The New Face of the Clean Water Act: A Critical Review of the EPA's Proposed TMDL Rules

James Boyd

Discussion Paper 00-12

March 2000

RESOURCES
FOR THE FUTURE

1616 P Street, NW
Washington, DC 20036
Telephone 202-328-5000
Fax 202-939-3460
Internet: *http://www.rff.org*

TABLE OF CONTENTS

THE NEW FACE OF THE CLEAN WATER ACT: A CRITICAL REVIEW OF THE EPA'S PROPOSED TMDL RULES

James Boyd[*]

1. INTRODUCTION

The United States is on the brink of a new era in water quality regulation. Proposed total maximum daily load (TMDL) rules are bringing to life a long-dormant approach to the identification, prioritization, and repair of the nation's polluted waters that promises to expand the gains in water quality secured by the Clean Water Act's (CWA) first 25 years.[1] Despite progress under the act, pollution or some form of habitat degradation continues to afflict 36% of surveyed river miles.[2] Moreover, of the nation's impaired rivers and streams, fewer than 10% are impaired primarily or secondarily by industrial point sources—the act's principal early target for pollution reductions along with municipal sewage treatment. These stark realities—as well as an abundance of litigation directed at the agency—have prompted the U.S. Environmental Protection Agency (EPA) to explore the potential of the CWA's section 303(d) to promote a wide variety of new actions to protect the nation's waters.

Long-neglected but always a part of the CWA, section 303(d) requires states to identify waters that are not in compliance with water quality standards, establish priorities, and implement improvements. In 1996, the EPA convened a Federal Advisory Committee, which culminated in a 1998 report and subsequent proposed rules for implementation of the TMDL program and associated changes in the National Pollutant Discharge Elimination System (NPDES) for point sources.[3]

As the proposed rules explain, "the TMDL specifies the amount of a particular pollutant that may be present in a waterbody, allocates allowable pollutant loads among sources, and provides the basis for attaining or maintaining water quality standards." [4] Within this description lies a significant shift in the way water quality is regulated. Instead of the technology-based, end-of-pipe approach to point sources that has

---

[*] Fellow, Resources for the Future, Washington DC, 20036 (*boyd@rff.org*).

[1] 33 U.S.C. §§ 1251-1387. For 1977 amendments to the act, see Pub. L. No. 95-217, 91 Stat. 1566 (1977).

[2] According to states' 1996 reporting under §305(b) of the CWA. National Water Quality Inventory: 1996 Report to Congress, EPA841-F-97-003, U.S. Environmental Protection Agency, Office of Water, April 1998. Summarized in EPA documents available at *www.epa.gov/ow/resources/9698*.

[3] Respectively, Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL Program, EPA 100-R-98-006, July 1998 (hereafter FAC); 40 CFR Part 130, Proposed Revisions to the Water Quality Planning and Management Regulation; Proposed Rule, 64 Fed. Reg., August 23, 1999, (hereafter CFR1); 40 CFR Part 122, 123, 124 and 131, Revisions to the National Pollutant Discharge System Program and Federal Antidegradation Policy In Support of Revisions to the Water Quality Planning and Management Regulation; Proposed Rules, 64 *Fed. Reg*., August 23, 1999 (hereafter CFR2).

[4] CFR1, 46013.

characterized CWA enforcement to date, the TMDL program promises an “ambient” approach to water monitoring and standards. That is, instead of focusing on releases from known sources of water pollution (i.e., monitoring discharges from discrete, identifiable pollution sources), regulation and reporting will increasingly be concerned with the *in situ* quality of waterbodies themselves. While this sounds like simple common sense, it should be emphasized that an ambient approach to water quality enforcement is largely untried.[5] For a variety of mostly pragmatic reasons, federal and state programs have focused on the regulation of point sources via technology-based standards to secure effluent reductions. But the low-hanging fruit of low-cost, high-volume point source reductions has largely been harvested. Today, significant water quality improvement implies the expansion of controls to nonpoint sources of pollution.

While the proposed TMDL rules have significant implications for point sources, it is the impact on nonpoint source regulation that is the TMDL program's most important characteristic. Because ambient monitoring will find a large number of the nation’s waterbodies to be impaired, and because nonpoint sources are a primary cause of that impairment, TMDLs will change the politics, economics, and implementation of water quality regulation.

This paper provides a description and critical review of the EPA’s proposed TMDL rules. The analysis is not critical of the overall movement toward this type of regulatory approach. In fact, TMDL-based rules should be thought of as an inevitable step toward a mature phase of regulation in which all sources of water quality degradation are addressed. However, the review is critical in the sense that it takes a sober view of the significant challenges facing regulators. After all, there is a reason nonpoint sources have largely escaped regulation over the last 25 years. Federal authority to mandate nonpoint source controls remains weak. Implementation of the analytic tools required by the TMDL process will be costly and difficult. And conflicts are almost certain to arise due to the geographically interrelated nature of pollution sources and legal jurisdictions. Also, the new rules explicitly create incentives for pollutant trading across point sources and nonpoint sources. According to one of the new rules, “EPA is seeking to establish a market for pollutant trading, in the hopes of creating more effective and efficient mechanisms for restoring water quality.”[6] While laudable as a means to promote flexible, cost-effective discharge controls, water quality trading should properly be viewed as a tall order with numerous barriers to implementation.

The paper does not address the debate over the CWA’s net social benefits.[7] Rather, the paper takes the CWA’s legal requirements as given and considers the

[5] Interestingly, however, statutory approaches that pre-date the Clean Water Act, such as the Water Quality Act of 1965, called for ambient water quality standards and state-driven implementation plans. The failure of these earlier approaches to water quality regulation are a cautionary tale. The difficulties inherent in linking particular sources to ambient conditions are daunting. For an overview of this early history, see Allen Kneese and Charles Schultze, *Pollution, Prices, and Public Policy.* The Brookings Institution, 1975, p 3050.

[6] CFR2, 46068.

[7] This issue has received significant attention from economists and from the EPA. Many studies find that the incremental costs of CWA rules exceed their benefits, as measured by willingness to pay for improved water quality. For an analysis of this issue, see Randolph Lyon and Scott Farrow, An Economic Analysis of Clean Water Act Issues, 31 *Water Resources Research* 213223, 1995. Also see U.S. EPA, President Clinton’s Clean Water Initiative: Analysis of Benefits and Costs, EPA Rep. 800-R-94-002, 1994.

economic implications of movement toward a TMDL-driven regulatory system. In addition to an overview of current water quality conditions, Section 2 sets out the history of the TMDL program's development, and offers a brief description of the proposed rules. Section 3 details TMDLs that have been completed. Section 4 explores a set of legal and economic challenges presented by the program's future implementation and makes some recommendations for the ways in which the program can be made most effective. Section 5 considers the difficulties associated with water quality trading. Section 6 offers a general set of conclusions based on the paper's analysis of the TMDL program.

2. TMDL PROGRAM BACKGROUND

The way water quality priorities are identified, the way responsibility for improvements is assigned, and the economic, political, and practical challenges of implementation are all changing. The history of Clean Water Act implementation—both its successes and failures— helps to explain why the TMDL program's time has come.

2.1 The Clean Water Act's Successes and Failures

Within 10 years of the Clean Water Act's passage, significant improvements in water quality were being reported by water scientists and regulators. An analysis of changes in water quality over the period 1974 to 1981 documented widespread reductions in lead and fecal bacteria concentrations, a reduction in industrial and municipal biological oxygen demand loads of 71% and 46%, respectively, and some geographically focused improvements in measures of dissolved oxygen deficit.[8] To put the accomplishment in better perspective, these gains came during a period when inflation-adjusted GNP increased 25% . The gains were largely due to CWA-related expenditures on the improvement of municipal sewage treatment. Between 1970 and 1985 the fraction of U.S. population served by wastewater treatment jumped from 42% to 74%.[9]

In addition to improvements in municipal wastewater treatment, technology-based standards for industrial point sources began to yield large improvements. Starting in the early 1980s, point sources have had to meet effluent limits consistent with a variety of technology-based standards such as "best available technology economically achievable."[10] Establishment of the NPDES permitting system has brought reporting, penalty, and anti-backsliding provisions to the regulatory scheme. Complementing this federal permit authority, section 505 of the CWA enables citizens to file suit for compliance with NPDES permits or EPA orders.[11] Together, these enforcement tools

[8] Richard Smith, Richard Alexander, and M.Gordon Wolman, Water Quality Trends in the Nation's Rivers. 235 *Science* 1607, 1987.

[9] World Resources Institute, *World Resources 1992-1993*, 1992, 167.

[10] Compliance was phased in over a period of years, with the timing depending on the source category and effluent classification.

[11] The CWA's citizen suit provisions are thought to have been particularly effective, at least relative to their use under other statutes. See Charles Abell, Ignoring the Trees for the Forest: How the Citizen Suit Provision of the Clean Water Act Violates the Constitution's Separation of Powers Principle, *81 Virginia Law Review* 1957, 1995. For a more critical view of penalties under the CWA, see Robert Adler, Jessica Landman, and Diane Cameron, The Clean Water Act 20 Years Later, Natural Resources Defense Council, 1993, 166-170. And see Michael Healy, Still Dirty After Twenty-Five Years: Water Quality Standard

have precipitated significant reductions in industrial point source releases. For instance, between 1987 and 1990 toxic discharges to surface water fell from 417 to 197 million lbs per year, according to Toxics Release Inventory data.[12] By setting limits on the discharge of more than 60 pollutants, including organic pollutants and heavy metals, the EPA Office of Water currently estimates that the program reduces conventional pollutant discharges by 108 million lbs and toxic discharges by 24 million lbs annually.[13] A rough, but illustrative, benchmark of these collective improvements is offered by the EPA:

> In 1972, most estimates were that only 30 to 40 percent of assessed waters met water quality goals such as being safe for fishing and swimming. Today, state monitoring data indicate that between 60 to 70 percent of assessed waters meet state water quality goals.[14]

At least an academic consensus exists that the CWA is one of the environmental movement's success stories, owing to its capacity to motivate point source controls.[15] But to say that the CWA has improved water quality is not to say that further efforts are not indicated. In fact, the nation's waters remain significantly polluted.[16]

A corollary to the CWA's achievements is the sobering fact that 30% to 40% of waters still fail to meet state standards. More specifically, according to the latest National Water Quality Inventory, 36% of the rivers and streams surveyed were partially or fully impaired, and water quality is "threatened" in an additional 8%. Of the surveyed lakes, 39% were partially or fully impaired, with water quality threatened in an additional 10%. Of surveyed estuaries, 38% are reported to be partially or fully impaired, with water quality threatened in an additional 4%.[17] Casting the data somewhat differently, the states have identified more than 20,000 individual river segments, lakes, and estuaries as polluted. This amounts to 300,000 miles of river and 5 million acres of lakes classified as polluted.[18]

The data strongly suggest that improvements in water quality have been disproportionately due to point source regulation. Recognition is now widespread that nonpoint sources are of principal concern. Consider the EPA's most recent ranking of sources contributing to water quality impairment:

Enforcement and the Availability of Citizen Suits, 24 *Ecology Law Quarterly* 393, 1997 (for an analysis of whether citizen suits are available in the context of water-quality-based CWA violations, rather than permitting violations).

[12] The study in which these figures are cited is highly critical, however, of the implementation of point source regulations under the CWA. Cited in Adler, Landman, and Cameron, supra note 11,at 18.

[13] U.S. EPA Clean Water Successes and Challenges, at *http://www.cleanwater.gov/action/c1a.html.*

[14] Ibid.

[15] Drew Caputo, A Job half Finished: The Clean Water Act After 25 Years, 27 *ELR* 10574, November 1997; Robert Percival (ed), Alan Miller, and Christopher Schroeder, *Environmental Regulation: Law, Science, and Policy* (Little, Brown & Co., 1996).

[16] When it comes to overall water quality and the water-quality-based regulations in the CWA, critics can be quite blunt: "evaluated from a variety of perspectives, the enforcement of the water quality-based system of pollution control must be viewed as a failure." Michael Healy, Still Dirty After Twenty-Five Years: Water Quality Standard Enforcement and the Availability of Citizen Suits, 24 *Ecology Law Quarterly* 393.

[17] National Water Quality Inventory*,* supra, note 2. The surveys covered 19% of all stream miles, 40% of all lake acres, and 72% of all estuarine waters.

[18] U.S. EPA, Office of Water, Overview of the TMDL Program, *www.epa.gov/OWOW/tmdl/tmdlfs.html.*

Rank	Rivers	Lakes	Estuaries
1	Agriculture	Agriculture	Industrial discharges
2	Municipal point sources	Unspecified nonpoint sources	Urban runoff/ storm sewers
3	Hydrologic modification	Atmospheric deposition	Municipal point sources
4	Habitat modification	Urban runoff/ storm sewers	Upstream sources
5	Resource extraction	Municipal point sources	Agriculture

Source: The Quality of Our Nation's Water, Overview of States §305(b) water quality reporting for the year 1996, U.S. EPA, p. 13.

Industrial sources, while present on this list, clearly do not predominate. Instead, a host of nonpoint sources, in particular from urban and agricultural runoff, loom large.[19]

Pesticide, fertilizer, and animal waste runoff from agriculture is the single largest contributor to the impairment of rivers and lakes. The private incentive of agriculture to ensure the largest yields via perhaps excessive application of pesticides and fertilizers is a classic example of an environmental externality, since much of the application inevitably migrates into common resource waterbodies. Logging and construction activities, many of them on federal lands, are a significant source of sediment contamination, as runoff carries fine-grained soils from roads and construction sites into lakes and streams. In urban and suburban areas, watershed degradation is closely tied to increased population density and residential and commercial development. In such areas the relatively impermeable nature of groundcover leads to rapid, unfiltered runoff from roadways and parking lots, chemically treated lawns, and commercial establishments.[20] Increased attention is also being given to atmospheric deposition, where pollutants from airborne dust and industrial and commercial air emissions are absorbed by surface waters or precipitated via rainfall.[21] In the Northwest, elevated water temperatures are having a negative impact on cold-water salmon habitat.[22] Finally, legacy pollution (i.e., pollution no longer being discharged) that has collected in sediments is a significant source of ongoing waterbody impairment.[23]

[19] In common parlance, pollution from nonpoint sources is "runoff caused primarily by rainfall around activities that employ or cause pollutants." *United States v. Earth Sciences,* 599 F.2d 368,373 (10th Cir. 1979).

[20] Compare the "rainfall allocation" for natural and urban groundcover. With natural groundcover, approximately 40% evaporates, 50% infiltrates the soil, and 10% runs off. In an urban setting 30% evaporates, 15% infiltrates, and 55% runs off. Northeastern Illinois Planning Commission, *Urban Stormwater Best Management Practices for Northeastern Illinois,* (Northeastern Illinois Planning Commission: Chicago, IL) 1993.

[21] The proposed rules explicitly include atmospheric deposition as a nonpoint source of pollutants. CFR1, 46016.

[22] Water temperature is viewed as a component of overall water quality. *Environment Reporter*, Temperature Becoming Larger Issue for Northwest Dischargers, Official Says, August 20, 1999, p. 795.

[23] EPA estimates that 10% of the nation's lakes, rivers, and bays have sediment contaminated with toxic chemicals that can kill fish living in those waters or impair the health of people and wildlife who eat

One of the reasons these sources are such a significant problem is that they present serious implementation, monitoring, and enforcement challenges. But the water quality problems they cause can no longer be ignored, particularly given the significant reductions already secured from point sources.[24] In this context, it is not surprising that political and legal pressure is being applied to the EPA, and in turn to the states, to make something of the regulatory potential contained in the CWA's TMDL provisions.

2.2 The Changing Politics of Water Quality

The seeds of this shift in regulatory emphasis have been in place since the act's passage in 1972. Within section 303 lie provisions that call for an ambient-water-quality-driven (rather than end-of-pipe) approach to enforcement. The section calls upon the states to identify waters for which the point source controls elsewhere in the act "are not stringent enough to implement any water quality standard applicable to such waters."[25] States must prioritize any waters so identified, based on analysis of use and severity of degradation, and establish total maximum daily pollutant loads sufficient to bring the waters into compliance.

Section 303 provisions were largely ignored by states and the federal government during the first two decades of CWA enforcement.[26] But nonattainment of water quality goals and the desire to bring more sources into the regulated sphere has led to a reexamination of the latent enforcement power contained in section 303. The importance of the section is, first, that it requires state-wide assessments and public documentation of water quality problems. As the public becomes aware of the "impaired" nature of the waters around their communities, this reporting alone will provide a motivation for state regulatory efforts. Second, the TMDLs themselves appear, at least in principle, to imply that states must allocate pollutant load reductions to sources not currently covered by load restrictions. Since load reductions have been wrung from point sources over a period of 25 years, and since the bulk of current impairment is caused by nonpoint sources, any state seeking further load reductions—at least on a cost-benefit basis—will be led directly to nonpoint sources. In this way, the shift to ambient monitoring and standards almost necessarily leads to a greater emphasis on nonpoint sources.

Enforcement of section 303 clearly alters the politics of load reduction. The need to meet *in situ* water quality standards sets up a state-by-state confrontation between well-organized industrial interests—who can claim to have already paid their pollution control dues—and organized agricultural, silvicultural, and municipal interests who resist the "expansion" of CWA-driven requirements to their hard-to-solve nonpoint problems. An industrial and municipal constituency for nonpoint source controls can already be

---

contaminated fish. Listing of Fish and Wildlife Consumption Advisories, EPA 823-C-97-004, 1997; The Incidence and Severity of Sediment Contamination in Surface Water of the United State*s*, EPA 823-R-97-006, 007, 008, 1998).

[24] In the words of one observer, "unless TMDLs include quantified restrictions on nonpoint sources, they are wasting everyone's time." Oliver Houck, TMDLs, Are We There Yet? The Long Road Toward Water Quality-Based Regulation Under the Clean Water Act, 27 *ELR News and Analysis* 10391, July 1997, 10401.

[25] 33 U.S.C. §1313(d).

[26] For a detailed analysis of the history of the section 303 provisions in the context of the CWA's overall implementation, see Houck, *supra* note 24 and Oliver Houck, TMDLs: The Resurrection of Water Quality Standards-Based Regulation Under the Clean Water Act, 27 *ELR News and Analysis* 10329, August 1997.

detected. According to the Director of the Association of Metropolitan Sewerage Agencies, "In the absence of nonpoint source controls, all these criteria drive tighter standards. All that's left is tighter limits on permits."[27] This scenario is obviously of great concern to current point source permit holders. A minority (dissenting) contribution to the Federal Advisory Committee Report by a municipality representative and industrial source representative echoed the worry saying, "It is patently unfair to encourage states to impose further burdens on point sources merely because of the absence of federal enforcement authority over nonpoint sources."[28]

The EPA's authority to implement the new TMDL and NPDES permitting rules is not accepted by all parties. Even if the new rules are successfully promulgated, many opponents will not accept the changes quietly. Following rule publication, members of a House subcommittee criticized the EPA for not requesting Congress to enact authorizing legislation in support of the TMDL program.[29] Some agricultural interests argue that the proposed TMDL rules "illegally link nonpoint source runoff to the federally dictated and enforceable TMDL program" by reading the CWA to cover only waters impaired by point sources.[30] The EPA's position is that the CWA provides ample authority for the proposed TMDL rules. Within the proposed rules themselves, the EPA counters the argument that the agency has no authority to regulate nonpoint sources. "Section 319, a section that exclusively addresses nonpoint sources, provides clear evidence that Congress did not intend to limit the term 'pollutant' to point sources."[31] If a state fails to impose controls over an operation that is the source of an ongoing water impairment, the agency contends that the CWA provides it with authority to step in and issue Best Management Practices (BMPs) or other controls to reduce nonpoint pollution.[32]

2.3 Litigation

The direct impetus for the new focus on section 303 was a series of court cases, beginning in the late 1980s that challenged the EPA's oversight of the states' responsibilities. Until very recently, most states had failed to submit their assessments of polluted waters (if those assessments even existed at all), and had therefore failed to engage in the prioritization of waters for cleanup, promulgation of TMDLs, and implementation of associated discharge controls called for under section 303. The history of this litigation has been usefully summarized by EPA itself, and by others.[33] Currently,

[27] Chances for Clean Water Bill Dim; EPA to Use Existing Authorities on Nonpoint Sources, *Environment Reporter*, Jan 22, 1999, S-18-19.
[28] FAC, I-4.
[29] House Panel Members Question EPA Authority to Issue TMDL Proposal, *Environment Reporter*, November 5, 1999, p. 1241.
[30] This argument was presented in a memorandum to the Office of Management and Budget from the National Pork Producers Council, the National Cattlemen's Beef Association, and the American Crop Protection Association, reported in Waters Impaired By Nonpoint Sources Would Be Listed, Draft TMDL Rule Says, *Environment Reporter*, p. 520, July 16, 1999.
[31] CFR1, 46021. Federal authority over nonpoint sources is analyzed in more detail in section 4.1 infra.
[32] Testimony of Chuck Fox, EPA assistant administrator for water, cited in *Environment Reporter*, note 29 supra.
[33] See *www.epa.gov/OWOW/tmdl/lawsuit1.html* and Houck, supra, note 26. According to Houck, the states "By and large, did not do anything called for under §303(d)…They did not do it in the 1970s. They did not do it in the 1980s. They did not do it at the outset of the 1990s, nor did EPA—until a series of citizen suits rocked EPA and the states into a hasty rereading of §303(d) and the current scramble to comply," 10344.

the EPA is under court order in 17 states to establish TMDLS if the states fail to do so. In 14 other states litigation has been filed (or notice has been given of intent to file) seeking to compel EPA establishment of TMDLs.[34]

The Federal Advisory Committee and the proposed rules should be viewed as a direct outgrowth of this litigation.[35] The litigation has also had an immediate effect on state assessments and reporting of impaired waters. *Idaho Sportsmen's Coalition v. Browner* is illustrative.[36] As of 1989, Idaho had submitted no list of "water quality limited segments" (WQLSs). As of 1992 the state had a list, but one with only 36 listed WQLSs. Using a "constructive submission" theory, the court found the EPA's approval of Idaho's compliance with section 303 to be arbitrary and contrary to law. Under court order, the EPA has since approved a list identifying 962 Idaho WQLSs. All states and territories have now at least submitted a list, with full EPA approval secured by 38 states.[37]

2.4 Brief Overview of the Proposed Rules

The proposed revisions to the EPA's TMDL rules provide more specificity and structure to the operation of the program. The rules lay out a basic set of requirements for the states, including:

- *Which waters are listed.* While it is largely up to an individual state to determine which waters are impaired, the rules require public review of the procedures by which a state arrives at its list. And EPA has final approval authority over listings and the methodologies used to derive them. According to the rules, the EPA's view is that "the section 303(d) list should serve as a comprehensive public accounting of all waterbodies impaired or threatened by pollution and pollutants, irrespective of the tool or mechanism being used to achieve standards."[38]

- *A format for listing and the assignment of priorities.* The states are required to rank waters by their degree of impairment and to assign waters on the list to categories that reflect their priority and progress toward meeting standards. Impaired waterbodies designated as public drinking water supplies and those posing a threat to species listed under the Endangered Species Act, must be designated a high priority.[39] Apart from that, the states are allowed discretion, subject to federal

[34] Cases establishing the failure of a state to meaningfully or fully submit the required 303(d) lists and need to develop TMDLs include *Northwest Environmental Defense Center, et. al. v. EPA*, No. 85-1578 (D.Ore.); *Alaska Center for the Environment v. Browner*, 20 F.3d 981 (9th Cir. 1994); *Sierra Club, et al. v. Hankinson*, 939 F.Supp 865 (N.D. Ga. 1996). Consent decrees or settlement agreements include *Pacific Coast Federation of Fishermen's Associations, et al. v. Marcus, et al.*, No. 95-4474 MHP (N.D. Calif.); *American Littoral Society, et al. v. EPA*, No. 96-489 (E.D. Pa.); *Defenders of Wildlife, et al. v. Browner, et al.*, No. 93-234 TUC ACM (D.Ariz.).

[35] Note 3 supra.

[36] 951 F.Supp. 962, 964 (W.D. Washington 1996) (describing the case's procedural history).

[37] It is important to note that these are lists of impaired waters, not the states' final TMDL plans.

[38] CFR1, 46025. States have latitude to determine the geographic scope of a waterbody or segment that is listed. Listing can relate to an entire basin or individual stream segments. There is a tradeoff here. Too large an area may overwhelm the regulator's ability to monitor, evaluate, and implement a plan effectively. Too small an area may fail to account for all of the sources contributing to the problem.

[39] CFR1, 46026.

oversight. A range of factors may be considered in the development of the priority rankings. “These factors include immediate programmatic needs, vulnerability of particular waterbodies as aquatic habitats, recreational, economic and aesthetic importance of particular waterbodies, degree of public interest and support, and State, Territorial, authorized Tribal, or national policies and priorities.”[40]

- *Timelines.* States are required to establish TMDLs for all waterbodies within 15 years. TMDLs for waterbodies listed as “high priority” must be established first, and states are “encouraged” to develop TMDLs for such waters within 5 years of listing.

- *The implementation of TMDLs themselves.* All TMDLs must identify the pollutants contributing to impairment and establish the load reductions necessary to bring the water into compliance, including a margin of safety. The TMDL must identify pollutant sources, including nonpoint sources. And the TMDL must feature an implementation plan, with a list and timeline for actions, including monitoring and verification of compliance. The implementation plan also includes an “allocation” of load reductions to different sources. Local conditions—ecological, political, and economic—will be allowed to determine the nature of the allocation. According to the rule, TMDLs “provide for tradeoffs between alternative point and nonpoint source control options so that cost effectiveness, technical effectiveness, and the social and economic benefits of different allocations can be considered by decision-makers.”[41]

State-level TMDL development, particularly the allocation of load reductions, is likely to spur a host of innovative approaches to pollutant load reductions by drawing new sources and trading mechanisms into new control systems. But to complement this “many flowers will bloom” flexibility, the proposed rules codify a set of requirements meant to guarantee meaningful and comparable state initiatives.

The proposed TMDL rules are also accompanied by proposed changes to the NPDES permitting system for point sources.

- *New point source offset requirements.* During the period (perhaps 20 years or more) until TMDL benefits can be fully realized, the new rules seek net reductions in point source discharges to impaired waterbodies. The proposed rules require all “large” new dischargers and existing dischargers undergoing a “significant” expansion in discharges on impaired waterbodies to offset the new discharges, by an amount equal to 150% of the new discharge.[42]

- *Expansion of point source designation.* In order to expand its authority to previously unregulated sources, the EPA proposes to designate large animal feeding, aquatic animal production, and certain forestry operations as point sources. Thus

[40] CFR1, 46025.
[41] CFR1, 46030.
[42] CFR2, 46059. And see discussion, note 154 infra.

classified, these facilities would fall under NPDES permit requirements.[43] This reclassification is expected to increase from 2,000 to 20,000 the number of feedlot operations alone that are required to secure permit approval.[44]

These rules are analyzed in more detail below. While still in a proposal and comment phase, and with significant implementation questions remaining, the rules should nevertheless be recognized as a significant new development in the nation's approach to water quality improvement.

3. COMPLETED TMDLS: AN ILLUSTRATION

In response to the threat of legal action or court orders, a number of states have moved forward with the development of loading standards for priority impaired water segments.[45] To illustrate the components and practical implications of a TMDL analysis and plan,[46] the Columbia Slough TMDLs are described here, though they should not be viewed as necessarily representative of TMDLs generally. The problems and solutions identified in TMDL planning are highly idiosyncratic. The Columbia Slough case was selected for description, however, because it involves a complex set of impairments and includes detailed analysis and concrete implementation plans by the state. In fact, the Columbia Slough TMDLs are notably specific in their description of the enforcement and implementation tools that will be called upon to achieve water quality improvements.

3.1 Columbia Slough TMDLs

Once impairments are identified through the listing process, TMDL planning turns to the identification of pollutant sources, the allocation of responsibility for source reductions, and implementation and enforcement of the allocations. These steps are illustrated in turn.

Columbia Slough is a roughly 19-mile-long collection of mostly shallow water channels located on the Columbia River's floodplain near Portland. A variety of land uses—industrial, residential, and agricultural—occurs in the 40,000 acre area that drains into the slough. The geographic scope of the TMDLs was determined largely by hydrological characteristics, such as drainage areas and tidal flows. EPA approved the TMDLs for Columbia Slough in November 1998.

3.1.1 How are water quality problems identified?

The first step in the TMDL process is listing a waterbody as impaired. This process identifies by category the cause of impairment (e.g., excessive algae or lead) and compares existing conditions to the relevant water quality standard. Impairment is

[43] CFR2, 46074-78. The authority to reclassify pollution sources under the CWA resides with the EPA, affirmed by the D.C. Circuit in *NRDC v. Costle*, 568 F.2d 1369, 1377 (D.C. Cir., 1977).
[44] *Environment Reporter*, Vol. 29, No. 37, 1-22-99.
[45] Among others, California, Maryland, Pennsylvania, West Virginia, North Carolina, Delaware, and Oregon have completed EPA-approved TMDLs for some of their impaired water segments.
[46] Oregon Department of Environmental Quality, Columbia Slough TMDLs (1998) *http://waterquality.deq.state*.or.*us/wq/TMDLs/TMDLs.htm*, hereafter CSTMDL.

established in reference to criteria established and documented by the state.[47] These criteria describe the standards for each category of impairment, the data to be used, and guidelines to ensure the quality of data analysis.[48]

As an example, consider the state's framework for determining a chlorophyll *a* impairment. The beneficial uses affected by impairment include water-contact recreation, aesthetics, fishing, water supply, and livestock watering. The standards are expressed as numeric concentrations (e.g., mg/l).[49] Water quality is considered limited, and thus subject to listing, if the three-month average exceeds the numeric standard.[50] Data used for the 1998 listing of waterbodies come from a variety of sources, including the Oregon Department of Environmental Quality (DEQ) itself, as well as contractors and federal agencies. Standards and data vary by pollutant. For example, fish or shellfish consumption advisories issued by the Oregon State Health Division are used to indicate impairment due to toxic pollutants.[51]

The Columbia Slough was placed on the Oregon Department of Environmental Quality's 303(d) list because of a variety of impairments. The slough was found to be in violation of standards for chlorophyll *a*, dissolved oxygen, pH, phosphorus, bacteria, and a range of toxic pollutants, including lead, dioxin, and PCBs *[I wouldn't]* . These pollutants individually threaten one or more beneficial uses of the waterbody including recreational fishing, boating, swimming, or support of aquatic life. Water column, fish tissue, and sediment data were used to identify the slough as impaired. The data came from a variety of sources, including metropolitan agencies, the City of Portland Bureau of Environmental Services, Portland State University, and the EPA. Historically, monitoring of the waterbody has been conducted only "sporadically," according to the DEQ.[52]

The Columbia Slough case highlights the value of the listing process alone. As of 1998, Portland residents could look to a readily available state analysis of a waterbody, which lies in close proximity and provides them with a range of recreational, aesthetic, and commercial values. That the waterbody suffers from ten distinct forms of impairment is an easily comprehended and presumably politically salient piece of information.[53] Moreover, the listing process itself promotes higher quality and more consistent data collection and analysis.

3.1.2 How are sources and their contributions to impairment identified?

Once they have knowledge of impairment, states must design TMDLs that provide a defensible plan for source reductions to bring the affected waterbody into attainment. The development of TMDLs requires knowledge of sources and the pathways

---

[47] Oregon Department of Environmental Quality, Listing Criteria for Oregon's 1998 303(d) List of Water Quality Limited Water Bodies, October 1998.
[48] Standards are described in Oregon Water Quality Standards, Oregon Administrative Rules, Chapter 340, Division 41 (OAR 340-41).
[49] As established in OAR 340-41-150.
[50] There is a required minimum of five representative data points per sampling site, collected on separate days during the peak algal growing season.
[51] See note 47 supra.
[52] CSTMDL, p. 5.
[53] Like the Toxics Release Inventory, the provision of information relating to pollutant discharges alone may yield environmental benefits. Local political pressure on pollutant sources may be provoked by such listing. At a more national level, this kind of reporting also gives environmental advocates a useful way to compare and judge the performance of regulators and source categories.

by which pollutants are transported and deposited in the waterbody. Identification of sources and pathways requires a kind of holistic accounting exercise. To construct a source inventory, states typically will survey permitted sources (industrial and municipal point sources) and inventory land uses in the affected waterbody's drainage area to identify nonpoint sources, such as agricultural and urban runoff. In some cases, source identification requires the equivalent of detective work in order to connect ambient conditions with specific sources. As an example, severe oxygen depletion was detected in the Columbia Slough following a large winter storm. This finding suggested that a source of impairment was airplane de-icing chemicals that ran into the slough from Portland International Airport. In another case, elevated bacteria levels "substantially higher than those predicted via modeling" have directed attention toward the detection of illicit discharges.[54]

In addition to source identification, the development of a TMDL must be based on the estimate of the effect of source reductions and other control activities on water quality. In some cases, this process is straightforward. For example, an already permitted point source may discharge directly into the waterbody. If so, the source, transport, and deposition mechanism and contribution to loadings in the receiving waterbody are already known. In general, however, TMDLs will be geared toward waterbodies with multiple sources that migrate and enter the waterbody via a diverse set of pathways. Understanding the contribution of a particular source to loadings in this more general set of cases is a significant technical challenge.

Sources of impairment in the Columbia Slough include a complex mix of sewer overflows, urban runoff, landfill leachate, industrial discharges, sediments, and agricultural runoff. The complexity of making source determinations is compounded by a variety of interactions between ground and surface water, weather events, temperature, and water quality.[55] For this reason source contributions are rarely known with certainty. Instead, the regulator must rely on models that attempt to capture the factors that affect the transport, deposition, and ultimate fate of pollutants in the waterbody.

The models used are determined by the type of data available and the nature of the system being described. For instance, stormwater discharges can be monitored for lead. Such monitoring provides a rough gauge of the amount of lead deposition attributable to urban runoff. In turn, contributions to urban runoff by categories of sources can be estimated via modeling. Concretely, the land area in the drainage area occupied by industrial facilities or roadways can be used to estimate the fraction of lead runoff due to those sources. The Columbia Slough TMDL includes a particularly detailed analysis of lead loadings. Individual industrial, stormwater, and sewer point source permit holders are identified and their lead discharges assessed. In addition, there is analysis of lead contributions by land use category. For each category, including residential, industrial, commercial, parks, and traffic corridor, the land area is provided and estimates of the lead load (in pounds per year is estimated).[56] Consider the model used to calculate these loads for a single land use category:

[54] CSTMDL, p. 28.
[55] Steven Chapra, *Surface Water Quality Modeling*, McGraw Hill, 1997.
[56] CSTMDL, Appendix A, A-15.

> The contribution of lead from permitted industrial sites is calculated using the following equation: (Area x Annual Rainfall x Runoff Coefficient x Pollutant Concentration = Annual Pollutant Load). The annual rainfall for the watershed is given in Table 3-12 of the Portland MS4 permit application as 34.3 inches per year, and the runoff coefficient for industrial areas is given in Table 3-13 as 0.68.[57]

The example highlights the data requirements and assumptions that go into the calculation of a single number in a single analysis that is a component of a much larger evaluation of sources and relative pollutant contributions.

The modeling techniques and data required for TMDL implementation pose a significant challenge. Accordingly, they also contribute significantly to the costs of implementation.[58] Some simplicity and cost savings will undoubtedly be possible as states become more practiced in TMDL development—and as more resources are devoted to the development of data and models for use in this kind of program. However, the degree to which data sources and modeling techniques can be standardized is limited. Each listed water segment is in some sense unique, for example, in its hydrology, transport pathways, pollutant sources, and so forth. TMDL development will invariably involve some site-specific analysis (even if the point of the analysis is simply to show that some set of standard data and techniques is applicable to the waterbody).

As an example of the site-specific nature of analysis, consider the Columbia Slough TMDL's approach to excessive nutrient loadings. Because "point source loads are minor"[59] the search for source reductions involves groundwater controls, such as the installation of sanitary sewers. However, because the effect of these reductions is much delayed and "uncertain,"[60] the plan calls for changes in channel and stream flow. The recommended changes are based on a site-specific analysis of natural flows, temperature, time of year, and expected algae growth and flow management techniques available in the drainage area. The applicability of "general" modeling techniques to this kind of problem is limited.

For the Columbia Slough, the extent of documentation related to data and analysis and methods is exemplary, as is the sophistication of the analysis itself. In turn, however, the volume and complexity of the modeling techniques imply an equally complex array of simplifying assumptions and potential shortcomings. In general, the TMDL process highlights data limitations and our ignorance of the physical, chemical, and ecological factors that determine the fate of pollutants.

3.1.3 How is responsibility for reductions determined?

Having determined the contribution of categories of sources to impairment, the TMDL must assign load "allocations" (divisions of responsibility for reductions) that are

---

[57] CSTMDL ,Appendix A, A-15.

[58] An EPA study of TMDL costs identified modeling and data collection (monitoring) costs as the most significant contributors to the costs of TMDL implementation. The study of 14 completed TMDLs found that development costs ranged from $4,000 to more than $1 million dollars. Eight of the 14 cost more than $100,000. U.S. EPA,TMDL Development Cost Estimates: Case Studies of 14 TMDLs, Office of Water, EPA841-R-96-001, 1996.

[59] CSTMDL, p. 14.

[60] The report suggests that it will take 30 years to achieve a 40% reduction in groundwater nitrogen, CSTMDL, p. 24.

expected to bring the waterbody into compliance. In the case of some, though not necessarily all sources, these allocations will imply reductions in current discharges. Thus, the allocations determine responsibility for the technological or land management changes that will lead to improvements. For example, a currently discharging source, if allocated a zero wasteload, must totally eliminate its discharges.

In some cases the allocation is assigned to specific sources, in others to general categories—such as a type of land use. Not surprisingly, allocations to specific sources tend be directed at point sources and general allocations directed toward to nonpoint sources. As in the determination of sources, the allocation process often involves a quantitative modeling exercise. Modeling is used to estimate the impact of a load reduction from a particular source on the receiving waterbody. Models may also be used to predict how changes in land use brought on by economic growth will add to the waste load.[61]

Consider the allocations used to reduce biological oxygen demand (BOD) in the Columbia Slough. Recall that the two primary sources contributing to the oxygen deficit are Portland International Airport and urban runoff. Oregon allocated responsibility for reductions by considering the relative baseline contributions to the oxygen deficit. These relative contributions were determined, via modeling, to be 3.8 lbs of BOD airport load for every pound of urban runoff load. This ratio provided the basis for the allocation of reductions. Within these broad categories further divisions were made. For de-icing, 89% was assigned to the airport and the remaining 11% to the Oregon National Guard. For urban runoff, 46% was assigned to permitted stormwater dischargers and the remainder to future growth and nonpermitted sources.[62] In the course of the public comment process, the allocation was explained as follows: "DEQ … feels that allocations based on the relative contributions of the pollutant is appropriate for a situation in which one source causes most of the water quality impairment."[63] Note that the rationale for the allocation makes no reference to the costs of discharge controls. Instead, equity seems to be the underlying motivation. No explicit rationale need be, or is, given.

Allocations are also motivated by pragmatism. In several cases, the permitted (or allowed) allocation is equal to the baseline contribution of a source, implying no need for source reductions. These examples include "upstream" sources of bacteria (which, because they are upstream, are not controllable by this particular TMDL)[64] and atmospheric deposition of lead (uncontrollable for similar reasons).[65] Interestingly, specific point sources are in some cases also exempt from load reductions. This is true presumably because point sources are already subject to "best available" controls on releases. For example, a landfill generating lead-contaminated leachate was not required to achieve reductions in excess of its baseline allocation.

Discharge reductions in Columbia Slough are to come from a variety of sources. For bacteria, reductions come from the elimination of combined sewer overflow (CSO)

[61] If growth is expected, the TMDL must explicitly consider that expectation as a source category and provide an allocation for land use changes.
[62]CSTMDL, p. 12-14.
[63] CSTMDL, Appendix E, p. E-14.
[64] CSTMDL, p. 30.
[65] CSTMDL, p. 36.

discharges[66] and the elimination of illegal raw sewage sources. Both received a load allocation of zero.[67] The primary reductions in lead loadings are allocated to sources of urban runoff. These reductions are to come from changes in industrial stormwater permits and implementation of best management practices (BMPs) applied to commercial, industrial, and traffic corridor land uses.[68] For nutrients, reductions from a single agricultural point source and drainage district water flow management changes are required. Direct reduction in organic contaminants (such as DDT and Dioxin) are not possible since these pollutants are no longer being released. Instead, the TMDL focuses on erosion in the drainage area. Stormwater transport of contaminated sediment is the primary transport and deposition mechanism. The stormwater allocation is reduced. Moreover, of the total organic allocation, 33% is devoted to future growth, since construction promotes erosion and is expected to increase loads. Reductions are to be achieved through implementation of erosion-control BMPs.

3.1.4 How will implementation and enforcement of the TMDL be achieved?

Along with the allocation of loads, and the reductions in discharges they imply, TMDLs must specify policies to achieve those allocations.[69] How are allocations to be monitored? What enforcement tools can be brought to bear to ensure compliance? Is private or public funding available for the technological and management changes implied by the allocations? The more specific and helpful a TMDL is in response to these questions, the more likely are its load reductions to be translated from aspirations into reality.

The Columbia Slough TMDL is noteworthy in that it provides particularly detailed descriptions of implementation activities. Implementation takes a variety of forms, including monitoring, revisions to NPDES permits, public capital projects, and the use of BMPs. Monitoring requirements include an ongoing study of airport-related BOD, a survey of area septic systems to identify sources of bacteria, and monitoring of toxic runoff associated with environmental cleanup sites. Revision of the airport's NPDES permit is identified as a way to promote more effective treatment of de-icing runoff. [70] Public capital projects that will lead to reductions include the construction of sanitary sewers, removal of cesspools, construction of treatment facilities for CSOs, and separation of sewers from stormwater systems.[71] Both private landowners and local government entities are required to use a variety of BMPs, including redesign of roof drains to avoid bacteria discharges from septic systems, techniques to control erosion and the transport of contaminated sediment, and changes in flow management by the area drainage district. [72] Renewal of stormwater permits will also be made conditional on evidence of BMP compliance.[73]

---

[66] The city has been ordered to eliminate all untreated CSO discharges to the Columbia Slough (Amended and Stipulated Consent Order, WQ-NWR-91-75).
[67] CSTMDL, p. 30.
[68] BMPs are discussed in more detail in section 4.3, infra.
[69] "The implementation plan must contain reasonable assurance that the implementation activities will occur." CFR1, 46033.
[70] CSTMDL, p. 15.
[71] CSTMDL, p. 25.
[72] CSTMDL, p. 25.
[73] CSTMDL, p. 16. For more discussion of BMPs, see infra.

The plans also must be explicit in their assignment of responsibility for monitoring activities and BMP implementation among government entities. Memoranda of agreement between designated management agencies form the basis for this division of authority.[74] Responsibility is divided between the DEQ, a collection of municipal governments, county government, and the state departments of agriculture and transportation.[75] In addition, DEQ lists a set of possible funding sources for TMDL-related attainment projects, available to both private and public entities.[76]

On paper, the Columbia Slough TMDL illustrates the promise of a water-quality-driven regulatory approach. The TMDL identifies impairments and their sources, allocates responsibility for source reductions and management improvements, and offers a detailed plan for monitoring and implementing improvements. Thus, it marks an ambitious expansion of efforts relative to those associated with conventional water quality regulation. The TMDL expands waterbody and source monitoring and the techniques used to analyze pollutant transport and deposition. The plan also imposes regulatory requirements on previously unregulated sources and mandates changes in land and water management practices throughout the drainage area. Finally, the TMDL notifies the source of those problems and identifies the private and public parties responsible for improvements.

3.2 Other Examples

One of the distinguishing features of Columbia Slough is that agricultural nonpoint sources are not a significant source of impairment. As noted earlier, agricultural nonpoint sources will be featured in many TMDLs, because of the prevalence of excessive nutrient loadings in many of the nation's waterways. A brief description of nutrient TMDLs is therefore instructive. Like the Columbia Slough analyses, TMDLs for nutrients involve modeling exercises to determine source contributions from agriculture, urban nonpoint sources, and point sources— all of which can contribute to nitrogen and phosphorus loads.

North Carolina's plan for nitrogen reduction in the Neuse River basin is illustrative.[77] The TMDL estimates the relative contributions of point and nonpoint sources and calls for 30% reductions in nitrogen loads from both point and nonpoint sources. For agricultural nonpoint sources, the TMDL proposes to achieve reductions via farmer participation in local planning exercises or compliance with BMPs (specifically, installation of forested riparian areas or vegetative filter strips). Other initiatives included

[74] CSTMDL, p. 3.

[75] CSTMDL, p. 45.

[76] According to DEQ "several sources of funding are currently available, either through federal programs administered by the Natural Resource Conservation Service, or a local soil and water conservation district (SWCD). State costsharing dollars may be available through the SWCD or through a local watershed council. The state also has funding under the Oregon Plan for Salmon and Watersheds, which landowners, associations, or commodity groups can apply for directly. Finally, Oregon is applying to the U.S. Department of Agriculture for additional funding under the Conservation Reserve Enhancement Program." CSTMDL,, Appendix E, p. E-3.

[77] North Carolina Department of Environment and Natural Resources, Total Maximum Daily Load for Total Nitrogen to The Neuse River Estuary, North Carolina (1999) *http://h2o.enr.state.nc.us/TMDL/ Neuse_TMDL.PDF*>, hereafter Neuse River TMDL.

in the TMDL are a requirement that those applying fertilizer to areas of more than 50 acres receive training in nutrient management.

A characteristic of several nutrient TMDLs is that reductions are sought from both point sources and from nonpoint sources. Maryland requires NPDES permitting changes for sewage treatment in the Port Tobacco watershed.[78] California calls for revision of NPDES permits to meet nutrient reductions in San Diego Creek and Newport Bay.[79] Delaware's Nanticoke River TMDL requires nutrient removal at three wastewater treatment plants.[80] And Delaware's Indian River TMDL calls for the total elimination of point source discharges.[81] Interestingly, several TMDLs are also counting on reductions in atmospheric deposition from more stringent Clean Air Act controls on emissions of nitrogen oxides to meet nitrogen load reduction goals.[82]

In all of these cases, however, the net is also cast toward unregulated sources, including agricultural nonpoint sources. All of the aforementioned TMDLs set nonpoint allocations. The San Diego Creek TMDL proposes to extend discharge requirements to small, unregulated nurseries. It also requires the development of nutrient management plans for all agricultural operations not regulated by waste discharge requirements. The Maryland Port Tobacco TMDL's nonpoint allocation assumes no additional requirements beyond existing BMP practices. It does suggest that existing state programs will support the implementation of future nonpoint source controls, however. To achieve their nonpoint allocations, Delaware's Nanticoke River and Indian River TMDLs require plans to institute agricultural BMPs. . And as noted above, North Carolina's Neuse River TMDL explicitly requires expansion in the use of agricultural BMPs.

The problems associated with translating nonpoint allocations into concrete improvements are explored below.[83] TMDLs completed to date, however, do indicate that a set of previously unregulated, unmanaged sources is gaining, at the very least, heightened regulatory scrutiny.

4. LONG-RUN IMPLEMENTATION OF THE PROGRAM

Having described the scope and promise of the new TMDL rules, we turn now to issues raised by the long-run implementation of the program. The federal government and states have broad, if somewhat untested, legal authority to expand controls to previously unregulated sources. Their respective authorities are described below, as are the policy tools available to promote source reductions and beneficial land and water management

[78] Total Maximum Daily Loads of Nitrogen and Phosphorus for the Port Tobacco River, Maryland Department of the Environment (1999), *http://www.epa.gov/reg3wapd/tmdl/tmdl.htm*,hereafter Port Tobacco TMDL.

[79] Total Maximum Daily Loads for Nutrients, San Diego Creek and Newport Bay, California, U.S. EPA Region 9, *http://www.epa.gov/reg09/water/tmdl/final.html*, hereafter San Diego Creek TMDL.

[80] Delaware Department of Natural Resources and Environmental Control, Total Maximum Daily Load Analysis for Nanticoke River and Broad Creek, Delaware (1998), *http://www.dnrec.state. de.us/newpages/pdf/nbrtmdla.pdf,* hereafter Nanticoke River TMDL, viii.

[81] Del. Dep't of Natural Resources and Envtl. Control, Total Maximum Daily Load Analysis for Indian River, Indian River Bay, and Rehoboth Bay, Delaware (1998), *http://www.dnrec.state.de.us/newpages/pdf/ibfinaltmdl.pdf,* hereinafter Indian River TMDL.

[82] Neuse River TMDL, p 40.

[83] Infra.

practices. The set of scientific, legal, and practical challenges that states will face as they seek approval for and implementation of their TMDL programs is also explored.

4.1 Federal Authority and Nonpoint Sources

The Clean Water Act prohibits discharge of a pollutant without a permit.[84] This broad prohibition is subject to a very important limitation, however. It applies in a legal sense only to discharges from point sources.[85] One way to expand federal legal authority is the semantic strategy of simply relabeling nonpoint sources as point sources.[86] As described earlier, the EPA is currently proposing an expansion of the definition of point sources to large-scale feeding operations and certain aquacultural and silvicultural practices.[87] Even smaller agricultural operations may be reclassified as sources subject to NPDES permitting, or threatened with such reclassification as an incentive to improve management practices.[88] But despite efforts to expand the universe of sources subject to the CWA's permitting, there remains a large universe of sources that resist simple reclassification.

As a result, the CWA's powerful permit-driven mode of regulation is not applicable to the primary cause of current water degradation. Some federal leverage exists, but it is more indirect than that provided for the CWA's point source provisions. For example, section 319 of the act addresses waters impaired by nonpoint sources. The section requires states to submit reports of such impairment, identify broad categories of sources, and identify BMPs and other measures to control "to the maximum extent practicable" pollution from those sources.[89] States are left with the discretion to determine whether control efforts are to be regulatory or nonregulatory, compelled or voluntary. Nowhere in the section is an explicit enforcement authority granted the federal government. In principle the federal government could withhold a state's NPDES permitting authority if the state fails to follow through on section 319's requirements.[90] But this extreme measure is not a substitute for a more explicit, practical federal ability to compel nonpoint reductions.[91]

More subtle forms of federal influence are available. Appropriations are available to states under section 319 and section 208. The threat of funding withdrawals, while a relatively weak incentive given the limited nature of funds at stake, is available to EPA.[92] Section 208 instructs states, among other things, to develop a process to identify

[84] 33 U.S.C. 1311(a).
[85] 33 U.S.C. 1362(12).
[86] The EPA has some authority to make these determinations. See note 43 supra.
[87] See section 2.4 supra.
[88] *U.S. Water News*, Dairy Farmer Required to Obtain NPDES Permit for Manure, October, 1999, p. 15. The case involved a small dairy operation with significant manure management problems.
[89] 33 U.S.C. §1329(A-D).
[90] CWA § 303(e)(2)-(3), 33 U.S.C. §1313(e)(2)-(3) (the withdrawal of NPDES permitting authority).
[91] For criticisms of §319's weakness, see David Zaring, Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future, 20 *Harvard Environmental Law Review* 515, 1996 and Oliver Houck, TMDLs, Are We There Yet?: The Long Road Toward Water Quality-Based Regulation Under the Clean Water Act, 27 *ELR News and Analysis* 10391, 1997.
[92] The EPA received a $100 million increase in appropriations for fiscal year 1999 to deal with nonpoint source problems and considered making awards contingent on state adoption of improved nonpoint source initiatives. *Environment Reporter* Vol. 29, No. 37, January 22, 1999.

agriculture- and forestry- related nonpoint sources. These sources include return flows from irrigated agriculture, runoff from manure disposal areas and land used for livestock and crop production. The section sets forth procedures and methods (including land use requirements) to control such sources to the extent feasible [93] and provides revocable funding for the process.[94] EPA efforts to motivate state nonpoint initiatives is illustrated by an EPA memo to regional administrators, calling on them to "focus substantial grant dollars … toward those states that are providing reasonable assurances that nonpoint source load allocations established in TMDLs will in fact be achieved."[95] The memo also suggests that the administrators may "deny or revoke a state's enhanced benefits status under the new section 319 nonpoint source guidance." These types of funding incentives indicate the EPA's concern with state nonpoint program development. They also signal the lack of more substantive authority on the part of EPA to motivate that development.

Federal authority over the management of federal lands can be used to promote nonpoint source improvements. The Forest Service and the Bureau of Land Management can use their authority to ensure adequate water monitoring and the implementation of BMPs for grazing, logging, and road construction activities. In fact, both agencies have mandates to manage public lands for multiple uses, including recreation, fish and wildlife, and watershed uses.[96] Also, section 401 of the CWA empowers the states to review facilities or activities that require a federal permit. Thus, states can compel federal agencies to manage lands in a manner compatible with waterquality standards.[97]

Finally, the Department of Agriculture's Conservation Reserve and Wetland Reserve Programs in principle could be harnessed to promote BMPs on agricultural land. Access to agricultural price support and land retirement programs could be made conditional on the adoption of pesticide and fertilizer reductions, though this is not current practice.[98]

Regarding the TMDL program itself, it is clear that primary authority for policies to implement TMDLs resides with the states. States have primary responsibility for developing their own lists of impaired waters and they are granted wide latitude to determine their own priorities and implementation plans.[99] Recent litigation and the EPA's own posture suggest that there must and will be a strong federal oversight of these state programs, however.[100] The proposed rules outline the agency's vision of its own authority. According to the rules, "EPA has strong and diverse authorities to implement

---

[93] Section 208 calls for the development of areawide waste treatment plans by states. 33 U.S.C. 1288(b)(2)(F), 1998.

[94] 33 U.S.C. 1288(d), 1998.

[95] U.S. EPA, Office of Water, Memorandum, New Policies for Establishing and Implementing Total Maximum Daily Loads, August 8, 1997, *http://www.epa.gov/OWOW/tmdl/ratepace.html*.

[96] 16 U.S.C. §§528-529 (1998); 43 U.S.C. §1701 (1998).

[97] See Debra Donahue, The Untapped Power of Clean Water Act Section 401, 23 *Ecology Law Quarterly*, 201, 1996.

[98] Acceptance into the Conservation Reserve Program is currently sensitive to some environmental considerations, including proximity to waterbodies. For an analysis of the benefits of this kind of environmental targeting, see Peter Feather, Daniel Hellerstein, and LeRoy Hansen, Economic Valuation of Environmental Benefits and the Targeting of Conservation Programs, U.S. Dept. of Agriculture, AER-778, 1999.

[99] CWA § 303(d)(1)(A) and 40 CFR 130.7(b).

[100] See section 2.3 supra for a description of this litigation.

controls over nonpoint sources in the event that EPA were to disapprove a TMDL submitted by a State and to develop a TMDL for the impaired water."[101] This assertion sounds somewhat defensive—and should—since, as previously argued, federal authority to compel nonpoint controls is limited. However, the rule identifies section 504 as one particular source of federal authority. Under 504, the administrator can compel action when there is an "imminent or substantial endangerment to health or welfare of persons." As an example of such an endangerment, the rule suggests a community's inability to market contaminated shellfish.

But in general the federal TMDL program is not self-implementing. As the proposed rule acknowledges, load allocations for nonpoint sources are not directly enforceable under the CWA. "With respect to nonpoint sources," the rule reads, "the load allocations in a TMDL are only 'enforceable' to the extend they are made so by State laws and regulations."[102] Despite the federal government's clear role in prompting and overseeing state action under section 303, it is state law that ultimately will determine the effectiveness of the TMDL programs in their long-term implementation.

4.2 State Authority and Nonpoint Sources

The litmus test of the TMDL program's success will be its ability to promote more effective nonpoint controls at the state level.[103] Nonpoint sources will increasingly occupy the attention of states as they identify impairments and sources and develop plans for water quality improvement. But as argued above, nonpoint sources historically have not been the prime target of regulation. Moreover, there is likely to be political pressure at the state level to avoid an expansion of controls to this category of sources. State initiatives to date have relied heavily on voluntary, unenforceable measures, particularly with regard to agricultural runoff.[104] Taken together, these factors raise concerns about the states' willingness to meaningfully compel reductions in nonpoint loads. The EPA's proposed TMDL rules anticipate this concern by requiring "reasonable assurance" of implementation. These reasonable assurances require states to specify implementation policies, the timing of controls or incentives, analysis of the likely effectiveness of policies, and funding sources.[105]

For point sources, consistency with NPDES permits is considered a valid "assurance" of implementation. For nonpoint sources, the most direct assurance of implementation is the availability of state laws to compel nonpoint controls, and the willingness to enforce those laws. There are in fact a large number of state statutory provisions that could be called into service. These laws include general prohibitions

[101] CFR1, 46034.

[102] CFR1, 46042.

[103] There is some skepticism regarding the federal government's ability to force improvements in nonpoint policy. In the words of an official at the Chesapeake Bay Foundation, "there is nothing in [the new rules] that addresses the issue of ensuring that the reductions that are supposed to be achieved from nonpoint sources are real, and measurable, and enforceable." Quoted in *the Bay Journal*, October, 1999, p. 10.

[104] According to a detailed survey of state nonpoint pollution enforcement mechanisms, "agriculture is the most problematic area for enforcement mechanisms. ..where state laws exist, they often defer to incentives, cost-sharing, and voluntary programs." Environmental Law Institute*, Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution*, 1997, iii.

[105] CFR1, 46016. This includes analysis of the "anticipated or past effectiveness of the best management practices and/or controls that are expected to meet the wasteload and load allocations," CFR1, 46033.

against pollution discharges, enforcement actions triggered by fish kills or threats to public health, sedimentation and erosion laws, and laws designed to protect specific areas for conservation.[106] Most states have access to such statutory levers, which can be directly cited as a form of reasonable assurance. In addition, regulations governing stormwater runoff and zoning and other land use ordinances would likely qualify. Assurance could also be demonstrated by management contracts between government agencies and land users, memoranda of understanding between government entities, and bonding requirements to ensure appropriate land management practices. A variety of approaches will arise as state regulators seek innovative ways to motivate quality improvements. For example, there are proposals in Washington State to limit irrigation water allocations to farmers who fail to take precautions against sediment runoff.[107] In Iowa, a pilot insurance plan reduces the risk to farmers of under-performing crop yields when they scale back on fertilizer applications.[108] These examples are indicative of the policy innovation that is already occurring, and that can be harnessed by states to compel or otherwise promote nonpoint load reductions.

On one hand, the long list of existing state enforcement tools is reassuring. On the other hand, that long list has to date failed to yield adequate water quality in many of the nation's streams, lakes, and estuaries. In some cases the failure is due to explicit exemptions for certain nonpoint sources. In other cases the law may simply be unenforced. Many of the states with general discharge provisions explicitly exempt agriculture.[109] Massachusetts prohibits the discharge of any pollutant without a permit, but agricultural nonpoint discharges are exempted.[110] Exemptions are also found in more targeted regulations. In Ohio land development that disturbs the soil cannot occur without the approval of the state.[111] But this requirement does not extend to agricultural operations. The TMDL-driven need for load reductions may erode some of these statutory exemptions as point sources exert political pressure of their own to avoid further, costly point source reductions and environmental interests focus greater attention on impairments.[112] Dormant provisions may also be called into more active service by state program administrators, who must ultimately demonstrate real pollutant reductions under section 303.

[106] See Environmental Law Institute, Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution, Washington DC, 1998. According to the study, which reviews applicable laws in all 50 states, Puerto Rico, and the District of Columbia, "most states have a number of enforceable authorities that can be used to address various nonpoint source discharges." ELI's earlier study also showed, however, that many of these legal mechanisms contain exemptions and may not always be effectively enforced. Environmental Law Institute, 1997, i-v.

[107] Irrigators Warned to Clean Farm Runoff to Protect Fish Habitat, *U.S. Water News*, March, 1998, p. 14.

[108] Crop Insurance Plan Helps Farmers Reduce Nitrogen Use, *U.S. Water News*, March, 1999, p. 1. Over-fertilization is common, since it builds in a margin of safety (for the farmer) against fertilizer losses due to heavy rain-related runoff.

[109] Environmental Law Institute, 1997, 11.

[110] 314 Code Mass. R. 3.05.

[111] Ohio Rev. Stat. 1511.02(E).

[112] The State of Maryland recently imposed new rules on the ability of poultry slaughterhouses to spread sludge on fields beyond the fields' capacity to absorb it. The rules will be added as a condition of state permits governing slaughterhouse operations. *Washington Post*, Md. Poultry Firms to Face Strict Rules on Sludge Use, March 30, 1999, p. A6. The rules call for fines of up to $10,000 a day if found in noncompliance.

4.3 Best Management Practices as Enforceable Standards

Best Management Practices are a central feature of most nonpoint source control programs. BMPs are management standards that guide forest, agriculture, construction, and other activities in order to reduce nonpoint runoff. BMPs are based on the practical experience of land managers and improvements in the scientific and technical understanding of the relationship between land management practices and environmental impacts. In agriculture, examples include the installation of buffer strips along stream beds, adequate fencing to keep livestock from directly soiling surface water, the placement of sheds over manure piles to minimize runoff, and the use of pest control techniques that are low in chemical intensity. Forestry BMPs include harvest and road construction planning to avoid soil erosion from trails, roads, and stream crossings. Construction BMPs have a similar focus on techniques to minimize sedimentation due to erosion caused by soil disturbance. BMPs for municipalities include procedures to minimize the impact of road salting on urban runoff.

Depending on their application, BMPs can represent informal rules of thumb or be subject to approval by a government entity, such as a conservation district, state, or the U.S. Forest Service. As an illustration, Florida employs BMPs approved by a variety of organizations, including the U.S. Department of Agriculture Natural Resources Conservation Service and the Florida Department of Agriculture and Consumer Services (FDAC). FDAC has issued specific conservation practices for the purpose of protecting Florida's water resources (including streams, lakes, and wetlands) from pollution associated with forestry operations.[113] These BMPs were originally designed in the mid-1970s in response to the CWA, but were revised in 1993 with the assistance of representatives from state and federal government, universities, the forest industry, and environmental groups. The recommended practices are detailed and depend on the size and type of waterbody involved, the local soil type, and the general potential of the site for erosion and sedimentation. A BMP Technical Advisory Committee meets biennially to evaluate the status and progress of BMP implementation and effectiveness.[114]

Section 208 of the CWA, which mandates state water quality plans,[115] calls on states to describe in its plans the BMPS "which the [state] agency has selected as the means to control nonpoint source pollution where necessary to protect or achieve approved water uses." The section outlines the desired characteristics of BMPs for a variety of nonpoint source categories.[116]

BMPs represent the nonpoint analog to end-of-pipe controls on point sources. They identify the technologies and techniques that lead to pollutant reductions. In some cases, states use BMPs as an aspirational goal or background threat, rather than as enforceable standards. Colorado law calls for the development and approval of BMPs by

[113] FDAC, Silviculture Best Management Practices (1993).
[114] The Bureau of Water Analysis of the Florida Department of Environmental Regulation issued BMPs for Agriculture in 1978, pursuant to statutory requirements of the Clean Water Act. *See* Nonpoint Source Management Section, Florida Department of Environmental Regulation, *A Manual of Reference Management Practices for Agricultural Activities* (1978). Unlike the specific conservation practices for forestry operations, these BMPs are general practices or categories of practices required to achieve the abatement of nonpoint source pollution. The manual refers to the U.S. Department of Agriculture for specific BMPs that are applicable in Florida.
[115] See note 93 supra and associated text.
[116] 40 CFR 130.6 (c)(4)(iii)(A)-(G), 1998.

the state department of agriculture, but defines BMPs as "any voluntary activity, procedure, or practice."[117] Thus, BMPs are not directly enforceable. Colorado does encourage their use to avoid the possibility of future regulation if "continued monitoring reveals that rules and regulations … are not preventing or mitigating the presence of the subject agricultural chemical to the extent necessary."[118] But reliance on voluntary efforts should be viewed with skepticism, since such techniques are costly to employ.[119]

In other cases, BMPs are directly enforceable. Oregon law calls on the State Forestry Board to develop and require the use of BMPs "as necessary to insure that to the maximum extent practicable nonpoint source discharges of pollutants resulting from forest operations on forestlands do not impair the achievement and maintenance of water quality standards … for the waters of the state." Criminal and civil penalties can be levied for failure to use these BMPs.[120] This regulatory "stick" is complemented by a significant "carrot," however. Forest operations conducted in accordance with BMPs can be a defense against claims of violating water quality standards.[121] In Maryland, agricultural operations must employ BMPs under soil conservation district plans to protect nontidal wetlands.[122] Similar requirements are imposed on agriculture in proximity to waters flowing into the Chesapeake Bay.[123] Federal law can compel the implementation of BMPs, particularly on federal lands.[124] And states can independently force the federal government to make its financial assistance programs, permits, licenses, and development projects conform with state nonpoint control programs, which may feature BMPs.[125]

Recent cases illustrate a growing judicial awareness of the importance of BMPs. In *Sierra Club v. Martin*[126] the U.S. Forest Service's adherence to BMPs was at issue. In *Blue Mountains Biodiversity Project v. Blackwood*[127] BMPs associated with a site assessment were found to be inadequate, given the characteristics of the site. *Idaho Sporting Congress v. Jemmet*,[128] tested the compliance of a National Forest timber sale

[117] Colo. Rev. Stat §25-8-103(1.3), 1998.
[118] Colo. Rev. Stat §25-8-205.5(6)-(7), 1998. According to a state soil conservation district BMP guide for farmers, "if the voluntary approach is successful, further mandatory controls …will not need to be implemented." Shavano Soil Conservation District, Best Management Practices for Agriculture in the Uncompahgre Valley, 1997, p. 7.
[119] A study of barriers to BMP adoption found, not surprisingly, that the barriers were largely economic. "Many landowners noted the environmental benefits of the selected BMPs, but were reluctant to adopt them due to the direct costs involved." Eric Palas and Jeff Tisl, The Implementation of Innovative Best Management Practices in the Sny Magill Watershed, available at *http://www.igsb.uiowa.edu/inforsch/sny/implemen.htm.*
[120] Ore. Rev. Stat. 527.765.
[121] Ore. Rev. Stat. 527.765.
[122] Md. Code Ann., Nat. Res. §8-1205, 1998.
[123] Md. Code Ann., Nat. Res. §8-1808(c)(6), 1998.
[124] Richard Whitman, Clean Water or Multiple Use? Best Management Practices For Water Quality Control in the National Forests, 16 *Ecology Law Quarterly* 909, 1989.
[125] CWA §319(b)(2)(F), 33 U.S.C. §1329 (b)(2)(F), and Exec. Order No. 12372, Sept. 17, 1983. Also see note 97 supra, and associated text.
[126] 992 F.Supp. 1448 (N.D. Ga. 1998) (holding that the Forest Service had not failed to implement BMPs as required by federal law).
[127] __F.3d__, 1998 WL 828124 (9th Cir. 1998) (The BMPs employed in an environmental assessment were found to be inappropriate, since the area had suffered fire burn and increased levels of erosion.)
[128] 1997 WL 855506 (D. Idaho 1997) (determining that road construction in a Nez Perce National Forest timber sale had complied with all relevant BMPs).

contract with applicable BMPs. These cases suggest that increasingly BMPS can and will be examined to determine compliance with statutory land management requirements.

4.4 The Technical Basis for Listing Criteria and Load Modeling

The TMDL program requires states to develop scientifically and legally defensible data collection procedures, listing criteria, and watershed modeling tools.[129] TMDLs may be challenged if the implementing state agency fails to adequately define and employ these technical duties. In terms of listing waters as impaired, the EPA's proposed rules require states to include with their 303(d) lists a description of the methodology and factors used to prioritize and list waters as impaired.[130] As an example, the description of methodology can include an explanation of how the number and severity of "exceedances" of a numeric chemical criterion translate into an impairment. Similar requirements are applied to TMDL loadreduction plans. Implementation plans are required to contain monitoring and modeling procedures that will be used gauge the effectiveness of load reduction actions. States are also required to explain their approach to "assessing the effectiveness of best management practices and control actions for nonpoint sources."[131] These requirements may slow the process of TMDL implementation, since they require the adoption of what may for some states be new techniques. Pollutant sources, unhappy with their designation, may also seek relief from TMDL load reductions by challenging a state's modeling tools, water quality criteria, and data collection procedures.[132]

Recent litigation has focused on one state agency's inability to promulgate lawful 303(d) listing criteria and TMDLs associated with nutrient water quality standards.[133] In the case, the South Carolina Department of Health and Environmental Control's (DHEC) listing standards, and TMDLs based on them, were voided by an administrative law judge. The agency was found to have violated proper public notice and other procedural safeguards designed to subject its standards and models to technical and legal scrutiny. According to the court, "DHEC has pursued is mission with unpromulgated regulations that should have been, but were not, subject to the scrutiny of DHEC's Board, the South Carolina General Assembly, and the public."

While federal water quality standards are available, they are published by EPA only as nonregulatory guidance.[134] The promulgation of water quality standards lies

---

[129] See Section 3.1 supra.

[130] CFR1, 46019.

[131] CFR1, 46035.

[132] The Indian River TMDL process is illustrative, note 81 supra. Comments by a group representing agricultural interests called for peer review of data and modeling procedures "by a wide range of experts in the field of science" before the TMDL was implemented. The implementing agency's response pointed to use of a "state of the art" modeling tool developed by the U.S. Army Corps of Engineers and extensive peer review of data and technical assumptions by several interagency workgroups and technical advisory committees. Response to Public Comments, Indian River TMDL, *http://www.dnrec.state.de.us/* p. 6.

[133] *Western Carolina Regional Sewer Authority v. DHEC,* S.C. DHEC, No. 98-ALJ-07-0267-CC, June 21, 1999 (a consolidated ruling). Summarizing the larger issue at stake, the judge's opinion concludes that "At a fundamental level these contested cases are about relationships. The first is the relationship in science that links phosphorus, an essential nutrient in the aquatic food chain, to the production of the second link in that food chain, algae. The second relationship is between law and science."

[134] U.S. EPA, EPA's Quality Criteria for Water, 1986, EPA-440/5-86-001, 1986. The Proposed TMDL rule points to federal Safe Drinking Water Act standards (which are controlling for drinking water) as a possible

squarely within the jurisdiction of state law. Moreover, the CWA requires that criteria adopted by states must be consistent with their own laws governing how regulations become law.[135] DHEC's failure was to inadequately translate "narrative" state water quality criteria into "numeric" standards for phosphorus, inorganic nitrogen, and chlorophyll *a*. Narrative standards are common in state statutes and, as the term suggests, are general, verbal descriptions of required water quality. In South Carolina, one such narrative standard reads that waters shall be free from "waste in concentrations or combinations which interfere with classified water uses…, existing water uses, or which are harmful to human, animal, plant, or aquatic life.[136] The court explained that the state must "for both practical and regulatory reasons, 'translate' its narrative water quality criteria into numerical values when making Section 303(d0 listing determinations." The court found that the state failed to make this translation in a way that satisfied procedural requirements. The standards being used by DHEC failed to have "clear bounds and a rational basis for their implementation." The agency cannot relist the waters under 303(d) until the EPA approves the "translation procedure" for converting South Carolina's narrative criteria into numeric criteria.

Perhaps more significantly, the judge's ruling also requires the agency to conduct a case-specific assessment of the waterbodies and sources in question. Assessment of the waterbodies is essentially a data collection and evaluation exercise. The analysis of sources is typically more complicated. Specifically, the agency must conduct an evaluation "of the point and nonpoint source nutrient loadings, of other possible causes or contributors to water quality impairment, and of whether Section 303(d) listing can be avoided by DHEC's full implementation of existing point and nonpoint source controls, including full implementation of BMPs at nonpoint sources." This kind of exercise is fraught with technical difficulties. Analysis of loadings and the effect of load reductions requires some form of watershed-wide modeling that captures transport process (such as infiltration and runoff), groundwater and surface water interactions, pollutant accumulation and decay, and instream mixing. In the case of nonpoint source loads, the science is relatively undeveloped due to the complexity of interacting systems involved.[137] Knowledge of the relationship between control practices and loadings is particularly poor. According to an EPA supporting document for TMDL development, a key challenge facing agencies is "the lack of highly developed, scientifically sound approaches to identify problems in watersheds and to predict the results of potential control actions on water quality. While a wide variety of models is available, each comes with limitations on its use, applicability, and predictive capabilities."[138]

Consider one particular, and relatively narrow, technical issue: the interaction between groundwater and surface water quality. The "flows" of groundwater into surface

---

reference point for states against which they "can compare water quality monitoring data, or … use to add or revise water quality criteria to support public water supply use, in the absence of more stringent criteria that support more sensitive ecological uses." CFR1, 46017.

[135] 40 CFR §25.10(b).

[136] S.C. Code Ann. Regs. §61-68(E)(4)(d).

[137] David Zaring, Federal Legislative Solutions to Agricultural Nonpoint Source Pollution, 26 *ELR* 10128, March 1996, (discussing problems associated with tying specific nonpoint practices with specific waterbody impairments).

[138] U.S. EPA, Compendium of Watershed-Scale Models for TMDL Development, EPA 841-R-94-002, 1992, 4.

water (or vice versa) are themselves highly uncertain and may occur over a period of decades. Such uncertainty and attenuation make determinations of cause and effect nearly impossible. The long time lag also limits the ability of researchers to measure the effect of control actions on the quality of receiving water. Moreover, the conditions under which surface and groundwater interact have a crucial effect on water chemistry (acidity, oxygen content, temperature) and biological conditions that ultimately affect water quality.[139] Unfortunately, according to the U.S. Geological Survey, "research on the interface between ground water and surface water has increased in recent years but only a few stream environments have been studied, and the transfer value of the research results is limited and uncertain."[140]

A lack of scientific certainty will in and of itself not legally hobble TMDL plans, since certainty is not a prerequisite for program implementation.[141] Uncertainty does place a premium, however, on administrative procedures that provide the greatest possible level of scientific credibility to standards, models, and data collection. Accordingly, the technical details of state TMDL programs will need to engage in ongoing notice and comment procedures and evaluation by expert panels. This is likely to be a source of both significant upfront and long-run program costs.

4.5 Jurisdictional Conflicts

Section 303 provides a great deal of state latitude to determine standards and implementation strategies. This latitude, together with the lack of correspondence between state boundaries and watershed boundaries, raises the possibility of jurisdictional conflict over TMDLs. Most obviously, downstream water segments may inherit water quality problems from upstream sources in other states. Standards differ across states, sometimes to a significant degree.[142] Less stringent water quality standards and less effective implementation upstream can alone create impairments in a downstream state with stricter quality standards. For this reason, the proposed rules require states to identify a process for resolving disagreements with other jurisdictions.[143] The rules also state that the EPA may establish TMDLs "when interstate or international issues and coordination needs require EPA to assume a leadership role." This will be particularly true in the case of large rivers or boundary waters. The agency also sees a role for itself in determining "equitable upstream / downstream allocations … that account for loadings to downstream waterbodies like the Chesapeake Bay from far away upstream sources."[144]

The need for a federal coordinating presence is likely to be particularly acute when conflicts arise as the result of atmospheric deposition. Atmospheric deposition occurs when airborne pollution is deposited directly to the surface of the waterbody, or

[139] U.S. Geological Survey, Ground Water and Surface Water: A Single Resource, USGS Circular 1139, 1998.
[140] Ibid., 77.
[141] In fact, 303(d) explicitly requires TMDLs to seek load reductions with a margin of safety that takes into account lack of knowledge concerning the relationship between effluent limitations and water quality. 33 U.S.C. §1313(d)(1)(c).
[142] Permitted concentrations of certain chemicals may be 10,000 times more protective in some states than in others. Oliver Houck, The Regulation of Toxic Substances Under the Clean Water Act, 21 ELR 10528, 1991.
[143] CFR1, 46019.
[144] CFR1, 46037.

indirectly onto land and waters within the watershed that feeds the waterbody. Because atmospheric deposition is a major source of water impairment, section 303(d) inextricably links state compliance with controls mandated by the Clean Air Act. According to the EPA, 80% of the Delaware Bay's mercury load, 46% of Tampa Bay's cadmium load, and 27% of the Chesapeake Bay's nitrogen load have airborne sources.[145] The significance of these atmospheric loadings is that they implicate sources over a huge geographic area. Deposition in the Chesapeake Bay is a particularly pertinent example. Studies based on data from the National Acid Deposition Assessment Program suggest that only 25% of air deposition in the Chesapeake watershed originates from sources within the watershed (which contains areas in six states).[146] The Chesapeake NOx "airshed," which defines the geographic range of airborne nitrogen sources to the bay, covers areas in 13 states plus the District of Columbia. Given the significance of air deposition in that watershed, and the broad geographic range of sources, there is the distinct possibility of jurisdictional conflict that necessitates federal intervention.

4.6 TMDLs and Water Quantity Law

As they move toward implementation, TMDL rules will increasingly highlight the artificial distinction between water quality and quantity issues, particularly in the West. Water quantity decisions, which are controlled primarily by state law, often have a direct impact on water quality. For instance, changes in stream flow affect the transport of pollutants through a waterbody. Also, the amount of water taken or returned to a waterbody may significantly affect the dilution of pollutants in that system. Finally, water supply often determines the suitability of a waterbody as habitat for fish or other species. In fact, reduced stream flows can constitute "water pollution" under the CWA.[147] At a practical level, TMDLs will often have to account for seasonal changes in flow in order to set appropriate loadings consistent with state water quality standards.[148] Because of these interactions, water quantity decisions—relating to irrigation, damming, reservoir management, basin-to-basin trades, and the like.—may result in changes in the waters' 303(d) status. Correspondingly, TMDLs will in some cases constrain water transfers involving impaired waterbodies.

As argued above, a wide variety of unresolved legal issues attend the implementation of the TMDL program. The interrelationship between water quantity decisions and water quality conditions will present particularly challenging issues. Water quantity law has a well-deserved reputation for complexity. Water rights have both public and private characteristics, water law is largely state-determined, different laws govern groundwater and surface water (even though they are physically interdependent), and entirely different systems for establishing rights are used in different regions of the

[145] U.S. EPA, Deposition of Air Pollutants to the Great Waters: Second Report to Congress, EPA-453/R-97-011, 1997, 179-181. Atmospheric nitrogen loadings to coastal estuaries other than the Chesapeake Bay range from 12% to 44% of the total.
[146] *Bay Journal*, Chesapeake Bay Watershed and NOx Airshed, vol. 7, no. 6, September 1997.
[147] See PUD No. 1 of *Jefferson County v. Washington Department of Ecology*, 114 S. Ct. 1900, 1914 (1994) (limiting the Federal Energy Regulatory Commission's authority to supplant state water quality standards in dam licensing proceedings).
[148] "[Changes in flow] may require that, for some pollutants, different TMDLs are established for different levels of instream flow, based on variations in flow over the course of the year," CFR1 46016.

country.[149] In terms of interjurisdictional conflict, states have a long history of conflict over water quantity apportionment.[150] This type of conflict will likely increase under the TMDL program as water quality impairments become binding enforcement problems.

One consequence of quality concerns may be an increasing reliance on water quantity acquisitions to preserve stream flows, an approach endorsed by the TMDL Federal Advisory Committee.[151] Federal acquisitions have already occurred as a result of concerns over species habitat.[152] Many states already have in place the legal foundations necessary to allow purchase and trade of water rights to preserve instream flow.[153]

4.7 Offsets and the Location of Sources

TMDLs will raise the costs of, or create a prohibition against, source development in watersheds suffering from impairment. The most immediate impact will be seen under the proposed NPDES rule changes that require offsets to new point source discharges.[154] This kind of restriction, or any other policy that creates barriers to new sources, is a necessary element of any policy geared toward water quality improvements. An unintended consequence of TMDLs, however, is that they may encourage the migration of point and nonpoint sources to areas that are currently not associated with water impairment. In other words, TMDLs may lead to a kind of "greenfields" ("blue waters?") problem.[155] The more successful that policies are in limiting loadings in impaired areas, the greater will be the incentive of dischargers to relocate to areas where TMDL-driven restrictions are not as binding, or control costs are not as high.

5. ECONOMIC CONSIDERATIONS AND POLLUTANT TRADING

A distinctive feature of the EPA's approach to TMDL rules, and its watershed policy more generally, is an emphasis on trading to achieve "common-sense, cost-

---

[149] Generally speaking, Eastern states rely on a "riparian" foundation for water rights, while the "prior appropriation" system is used in the West. See generally, Joseph Sax and Robert Abrams, Legal Control of Water Resources: Cases and Materials, 1986, ("Water law is different, and in that difference lies the charm, the interest, the fascination and the complexity of water law …"), xvii. CWA §101(g) specifically preserves state jurisdiction over water quantity allocations.

[150] *Texas v. New Mexico*, 482 U.S. 124 (1987); *Kansas v. Colorado*, 514 U.S. 673 (1995). To avoid conflict, there are several interstate river compacts, such as the Arkansas River Compact, ch. 155, 63 Stat. 145 (1949); 1949 Colo. Sess. Laws 485 §1 (C.R.S. §37-69-101(1973); Kan. Stat. Ann. §82a-520.

[151] FAC, 51.

[152] Benjamin Simon, Federal Acquisitions of Water Through Voluntary Transactions for Environmental Purposes, 16 *Contemporary Economic Policy 422*, 1998 (describing federal acquisitions in the Snake and Yakima basins, California's Central Valley, and the Truckee-Carson basin in Nevada).

[153] Lawrence MacDonnell, Teresa Rice, and Steven Shupe, eds., *Instream Flow Protection in the West, 1989; Clay Landry, Saving Our Streams Through Water Markets: A Practical Guide*, Political Economy Research Center, 1998 (describing state laws to allow for instream flow markets and transfers).

[154] New source offsets must be acquired at a rate of 1.5 to 1 in order to build in a guaranteed net reduction, CFR2, 46065. There is already a new source restriction under the CWA ("No new permit may be issued to a new source or a new discharger, if the discharge from its construction or operation will cause or contribute to the violation of water quality standards") 40 CFR 122.4(I).

[155] Members of the TMDL federal advisory committee expressed this concern with regard to the point source offset proposal: "Some committee members are concerned that enforcing the discharge restriction may in fact encourage development to spread to less-polluted areas with fewer restrictions on land or water use." FAC, supra note 3, 17.

effective solutions for water quality problems."[156] In principle, trading is highly desirable. Trading allows sources with responsibility for discharge reductions the flexibility to determine where those reductions will occur. The financial incentives built into a trading scheme lead naturally to a situation in which the costs of pollution control are minimized.[157] Pollution permit markets, in a decentralized manner, assign control activities to the parties whose control costs are least. Such assignment is economically efficient. It is also politically attractive, since it minimizes compliance costs for a given pollutant reduction goal. In terms of water quality regulation, the desirability of trading arises out of a vast disparity in pollutant control costs across sources. The appeal is especially strong when nonpoint sources are considered.[158] Nonpoint source BMPs are thought to be a particularly cost-effective means to achieve water quality improvements.[159] For example, if point sources with high control costs can purchase cheaper controls from nonpoint sources, the control cost savings may be significant.

A wide variety of trading possibilities is contemplated by EPA. A justification for the new source offset rule is that "EPA believes this proposed requirement will serve as a catalyst for the establishment of a trading market between large new dischargers and existing dischargers undergoing a significant expansion, and existing point source dischargers or nonpoint sources."[160] Point-point, point-nonpoint, and nonpoint-nonpoint trades are all envisioned.[161] The cost savings and flexibility provided by trading are the principal motivations.[162] Potential savings from point-point trading alone are estimated to be as high as $1.9 billion per year.[163]

The theoretical desirability of pollution trading is accompanied by a host of sobering practical challenges, however.[164] And the history of actual point-point trading to date under the CWA is very limited. More limited still is persuasive evidence that trading actually will result in significant cost savings.

5.1 Trading under the Clean Water Act

The history of water quality trading can be summarized relatively briefly. There are approximately 15 trading programs in the United States, though not all have actually

---

[156] U.S. EPA, Draft Framework for Watershed-Based Trading, EPA 800-R-96-001, 1996, ix (hereafter Watershed Framework).

[157] See generally, J. Dales, Pollution, Property, and Prices, 1968 and Thomas Tietenberg, Emissions Trading, an Exercise in Reforming Pollution Policy, Resources for the Future, 1985.

[158] See Lyon and Farrow, note 7, supra. They find that the net benefits of nonpoint controls, while negative, are significantly larger than a variety of point source controls.
Analysis of the possible cost savings from one trading program found point source-only controls to cost $70 million. But they would cost only $11million if reductions were achieved from nonpoint controls. John Hall and C.M. Howett, Trading in the Tar-Pamlico, *Water Environment & Technology*, 1994, 58.

[159] Kurt Stephenson, Patricia Norris, and Leonard Shabman, Watershed-Based Effluent Trading: The Nonpoint Source Challenge, 16 *Contemporary Economic Policy* 412, 1998, 413.

[160] CFR2, 46065.

[161] Watershed Framework, supra note 156.

[162] The EPA's proposed rule is designed to "provide for tradeoffs between alternative point and nonpoint source control options so that cost effectiveness, technical effectiveness, and the social and economic benefits of different allocations can be considered by decision-makers." CFR1, 46030.

[163] U.S. EPA, President Clinton's Clean Water Initiative, Office of Water, EPA 800-R-002, 1994.

[164] See generally, Robert Hahn and Gordon Hester, Marketable Permits: Lessons for Theory and Practice, 16 *Ecology Law Quarterly* 361, 1989; James Tripp and Daniel Dudek, Institutional Guidelines for Designing Successful Transferable Rights Programs, 6 *Yale Journal on Regulation 369*, 1989.

resulted in trades.[165] Notable trading experiments include the now-defunct Fox River BOD trading program in Wisconsin. Preliminary estimates of the savings from this point-point trading program were $7 million a year for the participating firms.[166] Unfortunately, and in stark contrast to the prediction of cost savings, the program only produced a single trade. In Colorado, the Dillon Reservoir trading system allows trade between point sources and nonpoint sources to reduce phosphorus loadings in the reservoir. Point-nonpoint trading activity has not actually materialized. However, two trades between nonpoint sources have occurred as nonpoint sources have become the primary remaining source of discharges.[167] The Minnesota Pollution Control Agency has approved a single trade, which substitutes nonpoint phosphorus source reductions for a point source reduction on the Minnesota River.[168] In North Carolina, the Tar-Pamlico plan calls for point source nutrient reductions. Point sources must meet a cap on discharges or make a mandatory financial contribution to a nonpoint source reduction fund used to implement agricultural BMPs. To date, the point sources have met the annually decreasing cap, primarily via improvements to treatment facilities.[169] These and other trading programs indicate state and EPA willingness to experiment with the trading approach. They are not particularly inspiring examples, however, of trading's ability either to achieve significant cost reductions, or to spark enthusiasm from the regulated community. What is remarkable is how actual little trading has arisen from these programs.

5.2 The Barriers to Water Quality Trading

An effective trading system requires several fundamental ingredients. Among them are, first, a sound means of enforcement to ensure that commitments (load reductions) are adhered to; second, a legal foundation that allows control flexibility sufficient to generate financial gains to participation; and third, an administratively straightforward process for participating in the market.[170] In the case of water quality trading, many of these ingredients currently are missing.

Perhaps the greatest barrier to water quality trading is the sheer complexity of factors that determine watershed loadings. Even if a source's releases are perfectly known—a tall order in itself, particularly for nonpoint sources—the transport and deposition of releases are subject to numerous uncertainties relating to geography, hydrography, and weather conditions.[171] Once present in a waterbody, a pollutant's contribution to impairment is often a function of the waterbody's assimilative capacity

[165] 61 *Fed. Reg*. 4996, February 9, 1996, Effluent Trading in Watersheds Policy Statement,.
[166] W. O'Neill, "The Regulation of Water Pollution Permit Trading under Conditions of Varying Streamflow and Temperature," in E. Joeres and Martin David, eds, *Buying a Better Environment: Cost-Effective Regulation Through Permit Trading*, 1983, p. 225.
[167]Watershed Framework, supra, note 156, p. 8-1.
[168] State of Michigan, Department of Environmental Quality, State Program Summaries, *http:/www.deq.state.mi.us/swq/trading/htm/statesum.htm*.
[169] North Carolina, Department of Environment and Natural Resources, Tar-Pamlico Nutrient Sensitive Waters Strategy, *http://h20.enr.state.nc.us/nps/tarp.htm*.
[170] See Hahn and Hester and Trip and Dudek, supra note 164, for analysis of conditions necessary to support marketable permit programs generally.
[171] Nonpoint source load measurement is considered by some to be a surmountable and somewhat overblown problem, despite these uncertainties. See Stephenson, supra 159. Also, many similar challenges face air emissions trading programs, which have a relatively successful history.

(which is itself a function of rainfall), temperature, salinity, acidity, and other localized chemical characteristics. This variability causes several problems for a trading program because it makes it difficult to draw causal relationships between specific sources and water quality problems. This causation problem creates an obvious monitoring problem, unless releases can be monitored at each potential source. Second, it makes it nearly impossible to quantitatively relate control practices (e.g., a reduction in fertilizer application) to loadings.[172] Establishing those relationships is necessary to establish appropriate trading ratios. Trading ratios account for differences in the way control practices affect loadings. For instance, a pound of phosphorus applied to land far from a waterbody will tend to contribute less to loadings than one applied close to the waterbody. If trading is allowed to occur between owners of two different pieces of land that are respectively located far and near a waterbody, then an appropriate trading ratio must be established to ensure that the loading goal is met. Specifically, if landowners near waterbodies are to increase phosphorus applications, they must purchase reductions from their trading partners at a greater than 1-to-1 rate. The complexity of watershed interactions does not permit the implementation of such trading ratios.

The complexity of watershed systems also contributes to the overall monitoring problem. End-of–pipe monitoring allows for relatively precise monitoring of point source discharges. In general, this kind of precision is not available for nonpoint source loads. The EPA's proposed rules include "margins of safety" and greater than 1-to-1 offsets to account for the monitoring and causal uncertainties associated with nonpoint sources. [173] For instance, under the new-source offset provisions, point sources may be required to achieve offsets of up to 200%.

One counter-example is a nonpoint program for phosphorus releases into Lake Okeechobee that relies on nonpoint source monitoring. It is the exception that proves the rule, however. The monitoring takes advantage of the lake system's artificially constructed hydrography, including canals and pumping facilities. Elsewhere, monitoring strategies include proposals for remote-sensing via satellite to determine compliance with land management and construction requirements, such as buffers, cover crops, and irrigation systems.[174] Finally, in some cases, quantitative modeling may be used to indirectly estimate loadings. Results from studies in one area can be used to generalize the relationships between observable practices and typical effects in another. While clearly imperfect, such tools may be the most pragmatic means of injecting some knowledge of control-loading relationships into a trading framework.

---

[172] See generally, Stephen Crutchfield, David Letson, and Arun Malik, Feasibility of Point-Nonpoint Source Trading for Managing Agricultural Pollutant Loadings to Coastal Waters, 30 *Water Resources Research 825*, 1994; Arun Malik, David Letson, and Stephen Crutchfield, Point/Nonpoint Source Trading of Pollution Abatement: Choosing the Right Trading Ratio, 75 *American Journal of Agricultural Economics 959*, 1993.

[173] This is particularly true since nonpoint sources aren't subject to NPDES permitting. "In such cases," according to the rule, "the Director may require that a greater amount of reductions must be realized and require an offset greater than one and a half to one," CFR2, 46066. "When entering into an agreement with a nonpoint source, it may be somewhat more difficult to determine exactly how much reduction will be achieved."

[174] See Stephenson, Supra 159 for a discussion of such monitoring options and detailed discussion of their use in the Lake Okeechobee case and others.

While the problems associated with nonpoint monitoring and trading are significant, it is perhaps even more significant that water quality trading has to date failed to provide significant benefits even among point sources. The reasons for this failure are largely legal. Technology-based requirements (and their associated effluent standards) are non-negotiable under the CWA.[175] All point source dischargers must install appropriate treatment to achieve these required discharge levels. It is explicit EPA policy that trading participants can in no way be absolved of this baseline technical requirement.[176] While this position may be understandable from an enforcement standpoint, it significantly limits the flexibility over control options. And limited flexibility means limited gains from trading.

Flexibility is limited in a number of other ways.[177] For instance, point source effluent standards are industry-specific. Since effluent standards are non-negotiable under the CWA, presumably no trading can occur across firms in different industries. The practical effect of this lack of flexibility is that a firm seeking a trade may find no other eligible firms even to approach.[178] In financial parlance, the situation is equivalent to a lack of liquidity and undermines the ability of the trading market to discover and take advantage of cost savings. Another lack of flexibility arises from prohibitions on trading across pollutants. For instance, under the new-source offset proposal, the EPA makes clear that the offset must be for the same pollutant.[179]

The informational, scientific, and legal barriers to water quality trading are significant. State experimentation with nonpoint programs and the development of analytical techniques to relate control practices and loadings can be expected. But the history of water quality trading to date invokes pessimism regarding the benefits likely to be secured by sophisticated new trading schemes involving point and nonpoint sources. These schemes are largely untried and administratively complex.[180] The search for cost-effective approaches to water quality improvement should not be allowed to hinge on trading alone. Instead, a variety of more direct forms of regulation, such as mandatory, enforceable BMPs, should also, and perhaps first, be applied to nonpoint sources.

---

[175] The standards are defined by sections 301(b)(1), 301(b)(2), 304(b), and 306.

[176] Watershed Framework, supra note 156, 2-4.

[177] The EPA's real or perceived inability to introduce flexibilities into its highly media- and substance-specific regulatory programs is an ongoing source of debate generally. U.S. General Accounting Office, Environmental Protection: Challenges Facing EPA's Efforts to reinvent Environmental Regulation, GAO/RCED-97-155, 1997.

[178] One of the reasons Wisconsin's Fox River trading program failed to induce trades is that only a small number of firms was eligible. Robert Hahn, Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders, 3 *Journal of Economic Perspectives 95*, 1989, p, 98.

[179] "EPA recognizes that there may be circumstances where reasonable further progress toward attaining water quality standards could best be served by allowing the Director the discretion to offset a new or expanded discharge of one pollutant with a load reduction of a different pollutant for which the waterbody is also impaired. EPA, however, is concerned with the technical difficulties of implementing such an option." CFR2, 46069.

[180] It is sobering to keep in mind the difficulties associated with even the simplest monitoring and enforcement programs. Enforcement of point source permitting is itself difficult. According to one study, 65% of major facilities in Michigan were operating with expired NPDES permits, while 150 new facilities waited for new, first-time permits. U.S. GAO, EPA and the States – Environmental Challenges Require a Better Working Relationship, GAO/RCED 95-64 (1995).

5.3 Allocations, Baselines, and Liability

One of the most important policy choices in a trading system is the determination of who is initially responsible for pollutant reductions. Consider two different trading schemes. In the first, point sources are responsible for pollutant reductions but can purchase reductions from each other or from nonpoint sources. In the second, both point sources and nonpoint sources are responsible for reductions, but can trade among themselves to achieve those reductions in the most cost-effective manner. The federal TMDL program leaves the choice of trading program entirely up to the states. If states are to introduce trading, this type of choice will have to be made. At a basic level, this choice is one over the distribution of the costs of discharge reductions. Both systems allow trading, so theoretically both will result in the same least-cost pattern of reductions after trading has occurred. They differ, however, in their allocation of liability for reductions. In the former case, liability lies with point sources. This means that point sources must bear the costs of reducing their own releases or else pay nonpoint sources to reduce theirs. In the latter case, liability is shared. Since nonpoint sources are themselves subject to controls, they must bear the costs of achieving reductions, or purchase them elsewhere.

In addition to determining the initial liability allocation, any trading system must also clearly define baseline (before-the-fact) discharges. This baseline is necessary if trading-driven discharge reductions are to be verified by regulators. The artificial inflation of baselines is a problem that any trading system must address. Polluters selling credits have an incentive to inflate baseline discharges since inflation increases the amount of discharge reductions they can claim to provide. In the case of point sources, NPDES permits provide a verifiable inventory of baseline releases. Moreover, the point source permitting process counteracts any incentive to overstate releases. Under point source permitting, larger releases tend to imply more stringent, costly control technologies. The nonpoint source situation is quite different. Having not been subject to permit requirements, nonpoint sources lack an independently verifiable, and incentive-compatible baseline. Thus, a problematic tendency of such sources will be to initially overestimate releases in an attempt to generate larger reduction credits. One way to minimize this kind of problem is to allocate responsibility for reductions to nonpoint sources at the outset. With nonpoint discharge standards, nonpoint sources have a countervailing incentive to underclaim contributions to loadings. Of course the larger implication is the need for independent verification of releases.

The enforcement of a trading system is also directly related to the allocation of liability. For instance, consider the proposed rules' new-source offset requirements. This allocation of liability is akin to the first one considered above. Point sources are liable for off-setting reductions. These reductions can be purchased from nonpoint sources, however. In the event of noncompliance by a nonpoint source, it is the point source that is subject to enforcement action, not the nonpoint source.[181] This formulation is the case under the EPA watershed trading framework as well.[182] Consider comments on EPA's trading framework from one point source, concerned that "the lack of defined legislation and regulatory controls of nonpoint sources may result in the point source partner of a point source/nonpoint source effluent trading agreement being held solely liable for

[181] CFR2, 46072.

[182] Watershed Framework, supra note 156, 7-18.

violations of a water quality standard, even though the source of the violation may be the nonpoint source."[183] However, any point-nonpoint trade presumably involves a contractual agreement between the sources that is independently enforceable under contract law. While agency enforcement action would be directed at the point source, the point source could exercise its contractual remedy in order to secure the nonpoint source's compliance with contract terms. Nevertheless, point source liability for nonpoint source noncompliance increases the transaction costs associated with trading. This cost increase creates yet another argument for direct enforcement of nonpoint controls by states.

6. CONCLUSION

The Total Maximum Daily Load program will significantly alter the politics, economics, and implementation of water quality regulation. Improved monitoring of ambient water quality conditions and the accessible public documentation of impairments will focus government and public attention on water conditions that continue to be problematic, even after 25 years of CWA regulation. While industrial point sources will no doubt continue to be vivid symbols of the nation's water pollution problems, this image is increasingly inappropriate. Nonpoint agricultural, commercial, and urban sources, while harder to caricature, are the rightful focus of dissatisfaction. The most powerful aspect of EPA's proposed TMDL rules is that they are motivated by, and address, water quality issues created by nonpoint sources. The holistic, watershed-level analysis required by the TMDL process will inevitably identify a larger sphere of often unregulated discharge sources. For these reasons alone, the TMDL program is likely to promote significant, desirable changes in the targets and implementation of water quality regulation. This article has provided specific examples of TMDLs and the way in which they are improving the public's knowledge of impairments, motivating new analytic techniques for the identification of sources, and promoting experimentation with new water quality policies. This movement toward a water-quality-driven approach marks a welcome, mature phase of water quality regulation.

The changes to be initiated by the new TMDL rules present a host of challenges. These challenges call for tempered optimism and a willingness to confront the significant implementation issues that will arise from a TMDL-based regulatory system. First, there are numerous scientific difficulties associated with creating legally meaningful causal links between dispersed nonpoint sources, their control activities, and changes in surface water pollutant loadings. The causal linkages are poorly understood and even when developed in the most rigorous manner only apply to the watershed for which they were specifically developed. The complex and idiosyncratic nature of pollutant discharge, transport, and deposition processes means that the technical underpinnings of TMDLs will be costly.

Administrative costs, together with resistance from currently unregulated sources, will act as a brake on state efforts to propose bold new approaches to control activities. While water-quality-based regulation gives point sources an incentive to lobby for nonpoint controls, organized nonpoint interests will undoubtedly continue to resist

---

[183] See Original Comments on Watershed-Based Trading: Eastman Chemical Company (1996), *http://www.epa.gov/OWOW/watershed/tradecom/level3.ecc.html.*

control requirements. Federal authority to compel, and funding to entice, nonpoint controls is limited. The central role of state law and location-specific political conditions mean that TMDL implementation will vary across states. Several issues demand greater legal clarity. Interjurisdictional conflict is likely, since downstream jurisdictions will often inherit upstream water quality problems. Air deposition will present particularly knotty jurisdictional issues. The federal role in resolving these inevitable conflicts deserves attention. Also, the relationship between water quantity allocations and water quality will demand a reconciliation between state quantity and quality laws.

Finally, the rules' emphasis on trading among point sources and nonpoint sources should be viewed as a desirable aspiration, but also as a distraction in the near term. Significant administrative, monitoring, and enforcement barriers to water quality trading exist. The best direct evidence of these barriers is that trading simply between point sources has failed to be practical. Expansion of trading programs to nonpoint sources significantly expands their complexity. Point-point source trading is a challenge that should be met well before point-nonpoint or nonpoint-nonpoint trading is attempted on a large scale. One of the many preconditions for trading is that nonpoint sources be monitorable and that enforcement mechanisms exist to compel corrective actions when discharge restrictions are violated. Regulatory, legal, and technical efforts should first be directed toward this goal, which is in itself a significant challenge.