PREDICTING THE FUTURE AND ACTING NOW: CLIMATE CHANGE, THE CLEAN WATER ACT, AND THE LAKE CHAMPLAIN PHOSPHORUS TMDL

INTRODUCTION

In the coming decades, climate change impacts will drastically affect one of our most precious resources: high quality water. Indeed, we are already experiencing the impacts of climate change. Yet, to date, our nation's most powerful water quality tool, the Clean Water Act (CWA), has not been mobilized to meet these changes.[1] If the United States is to meet the challenges of climate change, the CWA must be utilized and the U.S. Environmental Protection Agency (EPA) must consider climate change in approving state water quality plans.

Climate change impacts affect water regimes at global and local hydrological scales, impacting both quantity and quality of available water.[2] The Intergovernmental Panel on Climate Change (IPCC) says with "high confidence" that "[h]igher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution."[3] Climate change models predict that water quantity will become scarce in the western United States.[4] In contrast, the eastern seaboard will face climate change impacts in the form of increased precipitation and temperatures.[5] These changes must be accounted for, and the CWA must be leveraged to adapt to them.

To protect water quality, EPA must consider climate change in approving state water quality plans. This imperative is crucial to the health of our nation's waters and the water quality of Lake Champlain. This Note argues that the CWA does and should require EPA to consider climate change in approving a state Total Maximum Daily Load (TMDL) and creating a federal TMDL. Thus, EPA must disapprove a state TMDL when, in creating the plan, a state fails to consider climate change as a factor

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1. Water Pollution Prevention and Control Act, 33 U.S.C. §§ 1251–1387 (2006) (commonly referred to as the Clean Water Act).

2. *See generally* INT'L PANEL ON CLIMATE CHANGE, CLIMATE CHANGE AND WATER: IPCC TECHNICAL PAPER vi 79 (Bryson Bates et al. eds., 2008), *available at* http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf (explaining the effects of climate change on water resources).

3. *Id.* at 3.

4. NAT'L ASSESSMENT SYNTHESIS TEAM, U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS ON THE UNITED STATES: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE: WEST (2000) [hereinafter USGCRP WEST 2000], *available at* http://www.globalchange.gov/publications/reports/scientific-assessments/first-national-assessment/474.

5. NAT'L ASSESSMENT SYNTHESIS TEAM, U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS ON THE UNITED STATES: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE: NORTHEAST (2000) [hereinafter USGCRP NORTHEAST 2000], *available at* http://www.globalchange.gov/publications/reports/scientific-assessments/first-national-assessment/470.

affecting water quality. This Note further argues that EPA's failure to consider climate change has rendered its approval of the Lake Champlain Phosphorus TMDL (Champlain TMDL) legally inadequate under the CWA.[6]

Lake Champlain receives inflowing water and pollution from three political states—New York, Vermont, and Québec—and thousands of square miles of land.[7] Climate change impacts increase phosphorus loading in freshwater lakes.[8] The effects of climate change exacerbate water quality problems.[9] These effects, combined with the statutory purpose and scheme of the CWA, compel EPA and the state agencies tasked with managing Lake Champlain water quality to consider climate change in their management plans.

The Conservation Law Foundation (Foundation) is a New England regional environmental advocacy organization.[10] On October 28, 2008, the Foundation filed a complaint in the United States District Court for the District of Vermont against the U.S. EPA Region One and the regional administrator seeking a declaration that EPA's November 2002 approval of the phosphorus TMDL for Lake Champlain was unlawful.[11] The Foundation sought an order setting aside EPA's approval of the TMDL and called for the establishment of a new phosphorus TMDL for Lake Champlain.[12] The suit raised several novel legal claims under the CWA. This Note narrowly focuses on the climate change aspect of the complaint.

The Foundation's complaint raised two interesting legal issues. First, does the CWA impose a duty on the state and EPA to consider climate change in creating water quality standards? Second, is such consideration feasible? This Note addresses the legal sufficiency of the approved Champlain TMDL in light of climate change impacts to water quality. Then, it evaluates the Foundation's argument that the CWA requires the state agency and EPA to consider climate change in the TMDL planning process. Finally, the Note argues that the CWA does and should continue to require

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6. Complaint for Declaratory Judgment and Injunctive Relief ¶ 74, Conservation Law Foundation v. Envtl. Prot. Agency, No. 2:08-cv-00238-wks (D. Vt. 2008) [hereinafter Complaint].

7. *Lake Champlain Basin Atlas: Lake and Basin Facts*, LAKE CHAMPLAIN BASIN PROGRAM, (2004), http://www.lcbp.org/Atlas/HTML/nat_lakefax.htm (last visited Apr. 17, 2011).

8. Erik Jeppesen et al., *Climate Change Effects on Runoff, Catchment Phosphorus Loading and Lake Ecological State, and Potential Adaptations*, 38 J. ENVTL. QUAL. 1930, 1930 (2009).

9. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: IMPACTS, ADAPTATION, AND VULNERABILITY 207–09 (James J. McCarthy et al. eds., 2001).

10. *About CLF*, CONSERVATION LAW FOUNDATION, http://www.clf.org/about-clf/ (last visited Apr. 17, 2011).

11. U.S. ENVTL. PROT. AGENCY, SECTION 303(d) LISTS AND TMDL LITIGATION (CHALLENGES TO EPA ESTABLISHMENT OR APPROVAL) 1 (Feb. 2009), *available at* http://www.epa.gov/owow/tmdl/pdf/section303d_listsandtmdl_litigation.pdf.

12. *Id.*

water managers to consider the impacts of climate change in water quality planning.

Part I of this Note briefly explains the regulatory and political framework of the TMDL process and gives background to the Foundation's complaint. Part II describes the Lake Champlain Basin and the lake's water quality issues related to the causes and effects of phosphorus loading. The Note then explains the inadequacies of the 2002 Champlain TMDL. Part III discusses the CWA in the climate change era and addresses uncertainties in climate modeling and the implications for water quality management. Part IV offers policy and regulatory solutions and argues that the CWA can be used both to mitigate the causes of climate change, and to adapt to the impacts of climate change.

I. BACKGROUND

A. The Conservation Law Foundation Complaint

In its complaint, the Foundation proffered several reasons why EPA violated the CWA in reviewing and approving the Vermont Agency of Natural Resources' Champlain TMDL.[13] The Foundation argued that EPA did not fulfill its obligation to provide a "margin of safety"[14] to account for any lack of knowledge between pollution controls and water quality, and that the Vermont Agency failed to provide "reasonable assurances"[15] that nonpoint source load reductions would occur. The complaint stated that the "[d]efendant's failure to consider accelerated climate change fatally compromised its analysis of the fundamental justifications supporting the Champlain TMDL's legal sufficiency."[16] Climate change will impact the lake through changes in precipitation, increased pollutant loads, increased water temperature, and altered flow regimes.[17] The Foundation sought an order to set aside EPA's approval of the Champlain TMDL and to compel EPA to comply with the CWA.[18]

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13. VT. AGENCY OF NATURAL RES. DEP'T OF ENVTL. CONSERVATION & N.Y. STATE DEP'T OF ENVTL. CONSERVATION, LAKE CHAMPLAIN PHOSPHORUS TMDL 1 (2002) [hereinafter CHAMPLAIN TMDL], *available at* www.anr.state.vt.us/dec/waterq/lakes/htm/lp_phosphorus.htm.

14. 33 U.S.C. § 1313(d)(1)(C) (2006); 40 C.F.R. § 130.7(c)(1) (2010); 40 C.F.R. § 130.2(i) (2010); Complaint, *supra* note 6, ¶ 23.

15. Complaint, *supra* note 6, ¶ 27; *see also Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992*, U.S. EPA, http://www.epa.gov/owow/tmdl/guidance/final52002.html (last visited Apr. 17, 2011) (requiring reasonable assurances that expected load reductions will be reached).

16. Complaint, *supra* note 6, ¶ 75.

17. *See infra* Part II.

18. Complaint, *supra* note 6, ¶ 94.

B. The TMDL Process

Generally, under the CWA and other environmental statutes, the federal government allows the states to implement the law. This regulatory framework is often referred to as "cooperative federalism."[19] States use this framework in the TMDL planning process. Congress made the law.[20] EPA is charged with promulgating regulations and enforcing the law.[21] EPA delegates some of the CWA implementation functions to the state, particularly, the creation and regulation of water quality standards.[22] Ultimately, EPA must ensure that the states comply with the CWA.[23]

A water body becomes "polluted" in the legal sense when it fails to meet the water quality standards set by the state.[24] "A Total Maximum Daily Load (TMDL) is an estimate of how much of a pollutant, or group of pollutants, a water body . . . can absorb without becoming polluted."[25] The TMDL process involves multiple steps.[26] First, the state must identify impaired waters.[27] Impaired waters are waters that do not meet the water quality standards for use (qualitative) and numeric water quality criteria (quantitative).[28] Second, the state must set a priority ranking of impaired waters according to the severity of pollution.[29] Third, the state must create a TMDL accounting for seasonal variation and including a margin of safety to reflect lack of certainty.[30] In the TMDL calculation, "pollutant loads from point sources (permitted discharges from identifiable points, such as industrial or municipal discharge pipes) are called 'waste load allocations' or WLAs, and loads from nonpoint sources (diffuse sources, such as urban, residential, or agricultural runoff) are called 'load allocation' or LAs."[31] The TMDL is the sum of the waste load allocation and load allocation with an additional margin of safety. Put into a simple equation: TMDL = WLA + LA + MOS.[32]

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19. ENVTL. LAW INST., LAW OF ENVIRONMENTAL PROTECTION, CHAP. 7 PART II: THE STATE-FEDERAL ALLOCATION OF RESPONSIBILITIES § 7:5 n.1 (2010) (explaining that the term "cooperative federalism" became popular during the first term of the Reagan Administration).

20. 33 U.S.C. §§ 1251–1387 (2006).

21. *Id.* at § 1319.

22. *Id.* at § 1313.

23. *Id.*

24. 33 U.S.C. § 1313(d) (2006).

25. *EPA New England Total Maximum Daily Load*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/region1/eco/tmdl/index.html (last updated Mar. 31, 2011).

26. *Id.*; 40 C.F.R. § 130.7 (2010).

27. 33 U.S.C. § 1313(d)(1)(A).

28. 40 C.F.R. § 130.7(b)(3).

29. 33 U.S.C. § 1313(d)(1)(A).

30. *Id.* at § 1313(d)(1)(C).

31. *EPA New England Total Maximum Daily Load*, *supra* note 25.

32. *Id.*

After creating a TMDL, the state submits it to the EPA regional office for approval.[33] If EPA approves the TMDL, the state allocates the permissible pollutant load among point source polluters and estimated nonpoint sources.[34] If EPA does not approve, EPA must then create the TMDL itself.[35]

Pursuant to the CWA TMDL process, the Vermont Agency of Natural Resources led the creation of the Champlain TMDL. Because Lake Champlain borders New York and Québec, these states are involved in setting the applicable water quality standards.[36] The Champlain TMDL plan was produced by the joint efforts of the Vermont Agency of Natural Resources, the New York State Department of Environmental Conservation, and agreements with the Québec Ministry of Sustainable Development, Environment and Parks.[37] This Note, for simplicity, will refer to the governmental conglomerate as the Vermont Agency.

The Vermont Agency collected data and prepared the Champlain TMDL. In September 2002, the Vermont Agency submitted its plan to the EPA regional office for Region One.[38] EPA approved the plan in November 2002.[39] In 2008, the Foundation sued EPA for approving the Champlain TMDL in violation of the CWA requirements.[40] The Vermont Agency was not a named defendant, but successfully intervened in the suit.[41]

C. Cooperative Federalism?

The final step of the TMDL process, EPA approval, is perhaps the best place to challenge the stringency of water quality standards incorporated in

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33. 33 U.S.C. § 1313(d)(2); 40 C.F.R. § 130.7(d)(1).

34. 40 C.F.R. § 130.7(a).

35. 33 U.S.C. § 1313(d)(2); 40 C.F.R. § 130.7(d)(2).

36. 33 U.S.C. § 1270 (2006). Congress created the Lake Champlain Basin Program by enactment in 1990. *Id.* at § 1270(a)(1). Under the program, New York, Vermont, and Québec coordinate water quality management in the basin. *Id.* at § 1270(b). Because Québec is a foreign state, it is not subject to regulation under the CWA. However, Québec has a substantial interest in the water quality of Lake Champlain, particularly because the lake drains north into the St. Lawrence River in Canada.

37. LAKE CHAMPLAIN BASIN PROGRAM, STATE OF THE LAKE AND ECOSYSTEM INDICATORS REPORT 3 (2008) [hereinafter STATE OF THE LAKE], *available at* http://www.lcbp.org/PDFs/SOL2008-web.pdf.

38. CHAMPLAIN TMDL, *supra* note 13. EPA Region 1 New England covers Vermont, New Hampshire, Maine, Massachusetts, Connecticut, and Rhode Island. *EPA Region 1*, U.S. EPA, http://www.epa.gov/region1/index.html (last visited Apr. 17, 2011).

39. U.S. ENVTL. PROT. AGENCY, NOTICE OF APPROVAL OF THE LAKE CHAMPLAIN PHOSPHORUS TMDL (Nov. 4, 2002), *available at* www.epa.gov/ne/eco/tmdl/pdfs/vt/lakechamplain.pdf.

40. *See generally* Complaint, *supra* note 6 (alleging that the EPA violated the Clean Water Act by approving the Lake Champlain TMDL).

41. *Id.* at 1; personal correspondence with Foundation.

the planning process.[42] It may not appear obvious, but the state has different interests at stake in the TMDL process than the EPA. States have often resisted federal control of environmental regulation under the CWA because of the cost of regulation and enforcement as well as the desire for independence and flexibility for development.[43] However, in the CWA, Congress made a clear policy choice to protect, restore, and conserve water resources regardless of individual states' reticence to regulate environmental quality at a cost to states, municipalities, and industry.[44] Furthermore, Congress recognized that water quality is a national concern.[45] The Supreme Court of the United States and EPA have also acknowledged that water moves without regard to state lines and good water quality is a national asset.[46]

Including climate change as a factor in the TMDL process will often require states to create more stringent water quality standards.[47] The state has a manifold interest in securing EPA approval of a TMDL that is insufficient to meet water quality standards. Indeed, the state's primary concern may be the state's budget.

First, the very process of creating a TMDL can be expensive and time-consuming.[48] Also, adjusting to new, more restrictive water quality standards costs the state and industry significant sums.[49] In contrast, the

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42. *See* 33 U.S.C. § 1365 (2006) (granting citizens standing to commence civil litigation to force the EPA to enforce the CWA and also to challenge EPA action under the CWA).

43. *See* OLIVER HOUCK, THE CLEAN WATER ACT TMDL PROGRAM: LAW POLICY AND IMPLEMENTATION 11–33 (1st ed. 1999) (discussing the history and evolution of CWA § 303).

44. 33 U.S.C. § 1251(a) (2006) ("The objective of this chapter is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.").

45. 33 U.S.C. § 1362(7) (2006). The CWA covers all "waters of the United States." *Id.*

46. Arkansas v. Oklahoma, 503 U.S. 91, 110 (1992) (upholding the EPA's construction that, under the CWA, permits to discharge any effluent into interstate waters must comply with the federally approved water quality standards of all affected states); *see also* Judith A. Shifrin, Note, *Environmental Law:* Arkansas v. Oklahoma *and the Protection of Downstream States Under the Clean Water Act*, 45 OKLA. L. REV. 321, 321 (1992).

47. *See* Robin Kundis Craig, *The Clean Water Act on the Cutting Edge: Climate Change and Water-Quality Regulation*, 24 NAT. RES. & ENV'T 14, 18 (2009) (arguing that incorporating climate change into the TMDL process would yield unfeasible requirements and cause the states great expense); *see also* NAT'L RESEARCH COUNCIL, ASSESSING THE TMDL APPROACH TO WATER QUALITY MANAGEMENT 90 (2001) (explaining that the TMDL process may result in stricter water quality standards).

48. *See* U.S. ENVTL. PROT. AGENCY, TMDL DEVELOPMENT COST ESTIMATES: CASE STUDIES OF 14 TMDLS 9 (1996), *available at* http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20004TFT.txt (finding that, in 1996, TMDL development could cost anywhere from $4,039 to over $1 million).

49. UNIV. OF CAL. AGRIC. ISSUES CTR., WATER QUALITY AND AGRICULTURE 2 (2009), *available at* http://aic.ucdavis.edu/publications/whitepapers/Water%20Quality.pdf. "TMDL waste discharge requirements will impose additional costs on California producers that will likely lead to shifts in adopted technologies, changes in the crop mix, and a shift in some farming activities to other regions. . . . Ongoing TMDL compliance across the state is therefore likely to involve substantial costs." *Id. See also* Robert W. Adler, *Integrated Approaches to Water Pollution: Lessons from the Clean Air*

state benefits from having some flexibility for growth in water quality standards. For example, the Lake Champlain Basin Program's State of the Lake Report found that a number of large wastewater plants—which discharge phosphorus-rich wastewater into the lake—are currently operating below their permitted capacity.[50] This gap leaves room for new development that would increase effluent from the wastewater plants.[51] Growth from new development would add more phosphorus to the already pollutant-laden system. However advantageous to the state, this flexibility is problematic for creating water-quality based water management plans because water-quality based effluent limitations reflect *current* water quality not future water quality after growth and increased pollution.[52]

The fact that the Vermont Agency operates under the executive branch of state government creates a further wrinkle in the TMDL's cooperative federalism process. The Governor appoints the head of the Vermont Agency, and the agency is subject to the Governor's directives.[53] In a more pro-development administration, the state agency may be inclined to produce a less stringent TMDL.

In contrast, EPA has less of a vested interest in approving an inadequate TMDL. EPA is not captive to the same politics as the state agency.[54] Furthermore, as a federal administrative agency, EPA is subject to mandates from the White House and Congress. Doubtless, EPA is subject to

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Act, 23 HARV. ENVTL. L. REV. 203, 252–53 (1999) (discussing political viability of implementing ambient water quality standards in light of the associated costs).

50. STATE OF THE LAKE, *supra* note 37, at 7; *see, e.g.*, *In Re* Montpelier WWTF Discharge Permit, 2009 Vt. Envt. Ct. No. 22-2-08, at *2–3 (heard on interlocutory appeal, No. 2009-286 (Vt. 2010)). The Montpelier Municipal Wastewater Treatment Facility currently operates well under what the National Pollutants Discharge Elimination System (NPDES) phosphorus permit allows. *Id.* at *2–3.

51. *In Re* Montpelier, Vt. Envt. Ct. No. 22-2-08 at *2–3.

52. 33 U.S.C. § 1313 (2006); 40 C.F.R. § 122.44(d) (2010).

53. Press Release, Vermont Governor Jim Douglas, Douglas Announces Three Cabinet Secretaries (Dec. 5, 2002), *available at* http://jimdouglas.vermontegov.com/tools/index.php?topic=GovPressReleases&id=381&v=Article. Announcing his appointment to the head of the Vermont Agency of Natural Resources, the former Governor said:

> It was important to me that the new Secretary of the Agency of Natural Resources understand that our goal will be to make this agency more responsive to the requests of the citizens we serve . . . . [The appointed head] understands that we can make the process more expeditious, more efficient, and more equitable without diminishing our strict environmental standards.

Id. Governor Shumlin appointed Deb Markowitz to the position in December 2010. John Dillon, *Markowitz Appointed Secretary of Agency of Natural Resources*, VPR NEWS, Dec. 6, 2010, http://vpr.net/news_detail/89434.

54. *See* Joel A. Mintz, *Has Industry Captured the EPA?: Appraising Marver Bernstein's Captive Agency Theory After Fifty Years*, 17 FORDHAM ENVTL. L. REV. 1, 1 (2005) ("Captive agency theory typically views regulators as subject to unique pressures and influences that invariably push their actions, and their decisions on policy questions, in a direction favored by regulated firms.").

shifting policies with changes in federal administration, but the point is that the EPA is not subject to local and state political pressures to the extent that state agencies are subject to such pressures.

These divergent interests create tension in the TMDL process. The state, perhaps understandably, may not want to lose flexibility to grow economically through development, agriculture, silviculture, and industry. Additionally, the state may not want to have to spend more to meet stricter standards.[55] Finally, the state may not want to duplicate the time and effort it takes to create a new TMDL. In contrast, EPA's main concern should be to enforce the CWA and its purpose: to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[56]

In 2007, the Vermont Legislature responded to the issue of the Champlain TMDL with the Lake Champlain Total Maximum Daily Load Plan.[57] It is laudable that the state legislature stepped in to direct the Vermont Agency to improve the Champlain TMDL. The statutes instruct the agency to reopen the Champlain TMDL in order to: (1) base the TMDL on more recent hydrological data;[58] (2) allocate phosphorus reductions on a subwatershed basis;[59] (3) provide reasonable assurances of further reductions;[60] and (4) allow for public participation.[61] However, notably absent from the statute is any reference to climate change as a consideration in the TMDL process.[62] Therefore, these legislative measures fall short of protecting Lake Champlain water quality.

Sound policy supports adapting current environmental laws to address the causes of climate change by requiring water quality management to make allowances for the impacts of climate change.[63] In the absence of any meaningful federal action addressing climate change,[64] some states have responded by creating their own processes.[65] In the landmark case *Massachusetts v. EPA*, the state forced the reluctant EPA to regulate

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55. *See supra* text accompanying notes 48–50.
56. 33 U.S.C. § 1251(a) (2006).
57. VT. STAT. ANN. tit. 10 §§ 1385–1386 (2010).
58. *Id.* at § 1385(a)(1)(A).
59. *Id.* at § 1385(a)(1)(B).
60. *Id.* at § 1385(a)(1)(C).
61. *Id.* at § 1385(b).
62. *Id.* at §§ 1385–1386.
63. *See generally* Lara Hansen & Christopher R. Pyke, *Climate Change and Federal Environmental Law*, 7 SUSTAINABLE DEV. L. & POL'Y 26 (2007) (suggesting how current environmental laws may incorporate the reality of climate change).
64. To date, and much to our national discredit, the United States has yet to pass a comprehensive national climate bill and has failed to sign on to international climate treaties.
65. *See generally* Cinnamon Carlarne, *Notes from a Climate Change Pressure-Cooker: Sub-Federal Attempts at Transformation Meet National Resistance in the USA*, 40 CONN. L. REV. 1351 (2008) (discussing state and regional responses to climate change in the absence of a federal response).

automobile emissions of greenhouse gases under the Clean Air Act.[66] Unfortunately, state and regional governmental efforts to address the causes and impacts of climate change have often been piecemeal, feel-good measures, which have failed to result in enforceable regulation. For example, the Southwest Climate Change Initiative does not create any binding commitments and the Powering Plains Initiative relies on voluntary efforts.[67] On the other hand, local, state, and regional policies do "promote tangible steps towards developing a comprehensive legal and political climate change regime in the United States."[68] State-created solutions may find national application. However, without comprehensive national legislation, the ability to address climate change is limited.[69] Furthermore, specific climate change impacts on water quality are best addressed under the current water quality regulatory matrix already in place under the CWA.

II. LAKE CHAMPLAIN WATER QUALITY WILL REMAIN IMPAIRED IF EPA FAILS TO INCORPORATE CLIMATE CHANGE INTO THE LAKE CHAMPLAIN PHOSPHORUS TMDL

A. The Lake Champlain Basin

The Lake Champlain Basin is a unique place where Congress has recognized the need to protect water quality and natural resources.[70] A watershed includes all the land that is drained by a network of rivers and streams, which flow into a larger body of water.[71] Most of Vermont's largest rivers are part of the Lake Champlain drainage basin.[72] Nearly half of the land area of Vermont drains into this basin,[73] covering 8,234 square miles and including the political entities of Canada, New York, and Vermont.[74] The lake is 120 miles long, with a surface area of 435 square miles and maximum depth of 400 feet.[75] The basin drains north into the St.

66. Massachusetts v. EPA, 549 U.S. 497, 528 (2007).

67. Carlarne, *supra* note 65, at 1369–70.

68. *Id.* at 1366.

69. *Id.* at 1367–68.

70. 33 U.S.C. § 1270 (2006) (establishing the Lake Champlain Basin Program and designating Lake Champlain as a priority area for environmental quality).

71. NAT'L RESEARCH COUNCIL, NEW STRATEGIES FOR AMERICA'S WATERSHEDS 14 (1999) (quoting WEBSTER'S DICTIONARY 1994).

72. *The Rivers of Vermont*, SAINT MICHAEL'S COLLEGE, http://academics.smcvt.edu/vtgeographic/textbook/rivers/rivers_of_vermont.htm (last visited Apr. 17, 2011).

73. CHAMPLAIN TMDL, *supra* note 13, at 1.

74. Complaint, *supra* note 6, ¶ 33.

75. CHAMPLAIN TMDL, *supra* note 13, at 1.

Lawrence River in Canada, terminating in the Atlantic Ocean.[76] Land uses in the basin include rural and urban uses.[77]

B. The Relationship Between Phosphorus and Climate Change

Nutrient loading is the major water quality issue in Lake Champlain.[78] Phosphorus occurs naturally and is an essential nutrient for plant and animal life.[79] However, in freshwater aquatic systems such as Lake Champlain, phosphorus normally occurs in very low concentrations.[80] Even a minor anthropogenic increase in phosphorus can set off a chain of undesirable events including accelerated plant growth and algal blooms, which, in turn, lead to low levels of dissolved oxygen (DO) and the death of fish, invertebrates, and other aquatic animals.[81] Anthropogenic sources of phosphorus pollution in Lake Champlain include industrial discharges, wastewater treatment plants, runoff from fertilized lawns and croplands, private septic systems, runoff from livestock manure, disturbed soil from development and silviculture, drained wetlands, and storm water.[82] Point sources, such as industrial discharges and wastewater effluent discharges, are regulated under the CWA.[83] Generally, nonpoint sources such as agricultural runoff and storm water are not currently regulated under the CWA.[84] In Lake Champlain, point sources contribute less than 10% of the total phosphorus load, while the remaining 90% comes from nonpoint sources.[85]

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76. *Lake Champlain Basin Atlas*, *supra* note 7.

77. STATE OF THE LAKE, *supra* note 37, at 7, fig.6.

78. *See* LAKE CHAMPLAIN STEERING COMM., LAKE CHAMPLAIN BASIN PROGRAM, OPPORTUNITIES FOR ACTION: AN EVOLVING PLAN FOR THE FUTURE OF THE LAKE CHAMPLAIN BASIN 8 (2003), *available at* http://www.lcbp.org/OFA-APRIL2003/Final-April03.pdf (listing as the first goal: "Reduce phosphorus inputs to Lake Champlain to promote a healthy and diverse ecosystem and provide for sustainable human use and enjoyment of the Lake").

79. U.S. ENVTL. PROT. AGENCY, VOLUNTEER STREAM MONITORING: A METHODS MANUAL § 5.6: PHOSPHORUS (1997), *available at* http://www.epa.gov/volunteer/stream/vms56.html.

80. Eric Smeltzer, *Phosphorus and Our Freshwater Lakes*, VT. AGENCY OF NAT. RES., www.anr.state.vt.us/site/html/reflect/phosphorusandlakes.htm (last visited Apr. 20, 2011) ("In freshwater lakes, however, phosphorus is usually the nutrient in shortest supply."); *see also* M. Halmann & M. Stiller, *Turnover and Uptake of Dissolved Phosphate in Freshwater. A Study in Lake Kinneret*, 19 LIMNOLOGY AND OCEANOGRAPHY 774, 774 (1974) (studying phosphorus uptake as a limiting nutrient in various fresh water bodies).

81. VOLUNTEER STREAM MONITORING, *supra* note 79; Miriam Reinhardt et al., *Phosphorus Retention in Small Constructed Wetlands Treating Agricultural Drainage Water*, 34 J. ENVIRON. QUAL. 1251, 1251 (2005).

82. STATE OF THE LAKE, *supra* note 37, at 7.

83. 33 U.S.C. §§ 1362(6), (12) (2006).

84. 40 C.F.R. § 122.3(e) (2010) (exempting from the NPDES permit requirement "[a]ny introduction of pollutants from non point-source agricultural and silvicultural activities, including storm water runoff from orchards, cultivated crops, pastures, range lands, and forest lands"); 33 U.S.C. § 1342(p) (2006).

85. STATE OF THE LAKE, *supra* note 37, at 7.

Climate change impacts will increase phosphorus pollution from nonpoint sources.[86] Storm water runoff is a nonpoint source that is generally not regulated under the CWA.[87] Several watersheds in the Lake Champlain basin are impaired by storm water runoff, including twelve in Vermont and seven in New York.[88] Logically, storm water pollution increases when storms occur.[89] Storms cause heavy precipitation to run over roads, parking lots, and lawns washing pollutants into storm drains and waterways.[90] Climate change will increase the frequency and intensity of precipitation events in the Northeast, including the Lake Champlain basin.[91] In addition to increased storm water runoff, heavy precipitation events will cause stream bank erosion and increased sediment transport into the lake.[92] Sediment also contains nutrients, especially when mixed with agricultural fertilizers and manure.[93] Thus, increased runoff associated with heavy precipitation will increase phosphorus loading in the lake.[94]

Climate change will also decrease the number of snow days[95] and the length of time that ice remains on the lake's surface.[96] This will impact the lake in a variety of ways. On a global level, decreased ice and snow decreases the earth's albedo (reflectivity), which allows the earth to absorb more heat, increasing warming.[97] On a watershed scale, less snow and ice will mean higher water temperatures.[98] The lake will become warmer

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86. Jeppesen et al., *supra* note 8, at 1930–39.

87. 33 U.S.C. § 1342(p)(l) (2010) (excluding storm water from permit requirements in the NPDES).

88. STATE OF THE LAKE, *supra* note 37, at 9.

89. Charles Duhigg, *As Sewers Fill, Waste Poisons Waterways*, N.Y. TIMES, Nov. 22, 2009, http://www.nytimes.com/2009/11/23/us/23sewer.html.

90. *After the Storm*, U.S. Envtl. Prot. Agency, http://www.epa.gov/weatherchannel/stormwater.html (last visited Apr. 17, 2010).

91. USGCRP NORTHEAST 2000, *supra* note 5, at 42.

92. STATE OF THE LAKE, *supra* note 37, at 11.

93. *See generally* ANDREW SHARPLEY & BRIAN HAGGARD, ROLE OF FLUVIAL SEDIMENTS IN MODIFYING PHOSPHORUS EXPORT FROM NORTHWEST ARKANSAS WATERSHEDS (2009), *available at* http://water.usgs.gov/wrri/08grants/progress/2008AR184B.pdf (explaining experimental setup and results for monitoring nutrient loads into various water bodies).

94. *Id.*

95. USGCRP NORTHEAST 2000, *supra* note 5, at 40, 99 (noting that rising water temperatures and the lessening effect on ice cover will affect lake ecosystems "especially in combination with chemical pollution").

96. *Id.* at 100–01 ("Temperature increases will very likely reduce ice cover and alter mixing and stratification of water in lakes, all of which are key to the nutrient balance and habitat value."); *Lake Champlain Basin Atlas*, *supra* note 7 (noting that the Lake is freezing less frequently across its widest part than it has in the past).

97. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY 83 (Martin Parry et al. eds., 2007) ("Non-climate drivers such as urbanization and pollution can influence systems directly and indirectly through their effects on climate variables such as albedo and soil-moisture regimes.").

98. *Climate Change – Health and Environmental Effects: Water Quality*, U.S. ENVTL. PROT.

sooner, and tributaries feeding the lake will experience changes in timing, amount, and temperature of discharge due to decreased snowmelt.[99]

Climate change will accelerate phosphorus loading in the lake and worsen the lake's damaged ecosystem. The two major and interrelated effects of increased phosphorus are eutrophication[100] and hypoxia.[101] Eutrophication occurs when a body of water receives too many nutrients.[102] The excessive nutrients act as fertilizer and cause excessive plant growth.[103] Normally, aquatic plant growth is limited by nutrient availability.[104] Invasive plants benefit disproportionately from increased nutrients in aquatic environments.[105] Invasive plants by definition are fast-growing and highly competitive.[106] In nutrient-rich waters, the success of invasive species leads to a net loss in biodiversity within a system as well as a general loss of native species, which are displaced by invasive species.[107] Eutrophication may even lead to the extinction of species.[108] Decreased biodiversity results in decreased resilience to change.

Eutrophication also results in toxic blue-green algal blooms in Lake Champlain.[109] Blue-green algae (cyanobacteria) live at the surface of the

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AGENCY (Sept. 8, 2009), http://www.epa.gov/climatechange/effects/water/quality.html#ref (citing INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY, *supra* note 97).

99. *Id.*

100. Eric O. Young & Donald S. Ross, *Phosphate Released from Seasonally Flooded Soils: A Laboratory Microcosm Study*, 30 J. ENVTL. QUAL. 91, 91 (2001) (noting that eutrophication in portions of Lake Champlain became apparent in 1977) (citation omitted).

101. Eric Smeltzer, State Limnologist at Vt. Agency of Natural Res., The Growing Hypoxic Zone in the Northeastern Arm of Lake Champlain, Oral Presentation at Saint Michael's College Lake Champlain Research Consortium Water Quality Conference (Sept. 29, 2006) (program and abstracts *available at* http://academics.smcvt.edu/lcrc/archives/water%20quality%20conference%202006.pdf).

102. Toxic Substances Hydrology Program, *Eutrophication*, U.S. GEOLOGICAL SURVEY, http://toxics.usgs.gov/definitions/eutrophication.html (last visited Apr. 17, 2010) ("Eutrophiciation [is t]he process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. These typically promote excessive growth of algae.") (emphasis omitted).

103. *Id.*

104. *See, e.g.*, G.C. Gerloff & P.H. Krombholz, *Tissue Analysis as a Measure of Nutrient Availability for the Growth of Angiosperm Aquatic Plants*, 11 LIMNOLOGY & OCEANOGRAPHY 529, 529 (1966) (finding that phosphorus was the nutrient limiting plant growth in eight of nine study lakes).

105. *See* Cynthia S. Kolar & David M. Lodge, *Freshwater Nonindigenous Species: Interactions with Other Global Changes*, *in* INVASIVE SPECIES IN A CHANGING WORLD 3, 14–15 (Harold A. Mooney & Richard Hobbs eds. 2000) (discussing how nutrient pollution can increase success of freshwater aquatic invasive species).

106. *See* National Invasive Species Information Center, *Plants*, U.S. DEP'T OF AGRIC., http://www.invasivespeciesinfo.gov/plants/main.shtml (last visited Apr. 17, 2011).

107. STATE OF THE LAKE, *supra* note 37, at 27.

108. *See* Navjot S. Sodhi et al., *Causes and Consequences of Species Extinctions*, *in* THE PRINCETON GUIDE TO ECOLOGY 514, 516 (Simon A. Levin ed., 2009) (noting that eutrophication from agriculture and deforestation can lead to extinction of aquatic species).

109. Gregory L. Boyer et al., *The Occurrence of Cyanobacterial Toxins in Lake Champlain*, *in*

lake and bloom when the surface water warms and there is insufficient vertical mixing of thermal layers in the lake.[110] The blooms can be as thick as pea soup and blow up onto shore.[111] Blue-green algae can produce neurotoxins that cause gastrointestinal problems and skin irritation, and can be dangerous if ingested.[112] In 1999, a dog reportedly died after ingesting toxic blue-green algae from Lake Champlain, followed by two similar algae-related canine deaths in 2000.[113] A 2005 report showed that "alert levels" of cyanobacteria were present at six sites during the summer, and multiple times at some sites.[114]

Algal blooms occur in the summer when the water warms.[115] A heat wave in July 2010 resulted in significant algal blooms even in portions of the lake previously clear of algae.[116] The aesthetic and toxic problems limit recreational opportunities for humans, can contaminate drinking water, and impair water quality for other aquatic life.[117] As phosphorus increases, the frequency and intensity of algal blooms rise as well.[118] A stated goal of the Champlain TMDL is "to protect against nuisance algal conditions during the summer months."[119] However, because the TMDL does not consider climate change, it is unlikely that the targets set for restricting phosphorus will lead to the desired outcome of decreased algal blooms.

Climate change impacts contribute to hypoxic conditions in the lake. Hypoxia occurs when oxygen is depleted within a biological system.[120] Dissolved oxygen is oxygen in the solution of water.[121] Dissolved oxygen

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LAKE CHAMPLAIN: PARTNERSHIPS AND RESEARCH IN THE NEW MILLENNIUM 241 (Thomas O. Manley et al., eds., 2004); *see also Blue-Green Algae*, LAKE CHAMPLAIN BASIN PROGRAM, http://www.lcbp.org/bgalgae.htm (last visited Apr. 17, 2011); *Blue-Green Algae in Lake Champlain*, VT. DEP'T OF HEALTH, http://healthvermont.gov/enviro/bg_algae/bgalgae.aspx (last visited Apr. 17, 2011).

110. *Blue-Green Algae*, LAKE CHAMPLAIN BASIN PROGRAM, *supra* note 109.

111. *Id.*

112. *Id.*

113. *Id.*

114. MARY C. WATZIN ET AL., MONITORING AND EVALUATION OF CYANOBACTERIA IN LAKE CHAMPLAIN: SUMMER 2005, REPORT TO LAKE CHAMPLAIN BASIN PROGRAM 11 (2006), *available at* www.lcbp.org/techreportPDF/53_BGA_2005.pdf.

115. *Blue-Green Algae*, LAKE CHAMPLAIN BASIN PROGRAM, *supra* note 109.

116. *2010 Algae Monitoring Results*, LAKE CHAMPLAIN COMM. (Dec. 2, 2010), http://www.lakechamplaincommittee.org/learn/news/item/?tx_ttnews[tt_news]=163&tx_ttnews[backPid]=83&cHash=6ce92f8919.

117. STATE OF THE LAKE, *supra* note 37, at 12–13. In 2006, cyanobacteria blooms caused Québec to close its beaches all season. *Id.*

118. *Id.* at 15 (noting that trace amounts of cyanobacteria have been found in treated drinking water).

119. CHAMPLAIN TMDL, *supra* note 13, at 9.

120. Toxic Substances Hydrology Program, *Hypoxia*, U.S. GEOLOGICAL SURVEY, http://toxics.usgs.gov/definitions/hypoxia.html (last updated Oct. 12, 2010).

121. *See* U.S. ENVTL. PROT. AGENCY, VOLUNTEER STREAM MONITORING: A METHODS MANUAL § 5.2: DISSOLVED OXYGEN AND BIOCHEMICAL OXYGEN DEMAND (1997), *available at* http://www.epa.gov/volunteer

concentration is an important water quality indicator.[122] Just as terrestrial organisms derive oxygen from the air to live, most aquatic organisms also require oxygen to live.[123] Aquatic organisms obtain oxygen in the form of dissolved oxygen in water. Increased phosphorus in water increases aquatic plant growth.[124] Both plant growth and decomposition of plant material consume oxygen.[125] In Lake Champlain, increased phosphorus leads to decreased dissolved oxygen and can lead to hypoxia.[126] Hypoxic conditions can kill fish and shellfish and negatively affect aquatic plant communities.[127] In turn, the lack of fish and shellfish negatively impact the food chain for fish-eating otters and birds.[128]

The amount of increased phosphorus required to create ecological imbalance depends on the assimilative capacity of the receiving water.[129] Assimilative capacity is dependent, in part, on the volume of the body of water and water temperature.[130] The volume of Lake Champlain is dependent on inflow from tributaries and runoff, precipitation, and evaporative rates.[131] Therefore, because water volume is highly climate-dependent, any change in climate will effect a change in assimilative capacity.[132] The same is true for lake water temperature and assimilative

/stream/vms52.html (explaining that water gains dissolved oxygen from the atmosphere and aquatic plants—water loses dissolved oxygen through respiration, decomposition, and other chemical processes).

122. *See*, *e.g.*, U.S. ENVTL. PROT. AGENCY, AMBIENT WATER QUALITY CRITERIA FOR DISSOLVED OXYGEN, WATER CLARITY AND CHLOROPHYLL *a* FOR CHESAPEAKE BAY AND ITS TIDAL TRIBUTARIES 7 (2003), *available at* http://www.chesapeakebay.net/content/publications/cbp_13142.pdf (noting the crucial importance of dissolved oxygen in aquatic ecosystems); *see also* N.C. STATE UNIV. DEP'T OF BIOLOGICAL AND AGRIC. ENG'G EXTENSION PROGRAM, LAKE CHAMPLAIN BASIN WATERSHEDS SECTION 319 NATIONAL MONITORING PROGRAM PROJECT 323 (2007) (using dissolved oxygen as a chemical water quality parameter).

123. Brian Oram, *Dissolved Oxygen in Water*, WATER RESEARCH CTR., http://www.water-research.net/Watershed/dissolvedoxygen.htm (last visited Apr. 17, 2011) ("The amount of DO an aquatic organism needs depends upon its species, the temperature of the water, pollutants present, and the state of the organism itself (adult or young, active or dormant).").

124. *Id.*

125. VOLUNTEER STREAM MONITORING, *supra* note 121.

126. Smeltzer, *supra* note 101.

127. ECOLOGICAL SOC'Y OF AM., HYPOXIA 1, *available at* www.esa.org/education_diversity/pdfDocs/hypoxia.pdf.

128. AMBIENT WATER QUALITY CRITERIA FOR DISSOLVED OXYGEN, *supra* note 122, at 7.

129. *See, e.g.*, Curtis J. Richardson & Song S. Qian, *Long-Term Phosphorus Assimilative Capacity in Freshwater Wetlands: A New Paradigm for Sustaining Ecosystem Structure and Function*, 33 ENVTL. SCI. TECHNOL. 1545, 1545 (1999) (demonstrating the phosphorus assimilative capacity of North American freshwater wetlands); *see also* 40 C.F.R. § 130.2(f) (defining related "loading capacity" as "[t]he greatest amount of loading that a water can receive without violating water quality standards").

130. *See id.* (defining assimilative capacity).

131. *See, e.g.*, S.W. Hostetler & E.E. Small, *Response of North American Freshwater Lakes to Simulated Future Climates*, 35 J. AM. WATER RES. ASS'N 1625, 1625–36 (1999).

132. *Id.* at 1625.

capacity.[133] Consequently, the TMDL for phosphorus in Lake Champlain should include not only climate factors based on historical data, but also a margin of safety based on likely future climate conditions considering climate change.[134]

Furthermore, the effects of climate change exacerbate phosphorous loading through synergistic processes.[135] For example, warmer water holds less oxygen.[136] Climate change predictions indicate general warming in the Northeast including shorter and warmer winter seasons.[137] The effects of phosphorus-induced hypoxia combined with increased water temperatures will lead to more dramatic detrimental decreases in dissolved oxygen in Lake Champlain.[138] Therefore, in light of climate change impacts, EPA should place stronger restrictions on phosphorus pollution entering the receiving waters of Lake Champlain. The EPA can do this by implementing clear requirements that a TMDL account for climate change impacts both on water regime (timing and quantity) and water quality.

C. The Inadequacies of the Approved Lake Champlain Phosphorus TMDL

The approved Champlain TMDL is legally inadequate on three grounds. First, the TMDL failed to provide the required margin of safety to account for lack of knowledge concerning the relationship between effluent limitations and water quality.[139] Second, in creating the TMDL, the Vermont Agency improperly relied on projections of future decreases in nonpoint sources without providing reasonable assurances that those

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133. *Id.*

134. Complaint, *supra* note 6, ¶¶ 55–56.

135. Cs. Sipkay et al., *Trends in Research on the Possible Effects of Climate Change Concerning Aquatic Ecosystems with Special Emphasis on the Modeling Approach*, 7 APPLIED ECOL. & ENVTL. RESEARCH 171, 176 (2009) ("Generally, climate change related to pollution of human origin enhances eutrophication processes.") (citation omitted); *see also* Verónica Ferreira & Eric Chauvet, *Synergistic Effects of Water Temperature and Dissolved Nutrients on Litter Decomposition and Associated Fungi*, 17 GLOBAL CHANGE BIOLOGY 551 (2011); Robin Kundis Craig, *Climate Change Comes to the Clean Water Act: Now What?*, 1 WASH. & LEE J. ENERGY, CLIMATE & THE ENV'T 9, 31 (2010) ("Thus, while the Clean Water Act may not be able to prevent the temperature impacts that arise directly from climate change, it certainly provides both the states and the EPA with clear authority to reduce synergistic temperature stressors on aquatic ecosystems.").

136. USGCRP NORTHEAST 2000, *supra* note 5, at 42; Sipkay et al., *supra* note 135, at 176. "There is an inverse relationship between water temperature and oxygen solubility. Increasing temperatures induce decreasing content of DO whereas the biological oxygen demand (BOD) increases, thus posing a double negative effect on aquatic organisms in most systems." *Id.* (citation omitted).

137. USGCRP NORTHEAST 2000, *supra* note 5, at 44–45.

138. *See* Sipkay et al., *supra* note 135, at 176 (explaining the inverse relationship between water temperature and dissolved oxygen).

139. Complaint, *supra* note 6, ¶¶ 61–66; 33 U.S.C. § 1313(d)(1)(C) (2006).

decreases would in fact happen.[140] Finally, the TMDL did not account for climate change induced shifts in seasonal variation.

The Champlain TMDL provides background information about the basin and describes the phosphorus problem in the lake.[141] The Champlain TMDL mentions three eutrophic zones.[142] In 2000, the Vermont Agency listed as impaired nine sections of Lake Champlain that did not meet the Vermont water quality criteria for phosphorus.[143] Pursuant to the CWA, both New York and Vermont prioritized the impaired waters and set dates for completing TMDLs for the impaired lake segments.[144] The Champlain TMDL identified the sources of phosphorus loading, explaining that point sources accounted for around 30% of the total load and the remaining 70% came from natural background and nonpoint sources.[145] The TMDL reports that 56% of the nonpoint source phosphorus came from agricultural land in the basin.[146] Vermont was responsible for the greatest amount of added phosphorus—30% of nonpoint source loading as well as 19% of point source loading.[147] The Champlain TMDL also listed the state-set water quality criteria for phosphorus for each segment of the lake.[148]

In creating a TMDL, the CWA requires the state to provide a "margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."[149] The Champlain TMDL purported to provide a margin of safety[150] as required by the CWA and EPA regulations.[151] However, this margin of safety is inadequate.[152] The Vermont Agency based the Champlain TMDL margin of safety on "implicit" factors—what they called "conservative assumptions" in its lake assimilative capacity modeling.[153]

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140. Complaint, *supra* note 6, ¶¶ 49, 51, 52; *see also Guidelines for Reviewing TMDLs*, *supra* note 15 (explaining that reasonable assurances must accompany assumptions of future nonpoint source emissions reductions).

141. CHAMPLAIN TMDL, *supra* note 13, at 1.

142. *Id.*

143. *Id.* at 3; 33 U.S.C. § 1313(d)(1)(A) (2006).

144. CHAMPLAIN TMDL, *supra* note 13, at 3.

145. *Id.* at 4. *But see* STATE OF THE LAKE, *supra* note 37, at 7 (stating that point sources account for only 10% of phosphorus load to the lake). This difference may be due to reductions in point source pollution from the 2002 Champlain TMDL to the 2008 STATE OF THE LAKE.

146. CHAMPLAIN TMDL, *supra* note 13, at 4.

147. *Id.* at 5, fig.2.

148. *Id.* at 8, tbl.2.

149. 33 U.S.C. § 1313(d)(1)(C)(2) (2006).

150. CHAMPLAIN TMDL, *supra* note 13, at 42–44.

151. 33 U.S.C. § 1313(d)(1)(C); 40 C.F.R. § 130.7(c)(1) (2010); 40 C.F.R. § 130.2(i).

152. Complaint, *supra* note 6, ¶ 23.

153. CHAMPLAIN TMDL, *supra* note 13, at 42–43 (explaining that other factors supported the margin of safety, including the fact that wastewater treatment plants were not operating at permitted

The margin of safety relied on two factors. First, that the ratio between particulate and dissolved phosphorus was lower in the model than actual estimates would indicate.[154] This is significant because particulate phosphorus is not generally bioavailable; that is, because the chemical is suspended in other particles, plants cannot access it directly.[155] Additionally, particulate phosphorus eventually settles into lake sediment and becomes unavailable.[156] In contrast, dissolved phosphorus, like dissolved oxygen, remains in the water column, is bioavailable, and readily contributes to plant growth and algal blooms.[157]

The second factor the Vermont Agency relied on to provide the required margin of safety was that predicted levels of phosphorus were lower than the criteria level for ten of the thirteen lake segments.[158] However, because the model entirely disregarded climate change, the lower predicted levels do not provide an adequate margin of safety for the lack of knowledge of climate impacts.

Under normal climate conditions, the two model factors the Vermont Agency relied upon may arguably provide some margin of safety. However, any buffers created in the TMDL will be overwhelmed as phosphorus inputs increase due to climate change impacts.[159] First, the Champlain TMDL did not take into account likely increases in precipitation and flood events associated with climate change.[160] These precipitation increases will increase the amount of dissolved phosphorus that enters the system as well as potentially disturb the phosphorus-laden sediment, which would release more phosphorus into the water.[161] This fact undermines the Vermont Agency's reliance on the "conservative" model, which predicted a "lower" particulate to dissolved phosphorus ratio.[162] This is especially true because the "actual estimates" failed to incorporate climate change as a controlling factor in both lake sediment disturbance and dissolved phosphorus inputs into the lake.[163]

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capacity and their belief that nonpoint sources of phosphorus would be reduced through the use of best management practices).

154. *Id.* at 42.

155. *Id.*

156. *Id.*

157. *Id.*

158. *Id.* at 43.

159. Jeppesen et al., *supra* note 8, at 1930 (noting that climate change is expected to increase phosphorus loading).

160. U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 107 (Thomas R. Karl, Jerry M. Melillo & Thomas C. Peterson eds. 2009) [hereinafter USGCRP 2009].

161. STATE OF THE LAKE, *supra* note 37, at 11 (explaining that nutrient-laden sediment is a significant source of phosphorus loading in the lake).

162. CHAMPLAIN TMDL, *supra* note 13, at 42.

163. *Id.*; *see also* Sipkay et al., *supra* note 135, at 172 (citing the IPCC 2007 report, noting that

The Vermont Agency's model also failed to account for the cumulative impact of phosphorus loading combined with fewer snow days, decreased ice cover, and higher temperatures in the lake.[164] Hence, the margin of safety purportedly provided by the conservative modeling assumptions is arguably valid only under current climate conditions. Under the influence of likely climate changes, these safety margins disappear. Consequently, the Vermont Agency failed to provide the requisite margin of safety.

The TMDL also failed to provide reasonable assurances.[165] EPA TMDL approval guidelines require that:

> When a TMDL is developed for waters impaired by both point and nonpoint sources, and the [wasteload allocation] is based on an assumption that nonpoint source load reductions will occur, . . . the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.[166]

This requirement is based on the assumption that, where a body of water is only impaired by point sources, the National Pollutant Discharge Elimination System (NPDES)[167] provides reasonable assurance that the wasteload allocations contained in the TMDL will be achieved.[168] Differently, here, the Vermont Agency relied on projected reductions in phosphorus pollution from nonpoint sources. Therefore, it was required to provide assurances that those reductions would be realized.[169] The Vermont Agency supported its presumption of nonpoint source reductions by pointing to state programs addressing storm water, erosion from development, and agricultural runoff.[170] The Vermont Agency pointed to funding available to implement "best management practices."[171] However,

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increased water temperature due to climate change has a negative effect on the water quality of lakes by reducing oxygen and releasing phosphorus from the sediment) (citations omitted).

164. *Id.*

165. *See Guidelines for Reviewing TMDLs*, *supra* note 15 (requiring reasonable assurances that expected load reductions will be reached).

166. *Id.*

167. 33 U.S.C. § 1342 (2006).

168. *Guidelines for Reviewing TMDLs*, *supra* note 15.

169. CHAMPLAIN TMDL, *supra* note 13, at 46.

170. *Id.* at 46–47.

171. *Id.* at 54.

the Vermont Agency relied on voluntary action by government and private parties without providing monitoring mechanisms. Nor did the Vermont Agency's assurance of nonpoint source reduction take into account the effects of climate change on discharges from nonpoint sources of phosphorus. Therefore, EPA violated its own guidelines by approving the Champlain TMDL in 2002.

The Champlain TMDL also failed to account for climate change induced shifts in seasonal variation.[172] The CWA requires, for every body of water for which a TMDL must be created, "[s]uch load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations."[173] The data on seasonal variations in the Champlain TMDL were based on historical flows[174] and did not consider the impacts that climate change will have on seasonal variation. For example, as noted above, winter weather is predicted to come later and end sooner in the Northeast.[175] This fact alone will impact the water quality and assimilative capacity of the lake. Therefore, the approved Champlain TMDL is inadequate because it failed to provide for climate-change-induced changes in seasonal variation.

III. CLIMATE CHANGE AND THE CLEAN WATER ACT

Facing the uncertainty and limitations of predicting climate change impacts, prudence requires speedy action informed by the best available

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172. *See* Sipkay et al., *supra* note 135, at 177–78 (noting that "climate is strongly dependent on season" and seasonal changes in snow melt influence the physical behavior of rivers).

173. 33 U.S.C. § 1313(d)(1)(C) (2006).

174. CHAMPLAIN TMDL, *supra* note 13, at 4–6 (stating that phosphorus estimates were based on 1991 hydrologic base year data); Complaint, *supra* note 6, ¶¶ 53–56 (arguing that using a historical hydrologic baseline, which varied significantly from subsequent years, negatively affects the legal sufficiency of EPA approval).

175. U.S. GLOBAL CHANGE RESEARCH PROGRAM, REGIONAL HIGHLIGHTS FROM GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES: NORTHEAST, *available at* http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/regional-climate-change-impacts/northeast (full report *available at* http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf).

> The annual average temperature in the Northeast has increased by 2ºF since 1970, with winter temperatures rising twice this much. Warming has resulted in many other climate-related changes including more frequent very hot days, a longer growing season, an increase in heavy downpours, less winter precipitation falling as snow and more as rain, reduced snowpack, earlier break-up of winter ice on lakes and rivers, earlier spring snowmelt resulting in earlier peak river flows, rising sea surface temperatures, and rising sea level.

Id. See also NORTHEAST CLIMATE IMPACTS ASSESSMENT, CLIMATE CHANGE IN THE U.S. NORTHEAST 1, 10–26 (2006), *available at* http://www.climatechoices.org/assets/documents/climatechoices/NECIA_climate_report_final.pdf (noting past temperature and climate projections for the United States northeast region).

science. The CWA is a flexible and comprehensive statute, adaptable to the needs and demands of the climate change era. Climate modeling provides the best science on which to base CWA water quality management plans. The TMDL process provides a regulatory opportunity to incorporate climate change into water quality planning.

A. The Clean Water Act Should Adapt to Climate Change

The CWA was drafted in 1972.[176] The original purpose of the CWA was to control pollution and restore the nation's waters for multiple uses.[177] To those ends, the CWA has been an effective regulatory tool relative to the condition of the nation's waters in 1972.[178] The question now before regulators and Congress is: How should the CWA and other environmental laws be used in the climate change era?[179] Current environmental laws should be construed to incorporate climate change factors in their functional analysis to meet the laws' goals and to protect our environment in light of climate change impacts.

Some argue that utilizing existing regulations to curb the causes of climate change may undermine efforts to obtain comprehensive climate change legislation.[180] In contrast, other commentators claim that using existing regulatory schemes to reduce the causes and mitigate the impacts of climate change is sound policy.[181] Most agree that existing regulations could provide adaptive management strategies to environmental problems that arise from, and with, climate change impacts.[182] The more specific question here

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176. 33 U.S.C. §§ 1251–1387 (2006). Although popularly known as the Clean Water Act, the law was originally codified as the Federal Water Pollution Control Act in 1948. The Act was reorganized and expanded in 1972.

177. 33 U.S.C. § 1251(a) ("The objective of this chapter is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.").

178. HOUCK, *supra* note 43, at 3 (providing as evidence that the 1972 Act worked: decreased industrial pollution, slowed rates of wetland loss, and decreased municipal loading).

179. *See generally* Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L.Q. 61 (2007) (explaining how current environmental law may adapt to the climate change era).

180. *See generally* Cary Coglianese & Jocelyn D'Ambrosio, *Policymaking Under Pressure: The Perils of Incremental Responses to Climate Change*, 40 CONN. L. REV. 1411 (2008) (explaining that incremental policy changes using the current solutions framework pose serious problems, and may cause more delay than no action at all). *But see* Massachusetts v. EPA, 549 U.S. 497, 533 (2007) (the U.S. Supreme Court expressly rejected the incremental nature of climate change regulation as an excuse for the EPA to evade its statutory obligation to regulate greenhouse gas emissions).

181. *See, e.g.*, Zinn, *supra* note 179 (explaining how current environmental law may adapt to the climate change era).

182. Robin Kundis Craig, *The Clean Water Act on the Cutting Edge: Climate Change and Water-Quality Regulation*, 24 NAT. RES. & ENV'T 14, 14, 16 (2009) (arguing that the CWA should not be used to control climate change sources but should and can be used as an effective adaptive tool for

is: How can the CWA contribute to efforts to deal with climate change and water quality management planning?[183] The CWA can be used both to regulate the emission of greenhouse gases because of their negative impact on water quality, and to anticipate and mitigate those negative impacts.

The IPCC (a Nobel-prize-winning organization and the world's most respected source for climate change information) recently released a report on climate change and water.[184] Among its findings, the IPCC suggests the negative impacts of climate change will outweigh any benefits.[185] Climate-change-induced changes in water quantity and quality effects energy, food supply, and rates of disease.[186] It is clear that climate change impacts will affect current water infrastructures.[187] Current management practices and basic assumptions will have to change to adapt to climate change induced changes in hydrology.[188] The CWA provides the current national regulatory structure for water quality management. It is a national imperative that water management methods and practices under the CWA adapt to climate change to protect water quality and quality of life.

B. Climate Change Modeling and Water Quality Planning

Climate modeling is the best tool regulators have for creating water quality management plans.[189] Admittedly, the limited accuracy of climate modeling complicates the TMDL process.[190] However, climate modeling is increasingly accurate at regional and watershed scales.[191] Additionally,

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climate change impacts).

183. Craig, *supra* note 135, at 23.

184. INT'L PANEL ON CLIMATE CHANGE, *supra* note 2. Although this document does not have a legal impact on the sufficiency of the approved Champlain TMDL, it provides urgent guidance for future water management in the face of climate change impacts.

185. *Id.* at 3.

186. *Id.*

187. *Id.* at 4.

188. *Id.* ("Current water management practices may not be robust enough to cope with the impacts of climate change.").

189. *See* Sipkay et al., *supra* note 135, at 175 (comparing four approaches to predicting climate change and concluding that "the modeling approach is a useful tool to make predictions for the future (as long as the assumptions are fulfilled), that we cannot achieve either by means of simulation experiments or field work").

190. *See, e.g.*, A.W. Wood et al., *Hydrologic Implications of Dynamical and Statistical Approaches to Downscaling Climate Model Outputs*, 62 CLIMATIC CHANGE 189, 190 (2004) (noting the difficulties in downscaling a global climate model to a hydrologic scale).

191. *See, e.g.*, Jeppesen et al., *supra* note 8, at 1930 (modeling phosphorus input on a regional and watershed scale); Andersen et al., *Climate-change Impacts on Hydrology and Nutrients in a Danish Lowland River Basin*, 365 SCI. TOTAL ENV'T 223 (2006) (modeling rainfall, runoff, and nutrient transfer and making quantitative predictions for changes in hydrological and nutrient conditions expected in the catchment area, including seasonal aspects); Hostetler & Small, *supra* note 131, at 1625 (modeling the

"[c]hanges in climate extremes are more likely to cause stress at the regional level than changes in the averages."[192] The advantage of climate models is that they incorporate a variety of quantifiable factors based on scientific understandings of climate, physics, chemistry, and ecology.[193] Models also allow scientists to examine the relationship between human activity and biological responses.[194] They also allow us to create predictions and projections about the future, while observational science only allows us to examine current and past conditions.[195] The real problem comes down to an issue of scale.[196] Climate change is generally modeled at a large scale, while water quality is managed at a regional or local scale. This fact is especially true for the TMDL, which is specific to one particular body of receiving water.

Models are more reliable on a larger scale, over longer periods of time and over larger areas of space.[197] Model results on a regional level have been less reliable.[198] In assessing current and future water quality in Lake Champlain, regulators work on a watershed scale. Other water regulators may work on an even smaller scale specific to a township or water body. The question, therefore, becomes: Is it feasible to impose a duty to consider climate change in TMDL planning when the data is uncertain?

In the instance of the 2002 Champlain TMDL, predictions were based on historic flow data that did not accurately represent recent trends.[199] Even in 2002, recent trends showed increased precipitation, increased frequency of

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physical responses such as temperature, mixing, ice cover, and evaporation of individual freshwater North American lakes to simulated future climates).

192. USGCRP NORTHEAST 2000, *supra* note 5, at 100.

193. *Id.* at 14.

194. *See infra* note 207.

195. *See*, *e.g.*, U.S. DEP'T OF ENERGY, *Climate Change Prediction Program*, http://ccpp.llnl.gov/ (last visited Apr. 17, 2011) (stating that their mission "is to advance climate change science and improve climate change projections using state-of-the-science coupled climate models, on time scales of decades to centuries and space scales of regional to global").

196. Filippo Giorgi, *Modelling Regional Climate Change*, SCI. & DEV. NETWORK, (Dec. 1, 2001), http://www.scidev.net/en/policy-briefs/modelling-regional-climate-change-.html.

> Obtaining reliable projections of climatic changes at the regional scale is one of the most central issues within the global change debate. In order to assess the social and environmental impacts of climate change and to develop suitable policies to respond to such impacts, information about climate change is needed by policy-makers not only at a national level, but on a regional and local scale as well.

Id.

197. USGCRP NORTHEAST 2000, *supra* note 5, at 18.

198. *Id.* at 17.

199. Complaint, *supra* note 6, ¶¶ 53–58 (the Vermont Agency based the TMDL on 1991 hydrologic data which was significantly drier than subsequent years).

heavy precipitation events, and increased temperatures.[200] Regardless of the accuracy of regional climate change models, the data supporting the TMDL approved by the EPA in 2002 was not reflective of contemporaneous climate trends in the region. Furthermore, current trends support climate model predictions.[201]

Regional climate models are becoming more reliable.[202] Additionally, because climate change is a global and not a local issue, regulators benefit from global advances in the science of climate change and resulting improvements in climate change modeling. For example, a recent study by scientists at the Aarhus University in Denmark shows the effect of climate change on freshwater lakes in Denmark.[203] The study used a regional Danish climate model, refining the scope of a global climate model, to predict the effects of phosphorus loading in individual freshwater lakes in Denmark.[204] The study's findings, and the type of regional model used in the study, could help inform scientists and policy makers in Vermont.

The uncertainty of climate change impacts calls for a more protective, rather than less protective policy.[205] Uncertainty in climate change impact predictions is multifaceted.[206] First, models must work on assumptions of emissions scenarios.[207] In turn, those scenarios are based on socioeconomic predictions and indicators.[208] Admittedly, uncertainty abounds when model complications are combined with limitations in the understanding of climate

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200. INTERNATIONAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 3.

201. USGCRP NORTHEAST 2000, *supra* note 5, at 22 (noting that both major climate change model projections predict an increase in the frequency of heavy precipitation events).

202. *See supra* text accompanying note 191.

203. Jeppesen et al., *supra* note 8, at 1931.

204. *Id.*

205. Frank J. Trelease, *Climate Change and Water Law*, *in* NATIONAL ACADEMY OF SCIENCE, CLIMATE, CLIMATE CHANGE, AND WATER SUPPLY 70 (1977) ("[W]e would be wise to plan for the unpredictable.").

206. Linda Mearns & Dough Nycha, *Uncertainty in Model Simulations*, THE WEATHER AND CLIMATE CHANGE IMPACT ASSESSMENT SCIENCE PROGRAM, http://www.assessment.ucar.edu/uncertainty_models/#2 (last visited Apr. 17, 2011) ("Uncertainty itself has various meanings and levels—it can refer to lack of knowledge, lack of certainty, disagreement among experts, or the fundamental nature of the scientific process which experiences uncertainties as part and parcel of the experimental method.").

207. The two most commonly used models are from the Hadley Centre for Climate Prediction and Research and the Canadian Centre for Climate Modeling and Analysis (known as the Hadley and Canadian models). These models use different emissions scenarios to predict future climate conditions. For more information on these models, see *Met Office Hadley Center*, MET OFFICE, http://www.metoffice.gov.uk/climate-change/resources/hadley (last updated Jan. 5, 2011) and *Climate Modeling and Analysis*, ENVIRONMENT CANADA, http://www.cccma.ec.gc.ca/eng_index.shtml (last updated Mar. 3, 2010).

208. U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 160, at 153 (explaining that comprehensive models include socioeconomic factors).

functions and ecosystem responses.[209] However, because the future cannot be predicted with certainty, a wise person prepares for the worst and hopes for the best. Societies should respond with similar precaution. The CWA provides the United States an available and useful avenue to respond to the impacts of climate change on water quality and availability.

C. Climate Change and TMDLs

The inadequacies of the Champlain TMDL provide an example of how water quality planning that does not factor in climate change can lead to continued violations of water quality standards.[210] This means that impaired waters may remain impaired despite the considerable resources invested in establishing a TMDL. Thus, it is in the interest of water quality managers as well as society at large to consider climate change in creating a TMDL.

The TMDL process provides a practical framework for incorporating climate change into water quality management planning. A TMDL must be created for each body of water "for which effluent limitations . . . are not stringent enough to implement any water quality standards applicable to such waters."[211] As climate change impacts are realized, the number of waters for which a TMDL must be created will likely increase. Additionally, because the TMDL process focuses on individual pollutants and their relative impacts on water quality, the TMDL planning process can account for the synergistic impacts of specific pollutants and climate change. These interactions are specifically important for phosphorus in Lake Champlain. Therefore, the TMDL provision of the CWA is a prime regulatory framework within which to incorporate climate change as a factor in water quality planning.

IV. SOLUTIONS FOR AN UNCERTAIN FUTURE

The EPA cannot rely on the uncertainty of climate change impacts to avoid its obligations under the CWA. The U.S. Supreme Court declared in *Massachusetts v. EPA* that the "EPA [cannot] avoid its statutory obligation by noting the uncertainty surrounding various features of climate change and concluding that it would therefore be better not to regulate at this time."[212]

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209. *See, e.g.*, Peter A. Stott & J.A. Kettleborough, *Origins and Estimates of Uncertainty in Predictions of Twenty-first Century Temperature Rise*, 416 NATURE 723, 723–26 (2002) (discussing various sources of uncertainty in climate predictions).

210. Craig, *supra* note 135, at 45 ("The core policy and legal question for the Clean Water Act in the climate change era is how the TMDL process should apply when a water quality standard violation arises because of climate change impacts. . . .").

211. 33 U.S.C. § 1313(d)(1)(A) (2006).

212. Massachusetts v. EPA, 549 U.S. 497, 501 (2007).

The Court has also noted that "[i]n the absence of updated regulations, courts will have to make ad hoc determinations that run the risk of transforming scientific questions into matters of law."[213] The agencies tasked with managing natural resources should responsibly deal with the scientific questions associated with climate change. The key to responding to climate change is adapting before crisis. In the water quality context this means creating, implementing, and enforcing water quality standards that are stringent enough to meet an uncertain future. Furthermore, reducing human-induced stressors, such as nutrient loading, may enhance the resiliency of aquatic ecosystems and enhance nature's ability to respond to the stresses of climate change.[214]

A. Using The Clean Water Act to Regulate Emissions

The CWA may be used to regulate emissions of greenhouse gases. Because the CWA requires EPA to set reference water quality criteria based on "the latest scientific knowledge,"[215] the CWA "arguably *requires* the EPA to investigate how climate change is affecting and will continue to impact the nation's waters and to respond with new recommendations for water quality managers."[216]

The CWA has been used to regulate the emission of carbon dioxide. In December 2007, the Center for Biological Diversity (Center) petitioned EPA to revise the pH water quality criteria to address ocean acidification.[217] Ocean acidification occurs when carbon dioxide in the air mixes with surface water in the ocean.[218] The Center sought to force the EPA to regulate the greenhouse gas, carbon dioxide, under the CWA.[219] Threatened with litigation, the EPA responded in January 2009, promising to issue a notice of data availability and to publish guidance regarding coral biocriteria.[220]

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213. Rapanos v. United States, 547 U.S. 715, 812 (2006) (Breyer, J., dissenting).

214. USGCRP NORTHEAST 2000, *supra* note 5, at 43–44 (suggesting adaptive strategies should "strengthen water quality and air quality controls to minimize the compounding of climate impacts").

215. 33 U.S.C. § 1314(a)(1).

216. Craig, *supra* note 135, at 27.

217. Petition before the EPA, Ctr. for Biological Diversity, Petition for Revised pH Water Quality Criteria Under Section 304 of the Clean Water Act, 33 U.S.C. § 1314, to Address Ocean Acidification (Dec. 18, 2007), *available at* http://www.biologicaldiversity.org/programs/oceans/pdfs/section-304-petition-12-18-07.pdf.

218. *See generally* THE ROYAL SOC'Y, OCEAN ACIDIFICATION DUE TO INCREASING ATMOSPHERIC CARBON DIOXIDE (2005), *available at* www.us-ocb.org/publications/Royal_Soc_OA.pdf.

219. Center for Biological Diversity, *supra* note 217, at 1.

220. Letter from Benjamin H. Grumbles, Assistant Adm'r U.S. Envtl. Prot. Agency, to Miyoko Sakashita, Attorney for Ctr. for Biological Diversity (Jan. 16, 2009), *available at* http://www.biologicaldiversity.org/campaigns/ocean_acidification/pdfs/EPA_Response_to_CBD_Ocean_Acidification_Petition.pdf (the Center filed a 60-day intent to sue notice on Nov.13, 2008).

The CWA has also been used to regulate the emission of mercury. In 2007, EPA approved a regional TMDL for mercury deposition in the Northeast.[221] This TMDL covers atmospheric mercury deposition into water[222] and, as such, does not regulate effluent discharged directly into the water from a point source. Instead, the TMDL regulates coal emissions.[223] This is similar to the regulation of carbon dioxide at issue in the Center's petition. Thus, in this way, the CWA can be used to regulate emissions that impact water quality. The same process could be used to regulate greenhouse gas emissions that negatively impact water quality through the mechanism of global climate change.

A potential problem with this approach is that the emissions generating climate change are not necessarily pollution mixing directly with water to cause chemical contamination. Climate change is effected through complex chemical processes in both air and water. Take for example the relationship between temperature and dissolved oxygen; or the relationship between increased precipitation and increased pollutant loads; or decreased precipitation, which reduces water volume and thereby increases pollutant concentrations.[224] Climate change increases water toxicity problems such as mercury pollution and acidification.[225] Managing greenhouse gas emissions under the CWA is feasible and advisable where no other legal framework is doing the job.

B. Using the Clean Water Act as an Adaptive Management Tool in the Climate Change Era

EPA should issue new guidance directing the states to include climate change criteria in their TMDL process. EPA has indicated that it is strategically and technically prepared to take this action.[226] However, they

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221. CONN. DEP'T ENVTL. PROT. ET AL., NORTHEAST REGIONAL MERCURY TOTAL MAXIMUM DAILY LOAD (2007), *available at* http://www.neiwpcc.org/mercury/mercury-docs/FINAL%20Northeast%20Regional%20Mercury%20TMDL.pdf (including Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont).

222. *Id.* at vi.

223. *Id.*

224. PUD No. 1 of Jefferson Cnty. v. Wash. Dep't of Ecology, 511 U.S. 700, 719 (1994) ("[T]here is recognition in the Clean Water Act itself that reduced stream flow, *i.e.*, diminishment of water quantity, can constitute water pollution.").

225. Sipkay et al., *supra* note 135, at 176. "[G]lobal warming induces further changes in physical and chemical characteristics of water bodies. Such indirect effects include decrease in dissolved oxygen content (DO), change in toxicity (mostly increasing levels), trophic status (mostly indicating eutrophication) and thermal stratification." *Id.*

226. U.S. ENVTL. PROT. AGENCY, NATIONAL WATER PROGRAM STRATEGY: RESPONSE TO CLIMATE CHANGE 43 (2008).

may lack the political will to do so and could face resistance from Congress which, in turn, faces pressure from constituents who may resist stricter water quality standards. Furthermore, this move may prove difficult to accomplish during the current prolonged economic downturn because of the cost to states.

There is reason to hope. The TMDL process itself was only implemented after pressure from litigation consisting mostly of citizen suits.[227] The pressure from environmental advocacy organizations, such as the Foundation, may provide the final push that will cause the EPA to incorporate climate change into the water quality management regulatory structure that it oversees and enforces under the CWA.

The legal theories behind the Foundation's Lake Champlain Phosphorus TMDL complaint hold true for TMDLs nationally. If this theory is replicated enough times, and enough suits are initiated, EPA may be persuaded to include climate change considerations in its regulations and guidance documents. State managers would then be required to consider climate change in water quality regulation and planning. Furthermore, if citizen suits target incorporating climate change into the implementation of other environmental statutes, Congress may finally be persuaded to address the issue of climate change—and the impact on environmental quality, the economy, and social structures—with a more comprehensive climate-change-specific statute.

CONCLUSION

Congress created the Clean Water Act to address the nation's water pollution problems. Over the course of three decades the statute and the regulatory scheme it supports have been largely successful. This is due in part to the comprehensive nature and goals of the CWA.[228] This effective and

227. 33 U.S.C. § 1365 (2006) (CWA citizen suit provision); *see also* HOUCK, *supra* note 43, at 75 ("[I]t is hard to think of any program more precipitously driven by citizen suits from absolute zero toward its statutory destiny than TMDLs.").

228. 33 U.S.C. § 1252 (2006).

> The Administrator shall, after careful investigation, and in cooperation with other Federal agencies, State water pollution control agencies, interstate agencies, and the municipalities and industries involved, prepare or develop comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters and improving the sanitary condition of surface and underground waters. In the development of such comprehensive programs due regard shall be given to the improvements which are necessary to conserve such waters for the protection and propagation of fish and aquatic life and wildlife, recreational purposes, and the withdrawal of such waters for public water supply, agricultural, industrial, and other purposes. For the purpose of this section, the

dynamic legislation can be used to adapt to the impacts of climate change. Furthermore, the CWA itself can adapt to the climate change era and be used to both restrict the causes and mitigate the effects of climate change. Climate change has enormous repercussions for water availability and water quality. The comprehensive nature of the CWA is expansive enough to incorporate climate change predictions into water quality management regulations. The future availability of clean water in our country and the associated quality of life depend on it.

Postscript

This issue moved forward in the interim between the writing and publication of this Note. In April 2010, the Foundation and EPA signed a settlement agreement, and EPA moved for a voluntary remand so that the EPA could reconsider its 2002 TMDL approval. The Vermont Agency objected and moved to deny the request for remand and dismiss the case. In August 2010, the court denied the State's motion and granted EPA's motion. Upon reconsideration, EPA withdrew its 2002 approval on January 24, 2011, based on its finding that the 2002 TMDL failed to provide an adequate margin of safety or reasonable assurances of nonpoint source reductions.[229] In its disapproval of the 2002 TMDL, EPA rejected the Foundation's argument that EPA ought to have considered climate change in 2002.[230] EPA also did not address climate change as it relates to the margin of safety or reasonable assurances of pollution reduction. However, EPA stated that it plans to consider possible climate-change-related impacts to phosphorus inputs to the lake when creating the new federal TMDL.[231]

–H. M. Zamudio[*]

> Administrator is authorized to make joint investigations with any such agencies of the condition of any waters in any State or States, and of the discharges of any sewage, industrial wastes, or substance which may adversely affect such waters.

Id.

229. U.S. ENVTL. PROT. AGENCY, RECONSIDERATION OF EPA'S APPROVAL OF VERMONT'S 2002 LAKE CHAMPLAIN PHOSPHORUS TOTAL MAXIMUM DAILY LOAD ("TMDL") AND DETERMINATION TO DISAPPROVE THE TMDL, Jan. 24, 2011, *available at* www.vlct.org/d/advocacy/TMDL_disapproval.pdf (disapproving the 2002 TMDL based on inadequate margin of safety and reasonable assurances).

230. *Id.*

231. Letter from H. Curtis Spalding, Regional Administrator, U.S. EPA Region 1, to Deborah Markowitz, Secretary, Vermont Agency of Natural Resources (Jan. 24, 2011) ("EPA has arranged to provide contractor support for . . . the assessment of the potential effects of climate change on nutrient loads to the lake.").

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