within the bounds of the section 404 regulatory program.

Furthermore, if regulators explicitly include consideration of ecosystem services in wetland and stream trading, geographic service areas could be fit to the appropriate functional and social constraints necessary to maintain the social value of particular services.[511] More site-dependent ecosystem services could utilize tighter geographic restrictions on trading while less site-dependent services could utilize broader geographic restrictions. An ecosystem service's spatial discount rate could also influence the size of its service area.

Designating multiple, unbundled service areas for mitigation banks could also help to alleviate tradeoffs between a mitigation provider's economic viability and excessive geographic redistribution of functions and services.[512] Mitigation banks and ILF programs could sell less site-dependent services in geographically expansive markets that encompass many prospective permittees, while more site-dependent services would require smaller service areas. Spatially expanded markets for less site-dependent services, such as carbon offsets or terrestrial habitat, could provide increased marketing opportunities for these types of unbundled credits; this could help to promote investment in restoration before impacts without compromising the spatial scale at which all compensation occurs. In addition, increased demand for less site-dependent services due to larger markets could offset any reduced demand for site-dependent services with smaller service areas.

Importantly, unbundled service areas for mitigation banks and ILF programs are also legally permissible under the Rule. First, the Rule acknowledges the problems posed by tradeoffs among an ecosystem's functions and services in a broad sense, noting that

> [l]ocational factors (e.g. hydrology, surrounding land-use) are important to the success of compensatory mitigation for impacted habitat functions and may lead to siting of such mitigation away from the project area. However, consideration should also be given to functions and services (e.g., water quality, flood control, shoreline protection) that will likely need to be addressed at or near the areas impacted by the permitted impacts.[513]

To partially ameliorate the functional and economic tradeoffs associated with trading in bundled functions and services, the Rule establishes that regulators may compel use of "on-site, off-site, or a combination of on-site and

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[510] *Id.* at 11.

[511] BenDor et al., *supra* note 159, at 276.

[512] *See* Shabman & Scodari, *supra* note 13, at 23.

[513] Corps Mitigation Rule, 33 C.F.R. § 332.3(c)(2)(ii) (2008); EPA Mitigation Rule, 40 C.F.R. § 230.93(c)(2)(ii) (2008).

off-site compensatory mitigation to replace permitted losses of aquatic resource functions and services."[514] Promoting the use of combined compensatory mitigation packages that join functions or services from different mitigation sites would facilitate use of multiple service areas for mitigation providers and permittees. Finally, while the legal status of credit stacking is presently uncertain, the unbundling scenario we have presented diffuses legal concerns about selling the "same credits . . . to provide mitigation for more than one permitted activity," which the Rule explicitly disallows.[515]

For multiple service areas that impose more justifiable geographic restrictions on trading to be implemented, standardized geographic units for these functionally or socially tailored service areas must be developed. An obvious reason why HUCs and ecoregions are the top spatial scale types utilized for contemporary geographic service areas is that they are readily available on a national basis and can be easily assigned to prospective bankers or ILF programs. If regulators choose to only evaluate biophysical function in setting spatial restrictions, existing hydrologic and biogeographic assessments such as HUCs and ecoregions would likely be useful in setting a mitigation provider's multiple service areas, though more sophisticated unbundling schemes may best operate with geographic units that are more tailored to specific biophysical function(s). However, if regulators choose to pursue no-net-loss of ecosystem services, current geographic units will need substantial modification to incorporate human populations and the spatial quality of compensatory mitigation necessary for replacement of certain services.[516] At one extreme, for services with little or no site-dependency in maintaining social benefits, the service area would be similar to or match a function-based service area. For services with high site-dependency, geographic units would need to incorporate the spatial distribution of human demand for these ecosystem services.

The need for standardized, functionally and socially based geographic units for ecosystem services presents a promising research agenda requiring collaborative work among geographers, ecologists, and economists. Designing these spatial delineation systems can lay the groundwork for improving the landscape and social context of section 404 compensatory mitigation projects.

CONCLUSION

In this Article, we have outlined the ecological and economic bases for setting spatial trading restrictions in aquatic resource compensatory mitigation markets and presented a comprehensive, nationwide survey of geo-

[514] Corps Mitigation Rule, 33 C.F.R. § 332.3(d)(2); EPA Mitigation Rule, 40 C.F.R. § 230.93(d)(2).

[515] Corps Mitigation Rule, 33 C.F.R. § 332.3(j)(1)(ii); EPA Mitigation Rule, 40 C.F.R. § 230.93(j)(1)(ii).

[516] *See* BenDor et al., *supra* note 159, at 276.

graphic service areas applied to mitigation banks. Through our empirical work on geographic service areas in aquatic resource compensation markets, we have shown the types of decisions that regulators and market participants face in designing and operating all environmental markets that trade spatially uneven commodities. We have also revealed the immense complexity of these markets and how geography influences a market's ecological outcomes and values, economic dynamics, and ultimately its legal regulation.

Clearly, the law, policy, and practice of ecosystem service markets are fluid. As environmental markets grow in scope and complexity, the scale of geographic trading restrictions will likely gain importance and become a constraining issue — hamstringing either regulability or profitability. Specific to wetlands and streams, compensatory mitigation's greatest problem has been ensuring the quality of restoration rather than its location relative to impacts. We suggest that geographic trading limits should promote thick markets to the extent that they incentivize market participants to supply high-quality restoration. Geographic trading limits tailored to unbundled ecosystem functions or services may enhance incentives for investing in restoration by increasing potential income streams for environmental entrepreneurs. Markets must also holistically consider spatial variation in the series of physical, chemical, biological, and economic factors that influence the quality of a restoration site's ecosystem functions and services. Unbundled service areas likely would provide better functional and societal bases for geographically limiting offset options. In general, when geographic trading restrictions preclude selection of amenable restoration sites, it may be appropriate to place restoration quality in higher demand than spatial proximity to impacts.

This lesson can be transferred to new, proposed, and existing markets for ecosystem services: restoration of ecosystem processes and ecological communities is extremely difficult. Restoration site locations should be chosen to maximize restored ecosystem services, with subsequent consideration of the location of degradation or pollution, rather than the other way around.